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STANDARDKESSEL BAUMGARTE - Power plants, plant operation and services for generating electricity, steam and heat from residues, primary fuels, waste heat and biomass.
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 2016, item 250, 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 re-use and recycling of municipal waste and reducing landfilling of biodegradable municipal waste. The laws also identify how to implement some of the obligations.
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, as amended),
- the Act of 11 September 2015 on waste electrical and electronic equipment (Journal of laws item 1688),
- the Act of 24 April 2009 on batteries and accumulators (Journal of laws of 2015, item 687, as amended)

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 2016, item 672), is the financial instrument designed to reduce landfilling of municipal waste and moving waste management up the hierarchy.

1.2. National waste management plan

On 1 July 2016 the Council of Ministers adopted the resolution on the National waste management plan 2022. National waste management plan 2022 constitutes the update of the National waste management plan 2014 which was binding for the period from 2011 to 2016, and also contains the national waste generation prevention program. It determines actions for the period from 2016 to 2022 with the perspective until 2030.

As regards the municipal waste management, among others the following problems were identified:

- too small share of selectively collected waste at source, which is reflected in too low progress in subjecting waste to recycling processes;
- improper quality of collected waste caused by the absence of uniform standards in Poland with regard to selective municipal waste collection;
- the possibility of lump settlement of a company collecting municipal waste from residents, which makes it difficult for municipalities to control the stream of municipal waste;
- limited municipalities’ supervision over proper waste handling caused by selection of joint tender procedure for collection and management of waste;
- too large share of landfilled municipal waste in relation to generated waste;
- too large share of mixed municipal waste in the stream of collected municipal waste, which in consequence leads to too large remnants mass after mechanical and biological treatment of municipal waste directed for landfilling;
- insufficient number of stationary municipal waste selective collection centres;
the current landfill fee system still insufficiently motivating municipalities and other entities participating in the municipal waste management to manage the waste in a manner different than landfilling;

occurrence of cases of landfilling selectively collected biodegradable waste despite the ban on such proceedings;

occurrence of cases of landfilling of municipal mixed waste without pre-treatment;

insufficient education concerning waste management caused by too small commitment of municipalities in the broadly understood educational and information actions addressed to different target groups;

too low awareness and insufficient knowledge of the majority of society concerning proper municipal waste management, among others aiming at limiting waste generation at source, selective waste collection;

reduced values of achieved recycling levels of raw materials in some areas of the country as a consequence of transferring part of the raw materials for alternative fuel production;

a large number of illegal landfills – at the end of 2014 in Poland there were 2,371 illegal landfills, that is by 15 percent less than in the previous year;

absence of municipal waste management monitoring system based on a database on products, packaging and waste management;

absence of current research concerning municipal waste management, among others the research concerning analysis of waste morphological composition and physical-chemical properties, in particular voivodships.

However with regard to packaging waste, partly constituting municipal waste, the following problems were indicated:

unsuitable quality of packaging waste collected selectively in households preventing their recycling,

insufficient output capacities of installations for multiple-material packaging waste treatment in the context of the required levels of recovery and recycling;

still insufficient consideration of environmental aspects when designing a product with intention to improve impact characteristics which the given product has on the environment at the stage of manufacturing and throughout the whole life cycle, such as: limitation of packaging weight and limitation of the size of packaging as compared to the amount of a product, use of multiple-use packaging, if it is of ecological and economic justification.

On the other hand, in the case of waste batteries and accumulators and waste electronic and electrical equipment the following problems were identified:

the threat of failure to achieve the required levels of collection of waste portable batteries and accumulators in the amount of 45 percent in connection with non-achievement of the required level of collection of waste portable batteries and accumulators in 2014,
• incorrect handling of waste portable batteries and accumulators by final users,
• absence of an effective system of selective collection of waste portable batteries and accumulators ensuring achieving the required levels of collection,
• illegal disassembly of waste electronic and electrical equipment (WEEE) outside the processing plant,
• the possibility of occurrence of future difficulties in achieving the annual collection WEEE levels required by the regulations of the Act of 11 September 2015 on waste electrical and electronic equipment, taking into account the information regarding the achieved levels of collection of waste electrical and electronic equipment in the period from 2011 to 2014;
• the improper handling of WEEE by final users, in particular in the scope of the merits of their selective collection.

In municipal waste management, including food waste and other biodegradable waste, among others the following objectives were adopted:
• reduction in the quantities of generated waste:
  * limitation of food waste,
  * introduction of selective collection of bio-waste from catering establishments;
• increase in awareness of society concerning proper municipal waste management, including food waste and other biodegradable waste;
• achieving functioning of waste management systems, in accordance with the waste hierarchy and achievement of the levels given below – in order to calculate the value of particular percentage indicated below, all collected municipal waste including construction and demolition waste coming from households should be included:
  * achieving the level of preparing for reuse and recycling of the following fractions: paper, metals, plastics and glass from municipal waste in the amount of minimum 50 percent of their weight to 2020,
  * by 2020 the share of the weight of incinerated municipal waste and waste originating from treatment of municipal waste in relation to the generated municipal waste must not exceed 30 percent,
  * by 2025, 60 percent of municipal waste should be subjected to recycling,
  * by 2030, 65 percent of municipal waste should be subjected to recycling,
  * reduction of landfilling of municipal waste to maximum 10 percent by 2030;
• reduction in share of mixed municipal waste in the whole stream of collected waste – increase in the share of selectively collected waste:
  * covering all owners of real estate with tenants with selective municipal waste collection system,
* introduction of uniform standards of selective municipal waste collection system across the whole country by the end of 2021 – the standardisation is intended to provide a minimum level of selective waste collection especially with regard to municipalities in which unacceptable division into dry and wet waste still applies,

* providing the highest possible quality of collected waste by the relevant systems of selective waste collection, in such a way that they could be recycled in the most effective way,

* introduction in all municipalities in Poland of systems for selective collection of green waste and other bio-waste at source – by the end of 2021;

- reduction in the quantity of biodegradable municipal waste directed to landfills in order to landfill no more than 35 percent of mass in 2020 as compared to the mass of this waste generated in 1995;

- cessation of landfilling of selectively collected biodegradable waste;

- cessation of landfilling of mixed municipal waste without pre-treatment;

- reduction in the number of illegal sites for depositing of municipal waste;

- creation of monitoring system of the municipal waste management.

In packaging and packaging waste management, among others, the following objectives were adopted:

- ensuring appropriate quality of selectively collected packaging waste in households,

- maintenance of levels of recovery and recycling at least at the level specified in appendix no. 1 to the Act of 13 June 2013 on packaging and packaging waste management,

- achieving and maintenance of at least the levels of recovery and recycling in particular years for multiple-material packaging specified in the Regulation of the Minister of the Environment of 16 April 2014 on minimum annual levels of recovery and recycling for multiple-material packaging and for packaging of hazardous agents, in particular years, below which cannot be defined the levels in agreement concluded with the marshal of the voivodship – Journal of Laws item 618,

- elimination of unfair practices with regard to issuing documents confirming recovery of packaging waste,

- increase in awareness of users and sellers of agents containing hazardous substances, including plant protection agents, with regard to proper packaging handling of these products.

The following objectives were adopted in the management of waste batteries and accumulators:

- greater awareness of the society and entrepreneurs about the proper handling of waste batteries and accumulators;
• achieving in 2016 and the following years the collection rate of waste batteries and accumulators, of at least 45 percent of mass of introduced batteries and accumulators;

• maintenance of the efficiency of recycling of:
  * waste acid-lead batteries and accumulators of at least 65 percent,
  * waste nickel-cadmium batteries and accumulators of at least 75 percent,
  * other waste batteries and accumulators, amounting to at least 50 percent of mass of waste batteries or accumulators.

The following objectives have been adopted in the management of waste electrical and electronic equipment:

• increase in awareness of the society and entrepreneurs about the proper handling of waste electrical and electronic equipment (WEEE),

• limitation of WEEE generation,

• ensuring the achievement of the adequate level of WEEE collection – as specified by law,

• ensuring the achievement of proper levels of recovery and recycling of waste electrical and electronic equipment – as specified by law.

With regard to waste management, including food waste and other biodegradable waste, inter alia the following directions of activities were determined:

In general scope

• carrying out of tests with regard to municipal waste management, among others, tests concerning analysis of morphological composition and physical-chemical properties of waste,

• maintaining the funding – e.g. by financial instruments – of the investments focused on modernisation of installations processing municipal waste, including selectively collected biodegradable waste, so that they could adjust and meet the high environmental protection standards,

• limitation of possibilities of public financing of the investments related to management of municipal waste and waste generated from their treatment – in case there is the risk of non-achievement of the pursued goals by 2020 or a surplus of capacities of installations in the waste management regions or voivodships in relation to an available waste stream,

• organising and conducting educational and information activities on the national and municipal level aimed at, among others:
  * raising awareness of the society with regard to municipal waste prevention, including biodegradable waste, with particular emphasis on a proper, that is rational, planning of purchases of food products in order to prevent food waste,
Possibilities of Development of Municipal Waste Recycling and Incineration in Poland

* relevant handling of waste, including biodegradable waste, especially with regard to selective municipal waste collection,
* promotion of such bio-waste treatment technologies, as a result of which a valuable, environment-friendly material is created, used for fertilisation or reclamation,
* promotion of proper methods of waste handling and the benefits resulting from this – broadly understood educational and information actions addressed to different target groups, in particular kindergarteners, pupils and students, general public and decision-makers,

- identification of the percentage difference between the rates of fees for waste collected in a selective manner and waste collected in a non-selective manner, to create an incentive to collect waste selectively,
- making an analysis of waste distribution with breakdown into the municipal waste management regions at the stage of updating particular voivodship waste management plans, along with the indication of municipalities comprising each of the regions, so as to correctly use the capacities of installations, taking into consideration environmental and economic aspects,
- municipal waste management by the municipalities under the system of municipal waste management regions and on the basis of regional installations for municipal waste treatment;
- implementation of best available techniques (BAT) by entrepreneurs.

It is also planned to introduce in the future a solution consisting in the possibility of using in house public procurement with regard to municipal waste management in order to enable municipalities to effectively control the way municipal waste is managed.

With regard to collection and transportation of waste

- implementation of a relevant system of selective collection and receipt of waste at source at least with regard to the following fraction of municipal waste:
  * paper and cardboard,
  * metals, plastics, multi-material packaging,
  * glass,
  * ash,
  * bio-waste, including green waste.

In addition, an indicated direction of operation is:
* separate collection of paper and cardboard and separate collection of packaging glass so as to prevent their contamination – as a result, raw materials will be of proper quality and, at the same time, possible to be recycled,
* collection and transportation of selectively collected waste in a manner preventing their mixing:
• ensuring the possibility of selective collection by means of municipal waste selective collection centres and, if possible, in a different way, convenient for the inhabitants, at least with regard to the following waste fractions:
  * waste batteries and accumulators,
  * WEEE,
  * expired medicines and chemicals,
  * furniture and other bulky waste,
  * used tyres,
  * green waste,
  * ash,
  * construction and demolition waste constituting municipal waste;

• apart from provision of selective receipt of municipal waste at source and receiving waste in municipal waste selective collection centres it is recommended to ensure the waste collection by means of the groups of containers for packaging waste collected selectively and the mobile collectors;

• self-management of green waste and other bio-waste in rural areas, among others, in home composting units or in biogas plants and, in the case of the areas with detached houses, in home composting units.

With regard to preparing for re-use and recycling

• modernisation of technology in installations of mechanical biological treatment of municipal waste. After modernising, the mechanical part of these systems is to be used for effective sorting out of raw material waste and additional treatment of waste segregated at source, while the biological part is to be used for composting or fermentation of bio-waste and green waste;

• pursuit of the maximum increase in mass of recycled municipal waste, so as to ensure that it is possible to reach the assumed goals in this respect:
  * making an analysis of the possibility to recycle in each voivodship, first of all, plastics, multi-material packaging and packaging of hazardous agents,
  * in the case of materials recycling of which requires substantial expenditure on construction of an installation an effective system of collection and transportation of these raw materials to the existing installations should be ensured,
  * eco-design – the designing extending product life, permitting the maximum use of reusable and recyclable elements, including the implementation of research projects in the above scope,
  * promotion and implementation of activities aimed at preparing for re-use and recycling of products or materials suitable for this, separated from a stream of municipal waste,
* creating legal and economic conditions for the implementation of installations enabling treatment of all selectively collected waste,

* stimulation of development of the market of secondary raw materials and products containing secondary raw materials by supporting the cooperation of producers and recovery organisations representing them, industry organisations and local government units and, consequently, enforcement of obligations with regard to preparing for re-use and recycling, promotion of products manufactured from waste materials by the relevant promotional and educational actions, as well as public procurement.

**With regard to other methods of waste recovery and disposal**

- maximisation of the levels of recovery requires implementation of the following directions of activities:

  * issuing decisions related to execution of goals fulfilling the assumptions of waste management plans and their enforcement,
  * information and promotion with regard to the planned strategic investments in accordance with waste management plans,
  * supporting and propagating research concerning technologies of recovery;

- analysis of possibilities and introduction of new rates of environmental fees which will result in shaping correct attitudes in the scope of waste management in accordance with the waste hierarchy:

  * verification of possibilities and conditions for increasing landfill fees,
  * verification of the possibilities and conditions of implementation of the new assumptions with regard to thermal and mechanical biological treatment of waste in such direction so that recycling of waste is, as a whole, more profitable in economic terms – appropriate shaping of new rates of environmental fees;

- limitation in landfilling of biodegradable waste affects the need for:

  * creating by local government authorities the incentives with regard to management of green waste and other bio-waste in home composting units – financing or co-financing of home composting units,
  * construction or modernisation of technological lines for its treatment:
    - organic waste composting plants,
    - organic waste fermentation installations,
    - waste incineration systems with a component processing the waste originating from treatment of municipal waste and RDF, with energy recovery, taking account of the required levels of preparing for re-use and recycling;
implementation of a balance system of application of incineration methods for municipal waste treatment with energy recovery:

* development of incineration methods of municipal waste treatment should proceed in a manner not presenting the risk for the agreed levels of preparing for re-use and recycling,

* coordination of activities at the level of particular voivodships with regard to development plans of infrastructure used for municipal waste treatment, in particular for waste incineration installations, and their subsequent implementation. Determinations concerning the coordination activities should particularly take account of the estimated availability of municipal waste, while it is reasonable to make arrangements in particular voivodships related to the possibility of integrating cement factories with the system of processing waste originating from municipal waste. Ensuring no waste incineration installation is financed from public measures, namely both from environmental protection funds, the EU funds, as well as the budget of the state and local government units, if the share of mass of thermally treated municipal waste and waste originating from municipal waste treatment in a voivodship or country exceeds thirty percent in relation to generated municipal waste,

* carrying out an analysis of municipal waste stream in municipal waste management regions and, based on designated goals, in particular the need for providing an appropriate mass of waste for recycling, designing the processing capacities of the installations for municipal waste management, including:
  - it is necessary to verify at the stage of preparing updates of particular voivodship waste management plans the investment needs in all the waste management regions, including the justified character of development of a new installation, in particular an installation for mechanical biological treatment of municipal waste and a waste incineration installation, as well as adjusting their processing capacities to the current and forecasted needs in this respect, including considering the specific nature of a managed stream, in particular in the context of the possibility to use RDF,
  - capacity of all the installations for incineration of municipal waste and waste originating from treatment of municipal waste in a given voivodship should not exceed thirty percent of the amount of waste generated in this voivodship. Otherwise, the achievement of the required levels of recycling may be compromised,

* after making an analysis of a municipal waste stream and separating a fraction intended for recycling it is necessary to make use of an energy potential of a fraction generated as a result of the operation of installations for mechanical biological treatment of municipal waste in the installations holding appropriate permits, to the extent not presenting the risk for the agreed levels of preparing to re-use and recycling.
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- Easy retrofitting
- High availability
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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 2004-2014. The total mass of treated municipal waste corresponds to the mass of collected municipal waste. The decrease in the amount of waste observed in years 2010-2013 can be caused by significant emigration and changes in material status of part of the population. In 2014 which was 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, mass of treated municipal waste significantly increased. 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.

Table 1: Municipal waste management in Poland in 2004-2014 (according to CSO data submitted to Eurostat)

<table>
<thead>
<tr>
<th>Year</th>
<th>Mass of treated municipal waste thousand Mg</th>
<th>Mass of municipal waste treated using different methods</th>
<th>Percentage of municipal waste treated using different methods %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mass recycling</td>
<td>Incineration</td>
<td>Land-filling</td>
</tr>
<tr>
<td>2004</td>
<td>9,715</td>
<td>243</td>
<td>44</td>
</tr>
<tr>
<td>2005</td>
<td>9,352</td>
<td>367</td>
<td>44</td>
</tr>
<tr>
<td>2006</td>
<td>9,877</td>
<td>487</td>
<td>45</td>
</tr>
<tr>
<td>2007</td>
<td>10,083</td>
<td>580</td>
<td>41</td>
</tr>
<tr>
<td>2008</td>
<td>10,036</td>
<td>895</td>
<td>40</td>
</tr>
<tr>
<td>2009</td>
<td>10,053</td>
<td>1,421</td>
<td>46</td>
</tr>
<tr>
<td>2010</td>
<td>10,040</td>
<td>1,783</td>
<td>39</td>
</tr>
<tr>
<td>2011</td>
<td>9,828</td>
<td>1,173</td>
<td>45</td>
</tr>
<tr>
<td>2012</td>
<td>9,581</td>
<td>1,244</td>
<td>51</td>
</tr>
<tr>
<td>2013</td>
<td>9,474</td>
<td>1,499</td>
<td>*766</td>
</tr>
<tr>
<td>2014</td>
<td>10,330</td>
<td>2,179</td>
<td>*1,560</td>
</tr>
</tbody>
</table>

Table 2 shows information on the morphological composition of municipal waste – according to the National Waste Management Plan 2014 and 2022; Table 3 shows the existing capacity in the recycling and incineration of municipal waste as of the end of 2014. 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.

* Data on incineration for 2013 and 2014 also include co-incineration of alternative fuels produced from municipal waste in cement plants, which in this case constitutes a dominant part, exceeding multiple time the incineration in the only Polish incineration plant with a capacity of approx. 40 thousand Mg/year.
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 expansions of biological and mechanical treatment and composting, more than half of MSW is still landfilled. Further investment is needed to meet the 2020 targets, notably for the recycling and composting of MSW.

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.

Table 2: Morphological composition of waste in Poland in 2008

<table>
<thead>
<tr>
<th>No.</th>
<th>Fraction</th>
<th>Share of fraction in generated waste:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>in big cities*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>1.</td>
<td>Paper and paperboard</td>
<td>19.1</td>
</tr>
<tr>
<td>2.</td>
<td>Glass</td>
<td>10.0</td>
</tr>
<tr>
<td>3.</td>
<td>Metals</td>
<td>2.6</td>
</tr>
<tr>
<td>4.</td>
<td>Plastics</td>
<td>15.1</td>
</tr>
<tr>
<td>5.</td>
<td>Multi-material waste</td>
<td>2.5</td>
</tr>
<tr>
<td>6.</td>
<td>Kitchen and garden waste (bio-waste)</td>
<td>28.9</td>
</tr>
<tr>
<td>7.</td>
<td>Mineral waste</td>
<td>3.2</td>
</tr>
<tr>
<td>8.</td>
<td>Fraction of less than 10 mm</td>
<td>4.2</td>
</tr>
<tr>
<td>9.</td>
<td>Textiles</td>
<td>2.3</td>
</tr>
<tr>
<td>10.</td>
<td>Wood</td>
<td>0.2</td>
</tr>
<tr>
<td>11.</td>
<td>Hazardous waste</td>
<td>0.8</td>
</tr>
<tr>
<td>12.</td>
<td>Other categories</td>
<td>3.2</td>
</tr>
<tr>
<td>13.</td>
<td>Bulky waste</td>
<td>2.6</td>
</tr>
<tr>
<td>14.</td>
<td>Waste from green areas</td>
<td>5.3</td>
</tr>
</tbody>
</table>

* 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 cities, 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 2014

<table>
<thead>
<tr>
<th>No.</th>
<th>Type of process</th>
<th>Existing capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Paper recycling in paper mills</td>
<td>about 2,100,000</td>
</tr>
<tr>
<td>2.</td>
<td>Recycling of ferrous metals in steelworks</td>
<td>about 8,000,000</td>
</tr>
<tr>
<td>3.</td>
<td>Recycling of glass packaging in glassworks</td>
<td>650,000 – 750,000</td>
</tr>
<tr>
<td>4.</td>
<td>Recycling of flat glass in glassworks</td>
<td>250,000 – 300,000</td>
</tr>
<tr>
<td>5.</td>
<td>Incineration of mixed municipal waste in incinerators</td>
<td>42,000</td>
</tr>
<tr>
<td>6.</td>
<td>Co-incineration of high-calorie fractions of municipal waste in cement plants</td>
<td>ca. 1,000,000</td>
</tr>
</tbody>
</table>
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 – among others according to the European Commission’s proposal for 2025 and 2030 and the incineration target set up in the National waste management plan 2022. The results are shown in Table 4.

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

<table>
<thead>
<tr>
<th>Amount of generated municipal waste (million Mg)</th>
<th>Required level of recycling</th>
<th>Necessary target capacity for recycling (million Mg)</th>
<th>Maximal allowable target capacity for incineration according to the National waste management plan 2022 (million Mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>50</td>
<td>5.00</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>6.00</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>65</td>
<td>6.50</td>
<td>3.00</td>
</tr>
<tr>
<td>12</td>
<td>50</td>
<td>6.00</td>
<td>3.60</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>7.20</td>
<td>3.60</td>
</tr>
<tr>
<td></td>
<td>65</td>
<td>7.80</td>
<td>3.60</td>
</tr>
<tr>
<td>15</td>
<td>50</td>
<td>7.50</td>
<td>4.80</td>
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<td></td>
<td>60</td>
<td>9.00</td>
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<td>65</td>
<td>9.75</td>
<td>4.50</td>
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</tbody>
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Given the morphological composition of municipal waste and degree of contamination of waste, recycling at the level of 65 percent – with today’s technology – is very difficult to be achieved, 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 faction, 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 that 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 fifty 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.