



SMARTEnvi PROJECT

**SMART DECISION TOOLS FOR REDUCING HAZARDS TO OUR
ENVIRONMENT AND WATER RESOURCES BY
REHABILITATING OPEN DUMPS**

NATIONAL REPORT POLAND



Silesian University
of Technology



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1. Preface

Poland has found itself in a situation in which the urgent implementation of measures to organize the sphere of waste management has become a priority for the government, and above all for local governments.

The new National Waste Management Plan (NWMP) was introduced, which covers the scope of activities necessary to ensure integrated waste management, consistent with the hierarchy of waste management methods, and in line with the activities of the circular economy. However, the analysis of the content of NWMP raises some doubts.

One of the important elements determining the shape of the waste management system is the amount of waste generated per capita. The current value of this indicator in Poland is 261 kg / person (value for 2014) [1]. Forecasting the tendency of changes, due to many factors, is very difficult, however, by assumption, an increase in consumption and the general development of the country is usually accompanied by an increase in the amount of generated waste.

The scenario consistent with the assumptions of the NWMP, called the high hypothesis, assumes that the annual increase in the amount of municipal waste generated per capita will amount to 1% (the low hypothesis assumes only 0.6% annual growth). According to this scenario, assuming the base year 2014 (from which the latest Statistics Poland (GUS) data come from), the amount of waste generated by one inhabitant will amount to 277 kg / person in 2020 and 291 kg / person in 2025. In 2030, each of us will generate 306 kg of waste. This is a very good result, taking into account the "achievements" of Western European countries in this field. Currently, a statistical inhabitant of the European Union accounts for 475 kg (in 2014) [2] of generated municipal waste, but there are significant differences between the Member States. Most waste per person was generated in Denmark in 2014 - 759 kg. The next places were taken by Cyprus, Germany, Luxembourg and Malta - 600-650 kg. For the Czech Republic, the average per person was 310 kg, and for Slovakia - 321 kg.

Poland's result is below the EU average. Perhaps Poles are a very conscious society and each of us aims to minimize waste production. Another possible scenario, however, is the low awareness of Poles in the field of environmental protection issues, resulting in continuous incineration of waste in rural areas and the operation of "wild landfills". Unfortunately, due to weak records and monitoring of the amount of municipal waste generated and managed in Poland, it is difficult to draw clear conclusions.

Taking into account the above assumption regarding the amount of generated waste and the projected number of people in Poland (birth rate at the level of -0.2% per year, assumption of the National Welfare Policy), it was estimated that in 2020 the amount of municipal waste in our country

will be 10.9 million tonnes, in 2025 - 11.3 million tonnes, and in 2030 - 11.8 million tonnes. Comparing 2030 to the base year (2014), the mass of waste would only increase by 13.8%.

In order to meet the current requirements in the processing of municipal waste stream, we should be guided by the principles of the waste hierarchy, which aims to reduce the burden on the environment with their increasing stream. In the first place, waste should be prevented, then, when it is possible, activities aimed at preparing them for reuse, recycling or other recovery processes should be carried out, and when the above-mentioned measures are not possible for certain types of waste, the waste should be disposed of (in this thermal). This structure will require, first of all, the development of a system of selective waste collection, enabling their recycling and reuse, and then - ensuring the possibility of their thermal processing, with the use of technologies enabling the production of heat and electricity.

In accordance with the assumptions of the circular economy package and the current national regulations (including the Regulation of the Minister of the Environment of May 29, 2012 on the levels of recycling, preparation for re-use and recovery by other methods of certain fractions of municipal waste) - recycling levels municipal waste should be 50% in 2020, 60% in 2025 and 65% in 2030. Currently, the required level is 18%, which means that - to meet the requirements of the European Commission - we must recycle almost three times more waste and recovery compared to today. According to practitioners, this is an unattainable goal.

One of the obstacles to its achievement may be plans for the development of thermal waste treatment installations, of which - according to the NWMP - there will be seven (including those currently operating), with a total processing capacity of 1.03 million tonnes / year. Interestingly, the NWMP project assumed the construction of 18 new installations, with a total capacity of 3.1 million tonnes / year [3].

2. Main trends in the generation and collection of MSW

In whole EU the MSW generation for 2019 totals vary considerably, ranging from 280 kg per capita in Romania to 844 kg per capita in Denmark (fig. 2.1). The main differences between the different consumption trends depend on the way municipal waste is collected and managed. Depending on how waste is collected from different sectors, including trade and administration, and whether it is managed together with municipal waste, we can compare the differences in approach.

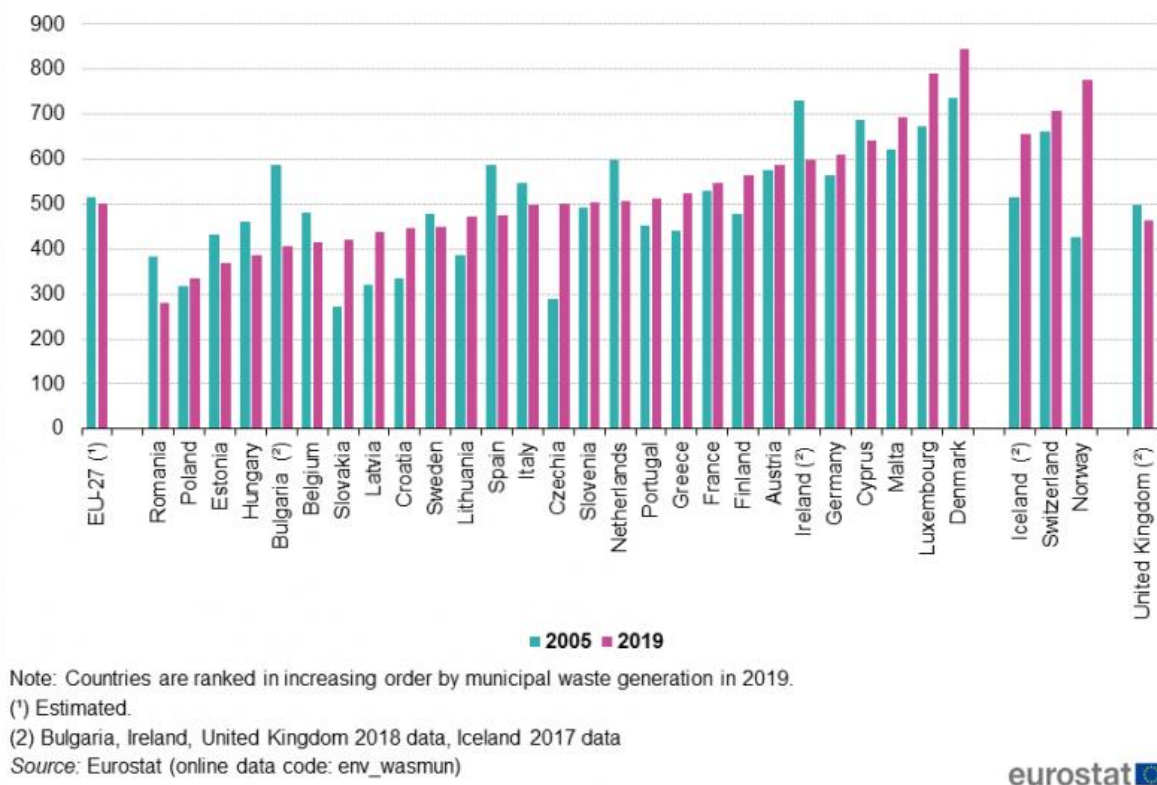


Fig. 2.1. MSW generation in EU countries in 2005 and 2019 [kg/capita].

In Poland data on the general trends in MSW collection and utilization according to date form Statistics Poland (GUS) are presented on following figures.

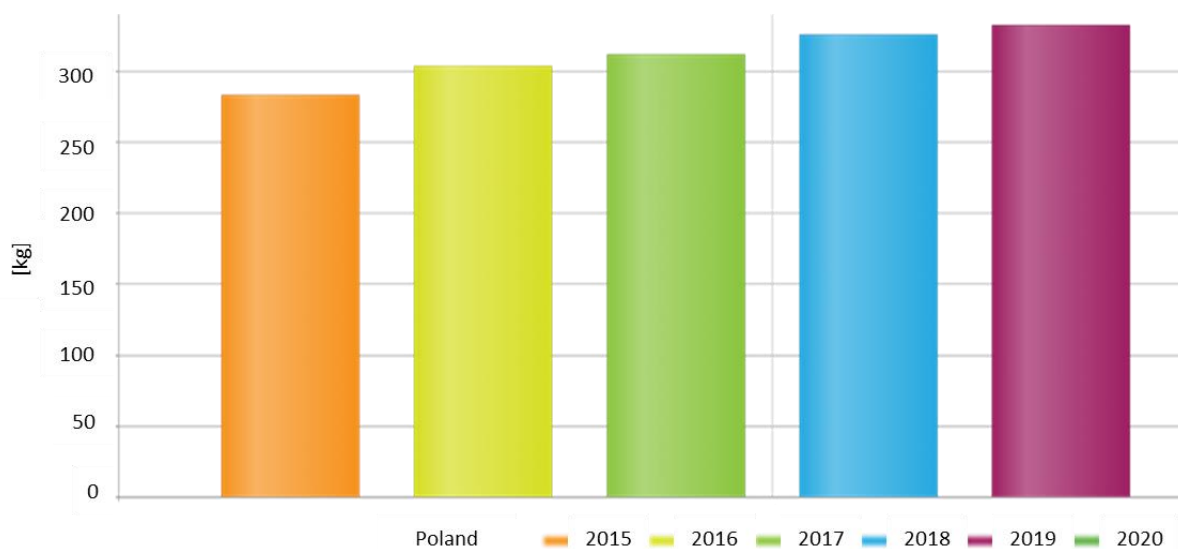


Fig. 2.2. Mass of municipal waste generated per capita

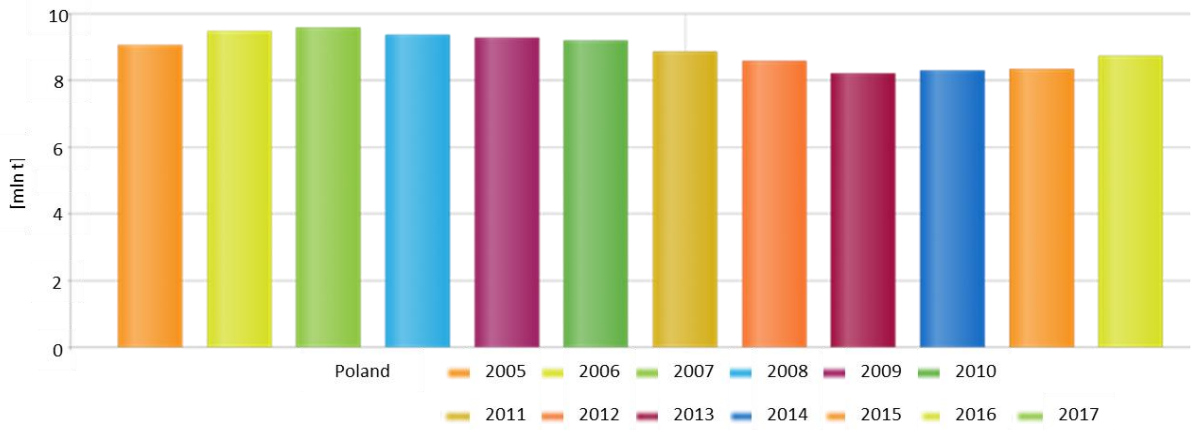


Fig.2.3. Mass of mixed MSW collected

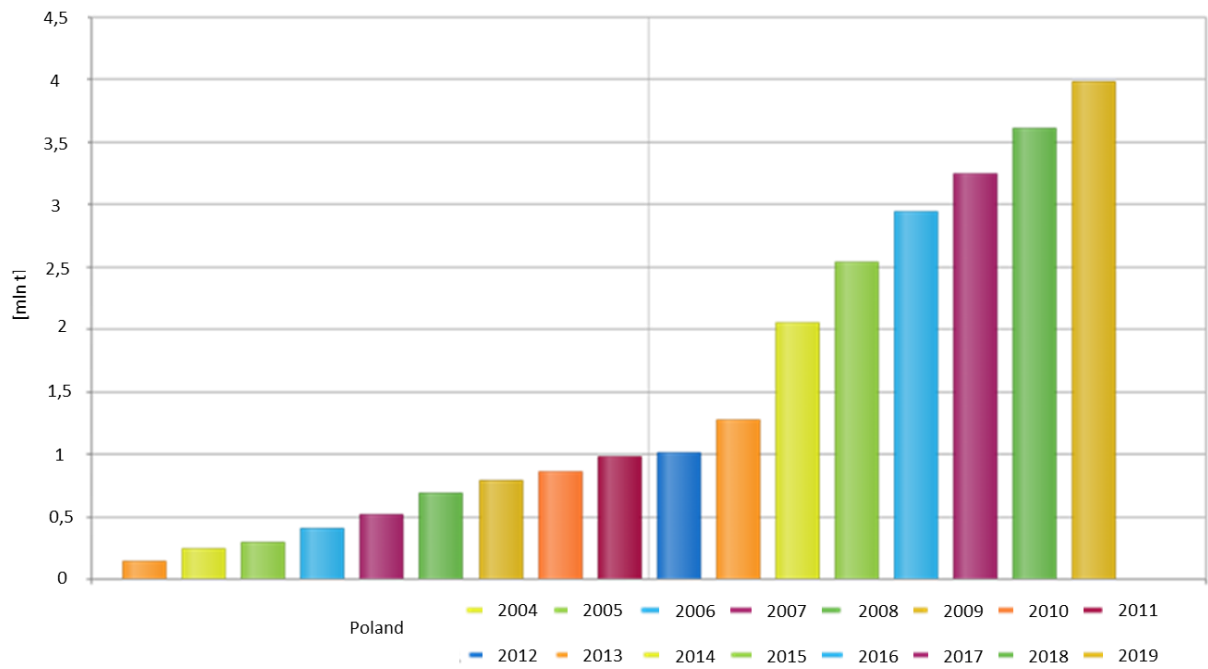


Fig.2.4. MSW collected selectively

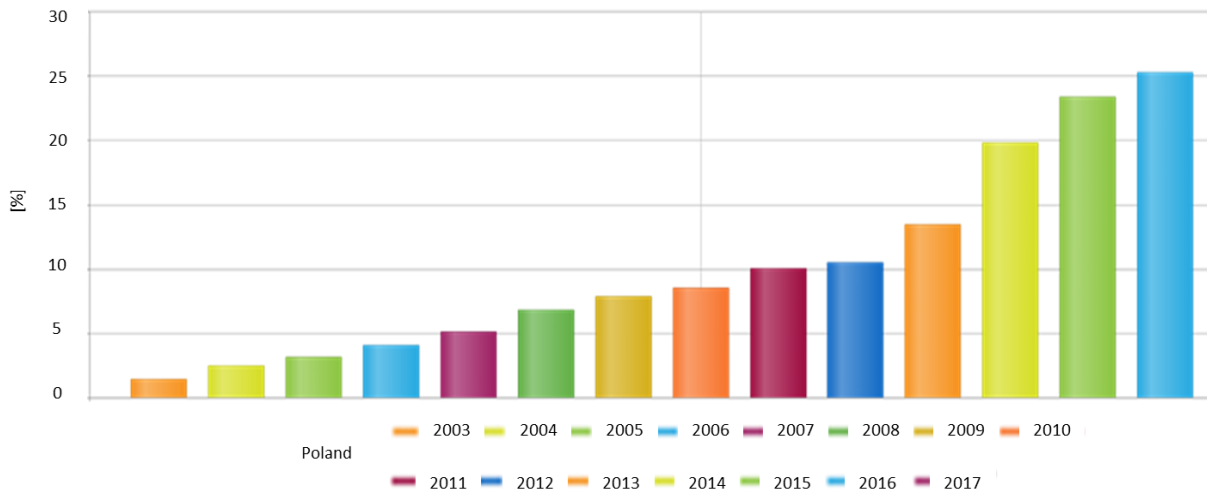


Fig. 2.5. Share of MSW collected selectively

The data shown on fig 2.1., 2.2., 2.3., 2.4. and 2.5 shows that the total MSW generation was growing in previous years. This trend could continue in following years. At the same time the mass of mixed MSW waste collected is slowly going down together with rapid growth in selective collection. This could suggest that the proper utilization of different fractions of MSW is becoming the main form of waste utilization and the role of landfills will be reduced significantly in the future.

3. Solid wastes treatment

The amount of municipal waste landfilled has decreased across the EU. In the period from 1995 (286 kg / person) to 2019 (119 kg / person) it decreased by 67 million tonnes, i.e. by 56% (Fig. 3.1). The average annual decline is around 3.3%. Earlier, in the years 2005-2019, this decrease amounted to as much as 3.5% annually.

This is the result of the implementation of Directive 62/1994 on packaging and packaging waste, in which at least 50% of packaging had to be recovered.

This was also influenced by Directive 31/1999 on the landfilling of biodegradable municipal waste and the reduction of this stream to 75% by July 16, 2006, to 50% by July 16, 2009 and to 35% by July 16, 2016. Legislative changes caused national governments to adopt their own waste management strategies and to increase levels of other forms of waste treatment than landfilling, e.g. composting, incineration, mechanical biological treatment.

Currently, the European Commission has implemented a package related to the circular economy, which is also expected to intensify these activities. 169 / 5000

In the analyzed period, the share of waste incineration also grew steadily. From 1995 to 2019, the share increased by 100%, which in 2019 amounts to 134 kg of incinerated waste per capita.

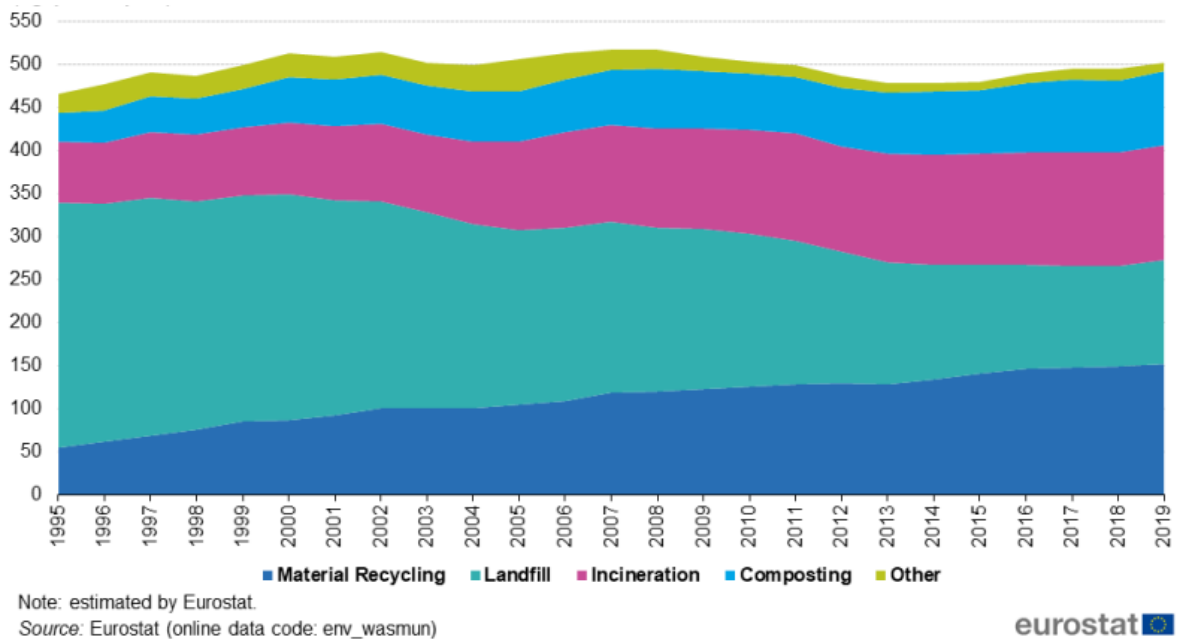


Fig. 3.1. Municipal waste treatment in EU27, 1995-2019 [kg/capita].

As a result, the overall share of municipal waste recycled or composted increased from 19% to 48%.

When analyzing the presented data, we should often look for additional information to obtain a complete set of data and link it to the amounts of municipal waste deposited, incinerated, composted and recycled and to compare it with the amount produced in the country. [4].

General direction and plans for MSW treatment are placed in National Plan for Waste Management 2022 (KPGO 2022). In this document, a lot of space is devoted to the forecasted changes in the field of waste management. In this fragment of the analyzes, particular attention should be paid to the considerations concerning the future of municipal waste management installations.

In particular, it has been indicated several times that in connection with the assumed - at the European and national level - targets for the recycling levels of municipal waste (65% by 2030) and packaging (75% by 2030) and the reduction of waste landfilling (max. 10% by 2030), MBP installations and other installations for the mixed municipal waste stream will change their purpose as polishing selectively collected waste, and the biological part will be intended for green waste and other biodegradable waste.

At the same time, it was stated that in the future at the WPGO level it will be necessary to verify the existing and planned in the coming years processing capacity of installations conducting mechanical waste treatment processes with a total capacity of approx. 15.9 million Mg and MBP with a total processing capacity of approx. 9.4 million Mg in the mechanical part. and in the biological part - about

4 million Mg in order to gradually transform these installations into sorting plants for polishing selectively collected waste and installations for biological treatment of bio-waste and green waste. On the other hand, thermal treatment should not be used for more than 30% of generated municipal waste. The objective in question takes into account the thermal conversion of municipal waste and waste from the processing of municipal waste.

It was also emphasized that there is no justification for the creation of further waste landfills intended for the storage of municipal waste and waste from the municipal waste stream.

Ultimately, however, it was found that a detailed analysis in this regard belongs to the marshals of voivodeships.

In National Plan for Waste Management 2022 (NWMP 2022), eleven goals were formulated for the management of municipal waste, including food waste and other biodegradable waste:

1. reducing the amount of waste generated:
 - reducing food waste,
 - introducing separate collection of bio-waste from mass caterers;
2. increasing public awareness of the proper management of municipal waste, including food waste and other biodegradable waste;
3. bringing the functioning of waste management systems in accordance with the hierarchy of ways of dealing with waste.

In order to calculate the individual percentages indicated below, all municipal waste collected and collected (including construction and renovation waste) from households should be included:

- achieving the level of recycling and preparation for re-use of fractions: paper, metals, plastics and glass from municipal waste in the amount of at least 50% of their weight by 2020,
 - by 2020, the share of the mass of thermally converted municipal waste and waste from the processing of municipal waste in relation to the generated municipal waste may not exceed 30%,
 - 60% of municipal waste should be recycled by 2025,
 - 65% of municipal waste should be recycled by 2030,
 - reduction of municipal waste landfilling to a maximum of 10% by 2030.
4. reducing the share of mixed municipal waste in the entire stream of collected waste (increasing the share of separately collected waste):

- covering all owners of real estate where residents live with the system of selective collection of municipal waste,
 - introducing uniform standards of separate collection of municipal waste throughout the country by the end of 2021 - standardization is aimed at ensuring a minimum level of selective waste collection, especially in relation to municipalities where an unacceptable division into "dry" - "wet" waste is applied,
 - ensuring the highest quality of collected waste by appropriate selective waste collection systems, in such a way that they can be recycled in the most efficient way possible,
 - introducing systems for selective collection of green waste and other bio-waste at source in all municipalities in the country - by the end of 2021;
5. reducing the amount of biodegradable municipal waste going to landfills so that in 2020 no more than 35% of the weight of this waste is landfilled in relation to the weight of waste generated in 1995;
 6. to stop storage of separately collected biodegradable waste;
 7. to stop depositing mixed municipal waste without processing;
 8. reducing the number of illegal municipal waste disposal sites;
 9. establishing a municipal waste management monitoring system;
 10. monitoring and control of the handling of the municipal waste fraction sorted out from the mixed municipal waste stream and not intended for storage (fraction 19 12 12);
 11. balancing the functioning of the municipal waste management system in the light of the prohibition on landfilling certain fractions of municipal waste and waste from municipal waste treatment, including waste with a total organic carbon content above 5% DS and with a heat of combustion above 6 MJ / kg dry weight, from 1 January 2016. [5].

In order to achieve the above-mentioned goals, NWMP 2022 formulated a number of directions of activities related to municipal waste management. Among them, the issues that are particularly important from the perspective of local government units deserve special attention.

Firstly, it was assumed that the financing of investments, including financial instruments, aimed at the modernization of installations processing municipal waste, including biodegradable waste collected separately, will be maintained, so that it can adapt and meet high environmental protection standards.

At the same time, a restriction of the possibility of financing investments in the field of municipal waste management and waste from its processing from public funds has been stipulated - in the event

of a threat to the possibility of achieving the set goals by 2020 or in the event of excess processing capacity of installations in waste management regions or provinces in relation to the available waste stream.

Secondly, it was announced to organize and conduct educational and information activities both at the national and municipal level, aimed at, inter alia:

1. Raising awareness of the society in the field of waste prevention, including biodegradable waste, with particular emphasis on proper, i.e. rational planning of food purchases in order to prevent food waste,
2. Proper handling of waste, including biodegradable waste, especially in the field of selective collection of municipal waste,
3. Promotion of such bio-waste treatment technologies, which result in the production of a full-value and environmentally safe material used for fertilization or rehabilitation purposes,
4. Promoting the correct way of handling waste and the resulting benefits (broadly understood educational and information activities aimed at various target groups, in particular preschoolers, pupils and students, the general public, as well as decision-makers).

Conducting a nationwide information and education campaign on the handling of individual types of waste (including the development of recommendations for municipalities relating to the implementation of information and promotion campaigns on waste management, in particular in the field of selective waste collection) is planned by the end of 2018. The entity carrying out this task is the Ministry of the Environment.

At the same time, it is planned to collect and share educational materials on waste prevention and proper waste management for schools. This task is to be carried out in 2016 in cooperation with the Ministry of National Education and the Center for Education Development. It should be emphasized that the participation of the Ministry of National Education in the field of education and information activities was defined far too narrowly. It is necessary to introduce the broadest possible elements of environmental education, including waste management, into the curricula as soon as possible. In this respect, communes may support educational activities of schools and kindergartens, but cannot replace them in this respect.

Thirdly, it is planned to create a legal and organizational basis for municipalities to control the proper collection and management of municipal waste, in particular by abolishing legal solutions relating to

the possibility of a flat-rate settlement of a company collecting municipal waste from residents in proportion to its quantity and combining a tender for waste collection and management.

These announcements, as mentioned in the first part of the article, should be considered controversial. Again, the emphasis is on control activities on the part of municipalities, ignoring the need to significantly strengthen the functions and control capabilities of environmental protection inspections (however, it should be noted that the action schedule directly indicates the control of entities involved in municipal waste management by Provincial Environmental Protection Inspectorate - WIOŚ).

At the same time, a number of practical difficulties may be associated with the organization of separate tenders for the collection and management of municipal waste, which may translate into the operating costs of the entire system.

4. Waste and Circular Economy

EU governments, including the Polish government, recognized that the implementation of a circular economy will increase the innovation and competitiveness of entrepreneurs, especially compared to other entities, including from around the world. A roadmap for this transformation was adopted in 2019 and has been successfully implemented. It was the result of the establishment of a CE working group, in which companies, ministries, universities and other entities interested in CE implementation are involved.

The Polish Road Map was created to successfully implement CE in Poland and primarily focuses on activities that minimize waste generation [7]:

- Sustainable industrial production - in which the role of Poland can be indicated
- Sustainable consumption - showing the benefits of living close to zero waste - buys less, uses more
- Bioeconomy - including bio waste management;
- New business models - directions for companies, with an indication of the benefits of implementing CE;
- Implementation, monitoring and financing of CE.

The CE Road Map contains guidelines for legislative bodies that show how to increase the use of secondary raw materials in Poland and proposals for activities related to waste management.

Currently the stage of implementation of CE goals is still not satisfactory. One of indicators that could be used are recycling rates for MSW in Poland. Comparing them to EU average it is still much to be done (Fig. 4.1).

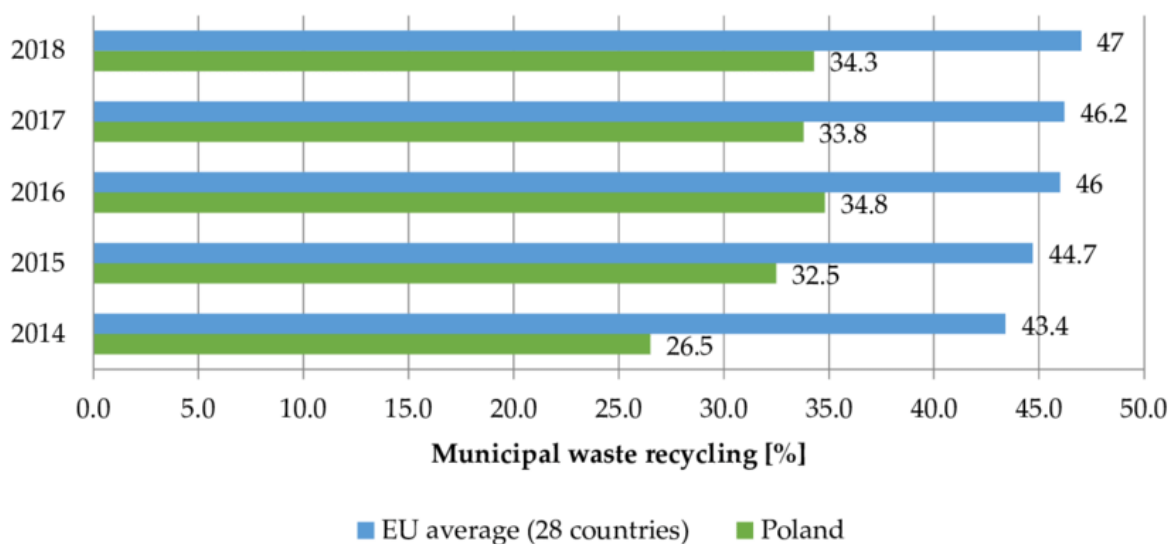


Fig. 4.1. Recycling of municipal waste in Poland and the EU in 2014-2018 [7]

5. Open dumps data

At the end of 2019, there were 278 municipal landfills, covering a total area of 1,670 ha. Over 92% of them were equipped with degassing installations, as a result of which approx. 91 153 thousand tonnes were recovered by burning the captured gas. MJ of thermal energy and approx. 112 914 thousand kWh of electricity.

In 2019, 16 landfills were closed, with a total area of approximately 52.8 ha. In 2019, 11,371 illegal landfills were liquidated in Poland, of which approx. 26,000 were collected in total. tons of municipal waste. At the end of 2019, 1,873 illegal landfills were recorded. The general trends towards landfills in Poland are shown on figures 5.1.-5.4.

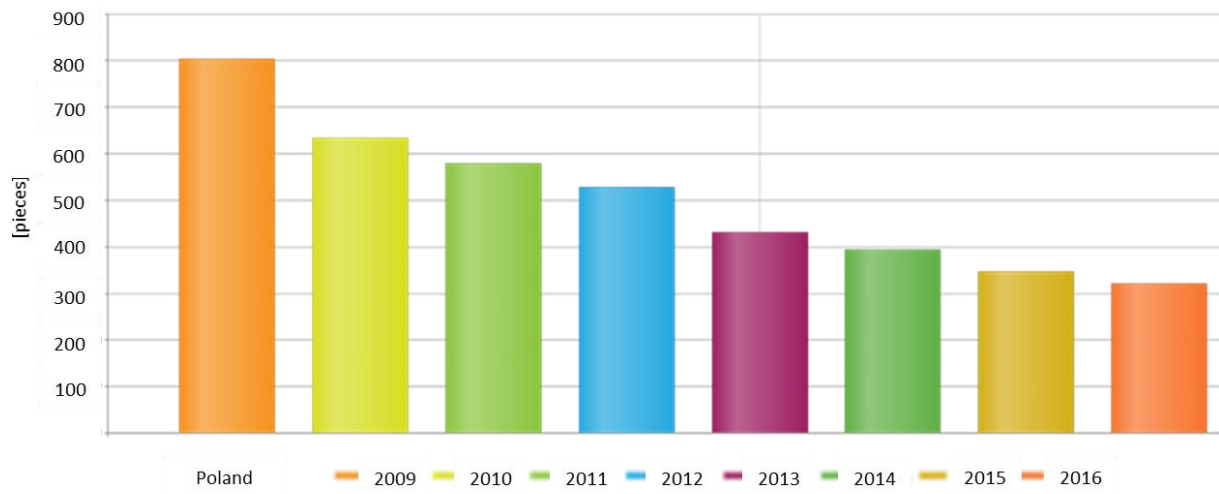


Fig. 5.1. Number of MSW landfills in operation

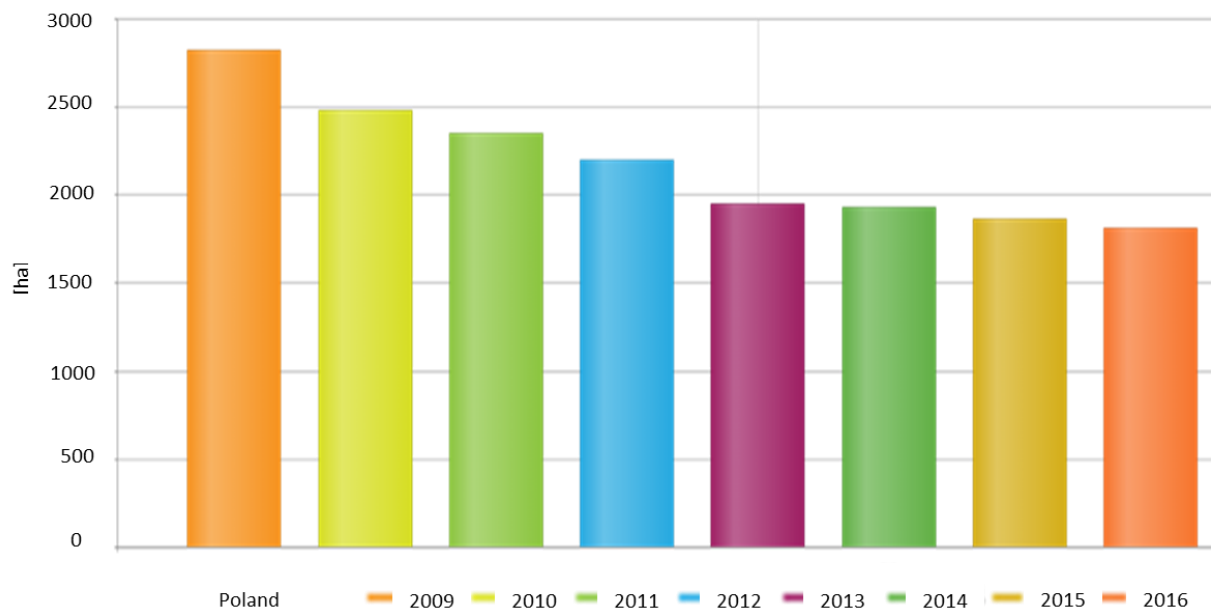


Fig. 5.2. Area of MSW landfills in operation

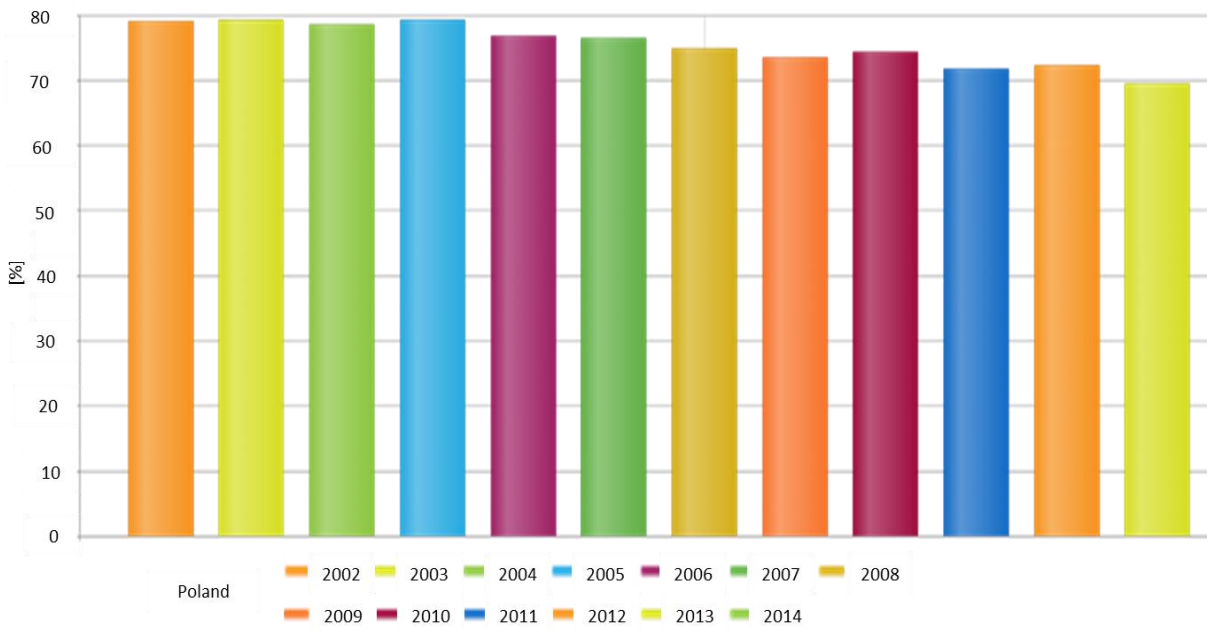


Fig. 5.3. Wastes produced and stored so far (accumulated, excluding municipal waste)

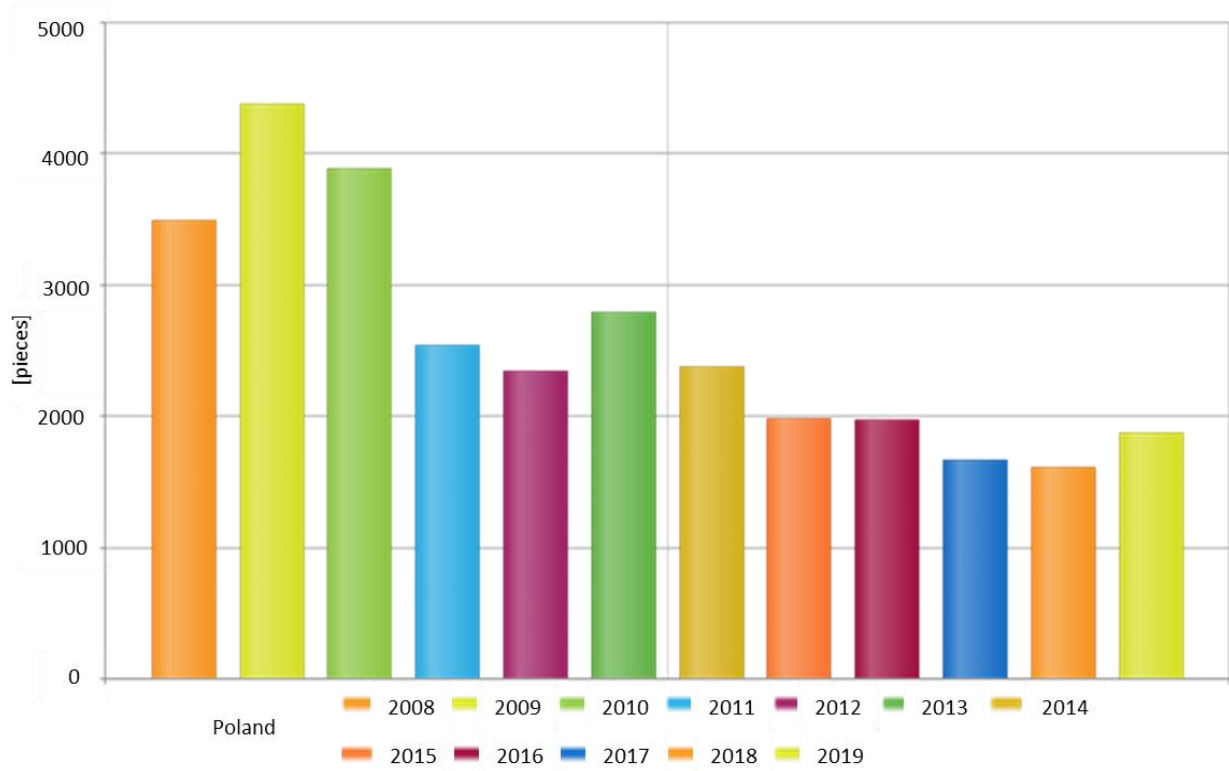


Fig. 5.4. Number of MSW landfills

6. Rehabilitation of open dumps

In general rehabilitation process could be divided into following parts:

1. Preparatory work
2. Technical rehabilitation
3. Biological rehabilitation
4. Final cleaning work activities

Preparatory work includes:

1. demolition of technological roads. The disassembled panels were used to lay a technological road leading to the top of the landfill.
2. disassembly of the degassing installation - for the duration of the works related to the correction of the slope inclination and the shape of the landfill body, the installation was disconnected and disassembled.
3. cleaning the slopes of the landfill and the plateau of oversized waste.

Technical rehabilitation includes:

1. correction of the slope of the external slopes of the landfill quarters
2. transfer of waste masses to the operational voids of the quarters
3. reprofiling the technological road leading to the plateau from the western slope
4. execution of a leveling layer on slopes and plateaus
5. placing an anti-erosion mat on profiled slopes
6. execution of the so-called drainage "French drain" on the top of the landfill.
7. The slope of the external slopes of the landfill section was corrected by removing excess waste from the slopes and moving them to the exploitation voids. The displaced waste was subject to concentration on an ongoing basis.
8. An inter-scarp ledge was made for the purpose of safer work with the correction of the slope inclination.
9. After the works related to the correction of the slope slope were completed, a leveling layer with a thickness of 0.15 m was made.

10. A reclamation layer with a thickness of 0.45 m was applied to the leveling layer. The fertile layer was created on the slopes in two stages. A biomat was placed on the first fragment of the layer with a thickness of 0.40 m and sown with a mixture of grasses, and then a second layer of soil with a thickness of 0.05 m was spread.
11. The biodegradable mat made of coconut fibers is used to prevent surface erosion, and mainly to stabilize the fertile layer during the plant rooting phase.
12. In order to protect the slopes against water erosion, a drainage was made on the top of the landfill, the so-called "French drain". The trench was lined with geotextile and filled with aggregate.
13. During the works on the plateau, 4 degassing wells were renovated and modernized. These wells are to be used to assess the amount of produced and emitted gas as well as its chemical composition (research and measurement wells).

Biological rehabilitation is aimed at initiating soil-forming processes, restoring biological life and fertilizing the soil. In order to improve the biological fertility layer, the sowing of perennial grasses is used.

The mixture was selected so that the plants that build them are resistant to changing habitat conditions, and at the same time have a good effect on the physical and chemical properties of the soil.

The following mixtures of grasses were used in the mixture:

- common broom (*Agrotis vulgaris*), red fescue (*Festuca rubra*), English ryegrass (*Lolium perenne*), timothy meadow (*Phleum pratense*)
- In order to recreate places favourable for the development of small fauna and avifauna, shrubs were planted on the slopes, such as:
- Dewberry (*Rubus caesitus*), spiny spring (*Rubus plicatus*), wild hazel (*Coryllus avellana*), wild raspberry (*Rubus idaeus*), Iva willow (*Salix caprea*)

The **cleaning works** consisted in tidying up the surrounding ditch from the waste it contained and supplementing the fencing of the area. In addition, the backyard of the repository was cleaned up, consisting in demolishing the facilities and leveling the area.



Fig. 6.1. Rehabilitated municipal waste landfill in Mińsk Mazowiecki [8]

7. Legislations and directives about solid waste management and open dumps

Council Directive 1999/31 / EC of 26 April 1999 on the landfill of waste imposed on the Member States, inter alia, the obligation to take measures to prevent the existing waste landfills from continuing their operations, if they are not adapted to the requirements specified in the above-mentioned directive. Poland's accession to the European Union in 2004 was therefore associated with the need to adapt the landfills operated in the country to the technical requirements contained in the above-mentioned directive or, failing that, to their closure. Even before accession to the European Community, the national law introduced regulations modeled on the provisions of Directive 1999/31 / EC, concerning, inter alia, obligation of landfill managers to submit, by 30 June 2002, an ecological review of the existing landfill, and then to adjust its operation to the requirements of the Act on waste or to close it by 31 December 2009.

The deadline for the closure of non-compliant landfills, set out in national regulations, in the case of municipal landfills, was stricter than the transitional periods negotiated by Poland and set out in the Accession Treaty, allowing, by way of derogation from Directive 1999/31 / EC, not to apply until

January 1, 2012 for of such landfills water governance and leachate management, land and water protection, gas governance and stability requirements.

Issues related to the closure and rehabilitation of waste landfills and the monitoring of their impact on the environment, both in the operational and post-exploitation phase, result directly from the applicable provisions of Community and national law and the provisions of national strategic and planning documents in the field of waste management, including the operation of landfills waste. They clearly show the need to discontinue use and close down landfills that do not meet the requirements set out in the regulations in question [9].

8. Target Groups

The solid Waste Management (SWM) sector needs a lot of engineers in order to fix all challenges in that area, especially in the landfilling and open dumps sectors. Regarding the waste management hierarchy, the disposal of waste in that way is the worse option. In order to make it happened some actions and tools should be delivered to the professionalist with special attention to the students and alumni of waste study. Education is recognized as fundamentally important for the creation of an EU knowledge-based society and can help to create a solid base of knowledge and professional tools and materials. Regarding this, the SMARTEnvi project goals are to enhance the quality of education and professional development of target groups to improve the quality of their competence and skills by different intellectual outputs of the project.

8.1. Target groups benefiting from SMARTEnvi

The target group to improve the quality of their competence and skills, to establish the links between theory and practice is as follows:

- Municipalities – operating landfills – the largest groupe
- Landfill independent operator
- Waste management companies
- Environmental protection funds like National Fund for Environmental Protection
- Authority – related to environmental protection on different levels:
 - local (municipality),
 - district (powiat),
 - voivodeship - province (województwo),
 - national,
 - European

8.2. Best strategy proposal for target groups involvement

The main point of the strategy proposal is to identify the needs of target groups (technicians, engineers, decision-makers, and private sector representatives related to SWM sector) in order to achieve benefits from all intellectual outputs of the projects (materials, platform, online tools etc.)

The strategy proposal includes different types of activities options:

- Direct consultations with representatives at local/national level to cross current needs of them with project goals
- Questions forms in order to collect data which helps improve of the intellectual outputs in the project
- Data analysis which can help to extend the target group and helps to achieve the best results

9. Dissemination

The dissemination activities for SMARTEnvi project will include several types of activities and materials to achieve the goal on waste disposal issue and to involve as much as possible stakeholders and engineers includes future ones (students and alumni in this field of study) of the waste sector.

The people involved in the project take care about promotion of the project intellectual outputs during the whole project timeline. The online and printed material will be sharing on different ways and activities which helps to divers the projects results. The main activities includes:

- Online dissemination tools (websites; social media; application);
- Activities on different stages of the project - dissemination events in presence (meetings, trainings, seminars, conferences, webinars, courses, multiplier event, transnational meeting);
- Educational online material (news on websites, e-mails; PPT presentations on the conference or dedicated events) and printed material (dissemination leaflets and newsletters);

10. Conclusions and recommendations

Sum up of notice and information related to the SMARTENVi project and waste sector should be analyzed:

- In Poland MSW poses just 10% of the total waste stream
- MSW volume per capita is pretty stabile

- The selective collection is rising rapidly – making current value on the level of 25%
- Legislation goes in direction of drastic reduction of landfill as a method of waste management – only small fraction of interest waste could be landfilled, the mixed MSW should be reduced due to economic pressure
- In the future landfilling will be rather marginal due to legislation requirements and circular economy implementation
- Number of landfills is falling down and the quality of environmental protection is currently high
- Many landfills has been rehabilitated and the process continues – there is a space for further actions including active rehabilitation.
- Many institutions in Poland could be interested in expert system for optimal rehabilitation – die to Circular economy trends and principles
- At the end of 2019, there were 278 municipal landfills, covering a total area of 1,670 ha.
- Over 92% of them were equipped with degassing installations, as a result of which approx. 91 153 thousand tonnes were recovered by burning the captured gas. MJ of thermal energy and approx. 112 914 thousand. kWh of electricity.
- In 2019, 16 landfills were closed, with a total area of approximately 52.8 ha.
- In 2019, 11,371 illegal landfills were liquidated in Poland, of which approx. 26,000 were collected in total. tons of municipal waste.
- At the end of 2019, 1,873 illegal landfills were recorded.

Council Directive 1999/31 / EC of 26 April 1999 (adopted in Poland in 2001) on the landfill of waste imposed on the Member States, inter alia, obligation to close landfills that do not meet environmental requirements by December 31, 2009.

According to the report of the Supreme Audit Office (NIK), by that time, contrary to the applicable regulations, about 300 landfills that did not meet the legal requirements had not been closed. In addition, almost 180 such facilities were still in operation after January 1, 2012. Currently process is far advanced.

At a national level, the project team needs to check the competence and links between theory and practice of professionals occupied in the solid waste management area (technicians, engineers,

decision-makers, and private sector representatives related to the SWM sector) and it should be verified in order to create materials and tools matched for the project stakeholders.

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