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Foreign Experience In Waste Management And Recycling Of Secondary Raw Materials

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Abstract. The article provides an assessment of the effectiveness of the implementation of measures in the field of regulating the management of waste from the processing of secondary raw materials. Application of foreign experience in waste management and recycling of secondary raw materials in countries. The author analyzed the implementation of a project related to waste management and processing of secondary raw materials, systematized the most successful international experience in the field of regulating the management of municipal solid waste, and summarized the best foreign practices in this area.
Key words: recycling of secondary raw materials, waste, international experience, regulation, largest waste producers.

Currently, the processing of secondary material and energy resources is generated to the greatest extent in large industrial centers, where there are fundamental opportunities for their recycling and reuse. However, the difficulty of industrial processing of solid waste lies in the complexity of its morphological composition. To date, there is no consensus as to which solid waste processing technology is the most rational. Thus, the technology for separate collection of resource-valuable fractions of solid waste: glass, waste paper, polymer and metal bottles and cans, food waste has received significant development in the world. Sorted waste from containers can be easily recycled Waste management or waste disposal includes the processes and actions required to manage waste from its inception to its final disposal This includes the collection, transport, treatment, and disposal of waste, together with monitoring and

regulation of the waste management process and waste-related laws, technologies, and economic mechanisms.

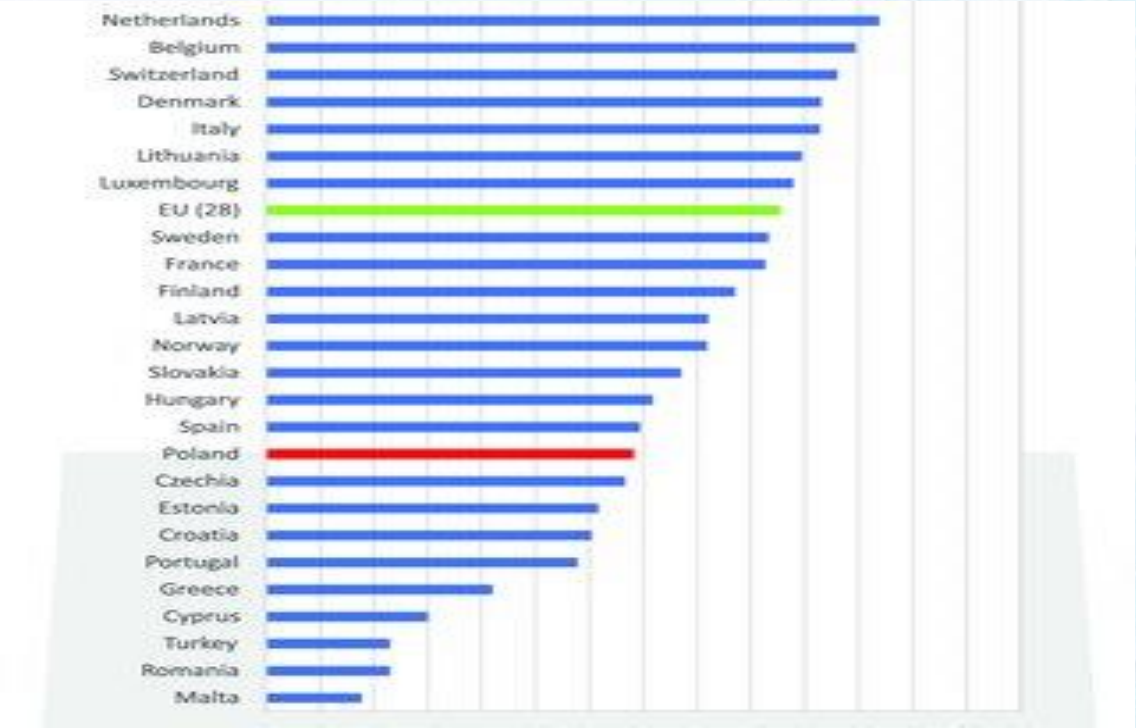
Waste can be solid, liquid, or gases and each type has different methods of disposal and management. Waste management deals with all types of waste, including industrial, biological, household, municipal, organic, biomedical, radioactive wastes. In some cases, waste can pose a threat to human health. Health issues are associated with the entire process of waste management. Health issues can also arise indirectly or directly: directly through the handling of solid waste, and indirectly through the consumption of water, soil, and food. Waste is produced by human activity, for example, the extraction and processing of raw materials. Waste management is intended to reduce the adverse effects of waste on human health, the environment, planetary resources, and aesthetics.

The aim of waste management is to reduce the dangerous effects of such waste on the environment and human health. A big part of waste management deals with municipal solid waste, which is created by industrial, commercial, and household activity.

Waste management practices are not uniform among countries (developed and developing nations); regions (urban and rural areas), and residential and industrial sectors can all take different approaches.

Proper management of waste is important for building sustainable and liveable cities, but it remains a challenge for many developing countries and cities. A report found that effective waste management is relatively expensive, usually comprising 20%–50% of municipal budgets. Operating this essential municipal service requires integrated systems that are efficient, sustainable, and socially supported. A large portion of waste management practices deal with municipal solid waste (MSW) which is the bulk of the waste that is created by household, industrial, and commercial activity. According to the Intergovernmental Panel on Climate Change (IPCC), municipal solid waste is expected to reach approximately 3.4 Gt by 2050; however, policies and lawmaking can reduce the amount of waste produced in different areas and

cities of the world. Measures of waste management include measures for integrated techno-economic mechanisms of a circular economy, effective disposal facilities, export and import control and optimal sustainable design of products that are produced.



Rating of countries by level of waste recycling in 2021

In the first systematic review of the scientific evidence around global waste, its management, and its impact on human health and life, authors concluded that about a fourth of all the municipal solid terrestrial waste is not collected and an additional fourth is mismanaged after collection, often being burned in open and uncontrolled fires – or close to one billion tons per year when combined. They also found that broad priority areas each lack a "high-quality research base", partly due to the absence of "substantial research funding", which motivated scientists often require. Electronic waste (ewaste) includes discarded computer monitors, motherboards, mobile phones and chargers, compact discs (CDs), headphones, television sets, air conditioners and

refrigerators. According to the Global E-waste Monitor 2017, India generates ~ 2 million tonnes (Mte) of e-waste annually and ranks fifth among the e-waste producing countries, after the United States, the People's Republic of China, Japan and Germany.

Effective 'Waste Management' involves the practice of '7R' - 'R'efuse, 'R'educe', 'R'euse, 'R'epair, 'R'epurpose, 'R'ecycle and 'R'ecover. Amongst these '7R's, the first two ('Refuse' and 'Reduce') relate to the non-creation of waste - by refusing to buy non-essential products and by reducing consumption. The next two ('Reuse' and 'Repair') refer to increasing the usage of the existing product, with or without the substitution of certain parts of the product. 'Repurpose' and 'Recycle' involve maximum usage of the materials used in the product, and 'Recover' is the least preferred and least efficient waste management practice involving the recovery of embedded energy in the waste material. For example, burning the waste to produce heat (and electricity from heat). Certain non-biodegradable products are also dumped away as 'Disposal', and this is not a "waste-'management'" practice.

One of the main directions of waste disposal in the world today is their incineration, but not so much for the purpose of their destruction as for the production of thermal energy, using waste as fuel for boiler houses. In Sweden, such boiler houses are built with several boilers for different types of fuel: one boiler is constantly operating, the fuel for which is solid household waste; the remaining boilers burn oil, coal, peat, and firewood. Much attention is paid to cleaning smoke emissions; 1/3-1/2 of the estimated cost of boiler houses is spent for these purposes. The largest amount of waste subjected to burial, as one of the main methods of waste management, is used in countries such as Bulgaria, Malta, Latvia, Lithuania, Cyprus, Turkey, Greece, Romania, Poland, Estonia, etc. In the above countries, waste incineration as no waste management method is used. In Poland, most of the waste is subject to storage (burial) - 65%, while 34% of solid waste is recycled, and only 1% is incinerated. In Germany, environmentally friendly thermal processing technology has been developed, on the basis of which economical modular plants are created that

process municipal solid waste and make it possible to supply electricity to cities and agricultural areas, providing a significant share of their electricity needs.

Countries in Global Waste Index 2022 are sorted in a descending order, beginning with the best rated nations coming down to the biggest waste-producing nations in the world

Rank	Rank 2019	Country	Waste Generated	Recycling	Incineration	Landfill	Open Dump	Unaccounted Waste	Recycled / Generated	Final Score
01	↔ 01	South Korea	400 kg	243 kg	88 kg	46 kg	0 kg	0 kg	60,8 %	100,0
02	↑ 11	Denmark	845 kg	300 kg	382 kg	7 kg	0 kg	0,2 kg	35,6 %	94,9
03	↑ 06	Germany	632 kg	302 kg	204 kg	5 kg	0 kg	13 kg	47,8 %	90,4
04	↔ 04	Switzerland	706 kg	210 kg	333 kg	0 kg	0 kg	0 kg	29,8 %	89,3
05	↑ 07	Finland	596 kg	168 kg	345 kg	3 kg	0 kg	0,1 kg	28,2 %	89,3
06	↑ 09	Norway	726 kg	256 kg	337 kg	17 kg	0 kg	6 kg	35,3 %	88,5
07	↓ 03	Japan	336 kg	66 kg	268 kg	3 kg	0 kg	0 kg	19,6 %	86,9
08	↓ 05	Netherlands	535 kg	148 kg	224 kg	7 kg	0 kg	0 kg	27,7 %	86,5
09	↓ 02	Sweden	431 kg	87 kg	259 kg	3 kg	0 kg	0 kg	20,2 %	84,8

10	↑ 15	Luxembourg	790 kg	232 kg	257 kg	31 kg	0 kg	2 kg	29,4 %	83,5
11	↓ 08	Belgium	416 kg	147 kg	179 kg	5 kg	0 kg	9 kg	35,3 %	83,1
12	↑ 21	Ireland	598 kg	175 kg	255 kg	86 kg	0 kg	6 kg	29,3 %	79,7
13	↓ 10	Poland	346 kg	92 kg	74 kg	138 kg	0 kg	0 kg	26,6 %	79,5
14	↑ 17	France	537 kg	121 kg	204 kg	97 kg	0 kg	0,1 kg	22,5 %	78,9
15	↑ 16	Hungary	364 kg	81 kg	62 kg	182 kg	0 kg	0,2 kg	22,3 %	75,1
16	↑ 23	Lithuania	472 kg	130 kg	70 kg	102 kg	0 kg	6 kg	27,5 %	74,5
17	↑ 19	Austria	588 kg	154 kg	226 kg	12 kg	0 kg	12 kg	26,2 %	74,2
18	↑ 20	United Kingdom	463 kg	126 kg	190 kg	69 kg	0 kg	13 kg	27,2 %	73,4
19	↓ 13	Australia	559 kg	150 kg	152 kg	288 kg	0 kg	0 kg	26,8 %	72,9
20	↓ 12	Czech Republic	499 kg	110 kg	76 kg	231 kg	0 kg	0 kg	22,0 %	71,0

Waste hierarchy. The waste hierarchy refers to the "3 Rs" Reduce, Reuse and Recycle, which classifies waste management strategies according to their desirability in terms of waste minimisation. The waste hierarchy is the bedrock of most waste minimization strategies. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of end waste; see: resource recovery. The

waste hierarchy is represented as a pyramid because the basic premise is that policies should promote measures to prevent the generation of waste. The next step or preferred action is to seek alternative uses for the waste that has been generated, i.e., by re-use. The next is recycling which includes composting. Following this step is material recovery and waste-to-energy. The final action is disposal, in landfills or through incineration without energy recovery. This last step is the final resort for waste that has not been prevented, diverted, or recovered.

The waste hierarchy represents the progression of a product or material through the sequential stages of the pyramid of waste management. The hierarchy represents the latter parts of the life-cycle for each product.

Life-cycle of a product. The life-cycle begins with the design, then proceeds through manufacture, distribution, and primary use, and then follows through the waste hierarchy's stages of reduce, reuse, and recycle. Each stage in the life-cycle offers opportunities for policy intervention: to rethink the need for the product, to redesign to minimize waste potential and to extend its use. Product life-cycle analysis is a way to optimize the use of the world's limited resources by avoiding the unnecessary generation of waste

Polluter-pays principle. The polluter-pays principle mandates that the polluting party pays for the impact on the environment. With respect to waste management, this generally refers to the requirement for a waste generator to pay for appropriate disposal of the unrecoverable material

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