1st International Scientific Conference "Modern problems in Geophysics", Proceedings,
ISBN 978-9941-36-434-1, ISSN 3088-4349, Tbilisi, Georgia, November 6-8, 2025

# PROSPECTS FOR RECYCLING OF GARBAGE WASTE USING W2E TECHNOLOGY

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***Abstract.*** *The article provides an overview of the world's methods of energy recycling of waste recycling (W2E technology). Data on the accumulation of municipal solid waste and its processing by the construction of waste processing plants in the Chechen Republic are presented. For the possibility of comparison, information has been collected on the volume of municipal solid waste generated and processed, recycling technologies, and the efficiency of enterprises both in Russia and abroad. Some analysis of the degree of impact of incinerators on the environment is carried out. Attention is drawn to the trends, political and social aspects of the construction of such facilities. The possibility and levers of bringing into effect the widespread introduction of the principle of waste-free production and the role of the architectural appearance of buildings in this matter are being considered. The conclusion is made about the prospects of building a plant based on W2E technology on the territory of the Chechen Republic.*

***Key Words:*** *MSW, energy from waste, incinerator, W2E technologies*

In the European Union, energy waste disposal is considered as part of measures to achieve the goals set by the European Commission in the Waste Disposal Directive. According to CEWEP data for 2017, Finland is the European leader in incineration, sending 58% of garbage for energy disposal, followed by Denmark, Sweden and Norway with 53%, as well as Switzerland with 47%. In Germany, Austria, France and Italy, this figure is about 20-40%. The average for the 28 EU countries was 28% [3, 5, 8]. In the USA in 2017, 12.7% of all solid household waste (MSW) was burned to generate energy, 52.1% of MSW ended up in landfills. In 2018, 68 American plants generated about 14 billion US dollars. kWh of electricity due to the combustion of 29.5 million tons of combustible solid waste.

In Asian countries, against the backdrop of rapid urbanization and annual population and solid waste growth, governments are promoting various energy recycling programs. China's government targets include the processing of half of MSW at W2E plants in the 2020s. The deployment of W2E enterprises in India is slow: just under 300 MW of capacity was installed at the end of 2017, and the country's largest plant (24 MW) was commissioned in New Delhi only in 2017. In Thailand, as part of the Alternative Energy Development Plan, a long–term goal has been set – to increase the installed capacity of waste recycling plants to 550 MW by 2036. Pakistan, Vietnam and Indonesia are encouraging the creation of new enterprises through a guaranteed tariff for electricity [4].

According to the general contractor Octopus Renewables, in the Oldhall industrial area in Erwin (Ayrshire, Scotland), the planned complex will be able to produce 17 MW of electricity. This will allow it to supply energy to 30,000 homes, as well as provide heat and steam to industrial enterprises adjacent to the territory. Meanwhile, construction of the world's largest Waste Energy plant continues in Dubai (United Arab Emirates), which is currently about 45% ready. The plant's capacity will be 1.9 million tons of waste per year, which is about 45% of Dubai's total waste. The company will generate 200 MWh of energy, most of which will be supplied to the local grid, supplying electricity to more than 135 thousand homes annually. The plant, which was first announced in 2018, will allow Sharjah to increase its current waste disposal rate from 76% to 100%. The launch of the enterprise will allow Sharjah to become the first city in the Middle East with zero waste, turning tailings into renewable energy. The company in Sharjah is capable of disposing of 300,000 tons of non-recyclable waste annually, producing 30 MW of electricity for 28,000 homes. At the same time, it will also reduce CO2 emissions in the amount of 450 thousand tons annually [6, 7, 9].

In the capital of the Danish Kingdom (Denmark) The Amager Bakke plant operates in Kopenganen, capable of processing up to 440 thousand tons. garbage per year. Another landmark Danish project in the city of Roskilde, which has a capacity of up to 350 thousand tons of waste per year.

In Sweden in 2017, 34 incinerators accepted 2.4 million tons of Swedish household waste and 1.5 million tons of imported waste. The plant in Poland is capable of incinerating 220 thousand tons of household waste annually. In 2007, the Isseane Syctom plant with a capacity of 460 thousand tons of MSW per year was built in France on the banks of the Seine. In 2011, the largest Riverside plant for the thermal processing of MSW with a capacity of 670 thousand tons of waste per year was commissioned in London. The Gross Green plant in Leeds, England, opened in April 2016, incinerates more than 200,000 tons of waste. A large thermal waste recycling plant in the Netherlands (AEB Amsterdam) is located in Amsterdam and supplies electricity and heat to 75% of all residents and offices in Amsterdam, recycling 300,000 tons of waste per year. In China, about 200 million tons of waste are incinerated per year, which is about 40% of all Chinese garbage. This figure is planned to be raised to 60%. One of the most famous projects today is the Shenzhen East waste–to-Energy Plant, which is capable of processing more than 5,000 tons of garbage per day (182 million tons per year). In Japan, 5% of MSW is subject to burial. 70% is burned by plasma gasification. The capacity of one of the plants here is about 300 thousand tons per year, which is a quarter of the city's garbage. The West Palm Beach waste-to-energy processing plant operates in Florida, the largest city in the United States. Its capacity allows to burn 3 thousand tons of MSW per day, which is 1 million tons per year and is a high-tech plant of the W2E type [10, 11, 12].

The volume of landfills in Russia has reached 4 million hectares, which is comparable to the territory of the Netherlands. Energy recycling should be implemented only within the broader hierarchy of waste management in the areas of prevention, preparation for reuse, recycling, recovery and disposal. W2E plants cause less air pollution than coal-fired thermal power plants, but more than those powered by natural gas.

In the Russian Federation, household waste has only recently been treated as an energy carrier. For example, the current RT-Invest energy waste disposal plant (part of Rostec State Corporation) has confirmed the status of a facility operating on the basis of renewable energy sources, completed the certification procedure for generating equipment and began supplying power to the wholesale electricity market. Since commissioning, the plant has generated almost 70 million kWh, disposed of 150 thousand tons of municipal waste unsuitable for recycling [1, 3].

The RT-Invest energy recycling plant, located in the Urban district of Voskresensk, Moscow region, processes about 2 thousand tons of waste daily. Annually, the plant is able to dispose of 700 thousand tons of waste unsuitable for recycling, generating about 500 million kWh of electric energy. RT-Invest is building three more energy recycling plants in the Moscow Region: in Solnechnogorsk, Naro-Fominsk and Bogorodsky districts. And another factory in the Republic of Tatarstan. In total, five green power plants will produce more than 2.2 billion tons. kWh of energy per year.

In the Krasnodar Territory, it is planned to build two waste incineration plants in the region (using W2E technology). RT-Invest of Rostec State Corporation will be engaged in the construction. During the peak summer period, over 1 million people can be present at the same time on the territory of the city of Sochi, located in the Krasnodar Territory. These are residents and guests of the resort. According to the Sochi city administration, in 2021, the amount of waste from the Belorechensk landfill exceeded 320 thousand tons. Waste recycling issues, as well as problems related to reducing existing landfills around Russian cities, are an important socio-economic task. A significant number of waste incineration plant projects are regularly proposed for consideration by regional leaders and other high-ranking civil servants, and the vast majority of such proposals are rejected [1, 2, 7].

For example, the highest 100% value of electricity consumption in the Chechen Republic in 2024 reached 3615 million kWh, which means that electricity generation from the existing four waste sorting complexes of the republic with a total capacity of 270 thousand tons per year may amount to about 170 million kW.hours per year. This value of electricity generation will provide the republic with up to 5%. In order to reduce the volume of MSW sent for burial in the Chechen Republic, thanks to the financial support of the Ministry of Natural Resources of the Russian Federation in the amount of 725198.6 thousand tons. In 2022, four waste sorting complexes with a total capacity of 270 thousand tons per year were commissioned, including: in Gudermes, with a capacity of 100 thousand tons per year; in Shali, with a capacity of 100 thousand tons per year; in Achkhoy–Martanovsky municipal district, Samashki village, with a capacity of 50 thousand tons per year; in the Nadterechny municipal district, Znamenskoye village, with a capacity of 20 thousand tons per year.

Thanks to the support of the Ministry of Natural Resources of Russia, in 2022, the Ministry of Construction of the Chechen Republic purchased containers for the separate accumulation of municipal solid waste in the amount of 6927 units. in the amount of 131.062 million rubles. The Government of the Russian Federation has signed an order on the allocation of funds for the construction of a waste recycling plant in Grozny, Chechen Republic, in 2025 for the production of products with the selection of useful fractions at the waste sorting ecotechnopark. Thus, the Chechen Republic has significant potential and prospects for the creation of a modern waste incinerator with electricity generation based on technology.

## Conclusions

- It is necessary to carry out systematic explanatory work among the population about the rules of waste management, the need for separate garbage collection.
- As part of the "garbage" reform in Russia, it is useful to adopt the Japanese practice of developing environmental requirements for emissions of harmful substances at MSZ, including in the field of drawing up their own, more stringent than state, environmental standards for individual enterprises.
- The development of enterprises' own environmental standards and their implementation will contribute to improving the environmental performance of individual plants, as well as improving public opinion on thermal waste disposal.
- The development of MSW energy utilization in the Chechen Republic will contribute to improving the environmental situation and create new jobs.

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