

# SUSTAINABLE CONSTRUCTION WASTE MANAGEMENT - CHALLENGES AND OPPORTUNITIES IN PROMOTING THE CIRCULAR ECONOMY

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***Abstract.** The sustainable management of construction waste represents a major challenge in promoting the circular economy. Construction is responsible for a significant amount of waste, and its proper management is essential to minimize environmental impact and create an efficient circular system. This article examines the challenges and opportunities associated with the sustainable management of construction waste. Challenges include the diversity and complexity of materials used in construction, as well as the need to develop adequate infrastructures for waste collection, sorting and recycling. However, there are also many opportunities in promoting the sustainable management of construction waste. The circular economy offers the opportunity to turn waste into valuable resources through recycling, reuse and reuse. To fully exploit these opportunities, collaboration between the public and private sectors is required, as well as the development of coherent policies and regulations for the management of construction waste. In conclusion, the sustainable management of construction waste represents both a challenge and an opportunity in promoting the circular economy. By adopting effective strategies and policies, implementing innovative technologies and involving all stakeholders, we can help reduce the impact of construction waste on the environment and build a more sustainable future. This paper was supported by the State Program 20.80009.0807.22 Development of the mechanism for the formation of the circular economy in the Republic of Moldova.*

***Keywords:** circular economy, waste management, construction waste management, sustainable construction, recycling, reuse, environment*

***JEL:** Q01, Q53, Q56*

***UDC:** 338.45:628.4*

**Introduction.** The sustainable management of construction waste is a particularly important aspect in the current context of sustainable development. Construction waste, generated by construction and demolition activities, represents a significant source of impact on the environment and natural resources. Construction and demolition produce large amounts of waste that has traditionally been improperly treated and ended up in landfills or incinerated, generating greenhouse gas emissions and other negative environmental impacts (Roslan et al., 2016).

Construction waste contributes to environmental degradation in multiple ways. Deforestation for building materials affects biodiversity and destroys natural ecosystems. The production and transport of construction materials generates

greenhouse gas emissions, contributing to climate change. Also, improper storage of construction waste can lead to soil and groundwater pollution, affecting the quality of life and health of local communities (Labaran et al., 2022).

There are several challenges in construction waste management that require a sustainable approach and innovative solutions.

*First of all*, the construction sector generates a considerable amount of waste, which requires efficient management to reduce the impact on the environment.

*Secondly*, many operators in the construction industry still lack adequate systems for the collection, sorting and treatment of construction waste. This leads to waste of resources and environmental pollution.

*Thirdly*, implementing effective construction waste management methods may involve higher initial costs and may require adaptation to waste management regulations and legal requirements.

Thus, promoting the circular economy in this area can bring many benefits, such as reducing the impact on the environment, conserving resources, increasing efficiency and stimulating innovation (Roslan et al., 2016).

In the Republic of Moldova, the problem of construction waste is current for several reasons. The growth of the construction sector in recent years has led to increased waste generation as infrastructure and residential and commercial projects have developed. However, a large proportion of construction waste is still inadequately managed due to a lack of adequate infrastructure and facilities. Improper storage of these wastes in landfills or their illegal disposal affects the environment and public health. Also, the level of awareness and understanding of the importance of proper construction waste management is still low among actors involved in the construction industry. Many construction organizations do not adopt responsible waste management practices.

In addition, there is a need for clearer and more rigorous regulations and policies in the field of construction waste management, as well as the promotion of sustainable construction practices. An integrated and coordinated approach is needed to solve this problem and to promote the sustainable management of construction waste according to the principles of the circular economy.

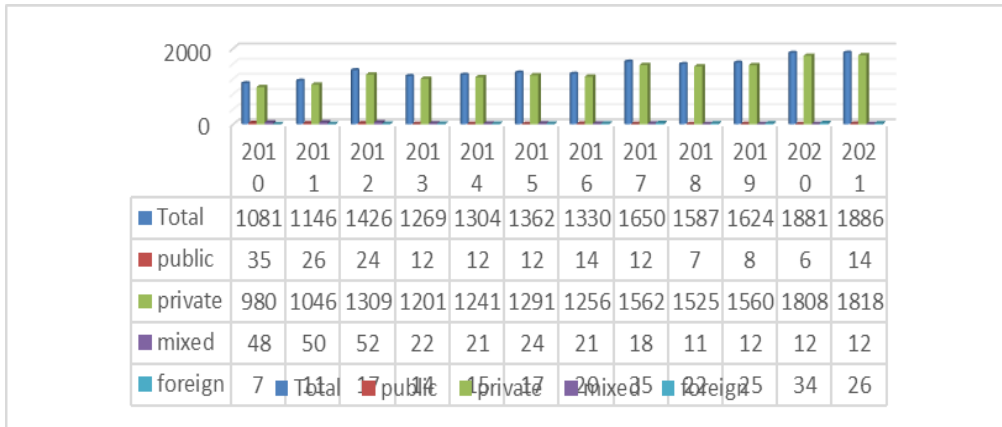
**Assessment of the construction waste sector in the Republic of Moldova.** The construction sector in the Republic of Moldova has seen a significant evolution in recent decades. In the post-communist period, the construction sector underwent some transformations and adjustments, and today it represents one of the most important industries of the Moldovan economy.

After the independence of the Republic of Moldova in 1991, the construction sector went through a process of restructuring and adapting to the new market conditions. In the 1990s, the construction industry was affected by economic instability and a lack of investment, which led to a significant decline in activity in the sector. However, over the past two decades, the construction sector has experienced substantial growth, driven by infrastructure investment, residential and commercial project development, and financial support from international partners.

This upward trend was supported by a stable economic growth in the Republic of Moldova. The total number of construction organizations generally increased

during this period, from 455 in 2000 to 1,886 in 2021. There was steady growth until 2012, and then a significant jump in the number of organizations in 2013, from 1,426 to 1,881 in 2020, continuing with a slight increase in 2021 (NBS, 2022).

If we analyze construction organizations by form of ownership, the number of construction organizations owned by the public sector fluctuated during this period, with a relatively small number of organizations (between 12 and 35). The figures show a slight increase from 2000 to 2008, followed by a downward trend until 2019, with a marginal increase in 2020 and 2021 (NBS, 2022).



**Fig. 1. Construction organizations by ownership, period 2010-2021.**

Source: made by the author based on data taken from the National Bureau of Statistics

Construction organizations owned by the private sector represent the majority - 96% of all enterprises, with a constantly growing number. There were significant jumps in 2005, 2008, and 2012, and there has been steady growth from there, reaching 1,560 in 2020 and 1,818 in 2021 (NBS, 2022). The number of mixed organizations has been relatively stable at around 50, with a slight downward trend in recent years.

Regarding the data for construction organizations with foreign participation, we can see a significant increase in 2006, from 8 to 17, and further fluctuations until 2021. The number of joint ventures increased from 4 in 2000 to 16 in 2021 (NBS, 2022).

There was a general upward trend with minor fluctuations. In the figure 1 we reflected the data on the evolution of construction enterprises in the Republic of Moldova for the period 2010-2021. Overall, the data indicate a significant increase in the value of construction work over the period under review, with an emphasis on new construction, capital repairs, and current maintenance and repair work.

Thus, the total value of construction works registered a significant increase from 4,853.5 million lei in 2010 to 16,914.1 million lei in 2021. The share of residential buildings in total construction works fluctuated between 24.3% and 33.1%, with an increasing trend in recent years (NBS, 2022).

At the same time, the share of non-residential buildings in the total construction works has fluctuated, but in general has decreased slightly in recent

years, and the share of engineering constructions in the total construction works had a constant upward trend during the analyzed period.

In general, *a significant increase in the value of construction works is observed in each category analyzed. Residential buildings and engineering constructions had the largest share of total construction work, while non-residential buildings had a smaller but significant share.*

**Table 1. The value of construction works by property type, in millions of lei (selected years)**

	2010	2012	2014	2016	2017	2018	2019	2020	2021
Total	4853,	6113,2	8707,	8200,0	9100,1	11356,	13408,	15090,	16914,
Public	179,5	177,0	204,4	126,4	160,8	111,8	168,9	165,6	197,1
Private	4063,4	4765,0	6836,	6906,9	7614,3	9651,1	11036,	12898,	14829,
Mixed	369,8	409,1	562,4	546,4	722,5	870,8	600,5	670,6	543,7
Foreign	125,9	588,5	914,9	409,5	437,4	313,4	1081,1	1198,9	1250,1

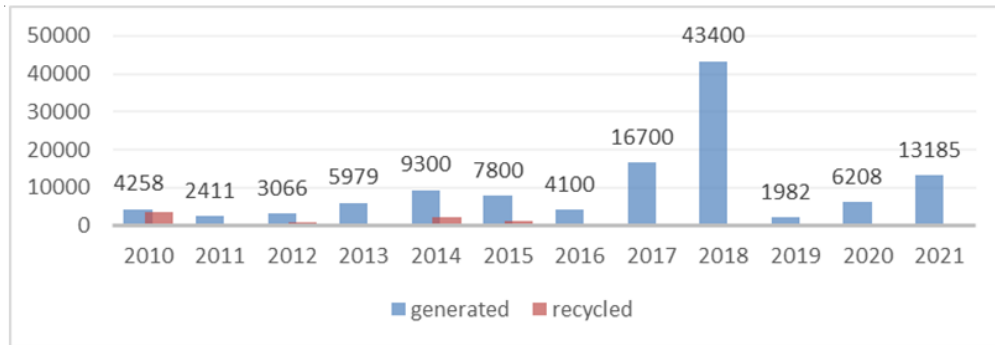
Source: National bureau of Statistics, 2022

The evolution of the construction sector was manifested by the increase in the number of construction projects, the diversification of the types of buildings and developed infrastructure, as well as by the modernization and improvement of the quality of construction works. Thus, in recent years, the Republic of Moldova has seen the development of large projects such as office buildings, shopping centers, hotels, as well as infrastructure projects such as roads, bridges and airports. The construction sector has also contributed to the creation of jobs and the stimulation of the local economy by involving a large number of workers, developing the construction materials industry and increasing the demand for related services.

*Despite the progress made, the construction sector in the Republic of Moldova still faces certain challenges, such as adequate waste management, compliance with quality standards, energy efficiency and sustainability of constructions, as well as the development of the necessary infrastructure.*

Thus, in 2021, the total volume of waste generated from construction registered a significant increase, reaching 13,185.8 tons. However, of these, only 421.0 tons were recycled. We note that the volume of construction waste has increased over time by 209.6% between 2010 and 2021 (NBS, 2022). We can see that there is a correlation between the value of construction work and the volume of waste generated.

*In general, an increase in the value of construction work often implies an increase in the volume of waste generated. Therefore, if we were to forecast the amount of waste generated in the future, it is expected to maintain the trend of increasing the volume of waste generated in construction.*



**Fig. Volume of generated and recycled waste from construction, in tons**

*Source:* made by the author based on data taken from the National Bureau of Statistics

However, *in terms of waste recycling, progress has been limited, given the small percentage of waste recovered compared to the total volume generated.* Thus, in 2020, only 168.6 tons of the total of 6,208.4 tons of waste generated from construction were recovered, and in 2021, only 421.0 tons of the total of 13,185.8 tons of waste generated were recycled, or 3.19%. These values represent small percentages in relation to the total volume of waste generated.

This conclusion underlines the need to pay more attention to the recycling of construction waste and to implement appropriate measures to promote this practice. Recycling construction waste can have multiple benefits, such as conserving resources, reducing environmental impact and saving energy.

There is a need to implement policies and initiatives that encourage and facilitate the recycling of construction waste, as well as to provide support and resources to develop the necessary infrastructure and technologies.

Also, the involvement of all stakeholders, including builders, developers, authorities and the wider community, is essential to promote a sustainable approach to construction waste management and to achieve significant progress in recycling.

At the same time, we mention that in recent years there is *a lack of data regarding the destruction or storage of construction waste at authorized landfills in the country.* It is important to keep records of the collection and availability of complete and up-to-date data on the storage and disposal of construction waste in order to perform a comprehensive analysis and develop effective waste management strategies.

Within the same strategy, the need to implement legal and organizational measures to promote the reuse, recycling and recovery of construction and demolition waste is emphasized. These measures aim to optimize waste management, minimize environmental impact and promote the circular economy in the construction sector. By adopting appropriate policies and regulations, the construction sector is encouraged to implement more sustainable practices and reduce the volume of waste generated, thus contributing to the protection of the environment and the efficient use of resources.

There are several examples of practices from other countries that highlight the importance of the collection and availability of complete and up-to-date data on construction waste management. Here are some cases:

**Germany** has a well-developed construction waste management system known as "*Kreislaufwirtschaft Bau*" (circular construction economy). Under this system, authorities and construction industry organizations regularly monitor and report the amount and types of waste generated and managed in the construction sector (Deloitte, 2015). This data is used to develop effective policies and strategies in the field of construction waste management.

According to Dr. Matthias Frederichs, managing director of the Federal Association of Building Materials - Stone and Earth, mineral waste from construction is almost completely recycled at present, which frees up landfills and conserves primary raw materials. Also, more than 13% of aggregate demand is now met by recycled construction materials. Relevant data shows that in 2020, out of a total of 220 million tons of mineral construction waste generated, more than 197 million tons, about 90%, were recycled in an environmentally friendly way. In this regard, the road construction sector has achieved the highest recycling rates of approximately 96% through innovative extraction and recycling processes that allow materials to be processed and reused locally (DA, 2023).

Selective dismantling and strict separation of waste contribute greatly to the fact that more than 94% of construction debris can now be used for other purposes (DA, 2023).

The **UK** has a strong approach to monitoring and reporting construction waste. According to government requirements, builders must record and report the amount and destination of waste generated during the construction process. This data is collected and used to assess environmental impact and develop policies and initiatives to manage and reduce construction waste (Adams, 2022).

The **Netherlands** promotes a circular approach to construction waste management. The Dutch authorities collect and analyze data on construction waste to assess the sector's performance and monitor progress in recycling and waste reduction. This data is used to support the development and implementation of effective waste management policies and measures (Schut, 2015).

The Netherlands has introduced a landfill tax on construction waste, which encourages builders to reduce the amount of waste generated and encourage the recycling and reuse of materials. This measure encourages industry to adopt more sustainable practices and reduce environmental impact. Under this tax, builders have to pay an upfront amount to store the waste resulting from construction activities. However, the amount paid can be recovered in whole or in part if the builders demonstrate that the waste has been managed in a sustainable way, through recycling or reuse.

The exact amount of the landfill tax for construction waste in the Netherlands can vary depending on various aspects, such as local regulations and the size of the waste generated. The fee can be determined according to the weight or volume of the waste stored (Scharff, 2014).

These examples illustrate that many countries recognize the importance of collecting and making available complete and up-to-date data on construction waste. This data is used to assess environmental impact, develop effective strategies and policies, and promote sustainable construction waste management.

***The absence of relevant data may indicate a lack of adequate monitoring and reporting of activities related to the storage and disposal of construction waste. It is important that the authorities and organizations involved develop and implement robust data collection and reporting systems to have a clearer understanding of how construction waste is managed.***

Also, these aspects are reflected in *the Waste Management Strategy in the Republic of Moldova for the years 2013-2027, approved by GD No. 248/2013*. The strategy emphasizes the fact that, in accordance with the experience of other countries such as Romania and Latvia regarding the rate of construction and demolition waste, it is forecasted that in the period 2010-2027 the amount of construction and demolition waste per capita in the Republic of Moldova will increase in consistent with real GDP growth in the country. Thus, *it is estimated that the total amount of construction and demolition waste will increase to 2.6 million tons in 2027.*

Any new construction, demolition or reconstruction also means waste, often the materials used are toxic, such as asbestos. More waste is generated from renovation/modification works than from the construction works of a new building. Therefore, ***it is necessary to address the circularity and sustainability of materials used in construction in the Republic of Moldova.***

The products and materials used in construction may contain highly toxic carcinogenic or allergenic compounds, irritant compounds and compounds with unknown toxic properties: degradation products, volatile and semi-volatile organic compounds (formaldehyde, aromatic organic solvents), antiparasitic compounds, biological pollutants (fungi, moss, bacteria), natural and artificial mineral fibers (asbestos, glass wool, basaltic mineral wool). After prolonged storage, some non-hazardous materials can become hazardous through contact with various polluting agents.

Producers and owners of construction and demolition waste do not pay enough attention to their management. ***Some construction companies conclude contracts with sanitation services for the collection of this waste, but it is not sorted by type of material, and it is only removed, not reused, recycled or recovered.***

In the light of all these aspects and understanding the importance of an efficient management of construction and demolition waste, ***the conclusion was reached of the need to develop a specific normative act in the Republic of Moldova.*** This normative act should clearly and precisely regulate the aspects related to the management of construction and demolition waste, taking into account the responsibility of the owner of the construction activity and the local public administration authorities.

***A draft Law in this regard could define the responsibilities and obligations of builders in terms of waste management, including the collection, transport, storage and disposal of it properly. It could also set clear criteria and standards***

*for the recycling, reuse and recovery of construction and demolition waste, thus promoting the circular economy and reducing environmental impact.*

In addition to the specific regulations on waste management, this draft Law could also provide for effective monitoring and control mechanisms, which would ensure compliance with the provisions and sanction non-compliance. It could also *establish support instruments and incentives to promote sustainable practices in the construction sector, including tax facilities or financing for investment in appropriate technologies and infrastructure for waste management.*

The development and adoption of such a draft law would represent a significant step in the development of a coherent and efficient legal framework for the management of construction and demolition waste in the Republic of Moldova. This would contribute to the protection of the environment, the responsible use of resources and the promotion of a sustainable approach in the construction sector, given its economic importance and significant impact on the environment.

For example, in **Romania**, there are legal provisions that impose the obligation of construction companies to manage the waste generated on construction sites in a responsible way. These obligations include sorting, reusing, recycling or properly disposing of waste. Thus, builders are obliged to request the services of companies specialized in sanitation or waste management to ensure that they are treated in accordance with the legislation in force. With regard to waste resulting from construction works in housing, the owners or beneficiaries of these works are responsible for using the services of sanitation companies or other specialized operators for waste management. This ensures proper disposal of waste and avoids negative impact on the environment (Stratos, 2023).

There are also economic operators in Romania that own crushers, facilities that allow the transformation of concrete and bricks resulting from demolitions into materials that can be reused in subsequent constructions. This crushing practice helps to reduce the volume of waste and promote recycling in the construction industry.

At the same time, we can mention the extension project of the Fedballe school in **Denmark**. This extension was designed using mainly natural materials such as wood and straw. Modular prefabricated parts have also been used, which facilitate assembly and subsequent reuse. By adopting these materials and modular solutions, the production of new materials was avoided and instead used existing resources that would normally have been disposed of by burning (StirWorld, 2023).

This project demonstrates the circular approach in construction, which seeks to give new use to existing materials and reduce environmental impact.

Another interesting example is the **UK** company Kenoteq, which has developed K-Briq, a durable, compressed, non-burning building brick. About 90% of the content of this brick consists of construction and demolition waste, such as concrete, brick and plasterboard. The production of K-Briq generates less than a tenth of the carbon emissions associated with the production of a conventional brick. This brick has the same appearance and weight as a regular brick, but offers improved thermal insulation properties. Another advantage is that K-Briq can be produced in various colors (DeZeen, 2020).

In the Republic of Moldova, there are several relevant normative acts for the management of construction and demolition waste, such as the Waste Law, the



Code of Practice in Construction<sup>4</sup> and the Code of Practice in Construction CP A.09.04:2014 - Management of construction and demolition waste. They provide a legal framework for the regulation and monitoring of waste management in the construction sector.

For example, in the municipality of Chisinau, the General Directorate of Communal Housing and Planning within the city hall initiated the public consultation for the approval of the Regulation for the management of construction and demolition waste in the municipality of Chisinau. Thus, the municipal authorities propose to create safe and environmental protection conditions for the management of this waste. The purpose of drafting and adopting this regulation is to solve the problems related to the management of waste resulting from construction and demolition activities in the municipality of Chisinau. The project establishes a unitary legal framework for the management of these types of waste, specifying the conditions that must be met for safe and environmental protection management. At the same time, through this initiative, it is aimed to increase the degree of recovery and recycling of construction and demolition waste, as well as to reduce the amount and degree of danger of this waste.

There are few companies in the country that offer construction waste disposal services, but communication and transparency of how this waste is treated and managed can be improved. It is important that these companies promote responsible waste management practices and provide clear information about their fate, in line with legislative requirements and circular economy principles.

**Conclusions.** The problem of construction waste represents a major challenge in the Republic of Moldova, with impacts on the environment, public health and sustainable development. The growing volume of the construction sector, inadequate waste management, low awareness and insufficient regulations are contributing factors to this problem.

Adequate management of construction waste is essential to minimize the impact on the environment and to promote sustainable development in the Republic of Moldova. The increased volume of the construction sector in recent years has generated a significant amount of waste, and its inadequate management represents a serious threat to the environment and public health.

Construction waste contains a variety of materials, including concrete, wood, metal, glass and plastic, which can have a negative impact on soil, groundwater and air if improperly disposed of or incinerated. This waste can contain hazardous chemicals and release pollutants into the environment, affecting air and water quality.

In addition, inadequate management of construction waste can lead to excessive land occupation by landfills, contamination of soil and groundwater, and even leakage of waste into rivers and lakes. These negative environmental effects have long-term consequences and can affect biodiversity and the balance of ecosystems.

In addition to the environmental impact, the problem of construction waste also affects public health. Hazardous chemicals contained in construction waste can be toxic to humans if inhaled or ingested. Also, improper management of these

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<sup>4</sup> [http://www.ednc.gov.md/upload/61/CP\\_.01.022018.pdf](http://www.ednc.gov.md/upload/61/CP_.01.022018.pdf)

wastes can generate unsanitary conditions, favorable to the emergence of diseases and infections.

Sustainable development is an important goal for the Republic of Moldova, and the efficient management of construction waste plays a crucial role in achieving this goal. Promoting the circular economy in the construction sector can bring a number of opportunities, such as reducing resource consumption, reusing and recycling materials, and creating jobs in the recycling industry.

To tackle this problem, an integrated and coordinated approach is required, involving the involvement of all key actors such as government, local authorities, the private sector, non-governmental organizations and the wider community. Clear regulations and policies are needed to promote responsible practices in the management of construction waste, as well as investment in infrastructure and facilities for the collection, sorting, recycling and proper disposal of this waste.

By adopting a sustainable and responsible approach to construction waste management, the Republic of Moldova can reduce its environmental impact and create a healthier and more sustainable built environment for communities. Concerted efforts and investment are needed to develop and implement innovative and sustainable solutions in the management of construction waste, so that it becomes a valuable resource, and not a problem, for the future of the country. At the same time, it is necessary to develop the appropriate infrastructure and facilities for the collection, sorting, recycling and proper disposal of waste.

Improving the legal framework and policies in the field of construction waste management is also crucial to promote responsible and sustainable practices. Opportunities exist in promoting circular economy principles such as efficient use of resources, recycling and reuse of recoverable materials. Collaboration between all stakeholders, including designers, developers, builders, material suppliers and local authorities, is essential to implementing sustainable and responsible building practices.

By properly managing construction waste, we can help reduce environmental impact, conserve natural resources and improve quality of life. This will not only help us protect the environment, but also contribute to the development of a sustainable circular economy and create a healthier and more resilient built environment for future generations.

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