On the Way to a Circular Economy: Monitoring Belarus' Progress Based on the EC Framework[1]

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Abstract

This paper presents an assessment of Belarus' progress on the way to the circular economy as compared to a number of the European countries. The monitoring framework proposed by the European Commission is chosen for these purposes, since its indicators capture the key elements of a circular economy, have a high degree of practical application, are easy to analyze and informative. The existing system of recording in Belarus does not permit to calculate some indicators used by the European Commission. The assessment has also revealed that a number of indicators need adjusting. First, the high share of saline waste in the total generation of waste in Belarus—about 63-68 % in 2012-2017—precludes valid comparisons to those countries that do not have a developed potash industry. Second, in order to obtain reliable results, it is necessary to take into account the unique features of waste recording and movement associated with the fact that a significant part of the waste is locked up at storage sites. The study shows that Belarus has got a potential for reducing the generation of waste, increasing the recycling rate of municipal solid waste, as well as the recovery rate of construction and demolition waste, and expanding the substitution of primary resources with secondary raw materials. The transition to a circular economy calls for investments in engineering and design services, waste recycling technologies and processes, upgrading existing production facilities to improve the resource efficiency and the ability to work using secondary raw materials. To create the conditions that encourage investment in circular economy sectors, it is advisable to take efforts to improve the reliability and international comparability of data, develop the quality standards for secondary raw materials, and build a public information platform, which would enable monitoring of the circular economy development and information exchange between all the stakeholders in this sector in Belarus.

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Contents

1. Introduction

Indicators play a key role in the economic assessment at all levels, from enterprises to states, regions, and the global economy. Many of them are calculated in accordance with the international standards and offer a basis for important decision-making in both the public and private sectors. At the same time, it must be understood that measuring the progress on the way to a circular economy would require new indicators, which differ radically from those used in a linear economy.

At present, the official statistical resources in Belarus do not offer a set of indicators measuring the country's progress to the circular economy. Belstat posts some data on the generation of industrial waste by economic activity, municipal solid waste (MSW), and hazardous waste management on its website under the heading 'Environment'. Some indicators are also available per capita and per GDP unit.

The transition to a circular economy entails great opportunities for making the economic system more sustainable and greener, while conserving the primary resources, creating new jobs and strengthening the competitiveness of enterprises. A comprehensive monitoring framework is the basis for understanding how different elements of a circular economy evolve over time, which factors have a positive effect on the transition to a circular economy, and whether the measures currently being taken are sufficient. The results of such monitoring constitute the basis for setting priorities in short-, medium- and long-term planning the of the circular economy development.

Therefore, this paper focuses on finding indicators for Belarus, which would be equivalent to those used to measure the progress to a circular economy internationally, as well as on calculating and comparing their values with those for other countries. This would give an idea of how much attention is paid in Belarus to this sector, in which areas the country is lagging behind others, in which spheres there are prospects for development, and what problems should be addressed.

At present, there are various indicators that can be used to analyze the circular economy. However, the monitoring framework proposed by the European Commission (EC) is chosen as a benchmark for Belarus for the following reasons: first, the country lacks a comprehensive framework of indicators to measure its progress to the circular economy; second, Eurostat regularly calculates indicators for the European Union (EU) countries using its monitoring framework for the circular economy, which indicates that the indicators have a high degree of practical application, are easy to analyze and informative; third, the EC continues to work on their improvement; fourth, the EU has gained quite a lot of experience in the development of the circular economy, therefore, to understand the situation in Belarus, it would be useful to benchmark its performance against the EU member countries.

The international comparison of Belarus' progress to the circular economy covers both the leading European countries (Norway, the Netherlands, Sweden etc.) and its neighboring countries in the region (Lithuania, Poland, Czechia, Hungary).

The paper is structured as follows: the second section offers a brief description of the monitoring framework for the circular economy proposed by the EC. The third section gives an overview of the situation with waste in Belarus. The fourth one provides a comparative analysis of the circular economy indicators for selected countries of the EU, Norway and Belarus. The fifth section concludes with key findings and recommendations.

2. Monitoring Framework for the Circular Economy[2]

The transition towards a circular economy is not limited to certain materials and sectors, it embraces the entire economic system. Monitoring progress on the way to a circular economy should primarily facilitate the understanding of trends in preserving the economic value of products and resources, as well as trends in waste generation. Since there is no single measure to capture the entire complexity and the many dimensions of the transition to a circular economy, the best solution would be to use a framework of indicators.

In 2015, the EC put forward its Action Plan for the Circular Economy,[3] indicating its intention to create a simple and effective monitoring framework. The framework of circular economy indicators proposed by the EC draws upon and compliments the existing Resource Efficiency Scoreboard[4] and Raw Materials Scoreboard[5]. The indicators were selected based on the following key criteria: a) the ability to capture the key elements of a circular economy; b) data availability; c) thematic relevance, acceptance, ease of use, etc.

The monitoring framework includes ten indicators, which are grouped under four headings:

- Production and Consumption;
- Waste Management;
- Secondary Raw Materials;
- Competitiveness and Innovation.

Each set of indicators describes either a certain stage of the lifecycle of resources, products and services or a certain aspect of the circular economy. 'Production and Consumption' includes four indicators reflecting the EU self-sufficiency for raw materials, green public procurement, waste generation, and food waste. However, the methodology for the calculation of the 'Green public procurement' and 'Food waste' indicators is under development. The recycling rates of all waste and specific waste streams are grouped under the heading 'Waste Management'. The indicators under 'Secondary Raw Materials' focus on two aspects: the contribution of recycled materials to the total raw materials demand and the international trade in recyclable raw materials. Investment, employment, and gross value added related to circular economy sectors, as well as patents related to recycling and secondary raw materials are covered under 'Competitiveness and Innovation'.

A comparative analysis of the methodology for calculation of the circular economy indicators proposed by the EC and their equivalents for Belarus is presented in the Annex.

3. Unique Features of Industrial Waste in Belarus: Potash Fertilizers and their Impact

To assess the situation with waste, it is important to understand the structure of waste generation, movement and accumulation of waste stocks. The indicators reflecting the contribution of consolidated categories of waste to the total generation of waste, as well as the total recycling rate and cumulative stocks of waste in Belarus shed some light on this situation.

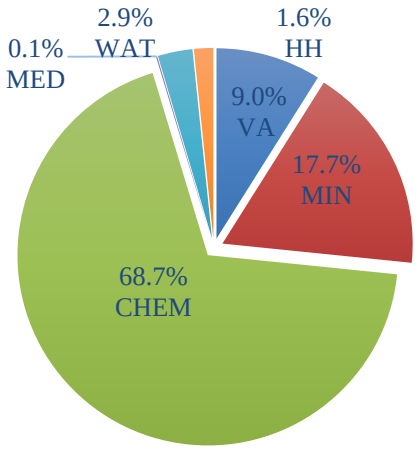
[2] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on a monitoring framework for the circular economy. http://ec.europa.eu/environment/circular-economy/pdf/monitoring-framework.pdf.

[3] COM (2015) 614 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52015DC0614.

[4] Resource Efficiency Scoreboard. http://ec.europa.eu/environment/resource_efficiency/targets_indicators/scoreboard/index_en.htm.

[5] Raw Materials Scoreboard. https://publications.europa.eu/en/publication-detail/-/publication/1ee65e21-9ac4-11e6-868c-01aa75ed71a1.

Figure 1 shows that, of all categories of waste defined in the classifier, the largest share is generated by chemical production facilities – 68.7 %, followed by mineral waste – 17.7 % and vegetal and animal waste – 9.0 %. The total share of medical waste, waste of water boiler and heat economy and drinking water, wastewater, storm water treatment and sewage, household waste and similar industrial waste did not exceed 5.0 % in 2017. At the same time, saline waste accounts for over 98.0 % of waste generated by chemical production facilities.

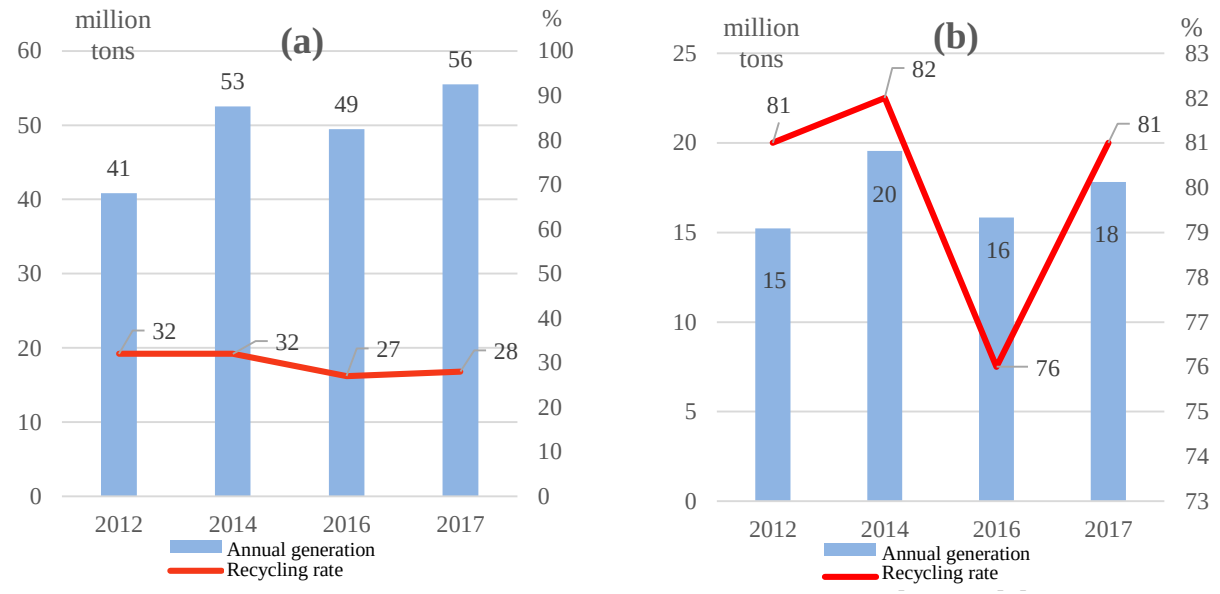


Note: VA – vegetal and animal waste; MIN – mineral waste; CHEM – waste of chemical and allied industries; MED – medical waste; WAT – waste (sludge) of water boiler and heat economy and drinking water, wastewater, storm water treatment and sewage; HH – household waste and similar industrial waste.

Source: RUE "Bel RC «Ecology»".

Figure 1. Structure of industrial waste generation in Belarus, 2017, %

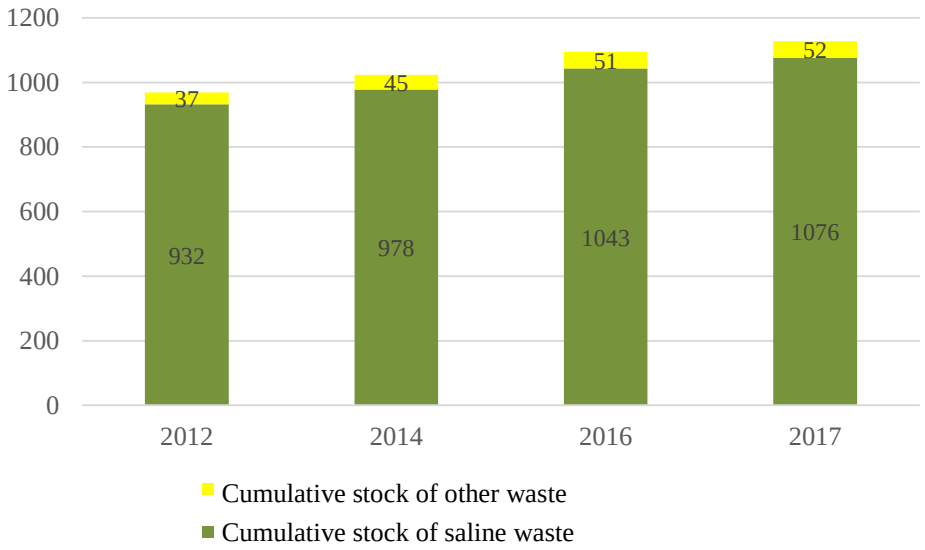
In Belarus, the annual generation of industrial waste grew by 36 % in 2017 against 2012, while the recycling rate did not change significantly (Figure 2a). Figure 2 shows that the volume of waste generation tended to fluctuate in 2012-2017. As there is a correlation between waste generation and GDP (*WASTEDIVE, 2016*), the drop of the volume of waste by 7.6 % in 2016 against 2014 may be explained by the GDP at constant prices drop by 6.2 % over that period. The generation of waste increased by 29.3 % in 2014 against 2012, which could be a result of both the overall GDP growth at constant prices over that period and, among other factors, the increase of the gross value added in the mining industry, which was 57.7 %.



Source: Own calculations based on the data provided by RUE "Bel RC «Ecology»".

Figure 2. Industrial waste generation and recycling rate in Belarus, 2012-2017: (a) – total; (b) – excluding saline waste

Due to the growing generation of waste and low recycling rates, Belarus faces accumulation of waste stocks (Figure 3). In Belarus, the cumulative waste stocks grew from 969 million tons to 1,128 million tons or by 16 % in 2017 against 2012. At the same time, saline waste accounted for 95-96 % of the total stock.



Source: RUE "Bel RC «Ecology»".

Figure 3. Industrial waste stocks in Belarus, 2012-2017, million tons

In 2012-2017, saline waste accounted for 63-68 % of the total generation of waste, which is due to the fact that Belarus has a well-developed potash fertilizer industry[6]. On average, 3-4 tons of waste

[6] Belarus produces about one fifth of the world output of potash fertilizers (*SPUTNIK, 2017*).

are generated per 1 ton of potash fertilizers *(Lebedevich, M.V., Roshka, T.B., 2012)*. In 2012-2017, about 32 million tons of such waste was annually generated in Belarus, of which not more than 4 % was used for road sprinkling, thermal power needs, etc. In other countries, small amounts of saline waste are used as secondary raw materials for table salt production, such waste is placed in surface watercourses and seas, and part of solid waste is used for mine stowing (*Reference Book "Ecology", 2018*).

The high share of saline waste in the total waste generation and the low rate of its recycling significantly affect the circular economy indicators in Belarus. For the purposes of this paper, saline waste is not taken into account for the calculation of the circular economy indicators to improve the comparability of data between the EU countries, Norway, and Belarus, since only Germany is a major producer of potash fertilizers within the EU (Tables 3, 4, and 6).

Table 1. Belarus' circular economy indicators significantly affected by saline waste, 2010-2016

Indicator	2010	2012	2014	2016
Generation of waste excluding major mineral wastes, per GDP unit[7], kg / '000 USD, PPP[8]				
- including saline waste	231	197	246	258
- excluding saline waste	46	42	52	47
Generation of waste excluding major mineral wastes, per domestic material consumption, %[9]				
- including saline waste	22.9	20.4	27.0	25.5
- excluding saline waste	4.5	4.3	5.7	4.7
Recycling rate of all waste, excluding major mineral waste, %				
- including saline waste	-[10]	19.4	17.6	16.2
- excluding saline waste	-[11]	80.0	75.8	72.4

Source: For the EU countries – Eurostat. For Belarus – own calculations based on data provided by RUE "Bel RC «Ecology»". For the EU countries and Belarus, the data on GDP, PPP (constant 2011 USD) – the World Bank. For Belarus, the data on domestic material consumption – UN Environment.

Figure 2b and Tables 1, 3, 4, and 6 show that the values of certain circular economy indicators for Belarus, excluding saline waste, seem to be over or underestimated compared to advanced countries in this sector, which gives rise to some doubts as to their accuracy and points at problems with waste statistics in Belarus (*Shershunovich, Y.S., Tochitskaya, I.E., 2018*).

[7] At constant 2011 prices.

[8] As there are no data available on mineral waste in Belarus for 2010, the calculation for this category of waste was made based on the average share of mineral waste in the total waste for 2012, 2014, 2016, and 2017. A similar calculation was also made for saline waste in Belarus for 2010.

[9] As there are no data available on mineral waste in Belarus for 2010, the calculation for this category of waste was made based on the average share of mineral waste in the total waste for 2012, 2014, 2016, and 2017. A similar calculation was also made for saline waste in Belarus for 2010.

[10] No data available for the calculation.

[11] No data available for the calculation.

4. Circular Economy Indicators Proposed by the EC and their Equivalents for Belarus

Belarus' progress to the circular economy is assessed using the methodology developed by the EC, which groups indicators into 4 sets: Production and Consumption; Waste Management; Secondary Raw Materials; Competitiveness and Innovation. However, in view of the unique features of waste recording and movement, some of the indicators have been adjusted for Belarus, and the calculation of some of them (under 'Waste Management' and 'Competitiveness and Innovation') appears to be impossible. However, the comparison of indicators for Belarus with those for the EU countries and Norway is presented for information purposes and should be treated with a certain degree of care due to the methodological differences in statistics, problems with waste recording, and coverage of respondents in Belarus.

Production and Consumption

The process of urbanization is accompanied by the growth of one of the most significant 'by-products' of an urban lifestyle – municipal solid waste (MSW) (its equivalent in Belarus is household solid waste). It includes household waste, as well as waste generated in commerce, offices and public institutions, which is collected by or on behalf of municipal authorities. The generation of such waste is affected by the level of economic development, the degree of industrialization, the habits of households, and the local climate. With the growth of real incomes and the improvement of the quality of life, the population tends to consume more goods and services and, thus, the generation of municipal solid waste increases. At the same time, city dwellers tend to dispose of twice as much garbage as rural ones. Although the share of municipal solid waste in the total volume of waste is usually less than 10 %, trends in its generation reflect the degree, to which the mentality and lifestyle of people would promote the development of a circular economy in their country. In particular, consumers can demand greener goods and less packaging. In Belarus, the volume of such waste per capita (Annex, indicator 3.1) grew by 20 % in 2016 against 2010 (Table 2). Although the generation of municipal solid waste per capita in Belarus is close to that in such countries as Czechia and Hungary, it should be kept in mind that there is no system of recording based on waste weighing[12] in Belarus, which makes this indicator very sensitive to the coefficient used to convert volume units into mass ones. It does not permit to formulate valid conclusions based on a direct comparison with other countries.

The total for the EU generation of municipal solid waste was characterized by irregularity in the period under study. In 2010-2014, it tended to decline, but that trend reversed in 2016. It should be noted that the EU member states include different types of materials into their definitions of 'municipal solid waste', which affects significantly the differences between countries in the volume of generation. However, Eurostat and the Directorate General for Environment of the EC are taking further steps to ensure the harmonization of the methodology and comparability of the data between the countries.

Table 2. Generation of municipal solid waste, kg per capita, 2010-2016

Country	2010	2012	2014	2016
Belarus	342	346	379	409
Total for the EU	504	485	478	482
- Sweden	439	450	438	443
- Denmark	-[13]	791	789	777
- Finland	470	506	482	504

[12] The volume of municipal solid waste (MSW) is calculated indirectly, based on the number of special-purpose motor vehicles involved in its removal from settlements *(Shershunovich, Y.S., Tochitskaya, I.E., 2018*).
[13] Not available.

- the Netherlands	571	549	527	520
- Germany	602	619	631	627
- Czechia	318	308	310	339
- Hungary	403	402	385	379
- Poland	316	317	272	307
- Lithuania	404	445	433	444
Norway	469	477	423	754

Note: Data for 2017 are not presented as the data for the EU countries are not available.

Source: For the EU countries – Eurostat. For Belarus – Belstat.

One of the key challenges that the circular economy helps address is maximizing the return on limited resources. Reducing the quantities of waste generated is an important component of improving a country's resource and material efficiency. It helps mitigate the impact on the environment, save valuable resources, and improve the competitiveness of enterprises. Therefore, in order to assess the progress towards a more resource efficient economy, it is important to monitor the overall volume of waste generation. In some EU countries, mineral waste accounts for a large share. It is generated mainly in the mining and construction sectors and also includes dredging spoils and contaminated soils. Since the generation of major mineral wastes is very uneven and is registered in large quantities only in some EU countries, to improve comparability, it is not taken into account according to the EC methodology for such circular economy indicators as the generation of waste per domestic material consumption and per GDP unit. The latter (Annex, indicator 3.2) is calculated using the GDP, PPP (constant 2011 USD).

Despite the fact that the international agenda covers the issue of eliminating the relationship between economic growth and increasing volume of waste, the correlation between the trends of waste generation and GDP persists. The data presented in Table 3 show that in Belarus, the relative indicator of waste generation increased slightly in 2016 against 2010. However, it grew significantly in 2014.

In 2010-2012, the generation of waste per GDP unit in Belarus (Table 3) was comparable to such countries as Czechia, Lithuania, Germany, Denmark, and Sweden, ranging from 42 to 46 kg / '000 USD, PPP. As a result of growth of waste generation in 2014, this indicator for Belarus exceeded those for the abovementioned EU countries, reaching the level of Hungary and the Netherlands. The experience of Norway, however, shows that most of the EU countries, as well as Belarus have the capacity to reduce their generation of waste.

Table 3. Generation of waste excluding major mineral wastes, per GDP unit[14], kg / '000 USD, PPP, 2010-2016

Country	2010	2012	2014	2016
Belarus	46[15]	42	52	47
Total for the EU	50	49	49	-[16]
- Sweden	46	44	43	-
- Denmark	44	39	39	-
- Finland	113	98	64	-
- the Netherlands	58	56	57	-
- Germany	42	42	44	-

[14] At constant 2011 prices.

[15] As there are no data available on mineral waste in Belarus for 2010, the calculation for this category of waste was made based on the average share of mineral waste in the total waste for 2012, 2014, 2016, and 2017. A similar calculation was also made for saline waste in Belarus for 2010.

[16] Not available.

- Czechia	42	42	38	-
- Hungary	52	50	50	-
- Poland	81	80	81	-
- Lithuania	47	41	43	-
Norway	27	31	30	-

Note: Data for 2016 and 2017 are not presented as the data for the EU countries are not available.

Source: For the EU countries, generation of waste excluding major mineral wastes – Eurostat. For Belarus – own calculations based on the data provided by RUE "Bel RC «Ecology»". For the EU countries and Belarus, the data on GDP, PPP (constant 2011 USD) – the World Bank.

Just as the previous indicator, the generation of waste excluding major mineral wastes per domestic material consumption (Annex, indicator 3.3) describes the efficiency of resource use. However, the volume of waste is compared in this case to inputs rather than outputs. This indicator reflects the share of waste in inputs used for production. The trends of this indicator are consistent with the trends of the generation of waste per GDP unit (Table 4).

The generation of waste per domestic material consumption[17] in Belarus should be compared to the values for other countries with care. Its values are too low, which points at problems with the quality of the data in this area rather than at the country's high resource efficiency and is partially explained by the fact that saline waste was excluded from the calculation.

Of all the countries of the EU and the European Free Trade Association, Norway is the most efficient from the point of view of material resource use—its generation of waste per domestic material consumption does not exceed 6.6 %—while the highest level of material resource use is registered in the Netherlands, with its generation of waste per domestic material consumption reaching 25.0%.

Table 4. Generation of waste excluding major mineral wastes, per domestic material consumption, %, 2010-2016

Country	2010	2012	2014	2016
Belarus	4.5[18]	4.3	5.7	4.7
Total for the EU	12.3	12.6	12.8	-[19]
- Sweden	9.2	8.7	8.3	-
- Denmark	9.1	7.5	8.1	-
- Finland	13.1	11.8	8.1	-
- the Netherlands	23.0	24.2	25.0	-
- Germany	11.1	11.0	11.3	-
- Czechia	7.4	8.0	7.3	-
- Hungary	11.6	13.1	9.4	-
- Poland	10.5	10.3	11.5	-
- Lithuania	7.9	7.8	7.5	-
Norway	6.0	6.6	6.6	-

Note: Data for 2016 and 2017 are not presented as the data for the EU countries are not available.

Source: For the EU countries – Eurostat. For Belarus, generation of waste excluding major mineral wastes – own calculations based on the data provided by RUE "Bel RC «Ecology»", domestic material consumption – UN Environment.

[17] Excluding major mineral wastes.

[18] As there are no data available on mineral waste in Belarus for 2010, the calculation for this category of waste was made based on the average share of mineral waste in the total waste for 2012, 2014, 2016, and 2017. A similar calculation was also made for saline waste in Belarus for 2010.

[19] Not available.

Waste Management

The expansion of waste recycling reduces the need for raw materials and, thus, leads to lower demand for primary resources and mitigates the negative impact of the generation of waste on the environment. In the context of a circular economy, the recycling rate of waste is seen as an important indicator of the production chain optimization.

Due to its heterogeneous composition, efficient recycling of municipal solid waste (Annex, indicator 5.1) is a challenging task. According to the EC, the share of recycling of municipal solid waste in its total generation serves as a good indicator of the quality of the entire national waste management system. The recycling rate of municipal solid waste is one of the indicators used to measure the achievement of the Sustainable Development Goals, which indicates its high value on a global scale.

At present, the rate of extraction of secondary material resources (SMRs) from household solid waste could be used as an equivalent of the recycling rate of municipal solid waste for Belarus. At the same time, it should be borne in mind that, in contrast to the indicator used in the EU countries and Norway, the rate of extraction reflects the amount of SMRs relative to the generation of MSW prior to its actual recycling. In 2012, SE "Operator of Secondary Material Resources" was established to coordinate activities in the field of SMRs in Belarus. There are also plans to use MSW to generate energy in future. According to the National Strategy for Sustainable Socio-Economic Development of the Republic of Belarus for the Period until 2030[20], the indicator 'Recycling of MSW' is to go up to 40 % by 2030. The EU has set a more ambitious goal – the recycling rate of this waste is to reach 65 % by 2030. Our analysis shows that, compared to the EU countries, Belarus has a considerable potential for improving its recycling rate of municipal solid waste (Table 5). As the experience of Czechia and, most notably, Lithuania proves, progress in recycling of this waste can be achieved quite quickly subject to the availability of appropriate resources.

Table 5. Recycling rate of municipal solid waste, %, 2010-2016

Country	2010	2012	2014	2016
Belarus[21]	-[22]	-	15.4	15.4
Total for the EU	38.3	41.5	43.7	45.8
- Sweden	48.1	47.2	49.9	48.9
- Denmark	-[23]	42.1	45.1	47.7
- Finland	32.8	33.3	32.5	42.0
- the Netherlands	49.2	49.4	50.9	53.1
- Germany	62.5	65.2	65.6	66.1
- Czechia	15.8	23.2	25.4	33.6
- Hungary	19.6	25.5	30.5	34.7
- Poland	21.4	19.6	32.3	44.0
- Lithuania	4.9	23.5	30.5	48.0
Norway	42.1	39.8	42.2	38.2

Note: Data for 2017 are not presented as the data for the EU countries are not available.

[20] National Strategy for Sustainable Socio-Economic Development of the Republic of Belarus for the Period until 2030 (approved by Minutes of the meeting of the Presidium of the Council of Ministers of the Republic of Belarus No. 10 dated 2 May 2017). (in Russian). https://economy.gov.by/uploads/files/NSUR2030/Natsionalnaja-strategija-ustojchivogo-sotsialno-ekonomicheskogo-razvitija-Respubliki-Belarus-na-period-do-2030-goda.pdf.

[21] An equivalent indicator – the rate of extraction of secondary material resources from household solid waste – is used for Belarus.

[22] No data available for the calculation.

[23] Not available.

Source: For the EU countries – Eurostat. For Belarus – own calculations based on the data available in reports of SE "Operator of Secondary Material Resources" and Belstat data.

The EU's approach to waste management is based on the 'waste hierarchy', which sets the following priority order when shaping waste policy at the operational level: prevention, (preparing for) reuse, recycling, recovery, and disposal. Turning waste into a resource is one of the key drivers of a circular economy. If one industry's waste becomes another's raw material, there is transition to a circular economy where the generation of waste is eliminated, and resources are used in the most efficient way. The recycling rate of the total volume of waste, as well as specific waste streams enables monitoring the implementation of the waste management strategy, taking into account the principle of the waste hierarchy.

In Belarus, the recycling rate of all waste generated, and the recovery rate of construction and demolition waste in particular, cannot be directly compared to the values for the EU countries for a number of reasons:

1) in Belarus, these indicators are calculated based on the total generation of waste, while in the EU countries and Norway – based on the volume of waste delivered to treatment and disposal facilities. Thus, in the EU countries and Norway, the monitoring of waste recycling is exercised on its arrival at the facilities for treatment and disposal[24] (*Shershunovich, Y.S., Tochitskaya, I.E., 2018*);

2) since less than half of the enterprises that can generate industrial waste, file their reports, the generation of waste is underestimated in the calculation of the recycling rate of waste;

3) in the EU countries, recycling does not include energy recovery, while in Belarus, waste recycling[25] means the utilization of waste to manufacture products, generate energy, perform work, provide services;

4) the calculation is based on the aggregate data provided by RUE "Bel RC «Ecology»", where it was impossible to separate 'waste recycled' from 'waste recycled, transferred per year', which resulted in overestimating the recycling rate.

The excessively high values of the recycling rate of all waste excluding major mineral wastes in 2012-2016 (Table 6) are a clear illustration of significant problems with the data quality and availability in Belarus. Moreover, it impedes the understanding of the real situation in the field of its recycling.

To improve the recycling rate of waste, the prospects of future product recycling should be taken into account already at the stage of designing the products. Mobilizing investments in infrastructure for separate collection and recycling of waste, creating a framework of regulatory and economic incentives for a circular economy contribute to the development of waste recycling.

Table 6. Recycling rate of all waste excluding major mineral wastes, %, 2010-2016

Country	2010	2012	2014	2016
Belarus	-[26]	80	76	72
Total for the EU	53	53	55	-[27]
- Sweden	51	53	51	-
- Denmark	56	64	59	-
- Finland	33	41	41	-

[24] Since a significant part of such waste is locked up at storage sites, including enterprise sites, it is not relevant to calculate this indicator for Belarus using the EU methodology as it would not reflect the real situation with its recovery (recycling) (*Shershunovich, Y.S., Tochitskaya, I.E., 2018*).

[25] Law of the Republic of Belarus "On Waste Management" No. 271-Z dated 20 July 2007. (in Russian). http://kodeksy-by.com/zakon_rb_ob_obrawenii_s_othodami.htm

[26] No data available for the calculation.

[27] Not available.

- the Netherlands	71	71	72	-
- Germany	55	54	53	-
- Czechia	50	58	60	-
- Hungary	36	35	40	-
- Poland	58	55	60	-
- Lithuania	50	51	57	-
Norway	-	-	-	-

Note: Data for 2016 and 2017 are not presented as the data for the EU countries are not available.

Source: For the EU countries – Eurostat. For Belarus – own calculations based on the data provided by RUE "Bel RC «Ecology»".

Belarus' current system of recording does not enable the calculation of such circular economy indicators as the recycling rate of packaging, including separate rates for plastic and wooden packaging, waste of electrical and electronic equipment (e-waste), and biowaste based on the EC methodology. Therefore, of the whole set of 'Waste Management' indicators, only the recovery rate of construction and demolition waste can be calculated (Annex, indicator 6.6).

Construction and demolition of buildings and structures is one of the largest sources of waste in the EU countries. In Belarus, it accounts for 14 to 17 % of the total waste (data for 2012-2016). Construction and demolition waste is both recycled at the enterprises, where it is generated, and used for the reclamation of quarries, improvement of industrial sites, and filling of roads. By 2016, Belarus had reached the recovery rate of construction and demolition waste of 81 %, although this figure fluctuated significantly in previous years. The experience of Denmark, the Netherlands, Germany, Czechia, Poland, and Lithuania, where the recovery rate of construction and demolition waste exceeded 90 %[28] in some years, indicates that this area is promising. The high fluctuations of this indicator in some countries (e.g. in Finland, Sweden, Hungary, Norway) could be a result of the uneven development of the construction sector itself and some methodological problems. For example, the recovery rate of construction and demolition waste covers backfilling, but there is no harmonized application of this concept in the EU countries.

The important factors for feeding these materials back into the economy include: the composition and type of construction materials, the design of buildings and structures, selective demolition, which allows for a separation of recoverable fractions, as well as quality assurance systems for secondary raw materials to build up trust in recycled materials.

Table 7. Recovery rate of construction and demolition waste, %, 2010-2016

Country	2010	2012	2014	2016
Belarus	-[29]	79	59	81
Total for the EU	78	-[30]	88	-
- Sweden	78	-	55	-
- Denmark	84	-	92	-
- Finland	5	-	83	-
- the Netherlands	100	-	99	-
- Germany	95	-	-	-
- Czechia	91	-	90	-
- Hungary	61	-	86	-

[28] Both in Belarus and in the EU countries, part of construction and demolition waste is used for the reclamation of quarries, backfilling trenches and road repair. Such application is not quite 'circular', since it does not contribute to the preservation of the value of materials and, thus, does not correspond to the objectives of the circular economy.
[29] No data available for the calculation.
[30] Not available.

- Poland	93	-	96	-
- Lithuania	73	-	92	-
Norway	44	-	78	-

Note: Data for 2016 and 2017 are not presented as the data for the EU countries are not available.

Source: For the EU countries – Eurostat. For Belarus – own calculations based on the data provided by RUE "Bel RC «Ecology»".

Secondary Raw Materials

In a circular economy, as the product reaches the end of its life cycle, its components and materials are recycled and then reused as secondary raw materials. This improves the security of supply of raw materials, reduces the reliance on imported primary resources, and mitigates the negative impact of production and consumption on the environment.

The circular material use rate (Annex, indicator 7.2), as one of the options for assessing the overall level of development of a circular economy, reflects the extent, to which primary raw materials are replaced with secondary raw materials. Table 8 shows that the largest proportion of raw materials demand is satisfied with recycled waste in the Netherlands (over 26 %) and the smallest – in Lithuania (3.8-3.9 %). This indicator as the total for the EU tends to increase, which is consistent with the region's policy of transition to a more circular economy.

The methodology for calculating this indicator has been adjusted for Belarus[31]. The circular material use rate gives a rather stylized picture of the situation in the country, since the calculation of the use of these materials was based on the aggregated data provided by RUE "Bel RC «Ecology»", where it was impossible to separate 'waste recycled' from 'waste recycled, transferred', which resulted in overestimated values.

The low circular material use rates on average for the EU and for Belarus could be a consequence of the lack or poor development of technologies for their recycling, as well as the economic inexpediency at this stage.

Table 8. Circular material use rate, %, 2010-2016

Country	2010	2012	2014	2016
Belarus	-[32]	8.2	10.7	8.2
Total for the EU	10.8	11.2	11.4	-[33]
- Sweden	7.4	8.4	6.7	-
- Denmark	8.7	7.2	9.8	-
- Finland	13.5	15.3	7.3	-
- the Netherlands	25	26.7	26.7	-
- Germany	11.0	10.7	10.7	-
- Czechia	5.3	6.3	6.9	-
- Hungary	5.2	6.1	5.4	-
- Poland	10.8	10.6	12.5	-
- Lithuania	3.9	3.8	3.8	-
Norway	-	-	-	-

Note: Data for 2016 and 2017 are not presented as the data for the EU countries are not available.

[31] For Belarus, the denominator includes only the domestic material consumption as it should cover the consumption of both primary and secondary raw materials. Under the EC methodology, the denominator includes the domestic material consumption and the circular material use.

[32] No data available for the calculation.

[33] Not available.

Source: For the EU countries – Eurostat. For Belarus – own calculations based on the data provided by RUE "Bel RC «Ecology»" and UN Environment.

The Action Plan for the Circular Economy aims to boost the market for secondary raw materials. The driver for that is the demand generated through the use of recycled materials in goods and infrastructure. Some types of secondary raw materials (e.g. paper, metals) are in high demand in the EU countries, while the demand for others (e.g. plastics) is still insufficient. The private sector plays an important role in shaping the demand and supply chains. One of the barriers to the development of the market for secondary raw materials is the lack of confidence of the players of this sector in the quality of such materials. Therefore, the EC plans to develop the quality standards for secondary raw materials, which would apply across the EU. A significant factor to boost the development of this market is the availability of data on secondary raw materials. For example, the EC is going to launch an information system on raw materials and support the study of flows of raw materials. Tracing the transboundary flows of secondary raw materials allows understanding the trends in that market, as well as to assess the degree of maturity of the market itself.

Two indicators – 'Export of recyclable raw materials' (Annex, indicator 8.2) and 'Import of recyclable raw materials' (Annex, indicator 8.1) – cover only certain types of materials: waste from plastics, paper and cardboard, precious metals, iron and steel, copper, aluminum and nickel. For Belarus, the calculation was based on codes of the Harmonized Commodity Description and Coding Systems (HS-codes)[34], which coincide with the codes of the Combined Nomenclature (CN-codes)[35].

Although export growth was 261.9 % in 2016 against 2010, Belarus' export of recyclable raw materials continued to be the smallest of all the countries under study. This may be due to the immaturity of the domestic market for secondary raw materials. Paper and cardboard waste—ranging from 43.6 % to 63.5 %—prevailed in export in the period under study. This trend can be explained by the fact that, of all the primary resources, which serve as the basis for secondary raw materials included in this indicator, Belarus is best endowed in those used for the production of paper and cardboard. Export of iron and steel (14.0 % to 30.9 %) and plastics waste (16.7 % to 28.5%) came second. Of the studied types of raw materials, copper, aluminum and nickel accounted for the smallest share (2.8 to 16.7%). There was no export of precious metal scrap during that period.

By comparison, in Poland, iron and steel scrap accounted for 51.3 % of export of recyclable raw materials, waste paper and cardboard – for 28.3 %, copper, aluminum and nickel scrap – for 11.5 % in 2016. In Czechia, iron and steel scrap constituted 64.9 % of export, paper and cardboard waste – 26.4 %, while the shares of the other types taken separately did not exceed 5 % in 2016.

Table 9. Export of recyclable raw materials, '000 tons, 2010-2016

Country	2010	2012	2014	2016
Belarus	23.7	60.3	56.8	85.9
Sweden	1,980.6	2,286.1	2,236.3	2,207.1
Denmark	2,961.4	2,238.6	2,535.8	2,432.5
Finland	492.7	636.8	627.5	533.1
the Netherlands	10,239.2	9,869.2	8,353.4	9,038.0
Germany	16,022.2	16,239.6	15,229.6	14,663.8
Czechia	2,589.8	2,910.5	2,972.0	2,783.9
Hungary	1,314.5	1,470.4	1,347.2	1,266.5
Poland	2,152.1	2,887.7	3,077.7	2,671.2
Lithuania	664.7	721.7	729.3	717.8

[34] For Belarus, export and import of recyclable raw materials were calculated based on the HS 2007 codes for 2010 and HS 2012 codes for 2012, 2014, and 2016.

[35] They were used to calculate these indicators for the EU countries.

Norway	-[36]	-	-	-

Note: Data for 2017 are not presented as the data for the EU countries are not available.

Source: For the EU countries – Eurostat. For Belarus – World Integrated Trade Solution (WITS).

Table 10 shows that the trends in import of secondary raw materials in Belarus are completely different compared to their export. The volume of import dropped by 24.6 % in 2016 against 2010. In 2010-2016, Belarus' import of secondary raw materials was generally at the level of Sweden and Poland, second only to the Netherlands and Germany. However, this situation is not associated with the development of the market for secondary raw materials, but with the operation of the metallurgical industry in the country where there are no own resources for that. During the period under study, iron and steel scrap accounted for 92.5 % to 97.0 % of Belarus' import of secondary raw materials.

In Lithuania, for example, the most 'popular' recyclable raw materials imported in 2016 included paper and cardboard waste (46.4 %), followed by plastics waste (28.5 %) with iron and steel scrap being only the third one (18.4 %). In Poland and Czechia, iron and steel scrap represented the largest item of import of recyclable raw materials in 2016—44.9 % and 60.6 % respectively—but their shares were not so high as in Belarus. In Poland, paper and cardboard waste accounted for 27.5 %, copper, aluminum and nickel scrap – for 18.5 %; in Czechia, plastics waste accounted for 15.5 %, copper, aluminum and nickel scrap – for 16.1 % in 2016.

Table 10. Import of recyclable raw materials, '000 tons, 2010-2016

Country	2010	2012	2014	2016
Belarus	1,687.1	1,466.5	1,307.6	1,272.5
Sweden	1,788.4	1,585.4	1,358.9	1,254.3
Denmark	393.3	463.2	368.6	232.1
Finland	834.7	145.2	186.3	122.2
the Netherlands	5,666.3	5,690.0	4,915.2	5,359.4
Germany	11,210.0	11,729.4	11,366.2	10,866.2
Czechia	631.1	778.9	856.1	786.2
Hungary	476.1	535.1	550.1	616.0
Poland	900.3	1,032.6	1,396.1	1,751.1
Lithuania	163.2	217.5	176.8	174.9
Norway	- [37]	-	-	-

Note: Data for 2017 are not presented as the data for the EU countries are not available.

Source: For the EU countries – Eurostat. For Belarus – World Integrated Trade Solution (WITS).

Competitiveness and Innovation

The transition to a circular economy calls for investments in eco-design, waste recycling technologies and processes, upgrading existing production facilities to improve the resource efficiency and for the ability to work using secondary raw materials, and creation of a comprehensive monitoring framework. The development of a circular economy is accompanied by growth of the overall share of circular economy sectors in GDP, as well as an increase in the number of people employed there.

In the EU countries and Norway, the indicators under 'Competitiveness and Innovation' describe two sectors: recycling, repair and reuse. In Belarus, various indicators related to this set covered different economic activities as in some cases it was impossible to collect the data for the individual subcategories of these activities.

[36] Not available.
[37] Not available.

For Belarus, the indicators 'Gross investment in tangible goods related to the circular economy sector both as a percentage of GDP at current prices and as a percentage of total gross investment' (Tables 11 and 12) were calculated for the economic activity 'Waste collection, treatment and disposal, materials recovery'[38]. Since they do not cover repair, they are not fully comparable to those for the EU countries and Norway. It should also be noted that, when calculating these indicators for Belarus, the fixed capital investment is used, while for the EU countries and Norway, they use the gross investment in tangible goods, which, according to their methodology, covers also investment in non-produced tangible goods such as land.

Table 11 shows that in Belarus, the gross investment in tangible goods related to the circular economy sector as a percentage of GDP (Annex, indicator 9.1) decreased by 0.03 percentage points in 2010-2016.

In the EU countries and Norway, the investment in circular economy is less than 1 % of GDP. In a study on Czechia and Poland (*Wijkman, A., Skanberg, K., 2016*), it is noted that in order to move to a circular economy, it should be at least 3 % of GDP annually. The investment will be primarily needed in the following sectors:

- agriculture and forestry, timber, and pulp and paper industries – to produce biofuels and develop new bio-based products;
- maintenance and repair, and recycling – to improve material efficiency;
- engineering and design services, as well as education – to meet the demand for new competencies in such areas as product design, recycling and remanufacturing, as well as development of innovative business models.

Table 11. Gross investment in tangible goods (percentage of GDP at current prices) related to the circular economy sector, 2010-2016

Country	2010	2012	2014	2016
Belarus	0.08	0.06	0.06	0.05
Total for the EU	-[39]	-	0.11	-
- Sweden	0.12	0.11	0.11	-
- Denmark	0.08	0.10	0.08	-
- Finland	0.09	-	0.09	-
- the Netherlands	0.15	0.12	0.10	-
- Germany	0.08	0.09	0.08	-
- Czechia	-	-	-	-
- Hungary	0.11	0.10	0.15	-
- Poland	0.17	0.16	0.18	-
- Lithuania	0.10	0.17	0.12	-
Norway	0.14	0.12	0.12	-

Note: Data for 2016 and 2017 are not presented as the data for the EU countries are not available.

Source: For the EU countries – Eurostat. For Belarus – own calculations based on Belstat data.

In 2012, the share of gross investment related to the circular economy sector in the total gross investment in Belarus (Table 12) dropped against 2010, however, starting from 2014, it tended to

[38] Since it appeared to be impossible to separate the subcategories of repair from such economic activities as 'Wholesale and retail trade; repair of motor vehicles and motorcycles', 'Manufacture of rubber and plastic products', 'Other manufacturing; repair and installation of machinery and equipment', 'Provision of other services', the data on those subcategories were not included in the indicators under study.

[39] Not available.

grow gradually. Even taking into consideration the fact that this indicator for Belarus does not cover repair and investment in land, it is still too low compared to the EU countries and Norway.

In most of the presented EU countries and Norway, the gross investment in tangible goods related to the circular economy sectors tended to decline as a percentage of the total gross investment in 2010-2014. However, in a number of countries (Denmark, Hungary), it was still growing, while in Germany and Lithuania, there were mixed trends: in 2012, there was a substantial growth, while in 2014, there was a significant drop. It may point at the fact that the circular economy sector is at an early stage of its development even in the region, which adopts initiatives at the legislative level to facilitate the transition to a circular economy.

Table 12. Gross investment in tangible goods (percentage of total gross investment) related to the circular economy sector, 2010-2016

Country	2010	2012	2014	2016
Belarus	0.25	0.21	0.23	0.27
Total for the EU	-[40]	-	1.32	-
- Sweden	1.22	1.15	1.10	-
- Denmark	0.89	1.09	1.03	-
- Finland	1.45	-	1.31	-
- the Netherlands	2.32	1.62	1.37	-
- Germany	1.28	1.47	1.22	-
- Czechia	-	-	-	-
- Hungary	0.99	0.93	1.16	-
- Poland	1.80	1.77	1.68	-
- Lithuania	1.08	1.54	1.09	-
Norway	1.45	0.92	1.02	-

Note: Data for 2016 and 2017 are not presented as the data for the EU countries are not available.

Source: For the EU countries – Eurostat. For Belarus – Belstat data.

An economy that encourages reuse and recycling, as well as lengthening the product life cycle, is inherently more labor-intensive than a system based on a linear flow of resources. The main reason is that the preservation and restoration of an existing product through repair and maintenance, upgrading etc. requires more labor resources than mining and industrial production (especially using highly automated and robotic equipment).

For Belarus, the number of persons employed as a percentage of total employment related to the circular economy sector (Annex, indicator 9.2) covers only one type of economic activity – 'Waste collection, treatment and disposal, materials recovery'[41]. As the data for earlier periods are not available, the indicator was calculated only for 2016, and it amounted to 0.49 %. Thus, at their initial stage of development in Belarus, the circular economy sector account for less than 1 % of jobs in the economy. In accordance with global trends, employment in this sector (Table 13) would tend to reach 3-4% of the total number of persons employed in the EU countries and Norway.

Table 13. Number of persons employed (percentage of total employment) related to circular economy sector, 2010-2016

Country	2010	2012	2014	2016

[40] Not available.

[41] Since it appeared to be impossible to separate the subcategories of repair from such economic activities as 'Wholesale and retail trade; repair of motor vehicles and motorcycles', 'Manufacture of rubber and plastic products', 'Other manufacturing; repair and installation of machinery and equipment', 'Provision of other services', the data on those subcategories were not included in the indicators under study.

Total for the EU	-[42]	1.68	1.71	-
- Sweden	1.53	1.59	1.56	-
- Denmark	1.24	1.32	1.37	-
- Finland	1.59	-	1.75	-
- the Netherlands	1.22	1.23	1.16	-
- Germany	1.41	1.42	1.47	-
- Czechia	-	-	-	-
- Hungary	1.88	1.88	1.74	-
- Poland	2.07	2.11	2.13	-
- Lithuania	2.34	2.61	2.79	-
Norway	1.82	1.77	1.84	-

Note: Data for 2016 and 2017 are not presented as the data for the EU countries are not available.

Source: For the EU countries – Eurostat. For Belarus – own calculations based on Belstat data.

The gross value added related to the circular economy sector as a percentage of GDP at current prices (Annex, indicator 9.3), as well as the other indicators under 'Competitiveness and Innovation', generally reflect the level of development of the circular economy in a country.

According to some studies[43], an increase in the gross value added by 1 % for the economic activities related to lengthening the product life cycle, could generate a cumulative effect of 7.9 billion euros per year for the EU.

Even taking into account the trend of growth of this indicator in Belarus, the gross value added related to the circular economy sector remains lower than in the EU countries and Norway. At the same time, the data on such economic activity as 'Water supply; waste collection, treatment and disposal, remediation activities'[44] was used for the calculation, which potentially makes it overestimated for Belarus. Of the countries presented in Table 14, the highest values of this indicator are observed in Poland and Norway – over 1% of GDP. In general, the low level of the gross value added points at both the initial stage of development of this sector and the potential problems with the methodology for determining which industries or parts thereof are related to the circular economy.

Table 14. Gross value added at factor cost (percentage of GDP at current prices) related to the circular economy sector, 2010-2016

Country	2010	2012	2014	2016
Belarus	0.59	0.63	0.72	0.72
Total for the EU	-[45]	0.98	1.00	-
- Sweden	0.94	0.96	0.94	-
- Denmark	0.82	0.84	0.83	-
- Finland	0.95	-	0.95	-
- the Netherlands	0.85	0.88	0.81	-
- Germany	-	0.97	0.97	-
- Czechia	-	-	-	-

[42] Not available.

[43] European Parliamentary Research Service.
http://www.europarl.europa.eu/thinktank/infographics/circulareconomy/public/index.html.

[44] For the purposes of calculating the gross value added, it appeared to be impossible to separate waste collection, treatment and disposal, materials recovery from the economic activity 'Water supply; waste collection, treatment and disposal, remediation activities' or to separate repair from such economic activities as 'Wholesale and retail trade; repair of motor vehicles and motorcycles', 'Manufacture of rubber and plastic products', 'Other manufacturing; repair and installation of machinery and equipment', 'Provision of other services'.

[45] Not available.

- Hungary	0.84	0.79	0.83	-
- Poland	1.12	1.09	1.13	-
- Lithuania	0.8	0.95	0.95	-
Norway	1.08	1.02	1.04	-

Note: Data for 2016 and 2017 are not presented as the data for the EU countries are not available.

Source: For the EU countries – Eurostat. For Belarus – own calculations based on Belstat data.

As there are no statistics on patents by types of economic activities in Belarus, it appears impossible to calculate the number of patents related to recycling and secondary raw materials (Annex, indicator 10).

5. Findings and Recommendations

The transition to a circular economy calls for a comprehensive monitoring framework based on measuring the progress on this way at all stages of the life cycle of resources and products. One attempt to implement such a system is the framework of circular economy indicators proposed by the EC. The fact that they have a high degree of practical application, are easy to analyze and informative, and able to reflect the key elements of a circular economy, explains the choice of this framework to assess the development of a circular economy in Belarus.

Attempts to calculate indicators for Belarus and compare their values to those for the EU countries and Norway have disclosed the following problems:

- it is impossible to calculate some indicators based on the aggregate data provided by RUE "Bel RC «Ecology»" and publicly available data (the recycling rate of packaging (Annex, indicator 6.1), including that separately for plastic (Annex, indicator 6.2) and wooden packaging (Annex, indicator 6.3), e-waste (Annex, indicator 6.4), biowaste (Annex, indicator 6.5), and the number of patents related to recycling and secondary raw materials (Annex, indicator 10));
- it is necessary to adjust a range of indicators for a number of reasons: due to 1) the unique features of waste recording and movement, for example since a significant part of such waste is locked up at storage sites, including enterprise sites; 2) methodological differences in statistics for Belarus and those for the EU countries and Norway; 3) the high share of saline waste in total waste generation (the following indicators have been adjusted: the generation of waste excluding major mineral wastes per GDP unit (Annex, indicator 3.2) and per overall domestic material consumption (Annex, indicator 3.3), the recycling rate of all waste excluding major mineral waste (Annex, indicator 5.2), the recovery rate of construction and demolition waste (Annex, indicator 6.6), and the circular material use rate (Annex, indicator 7.2));
- due to the problems with data on waste (*Shershunovich, Y.S., Tochitskaya, I.E., 2018*), and as a result of changes in the Common Classifier of Economic Activities etc., some indicators are either overestimated or underestimated that impedes valid direct comparisons with other countries (that is mostly related to the following indicators: the generation of municipal solid waste per capita (Annex, indicator 3.1), the generation of waste excluding major mineral wastes per domestic material consumption (Annex, indicator 3.3), the recycling rate of all waste excluding major mineral waste (Annex, indicator 5.2), the circular material use rate (Annex, indicator 7.2), as well as the set of indicators under 'Competitiveness and Innovation').

The analysis of those indicators, where comparisons with other countries are most relevant, has revealed that the circular economy in Belarus is at an early stage of its development. The recycling rate of municipal solid waste was 15.4 % in 2014-2016, while the average for the EU was 28.3 and

30.4 percentage points higher in 2014 and 2016 respectively. At the same time, according to the EC, the share of use of such waste in its generation is a good indicator of the quality of the entire national waste management system. The level of development and the size of the circular economy sector are characterized by the investment mobilized and the number of persons employed there. In Belarus, the gross investment related to the circular economy sector accounted for less than 0.3 % of the total investment in 2010-2016, while in the EU countries and Norway, this indicator ranged from 0.89 % to 2.32 % during the period under study. Even taking into consideration the fact that this indicator for Belarus does not cover repair and investment in land, it is still too low compared to the other countries. The number of persons employed in the circular economy sector in Belarus (0.49 % of total employment in 2016) also indicates that the global trends in the circular economy development are not yet fully reflected in the country.

The analysis made has helped identify a number of promising areas in the field of waste management for Belarus. First, there is an untapped potential to reduce the generation of waste in the country — with Norway taken as the benchmark, it is estimated at 22 kg / '000 USD, PPP. Second, further practical steps are needed to improve the recycling rate of municipal solid waste, since Belarus is significantly lagging behind the EU countries and Norway in this area today. Third, although Belarus had reached the recovery rate of construction and demolition waste of 81 % by 2016, the experience of advanced countries shows that this value could be above 90 %. Fourth, further substitution of primary resources with secondary raw materials in the economy would help improve the competitiveness of enterprises, save valuable resources, and mitigate the impact on the environment.

The transition to a circular economy is accompanied by mobilization of investment in the sector of engineering and design services, which will take into account the prospects of product recycling already at the stage of designing the product, waste recycling technologies and processes, upgrading existing production facilities to improve the resource efficiency and for the ability to work using secondary raw materials, and developing new bio-based products.

For Belarus to develop a circular economy and create the conditions that encourage investment in the circular economy sector, it is advisable to:

- take efforts to improve the methodology of defining the industries or activities related to the circular economy sector;
- develop the quality standards for secondary raw materials to expand their use in the economy and strengthen producers' confidence in their use;
- improve the reliability and availability of data on waste, which would facilitate more accurate comparisons;
- build a public information platform, which would enable monitoring of the circular economy development and information exchange between all the stakeholders in this sector.

References

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on a monitoring framework for the circular economy. http://ec.europa.eu/environment/circular-economy/pdf/monitoring-framework.pdf.

COM (2015) 614 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52015DC0614.

Resource Efficiency Scoreboard. http://ec.europa.eu/environment/resource_efficiency/targets_indicators/scoreboard/index_en.htm.

Raw Materials Scoreboard. https://publications.europa.eu/en/publication-detail/-/publication/1ee65e21-9ac4-11e6-868c-01aa75ed71a1

RUE "Bel RC «Ecology»". http://www.ecoinfo.by/.

WASTEDIVE (2016). https://www.wastedive.com/news/chief-economist-notes-direct-correlation-between-waste-volumes-and-gdp/429576/.

AGRONEWS (2018). (in Russian). https://agronews.com/by/ru/news/analytics/2018-02-22/kalij-prodolzhaet-dorozhat.

SPUTNIK (2017). https://sputnik.by/analytics/20170906/1030667048/mirovoj-kalijnyj-rynok-peredyshka-zakanchivaetsya-vperedi-konkurenciya.html.

Lebedevich, M.V., Roshka, T.B. (2012). Assessment of Environmental Risks in Potash Fertilizer Production at BELARUSKALI OJSC, Polessky State University. (in Russian). 81- 83.

Reference Book "Ecology" (2018). (in Russian). http://ru-ecology.info/post/103668700050014/.

Eurostat / Circular economy / Indicators / Main tables. http://ec.europa.eu/eurostat/web/circular-economy/indicators/main-tables.

Belstat / Macroecomy and environment / Environment / The Shared Environmental Information System / I. Waste / I.1 Waste generation. http://www.belstat.gov.by/ofitsialnaya-statistika/makroekonomika-i-okruzhayushchaya-sreda/okruzhayuschaya-sreda/sovmestnaya-sistema-ekologicheskoi-informatsii2/i-othody/i-1-obrazovanie-othodov/.

Eurostat / Environment / Waste / Database. http://ec.europa.eu/eurostat/web/environment/waste/database.

The World Bank / Data. https://data.worldbank.org/indicator/NY.GDP.MKTP.PP.KD?locations=US-RU.

UN Environment. https://environmentlive.unep.org/country/data/BY#charts.

SE "Operator of Secondary Material Resources". (in Russian). https://vtoroperator.by/.

Shershunovich, Y.S., Tochitskaya, I.E. (2018). Waste Statistics in Belarus: Tight Spots and Broad Scope for Work, PP GE no. 2. http://eng.beroc.by/webroot/delivery/files/GE_2_eng.pdf.

National Strategy for Sustainable Socio-Economic Development of the Republic of Belarus for the Period until 2030 (approved by Minutes of the meeting of the Presidium of the Council of Ministers of the Republic of Belarus No. 10 dated 2 May 2017). (in Russian). https://economy.gov.by/uploads/files/NSUR2030/Natsionalnaja-strategija-ustojchivogo-sotsialno-ekonomicheskogo-razvitija-Respubliki-Belarus-na-period-do-2030-goda.pdf.

World Integrated Trade Solution (WITS). https://wits.worldbank.org/.

Wijkman, A., Skanberg, K. (2016). The Circular Economy and Benefits for Society Jobs and Climate Clear Jobs Winners in an Economy Based on Renewable Energy and Resource Efficiency. A study report at the request of the Club of Rome with support from the MAVA Foundation.

Belstat / Real sector of the economy / Investment and construction / Annual data / Fixed capital investment by economic activity. http://www.belstat.gov.by/ofitsialnaya-statistika/realny-sector-ekonomiki/investitsii-i-stroitelstvo/osnovnye-pokazateli-za-period-s-__-po-____gody_8/investitsii-v-osnovnoy-kapital-po-vidam-ekonomicheskoy-deyatelnosti/.

Belstat / Macroecomy and environment / National accounts / Annual data / Gross domestic product. http://www.belstat.gov.by/ofitsialnaya-statistika/makroekonomika-i-okruzhayushchaya-sreda/natsionalnye-scheta/godovye-dannye_11/proizvodstvo-valovogo-vnutrennego-produkta/.

National Bank of the Republic of Belarus (2018). Official Average Exchange Rate of the Belarusian Ruble against Foreign Currencies. https://www.nbrb.by/statistics/Rates/AvgRate/.

Belstat / Social sector / Employment and wages / Annual data / Employment by kind of economic activity in 2010-2017. http://www.belstat.gov.by/ofitsialnaya-statistika/solialnaya-sfera/trud/godovye-dannye/chislennost-zanyatogo-naseleniya-po-vidam-ekonomicheskoy-deyatelnosti-2010-2016-gg/.

European Parliamentary Research Service. http://www.europarl.europa.eu/thinktank/infographics/circulareconomy/public/index.html.

Belstat / Macroeconomy and environment / National accounts / Annual data / Gross domestic product by types of economic activity. http://www.belstat.gov.by/ofitsialnaya-statistika/makroekonomika-i-okruzhayushchaya-sreda/natsionalnye-scheta/godovye-dannye_11/valovoi-vnutrennii-produkt-po-vidam-ekonomicheskoi-deyatelnosti/.

List of CPC codes for indicator calculation. http://ec.europa.eu/eurostat/documents/8105938/8465062/cei_cie020_esmsip_CPC-codes.pdf.

Annex. Comparative Analysis of the Methodology for the Calculation of the Circular Economy Indicators Proposed by the EC and their Equivalents for Belarus

	EU indicator	Methodology for calculation	Equivalent for Belarus	Methodology for calculation
1	2	3	4	5
	Production and Consumption			
1.	EU self-sufficiency for raw materials (percentage)	1- Import reliance Import reliance = net import / domestic consumption = (import – export) / (domestic production + import – export). The indicator is calculated for each type of raw materials in total for the EU.	Impossible to calculate	
2.	Green public procurement	The indicator measures the share of public procurement procedures, which include environmental aspects. The indicator is under development.	Impossible to calculate	
3.	Waste generation			
3.1	Generation of municipal solid waste (kg per capita)	The indicator measures the waste collected by or on behalf of municipal authorities and disposed of through the waste management system; it consists of waste generated by households, similar wastes from sources such as commerce, offices and public institutions may be included, per capita.	Generation of household solid waste (MSW) per capita (kg per capita)	Generation of household solid waste / total population. According to the List of Household Waste, such waste includes waste from human vital activities, street and yard sweepings; waste from research, education, sporting, cultural and religious activities; waste from trade, social service and transport activities; waste from administrative managerial and economic activities; waste of health care facilities.
3.2	Generation of waste excluding major mineral wastes, per GDP unit (kg / '000 USD, PPP)	The indicator is defined as all waste generated in a country (in mass unit), excluding major mineral wastes, divided by the GDP, the GDP is in constant 2011 USD. The major mineral wastes include the following categories:	Generation of waste excluding major mineral wastes, per GDP unit (kg / '000 USD, PPP)	(Total waste generated per year – major mineral wastes) / GDP, PPP (constant 2011 USD). Major mineral wastes include 'Other mineral solid waste', 'Other mineral waste, including product refining waste', 'Furnace fragments (breakage), metallurgical and foundry rubble

	EU indicator	Methodology for calculation	Equivalent for Belarus	Methodology for calculation
		- Mineral waste from construction and demolition (EWC-Stat 12.1) - Other mineral wastes (12.2,12.3, 12.5) - Soils (12.6) - Dredging spoils (12.7). Under the EC methodology, all waste generated in a country, excluding major mineral wastes, is divided by the GDP in EUR, chain linked volumes (2010), but for the purposes of international comparisons, the denominator is replaced with the GDP, PPP (constant 2011 USD).		(rejects)', 'Metallurgical slags, dross and dust', 'Mineral sludge'.
3.3	Generation of waste excluding major mineral wastes, per domestic material consumption (percentage)	The indicator is defined as all waste generated in a country (in mass unit), excluding major mineral wastes, divided by the domestic material consumption (in mass unit).	Generation of waste excluding major mineral wastes, per domestic material consumption (percentage)	(Total waste generated per year – major mineral wastes) / domestic material consumption.
4.	Food waste (million tons)	The indicator measures the waste generated in the production, distribution and consumption of food. The indicator is under development.	Food waste ('000 tons)	It could include waste under the following categories: 'Waste of food production', 'Waste of flavor product production', 'Food waste', 'Vegetable and animal oils production waste', 'Vegetable and animal fat and grease production waste', 'Waste containing vegetable and animal fat products', 'Vegetable oil waste products', 'Slime (sludge) containing vegetable and animal fat products', 'Vegetable and animal fat refining residues'.
Waste Management				
5. Recycling rates				

	EU indicator	Methodology for calculation	Equivalent for Belarus	Methodology for calculation
5.1	Recycling rate of municipal solid waste (percentage)	The indicator measures the share of recycled municipal waste in the total municipal waste generation. Recycling of municipal waste includes material recycling, composting and anaerobic digestion.	Rate of extraction of SMRs from household municipal waste (percentage)	Secondary material resources from household municipal waste collected and prepared for recycling / household municipal waste.
5.2	Recycling rate of all waste excluding major mineral wastes (percentage)	The indicator is calculated as recycled waste (other than energy recovering and backfilling) divided by total waste treated, excluding major mineral wastes. Recycled waste includes all waste sent for recovery, other than energy recovering and backfilling. Recycled waste is adjusted as following: waste treated in domestic plants plus waste sent out of the country for recycling minus waste imported and treated in domestic recycling plants.	Recycling rate of all waste excluding major mineral wastes (percentage)	(Waste recycled / transferred – major mineral wastes) / (total waste in the country – major mineral wastes).
6. Recycling / recovery for specific waste streams				
6.1	Recycling rate of overall packaging (percentage)	The indicator is defined as the share of recycled packaging waste in all generated packaging waste. Packaging waste covers wasted material that was used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer, excluding production residues.	Impossible to calculate	In Belarus, there are no separate statistics for packaging waste, but there are relevant categories available in the waste classifier.
6.2	Recycling rate of plastic packaging (percentage)	The indicator is defined as the share of recycled plastic packaging waste in all generated plastic packaging waste. Plastic packaging waste covers wasted material that was used for the containment, protection, handling, delivery and presentation of goods, from raw materials to	Impossible to calculate	In Belarus, there are no separate statistics for plastic packaging waste, but there are relevant categories available in the waste classifier.

	EU indicator	Methodology for calculation	Equivalent for Belarus	Methodology for calculation
		processed goods, from the producer to the user or the consumer, excluding production residues.		
6.3	Recycling rate of wooden packaging (percentage)	The indicator is defined as the share of recycled wooden packaging waste in all generated wooden packaging waste. Wooden packaging waste covers wasted material that was used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer, excluding production residues.	Impossible to calculate	In Belarus, there are no separate statistics for wooden packaging waste, but there are relevant categories available in the waste classifier.
6.4	Recycling rate of e-waste (percentage)	The indicator is calculated by multiplying the 'collection rate' by the 'reuse and recycling rate'. The 'collection rate' equals the volumes collected of waste electrical and electronic equipment in the reference year divided by the average quantity of electrical and electronic equipment put on the market in the previous three years (both expressed in mass unit). The 'reuse and recycling rate' equals the weight of waste electrical and electronic equipment that enters the recycling/preparing for reuse facility divided by the weight of all separately collected waste electrical and electronic equipment (both in mass unit).	Impossible to calculate	In Belarus, there is currently recording of only collected waste electrical and electronic equipment.
6.5	Recycling of biowaste (kg per capita)	The indicator is indirectly measured as the ratio of composted/methanised municipal waste (in mass unit) over the total population.	Recycling of biowaste (kg per capita)	Share of composted household solid waste*household solid waste / total population. There is currently no recording of composted .

	EU indicator	Methodology for calculation	Equivalent for Belarus	Methodology for calculation
6.6	Recovery rate of construction and demolition waste (percentage)	Waste from construction and demolition, which is prepared for reuse, recycled or subject to material recovery, including through backfilling operations, divided by the total construction and demolition waste delivered to treatment and disposal facilities (treated). The construction and demolition waste includes non-hazardous waste under the waste category 'Mineral waste from construction and demolition' (12.1).	Recovery rate of construction and demolition waste (percentage)	Construction and demolition waste recovered / transferred per year / construction and demolition waste generated per year. In Belarus, the construction and demolition waste categories corresponding to those in the EU include 'Other mineral solid waste', 'Other mineral waste, including product refining waste'.
Secondary Raw Materials				
7. Contribution of recycled materials to raw materials demand				
7.1	End-of-life recycling input rates (EOL-RIR) (percentage)	The indicator measures, for a given raw material, the share of its total input into the production system that comes from secondary raw materials replacing primary raw materials.	Impossible to calculate	
7.2	Circular material use rate (percentage)	Circular material use rate = circular material use / (domestic material consumption + circular material use) Circular material use = amount of waste recycled in domestic recovery plants minus imported waste destined for recovery plus exported waste destined for recovery abroad.	Waste recycling rate (percentage)	Waste recycled/transferred per year / domestic material consumption.
8. Trade in recyclable raw materials (ton)				
8.1	Import of recyclable raw materials (ton)	The indicator measures the quantities (in mass unit) of selected waste categories and by-products as per list that are imported. These include secondary raw materials from plastics, paper and cardboard, precious metals, iron and steel, copper, aluminum and nickel.	Import of recyclable raw materials	The indicator measures the quantities (in mass unit) of selected waste categories and by-products as per list that are imported. These include secondary raw materials from plastics, paper and cardboard, precious metals, iron and steel, copper, aluminum and nickel.

	EU indicator	Methodology for calculation	Equivalent for Belarus	Methodology for calculation
8.2	Export of recyclable raw materials (ton)	The indicator measures the quantities (in mass unit) of selected waste categories and by-products as per list that are exported. These include secondary raw materials from plastics, paper and cardboard, precious metals, iron and steel, copper, aluminum and nickel.	Export of recyclable raw materials	The indicator measures the quantities (in mass unit) of selected waste categories and by-products as per list that are exported. These include secondary raw materials from plastics, paper and cardboard, precious metals, iron and steel, copper, aluminum and nickel.
Competitiveness and Innovation				
9. Investment, jobs and gross value added related to the circular economy sector				
9.1	Gross investment in tangible goods (percentage of GDP at current prices) related to the circular economy sector	The indicator is defined as investment during the reporting period in all tangible goods, including new and existing tangible capital goods, having a useful life of more than one year including non-produced tangible goods such as land. Investments in intangible and financial assets are excluded. The indicator is related to the recycling sector and repair and reuse sector.	Investment in fixed capital in waste collection, treatment and disposal, materials recovery (% of GDP at current prices)	Investment in fixed capital in waste collection, treatment and disposal, materials recovery / GDP *100
9.2	Number of persons employed (percentage of total employment) related to the circular economy sector	Number of persons employed includes persons who work both in the firm and outside the firm but belong to it. The indicator is related to the recycling sector and repair and reuse sector.	Number of persons employed in waste collection, treatment and disposal, materials recovery (% of total employment)	Number of persons employed in waste collection, treatment and disposal, materials recovery / total employment in the national economy * 100
9.3	Gross value added at factor cost (percentage of GDP at current prices) related to the circular economy sector	Value added at factor costs is the gross income from operating activities after adjusting for operating subsidies and indirect taxes. It can be calculated as the sum of turnover, capitalized production, other operating income, increases minus decreases of stocks, and deducting the following items: purchases of goods and services, other taxes on products which are linked to turnover but not deductible, duties and taxes linked to production. Value adjustments	Value added in water supply; waste collection, treatment and disposal and remediation activities (% of GDP at current prices)	Value added in water supply; waste collection, treatment and disposal and remediation activities / GDP * 100

	EU indicator	Methodology for calculation	Equivalent for Belarus	Methodology for calculation
		(such as depreciation) are not subtracted. The indicator is related to the recycling sector and repair and reuse sector.		
10	Number of patents related to recycling and secondary raw materials	The indicator measures the number of patents related to recycling and secondary raw materials as per List of CPC codes for indicator calculation.	Impossible to calculate	In Belarus, there are no statistics on patents by types of economic activities.

Source: For the EU countries – Eurostat. For Belarus – own presentation.