Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan

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BIODEGRADABLE WASTE IN THE REPUBLIC OF KAZAKHSTAN

Regulatory Framework and Infrastructure Assessment for Municipal Waste Management

Acknowledgement

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List of acronyms and abbreviations

AIC	agro-industrial complex
AIFC	Astana International Financial Centre
BAT	best available techniques
BDW	biodegradable waste
BGP	biogas plants
BGS	biogas stations
BPP	biogas power plant
CE	circular economy
CH_4	methane
CO_2	carbon dioxide
EC	European Commission
EPR	Extended producer (importer) responsibility
EU	European Union
GDP	gross domestic product
GE	Green Economy
GEF	Global Environment Facility
GEP	Green Economy Program
GFC	Green Finance Centre
GHG	greenhouse gas
ha	hectare
HACCP	Hazard analysis and critical control points – an international standard defining the requirements for effective control of food safety
ISO	International Organization for Standardization
kWh	kilowatt hours
KZT	Kazakhstani tenge (currency)
MSW	municipal solid wastes
MW/MWt	megawatts of thermal energy
NGO	non-governmental organization
RDF	refuse-derived fuel
RES	renewable energy sources
RoK / RK	Republic of Kazakhstan
SCP	Sustainable Consumption & Production
SDG	United Nations Sustainable Development Goal
UN	United Nations
UNDP	United Nations Development Program
UNDP-GEF	UNDP Global Environment Facility
VC	value chain

Introduction

This report provides an overview of the current situation in biodegradable waste management (BDW) in the Republic of Kazakhstan, and considers the opportunities for the development of a Circular Economy (CE) while incorporating the principles of Sustainable Production and Consumption (SCP).

The policy and institutional framework of Kazakhstan (Strategies/Concepts, programs, regulations, government projects, experience, and financial instruments) were reviewed as the basis for this report, the main indicators on volumes and types of BDW are provided, and generalized recommendations are presented for the necessary components of a waste management system.

BWM systems were chosen because of the impact of waste on the environment, including greenhouse gas emissions (GHG), and the criticality of the current situation and their absence of proper management.

This report sets out recommendations as per SCP Principles, the CE, and the EU Farm to Fork strategy, all of which are aimed at improving the waste management system in Kazakhstan and developing a society with a responsible approach to consumption.

The National Legislation defines biodegradable waste as waste that is capable of undergoing anaerobic or aerobic decomposition, including waste from gardens, parks, food and cooking, along with food industry waste and waste paper. Within the framework of this report, we will also consider agricultural waste and sludge from sewage treatment plants as BDW, since such waste can also be biodegraded.

Sustainable Consumption and Production (SCP)

Sustainable Consumption and Production (known as SCP) is about doing more and better with less. It is also about decoupling economic growth from environmental degradation, increasing resource efficiency and promoting sustainable lifestyles.[1]

The analysis of SCP tools and the possibilities of their implementation in Kazakhstan are described in the draft SCP Action Plan for the Republic of Kazakhstan. The document was prepared as part of the technical assistance to the Republic of Kazakhstan within SWITCH-Asia Program on Sustainable Consumption and Production, funded by the European Union. That draft provides the technical basis for the proposed Sustainable Consumption and Production Action Plan (SCP), and three main value chains in Kazakhstan were identified:

- Agriculture and agricultural products
- extraction, processing, and use of fossil fuels (gas, oil, and coal), and their use associated with the main issues of energy efficiency, climate change and greenhouse gas (GHG) emissions, renewable energy sources, and air quality
- Metal ore mining and processing for export and domestic use
- In addition, the draft National SCP Action Plan includes intersectoral topics that are a priority for the development of the Green Economy in Kazakhstan:
- Water resources
- Municipal solid waste management

The development of a **national Action Plan for the transition to SCP** or the inclusion of SCP in the national strategy as a priority or objective is **an indicator of SDG 12.1**.

Thus, Kazakhstan's adoption of the SCP Action Plan and its further implementation will comply with the obligations of the Republic of Kazakhstan to implement the SDGs, including SDG 12, Responsible consumption and production.

1 https://www.unep.org/explore-topics/resource-efficiency/what-we-do/sustainable-consumption-and-production-policies

The **Key Principles** of SCP include[2]:

1. Improving the quality of life without increasing environmental degradation and without compromising the resource needs of future generations
2. Decoupling economic growth from environmental degradation by:
    - Reducing material/energy intensity of current economic activities and reducing emissions and waste from extraction, production, consumption and disposal
    - Promoting a shift of consumption patterns towards groups of goods and services with lower energy and material intensity without compromising quality of life
3. Applying life-cycle thinking which considers the impacts from all life-cycle stages of the production and consumption process
4. Guarding against the re-bound effect, where efficiency gains are cancelled out by resulting increases in consumption

Three fundamental concepts may be extracted from the above definitions and principles: **resource efficiency, substitution, and circularity**. Drawing on these concepts, SCP may be seen as a delivery agent for a national Green Economy (GE); see Figure 1.

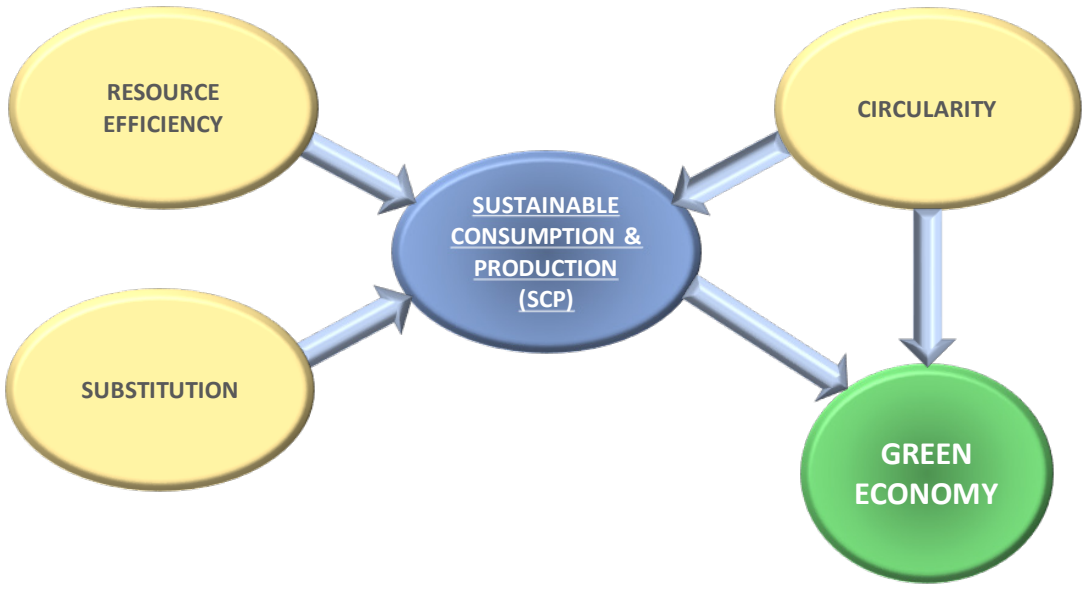


Figure 1. SCP, together with circularity, contributes to the Green Economy

In the draft Action Plan for Kazakhstan, the SCP concepts are defined as follows:

Resource Efficiency (Use Less): reduce the consumption of energy, water and materials in production; design, buy and use fewer resource-intensive products. Some examples:

- Increase the energy efficiency of buildings by improving insulation
- Adopt water-saving techniques to reduce the net freshwater consumption of agricultural and industrial production
- Optimise product design and production operations so that fewer resources are consumed in making and using consumer products
- Consumers purchase resource efficient products (incentivised by eco-labelling and communication messaging, for example)

2 https://sdgs.un.org/sites/default/files/publications/1951Sustainable%20Consumption.pdf

Substitution (Use Better): use harmless or less harmful resources to produce goods and services:

- Produce, buy, and use paints that contain fewer, or are free of, organic solvents
- Generate electricity using renewable energy sources instead of fossil fuels

Circularity ('From Cradle to Cradle'): in a minimalist sense, this method involves saving resources by recycling or reusing a product or waste stream. A fuller interpretation, as exemplified by the Circular Economy approach being adopted by the EU, represents a strategic transformation from a linear to a more sustainable economy that decouples economic growth from resource use (see Section 1.3). It thus affects product design, production, end-of-life product management and consumer behaviour, and includes waste recycling (solid, liquid, gaseous), as for example:

- Recovery and recycling of waste streams (solid, liquid and gaseous) at production sites and from consumers, and, where this is not possible, in off-site facilities etc.
- Designing products for low-resource consumption while in use, and for durability, repairability, and ease of end-of-life disassembly (i.e. 'circularity')
- Applying a value-chain approach in key sectors, including measures to reduce all forms of waste systematically, and reusing or recycling whatever waste is produced
- Adopting necessary systems and infrastructure to enable the recovery and reuse/recycling of constituent components and materials from products that have reached the end of their lives

1. Legislation in BDW management

This section provides an overview of the Regulatory Legal Framework in Kazakhstan, with a focus on the documents governing BDW management. This overview is necessary for further analysis and development of recommendations for improving the legislation and its drafting for a better implementation of SCP tools and the development of a circular economy (CE).

At the state level, the current legislation provides for the main requirements to introduce CE and a rational approach to production and consumption. There are requirements to use secondary raw materials in the production and a mechanism for Extended Producer Responsibility along with energy efficiency and green financing; reference books with the best available technologies are being developed.

Creating an efficient economy means not only the proportional absorption of resources, it is also necessary to introduce a more systematic approach to production, reduce the value chain (intermediaries), develop additional or new areas for processing secondary raw materials, and re-equip production. All this should be taken into account at the legislative level and supported economically. Some of these objectives can be implemented using SCP Tools.

1.1 State policy of the Republic of Kazakhstan on waste

The state policy of the Republic of Kazakhstan, which regulates waste management, including biodegradable waste, is based on the **Concept for the transition of the Republic of Kazakhstan to the Green Economy** (*Decree of the President of the Republic of Kazakhstan dated May 30, 2013 No. 577, On the Concept for the transition of the Republic of Kazakhstan to the Green Economy*).[3]

The Concept includes a vision for the further development of the country, taking into account a careful approach to natural resources, the development of renewable energy sources, and fostering green behaviour in the population. The document contains indicators to reduce the environmental burden and risks for the population.

According to the Concept, by 2030 the share of waste recycling should be 40%, and 50% by 2050.

This provision of the Concept is in line with the **Sustainable Development Goals,** accepted by Kazakhstan, including**:**

- **SDG-12.3** - By 2030, halve per capita global food waste at the retail and consumer levels and reduce food wastage along supply chains, including post-harvest losses
- **SDG-12.5** - By 2030, substantially reduce waste by taking action to prevent, reduce, recycle and reuse waste

In general, SDG-12 is dedicated to the transition to sustainable consumption and production patterns and covers a wide range of tasks that can determine the steps towards the further development of the Green Economy for Kazakhstan in the field of waste management and the raw materials sector.

In 2022, the Concept underwent revisions, taking steps accomplished in the previous period into consideration, and with the possibility of expanding the targets. Consideration is being given to including additional indicators on **rational/sustainable production and resource consumption** (**Water, Energy Generation, Waste Management).**

3 In Russian. https://adilet.zan.kz/rus/docs/U1300000577

Practical steps for the implementation of the Green Economy are defined in **the Action Plan for the implementation of the Concept for the transition of the Republic of Kazakhstan to a Green Economy for 2021–2030** (approved by Decree of the Government of the Republic of Kazakhstan dated July 29, 2020 No. 479, hereinafter referred to as the Plan).[4]

The following points of the action plan are the most relevant from the perspective of BDW Management System and introduction of SCP and CE Tools:

- Introduce modern methods of organic agriculture
- Organize a separate collection of waste in settlements
- Construct biogas plants at sewage treatment plants and poultry farms

As part of its low-carbon development commitments, Kazakhstan is developing a national **doctrine (strategy) for achieving Net Zero by 2060**. The draft paper notes that biodegradable waste is a source of methane (CH_4) and carbon dioxide (CO_2) emissions from the anaerobic decomposition of organic waste and sludge in MSW landfills or anaerobic wastewater treatment.

Implementation of the Strategy will require practical recommendations and requirements to reduce BDW in the process of production and consumption.

The following SCP tools can be applied as guidelines:

- Control of losses in the chain of crop production and processing of agricultural products
- Revision of the shelf life of finished products
- Reduce or eliminate the products with a high proportion of waste/residue
- Promote secondary use of products (use of residues in other formulations)
- Study efficient waste management practices in similar industries (Benchmarking)
- Best available techniques (BAT) Introduction

In 2019, the European Union adopted *The European Green Deal*[5], an economic development strategy that aims to achieve Net Zero by 2050, that promotes among other actions 'decoupling', a strategy that separates natural resource use and environmental impact from economic growth for the development of an environmentally sustainable economy, which has a positive effect on populations as well.

A further development of the Green Deal on food security and biodegradable waste management in the EU is the **Farm to Fork** strategy, the key areas of which include:

- Sustainable food production
- Food security
- Sustainable practices in food processing, wholesale and retail trade, hospitality, and catering
- Sustainable food consumption and facilitating the transition to healthy, sustainable diets
- Reduction of losses and waste in food production
- Reduction of pesticides

Similar institutional steps have been partially taken in Kazakhstan to assess and develop further steps to improve the health of the population, ensure the continuity of affordable and high-quality products, and develop a rational approach to consumed resources. To do so, there are fundamental regulations in **Agriculture** (*Law of the Republic of Kazakhstan 'On production of organic products' dated November 27, 2015, No. 423-V 3PK*), **Environmental Protection** (*Environmental Code of the Republic of Kazakhstan, dated*

4 In Russian. http://adilet.zan.kz/rus/docs/P2000000479#z14

5 https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

January 2, 2021 No. 400-VI), in **Food Safety** (*Law of the Republic of Kazakhstan dated 21 July 2007 No. 301-III 'On Food Safety'*) and many others. There are also standards for handling food and agricultural products.

Kazakhstan is included in the list of 30 countries that are the largest producers of grain in the top ten exporters of wheat and the top 15 countries in terms of arable land. **Issues of healthy nutrition of the population, rational land use, the transition to organic farming, respect for crops and their processing, and how products are used, are important and solutions must be found now.**

The main document regulating environmental protection, including waste, is the **Environmental Code of the Republic of Kazakhstan**. In 2021 the Code and related regulations were updated.

For the first time, the New Environmental Code introduces, among other things, principles of environmental legislation, as well as **principles of state environmental policy in Waste Management** as follows:

- Hierarchies
- Proximity to the source
- Liability of the waste generator
- Extended producer (importer) responsibility (EPR)

The Environmental Code also regulates **economic incentives for activities aimed at protecting the environment**, by including tools to support Green Technologies focused on the production of non-toxic products in a closed cycle **Production – Recycling – New Production**, and waste reduction through innovations in technologies and consumption patterns.

An analysis of the Environmental Code and the legislation of the Republic of Kazakhstan shows, on the whole, that the mainstream regulations and support measures of the Republic of Kazakhstan in Waste Management are aimed at managing already generated waste, and that **the mechanism for preventing waste generation is poorly developed**, which contravening the priorities of the waste management hierarchy. In this context, SCP measures can be applied to prevent the generation of waste, by stimulating for example a reduction in consumption, reviewing the shelf life of products, and controlling the supply chain.

The **EPR operator** was created to implement the principle of Extended Producer (Importer) Responsibility in Kazakhstan through the *Law of the Republic of Kazakhstan dated November 17, 2015, No. 407-V, 'On Amendments and Additions to Certain Legislative Acts of the Republic of Kazakhstan on Industrial and Innovation Policy Issues'*. The main roles of the EPR Operator include the obligation to maintain funding for enterprises processing the approved waste list. Since 2022, the roles of the Operator have been transferred to Zhasyl Damu JSC. The EPR applies to vehicles and car components (tires, batteries, oils, and special fluids), agricultural machinery (tractors and combines), paper, cardboard, metal, glass, plastic and combined packaging, packaged goods, and electrical and electronic equipment.

Furthermore, the Environmental Code of the RoK gives the meaning of biodegradable waste and stipulates a ban on the disposal of food waste and introduces the concept of energy waste disposal. The following sections describe these points in more detail.

1.2 Biodegradable Waste

The Environmental Code of the RoK defines biodegradable waste as **waste that can undergo anaerobic or aerobic decomposition, including waste from gardens, parks, food, and cooking, and other waste comparable to food industry waste, and waste paper.** This definition corresponds to the equivalent from the European Union Directive on landfilling (1999/31/EU)[6]: 'biodegradable waste' means any waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste, paper, and paperboard.

6 https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A31999L0031

However, in addition to food, plant, and comparable wastes, other wastes may be biodegradable, such as **Agricultural Waste** (animal manure, bird droppings, animal bedding), **Sewage Treatment Plant Sludge**. Composting manure and sludge or generating energy/biogas are also biodegradable processes. There are mandatory composting/drying requirements for manure and bird droppings (see section 1.5 Composting). Thus, it would be logical to include them in the **Biodegradable Waste** List.

RECOMMENDATION:

Explore expanding or specifying the list of biodegradable wastes to include agricultural waste and sewage treatment plant sludge.

This need is justified by the fact that in the future, with the strengthening of the national requirements for the processing of biodegradable waste, and subsequent support for requested applied technologies along with the allocation of subsidies, these wastes will be considered in the general group. Furthermore, the technologies used either for composting or for biogas/energy production from food, plant, agricultural waste, and sludge are identical.

The further use of BDW processing products can become a significant contribution to the development of CE in Kazakhstan.

The SCP Action Plan has already been developed for the Republic of Kazakhstan as part of the Technical Support of the Switch-Asia program, and this plan provides for Biodegradable Waste Management guidelines driven by SCP Tools. The paper looks at the main agricultural value chains and how waste can be reduced at each stage.

1.3 Separate Waste Collection

The separate collection of waste is the basis for the efficient use of secondary resources. This method is at the heart of the Circular Economy and is one of the SCP Tools.

To promote the recycling of Municipal Waste, the Environmental Code of the RoK includes a requirement for the separate collection of MSW of two types: '**dry**' **waste** (paper, cardboard, metal, plastic, and glass) and '**wet**' **waste** (food waste, organic materials and so on) (*Environmental Code of the Republic of Kazakhstan, Article 321*).

The Decree of the Ministry of Ecology, Geology and Natural Resources of the RoK dated December 2, 2021 No. 482 approved requirements for separate collection of waste types, including types or groups of SCPs of waste subject to mandatory separate collection, taking into account technical, economic and environmental feasibility.

The separation of municipal waste into two streams has already been introduced in large cities and towns over the past few years with the support of the **EPR Operator**. Initially, the priority was the collection of secondary raw materials, such as plastic, glass, and waste paper. This waste could be sorted and further processed. Another stream was miscellaneous types of waste, including food, hygiene products, etc., which were sent to the landfill without sorting. In some cases, fluorescent lamps and furniture were collected separately.

According to Forbes (Kazakhstan)[7], in 2018–2019, the financial support of the EPR operator covered 12,196 containers for a separate collection that were installed in 10 regions and the city of Nur-Sultan; 147 collection points were installed in 8 regions, and 28 units of specialized vehicles were purchased. Besides, 2,321 containers for mercury-containing lamps and chemical power sources were installed in 11 regions.

7 https://forbes.kz/news/2020/03/03/newsid_220260

Today, the issue of introducing a separate collection of Municipal Solid Waste (MSW) in four more cities is being considered.

Recycling and disposal of MSW in the RoK for 2020 amounted to 18.6%, which also indicates that waste sorting is being carried out, although in small volumes. An MSW Sorting Level Indicator is not included in the current regulatory documents of the RoK.

Based on the hierarchy of waste management and best practice of the world community for the rational use of resources, it is necessary to develop and promote measures for the primary sorting of waste. **It is also necessary to consider the possibility of including guidelines on the importance of waste sorting 'at the source' and rational consumption as elements of a green economy in the curricula of preschool, school, university, and professional specialized education.**

1.4 Food Waste

With effect from January 1, 2021, Kazakhstan introduced a **ban on the disposal of Food Waste at Landfills** *(Environmental Code of the Republic of Kazakhstan, Article 351).*

With regards to this ban, a suspensive rule was adopted twice due to the lack of appropriate infrastructure in the regions of the Republic:

- Until December 31, 2018 (*Law of the Republic of Kazakhstan dated April 5, 2017 No. 56-VI ZRK 'On amendments and additions to the Environmental Code of the Republic of Kazakhstan'*);
- Until December 31, 2020 (*Law of the Republic of Kazakhstan dated May 24, 2018, No. 156-VI 'On amendments and additions to certain legislative acts of the Republic of Kazakhstan on improving the regulation of business activities'*).

These suspensive measures indicate that there are no real tools to implement the requirement. SCP tools can be applied to address this issue, with a focus on preventing food waste, promoting sustainable consumption behaviour, reviewing product shelf life, and strengthening control in the supply chain. Some of these requirements are incorporated in the current legislation.

For example, **food waste**, except food waste from infectious hospitals (thus excluding waste from tuberculosis and dermato-venerological wards), **may be used for livestock feed** *(Order of the Acting Minister of Healthcare of the Republic of Kazakhstan dated December 25, 2020, no. ҚД ДСМ-331/2020; Registered with the Ministry of Justice of the Republic of Kazakhstan dated December 28, 2020 no. 21934, 'On approval of the Sanitary Rules 'Sanitary and epidemiological requirements for the collection, use, application, disposal, transportation, storage and disposal of production and consumption wastes')*. Measures such as these will lead to a reduction in the disposal of waste in landfills.

There are also requirements (technical regulations) for the quality and storage conditions of food and beverages/water, and meeting these requirements can reduce food waste.

Quality certificates for compliance with the requirements of **ISO** and **HACCP** are also being introduced. For example, the Development Program of the Almaty Region for 2016–2020 reported that 422 enterprises produce food in the region, accounting for 58% of the industrial volume and 71% of the manufacturing industry of the region. Quality certificates for compliance with the requirements of the international standard (ISO, HACCP) are being implemented in 40 enterprises.

1.5 Composting

According to Green Economy principles, composting, as well as the method of obtaining biogas, are the most acceptable practices. Such methods support the circular economy and should be actively promoted by the State. Subject to quality control of the source and technology for composting biodegradable waste, the compost obtained after processing can become a substitute for chemical fertilizers. **Replacing hazardous chemicals in the fertilizer production chain with safer, less harmful components/elements is one of the principles of sustainable production.**

The current legislation of the Republic of Kazakhstan does not yet have clear requirements and guidelines for the management and composting of BDW. The Environmental Code of the RoK governs only **Local Executive Bodies** to reduce the disposal of BDW, including measures for their recycling, composting, production of biogas, and (or) use for the production of products or energy (*Eco Code of the Republic of Kazakhstan, Article 351*) in addition, there are no relevant by-laws.

The RoK Environmental Code also obliges MSW Landfill Operators to reduce landfill methane emissions by reducing the volume of biodegradable waste landfilled, as well as through the collection and disposal of landfill gas *(RoK Environmental Code, Article 350).*

In addition to the RoK Environmental Code, there are Waste Management References to this technique in several other regulatory documents. For example:

- 'To decontaminate waste at the landfill, **field pile composting methods are used** for landfills that obtain less than 120,000 m^3 MSW per year and they use the MSW trench storage technique.' (*Decree of the acting Minister of Health of the Republic of Kazakhstan dated December 25, 2020, No. ҚР DSM-331/2020 'On approval of the Sanitary Rules 'Sanitary and epidemiological requirements for the collection, use, application, disposal, transportation, storage and disposal of production and consumption waste'*).
- 'Manure is used to enrich the soil with nitrogen and plant nutrients and is subjected to preliminary neutralization (thermal drying and **composting**)' *(Decree of the Minister of Agriculture of the Republic of Kazakhstan dated April 29, 2020 No. 143. 'On approval of the technical regulation 'Safety requirements fertilizer"*).
- 'The design of the landfill for municipal solid waste consists of the following elements:
  - an access road,
  - an MSW storage area,
  - an administrative and economic zone,
  - a site for accommodating waste sorting production,
  - **a composting site for wood and vegetable waste'** (*Building Standard SN RK 1.04- 15-2013 'Landfills for municipal solid waste'*).

In general, no document as yet elaborates in any detail on the requirements for this technology and the arrangement of composting sites in Kazakhstan. For these purposes, one can use documents from open sources on the Internet and engage relevant experts.

1.6 Renewable Energy Sources & Biogas Generation

Kazakhstan has the regulatory framework to develop renewable energy sources, including the use of biogas technologies.

In 2009, the law '**On Supporting the Use of Renewable Energy Sources**' was adopted, which defined the goals, forms, and areas of renewable energy sources support.

In addition to this law, the **Rules for determining fixed rates were adopted** *(approved by a Decree of the Government of the Republic of Kazakhstan dated December 29, 2017 No. 925),* which establish the procedure for determining fixed rates for electricity produced by renewable energy facilities, including biogas.

At the same time, the Concept for the transition of the Republic of Kazakhstan to a Green Economy contains **goals and target indicators of a Green Economy with the Renewable Energy Sources Section**, where the use of biogas was not formally included (see Table 1.6.1).

Table 1.6.1. Green Economy Goals and Targets

Target description	by 2020	by 2030	by 2050
Share of alternative sources* in electricity generation	Solar and wind: not less than 3%	30%	50%

** Solar power plants, wind power plants, hydroelectric power plants, and nuclear power plants.*

Given the fact that the current legislation provides the use of biogas in RES through the law on RES, it remains an open question whether biogas plants will be included in the Concept as an indicator of a Green Economy. This could strengthen the role of biogas plants in the renewable energy market in Kazakhstan.

RECOMMENDATION:

Include the target indicator on the share of biogas plants in alternative sources of energy generation into the Concept for the transition of Kazakhstan to a Green Economy.

So far, Kazakhstan provides financial support mechanisms (subsidies) only for the processing of bird manure by composting and in a biogas plant *(Decree of the Acting Minister of Agriculture of the Republic of Kazakhstan dated July 23, 2018 No. 317 'On approval of the Rules for subsidizing the reimbursement of part of the costs incurred by the subject of the agro-industrial complex, with investments')*.

The introduction of requirements for the imminent construction of new MSW landfills with a landfill gas collection system suggests that it will be possible to use landfill biogas for power generation.

However, the issue of grading energy from waste technologies similar to the EU remains unresolved: **Communication from the Commission to the European Parliament, the Council, the European Economic Social Committee, and the Committee of the Regions 'The role of energy from waste in a circular economy'** *(COM/2017/034 final)*. According to this document, energy/heat generating techniques from waste can be correlated with methods of waste treatment; for example, incineration of waste to reduce its volume with little recovery is regarded as landfilling.

Kazakhstan has adopted the **Rules for the placement of renewable energy sources facilities** to determine the priority RES types for the regions *(approved by the Decree of the Acting Minister of Energy of the Republic of Kazakhstan dated July 27, 2016 No. 345)*.

According to these rules, the **Facilities Placement Plan for renewable energy sources** was approved (*approved by the Decree of the Minister of Energy of the Republic of Kazakhstan dated February 10, 2020 No. 47 'On amendments to the order of the Minister of Energy of the Republic of Kazakhstan'; dated February 24, 2017 No. 68 'On approval of the Plan for the placement of facilities for the use of renewable sources of energy'*). The planned biogas power plants with a total capacity of **17,817 MW** are shown in **Table 1.6.2.**

Table 1.6.2. RES Facilities – Biogas Power Plants

Sr. No.	Region, District, Location	Installed capacity, MW	Type of facility for the use of renewable energy
Northern Zone			
1.	Karaganda Region, Bukhar-Zhyrau District	1	Biogas Power Plant (BPP)
2.	Karaganda Region, Abay District	1.067	BPP
3.	Karaganda Region, near Zhezkazgan	5	BPP
4.	Karaganda Region, Karaganda City	4	BPP
5.	Kostanay Region, Karasu District	0.35	BPP
Southern Zone			
6.	Almaty Region, Ili District	6.4	BPP

The statistics of the Ministry of Energy of the Republic of Kazakhstan on the amount of electricity generated in 2020 using Renewable Energy Sources (hereinafter RES)[8] are given in **Table 1.6.3**.

Table 1.6.3. Electricity generated by Renewable Energy Facilities (RES) for 2020

Indicators	For 2020
Installed capacity (MW):	**1634.7**
Wind Farms	486.3
Small Hydropower Plants	229.04
Solar Power Plants	911.6
Biopower Plants	**7.82**
Power Generation (million kWh):	**3245.1**
Wind Farms	1076.7
Small Hydropower Plants	812.1
Solar Power Plants	1349.7
Biopower Plants	**6.6**
The share of electricity generated by RES in the total volume of electricity production	3%
The increase in generated electricity by renewable energy facilities in 2020 versus 2019 is 74%	

8 https://www.gov.kz/memleket/entities/energo/documents/details/128245?lang=ru

According to KEGOC (*Kazakhstan Electricity Grid Operating Company*), today one station using BDW sells the generated electricity to Agrofirma Kurma LLP, which is a poultry farm located in the Abay District, Karaganda Region. The plant with an installed capacity of 1.07 MW was put into operation in 2018, and the average annual output is 4800 thousand kWh.

In Kazakhstan, there are only a few enterprises that use biogas plants to process manure or sewage sludge:

- **Water Resources-Marketing LLP** (*Shymkent*) uses biogas plants at the Shymkent Water Channel and receives about 400 kWh of energy.
- **Volynsky Agro-industrial Complex** (*Karaganda Region*) uses biogas plants to process wastewater from a pig farm. Over 2 million m^3 of biogas, 3,650 MW of electrical and 4,197 MW of thermal energy, as well as 10 tonnes of microbiological fertilizers per day, are obtained from waste annually. All generated electricity furnishes the needs of the pig farm.
- **Karaman-K LLP** (*Kostanay region*) uses manure; the declared capacity is 0.35 MW.

As can be seen, the amount of electricity generated by biogas plants is negligible. At the same time, it allows us to partially solve several issues:

- Generation of electrical or thermal energy
- Biodegradable Waste Processing
- CO_2 emissions reduction
- Obtaining digestate (residue after the decay of biodegradable waste), which can be composted

RECOMMENDATION:

Review opportunities to support the processing of biodegradable waste at remote enterprises and farms to meet their needs for electricity and heat.

1.7 Best Available Techniques (BAT)

To develop sustainable production and consumption, it is recommended that good practices driven by resource efficiency be applied, in order to reduce the negative impact on the environment. Such experience in applied technologies and practices is described in best available techniques (BAT) reference books.

In Kazakhstan, the use of BAT to obtain an integrated environmental permit for emissions is a prerequisite.

Today the International Centre for Green Technologies and Investment Projects (IGTIP) manages the development of white and blue papers and reference books (BREF, for Best Available Technique Reference Document) in Kazakhstan.

The Centre has planned and is partially preparing BREF Reference Books on energy and raw materials priority areas for Kazakhstan. They also plan to develop reference books on waste processing/utilization technologies.

According to the Environmental Code of the Republic of Kazakhstan, users of natural resources can also choose any of the recommended technologies included in the reference books of the European Bureau for Integrated Control and Prevention of Environmental Pollution. There is a challenge, however, in using these reference books because of the **absence of an officially published translation**.

RECOMMENDATION:

Translate and publish the information with blue papers (BREF) of the EU on waste processing/utilization of Kazakhstani Internet resources.

2. State programmes and projects

State programs and projects are one of the mechanisms used to implement state policy. Analysing programs and projects makes it possible to determine priority areas for further development of industries and improvement of infrastructure. The introduction of SCP and CE at the legislative level should further establish their inclusion in sectoral/regional programs or projects.

2.1 Zhasyl Kazakhstan National Project

The Ministry of Ecology, Geology, and Natural Resources of the Republic of Kazakhstan has developed the Zhasyl Kazakhstan National Project for 2021–2025.

Over the next five years, it is planned to implement measures in the main areas that affect the quality of life of the population, such as improving water reservoirs, reducing air pollution, preserving biodiversity, greening the country, promoting eco-education, improving environmental culture, and setting up **Sustainable Waste Management**.

The planned amount of financing for the Sustainable Waste Management goal for the entire period of the project is KZT 210,674.2 million. The project partially resolves some issues on the development of industrial waste management and MSW in Kazakhstan. In terms of management, MSW provides for the purchase of containers in several areas. Unfortunately, processing food and other biodegradable waste were not considered in the document.

It can be assumed that the Project is poorly correlated with the accepted Waste Management Hierarchy. **It is necessary to build a waste management system as the priority of the country's population and economic efficiency.**

2.2 Agro-industrial Complex Development Program of the Republic of Kazakhstan

The reason for building this waste management system as a priority was expressed in the Decree of the Government of the Republic of Kazakhstan dated July 12, 2018 No. 423 'On approval of the State Program for the Development of the Agro-Industrial Complex of the Republic of Kazakhstan for 2017–2021'. **Goal**: Increase the competitiveness of the agro-industrial complex (AIC industry) by increasing labour productivity and exporting processed products.

One of the associated objectives is **to develop organic agriculture** as a tool to increase the exporting of agricultural products.

This document is interesting for BDW management, because one of the criteria for organic farming is cyclicity, which means that production waste (manure, haulm, trimmings) must be processed (e.g. transformed into compost or biogas) and returned into the agricultural process. To develop and maintain organic agriculture, an appropriate law was adopted (*Law of the Republic of Kazakhstan 'On the production of organic products' dated November 27, 2015, No. 423-V ZRK*).

The document gives a general overview of the requirements of organic agriculture, including voluntary eco-labels.

Given the resource-oriented agriculture in Kazakhstan, it is necessary to constantly maintain the quality of soils. **The use of compost for soil improvement will develop sustainable agriculture as intended in the circular economy philosophy**.

However, financial and regulatory support from the state is important for the development of organic agriculture. For example, it is necessary to gradually replace mineral fertilizers, pesticides, and herbicides with organic matter and products. But according to the Rules for Subsidizing Increasing Yields and Quality of Crop Products *(approved by Decree of the Minister of Agriculture of the Republic of Kazakhstan dated March 30, 2020 No. 107),* **subsidies are not allocated for organic fertilizers**.

It should be noted that there are preferential conditions for the payment of import customs duties with instalments of up to six months for agricultural machinery imported into the territory of the Eurasian Economic Union *(Code on customs regulation in the Republic of Kazakhstan dated December 26, 2017, No. 123-VI ZRK).*

As described in section 1.6, Kazakhstan provides subsidies for the processing of poultry manure in a biogas plant and by composting it.

It is necessary to consider the opportunity to use support measures for biodegradable waste composting techniques and the use of compost in agriculture.

Prospects for the development of the country's agriculture are indicated in the **Concept for the development of the agro-industrial complex of the Republic of Kazakhstan for 2021–2030** *(Decree of the Government of the Republic of Kazakhstan dated December 30, 2021 No. 960 'On approval of the Concept for the development of the agro-industrial complex of the Republic of Kazakhstan for 2021-2030')*

The issues of organic waste processing and their application (the circularity of the process) are covered by the following Action Plan Items of the said document (Table 2.2.1.).

Table 2.2.1. Actions from the Concept for the Development of the Agro-Industrial Complex of the RoK for 2021–2030

Sr. No.	Proposed activity	Proposed Implementation Period
1	Action 12. Legislative consolidation of state support for subsidizing the purchase of industrial organic fertilizers.	December 2027
2	Action 23. Create a unified system for monitoring, reporting and verification of greenhouse gas emissions from livestock	December 2023
3	Action 25. Harmonize legislation in the production and turnover of organic products with the provisions and norms of international and regional documents and standards	December 2023

The development of the agricultural sector of Kazakhstan and especially its niche, i.e. **organic farming**, will help expand the involvement of organic waste in the processing and use process and improve food security. This will contribute positively to the health of the population of Kazakhstan, as well as in countries that import its domestic products.

3. Waste volumes

Waste accounting is critical for assessing and making strategic decisions, both for investment processes and for evaluating the efficiency of actions taken. Furthermore, details on the types and volumes of produced BDWs will make it possible to assess the current and potential damage to the environment.

3.1 Food and Vegetable Waste

According to the statistics, **18,166** tonnes of **Food Waste** and **16,513** tonnes of **Tree and Foliage Waste were collected in Kazakhstan in 2020**. These figures do not reflect the actual volumes of waste generation. However, the volumes may be estimated by analysis of the MSW morphological composition. According to the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan (**MEGNR RoK**), about **4.5–5 million** tonnes of municipal solid wastes (MSW) are produced annually in Kazakhstan. According to information about the morphological composition of MSW in the country, the volume of food and vegetable waste accounts for approximately 30–35%, or **1.3–1.4 million tonnes** of food and plant waste annually (see Table 3.1.1.).

Table 3.1.1. Volume of MSW and Food Waste

Year	MSW (million tonnes)	Food Waste (million tonnes)
2020	4.6	1.4
2021	4.2	1.3

Data provided by Zhasyl Damu JSC, which acts as an operator of Extended Producer (importer) Responsibility.

The processing level of this type of waste is negligible. The average MSW recycling rate in Kazakhstan is 18%, and this mainly applies to plastics, waste paper, glass, and cans.

Calculations are complicated by the fact that food waste in rural areas is often used to feed livestock, and this is allowed in cases where food waste does not come from infectious diseases hospitals (including anti-tuberculosis or dermato-venereological hospitals *[Decree of the Acting Minister of Health of the Republic of Kazakhstan dated December 25, 2020, No. KR DSM-331/2020 'On approval of the Sanitary Rules' Sanitary and epidemiological requirements for the collection, use, application, disposal, transportation, storage, and disposal of production and consumption waste']*).

Basically, in all cities and villages, food waste is taken to landfills, despite the ban *(Environmental Code of the Republic of Kazakhstan, Article 351).*

According to the Concept for the transition of the Republic of Kazakhstan to a Green Economy, the forecast for food waste **by 2025** will reach **1.6 million tonnes** per year.

3.2 Sludge, Manure

The **volumes** of other types of BDW, according to the inventory of waste, are presented in Table 3.2.1.

Table 3.2.1. Sludge and Agricultural Waste Generation in 2019 and 2020

Waste types	2019	2020
Sludge from industrial enterprises, thousand tonnes	36.7	45.7
Pork slurry, thousand tonnes	220.6	143.5
Poultry droppings (manure), thousand tonnes	1513.8	1290.2

In **2021**, according to the new waste inventory form, **the following volumes of waste were processed**:

Table 3.2.2. Treatment of sludge and agricultural waste in 2021

Waste types	Volume (tonnes)
Animal faeces, urine and manure (including used straw), liquid effluents collected separately and treated off site	224,319.9
Waste water treatment	41,070.6

In 2020, there were 604 sewerage system facilities and 270 separate sewerage system utilities on the territory of the republic. All of these facilities are sources of sludge that can be recycled for energy and technical compost. **Technical compost** is used for fertilizing fields with industrial crops, and parks and for filling landfills and roads.

Manure reports should be compared with estimates based on manure/manure yield from livestock and poultry.

Table 3.2.3. Calculations of the manure volume in 2020

Type	Livestock (thousand heads)	Manure Output Rate per unit (t/year)	Manure Volume (thousand t per year)
Cattle	7436.4	8.0	59,491.2
Horses	2852.3	7.0	19,966.1
Camels	216.4	11.0	2380.4
Sheep, Goats	19,155.7	1.0	19,155.7
Pigs	813.3	2.0	1626.6
Poultry of all kinds	45,000.0	0.062	2,790.0
		Total, thousand t	**105,410.0**

Table 3.2.3 shows calculations of livestock and poultry manure, taking into account livestock statistics at the beginning of 2020 and based on average manure output rates. Various sources of manure output rate (solid and liquid fraction) were used for the calculation:

- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook
- Guidelines for the technological design of systems for the removal and preparation for use of manure and manure, RD-AIC 1.10.15.02-08, Ministry of Agriculture of the Russian Federation, 2008
- Technological design standards for camel breeding facilities, NTP-AIC 1.10.04.002-02, Ministry of Agriculture of the Russian Federation, Moscow, 2001

Comparison of data from different sources on the volume of poultry manure is comparable, while data on pig slurry vary greatly. There is no information on the manure of horses, small and large cattle, and camels in the inventory.

According to some open web sources, the annual output of **livestock and poultry waste** by dry weight is **22.1 million t**, or 8.6 billion m^3 of gas (cattle, 13 million tonnes; sheep, 6.2 million t; horses, 1 million t), **plant residues, 17.7 million t** (wheat, 12 million t; barley, 6 million t, or 8.9 billion m^3).

The total aggregated calculated volume of BDW in Kazakhstan per year (excluding unconfirmed volumes of sludge from treatment facilities) is **about 100 million tonnes, including 1.4 million t of food**.

4. Green finance

According to Kazakhstan's draft SCP Action Plan, financial incentives are a 'pull' mechanism and may include (time-bound) subsidies for greener consumer products, investment grants, low-interest loans for green investments, favourable tax incentives for innovative research or investment, etc.

The issues of Green Finance in Kazakhstan are handled by the Green Finance Centre (GFC)[9], which is a division of the Astana International Financial Centre (AIFC), created to develop and promote green finance in Kazakhstan and the Central Asian Region. The Centre provides first aid to potential issuers, investors, and market players to prepare for the issuance of green bonds on the AIFC Exchange.

During its existence, the CGF has developed the following key documents in the field of green finance: 'The concept of implementation and development of tools and principles of green finance', 'Strategy for ensuring AIFC Regional Leadership in the field of Green Finance until 2025', 'AIX Green Bonds Rules' (Rules of green bonds Astana International Exchange), Green Finance in Kazakhstan. Taken together, these documents provide a fundamental framework for the development of green finance, which offers several recommendations for development, including the identification of a lead body, as well as a framework for promoting green bonds in Kazakhstan.

Today, Kazakhstan has several lines of concessional lending that can be classified as green. For example, within the framework of the UNDP-GEF project 'Reducing the risks of investing in renewable energy sources', up to 10% of the remuneration rate is subsidized.

At the same time, the legitimate classification of these loans as green became possible because the new edition of the Environmental Code of the Republic of Kazakhstan (Article 130) introduced key concepts in the field of green finance: green finance, green projects, green technologies, classification of green projects (taxonomy), green bonds, and green loans.

Green financing refers to investments aimed at the implementation of green projects and attracted with the help of such instruments as green bonds, green loans, and other financial instruments determined by the authorized body for the regulation, control, and supervision of the financial market and financial organizations.

In addition, *Green Loans are targeted loans aimed at financing the implementation of Green Projects*. Therefore, the above projects should be classified as green by the classification of Green Projects or the Green Taxonomy after an assessment by the EC according to the RK document '*Classification (taxonomy) of green projects to be financed through green bonds and green loans*', developed by the AIFC–CGF.

9 https://gfc.aifc.kz/

Green Taxonomy (Green Projects Classification)

Kazakhstan has developed and approved the **Green Taxonomy** (*Decree of the Government of the Republic of Kazakhstan dated December 31, 2021 No. 996 'On approval of the Green Projects Classification (Taxonomy) to be financed through green bonds and green loans'*).

The taxonomy includes the following 7 categories in separate sections:

1) **Renewable Energy:** wind, solar, geothermal, hydro, bioenergy, supply chain and supporting infrastructure for renewable energy, hydrogen production
2) **Energy Efficiency:** increasing energy efficiency at existing locations and those under construction at industrial facilities, increasing energy efficiency in the budgetary and public sector, energy-efficient buildings and structures
3) **Green Buildings:** green buildings, related systems, building materials, green infrastructure
4) **Pollution Prevention & Control:** air quality, soil
5) **Sustainable Water & Waste Use:** sustainable use of water and water conservation, waste and wastewater, conservation and restoration of resources
6) **Sustainable Agriculture, Land Use, Forestry, Biodiversity Conservation, and Ecological Tourism**
7) **Clean Transport:** clean transport, low-carbon vehicles, clean transport infrastructure, clean transport information, and communication technologies

As can be seen from the titles of the sections, much attention will be paid to the efficiency of consumed resources and sustainability in their management.

The development of bioenergy, including through the use of biodegradable waste as a source, will partially solve the issues of reducing greenhouse gases and soil pollution, as well as contribute to the further development of the energy sector.

Green Taxonomy can become the tool that will further develop and regulate public Green Procurement or other economic levers to support the Green Economy.

5. Recommendations for legislation

A general analysis of legislation, state programs, and initiatives in organizing and managing biodegradable waste in Kazakhstan revealed several gaps and contradictions. In general, the legislation does not fully cover all issues of regulation of Biodegradable Waste Management.

Circular Economy (CE) principles are already being introduced in stages in Kazakhstan, the legislation is being updated, and national projects are being developed and implemented in the development of a Green Economy.

The components of the EU Farm to Fork Strategy could be a good addition to the National legislation. Some of the requirements of this Strategy are also being implemented in Kazakhstan, and this applies to the requirements for sorting packaging as well as the requirements for organic farming. As mentioned above, Kazakhstan approved the national Concept for the development of the agro-industrial complex for 2021–2030, which provides for organic farming.

It would also be useful to consider the strategy sections on understanding and using 'food best before dates'. This element of the strategy is part of the food waste prevention efforts, and one of the ways to achieve SDG 12.3 to reduce food waste and food loss by 2030.

The **recommendations** below will be presented to stakeholders (authorized state bodies, public associations, specialized enterprises, and competent international consultants) for debate and the development of final proposals to improve the Biodegradable Waste Management System with CE elements.

SUGGESTED RECOMMENDATIONS:

- **Expand the current sections on waste, water, and energy in the Concept for the transition of the RoK to a Green Economy, and incorporate the objectives for rational/sustainable production and consumption of resources**
- **Strengthen national legislation in the field of reducing food losses and food waste**
- **Consider expanding the list of biodegradable waste to incorporate agricultural waste and sludge from sewage treatment plants**
- **Consider options to introduce materials on the importance of waste sorting and rational consumption as elements of the Green Economy in the curricula of preschools, elementary and high schools, universities, and professional specialized education**
- **Introduce separate sorting of food waste at sources (catering facilities, food production, etc.)**
- **Include biogas plants in the target indicator for the share of alternative sources in energy generation in the Concept for the transition of Kazakhstan to a Green Economy**
- **Consider options to support the processing of biodegradable waste at remote enterprises, and farms to meet their needs for electricity and heat**
- **Translate and publish white paper and blue paper reference books (BREF) of the EU on waste processing/disposal on Kazakh internet resources**
- **Consider options to provide support methods in the organization and implement processing of biodegradable waste management (BDW) and the use of compost for organic agriculture**
- **Build the Waste Management System as the priority for the country's population and economic efficiency**

6. Biodegradable waste management system components

This section presents a vision of the necessary infrastructure, technologies, and other components of the BDW Management System, taking into account the hierarchy of waste management, resource efficiency, and the principles of the Circular Economy (CE).

6.1 Technology

As practical tools to implement the SCP and CE in the field of BDW processing, the following methods may be considered:

- **Composting**
- **Biogas Production**
- **Incineration with Energy Recovery**

All three technologies are poorly represented in Kazakhstan, even though the legal framework provides for their use in BDW processing.

There are other alternative technologies for BDW processing with the production of fuel brackets (RDF fuel) or animal feed. Due to high requirements for the quality of raw materials, the cost of technologies, and the complexity of scaling, we will not consider them in this report.

6.2 Composting

One of the requirements for CE regards the method of waste composting, with further re-use of compost for re-growing products. This method is driven by the process of natural decomposition of organic matter under the influence of microorganisms (bacteria, fungi), as well as insects. Composting is the most common BDW recycling method in the world due to the relatively low costs and simplicity of the process.

The output compost is a source of nitrogen, potassium, calcium, phosphorus, and several other nutrients for plants. Compost is also used to improve the composition and structure of the soil, which is important for Kazakhstan with its **gradual soil degradation**.

Composting is an **aerobic process,** i.e. requiring the presence of oxygen, in which waste is formed into heaps (piles) with the addition of structural material (leaves, straw, crushed branches, bark) for air circulation. Periodically, the heaps are mixed to control temperature and humidity, air access, and also to move the outer layers of the heap inward.

The process is **exothermic** (with heat release); therefore, when composting agricultural waste and food in heaps, pathogenic microorganisms are partially neutralized and weeds are destroyed.

The heat released by microorganisms (up to +70 °C) does allow **composting in the cold season**, and it is to be noted that the period of compost maturation will increase by 2–3 weeks.

Composting can take place in open or covered areas with hard, compacted soil. At the present time, Kazakhstan has no approved standard for composting sites.

Covered areas make it possible to partially control moisture and temperature, which is difficult in the open air.

To turn compost heaps (aeration), tedders/rakes are used. Compost turners can be self-propelled, tunnel and trailed.

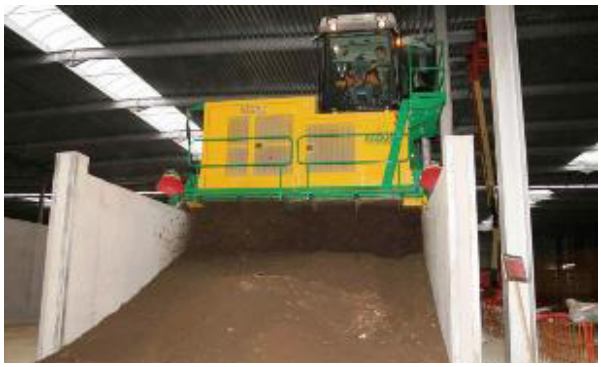
Self-propelled compost turners are equipped with additional systems for watering and introducing bacteria. This equipment can be applied on large sites with an intensive composting process. Currently this type of equipment is being used in Kazakhstan by the diversified enterprise Akmola Phoenix JSC *(Akmola Region)* for composting waste from a poultry farm. The equipment is manufactured by the German Company **Backhus**, which produces specialized machinery and equipment for the complex processing of organic waste with a capacity of 700–7000 m^3/h.

Figures 6.2.1. & 6.2.2. Self-propelled compost turners

In some cases, self-propelled turners can be moved between sites, which is convenient for forming a pool of objects, for example, by agreement between farms located in adjacent territories.

Tunnel compost turners are used in special composting facilities and cannot move between sites.

Figure 6.2.3. & 6.2.4. Tunnel compost turners



The tunnel technique is designed for intensive composting processes with temperature and moisture control. It is assumed that the complexes are supplied with a constant volume of raw materials throughout the year.

Trailed compost turners are the simplest and cheapest means of forming and aerating heaps. They can easily enter the arsenal of farming and gardening along with other attachments.

Figure 6.2.5. & 6.2.6. Trailed compost turners

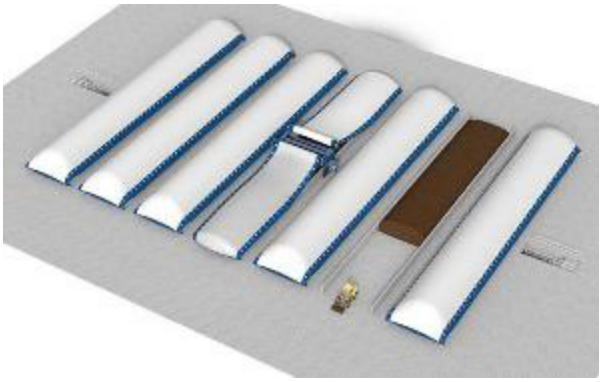
Trailed turners require additional space for passage and are limited by the height of the heap, which implies an increase in the area of the composting facility.

To obtain high-quality compost, it is necessary to provide a **fleet of equipment** for crushing/grinding structural material, sieves (drum sieve) in settlements to screen out large parts of compost that have not decayed, and debris residues (plastic, glass, metal, etc.).

In Kazakhstan, such equipment is sold **by Amkador-Astana LLP** and it **plans to localize production**.

To speed up the composting process and save on the construction of covered facilities, composting technology can be applied with **membrane coating of heaps**. Specialized turners are equipped with a membrane winding mechanism, which allows for a continuous aeration process. Covered heaps makes it possible to maintain the pace of composting in the cold season.

Figure 6.2.7. Compost heaps with membrane; Figure 6.2.8. Membrane compost turner



As a rule, heaps with such technologies are purged to control the access to air necessary for the vital activity of bacteria. A positive factor of such technology is the reduction of greenhouse gas (**GHG**) emissions. The technology also makes it possible to dry materials such as sewage treatment plant sludge.

Similar technologies are already being used in the Russian Federation in a harsh climate.

Strains of bacteria (**bio-destructors)** are added to the compostable raw materials.

6.3 Biogas Production

Given Kazakhstan's priority to reduce greenhouse gases, the biogas capturing technology during BDW Processing is becoming very relevant.

Biogas **plants** (BGP) or **stations** (BGS) are installations for gas production, mainly methane, obtained by hydrogen or methane fermentation of biomass. In the document, we consider biodegradable waste as a raw material. The main product of BGP functioning is **biogas** and **digestate** (BDW residues after fermentation). If biogas is to be used as a vehicle fuel, it must first be refined.

Production of **biofuels** can be one of the BDW Management System activities. The relevant standard already exists *(Law of the Republic of Kazakhstan 'On state regulation of production and turnover of biofuels' dated November 15, 2010, No. 351-IV)*. An experiment in bioethanol production from grain in the North Kazakhstan region at the Biokhim Plant has already been conducted; however, the enterprise was closed, and later when BioOperations LLP wanted to restart fuel production the start-up date was postponed.

If necessary, biogas can be burned in a cogeneration plant to produce **electricity** and **heat**.

Biogas plants are used globally mainly because of the possibility of generating energy and **controlling the release of methane resulting** from the decomposition of BDW (methane is superior to carbon dioxide in its 'greenhouse' properties).

- Fermentation can be wet (15–20% of dry feedstock) or dry (more than 20% of dry feedstock) and take place in an **anaerobic** (without air) or **aerobic** environment (with air).
- **Digestate** (residue of raw materials in the plant reactor) needs further drying or composting for field application and is inferior in nutritional properties to pure compost.
- The energy generated at the biogas plant **is renewable** and falls under the relevant RES Legislation.

In Kazakhstan, several small biogas plants are operating on subsidiary plots to meet the needs of farms. In some cases, homemade units are being used, without proper control of gas leaks and explosion hazards.

Today the market offers various BGP modifications for small and large BDW sources with all related equipment for feedstock preparation, energy cogeneration, and further digested processing.

The use of biogas as a transport fuel in Kazakhstan is not yet widespread due to the high cost of gas processing, and thus this topic will not be discussed here in this report.

The potential for biogas production in Kazakhstan using livestock waste and food waste is presented in the following table.

Table 6.3.8. Potential for biogas production in Kazakhstan

Biogas Source	**Total Livestock** (thousand heads)	**Biomass** (tonnes/year per unit)	**Total Biomass** (thousand tonnes/year)	**Biogas produced from 1 kg of biomass** (m^3)	**Total Biogas Production** (million m^3/ year)
Food Waste	-	-	1400.00	0.09	126.00
Cattle	7436.40	8.00	59,491.20	0.04	2379.65
Horses	2852.30	7.00	19,966.10	0.04	798.64
Sheep, Goats	19,155.70	1.00	19,155.70	0.06	1149.34
Pigs	813.30	2.00	1626.60	0.06	97.60
Poultry	45,000.00	0.06	2790.00	0.07	195.30
				Grand total	**4746.53**

Landfill Gas

It is also necessary to take into account the technologies available in some countries for collecting biogas at landfills, which is why such gas is called **Landfill Gas.**

The main advantage of Landfill Gas Collection is that it has reduced GHGs and a lower risk of spontaneous waste ignition.

The technology involves the appropriate design and management of landfills for collecting gas through gas outlet pipes. After the closure of the landfill, depending on the composition of the waste and its volume at the landfill, methane can be produced within 10–20 years.

Due to the small share of the management of existing landfills/dumps in Kazakhstan, we will not consider this technology in detail.

6.4 Incineration with Energy Recovery

The technology of waste disposal by incineration with energy recovery can take several directions. First of all, this is a variant of **partial or complete replacement of fuel at existing production facilities** to save resources. Advantages include the reduction or elimination of fossil fuel production and reduction of waste disposal. In most cases, coal or other fuels are replaced, for example, at thermal power plants, and cement plants.

As a rule, biofuels (high energy and low moisture content) are packed into pellets for easy loading. It is thus necessary to create an additional infrastructure for waste collection, drying, and pellet-moulding. In some cases, the waste is processed **by pyrolysis** (decomposition at high temperatures without access to oxygen) to obtain better-quality fuel.

The second type of incineration is the **sanitary disposal of organic waste**, for example, from medical institutions, and meat processing plants. In this case, obtaining energy is not the goal (**secondary energy resource**), and therefore, it does not have an economic incentive. This type of recycling is not scalable due to its specificities.

The third type of technology is the incineration of waste to **obtain electricity and thermal energy** at waste incineration facilities, the so-called 'waste-to-energy' technology. From a global perspective, this technology **is not renewable**.

In 2020 Kazakhstan adopted the Law 'On Supporting the Use of Renewable Energy Sources', which included the term 'Thermal Disposal' of waste. The main objective is to use the amount of waste in landfills/landfills and energy recovery.

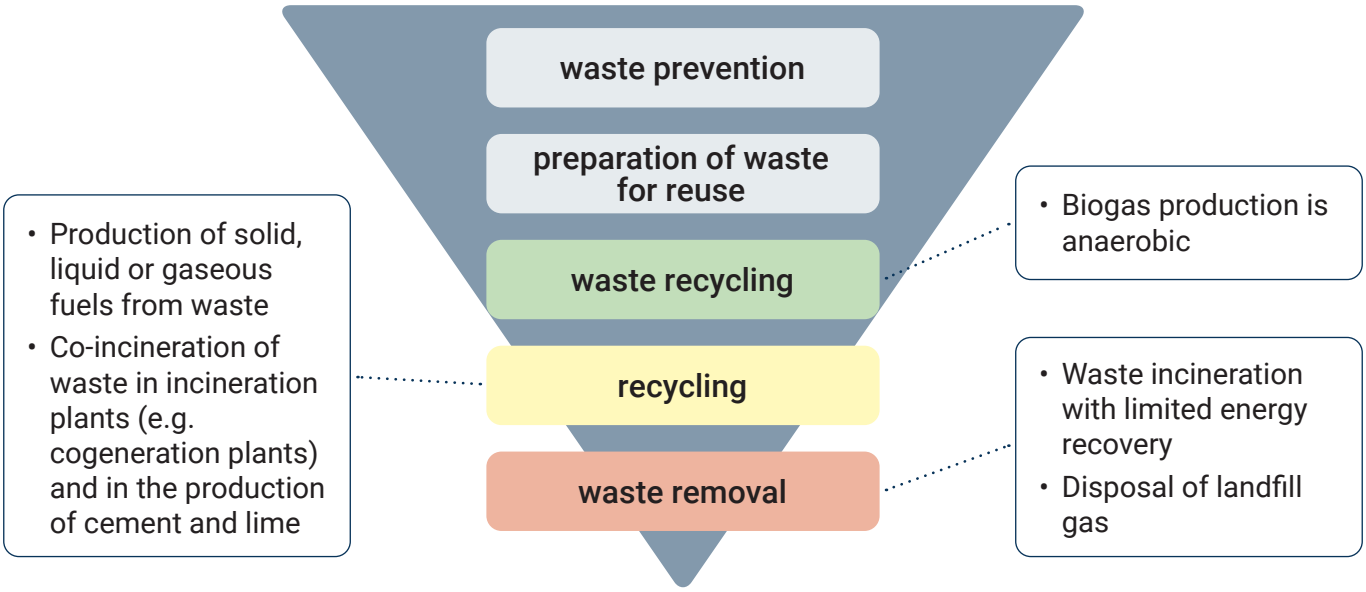
6.5 Priorities

All presented technologies must be considered with existing perspectives and priorities, such as **environmental friendliness**, **efficiency** (waste types), **scalability, and relevance**.

In Kazakhstan, **the priorities of waste management measures are hierarchical.** They are specified in **Article 329** of the Environmental Code of the Republic of Kazakhstan and are arranged in descending order of their preference in the interests of environmental protection and sustainable development. The hierarchy determines the **environmental friendliness of measures by rational use of resources, reduction of emissions, and the ability to apply the principles of a circular economy**.

Drawing on the experience of the EU in evaluating waste incineration methods, and taking into account the EU document '**Commission Communication to the European Parliament, Council, European Economic Social Committee and Committee of the Regions on The role of waste-to-energy in the circular economy**' *(The role of waste-to-energy in the circular economy COM/2017/034 final),* the methods under consideration can be compared with the measures and priorities in the Waste Management Hierarchy.

Figure 6.5.1. Waste Management Measures Hierarchy



Biogas production is comparable to gas processing and has a **high priority**. As we noted earlier, there are at least two objectives here: reducing waste generation and capturing greenhouse gases.

Incineration of wastes with limited recovery and landfill gas disposal **is the worst technique**.

As can be seen from the graph, **the best** way to manage waste is **to prevent waste generation**. The gradual transition of Kazakhstan to **Sustainable/rational Production & Consumption** (**SCP**) can contribute to resolving several major challenges in ecology, agriculture, energy, and the mining industry. In turn, rational behaviour will begin to improve the social and domestic dimensions.

Table 6.5.1 provides indicative performance indicators for various technologies in the processing of 100 kg of BDW.

Table 6.5.1. BDW Recycling Rates, per 100 kg of waste

Processing Method (100 kg waste)	**GHG emissions** (kg/t)	**Energy balance** (kWh)	**Compost formation** (kg)
Dry fermentation and composting	267 Reduction of CO_2 emissions	658 generation	63
Pure composting	80 CO_2 emissions	45 consumption	60
Burning	533 CO_2 emissions	83 consumption	0

Source: PÖTTINGER, Austria

In light of the objectives to reduce greenhouse gas emissions and switch to renewable energy, it is recommended to develop the processing of BDW in biogas plants of Kazakhstan.

The capacity of technologies can be assessed by the ability to solve the pressing problems of the region and the country. Table 6.5.2 indicates the current objectives from the Concept of Kazakhstan's transition to a Green Economy which are associated with BDW Processing.

Table 6.5.2. Technology Applicability to Green Economy Challenges

Sr. No.	Objectives	Compost production	Biogas production	Incineration with energy recovery
1	Reduce the landfills load	✅	✅	✅
2	Switch to renewable energy in stages	–	✅	?
3	Reduce Air Pollution	–	✅	–
4	Increase Agricultural Productivity	✅	✅	–
5	Reduce Chemical Pollution of soils and water reservoirs	✅	✅	–

6.6 Renewable Energy Sources (RES) Development

The transition to RES is a priority for the development of the Green Economy.

Kazakhstan has commitments and plans to introduce **RES**, whose share in the country's total energy resources should reach 10% by 2030. These are significant changes for the country's energy industry. Wind and solar energy are developing at an accelerated pace, and the possibilities of thermal sources are being studied. **But there is an opportunity and a need to continue to develop the energy of biogas plants, with an emphasis on waste processing.**

It should be clarified that all over the world, not only waste but also specially **grown crops with a high energy value play an important role in biofuel for biogas stations (BGS)**.

In Kazakhstan, a large quantity of plant and animal feed is grown for domestic and foreign markets; there are enterprises for processing agricultural products, food, and timber industries. All this activity is a source of biodegradable waste and can be used for BGS.

The market offers BGS of both small and large capacities. Private farms or facilities serving a large settlement can choose the right option.

More details on supporting the use of renewable energy sources can be found in the relevant Law of the Republic of Kazakhstan dated July 4, 2009, No. 165-IV.

6.7 Reducing Greenhouse Gas Emissions

Kazakhstan has developed, as part of its commitment to low-carbon development, a **National Doctrine (Strategy) to achieve Net Zero by 2060.**

Following the objectives of the Strategy, there is a need to apply technologies that minimize GHG emissions into the atmosphere. The previously mentioned calculations of the potential for biogas generation from BDW are also an indicator of **unavoided gas emissions into the atmosphere** (calculations are not verified and are based on average indicators).

Table 6.7.1 shows the approximate volumes of Greenhouse Gas Generation/Emissions, taking into account their share of the **4.8 billion m^3** of biogas assumed to be generated in Kazakhstan per year (estimated data).

Table 6.7.1. Greenhouse gases (GHGs): Quantity per biogas

Sr. No.	Gas in biogas (Total volume: 4.8 billion m^3/year)	Share (%)	Overall volume (bcm)
1	Methane	**50–87**	**2.4–4.2**
2	CO_2	**13–50**	**0.6–2.4**
3	Minor impurities of H_2 and H_2S are not taken into account	-	-

6.8 Switching to Organic Fertilizers

The replacement of mineral fertilizers with organic fertilizers is part of an organic farming development policy and one of the SCP Tools (Substitution).

Table 6.8.1 shows the consumption of mineral and organic fertilizers in Kazakhstan.

Table 6.8.1. Mineral and Organic Fertilizers Consumption in Kazakhstan (2012–2016)

#	Consumption of fertilizers in Kazakhstan	2012	2013	2014	2015	2016
Consumption of mineral fertilizers						
1	Area of agricultural land, million ha	21.5	21.5	21.2	21.0	21.7
2	The share of areas treated with **mineral fertilizers** in the total area of agricultural land	**6.8%**	**6.5%**	**7.4%**	**6.9%**	**7.6%**
Consumption of organic fertilizers						
3	Consumption of organic fertilizers, **thousand tonnes**	830.4	504.6	510.9	609.2	626.6
4	Share of areas treated with **organic fertilizers** in the total area of agricultural land	**0.6%**	**0.3%**	**0.3%**	**0.3%**	**0.4%**

According to the Rules for Subsidizing Increasing Yields and Quality of Crop Products, **subsidies are not allocated for organic fertilizers** *(approved by Decree of the Minister of Agriculture of the Republic of Kazakhstan dated March 30, 2020 No. 107).* Unless the competitive environment between mineral and organic fertilizers is enabled, it will be difficult to support organic farming and composting as part of the Waste Management Industry.

It is critically important for agricultural enterprises focused on the production of organic products to replace mineral fertilizers with organic ones, and compost is the most affordable. It should also be noted that in terms of price, waste type coverage, and ease of maintenance, composting is **the most scalable** method in agriculture.

6.9 Infrastructure

The Municipal Waste Management Infrastructure that has developed today in the cities and towns of Kazakhstan includes several disparate components:

- infrastructure at sources (containers, container sites, population outreach)
- the infrastructure of waste collection companies (bases, equipment, logistics)
- the infrastructure of landfills and waste processing facilities

Frequently these components are united within one management company.

Unfortunately, almost no attention is paid to the development of the **infrastructure for the consumption of BDW-processed products** (consumption of compost, purchase of electricity, and consumption of biogas):

- almost all agricultural facilities are focused on the use of mineral fertilizers and **do not have the equipment to use compost** or manure, which makes it difficult to replace hazardous components with safer ones
- the electricity transportation system is **not focused on small sources**, especially those that cannot supply it in a constant volume, thus the transition to renewable energy is complicated
- refining of biogas and its use for refuelling vehicles **should be addressed at the regional level** with the involvement of producers for efficiency and cost reduction, i.e. the development of the CE is not being stimulated in this domain

Developed and intensive consumption of BDW processed products will be the appropriate final element in the waste management chain, which is an indicator of the **circular economy** in this industry.

The interaction of all elements is the **Municipal Waste Management System** (hereinafter referred to as the **System**). There is also the influence of regulators and consumers of secondary raw materials.

Each of these elements, ideally, should be in harmony with the other, for which the modern requirements of the entire system are periodically systemized and adapted.

Thus, our 'ideal' infrastructure should include the following components:

- up-to-date legal and regulatory framework
- competent waste management personnel
- motivated population and enterprises as the primary source of segregated waste
- integrated waste management in terms of waste collection and sorting
- technological chain of waste processing or disposal
- waste accounting (BDW)
- consumer market for the resulting products of BDW processing
- the economic potential of the population (does not depend on the system).

As a result, the system shapes the **rates (**tariff) for utilities and **the cost of secondary raw materials/the output product** (compost, energy, biogas).

The quality of the systems is reflected statistically in terms of processed waste, compost or energy produced, and reduced greenhouse gases.

6.10 Staff Development and Public Outreach

An important role in the creation and management of a BDW system is played by competent personnel and an informed population.

As an analysis of the BAT for BDW processing has shown, the service market in this industry is still poorly developed in Kazakhstan, and the industry itself does not yet exist, either. The necessary conclusion is that there must be a shortage of relevant specialists in the labour market, as well as majors in this subject in the educational institutions.

There is a need **to develop the human resource capacity** of the system, especially the engineering and technical staff. The inputs must be delivered comprehensively to ensure an understanding of the critical waste management system processes.

Table 6.10.1 shows the majors that will be necessary to train human resources.

Table 6.10.1. Technical skills/academic majors required to develop a Waste Management Team and System

• Process Engineers (waste management, renewable energy, consumption of products from waste)
• Design & Engineering (construction and maintenance of waste management facilities, renewable energy sources, production of products from waste)
• Economists (servicing financial and economic matters, market for products from waste)
• Logisticians (logistics for waste collection and product sales)
• Lawyers (waste management contracts, sales of products, other service contracts, control of new standards)
• Communications Service (waste sources handling, products consumers relation, government agencies relations)
• Technicians, Mechanics (facilities, transport management, equipment maintenance, etc.)

It is also necessary to communicate with the population about the proper handling of waste: sorting at the source, and preventing waste from being thrown out in the wrong places.

6.11 BDW Processing Products Market

Considering infrastructure as a systemic mechanism, the RoK needs to create a market for services and demand for the final products of processing: **compost**, **energy**, and **GHG reduction services**. It is the production and consumption of products made from waste that distinguishes **the linear** from the **circular model of the economy.**

As mentioned earlier, it is necessary to stimulate the consumption of products from recycled waste, change the consumer mindset, and develop 'green' purchases. Unless these prerequisites are met, waste recycling risks will remain at the level of a subsidized industry with no prospects for development and independence.

There are advances to support the Green Economy:

- Enabled purchase of electricity from the BGS
- Taxonomy of green projects (classification)
- Subsidies for bird manure processing
- Part of the equipment has preferential terms for the import of agricultural machinery

However, there is still no support for buying compost.

6.12 System Complexity

The Balanced System implies an integrated approach to ensure the quality and quantity of technical equipment for municipal waste management facilities whose placement should be optimized in terms of logistics.

For example, in 2018, as requested by the State Institution 'Department of Energy and Housing and Utilities of the Almaty Region', a feasibility study was developed for the **Construction of the Regional Waste Management System in the Almaty Region**. The developer is GeoData Plus LLP. Given the density and dispersion of settlements, logistics solutions, and transport costs, we proposed ideas that took into account waste sources, MSW trans-shipment, processing, and disposal facilities.

Today, the project needs to be revised due to the introduction of new restrictions on the disposal of certain types of waste.

As the experience of developed countries shows, a properly organized **Municipal Waste Management System,** with appropriate support from the state and the population, can prevent significant soil/water pollution and become a profitable part of the economy as well as a large source of raw materials.

6.13 Population Economic Potential

Creating the Regional Waste Management System will take more than one year, and will require significant funds for establishment and support. An essential link in such a system is the **economic component: Tariffs, Subsidies, Green Purchases, and Fines**.

The European Union has the best success story in establishing the Municipal Waste Management System. For example, Germany (until 1990, West Germany) helped improve waste management in the former GDR after reunification. Kazakhstan could also attract specialists and technologies from Germany, Spain, Finland, South Korea, and other countries.

When building a National Waste Management System, we need to take into account the significant gap between economic opportunities, accepted standards, and available technologies in the EU and Kazakhstan. The following shows the waste collection rates in Germany:

Thus, for example, in Germany, the lowest utility rates are in Flensburg *(Schleswig-Holstein)* – EUR 127 per year, which was **KZT 60,000** at the exchange rate in 2020. The highest in Leverkusen (Federal State of North-Rhine Westphalia) is EUR 909 per year, or **KZT 430,000 per year**.[10]

For comparison, the rate in Astana (former city of Nur-Sultan) is KZT 390 per month or **KZT 4680 per year**. *(Decision of the Maslikhat of Nur-Sultan dated December 25, 2019 No. 476/60-VI 'On approval of rates for the collection, removal, disposal, processing and disposal of municipal solid waste in Nur-Sultan City').*

Rates have been and remain the main criterion for the System's Development.

10 https://aussiedlerbote.de/2020/01/skolko-platyat-za-vyvoz-musora-v-raznyh-gorodah-germanii/

Financing is tied to the income of the population, but in general, the needs for a quality environment in Kazakhstan and the EU remain the same.

It is expected that the development of the System will be stimulated by local executive bodies. Their mission is to organize actions to stimulate the reduction of biodegradable waste disposal, including measures for their processing, in particular by **composting and disposal**, including for the **production of biogas** and (or) **energy** *(Environmental Code of the Republic of Kazakhstan, Article 351).*

6.14 Biodegradable Waste (BDW) Accounting

The BDW accounting books section shows discrepancies in statistical data and in the calculations concerning waste generation rates. The same pattern applies to the data on renewable energy from biogas plants – the data of small producers were not taken into account. There is no market data for organic fertilizers.

There is not enough consolidated information that can be used to analyse the overall outlook of BDW production and potential processing capacities for RoK.

As a corollary, at present we have no forecast for the BDWs, nor control over their management. Given such realities, the **investment attractiveness of a business** for the processing of BDW and food waste, in particular, cannot be perceived as high. This situation also does not contribute to monitoring the efficiency of the measures taken (spent funds and coverage of actions), and finally, it is difficult to define sectoral or territorial indicators in the field of waste/recycled materials management.

7. Findings

Today in Kazakhstan there exists great potential for the consumption of secondary raw materials and the development of a circular economy (CE). Unfortunately, there are limitations in the ability to implement such plans in the short term for the following reasons:

- Non-competitive prices for waste management (removal) services
- Insufficient state support
- Insufficient control and regulation of the value chain
- Lack of a universal system for the sorting and proper storage of biodegradable waste (BDW) throughout the territory of Kazakhstan

The construction and development of the required waste management infrastructure, including food waste, is a comprehensive objective. The processing of BDW, driven by SCP Tools and a Circular Economy approach can be a good solution to the pressing challenges outlined in the Concept for the transition of the Republic of Kazakhstan to a Green Economy.

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