Justification of the Advantages of Project Financing in the Implementation of the MSW Management System

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Abstract. The implementation of the reform of the solid municipal waste management system (MSW) consists not only in creating the necessary infrastructure for collecting, transporting, processing and disposal of MSW, but also the necessary organizational and managerial (territorial schemes for handling MSW, investment programs, the creation of specialized institutions, in particular, the Russian environmental operator, etc.) and financial and economic (tariffs, financial instruments, economic levers, mechanisms for attracting investment) tools. The paper considers the possibilities and advantages of using project financing as a mechanism for attracting private investment in the MSW management system. The conclusions and practical results can be used by the bodies authorized to carry out the reform of the MSW management system, while creating favorable conditions for the development of the project financing mechanism in the MSW management system and improving its effectiveness.

1. Introduction
In his annual Address to the Federal Assembly, the President demanded that the responsibility of industrial enterprises be clearly established in order to minimize environmental damage, and that it be fixed in the law on emission quotas. The President emphasized the priority of people's life safety over corporate interests. The improvement of the system of regulation of environmental legislation can be seen in the creation of a new Department for supervision of the implementation of laws on environmental protection and nature management [1].

The Strategy for the development of industry for processing, recycling and disposal of production and consumption waste for the period up to 2030 [2], approved in January 2018, identifies the formation and long-term development of the industry for processing, recycling and minimizing the amount of waste that is not subject to further recycling, using the global 3R principle (prevention of waste generation, reuse, recycling into secondary resources). This goal implies the maximum involvement of waste in production, a systematic reduction in the amount of waste that cannot be disposed of, as well as providing this industry with modern high-tech equipment. It is expected that in the period 2016-2030 the volume of production and consumption waste generation will decrease by 8.8%, the share of disposed and neutralized waste in the total volume of generated waste will grow...
from 59.6 to 86%. The share of dependence on imported equipment should decrease by 50 percentage points (up to 10%) by 2030. Thus, in 12 years it is planned not only to create a waste management industry on the territory of the Russian Federation, but also to create a reserve for the export competitiveness of the corresponding segment of mechanical engineering, which is currently import-dependent. According to the data provided in this document, the amount of financing for the activities envisaged in the industrial development Strategy for waste treatment, utilization and neutralization is estimated at 5 trillion rubles. About half of the necessary funds will be raised from private investors, 25% will be provided under the extended liability of producers (including environmental charges), and 10% will be paid for negative impact on the environment and fines for environmental violations. The new approach to waste management was reflected in the changes made to the legislation. A watershed document was the new edition of the Federal law № 89-FZ "On wastes of production and consumption", which included: □ new terminology (refined the concept of "waste" introduced the term "recycling" and waste the concept of recycling, regeneration and recovery, etc.); □ new principles of waste management that determine the direction of industry development (a priority of recycling over incineration and landfilling); □ new regulations (prohibition of disposal of wastes containing useful components; extended producer responsibility; the Institute for regional operators); □ correction of authorities' powers, etc. [10].

2. First section
Since 2015, the term "waste" includes substances or objects formed both in the process of production and consumption, as well as in the process of performing works or rendering services [6]. In Russia, waste is classified in accordance with the Federal classification catalog of waste (FKKO) [7], which contains several thousand items. The classification shows: waste composition, source, aggregate state and physical form, as well as the hazard class.

The national project "ecology" sets specific goals that should be achieved by 2024: 1) increase the share of MSW directed to processing from 3% (2019) to 60% (2024); 2) increase the share of MSW directed to use from 1% (2019) to 36% (2024); 3) elimination of unauthorized landfills of 191 units by 2024. 4) commissioning by 2024 of 7 production and technical complexes for neutralization and disposal of waste of hazard classes 1 and 2; 5) introduction of by 2024, the capacity for processing MSW by 37.1 million tons and for recycling – 23.1 million tons [9,10]

When assessing the opportunities and prospects for MSW management in the Russian Federation, we should not forget the successful experience of the EU countries.

In 2019, the volume of MSW generation in 28 EU countries amounted to 242.5 million tons, of which 97.1% was subjected to one or another method of treatment. About 25.6% of MSW was placed in landfills, and about the same amount — 26.5% — was sent for incineration (including 23.2% for incineration with energy recovery). 29.5% of MSW was sent for recycling, and 16.8% was processed using composting and fermentation technologies (table 1) [5].

| Country     | Total treatment (TRT) | Recycl. (RCV_O) | Backfilling (RCV_B) | Energy Recovery (RCV_E) | Incineration (INC) | Landfilling (DSP_D) | Other disposal (DSP_O) |
|-------------|----------------------|-----------------|---------------------|------------------------|-------------------|---------------------|------------------------|
| EU-28       | 764 650              | 422 340         | 13 070              | 125 430                | 21 670            | 179 020             | 3 120                  |
| Belgium     | 38 802               | 30 362          | 0                   | 4 952                  | 2 008             | 1 480               | 0                      |
| Bulgaria    | 14 702               | 3 897           | 0                   | 446                    | 11                | 10 270              | 78                     |
| Czechia     | 12 128               | 7 249           | 1 069               | 1 064                  | 77                | 2 652               | 16                     |
| Denmark     | 8 373                | 5 125           | 0                   | 2 916                  | 3                 | 240                 | 88                     |
The MSW management system includes the following technological stages (figure 1).

| Country      | Generation (Mg/year) | Incineration (Mg/year) | Transportation (Mg/year) | Landfill (Mg/year) | Processing (Mg/year) |
|--------------|----------------------|------------------------|--------------------------|-------------------|----------------------|
| Germany      | 147 206              | :                      | :                        | :                 | :                    |
| Estonia      | 11 213               | 1 167                  | 288                      | 457               | 0                    |
| Ireland      | 3 712                | 1 506                  | 294                      | 575               | 44                   |
| Greece       | :                    | :                      | :                        | :                 | :                    |
| Spain        | 47 097               | 21 798                 | 28                       | 3 866             | 14                   |
| France       | 86 348               | 46 476                 | 0                        | 16 433            | 4 825                |
| Croatia      | 3 135                | 1 640                  | 0                        | 53                | 12                   |
| Italy        | 80 309               | 54 914                 | 0                        | 5 950             | 3 825                |
| Cyprus       | 740                  | 226                    | 17                       | 0                 | 499                  |
| Latvia       | :                    | :                      | 5                        | :                 | :                    |
| Estonia      | 11 213               | :                      | :                        | :                 | :                    |
| Hungary      | 9 554                | 4 135                  | 0                        | 983               | 80                   |
| Maltese      | 422                  | 180                    | 0                        | 0                 | 6                    |
| Netherlands  | 45 626               | 32 670                 | 0                        | 10 519            | 1 147                |
| Austria      | 14 494               | 9 599                  | 2                        | :                 | 1 238                |
| Poland       | 68 235               | 38 231                 | 3 982                    | 5 743             | 571                  |
| Portugal     | 8 721                | 4 502                  | 47                       | 1 256             | 24                   |
| Romania      | 19 741               | 5 825                  | 16                       | 2 478             | 100                  |
| Slovenia     | 2 322                | 1 866                  | 0                        | 303               | 42                   |
| Slovakia     | 6 470                | 2 824                  | 0                        | 558               | 36                   |
| Finland      | 10 218               | 3 741                  | 0                        | 5 192             | 55                   |
| Sweden       | 17 767               | 8 758                  | 30                       | 7 383             | 200                  |
| United Kingdom | 82 822          | 48 079                 | 793                      | 8 218             | 5 697                |

**Figure 1.** System for the treatment of MSW.
- collection of MSW from sources of education-the sources of MSW education are the owners of MSW, i.e. residents of apartment and private houses, importers, manufacturers, sellers of consumer goods and vehicles, as well as at other stages, the collection is carried out by a regional operator who has engineering and cleaning companies under contract.
- transportation of MSW-is carried out by transport companies that have signed contracts with regional operators and carry out garbage removal from the MSW collection area. Transportation of MSW is performed to one of the following possible objects in the system:
  - specialized landfills on the territory of the subjects of the Russian Federation-are specially equipped facilities designed for the placement and disposal of waste. The largest part of the waste is disposed of through m disposal, which causes the greatest damage to the environment.
  - incineration plants - an enterprise that uses the technology of recycling industrial and solid household/municipal waste through thermal decomposition (incineration) in boilers or furnaces. Of course, this method is also not the best option for solving the problem of recycling MSW.
  - waste processing plants are enterprises that process waste as completely as possible. But it also has furnaces, and only what cannot be processed in any other way is burned in them [12].
To ensure the above-mentioned activities, funding is required at each stage of the technological chain.
These circumstances strongly require the introduction of effective methods of financing all technological stages into the practice of MSW management. project financing can be offered as a priority method.
As a support mechanism at all stages of the technological chain of the MSW system, long-term project financing should become a popular financial support mechanism [8]. The essence of the mechanism is to attract funds to ensure a long-term large independent investment project in the field of MSW, in which funds are generated by the project itself. The peculiarity of this method of financing is that the funds are allocated not under a state or corporate guarantee and not under the security of property, but under the cash flow that will generate the project after its completion.
Possible participants in project financing their interests in the MSW system are shown in table 2.

### Table 2. Types of effects, target indicators, indicators efficiency and financial effectiveness of project financing in the MSW system.

| № | Members financial mechanism | Types of effects, efficiency, and financial performance | Indicators and target indicators |
|---|-----------------------------|------------------------------------------------------|---------------------------------|
| 1 | Regional MSW operator (WHO operators) | – | 4 - total number of municipal solid waste generated in one calendar year (kg or t); - number of municipal solid waste generated per capita in one calendar year (kg or t); - number of municipal solid waste sent for disposal and incineration in one calendar year (kg or t); - share of recycled municipal solid waste from the total amount of waste generated IN one calendar year (%); - share of municipal solid waste used for heat and |
| № п/п | Members financial mechanism | Types of effects, efficiency, and financial performance | Indicators and target indicators |
|-------|-----------------------------|-----------------------------------------------------|-------------------------------|
| 1     |                             | 3                                                   | electricity generation from the total amount of waste generated in one calendar year (%) |
|       |                             |                                                     | required level of return on invested capital; |
|       |                             |                                                     | net present value (NPV); |
|       |                             |                                                     | internal rate of return (IRR); |
|       |                             |                                                     | payback period (simple and discounted) |
| 2     | Private investor            | – gain profit;                                      | indicators of the borrower's creditworthiness and financial stability |
|       |                             | – financial efficiency (effectiveness) of the investment project | – to overcome the persistent deficit of the consolidated budget; |
|       |                             |                                                     | – improving the quality and reliability of housing and communal services provided to the population; |
|       |                             |                                                     | – elimination of accumulated environmental damage; |
|       |                             |                                                     | – release of budget funds and use them for other purposes; |
|       |                             |                                                     | – share of MSW allocated for disposal from the total number of MSW generated; |
|       |                             |                                                     | – share of MSW sent for processing from the total number of MSW generated; |
|       |                             |                                                     | – share of imports of equipment for processing and recycling MSW; |
| 3     | Financial and credit institutions | getting loan interest indicators of the borrower’s creditworthiness and financial stability | – improving the quality and reliability of housing and communal services provided to the population; |
| 4     | Government of the Russian Federation (Ministry of emergency situations, Ministry of industry, Ministry of natural resources, Ministry of construction) | – budget and economic efficiency; – social efficiency | – eliminating accumulated environmental damage; |
|       |                             |                                                     | – release of budget funds and use them for other purposes; |
|       |                             |                                                     | – share of MSW allocated for disposal from the total number of MSW generated; |
|       |                             |                                                     | – share of MSW sent for processing from the total number of MSW generated; |
|       |                             |                                                     | – share of imports of equipment for processing and recycling MSW; |
|       |                             |                                                     | – the number of the developed electronic models |
|       |                             |                                                     | – net present value (NPV) [3]; internal rate of return (IRR) [4]; payback period (simple and discounted); |
| 5     | Financial fund              | – financial efficiency (effectiveness); – social efficiency | – improving the quality and reliability of housing and communal services provided to the population; |
|       |                             |                                                     | – conservation and protection of the environment |
It is advisable to evaluate the effectiveness of project financing based on the calculation of an integral indicator using the formula 1:

\[ K = A \times ka + B \times kb + C \times kc + D \times kd + E \times ke. \]  

(1)

The coefficients A-E depend on certain conditions. So:

- If project financing directly affects the achievement of indicators, then the coefficient \( A = 1 \), if not, then \( A = 0 \);
- If project financing only indirectly affects the achievement of project indicators in the MSW chain system, then the coefficient \( B = 1 \), if not, then \( B = 0 \);
- If project financing affects the project implementation period (deviation of no more than 30 days), then the coefficient \( C = 1 \), if not, then \( C = 0 \);
- If project financing affects the project budget (deviation of no more than 3% of the total budget), then the coefficient \( D = 1 \), if not, then \( D = 0 \);
- If project financing can be classified as socially significant, then the coefficient \( E = 1 \), if not, then \( E = 0 \);

In this case: \( ka = 0.25 \); \( kb = 0.20 \); \( kc = 0.10 \); \( kd = 0.15 \); \( ke = 0.30 \).

In order to decide whether it is necessary to implement a particular project financing, this national project recommends applying the following criteria:

- If \( K \leq 0.44 \), then this project financing has a small weight in the project implementation, and therefore the refusal to Finance this event will not affect the project in any way.
- If \( 0.45 \leq K \leq 0.74 \), then this project financing has quite a significant weight in the implementation of the project, and therefore it is not recommended to refuse to Finance this event.
- If \( K \geq 0.75 \), then this project financing has a key weight in the implementation of the project, and therefore it is impossible to refuse funding in this case, otherwise it will lead to the curtailment of the MSW project.

3. Conclusion

Thus, the formation of a solid municipal waste management system in our country is just being formed. The article considers the main features of the mechanism for financing the waste sector in our country, examines the experience of foreign countries in handling them, and identifies potential risks and methods of financing the entire technological chain. A promising method of financing MSW is project financing, which assumes that cost recovery is carried out by generating income from the implementation of the project itself. The effectiveness of project financing was evaluated on the basis of an integral indicator.

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