Description of the basic activities for the realization of a new waste disposal scheme in Russia

Elena A Serebryakova\textsuperscript{1}[^2000-0001-5129-246], Elena P Smorodina\textsuperscript{1}[^2000-0001-8235-466], Irina V Kryuchkova\textsuperscript{1}[^2000-0003-2493-541] and Mr. Marco Passetii\textsuperscript{2}

\textsuperscript{1}Voronezh State Technical University, Voronezh, Russian Federation, \textsuperscript{2}University of Brescia, Brescia, Italy
E-mail: irishka-kryuchkova@mail.ru

Abstract. In some regions of Russia new waste management scheme is coming into operation in 2019. The Voronezh Region was one of the first to approve all the program documents necessary for this. In the framework of Voronezh region state program “Environmental Protection and Natural Resources”, the Voronezh Region Government Decree No. 524 of 30.06.17 allocated the subprogram “Regional program for waste management, including municipal solid waste”, the implementation of which is planned for 2018-2021. The main objective of the subprogram is to increase the proportion of waste that can be recycled, reused or disposed with minimal environmental damage. The article describes the main activities for the implementation of this subprogram and main trends of waste processing industry development in the conditions of digitalization. The article also describes the experience of waste sorting in Italy and some other countries, where this problem has been solved for more than 30 years.

Key words: waste, recycling, wastes sorting, regional waste management scheme, intermunicipal waste processing cluster, waste sorting complex.

1 Introduction

Nowadays the world economy is characterized by the development of various clusters, the essence of which lies in the formation of stable organizational, technological and economic ties between enterprises engaged in similar or related activities and concentrated in a certain territory. The territories on which clusters are formed become the leaders of economic development, which directly affects the country's competitiveness [1-7].

This phenomenon has also affected environmental protection activities. In connection with changes in legislation on waste management, environmental clusters began to appear in a number of Russian regions, which will ensure a positive effect in the field of environmental management and implementation of environmental projects in the region if they are provided with rational organization and operation of new territorial waste management schemes [8-13].

Many scientific studies are focused on reform of solid waste management. Works of P.A.Shohovaya, L.G. Elkina, N.G.Kopeikina are devoted to the questions of environmental cluster formation [3]. Development of secondary resources clusters is considered in E.S.Zaharenko’s work [4]. Tshovrebov E. S. considered features of strategic development of the industry in waste processing [5]. Recycling as the basis of the waste processing industry is considered in E.S.Zemskova’s work [2].

A. Alaev, S. Debabov, as well as E.F. Nikitinskaya and A.E. Poikin devoted their researches to the formation of cluster infrastructure [6]. As a result of studying the infrastructure of the waste...
processing industry, T.N. Somova and A.Z. Oshepkova came to the conclusion that its elements aim is to ensure safe human life [7]. M.V. Latipova, E.S. Shingarkina concluded that the better the infrastructure in the field of waste management is developed, the higher degree of regional ecological safety is [8, 9]. International experience in waste management is considered in the works of A.A. Napalkova, A.E. Nasadyuk, D. Borodina and A. Malyutina [14-17]. The main trends of formation and features of implementation of the intellectual waste management system are revealed in the works of Volodin V. M. [10], Vladimirov D.G., Vorotnikov A.M. [18], Shokhov P.A. [19], as well as E.A. Avdeeva and T.E. Davydova [11]. The possibility of implementing public-private partnership projects in environmental protection is described in the works of V.V. Gasilov and I.V. Kryuchkova [20].

Despite the fact that a lot of researches are devoted to the study of a new system of safe waste management, the features of the new industry transformation are still not well studied. In this regard, the goal of our research is to substantiate the possibility of implementing federal legislation to switch to a new waste management system at the regional level, by forming waste processing clusters.

2 Materials and methods

To achieve this goal we have analyzed the regulatory framework and scientific literature on the formulated problem, and also examined the features of the implementation of clusters approach in the field of waste management in the Voronezh region. The object of the research is a new system of safe waste management, implemented in Russian Federation.

Amendments to the federal legislation governing the management of municipal solid waste have been underway since 2014. The main idea is to introduce a new system aimed at reducing landfill in regions of Russia by increasing the amount of recycled waste.

The Voronezh region was one of the first regions to develop all the necessary documentation for the transition to a new waste management system. The government of the Voronezh region of 11.11.2015 № 856 (as amended on 03/24/2017 № 234) approved the state program of the Voronezh region “Environmental protection and natural resources”, under which the subprogram of the Voronezh region dated June 30, 177 Regional program in the field of waste management, including municipal solid waste”, the implementation of which is planned for the period 2018-2021.

The main objective of the subprogram is to minimize the impact of waste on the environment by involving as much waste as possible in recycling. Achieving this goal will be ensured by the implementation of four main activities [12]:

1. Construction and development of inter-municipal environmental waste processing clusters. Creation and development of production facilities for the processing of production and consumption waste.
2. Creation and development of infrastructure for environmentally safe, separate collection and removal of municipal solid waste.
3. Identification and liquidation of objects of accumulated damage, including unauthorized disposal of waste.
4. Creation and maintenance of an information resource in the field of waste management to provide the population with accessible information in this area.

As part of the implementation of the decisions of the territorial waste management scheme in the Voronezh region, eight inter-municipal ecological waste-processing clusters (IEWC) have been created and the design and construction of waste sorting complexes (WSC) is envisaged.

Also, a new regional waste management scheme assumes that in each of the eight inter-municipal waste-processing clusters a modern landfill will be created for the disposal of waste residues after sorting, mechanical and chemical treatment, as well as wastes that cannot be used as secondary raw materials. Existing landfills of MSW after the expiration of their service life are subject to closure and recultivation.

Table 1 shows the amount of funding required for the design and construction of waste sorting complexes and landfills for waste disposal in the implementation of the waste reform in our region.
Table 1. The amount of funding for engineering surveys, design and construction of waste sorting complexes and landfills for waste disposal [12].

| №  | Name of IEWC | Name of waste sorting complex (WSC) | Amount of funding, (millions of rubles) | Implementation period |
|----|--------------|-------------------------------------|----------------------------------------|-----------------------|
|    |              | WSC                                 | Landfills                              |                       |
| 1  | Voronezhskii | Semilukskii WSC Novousmanski WSC     | -                                      | Acting                |
|    |              |                                      | -                                      | Acting                |
| 2  | Paninskii    | Anninski WSC Paninski WSC Artinski WSC | 99,0                                | 199,0                | Until 2024              |
| 3  | Buturlinovskii | Pavlovskii WSC Talovskii WSC Buturlinovskii WSC | 326,0                                    |                       | 2018-2024               |
| 4  | Kalacheevskii | Kalacheevskii WSC                   | 69,0                                    | 134,0                | Until 2024              |
| 5  | Rossoshanski | Rossoshanskii WSC Olhovatski WSC Podgorenski WSC | 159,0                                | 244,0                | 2018-2014               |
| 6  | Bogucharski | Bogucharski WSC                     | 99,0                                    | 169,0                | 2019-2021               |
| 7  | Liskinskii   | Ostrogorzhskii WSC Bobrovskii WSC   | 259,0                                    | 474,0                | 2019-2021               |
| 8  | Borisoglebski | Povorinski WSC Borisoglebski WSC Gribanovskii WSC Novokhoperski WSC | -                                      | 329,0                | Acting 2018-2021        |
|    |              |                                      |                                        |                       | Until 2024              |
|    |              |                                      |                                        |                       | Until 2024              |

Currently, there are only three waste sorting complexes: Semilukskii, Novousmanski, Borisoglebski. The formation of the remaining WSCs should be completed by 2024.

The creation and development of an infrastructure for the safe waste management is important for ensuring the ecological well-being of the region. For each waste processing cluster, it is necessary to create its own infrastructure in the field of waste processing and disposal, which depends on the sources of waste generation and methods of processing. The main infrastructure facilities include facilities that are involved in the direct management of waste, i.e. carrying out the collection, sorting, disposal and transportation. Supporting infrastructure facilities ensure the functioning of the core ones. These include: facilities engaged in the development, production of technologies and equipment for the disposal, sorting and recycling waste; educational institutions providing training in the field of safe waste management; organizations that provide informational interaction of all elements of cluster infrastructure.

In order to increase the share of recyclable waste, Government Decree No. 1589-p of July 25, 17 was adopted, in accordance with which, it is forbidden to place scrap, waste of ferrous and non-ferrous metals, waste products containing mercury, tires, glass at landfills. Landfills are prohibited to place paper and cardboard, and from January 1, 2020 it will not be possible to dispose of computer and electrical equipment. Every year the list expands, therefore this waste needs to be involved in recycling. Without separate collection or sorting it is impossible to isolate a useful component, therefore, the introduction of separate waste collection on the territory of the Voronezh region is the next stage in the implementation of the new waste management scheme [13].

For effective implementation of this stage, it is advisable to study the international experience of separate collection and recycling of waste. A.A. Napalkova and A.E. Nasadyuk in their researches came to the conclusion that organization of waste processing activities depends on the degree of economic development of the country and its territory [14]. The more free space and the lower level of social-economic development of the country is, the worse the system of separate waste collection and their involvement in the recycling process is developed.
For example, in Italy they have been dealing with this problem since 1989 and in the country as a whole, the rate of separate waste collection is currently about 65% and there are practically no landfills and huge garbage dumps. The conditions for sorting and exporting will come from a company that performs separate garbage collection. The contracting company draws up a garbage collection calendar, provides tanks or garbage bags with bar codes for each family and thus tracks the volumes and the origin of various wastes. The price of garbage collection depends on the region, the company and the number of people in the family and is approximately 70 euros per year. For improperly sorted garbage disciplinary liability is provided in the form of a fine, which can reach 600 euros. Therefore, in order the population to know what and where to throw it, special reference books and educational articles are printed in Italy [15].

In the USA programs for wastes disposal and recycling have been approved, as a result of which 26% of municipal waste and 44% of industrial waste are recycled. Each household is provided with free containers for separate waste collection at the expense of the municipality [16].

Nearly 80% of waste is burned in plasma gasification in Japan. From the resulting slag engineers get material that is used for the construction of buildings, structures and even bulk islands. About 20% of waste is recyclable [17].

Since 2009, China has been implementing garbage reform aimed at increasing the share of recyclable waste, which currently stands at about 35%, and the bulk of the waste is incinerated at special thermal power plants. China imports waste from other countries and produces a lot of products from it: toys, clothes, etc. Since 2019, Chinese people refused to use disposable things.

The creation and maintenance of an information resource in the field of waste management to provide the population with accessible information in this area and automation of the waste management system is also a very important area of waste reform. The implementation of this event will increase the efficiency of the activities of regional operators collecting garbage, optimizing the movement of special equipment, automating tariff setting and exercising operational control over the collection and removal of municipal solid waste. The introduction of modern innovate technologies in the field of safe waste management will allow to obtain the expected effects [18].

In accordance with federal legislation on new waste management system, each region is obliged to develop a territorial scheme for waste management and turn it into electronic form before the end of 2020. The electronic scheme is designed to track in real time the volume of formation, morphological composition and movement of wastes. Increasing the transparency of movement at every stage of the waste life can be achieved through the introduction of end-to-end digital technologies.

3 Discussions
When moving to a new waste management system, many regions faced the following problems. Due to the lack of an effective system for separate waste collection, the tariff for garbage collection increases, therefore the volume and quality of waste processing decreases, which in turn leads to a decrease in the profitability of waste sorting and waste processing complexes. Most landfills don’t comply with environmental safety standards [5]. Timely resolution of these problems during the implementation of measures envisaged by the regional program in the field of waste management in the Voronezh region will allow creating such an infrastructure that will ensure the most effective interaction of specialists from various industries involved at all stages of the life cycle of solid municipal waste from generation to disposal [19].

In order to reduce the amount of waste transported to landfills in the territorial scheme of the Voronezh region, 19 groups of wastes are identified, which are recognized as priorities for the region in terms of their generation, environmental hazards and resource value [12].

Creation of conditions for separate environmentally safe collection, transportation and disposal of waste, as well as their further processing will be implemented by the Department of Housing and Public Utilities and Energy of the Voronezh Region by providing the municipalities of the region with a sufficient number of containers and special equipment for collecting and transporting waste, as well as creating stationary and mobile collection points for secondary material resources and wastes [13].
The general control over the movement of municipal solid waste from the container to the waste sorting complex with subsequent disposal of unprocessed waste is entrusted to the regional operator, who will receive full information about the sorted waste. In the case of placement of secondary material resources on the landfill, the responsibility will be borne by the landfill. In the future, it is planned to introduce separate waste collection at the level of house containers by installing two types of containers: food and non-food waste [13].

To provide the population of the Voronezh region with accessible information in the field of waste management, the Department of Natural Resources and Ecology of the Voronezh Region plans to create an information system for waste management based on the Regional Waste Cadastre and update the electronic model of the territorial waste management scheme. This, in turn, will require the introduction of new information services, presented in table 2.

Table 2. The main trends of waste recycling industry development in the context of digitalization.

| The main trends of innovate development of IEWC | Content base |
|-----------------------------------------------|--------------|
| Creating a digital base                        | Regional electronic territorial waste management scheme, various databases |
| Digitalization of safe waste management        | Production and implementation of innovative technologies for waste collection, transportation and disposal, automation and robotization of waste sorting and recycling. |
| Creation and implementation of analyzing platforms | Waste generation forecasting systems, optimization logistics schemes for waste transportation |
| Creation and implementation of blockchain platform | A system for ensuring control and transparency throughout the entire waste life cycle. |

The formation and implementation of digital infrastructure will allow achieving sustainable social and economic development of the city and the region.

4 Results
The results of the research allow us to make a conclusion that the transition to a new system of safe waste management is a rather complicated process that requires huge financial costs for the creation of waste sorting complexes, modern landfills for waste disposal, the organization of an effective separate waste collection system, and the development of partnerships with IT-companies and companies that are included in waste processing infrastructure of cluster. Creating favorable conditions for public-private partnership for the implementation of the activities of the subprogram in the field of waste management, as well as fostering a new environmental culture and creating a responsible attitude to consumption will improve the environmental situation in region and in country [20].

References
[1] Zhutaeva E N, Serebryakova E A, Kryuchkova I V 2017 Formation of a new waste management system based on the cluster approach in the Voronezh Region Scientific Journal Economics and Entrepreneurship 9 (part 4) (86-4) (Vol.11 Nom.9-4) pp 979-982.
[2] Zemskova E S 2017 Features of the implementation of cluster policy in the interests of the formation of organized recycling Scientific journal NRU ITMO. Series: Economics and Environmental Management 4 pp 125-134 doi: 10.17586 / 2310-1172-2017-10-4-125-134.
[3] Shokhova P A, Elkina L G, Kopeikina N G 2012 Ecological and economic cluster as a promising direction of greening the economy Bulletin of USATU Economics and national economy management Ufa: USATU, V. 16, 18 (53) pp 170-175.
[4] Zaharchenko E S, Plotnikov A N 2013 Formation and functioning of a cluster of secondary
resources as an institution of innovate development Innovate activity 4 (24) pp 5-7. doi: 10.17686/sced_rusnauka_2013-152

[5] Tskhovrebov E S 2018 Economic and legal aspects of the strategic planning of the waste processing industry (as part of the development of the construction complex) Vestnik MGSU T. 13 Vol. 10, pp 1193-1203 doi: 10.22227/1997-0935.2018.10.1193-1203.

[6] Nikitskaya E F, Poikin A E 2016 Conceptual approaches to the essential characteristics of economic and innovative infrastructure Internet journal "SCIENCE" Vol. 8, 2 http://naukovedenie.ru/PDF/77EVN216.pdf doi: 10.15862/77EVN216.

[7] Somova T N, Oshepkova A Z, Stolbov V A 2012 Waste management infrastructure: from concept to reality Messenger PNIPU. Urban studies, 3 pp 7-23.

[8] Latishova M V 2018 Revolving fund as a tool for improving the financing of infrastructure projects for the disposal of municipal solid waste in Russia Finance and credit T. 24, 5 pp 1178-1194 https://doi.org/10.24891/.

[9] Shingarkina V S 2015 The main organizational and economic problems of the disposal of municipal solid waste Messenger RAN 6 pp 184-193.

[10] Volodin V M, Nadkina N A 2018 Formation of an innovate infrastructure for digitalization of production at industrial facilities and APK Higher Education News Povolzhskii region. Economic studies 8 doi: 10.21685/2309-2874-2018-2-1.

[11] Avdeeva E, Davydova T, Skripnikova N and Kochetova L 2019 Human resource development in the implementation of the concept of “smart cities”, E3S Web Conf., International Science Conference SPbWOSCE-2018 “Business Technologies for Sustainable Urban Development”, 110 02139, 10 p. doi: 10.1051/e3sconf/201911002139

[12] 2015 Decree of the Government of the Voronezh Region of November 11, 856 On approval of the state program of the Voronezh Region Environmental Protection and Natural Resources (as amended on July 13, 2018)

[13] 2017 Decree of the Government of the Voronezh Region of 30.06.2017 524 “On Amendments to the Decree of the Government of the Voronezh Region of 11.11.2015 856”

[14] Napalkova A A, Nasadyuk A E 2015 Status and development trends of the market for services for disposal and processing of municipal solid waste in Asia-Pacific region Messenger DVFU. Economic and management, 2 pp 73-86.

[15] Borodina D https://www.vestifinance.ru/articles/115165

[16] 2012 How to get rid of garbage: to bury or to burn RBK 2013. Access mode: URL: http://top.rbc.ru/economics/16/11/2012/825336.shtml

[17] Malutina A 2015 How to sort and recycle waste in Japan 10.11.2015 Access mode: URL: https://recyclemag.ru/article/kak-sortiruyut-i-pererabatyvayut-musor-v-yaponii

[18] Vladimirov D G, Vorotnikov A M, Ipatova N S, Tarasov B A 2018 Waste management of Smart City using technological intelligent systems Management research magazine. Rubric: Economics, organization and management of facilities, industries, complexes T. 4 9 https://naukaru.ru/ru/nauka/article/23582/view.

[19] Vetrova N M, Gaisarova A A 2017 Development of environmental and economic management of the region: Ecological clusters of industry Scientific notes of the Crimean Federal University named after V.I. Vernadskii Economics and management T. 3 (69) 2. pp 18-26.

[20] Gasilov V V, Karpovich M A, Kryuchkova I V 2014 Model for the implementation of a public-private partnership project in environmental protection Conference proceedings “The international scientific and practical congress of economists and lawyers“ The genesis of genius, Geneva (Switzerland), 31 of January pp 93-98.