Carbon landfills: on the way to carbon neutrality

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Abstract. The development of the bioeconomy is driven by integration, which takes various forms. Natural integration involves business mergers and the creation of diverse organizational relationships, including conglomerates, transnational companies, and cartels, among others. Conversely, disintegration and quasi-integration entail the unbundling of businesses and the formation of formal associations, where the aim is to gain control over other business entities rather than acquiring their assets. An example of quasi-integration can be observed in enterprise clusters, which are groups of geographically localized and interconnected companies sharing common goals and strategies. While the advantages of company participation in clusters were evident at the end of the 20th century, it has become apparent by the early 21st century that integration interactions among companies are assuming new hybrid forms. Consequently, clusters themselves can undergo various transformations over a short period of activity.

1 Introduction

The study of the adoption of environmental innovations in various economic sectors indicates that the overall volume of such innovations in Russian companies remains relatively small [1]. This can be attributed, in part, to the recent pandemic, which had a significant adverse impact on the country's economy. However, there is a commitment from the Russian government to increase momentum and allocate more funding for innovative environmental projects in the near future.

Several key challenges contribute to the limited development of environmental innovations in the Russian Federation. These challenges include:

1. Fragmentation and Lack of Systematization: Administrative-legal documentation related to the regulation of environmental innovations lacks coherence and systematic organization.

2. Funding Shortages: Environmental projects often face a lack of adequate funding, which hampers their development and implementation.

3. Limited Tax Incentives: There is a scarcity of tax incentives to encourage and support environmental innovation initiatives.

4. Regional Administration Incentives: Many regional administrations lack the motivation to actively promote and invest in environmental innovations.

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5. Geopolitical Uncertainties: Political and geopolitical instabilities can act as deterrents to investments in environmental innovation projects.

6. Low Business Culture: The overall level of business culture in the realm of environmental innovation is currently insufficient.

7. Inadequate Support for Agro-Industrial Firms: Growing companies in the agro-industrial sector that offer environmentally friendly solutions receive inadequate support.

8. Underdeveloped Research and Production Facilities: The infrastructure for laboratory research and the development of "green" innovations remains underdeveloped.

9. Sectoral Productivity and Efficiency Challenges: Not all sectors and productions within the "green" economy outperform competitors in terms of productivity and efficiency.

10. Low Environmental Awareness: The general environmental consciousness and awareness within society remain at a low level.

Innovation is currently a driving force that permeates all aspects of society. It's virtually impossible to envision a world devoid of the technological innovations that have already been integrated into our lives, as well as the promising innovations on the horizon. Innovation has evolved into a catalyst for economic growth, societal advancement, and environmental progress in countries worldwide [3].

Consequently, in the near future, science, technology, and innovation will play a pivotal role in realizing the sustainable development goals of the Russian economy. A particularly promising area of development is environmental innovation. Environmental innovation encompasses a spectrum of advancements that can enhance industrial operations, enhance safety, improve living conditions, reduce the depletion of natural resources, and mitigate the adverse effects of industrial emissions and household waste on the environment. Notably, Russia's top political leadership has publicly acknowledged the issue of climate change and expressed a commitment to pursuing a more environmentally conscious path.

The term "ecological innovation" emerged in the latter part of the 20th century. As defined in the EU Eco-Technology Action Plan, green innovation involves the creation, dissemination, or adoption of innovations in products, processes, services, or management and business practices with the aim of reducing adverse environmental impacts and optimizing resource utilization across the entire lifecycle of economic activities.

According to the Russian Federal State Statistics Service (Rosstat), environmental innovations are characterized as "new and significantly improved goods, works, services, production processes, organizational or marketing methods that contribute to increased environmental safety, the prevention of negative environmental impacts, or environmental improvements."

In both research and practice, innovation is perceived as the outcome of long-term projects that involve stages of research and experimentation. Technological innovation in the realm of environmental conservation holds immense significance for businesses. However, statistics indicate that only a limited number of environmental innovations successfully transition to implementation and commercialization. This underscores the importance of continued active efforts by researchers and practitioners in this domain. In contemporary scientific discourse, the topic of innovation is prominently featured within the fields of environmental management, resource conservation, and treatment facilities.

2 Research Methodology

It is evident that the primary reasons for the active adoption of eco-innovations at the macro level are centered around enhancing sustainable development, promoting the transition to a greener economy, improving the quality of life for the population, and preserving natural ecosystems. At the regional level in Russia, the implementation of infrastructure projects

that yield synergistic benefits for the economy is imperative [4]. Eco-innovation serves as a competitive advantage upon which regional authorities can formulate development strategies for their respective areas, be it a region, republic, or city. At the municipal level of urban governance, green technologies contribute to cleaner and more comfortable urban environments for residents. Regional and governmental support for the development of environmental technologies in Russia plays a pivotal role in shaping the development strategy of specific territories or cities, ultimately enhancing their attractiveness to investors. At the micro level of organizations and enterprises, eco-innovations enhance the competitiveness of environmentally friendly products and services, which are experiencing growing demand among the population.

1. Clayton Christensen and Michael Raynor: These authors classified innovations into two categories: "sustaining" and "disruptive." Sustaining innovations aim to enhance existing products within current consumer parameters, while disruptive innovations aim to replace existing products, technologies, industries, and markets with new, user-friendly, cost-effective, and lower-quality alternatives.

2. B. Santo:Santo's definition of innovation as a socio-economic process underscored its potential for both profit and public benefit. He described it as a process that, through the practical application of ideas and inventions, leads to the creation of superior products and technologies.

3. Georges Mensch: Mensch linked the character and intensity of innovation activity with economic growth cycles. He categorized innovations into three primary types: basic, improving, and pseudo-innovations. Mensch considered innovation a crucial tool for enhancing investment efficiency and overcoming stagnation in economic development.

4. R.A. Fatkhutdinov: Fatkhutdinov defined innovation activity as a multifaceted process encompassing strategic marketing, research and development (R&D), organizational and technological preparation, production, design, implementation, and the dissemination of innovations to other domains [6]. He emphasized that innovative activity is characterized by specific actions performed using defined technology and procedures

These definitions and viewpoints offer diverse perspectives on the intricate nature of innovation and its significance in various contexts, ranging from entrepreneurship and economic growth to societal well-being.

3 Results and Discussions

Until now, human progress and development have been closely tied to the pursuit of environmental sustainability, a set of principles that have been globally recognized and embraced within the framework of the UN Millennium Development Goals (fig.1). The global community has long recognized the need to explore new avenues for humanity's development and economic growth. This is exemplified by the United Nations' initiatives aimed at establishing a new economic paradigm based on the concept of the "green economy."

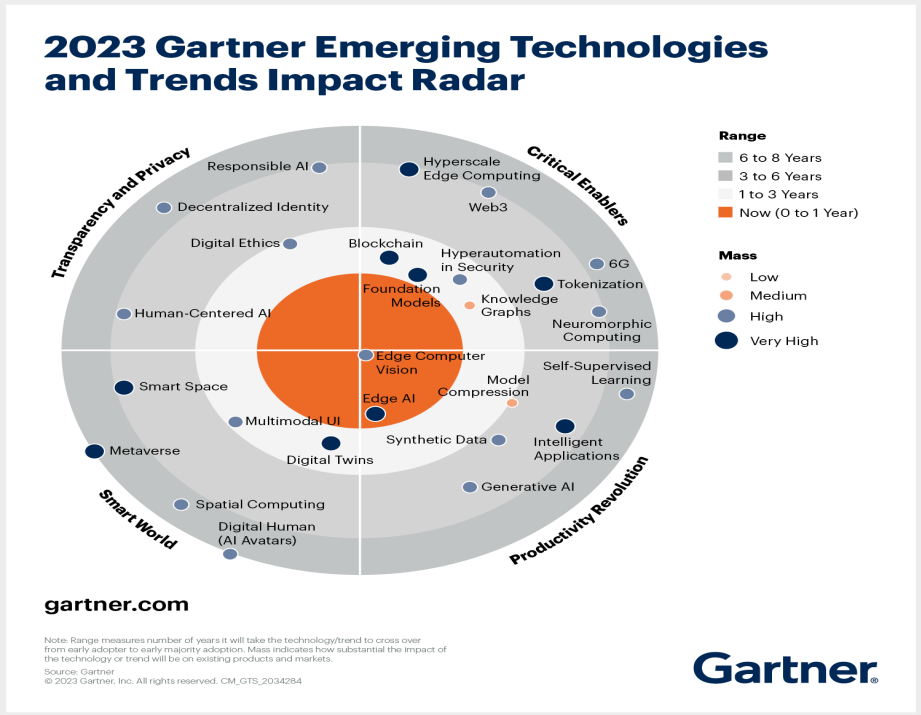

Fig. 1. Emerging Technologies on the 2023 Gartner Impact Radar.

These objectives are outlined in "Transforming Our World: The 2030 Agenda for Sustainable Development," with the goal of achieving them by 2030. The United Nations Environment Programme (UNEP) defines a green economy as an economic system that "fosters well-being and equity while significantly reducing environmental risks and ecological scarcities." In essence, the green economy is an economic model in which income and employment growth are achieved through both public and private investments that lead to reduced greenhouse gas emissions, decreased environmental pollution, improved energy and resource efficiency, and the preservation of biodiversity.

The principles of the green economy are increasingly becoming a central focus in the economic development strategies of numerous countries and regions worldwide [7]. Several countries, including the United States, the Netherlands, Switzerland, the Republic of Korea, Japan, China, and the United Kingdom, among others, have adopted national strategies to promote green economy development.

As per the recommendations of the United Nations Environment Programme (UNEP), a nation's investments in the green economy should amount to at least 1% of its GDP. Notably, East Asian countries such as China (3%), the Republic of Korea (2%), and Japan (1%) meet or exceed this criterion. In contrast, highly developed countries like the United States, Sweden, and Italy invest less than 1% of their GDP in the green economy.

In essence, environmental innovation encompasses the development of new products and processes that prioritize sustainability, minimize the utilization of resources, and reduce the emission of harmful substances [8]. Key areas of innovation within the environmental sector include advancements in technology, the development of efficient waste recycling methods, and the creation of technologies designed to mitigate environmental pollution.

Japan's experience in the field of eco-innovation and the integration of "green" technologies into its economy is highly instructive. Japan, as one of the world's leading economies, stands out for its excellence in eco-innovation and the effective implementation

of environmentally friendly technologies. Despite being the third-largest economy globally, Japan distinguishes itself with its advanced high-tech industries, particularly in electronics and robotics. Notably, Japan boasts a predominantly small and medium-sized business landscape, with nearly 99% of its companies falling into this category. However, environmental technologies play a significant role in Japanese research and development efforts.

Japan's New Growth Strategy, released in 2020, serves as a pivotal document outlining the nation's development direction until 2050 [9]. This strategy identifies environmentally oriented innovation as one of Japan's most rapidly advancing sectors and one of seven key areas for the country's strategic development. Recent emphasis in fundamental research has focused on environmental technologies that address climate change-related challenges. This includes advancements in energy conservation, energy efficiency, and low-carbon energy production, encompassing a broad spectrum of industries.

Japan has also concentrated on modernizing its transportation sector by developing smart transport systems, fuel cell vehicles, hybrid engines with plug-in rechargeable electric transmissions, and the production of biofuels for transportation. Moreover, Japan places a traditional priority on developing technologies to prevent environmental pollution, especially air pollution, as well as technologies for water and soil pollution control and waste management.

Japan has established a well-structured system for the development and implementation of environmental technologies, which includes government programs and initiatives from businesses and the public. Key features of Japan's innovative environmental development include [10]:

1. Government Support: The Japanese government actively determines the directions for innovative development within the environmental sector and addresses financing challenges associated with new product development.

2. Role of Small and Medium-sized Businesses: Small and medium-sized enterprises play a dynamic role in Japan's economy, driving the development and adoption of innovative solutions in production processes.

3. Intellectual Property: Japan places significant emphasis on intellectual property development, particularly patenting within the country.

4. Promotion of Domestic Innovation: Japan encourages domestic innovation, shifting from purchasing patents and licenses abroad to fostering national developments.

5. Cluster Regional Policy:nThe Japanese government has successfully adapted the cluster concept from the United States, fostering the development of clusters as a fundamental element of innovation policy [11].

6. Venture Sector: Japan's risk sector contributes to the growth of small and medium-sized businesses, identifying the most competitive modern solutions and promoting advanced technologies in both domestic and foreign markets.

Japan's comprehensive approach to eco-innovation serves as a model for countries seeking to advance their environmental technologies and contribute to sustainable economic growth.

4 Conclusions

In Russia, there is a growing trend where society is becoming increasingly concerned about improving the quality of life and ensuring environmental safety. Within this context, environmental innovations play a pivotal role and warrant more attention and focus on their implementation within enterprises. Experts often assert that Russia is still in the early stages of incorporating and developing environmental innovations.

The adoption of innovative, environmentally friendly, and economically viable technologies by enterprises offers several advantages. Firstly, it enhances the cost-effectiveness and efficiency of production processes, making businesses more competitive and profitable. Secondly, it promotes the adoption of sustainable practices, which is essential for addressing environmental concerns and reducing the ecological footprint of industrial activities.

To fully embrace environmental innovations, enterprises need to enhance their corporate governance practices and become more transparent and accountable. This shift towards a "green" economy not only benefits businesses but also has positive implications for social factors that significantly influence the quality of life for the population. Therefore, fostering environmental innovations in Russia is not only an economic necessity but also a crucial step toward achieving a higher quality of life and addressing environmental challenges.

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