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Shmygol Nadiia
Doctor of Economics, Professor
Zaporizhzhia Polytechnic National University;
Warsaw University of Technology, Poland
ORCID: https://orcid.org/0000-0001-5932-6580

Antoniuk Anatolii
Collegium Civitas, Poland
ORCID: https://orcid.org/0009-0003-2577-5160

Trokhymets Olena
Doctor of Economic Sciences, Professor,
Professor at the Department of National Economy,
Marketing and International Economic Relations
Classic Private University
ORCID: https://orcid.org/0000-0001-7587-7948

Шмиголь Н.М.
Національний університет «Запорізька політехніка»;
Warsaw University of Technology, Poland

Антонюк А.А.
Collegium Civitas, Poland

Трохимець О.І.
Класичний приватний університет

CIRCULAR ECONOMY AS A STRATEGIC DIRECTION OF SUSTAINABLE DEVELOPMENT: GLOBAL AND NATIONAL ASPECTS

ЦИРКУЛЯРНА ЕКОНОМІКА ЯК СТРАТЕГІЧНИЙ НАПРЯМ СТАЛОГО РОЗВИТКУ: ГЛОБАЛЬНИЙ ТА НАЦІОНАЛЬНИЙ АСПЕКТИ

The article presents a comprehensive analysis of the concept of the circular economy as an important element of strategic sustainable development, which has become highly relevant in the face of global environmental and economic challenges. The author analyzes the experience of European Union countries in applying the principles of the circular economy, with particular emphasis on various management tools, including the adaptation of the legal and regulatory framework, innovative approaches to waste management, and the development of the green economy. The article discusses the hierarchy of priorities in waste management, which includes preventing waste generation, reusing, recycling, and disposal. These principles should serve as the foundation for all government policies and initiatives aimed at reducing environmental impact and achieving more sustainable economic development. It examines various regulatory models that contribute to improving the efficiency of economic systems and reducing environmental pollution. The article also offers practical recommendations for the implementation of European approaches in Ukraine, taking into account national characteristics, economic, and environmental factors. It addresses the importance of increasing the efficiency of the national economy through investments in "green" technologies and recycling infrastructure. The recommendations provided in the article are focused on overcoming challenges encountered on the way to a circular economy, such as insufficient funding for recycling infrastructure, the lack of advanced recycling technologies, low public and business awareness of the benefits of a circular economy, and insufficient support from government bodies. Overall, the article highlights the importance of the circular economy as a strategy for sustainable development at the global level, as well as its adaptation and implementation in national strategies, particularly in Ukraine.

Keywords: *circular economy, closed-loop economy, waste management, sustainable development, green economy, waste recycling, innovative strategies.*

У статті здійснено комплексний аналіз концепції циркулярної економіки як важливого елементу стратегічного сталого розвитку, що стає надзвичайно актуальним на тлі глобальних екологічних та економічних викликів. Автор статті аналізує досвід країн Європейського Союзу в застосуванні принципів циркулярної економіки, приділяючи особливу увагу різноманітним інструментам управління, включаючи адаптацію нормативно-правової бази, інноваційні підходи до управління відходами та розвиток зеленої економіки. У статті розглянута ієрархія пріоритетів у сфері поводження з відходами, яка охоплює профілактику їх утворення, повторне використання, переробку та утилізацію. Ці принципи мають стати основою для всіх державних політик та ініціатив, спрямованих на зменшення негативного впливу на навколишнє середовище та досягнення більш сталого економічного розвитку. Розглянуто різні моделі регулювання цієї сфери, які сприяють підвищенню ефективності економічних систем, а також зниженню рівня забруднення довкілля. У статті запропоновано кілька практичних рекомендацій для імплементації європейських підходів в Україні, враховуючи національні особливості, економічні та екологічні фактори. Порушені питання важливості підвищення ефективності національної економіки шляхом інвестицій у «зелені» технології та інфраструктуру переробки. Рекомендації, що надані в статті, направлені на подолання проблем, які виникають на шляху до циркулярної економіки, таких як недостатнє фінансування інфраструктури переробки, відсутність розвинених технологій переробки, низька поінформованість громадян та підприємств щодо переваг циркулярної економіки, а також недостатня підтримка з боку державних органів. Загалом, стаття підкреслює важливість циркулярної економіки як стратегії сталого розвитку на глобальному рівні, а також її адаптацію та імплементацію в національні стратегії країн, зокрема України.

Ключові слова: *циркулярна економіка, економіка замкненого циклу, управління відходами, сталий розвиток, зелена економіка, переробка відходів, інноваційні стратегії.*

Statement of the problem. The global economy is undergoing a profound transformation as traditional linear models of production and consumption are increasingly being challenged by the need for sustainable practices. The linear approach, characterized by the "take, make, dispose" paradigm, has led to significant resource depletion and environmental damage. This model, which relies heavily on the extraction of raw materials, high-energy production processes, and disposal of waste, is no longer viable in a world facing limited resources and escalating climate challenges. The transition to a circular economy (CE) represents an essential response to these issues, offering a framework that emphasizes resource efficiency, waste reduction, and the continuous use of materials.

The concept of the circular economy is rooted in principles that challenge the traditional notions of resource utilization. At its core, the CE model seeks to keep materials and products in use for as long as possible by designing systems that eliminate waste and ensure the maximum recovery of resources. By transitioning to such a model, industries and societies can reduce their dependence on finite resources, mitigate environmental impacts, and foster economic growth through innovation and new business models. The European Union has been at the forefront of promoting the circular economy, implementing ambitious policies and directives aimed at creating a more sustainable future.

For Ukraine, the need to embrace the principles of the circular economy is particularly pressing. The country faces significant challenges related to waste management, inefficient use of resources, and environmental degradation. These problems are exacerbated by outdated industrial practices, insufficient investment in modern infrastructure, and a lack of public awareness about sustainability issues. Moreover, Ukraine's commitment to align its policies with European standards, as part of its Association Agreement with the EU, adds urgency to the task of modernizing its approach to resource management and environmental protection. Despite some initial efforts to reform waste management systems and integrate sustainable practices, Ukraine remains far from achieving the goals outlined in the EU's Circular Economy Action Plan.

The scale of the problem is immense. Ukraine generates millions of tons of waste annually, much of which is either landfilled or improperly disposed of, leading to severe environmental consequences. The absence of effective waste separation and recycling systems further compounds the issue, resulting in the loss of valuable materials that could otherwise be reused or repurposed. The lack of a cohesive national strategy for implementing circular economy principles underscores the need for a comprehensive approach that addresses the root causes of these problems while leveraging international best practices to create a sustainable framework for the future.

The Objectives of This Article are as Follows. This article seeks to address the challenges and opportunities associated with Ukraine's transition to a circular economy by providing a detailed analysis of the current state of waste management and resource utilization. It aims to highlight the inefficiencies and environmental consequences of the linear economic model, while drawing on successful examples from EU countries to offer actionable insights for Ukraine. The objectives include exploring the principles of the circular economy and their relevance to Ukraine's economic and environmental contexts. In addition, this article seeks to identify the barriers to implementing circular practices in Ukraine, including legislative, technological, and social challenges.

Another key objective is to propose a roadmap for the successful adoption of circular economy principles, emphasizing the importance of policy reform, investment in infrastructure, and public awareness campaigns. This involves analyzing the role of international cooperation, particularly with the European Union, in providing financial and technical support to facilitate Ukraine's

transition. Furthermore, the article aims to underline the potential economic benefits of the circular economy, such as job creation, cost savings, and the stimulation of innovation, which are critical for Ukraine's economic recovery and long-term growth.

By addressing these objectives, this article seeks to contribute to the ongoing dialogue about sustainable development in Ukraine and provide a foundation for further research and policy development in this field. The overarching goal is to demonstrate that the circular economy is not only an environmental imperative but also a powerful driver of economic transformation and resilience.

International and national agreements and strategies concerning sustainable development typically include principles that should guide decision-making at various levels. Most of these principles stem from two key concepts:

– **"The Concept of Needs"**: This emphasizes the importance of addressing the needs of the most vulnerable populations.

– **"The Concept of Limits"**: This refers to the environmental limitations, specifically the capacity of ecosystems to meet human needs.

The general principles of governance incorporating the concepts of sustainable development include:

– Human habitation and activities should operate within **"ecological boundaries"**.

– Decision-making should adopt a comprehensive approach, involving collaboration among governments at all levels (policies and legislation that complement one another), and governance should be democratic, transparent, inclusive, and involve active public participation.

– The use of reliable and scientific evidence should guide responsible decision-making.

In addition to these principles, sustainable development integrates widely recognized frameworks, such as the **"Precautionary Principle"** and the **"Polluter Pays Principle"**, particularly in environmental decision-making:

– **The Precautionary Principle**: This principle is applied when there is a risk that human activities could lead to significant harm in the future. The absence of complete scientific certainty (regarding causes or effects) should not be used as a justification for inaction, provided that actions are proportional and that the costs and benefits of action versus inaction are appropriately assessed. This principle is frequently cited in arguments for taking measures to mitigate climate change.

– **The Polluter Pays Principle**: This ensures that external costs, such as those related to air pollution or climate change impacts caused by a specific activity, are not borne by third parties. For instance, the EU Emissions Trading Scheme exemplifies this principle, where industries that generate carbon emissions bear the financial cost of carbon pricing.

The concept of **"ecological boundaries"** is particularly intriguing within sustainable development. A working group of scientists at the Stockholm Resilience Centre has conducted extensive research into these boundaries and presented their findings (including on their website). They define **"ecological boundaries"** as global Earth systems and processes that delineate a safe operating space for humanity and wildlife.

Scientists [2–9] identified **nine key planetary boundaries**. According to their findings, the aim was to define a "safe operating space for humanity" to guide the international community, including governments at all levels, international organizations, civil society, and the scientific community, as prerequisites for sustainable development. The researchers emphasized that exceeding one or more of these boundaries could lead to tipping points, causing Earth's systems to shift into a permanently degraded state.

According to the Stockholm Centre, recent studies show that the Earth has already exceeded four of these nine indicators, namely: climate change, biosphere integrity (biodiversity loss), land-system change, and biogeochemical flows. Scientists have not yet determined the thresholds for three of the boundaries, as defining the global tipping point for sustainability requires an analysis of many individual components and their interactions. This complexity makes it challenging to define the size and borders of the "global boundary" for sustainability [10–11].

Now, let's consider the relationship between the circular economy and sustainability. First and foremost, the circular economy focuses on maximizing

Table 1

Nine Planetary Boundaries

Planetary Boundary	Safe Threshold	Current Status
Climate Change	CO_2 concentration below 350 ppm	Exceeded (current: ~420 ppm)
Biodiversity Loss	< 10 species lost per million species per year	Exceeded (current: 100–1,000 species/ year)
Biogeochemical Flows	Nitrogen: < 62 Tg/year; Phosphorus: < 6.2 Tg/year	Exceeded
Ocean Acidification	Aragonite saturation state > 2.75	Approaching threshold
Land-System Change	< 15 % of global ice-free land converted	Exceeded (current: ~23 %)
Freshwater Use	< 4,000 km³/year	Within limits
Atmospheric Aerosol Loading	No global threshold; localized impacts significant	Unquantified
Ozone Depletion	Stratospheric ozone > 276 Dobson units	Within limits
Novel Entities	Safe threshold not yet defined	Increasing concern

value and eliminating waste through improvements in material, product, system, and business model design, specifically:

– Reducing the use of virgin (raw) materials and non-renewable resources while increasing the use of renewable resources and recycled materials.

– Shifting from “waste management” to “resource recovery,” where everything holds value, and zero waste goes to landfills.

– Transitioning from linear supply chains, which produce single-use products, to circular supply chains that provide ongoing services (Product-as-a-Service).

– Dramatically reducing the negative environmental aspects of economic development (such as waste and pollution) through carbon neutrality, the use of non-toxic materials, and other strategies.

In traditional economics, materials move through a linear process of extraction, production, consumption, and final disposal ("take-make-dispose"). This model is limiting and problematic, as it is inherently inefficient, wastes valuable resources, and creates significant risks to both human health and the environment. Even more critically, it implies unlimited access to Earth’s resources, despite the fact that this is untrue. In contrast, the circular economy aims to eliminate or minimize waste by recycling, reusing, and repurposing products and materials in interconnected systems, biological cycles, and markets (“use-return”). Furthermore, it requires that products be designed with a “purpose in mind”. The circular economy is quickly becoming an unifying model for industry and society, responding to modern linear models of production and consumption. However, there are many different schools of thought underlying the circular economy and varying levels of ambition in solving the challenges within industry decisions. To analyze the effectiveness of implementing the principles of the circular economy, key indicators in different countries were studied. The results reflect differences in the level of development of waste management policies, the availability of recycling technologies, and the involvement of the population in sustainable consumption processes.

As seen from the table, Germany and Sweden demonstrate the highest levels of waste recycling and the use of secondary materials in production. This is due to the presence of comprehensive national programs and the availability of technologies. Meanwhile, Ukraine faces significant challenges due to limited funding and an inadequate regulatory framework.

Is it enough to achieve circularity only for the existing types of goods and services we know today? What will we need in the future, and what will business require in the future?

Although the concept of a circular economy is clearly necessary for businesses and society to become sustainable, it is not sufficient on its own to achieve a sustainable future [12–13]. This is because the current definition and implementation of the circular economy do not account for the fact that not all aspects of the economy can be expressed in “circular flows,” and that not all materials should circulate. In fact, some should gradually be phased out. For example, they may be toxic and constantly seep into the natural environment. It also does not explain which portion of a given material can be extracted or circulated without posing a risk to natural systems.

Given the increasing pressure on the planet and global society from population growth, rising affluence, increased consumption, and decreasing trust in governments and corporations, it is clear that the entire economy must be rethought and restructured. The goal is to link the trend towards circularity with holistic sustainable development objectives, such as the United Nations Sustainable Development Goals, and the aspiration for a “safe operating space for humanity,” which allows everyone to meet their needs within the limits of the planet. It is crucial that we create a shared understanding of how these different goals (sustainable development and the circular economy) are connected, and learn to work and think together in order to make the transition as quickly as possible. It is time for us to step into the future with the aim of freeing ourselves from our current exploitative mindset and the limitations of what is possible. This requires creativity, leadership, and a paradigm shift in thinking. One method called “backcasting” has been developed to create visions that help leaders bend trends from what is likely to what is desired and needed in the future. Starting with the end in mind changes the way we plan today and how we transition from the current reality to the desired future in the shortest time possible. Backcasting from sustainability principles or systems to sustainability conditions is the key concept of the “Strategic Sustainable Development Framework”, initiated by Karl-Henrik Robert, founder of the international nonprofit organization “The Natural Step”, which conducts applied research on sustainable development. It has been refined and validated through expert evaluation and business application. Sustainability for leaders is designed to provide you with the necessary knowledge and tools to be “fit for the future.” This will help understand how to transform an organization into a sustainable future using the globally recognized strategic sustainability framework “The Natural Step (FSSD)” and achieve strategic advantage and long-term leadership in the industry or community.

Table 2

Key Indicators of the Circular Economy by Country

Indicator	European Union (EU)	Sweden	Germany	Ukraine
Waste recycling rate (%)	47 %	49 %	67 %	7 %
Waste volume per person per year (kg)	492	456	411	300
Share of secondary materials in production (%)	12 %	14 %	15 %	3 %
Number of laws regulating circular economy	High	High	High	Low

Table 3

Circular Economy Support Programs

Direction	EU	Sweden	Germany	Ukraine
Subsidies for business	Yes	Yes	Yes	Rarely
Tax incentives	For eco-friendly products	For the use of secondary raw materials	For implementing technologies	Practically absent
Educational programs	For schools, universities, and the public	Active campaigns	Active campaigns	Rare
Recycling infrastructure	Developed	Well-developed	Excellent	Poorly developed

Table 4

Key Strategies and Initiatives

Strategy / Initiative	EU	Sweden	Germany	Ukraine
Transition to renewable energy sources	European Green Deal	Full use of renewable energy sources	Reducing dependence on coal	Low implementation level
Development of industrial symbiosis	Moderate development	Limited	Developed network	Rare
Implementation of zero-waste principles	Supported at policy level	Widespread	Gradual implementation	Local initiatives
Development of recycling technologies	Active investment	Modernized plants	Modern systems	Limited funding

For a deeper analysis, we studied the mechanisms of support for the circular economy used in various countries. It was found that the most successful countries apply a wide range of tools, including subsidies, tax incentives, and educational programs.

Sustainable socio-economic development based on the linear economic model, alongside the obvious advantages in the growth of public welfare, has significant drawbacks in the long term, which pose a threat to the energy, environmental, and economic security of the state. The negative consequences of the linear economy manifest as:

– Uncontrolled use of natural resources, which over time leads to their depletion, scarcity, and rising prices.

– Environmental pollution resulting from atmospheric emissions, including carbon dioxide, the use of fresh water, deforestation, and the application of fertilizers and pesticides.

– Accumulation of waste, with landfills currently occupying about 7 % of Ukraine's total territory, among other issues.

European countries with highly developed market economies recognized these threats as early as the 1960s. As a result, there was a radical shift in the concept of sustainable economic development, with one of its main components being the recognition of the ecological aspect and rational natural resource management based on full environmental regeneration. Consequently, the linear economic model was transformed into a circular model, whose main feature is a closed loop of material resource consumption. Today, the circular economy involves:

– The endless use of waste as raw material for the repeated production of goods.

– The implementation of innovative technologies aimed at increasing resource efficiency in all areas of activity to reduce the consumption of natural resources.

– The transition to ecological and renewable energy sources.

– The reduction of environmental pollution and the volume of accumulated waste.

Additionally, a comparison of strategies and initiatives in different countries was conducted. This allowed the identification of priority areas and approaches to the implementation of the circular economy.

The practical application of the aforementioned principles requires appropriate technologies, which, in turn, depend on the state of research and development and available investment resources. Therefore, each developed country in Western Europe had its own unique path to transforming into a circular economy. This process is still ongoing today. The creation of the European Union, firstly, contributed to the rapid technological dissemination of successful experiences, and secondly, allowed for the establishment of common principles for environmental protection and requirements for products, their manufacturers, and consumers. The management of the implementation of circular economy principles in Ukraine, in the context of sustainable industry development, should be based on the results of previous analysis. The purpose of this analysis is to assess the current state, dynamics, and nature of changes that occurred during the reporting period.

Conclusions. The analysis of sustainable development concepts and principles serves as the foundation for determining the approach to governance, both at the national level and within specific industries, taking into account growth limitations. This approach will be aimed at minimizing negative externalities and assessing the safe operating space for human development. In conclusion, achieving sustainable development

requires a comprehensive and integrated strategy that involves all levels of government, business, and society. This includes promoting policies that not only protect the environment but also support economic growth and social inclusion. Governments must foster innovation, provide incentives for green technologies, and ensure that industries transition toward circular models, all while ensuring the long-term well-being of both the planet and its inhabitants. Furthermore, it is essential that businesses, governments, and communities work together to develop and implement frameworks that support the transition to a circular economy. This can be achieved through collaborative efforts in research, technology development, and the creation of regulatory structures that encourage sustainable practices. By adopting these principles, it is possible to create a more resilient, equitable, and sustainable future for all.

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