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Paths to Sustainable Development: Ecological (R)evolution

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Abstract. There is increasing talk about the need for mechanisms to reduce the pressure on our planet and the benefits of moving towards a green economy. In this regard, attention is focused on various packages of economic indicators, including several stages - from the creation of the product and its consumption to the need for waste management at the end of its life cycle. The circular economy is a model aimed at extending the life cycle of products. The aim of this study is to synthesize the main strategies and principles for sustainable waste management, the pros and cons of the circular economy, as well as to outline some potential paths for the transition to a circular economy. The relevance of the study is determined by modern trends in harmonizing policies and national measures for the management of packaging and packaging waste. Improving the quality of the environment by preventing and reducing the impact of packaging and packaging waste, preventing the production of packaging waste and promoting the reuse, recycling and other forms of recovery of packaging waste instead of its final disposal, thus contributing to the transition to a circular economy.

Key words: management, waste, circular economy, mechanisms, sustainability.

Introduction

The demand for raw materials and energy resources is growing, but many of them are limited in quantity. They are often not available within the EU and European countries become dependent on imports from other countries. The effect on the environment should not be underestimated - the extraction and consumption of raw materials increases energy consumption and greenhouse gas emissions. A more rational use of raw materials is also a measure against climate change.

The transition from waste management to a green economy is a key aspect of sustainable development, requiring a transformation in the way societies generate, treat and use resources. In traditional management models, waste is mainly seen as an end product of production and consumption processes, while in the concept of a green economy it is perceived as a valuable resource for reuse and recycling. According to a report by the Organization for Economic Cooperation and Development (OECD, 2021), the transition to a circular economy could reduce global carbon emissions by up to 39% and bring economic benefits through the creation of new industries and jobs. The European Commission also emphasizes that "the transition to a green economy requires a coherent policy to reduce waste, improve resource efficiency and promote eco-innovation" (European Commission, 2020). In Bulgaria, the Waste Management Act (WMA, 2012) provides the regulatory framework for the implementation of green economy principles, including waste prevention, reuse, and recycling (Ministry of Environment and Water, 2023). However, the transition requires significant investments, technological innovation, and an active role of business and civil society (Georgiev et al., 2022).

The aim of this study is to synthesize the main strategies and principles for sustainable waste management, the pros and cons of the circular economy, as well as to outline some potential paths for the transition to a circular economy.

The concept of the circular economy

The circular economy is a concept in which growth and prosperity are decoupled from the consumption of natural resources and the destruction of ecosystems. It is a strategy for securing natural resources so that all people can reach an acceptable level of prosperity without destroying the planet in the process.

Traditional waste management focuses on the collection, treatment, and disposal of waste, while the circular economy model seeks to prevent its formation at the design stage of products and production processes (Directive 2008/98/EC of the European Parliament and of the Council on Waste). The main principles of this model include:

- Waste prevention through eco-design and extending the life cycle of products.
- Reuse and recycling of materials, to reduce the need for new raw materials.
- Introducing innovations in resource management processes, including the use of biotechnology and renewable energy sources.

The circular economy is a model aimed at extending the life cycle of products. In practice, this means sharing, borrowing, reusing, repairing, and recycling existing materials and products for as long as possible. When a product reaches the end of its life, the materials it is made of continue to be used in other ways (Fig. 1).

This minimizes the generation of waste due to:

- Design for Longevity - Products are designed to be durable, repairable, and easy to upgrade to extend their usable life.
- Production - Manufacturing processes prioritize sustainable inputs, energy efficiency, and minimal environmental impact.
- Consumption - Consumers are encouraged to use products responsibly, focusing on maintenance and efficient resource use.
- Reuse & Repair - Products and components are reused or repaired to avoid waste and retain value.
- Recycle & Recovery - Materials are recovered and processed to re-enter manufacturing cycles, minimizing the need for virgin resources.
- Back to Production - Recovered and recycled materials are integrated into new products, closing the resource loop.

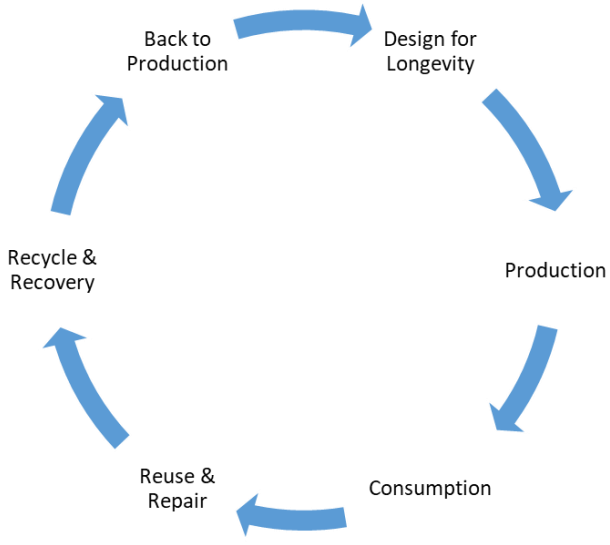

Fig. 1. Steps in the Circular Economy.

Circular business models serve to reduce the extraction and use of natural resources. As a result, the generation of industrial and municipal waste also decreases. They are key activities needed for the transition to a more efficient use of resources and a circular economy.

Circular business models use already existing materials and products as inputs and therefore

have a significantly smaller environmental footprint than traditional business models (Fig. 2).

The need for a circular economy is justified by the argument that the economy follows a linear model: extraction - production - consumption - waste, which is not sustainable because it requires continuous extraction of new raw materials. The idea is to arrange everything so that materials rotate in a circle for as long as possible. To form minimal amounts of waste and thus reduce the need for the extraction of primary raw materials and dependence on imports.

Such a growth model, in which natural resources are extracted, converted into products within the framework of production, which are driven by the growth of heavy industry and infrastructure, is particularly intensive in the use of resources, which are ultimately discarded. This leads to resource shortages and environmental pollution.

Fig. 2. Spiral Resource Flow.

Today, people extract and use about 50% more natural resources than 30 or 50 years ago. The majority of consumption is in industrialized countries. Rich countries with about a billion and a half people consume about ten times more resources than the rest of the world. Large countries like India and China are also pursuing economic growth, and their need for resources is growing rapidly. Approximately three billion new middle-class consumers are expected by 2030, which requires the search for new business models now if humanity is to continue to exist on this planet (Stahel, 2016).

Some policies and strategies at European and national level

The ***European Green Deal*** (2019) focuses on taking action to ensure that environmental and climate issues are addressed, thus ensuring a sustainable future for future generations. Achieving climate neutrality by 2050 is the most important priority. By moving to a circular economy, which is one of the focuses of the pact, the aim is to strengthen the competitiveness of the economy and increase the GDP of the community by 0.5% by 2030. In April 2020, an Advisory Council on the European Green Deal was established in the country. Among the main roles of the Council is to advise and assist the Council of Ministers in achieving a balance and reconciling national priorities in the areas of energy security, accelerated economic development, social justice, and environmental protection.

As part of the European Green Deal, in March 2020, the EC published a ***New Action Plan towards a Circular Economy*** with measures to accelerate the transition to a sustainable model and the recovery of natural resources, thereby reducing the impact on the environment and society. The new Action Plan aims to: establish a framework for sustainable product policy; key value chains in the field of products; a more effective waste policy aimed at their prevention, reuse, and recovery; create circular models for the benefit of people, regions, and cities.

The ***Plastics Strategy for a Circular Economy*** (2018) provides guidance on the use of plastics, highlighting the need to increase the recycling and recovery of plastic materials. By 2030, all plastic packaging must be recyclable or reusable. Member States also have targets to achieve a 25% recycled content of plastic in PET bottles by 2025, and all bottles must be made from at least 30% recycled materials by 2030. In addition, plastic products such as forks, knives, spoons, plates, and straws will be banned.

The ***European Industrial Strategy*** (2020) envisages reorganizing industry, supporting small and medium-sized enterprises (SMEs) in the transition, preserving Europe's sustainability and competitiveness, based on the green transition, digitalization, and setting global standards.

From Farm to Fork (2020) is a strategy to build sustainable food chains to protect nature, provide healthy food and support farmers, and to reduce the use of chemicals, pesticides, and fertilizers in growing crops. Among the main objectives of the Strategy is to reduce food loss and waste. The Commission is committed to halving food waste per capita at the retail and consumer level by 2030.

National Strategy for Small and Medium-sized Enterprises 2021-2027 sets out six priorities, one of which is "Environment". The measures under this priority include: support for improving the energy and resource efficiency of SMEs and increased use of renewable energy sources; certification of SMEs for environmental management; increasing the capacity of SMEs in the transition to a circular economy; and promoting environmentally friendly products through the EU Ecolabel. Regarding the measure related to the circular economy, the aim of the SME Strategy is a better inclusion of SMEs in the circular economy, better recycling practices in the largest waste-generating SMEs; more effective extended producer responsibility schemes covering more waste streams, wider use of secondary materials by Bulgarian SMEs, including through industrial symbiosis.

The ***National Programme for Innovation and Competitiveness 2021-2027*** has been developed in response to the European Green Deal. Among the three main priorities of the Programme is the "Circular Economy". The measures that will be supported under this priority include: investments in the use of alternative raw materials, the use of recycled materials as raw materials and the reuse of materials; improving waste management in enterprises, including the introduction of zero-waste technologies; the production of "green products", including eco-design; the redirection of production from single-use to reusable products and the modernization of products to extend their life; more sustainable production processes with minimal use of chemicals and harmful substances; the creation of partnerships between enterprises to achieve industrial symbiosis - sharing resources, services, secondary products, creating a connection between productions, in which waste from one is a raw material for the other; industry platforms for the exchange of good practices.

The ***National Programme for the Environment 2021-2027*** aims at "promoting the transition to a circular economy". To achieve this objective, the Programme envisages supporting measures related to the prevention of municipal waste generation, the construction of centers for preparation for reuse and repair, waste recycling, the development of the separate waste collection system and raising awareness of practices and behavior related to sustainable consumption, the circular economy and waste monitoring. Measures for the development of infrastructure related to municipal waste management at the regional level to achieve the 2030 targets for waste recycling and landfilling will also be supported.

The transition towards a circular economy in waste management

The Industrial Revolution created unprecedented growth and increased consumption of a variety of goods and services and established a linear economic approach of resource use, production of goods, consumption and disposal of unnecessary and unwanted goods and materials. The creation and destruction of value inherent in the linear economy leads to an increasing amount of waste, which means resource and financial losses, as well as the depletion of non-renewable and scarce resources and the deterioration of the environment. The destruction of value inherent in the linear economy also suggests the potential for an alternative approach, circular and restorative (Kirchherr et al., 2017).

The transition from a linear economy to a circular economy (Fig. 3) is a fundamental change in the economic order. This change must encompass the entire production cycle - product design, the movement of material flows, the creation of the right incentives and legal structures to stimulate business ideas. A change in the way consumers think is essential for these business ideas to be realized.

The transition to a circular economy requires action at many levels - international, European, national, local, business, and individual - and in many policy areas - waste management, vocational training, packaging and product design, research and development, and finance. Aspects of external trade and existing EU policies, such as the internal market, need to be taken into account.

The EU's growth strategy for the end of the decade aims to achieve a smart, sustainable, and inclusive economy, with high employment, productivity and social cohesion. The key initiative at the moment is the circular economy - an economy that produces virtually no waste. Resource and energy efficiency are the two main focuses of all discussions on sustainability. The European Union addresses sustainability in several aspects as demonstrated on Fig. 3.

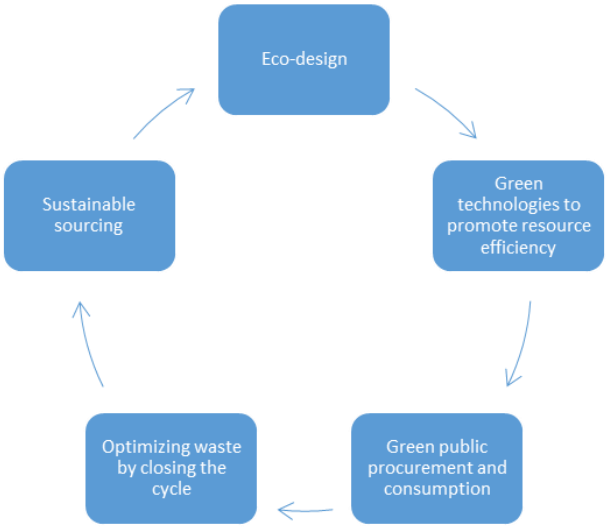

Fig. 3. Strategic Pillars for Circular Economy Transition.

Circular economy – pros and cons

According to the Ellen MacArthur Foundation report (2021), the circular economy could save over $1 trillion globally through more efficient use of resources. The circular economy can deliver savings for businesses and consumers through improved resource efficiency. Estimates suggest that by 2030, moving to a circular economy could reduce the EU's net resource costs by €600 billion per year, with total benefits estimated at €1.8 trillion per year after taking into account multiplier effects. Furthermore, research shows that stricter environmental legislation can provide a competitive advantage for businesses.

Advantages:

Resource Efficiency: Promotes the efficient use of resources, reducing dependency on raw materials and mitigating environmental impact.

Economic Growth and Job Creation: Can stimulate innovation and new business models, leading to job creation in sectors such as recycling, remanufacturing, and sustainable product design.

Environmental Protection: By prioritizing renewable materials and energy, the circular economy helps in reducing greenhouse gas emissions and pollution, thereby protecting ecosystems.

Sustainability: Encourages sustainable consumption patterns, contributing to long-term environmental health, which is essential for global development.

Resilience: Reduces reliance on imported materials and improves a country's resilience against global supply chain disruptions.

Disadvantages:

Initial Costs: Transitioning to a circular model can involve significant upfront investments in technology and infrastructure which might be challenging for developing economies.

Technological Dependency: Reliance on advanced digital technologies could widen the gap between developed and developing nations.

Regulatory Challenges: Implementing and enforcing regulations that support circular economy practices can be complex and require extensive changes to existing legal frameworks.

Market Dynamics: The shift could disrupt existing markets and industries, leading to short-term economic and social challenges such as job losses in traditional sectors.

Cultural and Behavioral Change: Requires a substantial shift in consumer behavior and busi-

ness practices which can be difficult to achieve and slow to evolve.

In summary, while a circular economy offers a pathway towards sustainable and inclusive growth, its successful implementation in international development contexts requires careful consideration of the economic, technological, and social factors.

The transition to a circular economy in Bulgaria – is it happening and where are we?

The transition of production to a circular economy is assessed by a set of indicators such as resource productivity, contribution of recycled materials to the demand for raw materials, amount of investment and added value in sectors related to the circular economy, innovations, eco-innovations and their results, etc. (Geissdoerfer et al., 2017).

The Bulgaria resource productivity, measured as a ratio of GDP and the amount of natural resources used, is one of the lowest in the EU. The amount of resources used depends on various factors, such as the structure of the economy (relatively high share of the mining industry in our country), the use of fuels for energy production, the implementation of large-scale infrastructure projects after the country's accession to the EU, as well as the preferential use of primary raw materials and resources, the use of outdated equipment and technologies.

The indicators for the relative share of value added and gross investment in fixed assets in the recycling and repair and reuse sectors for Bulgaria are higher than the EU average, and for the number of employees – equal to the EU average. There are no patents related to recycling and secondary raw materials in our country.

The development of innovation and in particular eco-innovation is a key part of the concept of achieving a Circular Economy. According to EC and Eurostat data, Bulgaria ranks second to last in the EU in terms of the eco-innovation index.

Small and medium-sized enterprises (SMEs) are the backbone of the economy. SMEs contribute to 76% of total employment and 65% of value added in the Bulgarian economy in 2018, a share higher than the EU average (56%). The competetiveness, innovativeness of the country's economy and its growth depend largely on the development of SMEs and the support they receive.

The share of SMEs offering environmentally friendly products or services is among the lowest in the EU, due to the low demand for environmentally friendly products, which are usually more expensive. Promoting the higher quality of eco-labelled products would stimulate demand and hence production.

There is no practice of analyzing any individual products in terms of their life cycle and their environmental impact at the end of their use (recycling, processing or disposal). SMEs do not recognize voluntary instruments such as eco-labelling schemes that would allow them to do so.

The low interest in eco-labelling and EMAS is linked to the fact that manufacturers do not appreciate the full range of opportunities that voluntary instruments offer. EMAS develops good practices for resource efficiency techniques outside the areas for which BAT has already been developed.

There is a strong interest in industrial symbiosis among businesses. The difficulties arise from insufficient and untimely information on available materials, and from the need to feed by-products from one production into another at the lowest possible transaction costs.

The country has significant potential for the extraction and recycling of many of the EU's critical raw materials. Many wastes from the mining and metallurgical industries are rich in critical raw materials and their recovery should be considered in order to create new economic activities while improving the environment.

Paths to sustainable development through a circular economy

Manufacturing: Most products are designed to become obsolete too quickly. Few products can be easily reused, repaired or recycled to a high standard. Our economy still produces products for single use only. The efforts of the European Union countries are aimed at changing this model by regulating the design and manufacturing of products in a way that increases their durability and makes them reusable, repairable and recyclable. Products in the circular economy contain a significant proportion of recycled materials, which in turn creates conditions for secondary production and high-quality recycling.

In terms of maximum recovery of value and recycling of products and materials after their use in new products or useful resources, the greatest

potential is determined by the use of construction waste.

The Regulation on Construction Waste Management and the Use of Recycled Construction Materials sets quantitative targets for the use of recycled construction materials in construction activities, which can be increased. Therefore, it is proposed to prepare an analysis of the possibilities for increasing the requirements for mandatory content of recycled materials in certain product groups and ways to strengthen control in construction. When awarding green procurements, a percentage for recycled materials is set, but subsequently no control is exercised over compliance with the requirement.

Life cycle: The way products are designed and manufactured can prevent up to 80% of their environmental impact, but there are also products that can stay in the economy instead of being landfilled. Instead of ending up in landfills, food waste can be used in the economy as soil conditioner or as a source of energy. Textiles and plastics are among the most suitable materials for recycling and new production. Digitalization and resource mapping will help industry to create supply chains, processing and production of new products.

Circular business models are the way in which enterprises create and retain value in order to increase resource efficiency and extend the useful life of products and materials. At the design stage of products, the use of new materials, renewable and/or less resource-intensive or fully recyclable, should be ensured for maximum recovery of materials after the product is no longer in use. In this regard, financing SMEs from the manufacturing industry for the introduction of eco-design, prioritized in key value chains – electronics, ICT, textiles and plastics, as well as for the introduction of models that allow the use of services instead of products, is the measure with the greatest direct effect towards the introduction of new business models. The optimal use or provision of services instead of selling a product aims to increase the value of the product's use during its life cycle. Given the innovativeness of the solutions sought, no more than 1,500 SMEs are expected to prepare quality projects for application in a timely manner, therefore it is proposed to create a mechanism for subsequent financing of eco-design project proposals, after the financial resources under the CPIP have been exhausted, through a financial instrument.

The preparation of quality eco-design projects can be supported by conducting information and training campaigns for businesses, through which the advantages of eco-labeling and its potential to positively impact manufacturers' market share and access to markets can be explained.

Ecosystems: We live in unprecedented times. The global economy is in a crisis that seems to be the most serious since the financial collapse of 2009, and it is possible that it will be even deeper. During this time, nature is recovering. A few months of pause in human economic activity has allowed the natural environment to begin to recover, which clearly shows us the pressure we humans are putting on natural systems with the current linear model of "extraction-production-consumption-disposal". Applying the circular approach will allow the restoration of natural systems and the achievement of a harmonious relationship between humans and nature.

SMEs are experiencing a shortage of personnel with knowledge and skills for the implementation of "green" voluntary instruments. A need has been identified for specialized training in "green" management and the regulatory requirements for conducting "green" business. Development of specialized training programs for "green" management and "green" business in vocational schools or as additional qualification in vocational training centers aims to meet this need of SMEs.

Consumption: Only 40% of consumers in the country recognize mandatory energy efficiency labels and only 10% - voluntary environmental labels. The rules for their use, certification schemes and control options are not known. This necessitates the need for additional information and training on environmental labels and their importance. Training should be targeted at different age and social groups. This allows schools, universities and consumer protection organizations to be involved in these activities.

The presence of information asymmetry, in turn, hinders the development of the market for products with environmental characteristics in the country. Consumers show little interest in environmental products, as a result of which their supply is too low. The limited penetration of the market for environmental products, combined with the low awareness of Bulgarian consumers,

opens the door for the emergence of unregulated eco-labels.

The high public awareness of the need to protect the environment can be used to increase commitment to such activities leading to a circular economy, such as buying second-hand products, repairing, sharing or renting products.

One way to do this is through information campaigns or activities focused on educating young people, such as including relevant topics in school curricula. Raising consumer awareness of the market for second-hand products, renting/leasing and repairing can also be achieved by creating electronic platforms.

Consumers are usually willing to repair damaged products, but they can easily give up their intentions if the repair involves more effort compared to replacing the product. Expanding the market for repair and maintenance services by incentivizing companies with such activities, as well as by providing repair and maintenance services at key locations in cities, in the so-called reuse centers, will make this type of service accessible and preferred. At the same time, this is an opportunity to improve access to employment and training for acquiring or improving professional qualifications for repair work for people from vulnerable groups.

The public sector, through the application of "green" criteria in public procurement, could stimulate the market for ecological products in the country. At the same time, the relative share of "green" public procurement is only between 5 - 7%. The main problems are associated with the low awareness of contracting authorities, who are not well acquainted with the requirements for ecological goods, services and environmental management systems. To solve the problem, trainings can be organized for central and local government employees regarding the inclusion of "green" criteria by product groups in public procurement, as well as the creation of a virtual space for the exchange of good practices.

Studies show that citizens have positive attitudes towards separate waste collection, but their actual actions do not confirm them (Ghisellini et al., 2016). Only about a quarter of residents in municipalities covered by these systems collect separately accumulated packaging waste. In most cases, citizens are not informed about the existence of separate collection sites in the municipality and do not take action to take advantage of this opportunity to dispose of bulky waste. The weak motivation of citizens can be corrected through financial instruments if the municipal waste fee is linked to the actual quantity and volume of waste disposed of. Effective separate collection can also be achieved by improving the infrastructure, providing for the possibility of separating biological waste and promoting the activities of separate collection sites.

The transition to a green and circular economy requires a strategic transformation of industries, businesses and consumer behavior. It is not just an environmental necessity, but an opportunity for economic growth and social prosperity. Achieving this goal requires cooperation between the state, business and society, as well as the effective implementation of policies and technologies that promote sustainable resource management.

Vision: The transition to a circular economy will provide Bulgaria with economic growth, a clean environment, social well-being and a society with a high level of environmental awareness that thinks about future generations. The country's policy for the transition to a circular economy will be implemented through a green and competitive economy, less waste and more resources and an economy that benefits consumers.

As a result of the transformation of the economy, resource efficiency will be increased and the added value of industrial production will increase. The consumption of some products will be replaced by services, and others will become suitable for longer use.

Individual productions will be connected so that they exist in symbiosis. The country will contribute to the provision of critical raw materials in European Union. The amount of landfilled waste will be reduced to a minimum, and the rest will be returned to the production cycle or recycled.

All this will be achieved by society joining forces and the state providing the necessary conditions and resources. The circular economy is a fundamental and long-term priority of the country's development policy, for which the necessary human, material and financial resources will be mobilized.

Conclusions

The circular economy is not a matter of choice, but of necessity, leading to a retreat from today's

planned or market (linear) economies and a shift towards a new type that minimizes waste and decouples economic growth from resource consumption.

Taken together, all these ideas form a program for the efficient use of resources for the coming years and, together with the improvement of economic well-being and the environment, once considered an impossible solution, is now called the CIRCULAR ECONOMY.

This change requires the combined efforts of government, business, financial and educational institutions. In essence, the circular economy is a systemic change that builds long-term sustainability, stimulates business, generates economic opportunities and creates social benefits with a neutral footprint on nature.

The circular economy is happening now, today! Industry is the flagship of the process, but it is difficult to claim that this will 100% come full circle. The market is the exclusive regulator and factor that will always make it change direction. The end user, although not entirely consciously, is increasingly involved. Will this lead to a completely waste-free society and eliminate the need for new mining? Probably never! But it will certainly help us leave a greener and livelier planet for future generations.

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