

CHALLENGES IN THE TRANSITION PROCESS TO THE CIRCULAR ECONOMY: A POINT OF VIEW OF A PACKAGING COMPANY

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Abstract: *Limitation and scarcity of natural resources, followed by rising demand and global competition for providing resources, emphasize vulnerability and dependance of different industries on import of these resources, considering increasing prices, volatility and uncertain political situations in supplier countries. European Commission explained Circular Economy (CE) as a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible, resulting in the extension of the product's life cycle and reduction of waste. Unlike the traditional linear economy based on "take-make-consume-dispose" approach, a CE strives to reduce consumption of raw materials and energy, greenhouse gases (GHG) emissions, material losses and waste, and to increase the usage of renewable or recyclable resources. In this context, it is hard to assess the readiness of companies willing to embrace the CE paradigm and which are the challenges in this transition. The research objective of this paper is to evaluate companies' readiness to implement circular business model and to detect the related potential challenges, according to measures recommended in the new national CE program. The research has been conducted from the point of view of a Serbian packaging company. In the paper are discussed results obtained in the research implementing measures recommended in the national CE strategy, as a way to improve CE potential and readiness of the analyzed company.*

Keywords: *circular economy, measures, packaging, resources*

1. INTRODUCTION

The European Environment Agency (EEA) emphasized that worldwide population is using more resources than our planet can produce in a given time and we have to reduce the extraction and usage of materials, and the generation of waste. Limitation and scarcity of natural resources, followed by rising demand and global competition for providing resources, emphasize vulnerability and dependance of different industries on import of these resources, considering increasing prices, volatility and uncertain political situations in supplier countries. Using renewable and recyclable resources reduces above mentioned risks occur in the supply chains (European Academies' Science Advisory Council, 2015).

The Circular Economy (CE) concept was first introduced in the report of Ellen MacArthur Foundation in 2013. Then, the European Commission (EC) defined it as a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible, in order to extend a life cycle of products, to reduce consumption of raw materials, water and energy, greenhouse gases (GHG) emissions, material losses and waste, and to increase the usage of recyclable resources (European Parliament, 2016). The four key CE principles are: use less, use longer, use again and make clean. Unlike the traditional linear economy approach (take-make-consume-dispose), a CE respects limitation of resources in the nature and strive to increase the share of renewable or recyclable resources while reducing the consumption of raw materials and energy and at the same time cutting emissions and material losses (EAA, 2016). With a CE the needs of planet's population can be fulfilled with just 70% of the materials currently used. The global economy is now only 7.2% circular, and the extraction and use of materials from virgin sources has been increasing (The Circularity Gap Report, 2023).

The CE concept deserves a particular attention in developing countries (Guimaraes Araújo et. al, 2021; European Environmental Bureau, 2020). In the CE development program in the Republic of Serbia for the period 2022-2024, the CE is recognized as an important strategic concept for the green transition of the Republic of Serbia, which in recent years has been placed high on the list of development priorities

It has to be accentuated that each country has a different starting point and will thrive at a different speed towards the CE. Implementing different circular solution in the economy and society requires to understand and respect local, national and socio-economic environment. In this complex and heterogeneous context, it is hard to assess the readiness of companies willing to embrace the CE paradigm, based on their location and belonging to specific economies and countries, and which are the challenges in their transitions.

The research objective of this paper is to evaluate companies' readiness to implement circular business model and to detect the related potential challenges, according to measures recommended in the new national CE program. The research has been conducted from the point of view of a Serbian packaging company.

The paper is structured as follows. After introduction, the research context is presented in the Section 2. In the section 3, the research methodology is explained. Results are shown and discussed in Section 4. Conclusions are presented in Section 5.

2. RESEARCH CONTEXT

2.1 Circular Economy: performance assessment, benefits, and barriers

Transition towards CE enables a lot of opportunities including reduced pressures on the nature and environment; reduced risks in the supply chain of raw materials, increased competitiveness, innovation, growth and rising employment rate (European Parliament, 2016). CE is based on business models which replace "the end of product life" concept. CE is a renewable industrial economy that has a changed concept of production and consumption in terms of product design, use of resources and waste generation. Brown et al. (2019) considered that the EC should support CE by promoting the collaboration of different actors in product development, process design and new business models.

According to Sassanelli and Terzi (2023), manufacturing companies strive to implement circular business models to limit their resource consumption and pollution generation, but they are still not completely ready and mature enough to develop CE strategies and practices in their business processes. Transition to circular business model requests multilevel and simultaneous changes in the company's organization, technology, management, and processes.

Del Mar Alonso-Almeida et al. (2020) emphasized that the mobilization of resources could be considered as a facilitator of the transition to the CE, but should be additionally supported by the strategies, such as product-life extension, resource efficiency and the useful application of resources (Bocken et al., 2016).

It has to be accentuated that each country has a different starting point and will thrive at a different speed towards the CE. Implementing different circular solution in the economy and society requires to understand and respect local, national and socio-economic environment. Some countries need to radically reduce material extraction and use, while others need to stabilize or even increase usage of materials. In the Circularity Gap Report (2023) countries are divided to: world's highest-income ("Shift") countries which consume the majority of the world's materials and overcome many planetary resource limitations. These countries have to reduce resources consumption and negative impacts on the environment. In the middle-income ("Grow") countries material and resource consumption has increased due to industrialization processes and these countries should stabilize and optimize their resource consumption to preserve their environment. "Build" countries present the majority of the planet's population, but use less than a 10% of the materials of "Shift" countries. These countries should focus on the building the infrastructure and increasing living standard, even if this requires increase in materials and resource consumption. Another reason why CE should be considered locally is that demand for recycled materials relative to virgin material depends on the type of material, and may be greater for some materials in developing countries than in developed ones. Also, sorting of materials to be recycled or reused is usually labor intensive and is therefore recommended to be done in low-wage countries. At the same time, recycling of appliances and electronics should be done in a few, large centers, because of economies of scale. The overall aim should be global circularity (European Academies' Science Advisory Council, 2015). However, it is still hard and complex to assess circular performances of companies in a systematized way.

Vinante et al. (2021) assessed practice-oriented CE at the firm level by collecting and analyses of CE indicators organizing them according to a new circular Value Chain framework, and emphasized that CE indicators are not explicitly linked to the firm's organizational functions involved in CE assessment. Bressanelli et al. (2021). proposed a readiness assessment model for manufacturing companies that usually have problems in understanding how to start a transition towards CE, which changes are needed in the design of products, production processes, business models, and supply chains.

The research of Demko-Rihter et al. (2023) suggested the framework to assess the level of readiness of companies to embrace the CE paradigm in developing countries, with the possibility to assess the circularity level of their products from the business model perspective.

The benefits of a CE are mirrored in improved competitiveness by improved resource efficiency and reducing raw materials and energy dependency, reduced risks of interruptions in supply chains and increasing costs of raw materials, reducing GHG emissions, waste management, creating new jobs and increasing employment rate, GDP growth (Taddei et al., 2022; Sassanelli et al., 2023). In addition, a CE could spur innovation across different industries because of the need to redesign materials and products for circular use (European Academies' Science Advisory Council, 2015).

At the same time, transition towards a CE brings a lot of barriers and challenges, such as financial resources, key economic enablers, technical skills, consumer behavior and business models, and multi-level governance (European Parliament, 2016). At the company level, investment in digital technologies, assets, and research & development (R&D) are required in considerable amount, and for SMEs it could be seen as one of the key obstacles in adoption circular business model. Subsidies and incentives to promote new circular business models, public investments in waste management and digital infrastructure should be provided at the state level (Dwivedi et al., 2023). Key economic enablers are lacking pricing systems encouraging efficient resource reuse and reflecting full environmental costs (European Academies' Science Advisory Council, 2015). Proper comparison of circular and linear economy could be done only by comparison of the real cost of the CE model (including all externalities into prices) and the real cost of the linear economy model (which currently excludes most externalities). Enabling correct pricing, the linear economy should evolve towards a CE model, as an iterative and interacting system. The majority of employees, especially in SMEs, do not have technical and other skills needed for CE. Only consumers informed and educated about benefits and challenges of CE will change their behavior by making buying decisions and waste sorting (Chiappetta et al., 2023).

Public authorities have at disposal different instruments for enhancing the pace of CE adoption (European Academies' Science Advisory Council, 2015):

- regulatory instruments (laws and directives);
- economic instruments (environmental taxes, fees and user-charges, certificate trading, refunded emission payments, environmental financing, green public procurement, deposit and refund schemes and subsidies);
- research and educational instruments (funding or incentives for R&D, education and training);
- cooperation instruments (technology transfer);
- informational instruments (eco-labelling, sustainability reporting, supply chain reporting, consumer advice services, environmental monitoring, etc.).

Collaboration between the public and private sectors is necessary for the transition to a CE. Public authorities and policy makers should support all participants in the transition process from linear to the circular economy, by favoring long-term benefits and interests over short-term rewards (The Circularity Gap Report, 2023).

2.2 Policy actions related to CE

In 2013, the European Parliament and the European Council adopted the 7th EU Environment Action Programme to 2020 'Living well, within the limits of our planet'. In 2015, with the aim to enable sustainable development and mitigate climate changes, two very important documents were adopted at the global level. The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, presented 17 Sustainable Development Goals (SDGs), as a way for action and global partnership between developed and developing countries in improvement of health and education, reduce inequality, and enhance economic growth, while mitigating climate changes and preserving natural environment.

To mitigate negative impacts of climate changes, world leaders at the UN Climate Change Conference (COP21) in Paris 2015 reached the Paris Agreement. Since enforcement of the Paris Agreement in 2016, 194 Parties (193 States plus the EU) have joined the Paris Agreement. The Paris Agreement provides a pathway for developed UN members to assist developing ones in their efforts to mitigate climate changes and prepare a framework for the transparent monitoring and reporting of countries' climate goals. Implementation of the Paris Agreement is essential for the achievement of the SDGs, and presents the beginning of a transition towards a net-zero emissions world. The Republic of Serbia, as a member of the UN, took on the obligations from the 2030 Agenda, and also, as a signatory to the Kyoto Protocol and obligations from the Paris Agreement.

In 2015 the EC adopted its first action plan for the circular economy “Closing the loop – An EU action plan for the circular economy” (COM/2015/614). The plan included measures to encourage the EU transition to a CE, increase global competitiveness, encourage sustainable economic growth and create new jobs. The specific measures covered by the action plan related to the improvement of production, consumption, waste management, raw material markets, reduction of food waste, reduction of plastic waste generation, innovations and investments, etc.

In December 2019, the European Commission has adopted a set of proposals to make the EU's climate, energy, transport and taxation policies fit for reducing net GHG emissions by at least 55% by 2030, compared to 1990 levels. The European Green Deal (COM/2019/640) will transform the EU into a modern, resource-efficient and competitive economy, and will improve the well-being and health of citizens and future generations, with the overall aim that Europe becomes the first climate-neutral continent by 2050. In November 2020 as part of the Green Deal, the Sofia Declaration on the Green Agenda for the Western Balkans was signed and included in the Communication on an Economic and Investment Plan for the Western Balkans adopted by the EC. It consists of five pillars, and one of them is the CE. In October 2021, the Action Plan for the implementation of the Green Agenda for the Western Balkans was adopted, which also includes activities in the field of CE.

The preparation of the strategic framework for the CE in the Republic of Serbia began in 2019 with the creation of an ex-ante analysis of the effects of the CE, which showed that a separate public policy document is needed for the field of CE. The Ministry of Environmental Protection initiated the development of the Circular Economy Development Program in the Republic of Serbia for the period 2022-2024. Although it is not a public policy document, an important document for the promotion of the CE concept is the Roadmap for the CE in Serbia, presented in May 2020. The Roadmap should encourage a dialogue between decision-makers, industry, the academic sector and civil society, to make systemic changes in the treatment of resources. Selected sectors analyzed in the document are: manufacturing industry; agriculture and food (accent on food waste); plastics and packaging; construction sector (accent on construction waste). Recommendations and examples of good CE practice are given for each sector.

The important segment of the Circular Economy Development Program in the Republic of Serbia is related to specific objectives and measures (regulatory, incentive, informative-educational) to achieve them. Within the Specific objective 1: Support to the economic sector in the transformation to a circular business model, is defined informative-educational Measure: Analysis of the potential for the application of the CE model in certain sectors of the processing industry and support for selected companies. The measure implies selection and detailed analysis of companies which have the potential to implement circular business model. Through the activities and processes of selected companies are realized the following aims of the CE, given in the CE Development Program:

1. increasing energy efficiency at the level of the plant or its parts;
2. reducing the use of natural resources as a result of applying the best available techniques;
3. reduction of waste generation;
4. reduction of air, water and soil pollution;
5. use of renewable sources of energy and materials;
6. application of new technologies and use of renewable materials;
7. extending the life of the product through design and maintenance;
8. reprocessing and recycling of certain components and materials;
9. research projects and innovations;
10. digitization.

3. RESEARCH METHODOLOGY

In this research mixed methods were used, including the data presented on the websites of the surveyed company and in the company's Sustainability report, prepared according to the standards of the Global Reporting Initiative. First, the researchers read the documentation prepared by the company about sustainability topics (the Yearly Sustainable Report of the last two years and the SDG Progress Report). Then, a meeting with the sustainability manager and her assistants was organized to discuss the topic introduced in the reports and to make the company's employees familiar with the research framework proposed in this research. A week later, a workshop was conducted for presenting them the CE Development Program and gathering their answers in a form. The researchers analyzed in the back office the answers gathered and, a last workshop was organized to discuss the results with the company's sustainability manager and other employees.

3.2 Company selection

After comprehensive and detailed analyze of companies operating in Serbia, in the recommended industries, suitable to implement circular business model and principles of circularity, the leading domestic manufacturer of printed and laminated cardboard packaging and blister cardboard with 143 employees, was selected. The biggest and the most important clients of the analyzed company operate in the food industry. The company was chosen because of its leading role in the Serbian manufacturing industry, in terms of the responsible usage of raw materials, energy, water, reduction in GHG emission, and constant developing of employees' awareness to behave manage resources responsibly.

The company has established effective monitoring and reporting of GHG emissions. All relevant GHG are taken into account and converted to CO₂ equivalents (CO₂e) as the base unit, and multiplied by their global warming potential. The company is committed to achieving zero GHG impact on the environment, and measures its impact and report on it transparently. The basic methodology of monitoring and reporting on GHG emissions was created according to the international GHG Protocol, currently includes the complete Scope 1 and Scope 2, while preparations for the Scope 3 scope are underway.

4. RESULTS AND DISCUSSION

Through the activities and processes given in the CE Development Program, the potential for the application of the CE model in the selected company was analyzed:

1. Increasing energy efficiency at the level of the plant or its parts

- **Reactive energy compensation**

The installation of a reactive energy compensation facility mitigates collision of frequencies and increases the degree of utilization of electrical energy. A reactive energy compensation facility the degree of utilization of electricity drawn from the power grid, thereby increasing the company's energy efficiency and reducing GHG emissions.

- **System for in-line control of ink application on sheets in the press**

New machines must have the possibility of installing a system for in-line control of the application of ink on the sheets in the press, which shortens a preparation and ensures uniform printing on all sheets. This system directly reduces resource consumption and waste generation, and increase the energy efficiency. The company has a Lithec system on all printing machines for in-line control of the application of color on the sheets in the press.

- **System for automatic logistics of displaying pallets on a printing machine**

Installing this system enables automatic display of pallets with printed sheets and insertion of empty pallets into the machine's feeder. This significantly reduces the process time and increases energy efficiency.

- **Installation of frequency regulators on electric motors**

Installed frequency regulators reduce large oscillations in the electrical grid during sudden switching on and off of powerful motors which lead to increased energy efficiency.

- **Energy efficiency lighting**

In the company were also installed LED lighting with motion sensors which reduce energy consumption, and taps with sensors which reduce water consumption.

2. Reducing the use of natural resources as a result of applying the best available techniques

The use of natural resources in the production has been decreasing and last year 94.7% of total chromocardboard and packaging paper that company processed were from recycled sources.

3. Reduction of waste generation

- **Upgrade of the system for automatic ejection and baling of paper and cardboard waste**

At the beginning of 2022, the company expanded the system for the automatic removal of paper and cardboard waste from production, and bought a baling press, able to meet the growth of production capacity. With the installation of a new improved baling system, GHG emissions caused by the stoppage of the paper waste disposal system were reduced by 64.15%.

- **Installation of an improved automatic machine for tying and stretching pallets of finished products**

New line for tying and stretching pallets of finished products was installed, able to use less thick tying tapes and stretch film, thus reducing the amount of packaging waste generated. The line has a greater capacity of tying and stretching a larger number of pallets of finished products in a shorter time, thus reducing resource consumption.

- **Responsible waste management**

The waste is managed responsibly with strict adherence to laws and best practices, which is reflected in the following processes and activities:

- a) Reducing the amount of generated waste, both waste resulting from the company's business activities (technical and process improvements), and waste generated by employees, their families and members of the local community (through employee and local community awareness activities, local community support projects and others).
- b) Sorting of waste at the moment of its generation, and after that in accordance with the waste management plan.
- c) Recycling island is technically equipped for temporary waste storage, with a minimum impact on human health and the environment. Given that the company is slowly outgrowing the capacity of the existing Recycling Island with the growth of its business, the Project of a new Recycling Island with surrounding greening was done in order to reduce the potential negative impact on the environment.
- d) The company uses the services of exclusively authorized waste operators, and all further activities related to the delivered waste are requested in order to ensure that the waste is managed responsibly and sustainably.
- e) Reuse of the waste whenever possible.
- f) Recycling - Most of the waste generated in company is recycled. In 2022, 96.94% of the total waste was recycled.

4. Reduction of air, water and soil pollution

In order to reduce emissions of polluting substances into the air, the burner was replaced on one of the CNG boilers for steam production and the combustion parameters of the heating boilers (pellets) were adjusted.

A grease and oil separator were installed with the function of purifying waste storm water before its discharge into the natural recipient - the nearby river.

The printing process is realized without the use of alcohol in the wetting system.

5. Use of renewable sources of energy and materials

- **The solar power plants**

The company installed solar power plants on the roofs of production and storage facilities, to significantly improve the company's energy efficiency.

An analysis of the justification for setting up a solar power plant in the company was done. Investing in the construction of a solar power plant with a capacity of 580 kWh, which would annually produce about 800,000 kWh of electricity for own needs, which accounts for about 40% of the total electricity needs, and at the same time 40% reduction in the consumption of electricity obtained from non-renewable sources. Due to the favorable location and the big average number of sunny days per year, a significant amount of energy could be saved, with the contribution to the " Zero CO2" project.

6. Application of new technologies and use of renewable materials

- **Robotization of packaging of finished products**

The company is currently working on the development of a project for the robotization of the process of packing transport boxes with finished products on pallets. This system will speed up and increase the productivity of the production process, reduce resource consumption and GHG emissions.

7. Extending the life of the product through design and maintenance

- **Eco Design**

Eco Design is the packaging design philosophy, which implies close cooperation with clients and optimization of the packaging production to reduce negative impact on the environment. In the production of packaging, company uses the minimum necessary amount of material, which is mainly recycled, and ecological paints and varnishes.

Eco-designed packaging is:

- a) produced using the least necessary number of materials while maximizing the utilization of all production resources and materials;
- b) produced using solely materials from sustainable and responsible sources, with the increasing percentage of FSC certified;
- c) designed to be easy, economical and fully recyclable at the end of its life;
- d) compliant with the requirements of the European Parliament and Council Directive 94/62/EC on packaging and waste packaging;
- e) gives added value to the product by enabling more functions (utility, protection, storage-transport and sales-marketing) and extended life;
- f) communicates the values of sustainable consumption and encourages responsible end-of-life management (PAP sign - recycling instructions).

8. Reprocessing and recycling of certain components and materials

- ***Using generated wood waste for heating***

The wooden pallets for transportation of ordered goods and materials, had no function and were ending their life cycle in the company's warehouse. Wooden pallets go through the process of mechanical wood chipping, and wood chips can be used later for heating. Wood chips from wooden pallets could cover 38% of the annual need for heating fuel.

- ***Using waste heat for heating company's buildings***

The company has started several projects for the reuse of waste heat generated in production processes, and its use for heating buildings during the heating season, among which are:

- a) Replacement of existing air compressors with modern ones which are more energy efficient, have a system for recovering waste heat generated during operation.
- b) Installation of a heat exchanger on the steam recovery system from the wave machine, which will remove excess heat from the steam returning to the boilers and conduct this steam to the heating system.

9. Research projects and innovations

B2B2C approach to packaging design is applied to respond to changing consumer demands and increase the value of clients' products. The company is mapping consumer needs to understand their expectation from packaging. A few years ago, was noticed the need for ecological and sustainable packaging, with an extended life cycle.

The innovation process resulted in several packaging solutions that have attractive design, protective function, an extended life, with the possibility of reuse after fulfilling primary function. After the end of the life cycle, such packaging is recycled, enabling circularity and significant savings.

10. Digitization

Digital transformation implies complete transformation of technology, business processes and the way of thinking through the application of digital tools and ideas that bring overall changes. In the analyzed company digital transformation is a continuous and comprehensive process, related to all aspects of the company's operations: business planning, production scheduling, information management, reporting, performance monitoring, performance-based incentives and so one.

- ***MES – Manufacturing Execution System***

The Manufacturing Execution System enables monitoring and managing the production, providing real-time insight into the operation of machines, the realization of planned activities, the degree of capacity utilization and the possibility of real time planning production scheduling.

MES collects data directly from sensors embedded in production equipment and matches them with data from the ERP system, in order to provide more accurate data.

MES enables increase of the efficiency of production processes and easily identification the losses points, which directly increases energy efficiency and reduces the consumption of resources and the amount of waste generated. MES enables monitoring of employees' performances, based on their direct efforts, as a key input for calculating their salaries.

- ***BI***

Using Business Intelligence (BI) technology will accelerate reporting and business analysis processes, reduce manual work and support decisions making.

Results of research of processes and activities in the analyzed company, operating in the packaging industry indicate that a company has already embedded circular business model, to neutralize the negative impact

on the environment, reduce energy consumption from non-renewable sources and achieve savings in the production process. In the last few years, the company has significantly improved its production process, enabling products and materials at the end-of-life to be used again in production through modular design. In production are used recyclable materials, technological processes are based on clean technologies, zero waste concept is implemented.

The company publishes the results of their corporate social responsibility (CSR) and commitment through a sustainability report aligned with the Global Reporting Initiative (GRI) methodology. The implementation of the CE concept is expected to lead in the long-run to improved financial performances, optimization of the production process, increased effectiveness and efficiency, with the positive impact on the local community and employees, which is always company's main motive and driving force. The company discloses annual GHG reports since 2022, and the company prepares for reporting according to the SBTi reporting methodology.

5. CONCLUSIONS

The analyzed company cooperates with key stakeholders - clients, suppliers and local community in order to overcome the challenges of modern business, related to sustainability. The company actively working on reducing the negative impact on the environment and invests in local community. Company's products (packaging) are responsible and sustainable throughout the entire life cycle. Company creates partnerships with its suppliers and includes them in all phases of product development, in order to response to the needs and demands of its clients. In addition, company strives to promote ethics, quality, environmental protection, employees' safety and health, responsible business and commitment to sustainability, and choose suppliers who share the same values and principles, and are ready to cooperate.

The direction of further research could be an analysis of potential to implement circular business model in other companies operating in different industries in Serbia, by testing fulfilling of specific objectives listed in the Measure defined in the CE Development Program of Republic of Serbia.

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