DOI: https://doi.org/10.36708/Littera_Scripta2023/2/2

The circular solution to the functioning of breweries

Michaela Jannová, Jana Portová

Institute of Technology and Business in České Budějovice, School of Expertness and Valuation, Czech Republic

Abstract

The article aims to identify the key circular solutions used in breweries, the factors influencing the motivation for environmental responsibility and the implementation of circular measures. The research is carried out using the method of a quantitative questionnaire, which was sent to brewery owners. The obtained results contribute to a better understanding of circular solutions used in breweries, their motivation for environmental responsibility and the implementation of circular measures. The conclusions also show that the motivation of breweries for environmental responsibility is excellent, and most breweries implement many activities for environmental protection. Limitations of the research mainly include the limited number of respondents.

Keywords: environmental responsibility, circular economy, breweries, sustainability, waste, recycling

Introduction

Robert Ackerman and Raymond Bauer are considered pioneers of corporate social responsibility, or Corporate Social Responsibility (CSR) (Changling et al., 2022). The concept emerged in the 1970s. They assumed that more than real commitments from executive management alone would be needed and that the moral challenges associated with CSR initiatives should not overshadow the organisational and managerial dilemmas caused by CSR-based policies (Acquier et al., 2011). Horák and Pavlová (2022) states that the debate on corporate social responsibility and the strategies organisations implement to spread their entrepreneurial activities encourages discussion on aspects that point to sustainable development. One of the mechanisms companies uses is the presentation of sustainability reports to show their CSR strategies (Murillo-Avalos et al., 2021).

An economically responsible company does not have problems with customers with the workforce, pays its obligations on time, improves its negotiating position when dealing with investors or the government, and, thanks to this, strengthens its economic performance (Horák and Katz, 2022). The company acts transparently and plays fair play. Social responsibility includes caring for company employees, their working conditions and their environment (Tlustý and Kmecová, 2022). A satisfied employee is essential for the success of the company. An ethically responsible company most often uses a code of ethics. This document contains ethical behaviour principles and must be drawn up realistically and adhered to. A philanthropically responsible business deals with charity. Businesses support other persons or non-profit organisations (Chena and Jin, 2023)

Kliestik et al. (2020) state that environmental responsibility has recently been hotly debated. It represents responsibility towards nature and the environment. We are not indifferent to what happens to our planet; we must take care of it for a better life for us and future generations. After many years of devastating nature, it is also time to give something back to nature. It is essential to address this topic because every resource is exhaustible. The ecological crisis is pushing all companies into changes in management and the use of the circular economy (Dvořáková et al., 2021). Various national and international organisations are creating specific initiatives to improve the environmental crisis, currently the Green Deal. The document contained complete definitions of the concept and was adopted at the national, international and European levels (Horák and Dušek, 2022). The document is generally a strategy to mobilise communities and businesses to create a green economy by implementing environmental solutions in various sectors (Smol, 2022).

There are many breweries worldwide, and each has a huge water and electricity consumption. There is a need to solve this problem and somehow reduce or transform consumption, as breweries leave a large ecological footprint. This can be achieved with the help of the circular economy (Dvořák et al., 2018). According to Bellemare et al. (2022), the circular economy focuses on environmental sustainability, while the social economy primarily refers to economic democratisation, collective entrepreneurship and the search for the common good.

Hayhoe et al. (2019) state that the essence of the circular economy is to keep resources in use as long as possible, extract value from them during use, and restore and regenerate products and materials at the end of each lifetime. Circular water management optimises water resources and recovers valuable resources from water and wastewater while mitigating emissions and increasing resilience to climate change (Brears, 2020).

This article aims to identify how breweries in the Czech Republic approach environmental responsibility and whether they apply a circular economy in their operations. It also proposes, concerning demanding financing, procedures for applying or maintaining environmental responsibility.

To fulfil the stated objective, two research questions are defined. A null hypothesis (H0) and an alternative hypothesis (H1) are established for each research question.

VO1: What circular solutions do breweries in the Czech Republic use in the post-covid era?

H0: At least 80% of breweries in the Czech Republic use some of the circular solutions.

H1: Breweries in the Czech Republic do not use any circular solutions.

VO2: What is the motivation for environmental responsibility and the introduction of circular measures for breweries in the Czech Republic in the post-covid era?

H0: Breweries in the Czech Republic have a significant motivation for environmental responsibility and the introduction of circular measures.

H1: The motivation for environmental responsibility and the introduction of circular measures in breweries in the Czech Republic must be higher.

Literary research

The circular economy in connection with breweries is in the interest of several surveys, mainly because breweries are very demanding in their operation. Verhuelsdonk et al. (2021), for example, state that breweries have a huge water consumption and thus, reusing wastewater is appropriate. Rasmeni et al. (2022), in turn, state that a large amount of organic waste is produced during the production of beer, which pollutes the environment. The disposal of by-products from beer production represents large costs and public pressure on the sustainable operation of the brewery. Following this, specific research by Sehn et al. (2021) found that breweries use malt residues to feed animals in the countryside, the yeast biomass is dehydrated and converted into brewer's yeast that can be offered commercially as probiotics and hot water is reused to clean the environment and equipment. Terefe et al. (2023) investigated the use of thresher-feeding dairy cattle in Ethiopia on farms near breweries. Data collection was carried out using a semi-structured questionnaire. 80% of farmers reported that threshing spoils quickly, and the rest reported odour and mould. The problem is that the threshed reaches the farms very wet, and the farmers would have to dry it or put it in silage, increasing their costs. They conclude the research by saying that further investigation and research are needed to see if dairy cattle have any negative health issues. Dias et al. (2023) devoted their attention to brewery wastewater. According to them, wastewater could be purified with the help of oleaginous yeasts and algae microorganisms, which can reduce energy consumption and the formation of dangerous sludge and the costs of its treatment.

Morgan et al. (2022) assessed how the environmental impacts of packaging and distribution can be mitigated in microbreweries. They evaluated seven breweries and compared their existing packaging and distribution practices with three mitigation options; using aluminium cans or reusable glass bottles instead of disposable glass bottles or using polyethene terephthalate (PET) drums instead of steel drums. The findings show that all participating breweries can achieve reductions in multiple impact categories if single-use glass bottles are changed to aluminium cans or reusable glass; further reductions are possible if the mode of transport is changed from small vans to distribution truck retailers. Using a PET keg as an alternative to a reusable steel keg is a less environmentally sustainable option when shipping

beer over short distances. Still, some savings are possible over long distances using vans. The optimal combination of truck-delivered reusable glass bottles reduces the carbon footprint by 45-55%, but implementation will require significant investment and coordination within the wider food and drink sector. Identifying the best packaging material requires a holistic approach considering the interactions and burdens across the manufacturing, distribution, use and end-of-life phases. For further research, they recommend focusing on cross-sectoral models to achieve optimised logistics and on the impact of new technologies such as packaging type and electric vehicle distribution to better understand the long-term prospects for mitigating the environmental impact of packaging and distribution.

Methods and Data

To fulfil the objective of this article and answer the set research questions, a quantitative research method will be chosen, namely data collection using a questionnaire. This questionnaire will be aimed at brewery owners. This is primary research, so it does not focus on any particular brewery size, rather it examines breweries in general as they exist in the market. Microbreweries do not share much information, so we decided to focus on larger breweries as well, namely Pilsner Urquell and Staropramen. Furthermore, a content analysis of the documents will be carried out. Specifically, the Annual Reports and Sustainability Reports of two large breweries in the Czech Republic – Pilsner Urquell and Staropramen – will be used. Within these documents, the strategic goals the breweries have set for their journey of environmental responsibility will be sought.

As outlined above, the questionnaire will be sent to brewery operators in the Czech Republic. Pilsner Urquell and Staropramen breweries also participated in this survey. The questionnaire will be created using the Forms tool from Google. It will consist of closed and open questions, which will be compulsory. A link to the questionnaire will be sent to breweries with a request to fill in and explain the purpose. This questionnaire will determine whether they consider themselves an environmentally responsible company, what circular solutions they use, their motivation for environmental responsibility and the introduction of circular measures. The research dealt with the content analysis of documents, where the paper has two areas that it deals with, one is the analysis of company documents in the context of the circular solution, the second part is the actual research in this area.

The data obtained from the questionnaire will be analysed using statistical methods using functions in MS Excel. Descriptive statistics will be used here to display the essential characteristics of the data, e.g.

average:

$$\bar{x} = \frac{x_1 + x_2 + \cdots + x_n}{n} \quad (1)$$

median:

$$Me(X) = x_{(N+1)/2} \quad (2)$$

dispersion:

$$Var(X) = \frac{1}{N}((x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \cdots + (x_N - \bar{x})^2) \quad (3)$$

Based on the questionnaire, it will be possible to answer predetermined questions. As part of the first research question, various circular solutions used in breweries will be identified and categorised, such as the management of threshing, the use of waste for other applications, the use of environmentally friendly alternative sources and the effort to reduce the consumption of input resources. As part of the second research question, answers will be sought to inquiries about why breweries started circular economy, what circular solutions they use and whether they plan to start with a circular economy.

First, hypotheses H0 and H1 for VO1 will be tested. Categorisation of answers regarding circular solutions used in breweries will be done. The frequencies of individual solutions will be analysed and compared. If at least 80% of breweries use some circular solution, H1 will be rejected, and H0 will be accepted. To test hypotheses H0 and H1 for VO2, the responses regarding the motivation for environmental responsibility and the implementation of circular measures will be analysed. It will be evaluated whether the reasons given by the breweries for introducing circular measures indicate a significant motivation. If motivation is significant, H1 will be rejected, and H0 will be accepted.

After analysing each research question, the information obtained will be evaluated and the results interpreted. We will focus on identifying the key circular solutions used in breweries, the factors influencing the motivation for environmental responsibility and the implementation of circular measures.

Results

Based on the latest surveys, there were 515 breweries (480 microbreweries) in the Czech Republic in 2019, and in 2018 they produced 21,272 thousand hectolitres of beer, with microbreweries accounting for roughly 2.5% of this amount. A microbrewery can be considered a brewery whose beer production is at most 10,000 hectolitres. According to the Czech-Moravian Association of Microbreweries, microbreweries will increase slightly in the coming years.

We can distinguish 3 types of beer according to the fermentation method. They are bottom-fermented (the most widespread in the Czech Republic) lagers, topfermented ALE (highly hopped beer), and spontaneously fermented (Lambic). Then the Czech breweries produce, beers with reduced alcohol content and non-alcoholic. Furthermore, we can distinguish light, semi-dark and dark beers according to the colour. Light is brewed from light malts; semi-dark and dark beer are brewed from dark malt added in different proportions to the light malt.

Sustainability of breweries

Pilsner Urquell is the most engaged large brewery in environmental responsibility. Since 2006, it has published a Sustainability Report every year in addition to its Annual Report. In it, they state their goals for improving the environment and the current results in environ-

mental engagement. In the 2021 report, Plzeňský Prazdroj (2022) set strategic goals for what it wants to achieve by 2025, 2030 and 2050. It intends to achieve carbon neutrality by 2025, thanks to the fact that all electricity for the breweries will be from renewable sources. Another goal concerns reducing the average water consumption needed to produce one hl of beer to 2.78 hl. Another plan focuses on waste. They want to ensure that none of their waste is in a landfill. Other strategic goals for the sustainability journey to 2025 relate to responsibility, in the sense that 90% of products will be produced with a reduction in sugar content or entirely without it, 20% of products will be non-alcoholic, and the last goal is to increase by 20% engagement in prevention programs. By 2030, they will reduce the carbon footprint of the supply-customer chain by 30%, water for their breweries will only be from sustainable sources, they will end the use of single-use plastics made from primary raw materials, all product packaging will be recyclable or reusable and at least half made from recycled materials, agricultural raw materials will be from sustainable sources, 25% of the products will be soft drinks, and the last goal is about diversity, they want to achieve a balanced proportion of men and women in management. By 2050, they want to achieve carbon neutrality across the entire supply-customer chain. They want to achieve carbon neutrality thanks to innovations and the modernisation of warehouses and malthouses (mainly replacing machines, boilers, and compressors). They use the heat supply as green energy by burning waste wood chips, which return almost 300,000 tons of burnt brown coal. Compared to 2020, total emissions were reduced by 0.67 MJ/hl, and in 2021 greenhouse gas emissions were reduced to 5.51 kg CO2 e/hl. Another contribution to carbon neutrality is using electric cars, which are currently being tested to see if the car's parameters cover the brewery's needs. They want to reduce average water consumption by investing in technology. They are now at 3L of water per 1L of beer, and downsizing is more complicated and slower. Figure No. 1 presents the development of water consumption per 1 litre of beer over ten years.

Figure 1: Development of water consumption

Source: Sustainability Report 2021 Plzeňský prazdroj.

They achieve sustainable agriculture thanks to using local raw materials suppliers, reducing their carbon footprint. They have reduced the consumption of single-use plastic from primary material by 80% since 2019. They use recycled paper for their bottled beer labels, saving 350 tonnes of new paper annually. Thanks to the innovation, the cans are 75% recycled aluminium, reducing the carbon footprint by 30% and saving 280 tons of new aluminium annually. They use glass bottles an average of 22 times. They leave the used stretch films to

another company, which continues to process them, and the paper labels from the bottles. They leave the waste threshing as fodder for cattle and then make crackers for people from it; in 2021, they utilised 794 kg of threshing. Due to the pandemic, the produced beer could not be sold in pubs, so they let it be fired in cooperation with the L'OR company, which created PROUD SPIRIT beer brandy. They achieve equalisation of the representation of women and men in management by offering women on parental or maternity leave reduced working hours, flexible working hours, or a contribution to preschool facilities for children under three. They strengthen responsibility through education, e.g. prevention of underage drinking, destruction of prejudices regarding non-alcoholic beer, and reliable communication of products.

Another brewery on the market that publishes reports on sustainable development is Brewery Staropramen. It has been publishing them since 2017. Staropramen (2022) established two areas of interest PEOPLE (Employees and community, Responsible consumption and corporate governance) and PLANET (Sustainable production). Taking care of its employees is essential for Staropramen. He realises that properly motivated employees are the best team players and a great business card for the entire company. They promote diversity and equal opportunities. They have five men and three women in top management. Within the community, they are involved in various programs, volunteering and sponsorship. As part of Responsible Consumption, the company promotes responsible consumption within projects and communications, producing products with a low alcohol content or non-alcoholic. Various quality audits take place at the brewery several times a year, such as the Kosher audit, which concerns the product line for the Israeli market so that customers can be sure that the product meets the requirements of Jewish dietary habits and laws. They rely on correct and truthful labelling of products on all labels and packaging. The second area of PLANET deals with sustainable production. The brewery buys 80% of its raw materials and services from local suppliers; all suppliers are vetted to have a responsible approach to the environment and reduce their ecological footprint together. The brewery used the pandemic period to innovate and modernise its IT infrastructure. He set goals for 2025 to protect the environment by reducing water consumption per 1 hl of beer to 3.42 hl; in 2021, consumption was 4.05 hl. Other purposes include reducing the consumption of electrical and thermal energy and reducing waste that goes to landfills, specifically so that no litter ends in landfills. The energy used is steam from natural gas, such as air and cold from cooling compressors. They still monitor all consumption and efficiency. They reuse the water used for cooling and thus also use the removed heat. From 2020, the brewery bottled Braník and Staropramen beer with a 30% share of recycled plastic. It can contain 70-90% recycled material. Almost 95% of the waste is recycled, and the rest is used in an incinerator to produce energy. He sold nearly 48,000 tons of threshing and 36,000 hectolitres of yeast to feed manufacturers. Logistics reduces emissions by using large-capacity forklifts and electric or gas-powered trucks. It is gradually renewing its vehicle fleet to vehicles with the EURO VI emission standard. Soon, they are also planning large-capacity forklift trucks with a purely electric drive, which will be powered by photovoltaics on the roof of the new warehouse.

Environmental Responsibility from the Perspective of Breweries

A total of 30 breweries were approached, and ten breweries participated in the survey.

80% of breweries use a circular economy. Brewery 1 and 4 do not use the circular economy for economic reasons. Brewery 1 stated that they are unfamiliar with it as another reason. Since it has been confirmed that at least 80% of breweries in the Czech Republic use some of the circular solutions, we accept hypothesis H0: At least 80% of the breweries in the Czech Republic use some of the circular solutions, and we reject H1: Breweries in the Czech Republic do not use any circular solutions.

Environmental protection is optional for 20% of breweries. Environmental safety is vital for 80% of breweries. These are disturbing results, and it is striking that despite all the demands not only from the European Union, the percentages of importance are not higher.

Other result presents whether breweries are considered an environmentally responsible enterprise. 70% of respondents believe it to be an environmentally accountable brewery, while 30% do not. Although Brewery 1, Brewery 2 and Brewery 10 are not considered environmentally responsible breweries, they still develop at least minimal activities to protect the environment. Brewery 1 sorts waste, Brewery 2 sorts waste, reuses wastewater and does not use single-use plastic barrels but metal. Brewery 10 sorts waste and reduces the energy consumption of machines and buildings.

Brewers´ grain is the final waste after boiling the malt and draining the wort. All surveyed breweries leave the threshed to cattle breeders, who use it as fodder. One brewery uses threshing even more for agricultural production or the production of green energy. It makes crackers from the threshing, yeast and malting waste are also left as feed for cattle, sewage sludge is left to be mixed into the soil as fertiliser, and waste filter diatomaceous earth is used for ploughing and lightening land for reclaimed land. Table No. 1 presents how breweries handle thresh.

Table 1: Brewers´ grain using

	Brewers´ grain using			
	Feeding animals	**Production a snack**	**Production of green energy**	**Agricultural production**
Brewery 1	x			
Brewery 2	x			
Brewery 3	x			
Brewery 4	x			
Brewery 5	x			
Brewery 6	x			
Brewery 7	x			
Brewery 8	x	x	x	x
Brewery 9	x			
Brewery 10	x			

Source: own processing.

Table No. 2 presents what activities breweries develop to achieve environmental responsibility. All breweries sort waste, and two breweries undertake all activities to perform environmental responsibility.

Table 2: Overview of activities to achieve environmental responsibility

Activities to achieve environmental responsibility							
	Waste sorting	**Energy saving**	**Reducing energy consump-tion**	**Wastewater reuse**	**Use of returnable packaging**	**Recupera-tion heat**	**Use of renewable resources**
Brewery 1	x						
Brewery 2	x	x		x	x		
Brewery 3	x	x		x			
Brewery 4	x						
Brewery 5	x	x			x	x	x
Brewery 6	x	x		x			
Brewery 7	x	x	x	x	x	x	x
Brewery 8	x	x	x	x	x	x	x
Brewery 9	x	x	x	x	x		
Brewery 10	x		x		x		

Source: own processing.

Table No. 3 presents the reasons for using the circular economy. Two breweries use circular economy for economic reasons, 3 CE breweries use it for economic and sustainability reasons, and 3 CE breweries use it for sustainability reasons. Brewery 1 and 4 need more motivation. Therefore, they do not use a circular economy. According to the results, we can say that hypothesis H0: Breweries in the Czech Republic have a significant motivation for environmental responsibility, and the introduction of circular measures is accepted, and we reject hypothesis H1: The motivation for environmental responsibility and the introduction of circular measures in breweries in the Czech Republic is low or non-existent.

Table 3: Motivation for circular economy

	Motivation for circular economy	
	Economic reason	**The reason for sustainability**
Brewery 2	x	
Brewery 3	x	
Brewery 5		x
Brewery 6	x	x
Brewery 7	x	x
Brewery 8	x	x
Brewery 9		x
Brewery 10		x

Source: own processing.

Discussion

The first research question, "What circular solutions do breweries in the Czech Republic use in the post-covid era?" can be answered thanks to a survey in which ten breweries participated. Environmental protection is essential to 8 of them. Therefore, they are also considered to be an environmentally responsible company and use a circular economy, except for Brewery 10, which is not considered environmentally responsible. One brewery, Brewery 2, for which environmental protection is not essential, uses a circular economy. Two breweries, Brewery 1 and Brewery 4, which do not use the circular economy, do not use it for economic reasons, and they are too small a business for that; Brewery 1 stated as another reason that they do not know it and further noted that they only sort waste. Therefore, we could accept H0 and reject H1. There is no need for a recommendation to maintain a circular economy because breweries have experienced it and are building a good brand reputation. Brewery 1 and Brewery 4 could invite experts and together come up with a suitable circular measure that would help them economically in the final.

All breweries dispose of waste threshing by providing it to livestock farmers, either free of charge or for a fee. Brewery 3 tried making cookies but soon gave up due to a lack of interest. Brewery 8 stated that they use threshing for agricultural production or the production of green energy, yeast and malting waste serve as feed, sewage sludge is mixed into the soil as fertiliser, and waste filter diatomaceous earth is used for ploughing and lightening the soil for recultivated areas, further from the threshing, in cooperation with an organic bakery, they produce crackers. Here we have comparable results of threshing for cattle as Sehnem et al. (2021) and Terefe et al. (2023).

Other circular solutions consist of the use of wastewater. Brewery 2 also uses water from cooling as utility water. Brewery 3 uses waste hot water to heat water for the next batch. Brewery 6 tries to make 100% use of water; the cooling water is heated during its application and is allowed into the hot water generator. Thus, the water used once is used again; in addition, it is heated to a temperature of around 60° C during cooling, so the heating in the hot water generator water is not so energy-intensive. Brewery 8, thanks to the technology enabling the transformation of slightly polluted water into potable water, can then use the water used for washing new cans, which is polluted somewhat, as service water. Brewery 9 also uses water from cooling to heat the next batch, like Brewery 3. Brewery 10 continues to use the water for utility purposes.

The second research question, "What is the motivation for environmental responsibility and the introduction of circular measures of breweries in the Czech Republic in the post-covid era?" can be answered thanks to the results of the questionnaire processed in Table 3. Breweries 2 and 3 are motivated by purely economic reasons for CE. Breweries 5, 9 and 10 are inspired to CE by sustainability reasons and Breweries 6, 7 and 8 are motivated by both reasons. With these results, we accept H0 and reject H1.

All breweries except Brewery 1 and Brewery 4 save more energy. Brewery 7, Brewery 8, Brewery 9 and Brewery 10 are taking steps to reduce the energy demand of buildings and

machinery. Six breweries (Brewery 2, Brewery 5, Brewery 7, Brewery 8, Brewery 9, Brewery 10) use returnable packaging. Three Breweries (Brewery 5, Brewery 7 and Brewery 8) use heat recovery and renewable sources.

Conclusion

This research aimed to identify how breweries in the Czech Republic approach environmental responsibility, whether they apply a circular economy in their operations, and propose procedures for applying or maintaining environmental responsibility. The aim of the research was fulfilled, as it was described here what circular measures the breweries use and how they approach environmental responsibility. Since breweries have been using a circular economy for a long time, they have experienced procedures, they are successful, and in this sphere, they are innovating the techniques themselves. Breweries that do not use circular economy were advised to call in experts for this solution, and together, they could find a suitable solution tailor-made for them.

The answers to the first two research questions show that breweries most often reuse waste water, turn the mash into snacks for people, and are motivated to do so for economic and sustainability reasons.

The limitations of the research lie in the fact that only some breweries participated in the questionnaire survey. Unfortunately, this research was met with the reluctance of brewery representatives to participate in the survey, even though they were offered that the questioning would take place in a form that would suit them.

Acknowledgement

This research was supported/funded by the Institute of Technology and Business in České Budějovice, project IVSUZO2301—The impact of the circular economy on the share prices of companies listed on the stock exchange.

References

ACQUIER A., DAUDIGEOS T., VALIORGUEB., 2011. Corporate social responsibility as an organizational and managerial challenge: the forgotten legacy of the Corporate Social Responsiveness movement. *Management,* **14**(4). ISSN 1286-4692.

ANDRIOLI JR., R., 2020. International Environmental Law: Responsibility in the Anthropocene. *Revista Juridica Portucalense,* **28**, 106-123. ISSN 2183-5799.

BARÓN DORADO A., GIMÉNEZ LEAL G., DE CASTRO VILA, R., 2022. Environmental policy and corporate sustainability: The mediating role of environmental management systems in circular economy adoption. *Corporate Social Responsibility and Environmental Management,* **29**(4), 830-842. ISSN 1535-3958.

BELLEMARE M. F., MARTIN-DÉRY S., ZIEGLER R., VEZINA M., RAUFFLET E., WALSH A., 2022. Synergizing Social Economy and Circular Economy. *Canadian Journal of Nonprofit and Social Economy Research*, **13**(1). ISSN 1920-9355.

BÎRGOVAN A. L., VATCA S. D., BACALI L., SZILAGYI A., LAKATOS E. S., CIOCA L. I. a CIOBANU G., 2022. Enabling the Circular Economy Transition in Organizations: A Moderated Mediation Model. *International Journal of Environmental Research and Public Health,* **19**(2). ISSN 1660-4601.

BREARS R. C., 2020. *The Circular Water Economy. In: Developing the Circular Water Economy*. Cham: Springer International Publishing, 2020-11-23, 31-44. Palgrave Studies in Climate Resilient Societies. ISBN 978-3-030-32574-9.

CAI L., HE C., 2022. *Corporate environmental responsibility and bank loans,* **31**(3), 741-761. ISSN 2694-6416.

DIAS C., SANTOS J. A. L., REIS A., LOPES DA SILVA T., 2023. The Use of Oleaginous Yeasts and Microalgae Grown in Brewery Wastewater for Lipid Production and Nutrient Removal: A Review. *Waste and Biomass Valorization.* ISSN 1877-2641.

DVOŘÁK P., ANDREJI J., FALTOVÁ LEITMANOVÁ I., PETRÁCH F., MRÁZ J., 2018. Accumulation of selected metals pollution in aquatic ecosystemsin the Smeda river (Czech Republic). Neuroendocrinology Letters. *Neuroendocrinology Letters,* **39**(5), 380-384. ISSN 2354-4716.

DVOŘÁKOVÁ L., HORÁK J., CAHA Z., MACHOVÁ V., HAŠKOVÁ S., ROWLAND, Z., KRULICKÝ T., 2021. Adaptation of small and medium-sized enterprises in the service sector to the conditions of Industry 4.0 and Society 4.0: evidence from the Czech Republic. *Economic Annals-XXI*, 7-8, 191, 67-87. ISSN 1728-6239.

HAYHOE T., PODHORSKÁ I., SIEKELOVÁ A., STEHEL V., 2019. Sustainable manufacturing in Indrustry 4.0: Cross-sector networks of multiple supply chains, cyber-physical production systems, and al-driven decision-making. *Journal of Self-Governance and Management Economics,* **7**(2), 31-36. ISSN 2329-4175. doi:10.22381/JSME7220195.

HORÁK J., Katz, K., 2022. Operating lease as a means and motivation for circular economy. *Ekonomicko-Manazerske Spektrum*, **16**(1), 114-124. ISSN 1337-0839.

HORÁK J., PAVLOVÁ. Š., 2022. Capital structure of companies applying principles of circular economy. *AD ALTA: Journal of Interdisciplinary Research,* **12**(1), 60-64. ISSN 2464-6733.

HORÁK J., DUŠEK K., 2022. The evolution of gold and silver commodity prices in the cirular economy. *Journal of Valuation and Expertness,* **6**(1), 11-27. ISSN 2533-6258.

CHANGLING S., ŠKAPA S., HORÁK J., YANING Y., 2022. Does core competence affect corporate social responsibility? *Journal of Competitiveness,* **13**(4), 132-150. ISSN 1804-171X.

CHEN Y., JIN S., 2023. Corporate Social Responsibility and Green Technology Innovation: The Moderating Role of Stakeholders. *Sustainability,* **15**(10), 8164. https://doi.org/10.3390/su15108164

KARASSIN O., BAR-HAIM, A. 2016. Multilevel corporate environmental responsibility. *Journal of Environmental Management,* **183**, 110-120. ISSN 0301-4797.

KLEŠTIK T., VALÁŠKOVÁ K., LAZAROIU G., KOVÁČOVÁ M., VRBKA J., 2022. Remaining financially zdravé a konkurenceschopné: The role of financial predictors. *Journal of Competitiveness,* **12**(1), 74-92. ISSN 1804-171X. doi:10.7441/joc.2020.01.05.

MAITRE-EKERN E., 2021. Re-thinking producer responsibility for a sustainable circular economy from extended producer responsibility to pre-market producer responsibility. *Journal of Cleaner Production,* **286**. ISSN 0959-6526.

MORGAN D. R., STYLES D., LANE E. T., 2022. Packaging choice and coordinated distribution logistics to reduce the environmental footprint of small-scale beer value chains. *Journal of Environmental Management,* **307**. ISSN 0301-4797.

MURILLO-AVALOS C. L., CUBILLA-MONTILLA M., SÁNCHEZ M. Á. C., VICENTE-GALINDO P., 2021. What environmental social responsibility practices do large companies manage for sustainable development? *Corporate Social Responsibility and Environmental Management,* **28**(1), 153-168. ISSN 1535-3958.

RASMENI Z., MADYIRA D. M., MATHERI, A., 2022. Comprehensive analysis of BSY as a biomass for potential energy resource recovery. *Energy Reports,* 8, s. 804-810. ISSN 2352-4847.

SEHNEM S., LOPES DE SOUSA JABBOUR A. B., da CONCEIÇÃO D. A., WEBER D., JULKOVSKI D. J., 2021. The role of ecological modernization principles in advancing circular economy practices: lessons from the brewery sector. *Benchmarking: An International Journal,* **28**(9), 2786-2807. ISSN 1463-5771.

SHAN Z., 2020. Research on Environmental Accounting based on Social Responsibility. *Canada: Clausius scientific pr inc703 kilmar cres*. ISBN 978-1-989348-47-5.

SHEEHY B., FARNETI F., 2021. Corporate Social Responsibility, Sustainability, Sustainable Development and Corporate Sustainability: What Is the Difference, and Does It Matter? *Sustainability,* **13**(11), 5965. ISSN 2071-1050.

SMOL M., 2022. Is the green deal a global strategy? Revision of the green deal definitions, strategies and importance in post-COVID recovery plans in various regions of the world. *Energy Policy,* **169**. ISSN 0301-4215.

SPIRKOVÁ M., POKORNÁ E., ŠUJANOVÁ J., SAMÁKOVÁ J., 2016. Environmental issues elimination through circular economy. *5th International Advances in Applied Physics and Materials Science Congress and Exhibition* (APMAS). 2016, (1727).

STRATEGIC FRAMEWORK OF THE CIRCULAR ECONOMY OF THE CZECH REPUBLIC 2040, 2021. Ministry of the Environment [online]. [2023-04-16]. Available from: https://www.mzp.cz/C1257458002F0DC7/cz/cirkularni_cesko/$FILE/OODP-Cirkularni_Cesko_2040_web-20220201.pdf

SUSTAINABLE DEVELOPMENT REPORT – STAROPRAMEN, 2021. Staropramen [online]. [2023-06-16]. Available from: https://pivovary-staropramen.cz/documents/zprava-o-trvale-udrzitelnem-rozvoji_2021_cz.pdf

SUSTAINABLE DEVELOPMENT REPORT – PLZEŇSKÝ PRAZDROJ, 2021. Plzeňský Prazdroj [online]. [2023-06-16]. Available from: https://udrzitelnost.prazdroj.cz/wp-content/uploads/2022/09/CZ_Zprava-o-udrzitelnosti_2021.pdf

TEREFE G., KITAW G., DEJENE M., FEKADU D., KIHALEW A., MEKONNEN B., WALELGNE, M., 2023. Dairy farmer's perception on feeding, conservation, and constraints of brewery by-products utilization in selected districts of Ethiopia. *Heliyon,* **9**(1). ISSN 2405-8440.

TLUSTÝ J., KMECOVÁ I., 2022. The degree of use of motivational factors depending on the sector and size of enterprises. *Entrepreneurship and Sustainability Issues,* **10**(2), 590-607. ISSN 2345-0282.

VERHUELSDONK M., GLAS K., PARLAR H., 2021. Economic evaluation of the reuse of brewery wastewater. *Journal of Environmental Management,* 281. ISSN 0301-4797.

WANG M., LIAO G., LI Y., 2021. The Relationship between Environmental Regulation, Pollution and Corporate Environmental Responsibility. *International Journal of Environmental Research and Public Health,* **18**(15). ISSN 1660-4601.

WIEGAND T., WYNN M., 2023. Sustainability, the Circular Economy and Digitalisation in the German Textile and Clothing Industry. *Sustainability,* **15**(11), 9111. https://doi.org/10.3390/su15119111

Contact address of the authors:

Bc. Michaela Jannová, School of Expertness and Valuation, Institute of Technology and Business in České Budějovice, Okružní 517/10, 37001 České Budějovice, Czech Republic
e-mail: michaelajannova@mail.vstecb.cz

Bc. Jana Portová, School of Expertness and Valuation, Institute of Technology and Business in České Budějovice, Okružní 517/10, 37001 České Budějovice, Czech Republic
e-mail: 27780@mail.vstecb.cz