BENEFITS, BARRIERS & BURDENS OF THE CIRCULAR ECONOMY

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1. Introduction

Each year as globalisation occurs, consumption increases and the planet's population continues to grow, Earth's finite resources become increasingly strained (Upadhyay et al., 2021). As governments, industries and populations begin to realise the magnitude of this issue, support for the Circular Economy (CE) grows. The global community is now seeking to replace the increasingly unsustainable Linear Economy (LE) currently being operated around the globe with a more sustainable alternative (Christensen, 2021). Transitioning from the LE to the CE means turning away from the harmful take – make – waste structure of the LE and adapting to a more ecological CE model that focusses on designing out waste, preserving the environment, and regenerating precious natural resources (Kok, 2013). Unlike the LE, the CE treats natural resources as finite commodities that should be protected to ensure long term ecosystem health. It is CE's prerogative to ensure economic growth alongside social and environmental gains.

By examining key features and problem areas of the CE this paper will highlight areas where policy makers may intervene to turn this economic theory into a reality.

2. Benefits, Barriers and Burdens

2.1 Benefits

There is a rich literature on the benefits of adopting a CE. As discussed in Section 2 benefits can be split into three categories; social benefits; economic benefits; and environmental benefits. This section will examine each category and highlight opportunities for policy makers to maximise the benefits of the CE.

2.1.i. Social Benefits

The social benefits of the CE are often less demonstrable than the environmental and economic benefits. As a result, Kirchherr et al., as cited by Repp et al., found that only 20 percent of publications defining the CE viewed social sustainability to be one of the CE's primary outcome (Kirchherr et al., 2017, Repp et al., 2021). As highlighted in Section 2, Clube and Tennant established that over time the social benefits of the CE have become lost in the CE's transition from theory to practice (Clube and Tennant, 2020). This may be a direct result of the sheer size and force of the LE requiring the CE to adapt to a more economic-centric modus operandi for a transition away from the LE to seem feasible.

Research does exist to confirm the social benefits of implementing a CE however it is not without challenges. In a modelling analysis of 300 existing CE strategies Aguilar-Hernandeza

et al., found that implementing CE strategies over the period 2020 – 2050 can generate a 'win-win-win' scenario by increasing social, macroeconomic and environmental benefits by 2030. However researchers also identified the existence of trade-offs between economic, social and environmental benefits (Aguilar-Hernandez et al., 2021). Additionally, social sustainability generated by the CE was found to be an integral part of engaging stakeholders in businesses that are leading the implementation of the CE in Italy and the Netherlands. Despite this researchers found the participant companies to have vague and nebulas perception of social sustainability and its benefits (Walker et al., 2021). As described in Section 2 Panchal et al., established that the CE is compatible with several SDGs; however, the same research also found the CE to have little to no compatibility with goals that have a strong social focus such as SDG1 (no poverty), SDG2 (zero hunger), and SDG3 (good health and well-being) (Panchal et al., 2021). The International Institute for Sustainable Development (IISD) found that adopting a CE in Europe is predicted to create a net increase of 700,000 jobs (The International Institute for Sustainable Development, 2018) and yet researchers fear that as a direct result of the same CE other regions will face a net decrease in employment (Repp et al., 2021, Aguilar-Hernandez et al., 2021).

The social benefits that can be generated by adopting the CE are underrepresented in the recent literature. Researchers have identified that trade-offs exist between social and environmental benefits with some regions more vulnerable to negative social effects of the CE than others. Moving forward CE policy must consider the existence of natural trade-offs and vulnerabilities. Policy makers should further research the social benefits of the CE and compensate those negatively affected through state support and financial aid to support the transition from LE to CE.

2.1. ii. Economic Benefits

From the global perspective implementing the CE across different sectors could add USD 2 trillion to the global economy annually by 2050, relative to the existing LE pathway (UNEP, 2017). It is estimated that by reducing material waste alone the global clothing industry would save USD 71 billion annually (Ellen MacArthur Foundation, 2013). At regional levels the CE has also been estimated to produce significant savings. Novel research by the Ellen MacArthur Foundation found that by adopting a CE Europe could increase overall economic benefits by €0.9 trillion vs those from the current LE pathway; increase EU GDP by 11% by 2030 vs 4% on the current LE pathway; and increase disposable income by €3,000 per EU household by 2030 compared to the current LE pathway (The Ellen MacArthur Foundation, 2015). Furthermore, at a local and national level the CE has already proven to be economically beneficial. In a case study of the Finnish Åland Islands, Kiviranta et al. found that adopting the CE can act as a catalyst in the transition to renewable energy and increase the economic profitability of energy systems (Kiviranta et al., 2020). Improving plastic recycling capabilities in the US

packaging companies could save USD 7.3 billion and profit USD 2.4 billion annually (Ellen MacArthur Foundation, 2013); and in China adopting a circular economic model in large scale pig farming is capable of saving RMB 193 million from carbon trading and emissions reduction alone (Xue et al., 2019).

There is evidence to support the economic benefits of implementing a CE at every economic level. However; installing the CE at larger scales is complex due to the interlinkages required between industries and institutions. Due to a lack of infrastructure that creates and supports such interlinkages the CE has not yet been able to penetrate regional and global levels of the economy. Additionally, the complex nature of global and regional CE has resulted in a research gap covering the benefits of the CE at this scale. This research gap likely contributes to the lack of real life implementation of CE at global and regional levels. For the full economic benefit of the CE to be felt more research must be done to fully assess the benefits of a global and regional CE and in the future a stronger, more circular, international CE policy approach must be put in place.

2.1.iii. Environmental Benefits

The linear economy that is currently operated at a global scale functions on a take – make – waste basis. As global temperatures rise and the environmental effects of climate change worsen each year it is becoming increasingly clear that the LE system has surpassed its limits (Wautelet, 2018). Figure 1 below shows by how much the average person in the UK exceeds their own ecological limits in one year.

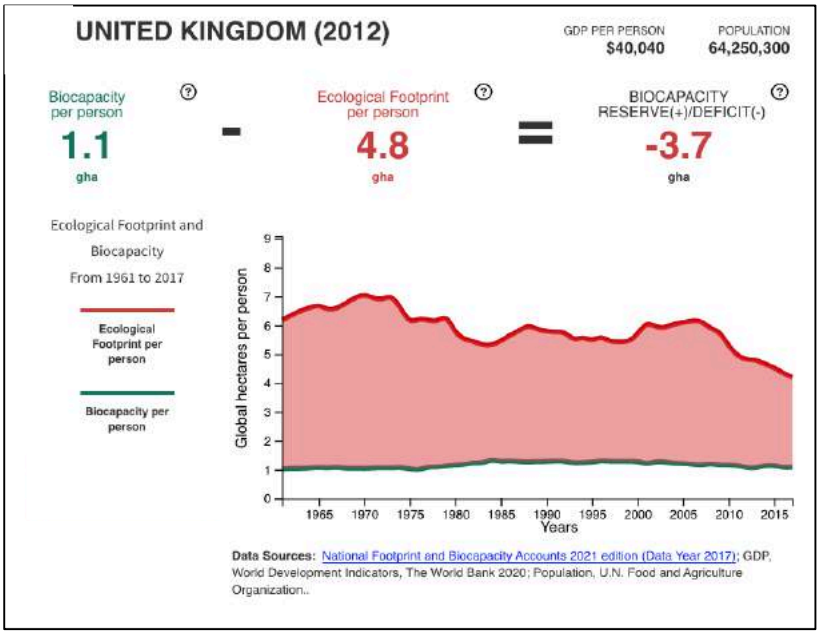

Figure 1 Amount by which UK citizens exceed their ecological limits within a year, *Source: (Footprint Calculator, 2021b)*

The map in Figure 2 shows how many countries are annually exceeding their planetary boundaries to meet the demands of the linear economy. Countries that are shown to keep consumption below what can be generated in a year are largely low income countries as shown in the comparison with Figure 3. For developing countries to achieve socio-economic growth without further exceeding planetary boundaries and for developed countries to stop further damage to the earth it is essential that the global population turns to a more sustainable economy.

The circular economy can help facilitate the sustainable development of developed and developing countries by decoupling the economy from the consumption of finite resources, reducing waste and regenerating natural resources (Kok, 2013). Many industries have already proven the environmental benefits of employing a CE in different ways. In the fishing industry,

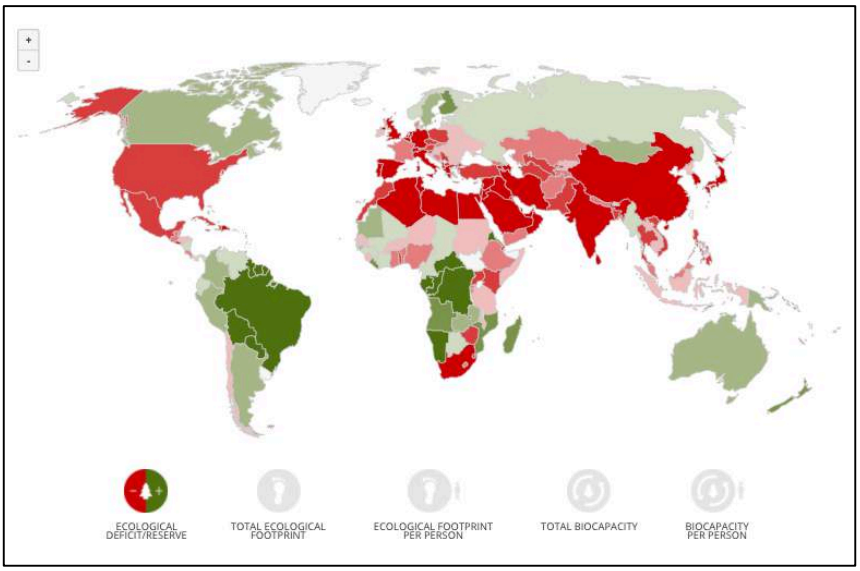

Figure 2 Countries with ecological deficits and reserves, *Source: (Footprint Calculator, 2021a)*

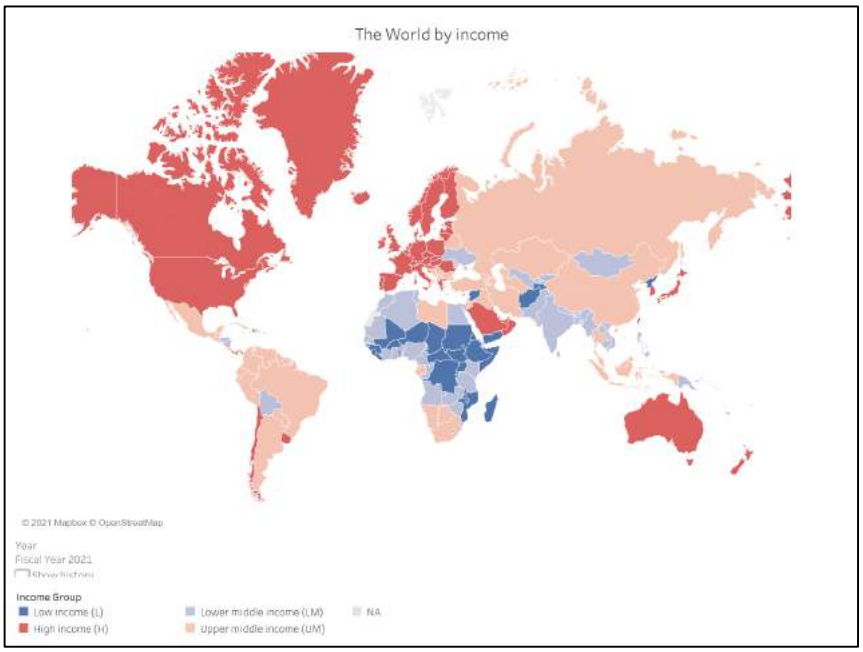

Figure 3 The World by income, *Source: (The World Bank, 2021)*

the CE has been identified as a means of establishing sustainable value chain models and adding economic value (Jacob et al., 2021). In 2015, the CE would have saved 3,091,891.81 t CO2-eq emissions from the Chinese large-scale pig farming industry (Xue et al., 2019) and in the modular building industry implementing a CE is estimated to cut GHG emissions by 88% (Minunno et al., 2020).

Critics of the CE such as (Clube and Tennant, 2020), (Hobson, 2021) and (Korhonen et al., 2018), as cited by (Larrinaga and Garcia-Torea, 2021) find that the environmental benefits of the CE principles alone may be insignificant if consumers do not change their behaviour to form more sustainable habits. Although there is no guarantee that the mere existence of a CE is enough to guarantee its success, analysis of existing CEs has found that the correct government support and successful private-public sector relations can be key drivers in bringing the CE to fruition. Therefore, it is essential when designing future transition policies policy makers consider measures that will support a change in consumer behaviour as well as implementing the CE (Christensen, 2021). Such measures may include education on the benefits of a CE, incentives, and collaboration with the private sector.

2.2 Barriers & Burdens

2.2. i. Barriers

This paper defines barriers as factors that currently prevent the CE from materialising fully. Barriers to implementing the CE are well documented in the literature[1]. Sampling 195 articles on this topic, Galvão et al. categorised barriers to the CE into seven groups: (i) technological, (ii) policy and regulatory, (iii) financial and economic, (iv) managerial, (v) performance indicators, (vi) customer and (vii) Social (Araujo Galvão et al., 2018). These findings are largely supported by Tura et al. in a similar review of drivers and barriers (Tura et al., 2019). The way in which barriers highlighted in this literature traverse the different levels of society (and the economy) illustrates that establishing a successful CE will require a structural change to occur at every societal level.

In the analysis produced by Galvão et al. out of the 195 articles sampled, 106 entries came from single sources. The diverse nature of the categories identified and the broad diaspora of source material gathered to complete the analysis in both studies speaks to the extensive reach of the CE. This is further evidenced by the sizable volume of publications on the CE reviewed by this report that covered a significant range of countries, regions and industries as shown in Section 3.1 ‘Benefits’. As previously established, by analysing CE literature it can be concluded that the circular economy applies to many if not every sector in society. The fact that barriers to the CE exist in so many parts of society speaks to a severe lack of supporting infrastructure across the private – public sector. Graftström and Aasma hypothesise that for a CE to work there must be coherence between the micro, meso and macro levels of the economy. This relies on integrated complimentary CE strategies between consumers (micro), economic agents (meso) and regions and/or governments (macro). Action

[1] See also (Kok, 2013, Shi et al., 2008) as cited in (Ritzén and Sandström, 2017).

at the macro and meso level are found to be key for the CE on a micro level to function well. When identifying barriers to the economy inconsistent policy and bad institutions were amongst the most prominent factors preventing a CE from materialising (Grafström and Aasma, 2021).

As identified by McKinsey & Company, to feel increased environmental and economic benefits the private and public sectors should be aiming to introduce CE into policy, business and social arenas (McKinsey, 2017). A common finding derived in literature that examines CE is that a lack of government and non-government support prevents CE from penetrating businesses and policies fully (Grafström and Aasma, 2021, Tura et al., 2019, Araujo Galvão et al., 2018). From the analysis in this paper it can be determined that a lack of infrastructure across regions presents a major barrier to successful deployment of a CE. Governments and international organisations must lay the foundation for a successful CE by consulting with stakeholders at the meso and micro level to establish integrated CE strategies. For CE to succeed in the future, the private-public sector must be made fully aware of the benefits from the CE. Once made aware, these sectors should find themselves beholden to a level of accountability that ensures relevant integrated infrastructure plans are made and implemented to maximise the benefits of CE.

2.2. ii. Burdens

This paper defines burdens as factors resulting from the implementation of the CE that have the potential to cause undesirable side effects unless negated. Adopting a CE will bring many benefits such as reducing economic dependence on finite resources and reducing environmental pressures thereby facilitating economic growth within planetary boundaries (Kok, 2013). However, without proper planning the negative consequences of adopting a CE could be severe. This paper has identified numerous potential burdens related to the CE such as; the effects an increased global share of renewable energy may have on demand for fossil fuels; the challenge of changing consumer behaviours; ensuring quality across product life-cycles; and the need to balance the macro layer of the economy between resilient interlinkages and risky over-dependence on links within the supply chain. Due to the scope of this paper, this analysis will focus on one potential burden to illustrate some of the increasing demands a CE will bring.

Renewable energy is widely considered to be an integral part of the CE. The Ellen MacArthur Foundation defines the circular economy as being founded on three core principles: preserving and enhancing natural capital; optimising resource yields by circulating products, components and materials; and designing out negative externalities such as pollution (Ellen MacArthur Foundation, 2015). Renewable energy addresses two of these principles and is an essential element in the process of sustainable development (Pukšec et al., 2019).

One potential major issue associated with CE and renewable energy is an increase in demand of critical minerals of which there is a finite supply. The clean energy transition demands significantly higher concentrations of rare earth minerals than the fossil fuel energy industry (Calvo and Valero, 2021) and demand for minerals is rapidly increasing. In the last five years' electric transport and grid storage have increased their share of final consumer demand of cobalt from 5% to almost 25%; this increase in demand contributed towards a five-fold price increase in cobalt between 2016 and 2018 (IEA, 2020). Increased dependence on ores and minerals has significant geopolitical ramifications. Deposits of rare earth elements are more densely concentrated than deposits of fossil fuels. In the case of the most in-demand elements (including lithium and cobalt) the top three global producers control upwards of 75% of global output. This creates supply chains that are extremely vulnerable to disruption as well as price volatility; concerns over lax social and environmental regulations inside mines are also common (IEA, 2020, Upadhyay et al., 2021). Analysis of the sector has found than 13 elements essential for the renewable energy sector present as high risk or very high risk to supply disruptions (Calvo and Valero, 2021). Table 1 below shows some key challenges regarding the supply of certain minerals.

Mineral	Key challenges
Cobalt	• High reliance on the DRC for production and China for refining (both around 70%) set to persist, as only a few projects are under development outside these countries. • Justified tightening of social and environmental conditions for production could put large volumes of supply at risk. • New supply is subject to developments in nickel and copper markets as some 90% of cobalt is produced as a by-product of these minerals.
Nickel	• New investments are not catching up with the expected growth in demand (due in part to the shift towards high-nickel battery chemistries). • Projects for battery-grade mines have track records of delays and cost overruns. • The ban on ore exports by Indonesia, the largest producer, casts doubt on the prospect of secure global supplies.
Copper	• Difficult to substitute due to its superior performance in electrical applications. • Production in both Chile and Peru (40% of global output) is subject to social disruptions and rising costs. Mines in South America and Australia are exposed to high levels of climate and water stress. • Mines currently in operation are nearing their peak due to declining ore quality and reserves exhaustion.
Rare earths	• Dominance of China across the value chain from mining to processing and magnet production. • Negative environmental credentials of processing operations. • Differences in demand outlooks for individual elements bring risks of price spikes for those in high demand (e.g. neodymium) and slumps for those in low demand (e.g. cerium).

Figure 4 Key Challenges Regarding the Supply of Certain Minerals *Source: (IEA, 2020)*

Steps must be taken to protect the supply chain of rare earth elements. Future macro and meso actors of the energy transition will have to carefully balance the fragility of mineral supply chains against the increase in demand. Recommended actions for government and industry actors include investing in creating an energy security framework that periodically reviews mineral supply and demand, and invests in new mines before old ones

become depleted. Recycling of materials, material R&D and sustainable resource development are also recommended to prolong the lifespan of resources (IEA, 2020). Stricter legislation in line with the technical perspective of the CE and increasing private – public relationships in line with CE principles may also reduce the risk of shortages in the future (Calvo and Valero, 2021).

3. Conclusion

This report has found several factors to be essential for the implementation of a successful CE. The first element necessary for a successful CE is clear policy support. Clear policy support enables investors and key actors to make long term commitments to the CE without fear of the project collapsing at the beginning. Thoughtful well-informed policy infrastructure will also be essential to negate future burdens of the CE as it matures. The second element necessary for a successful CE is collaboration between the private-public sector. Research highlighted in this paper has repeatedly shown private-public collaboration to be a key driver in a successful CE. The last factor essential for a successful CE is collaboration between the micro, meso and macro layers. This paper has highlighted findings that identify the macro and meso layers as the most influential layer in implementing the CE; meaning that for consumers' behaviour to change in a meaningful way the micro-layer of CE must be integrated with the other layers. Findings in this report also identified that without bottom up support the CE is likely to be unsuccessful, reiterating the importance of integrated CE strategies. Policy makers should focus on these three elements when design CE policies in the future. Further research could be done to test the validity of these finding by using them as a framework to assess successful and failed CE's.

Critics of the CE find several flaws in the system such as unevenly distributed benefits between developed and developing economies; dubiety over whether the CE can legitimately reduce GHG emissions and make consumers consume less; and the likelihood of trade-offs between environmental, social and economic benefits. These criticisms are vital for the development of successful CE policies and should be used to inform future policies fostering a transition to the CE. Although some may see these criticisms as a deterrent for implementing a CE or adopting CE principles it should be noted that the repercussions of continuing down the LE pathway are likely to be far more disastrous than transitioning to the CE. With the right policy support and financial infrastructure, the CE offers an opportunity for global economic growth within planetary boundaries indefinitely; in contrast, as the Earth's ecosystem deteriorates economic growth under the LE looks increasingly finite.

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6. Bibliography

Aguilar-Hernandez, Glenn A., Dias Rodrigues, João F. & Tukker, Arnold 2021. Macroeconomic, social and environmental impacts of a circular economy up to 2050: A meta-analysis of prospective studies. *Journal of Cleaner Production,* 278**,** 123421.

Araujo Galvão, Graziela Darla, de Nadae, Jeniffer, Clemente, Diego Honorato, Chinen, Guilherme & de Carvalho, Marly Monteiro 2018. Circular Economy: Overview of Barriers. *Procedia CIRP,* 73**,** 79-85.

Bank, The World. 2021. *The World by Income and Region* [Online]. Available: https://datatopics.worldbank.org/world-development-indicators/the-world-by-income-and-region.html [Accessed 03.06.21 2021].

Calculator, Footprint. 2021a. *Explore data* [Online]. Available: http://www.footprintcalculator.org/exploreData [Accessed 03.06.21 2021].

Calculator, Footprint. 2021b. *UK Annual Data* [Online]. Available: http://www.footprintcalculator.org/exploreData [Accessed 03.06.21 2021].

Calvo, Guiomar & Valero, Alicia 2021. Strategic mineral resources: Availability and future estimations for the renewable energy sector. *Environmental Development***,** 100640.

Christensen, Thomas Budde 2021. Towards a circular economy in cities: Exploring local modes of governance in the transition towards a circular economy in construction and textile recycling. *Journal of Cleaner Production,* 305**,** 127058.

Clube, Rebecca K. M. & Tennant, Mike 2020. The Circular Economy and human needs satisfaction: Promising the radical, delivering the familiar. *Ecological Economics,* 177**,** 106772.

Development, The International Institute for Sustainable 2018. Estimating Employment Effects of the Circular Economy. IISD.

Foundation, Ellen MacArthur 2013. Towards The Circular Economy 2. Ellen MacArthur Foundation.

Foundation, Ellen MacArthur 2015. Towards a Circular Economy: Business Rationale For an Accelerated Transition. Ellen Macarthur Foundation.

Grafström, Jonas & Aasma, Siri 2021. Breaking circular economy barriers. *Journal of Cleaner Production,* 292**,** 126002.

Hobson, Kersty 2021. The limits of the loops: critical environmental politics and the Circular Economy. *Environmental Politics,* 30**,** 161-179.

IEA 2020. Clean energy progress after the Covid-19 crisis will need reliable supplies of critical minerals. Paris: IEA.

Jacob, Céline, Noirot, Christelle, Anglada, Clémentine & Binet, Thomas 2021. The benefits of integrating socioeconomic dimensions of circular economy practices in the seafood sector. *Current Opinion in Environmental Science & Health,* 22**,** 100255.

Kirchherr, Julian, Reike, Denise & Hekkert, Marko 2017. Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling,* 127**,** 221-232.

Kiviranta, Kirsikka, Thomasson, Tomi, Hirvonen, Jonne & Tähtinen, Matti 2020. Connecting circular economy and energy industry: A techno-economic study for the Åland Islands. *Applied Energy,* 279**,** 115883.

Kok, L.; Wurpel, G.; Ten Wolde, A. 2013. Unleashing the Power of the Circular Economy. Netherlands: IMSA Amsterdam.

Korhonen, Jouni, Honkasalo, Antero & Seppälä, Jyri 2018. Circular Economy: The Concept and its Limitations. *Ecological Economics,* 143**,** 37-46.

Larrinaga, Carlos & Garcia-Torea, Nicolas 2021. An ecological critique of accounting: The circular economy and COVID-19. *Critical Perspectives on Accounting***,** 102320.

McKinsey 2017. Mapping the Benefits of a Circular Economy *McKinsey Quartely* McKinsey & Company.

Minunno, Roberto, O'Grady, Timothy, Morrison, Gregory M. & Gruner, Richard L. 2020. Exploring environmental benefits of reuse and recycle practices: A circular economy case study of a modular building. *Resources, Conservation and Recycling,* 160**,** 104855.

Panchal, Rohit, Singh, Anju & Diwan, Hema 2021. Does circular economy performance lead to sustainable development? – A systematic literature review. *Journal of Environmental Management,* 293**,** 112811.

Pukšec, Tomislav, Foley, Aoife, Markovska, Natasa & Duić, Neven 2019. Life cycle to Pinch Analysis and 100% renewable energy systems in a circular economy at sustainable development of energy, Water and Environment Systems 2017. *Renewable and Sustainable Energy Reviews,* 108**,** 572-577.

Repp, Lars, Hekkert, Marko & Kirchherr, Julian 2021. Circular economy-induced global employment shifts in apparel value chains: Job reduction in apparel production activities, job growth in reuse and recycling activities. *Resources, Conservation and Recycling,* 171**,** 105621.

Ritzén, Sofia & Sandström, Gunilla Ölundh 2017. Barriers to the Circular Economy – Integration of Perspectives and Domains. *Procedia CIRP,* 64**,** 7-12.

Shi, H., Peng, S. Z., Liu, Y. & Zhong, P. 2008. Barriers to the implementation of cleaner production in Chinese SMEs: government, industry and expert stakeholders' perspectives. *Journal of Cleaner Production,* 16**,** 842-852.

The Ellen MacArthur Foundation, The McKinsey Centre for Business and Environment, SUN (Stiftungsfonds für Umweltökonomie und Nachhaltigkeit) 2015. Growth Within: A Circular Economy Vision For a Competitive Europe. The Ellen MacArthur Foundation, The McKinsey Centre for Business and Environment, SUN.

Tura, Nina, Hanski, Jyri, Ahola, Tuomas, Ståhle, Matias, Piiparinen, Sini & Valkokari, Pasi 2019. Unlocking circular business: A framework of barriers and drivers. *Journal of Cleaner Production,* 212**,** 90-98.

UNEP 2017. Resource Efficiency: Potential and Economic Implications. A report of the International Resource Panel. *In:* Ekins, P., Hughes, N., et al. (ed.). United Nations Environment Programme.

Upadhyay, Arvind, Laing, Tim, Kumar, Vikas & Dora, Manoj 2021. Exploring barriers and drivers to the implementation of circular economy practices in the mining industry. *Resources Policy,* 72**,** 102037.

Walker, Anna M., Opferkuch, Katelin, Roos Lindgreen, Erik, Simboli, Alberto, Vermeulen, Walter J. V. & Raggi, Andrea 2021. Assessing the social sustainability of circular economy practices: Industry perspectives from Italy and the Netherlands. *Sustainable Production and Consumption,* 27**,** 831-844.

Wautelet, Thibaut. 2018. *Exploring the role of independent retailers in the circular economy: a case study approach.*

Xue, Yu-nan, Luan, Wei-xin, Wang, Hui & Yang, Yu-jie 2019. Environmental and economic benefits of carbon emission reduction in animal husbandry via the circular economy: Case study of pig farming in Liaoning, China. *Journal of Cleaner Production,* 238**,** 117968.