Dilemmas and contradictions, limits and possibilities of a corporate-led circular economy in times of climate change

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Karolina Hötzeneder
(Austria)

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Members of the Examining Committee:

Dr. Saturnino (Jun) M. Borras Jr.
Dr. Murat Arsel

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Inquiries:

International Institute of Social Studies
P.O. Box 29776
2502 LT The Hague
The Netherlands

t: +31 70 426 0460
e: info@iss.nl
w: www.iss.nl
fb: http://www.facebook.com/iss.nl
twitter: @issnl

Location:

Kortenaerkade 12
2518 AX The Hague
The Netherlands

Content

List of Acronyms

BIR	Bureau of international recycling
CE	Circular economy
CO2	Carbon dioxide
COM	European Commission
EPR	Extended producer responsibility
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FSC	Forestry Stewardship Council
GHG	Greenhouse gas
IMF	International monetary fund
IPCC	Intergovernmental Panel on Climate Change
ISS	Institute of Social Studies
OECD	Organisation for Economic Co-operation and Development
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme

Abstract

This paper explores the dilemmas and contradictions associated with a corporate-led circular economy in order to understand its possibilities and limitations to contribute to a significant reduction of greenhouse gas emissions. While targets were set in the Paris agreement to prevent a global warming above 1.5 degrees, greenhouse gas emissions are still increasing, with severe consequences for humanity and the planet. The circular economy is promoted by governments and inter-governmental organizations as a solution combine economic growth and ecological sustainability. This paper explores the questions if an economy can produce less and still grow, if a 'circular fix' can solve the climate crisis and if regenerating nature goes along with regenerating profits, in short, if the notion of a corporate-driven circular economy is utopian, or practical and do-able. This paper links the macro-level debates with the micro-level by studying the transition of one major corporate actor in the manufacturing sector to a circular economy.

Keywords

Circular economy – Climate change – Contradictions – Dilemmas – Sustainability - Capitalism

Chapter 1 Introduction

"Clearly, we are at a moment of fundamental shift in the history of capitalism and in the history of the climate system" (Moore 2017: 178)

1.1 Climate crisis & circular economy – a story of dilemmas and contradictions

Climate change has compelled corporations to rethink their strategies in capital accumulation in relation to ecology. This has paved the way for the concept of and increasing experiments on the so-called 'circular economy' (CE), that in turn is packaged as a win-win strategy: that is, corporations can continue to generate profit, while responding to the requirements of ecological sustainability. However, the two tasks of generating corporate profits and ecological sustainability involve dilemmas and contradictions. Can an economy produce less and still grow? Can a 'circular fix' solve the climate crisis? Does regenerating nature go along with regenerating profits? And, is the notion of a corporate-driven circular economy utopian, or practical and do-able? This study explores such difficult questions by looking into a major corporate actor.

Severe threats like extreme weather events, sea-level rise and bio-diversity loss are direct consequences of a global temperature rise above 1.5°C. Food and water scarcity, health impacts, poverty, habitat loss for human and non-human beings, mass migration and, as the IPCC report states, a risk to economic growth are indirect ones (IPCC 2018, Chapter 3). "Rapid and far-reaching transitions in land, energy, industry, buildings, transport, and cities" are needed to reduce human-caused Carbon dioxide emissions down to 45 percent compared to 2010 by 2030, and to 'net zero' around 2050 (IPCC 2018: 14). To avoid the predicted consequences for human and non-human life on the planet, "CO2 emissions from industry (…) are projected to be about 65-90% (interquartile range) lower in 2050 relative to 2010, as compared to 50-80% for global warming of 2°C (medium confidence)[1]" (IPCC 2018: 17).

The IPCC report (2018) stresses the urgency of action and change in all sectors. Voices in civil society are getting louder demanding, that states, inter-state governance institutions hold large corporations accountable for their GHG emissions and other environmentally harmful practices. Within the framework of the Paris Agreement (2015) targets were negotiated and committed to. However, so far neither states nor corporations are on goal with their reduction. Current policies are projected to result 3.3°C of global warming above pre-industrial by the end of the century, compared to 4.1-4.8°C if there wouldn't be any policies in place.

[1] "Each finding is grounded in an evaluation of underlying evidence and agreement. A level of confidence is expressed using five qualifiers: very low, low, medium, high and very high, and typeset in italics, for example, medium confidence. The following terms have been used to indicate the assessed likelihood of an outcome or a result: virtually certain 99–100% probability, very likely 90–100%, likely 66–100%, about as likely as not 33–66%, unlikely 0–33%, very unlikely 0–10%, exceptionally unlikely 0–1%. Additional terms (extremely likely 95–100%, more likely than not >50–100%, more unlikely than likely 0–<50%, extremely unlikely 0–5%) may also be used when appropriate" (IPCC 2018: 6).

"This result is similar to our estimate last year, reflecting the fact that little has changed in terms of government commitments and targets in the past 12 months" (climateaction-tracker.org). The gap between the current course towards 3.3 and the commitment to keep global warming down to 1.5 calls for immediate action. "Efforts along such pathways to date have been limited (medium confidence) and enhanced efforts would involve strengthened and timely action from all countries and non-state actors (high confidence)," states the IPCC special report (2018: 24).

So far, attempts have been made along the notion of a 'green economy', aiming to combine economic growth with environmental sustainability, mainly through efficient and sustainable use of resources and technical innovation. Corporations are "seeking ways to off-set extraction and pollution and looking for (better) mechanisms of conservation, while increasing opportunities for the accumulation of capital and profits. This leads to other massive changes in capitalism's organizational forms and institutional diversity, particularly as they relate to increasingly contested ecological and social limits" (Arsel et al. 2012: 55). Where the state is not setting a framework of rules and regulations, businesses have started to create private regulatory schemes under the umbrella of corporate social responsibility. However, measures to achieve the goals of the Paris agreement are not effective. On the contrary, CO2 emissions are still increasing (UNEP 2018: 4). Successfully lowering carbon emissions require, in my view, fundamental changes in the operational practices of the corporate sector, which are likely to challenge the logic of the current economic system. To navigate between the two supposedly opposite poles, sustainability and economic growth, creates a difficult task. This could explain why corporations and state and inter-state institutions have made little or no progress in achieving the goals of the Paris agreement.

Many of today's interconnected environmental problems, such as accelerated CO emissions in the atmosphere enhancing climate change or biodiversity and habitat loss, find their root cause in the current economic system with an ever-increasing linear throughput flow of materials and energy. This flow consists of raw material extraction, production, consumption accompanied by emissions, and finally ends with waste to landfill. While the economy is constantly growing, the extraction is the root cause for a shrinking ecosystem. This will inevitably lead to what Korhonen (2018: 38) calls a "head collision".

To circumvent such a "head collision" the idea of a 'circular economy' has started to emerge and has gained increasing attention. The most prominent definition comes probably from the Ellen MacArthur foundation, a development platform for the circular economy, which defines it as a "restorative and regenerative economic system" (www.ellenmacarthurfoundation.org). Its theoretical basis is found in the 'Cradle-to-Cradle' concept (Braungart et al. 2006) of eco-effectiveness and industrial ecology. However, its definition vary amongst practitioners and scholars (Kirchherr et al. 2017) and keeps expanding as the concept evolves. Recently, the Ellen MacArthur foundation widened the circular economy concept, which previously focused mainly on manufacturing, to the food system. Agroecology, originally associated with social movements as an alternative to the current global food system (Rosset and Altieri 2017: 1), has been integrated - or co-opted – to provide the basis for what is understood as the "restorative and regenerative" capacity of the CE concept. Throughout this research paper, the circular economy is understood as a corporate-driven concept that encompasses definitions from the Ellen MacArthur foundation, the European Union's circularity package and similar.

Compared to the linear throughput flow, the idea of the CE is to keep materials and energy circulating in the economic system. The concept comprises material cycles of "product, component and material reuse, remanufacturing, refurbishment, repair, cascading and upgrading", and is built on the use of renewable energy like "solar, wind, biomass and waste-derived energy utilization throughout the product value chain and cradle-to-cradle life cycle" (Korhonen et al. 2018: 37). The cycles aim to keep the value of materials circulating in the economic system, thereby reducing the demand for primary raw materials and energy.

This idea of a circular economy is promoted by the European Union and different national governments and businesses. China, confronted with heavy pollution and one of the world highest resource consumption due to its economy's exponential growth rates, has implemented a circular economy promotion law already in 2008 (Matthews and Tan 2016: 441).

Despite its numerous interpretations the contribution of the circular economy to the environmental, economic and social dimension of sustainable development is often highlighted. The environmental wins entail reduced raw material and energy consumption, reduced wastes and emissions, a reduced production consumption system and renewable substitutes for materials and energy. The economic benefits are supposed to arise from reduced costs for emission control, waste management, raw materials and energy, which are expected to further increase with advancing scarcity and the implementation of more restricting environmental legislations and taxes in the future. Further, new market and investment opportunities are emphasized. The social gains are anticipated by new employment opportunities and in an "increased sense of community, cooperation and participation through the sharing economy" (Korhonen et al. 2018: 40). The concept presents itself as a silver lining in the struggle to combine economic, ecological and social sustainability. However, most often, as in the EU's circular economy package, economic and environmental benefits outweigh the social ones.

Recently, attempts are made to draw a clearer line between the circular economy and climate change mitigation strategies. The Ellen MacArthur argues that "putting in place a circular economy is a fundamental step towards achieving climate targets" (Ellen MacArthur foundation 2019: 12) as well as increasing resilience towards climate change impacts. They claim that 55% of emissions can be eliminated by shifting towards renewable energy, the remaining 45% can be addressed by transforming production and usage of products, so the argument.

However, at this point in time, the circular economy lacks empirical evidence, as Korhonen et al. point out (2018: 37). The benefits in all three spheres and specifically in limiting global warming, are more assumed than empirically demonstrated or proven. Nevertheless, the concept has started to find its way into policy discourses and is shaping sustainability strategies – or at least narratives about sustainability strategies -- of large multinational corporations. Simultaneously, the circular economy model gains increasing attention in academic literature. A vast amount of literature has been published in the past year examining the concept's claims for economic, social and environmental improvements and with these the concept's limitations – and contradictions (Korhonen et al., 2018; Giampietro, 2019; D'Amato et al., 2019; Horvath et al., 2019; Millar et al., 2019; Schroeder et al., 2018). Whether and how a corporate-led circular economy can contribute to curbing the climate crisis ultimately poses a research problem in the midst of the fundamental question of whether sustainable growth is possible or not. To answer, one must question the relationship of capital and nature, its dilemmas and contradictions.

1.2 Research objective and question

1.2.1 Research objective

To reduce GHG emissions according to the goals of the Paris Agreement at this very moment will significantly impact the degree of global warming and so the impacts of climate change on society and planet. Whether governments will impose sanctions, and provide institutional platforms that would compel, discourage, encourage large transnational corporations towards or against specific paths will be critical. The objective of this research is to understand the dilemmas and contradictions of the much-promoted circular economy as a way out of the climate crisis. To do so this research will examine the conditions influencing the corporation's room to maneuver, the way the concept is translated to practice, and challenges, dilemmas and contradiction associated with the implementation of a circular economy model. The contribution of this research paper is to add to the empirical research on the circular economy and its implications.

1.2.1 Research question

Main question:

Can a corporate-driven circular economy contribute to solving the climate crisis? What are the limits and possibilities in the face of the manifold dilemmas and contradictions between capitalism and its ecological dimension?

Sub-questions:

1) What are the conditions shaping the response of the corporate sector towards climate change and enhance a shift towards a circular economy model?
2) How do corporations act in this moment? How do they translate and implement the circular economy model?
3) What are the dilemmas and contradictions of circular economy model?

1.3 Assumptions

The research is built on following two basic assumptions: First, that at this point in time, debates around sustainability in the context of and within multinational corporations has started to move beyond what is often critiqued as 'green washing' activities. Corporations acknowledge the biophysical limits of the planet and see climate change as a threat to continue business as usual. This moment of increasing consciousness raises questions in corporations about how operational practices need and can shift in order to reach the target of the Paris agreement. Second, corporations in their very nature are committed to profit making, but not necessarily to one specific way on how profit is made. As history shows, mechanisms and strategies have been adapted over time. Climate change in its magnitude will influence future ways of profit-making.

1.4 Relevance for development studies

Three main considerations motivate this research in the context of development studies. First, the circular economy model might offer a solution for lower-income countries to 'leap-frog' to more sustainable economic, ecological and social behavior compared to the pathway the industrialized countries have taken, and contribute to "vital human development goals, while remaining within planetary boundaries" (Schroeder 2019: 77). This becomes a crucial consideration in the field of climate change mitigation on a global level, insofar the circular economy model causes significantly lower GHG emissions than the linear system. Second, the way the industry in the Global North acts in regard to the pathways described in the IPCC report, significantly determine the degree of global warming. The accompanying impacts of a warming above 1.5 degree Celsius, however, such as climate-related poverty, food and water scarcity and ultimately worsening living conditions for human and non-human beings as a whole are anticipated to hit low income countries harder (IPCC 2019: 17). Third, implementing a new economic system might or might not alter the dynamics in global value chains. Seeing the circular economy model as a mitigation or adaptation strategy in the face of climate change, the distribution of adverse impacts of such strategies, particularly for poor and disadvantaged populations around the world, is a question of ethics and equity, as the IPCC report stresses (2018: 20) and need to be carefully observed.

Chapter 2 Theoretical framework, methodology & scope and limitations

2.1 Theoretical framework

To answer the research question, one might start to explore the conditions under which make corporations shift from a current linear economic system to a circular economy model. I want to explore this question under the lens of Marx's concept of *expanded reproduction*. "In capitalism commodity production is uniquely systematic and generalized. An ever-increasing range of goods and services is produced as commodities for market exchange in order to make profit." (Bernstein 2010: 25). Competition creates productive forces with a tendency towards overaccumulation of capital. The core logic is to keep capital productive by investments in the means of production and labor power. "Profit is reinvested to make more profit in an endless cycle of accumulation of further production and profit, what Marx called the expanded reproduction of capital" (Bernstein 2010:25). Capitalism presupposes, that the means of production are widely available.

This comes under new spotlight in times when natural resources become increasingly scarce and brings up the question, how capitalism will react to this changing situation. Committed to earn profits, resource scarcity will force capitalism to find new ways of accumulation, which are independent from the extraction of natural resources. "…[T]he problem is how to remake capital in ways consistent with the sustainability of nature", as O'Connor (1998: 238) argues.

The endless cycle of expanded reproduction of capital that tends to result in overaccumulation of capital in turn results in cycles of crisis in capitalism. If capitalism is in recurring cycles of crisis, how then is capitalism able to survive, as Harvey asked (2003: 63). For Harvey, *spatial-temporal fixes* are the main instrument of capital to deal with the crisis of overaccumulation and enable capital to expand and to avoid its own devaluation. "If over-accumulated capital does not or cannot move, on the other hand, then it stands to be devalued directly." (Harvey 2003: 66). The surplus produced needs either to be "absorbed by (a) temporal displacement through investment in long-term capital projects or (…) (b)spatial displacements through opening up new markets, new production capacities and new resources…". A field of tension opens up between new mechanisms of capital accumulation through extraction of natural resources and, consequently, the "depletion of the environmental commons land, air, water and proliferating habitat degradation" (Harvey 2003: 75). State institutions are in the role to facilitate such reallocation of capital. Not only new emerging markets lead to a growing, global competition for new frontiers of accumulation (Harvey 2003: 68), but the need for nature conservation sets limits to spatial expansion.

In the face of climate change the role of the state is dual and contradictory at the same time by being a facilitator of capital accumulation and maintaining legitimacy. "In any event, crisis-induced changes in production conditions necessarily lead to more state controls, more planning within the bloc of large-scale capital…" (O'Connor 1998: 170). While calls for action against climate change become louder, the state is expected to enable economic growth and setting limits for the corporate sector in their GHG emissions at the same time. This sets "constraints on the state capacity to carry out reforms" (Fox 1993: 15).

James O'Connor's *Second Contradiction of Capitalism* provides a theoretical framework to explore the ecological side to Marx political economy approach. He describes a contradiction "between capitalist production relations and productive forces, on the one hand, and conditions of production, on the other." (O`Connor 1998: 164). The crisis points at the "cost-side profit squeeze generated by the contradiction of capital and nature" (O'Connor 1998: 236). Next to the crisis of overaccumulation, or the first contradiction of capitalism, the environmental crisis can lead to a crisis of under-accumulation. In other words, the exploitation and degradation of nature will limit future profits as it destroys the means of production. Hence, O'Connor asks, "Does capital create its own barriers or limits by destroying its own production conditions?" (1998: 165). The idea of a purely demand driven production will meet a new reality. Given that corporations define nature as a condition of production, environmental degradation will result in a reduced productivity of the condition of production.

Consequently, environmental protection becomes a concern for corporations, in order to continue the expansion of capital, given that the accumulation of capital is based on the production and extraction of raw materials. Corporations find themselves in a field of conflict, where decisions need to be made between short versus long-term profitability. The second contradiction of capital implies that capitalism has to adapt in order to survive. The "Destruction of environment can lead to vast new industries designed to restore it (O'Connor 1998: 170). The circular economy model can be seen as an attempt to adapt to new circumstances without compromising on either on economic growth, or on environmental protection.

Daly argues, that the limitation of capital expansion does not sit in the availability and cost of labor any longer, but in the cost of environmental degradation. Consequently, investments should target the restauration of the ecosystem by for example refreshing soil fertility or by biodiversity conservation (2015: 4). He, however, questions the idea of sustainable growth, as "the present scale of the economy shows clear signs of unsustainability" and would be "multiplied by 5-10, lead to imminent collapse, and is in itself logically self-contradictory in a finite, non-growing ecosystem." (Daly 1996: 269). Daly suggests a *steady-state economy* model, in which population and capital would no longer grow, but "the art of living" would continue to improve", not in order to overcome the limits of growth, but to operate within. For this he suggests 3 principals: Renewable resources should be exploited in a manner such that: first, harvesting rates do not exceed regeneration rates, and second, waste emissions do not exceed the renewable assimilative capacity of the local environment." Third, "non-renewable resources should be depleted at a rate equal to the rate of creation of renewable substitutes." The circular economy model can be seen as an attempt to strive for such a steady-state condition through a "systemic adaptations". However, what is understood as a systemic adaptation may vary. The corporate driven CE project sees such a change in introducing new business models, which allow to control material and energy flows in a new way. From a Marxist perspective, a systemic change would require questioning the logic of capitalism itself. Whether and to what extent the circular economy has the capacity to be ecological sustainable lies in its interpretations.

This "systemic adaptations" can be understood from two different opposing standpoints. *Ecological modernization theory* (Huber 1991, Mol and Spaargaren 2000) sees "…continued industrial development as offering the best option for escaping from the ecological crises" (Fisher and Freudenburg 2001: 702) and proclaims, that environmental improvements are

economically and politically feasible, and the dynamics of the market enable ecological change. Ecological modernizations is seen as a pre-requisite for future economic growth (Fisher and Freudenburg 2001: 702) at the same time it "recognizes the environmental crisis as evidence of a fundamental omission in the workings of the institutions of modern society" (Hajer 1995: 7).

This view contrasts with the view of theorist like O'Connor and Schnaiberg, seeing capitalism and technological advancement as the core of the ecological crisis and argue that further industrialization will not solve, but rather aggravate environmental problems. In short, sustainable capitalism does not exist. The theory of *The treadmill of production* argues, that increases in efficiency by replacing labor with technology, have and have had, specifically after world war II direct implications on the demand for natural resources. An increase in production will automatically lead to an increase in natural resource depletion (Gould et al. 2004: 297). In this context the "…treadmill model underscores the importance of paying attention to dialectics and contradictions in the behaviors of individuals, groups, state, and industry. When we develop a sociological understanding of the constraints and choices within which individuals and institutions exist, environmental conflicts and solutions become clearer and yet more inaccessible" (Gould et al. 2004: 299).

The circular economy can also be critically examined through the lens of the concept of *socio-economic metabolism* in its attempt to enable infinite economic growth within the boundaries of the planet. Fisher-Kowalski and Haberl compare societies' metabolism with the metabolism of an organism, which "maintain a continuous flow of materials and energy with their environment to provide for their function, for growth and reproduction." The interaction between society and nature is described as the "conversion of raw materials into manufactured products, services and, finally, into waste" (1998: 574) and evaluates the material and energy throughput. The former, the basic metabolism, allows used resources to flow back into the system, whereas the extended metabolism produces waste, pollution and GHG emissions, which ascending density in the atmosphere is the root cause of climate change. This input-output calculation gives a simplified idea about the "inter-relations between natural, social, and economic processes" (Fischer-Kowalski et al. 1998: 576). To take sustainability seriously, would mean to reduce total material and energy throughput with a focus on the metabolism of the industrialized societies. This, despite to the growing awareness of the environmental consequences, doesn't correspond to most of "industrial society's everyday experiences" (Fischer-Kowalski et al. 1998: 582).

2.2 Methodology

This research is built on employing a number of analytical tools based on a qualitative approach in order to tackle the complexity of the research objective and the various components of the research questions. Secondary data was collected by reviewing international agency reports on climate change as the IPCC reports from 2018 and 2019, policy papers as the Circular economy package of the European Union as well as recent academic literature around the circular economy model. Primary data was collected from one corporation in the process of implementing the circular economy model.

The company, the interviews were conducted in, represents the industry sector. The core operations of this company lie in the manufacturing of wood and wood-based materials into consumer goods. This Europe based company illustrates a very specific case due to its vertical integration encompassing sourcing, production and retailing activities on a global level. This allows to capture the complexity of a transition to a circular economy model for the entire value chain, in which decision-making processes influence and are influenced by both sides, consumption and production, within one case study.

The company is highly depended on raw materials, and specifically on timber, but works to a lower extend with a wide range of other materials, such as cotton, plastic, metal, glass or ceramics. Timber and cotton are categorized as renewable materials and therefore sustainable materials. The company has further actively involved itself in the creation of the Forestry stewardship council (FSC), a voluntary regulatory scheme aiming to combine economic, ecological and social aspects in the forestry sector. It has also committed itself to work towards the goals of the Paris agreement and has decided to shift towards a circular economy model. The current CO2 emissions of the company make up 0,1% of the total global emissions, whereas 38% of its emissions come from material extraction and processing.

The case study was chosen to illustrate, how theory meets reality in terms of the conditions which are perceived as the most relevant on a corporate level and therefore shape behavior and responses of businesses towards climate change. Further, to understand how the theoretical concept of the circular economy is interpreted and translated to operational practices. Finally, to compare how the theoretical challenges, dilemmas and contradictions are reflected in the decision-making processes of companies in the transformation towards a circular model and a more sustainable business.

Next to the review of the company's official press releases and strategy papers published on their website, primary data was collected via 16 semi-structured interviews. The interviews took place via Skype in the period of Mid-September to Mid-October 2019. This period represents a specific moment in the implementation process of the circular economy, which has started 3 years earlier and is intended to be completed by 2030. The interviews provided first-hand accounts of considerations and learnings in the implementation process within the company so far, as well as evidence for the discourse and action taken to transform the current business model. Key informants were selected out of the core team, responsible for the overall implementation within the corporation. All of them are working with and representing different aspects encompassed in such a transition such as supply, legislation, communication, business steering and innovation and development. I completed this sample with interviewees, involved in day-to-day operations of product development, engineering, supply and commercial activities, in short, employees responsible for making everyday business decisions.

Further, participant observation plays an important role in my research. I have been an employee in the company for almost 20 years in different positions, business units and countries. My recent assignment was closely related to the creation, manufacturing and retailing of goods and has contributed significantly to my understanding what a transition of a business model means in the context of this corporation and the discourses that may arise. I was present at the moment the circular economy was introduced as the future way of operating the business and in the early discussions around the implications of such a shift on a practical level, specifically on a product design level. In the period the research was conducted I visited

the corporation twice and can draw from informal conversations with colleagues about the operational changes happening and from my personal observations.

At times, I experienced my positionality either as a challenge, or as an opportunity. My position somewhere in the spectrum of being a researcher and/or being an employee allows me to draw from practical and personal experiences for my academic work. At the same time, I see my contribution for my professional work in asking critical questions and contribute with considerations that might stretch the view of practitioners in their day-to-day operations. I hope, this research paper can add to the ongoing discourse and further development of a more sustainable business model.

2.3 Scope and limitations

This research zooms in from macro and meso level, from global and regional level to the micro level of one corporation in order to understand the implications of the transition of an economic model on a practical level. It needs to be taken into consideration that the corporate sector as such cannot be seen as one homogenous entity. However, even if confined to a particular case study, the analytical exploration allows to draw first conclusions about the capacity of the circular economy to contribute to a significant reduction of GHG emissions. The assumption here is, that challenges, dilemmas and contradictions at large remain the same within the manufacturing sector. However, those might differ from other industries, like the financial or energy sector.

This research paper focus on the environmental considerations which are, in the case of the circular economy, closely linked to economic ones. However, the concept claims to deliver into sustainable development in all three spheres including the social dimension. Millar points out that "numerous contradictions and knowledge gaps exist regarding how the Circular Economy can improve social equity" (2019: 11). D'Amato concludes, that social sustainability is not considered equally in the circular economy concept, besides anticipated job-creation. Job-creation in return is dependent on economic growth, and economic growth leads to further environmental depletion (2019: 462). And, Murry draws attention to the absence of the social dimension of Circular Economy concept (2015: 369). An entire field of social implications, its tensions and limitations in regard to the inter- and intragenerational equity (Murry 2015: 376), remains left for further studies.

The research intends to give an overview of dilemmas and contradictions that shape the outcome of this transition. Each could be described more in depth, which is not intended in the scope of this paper. As this research is done at an early stage of the implementation process, further research on how these dilemmas and contradictions were dealt with at a later stage could be interesting or when in the case of this specific company the transition is considered as completed. Whether and how those changes impact the dynamics in global value chains and finally, whether the Paris Agreement targets will be achieved or not, remains unanswered for now.

Chapter 3 Why change amidst difficult contradictions and dilemmas?

As main reasons for shifting towards a circular economy, the interview partners mentioned following interlinked topics: increasing resource scarcity, changing consumer behavior and the gap between actual CO2 emissions and the Paris Agreement target. Further does the prospect of a changing legislative landscape and stricter environmental regulations influence the decision. Resource scarcity and the consumer are seen as the two main driving forces to move away from the current linear business model.

There is a common point of view in the Company that the linear economy model cannot proceed. One interviewee said, *"and this is a fact, that we will not have resources. So, we cannot survive"*[2]. Resource scarcity leads to competition for raw materials and therefore to increasing raw material prices and higher costs of production. According to the price index of the IMF industrial inputs that include agricultural materials and base metals have increased 139% - more than double - between 1992 to 2018. Prices for timber have increased by 63,53% between 1990 and 2016 (www.data.imf.org). Recycling material and circulating value is therefore seen as a pre-requisite to maintain a business. From the perspective of the interviewees, protecting ecosystems and engaging in nature regeneration is in the interest of the corporation and a transition towards a circular economy becomes a strategic business decision. Scarcity is seen as a driver for innovation in the field of material innovation and material efficiency. Resource availability for production is predicted to be at risk with increasing and unpredictable weather events due to climate change (IPCC 2019: 5). Some interviewees expect increasing debates around land use in times of climate change and governments prioritizing food production over commodity production due to growing food insecurity (IPCC 2019: 7). At the same time food production according to the Food and Agriculture Organization of the United Nations (FAO) should increase by 70% in the next 50 years (www.fao.org).

This connects to the third main reason: the aimed reduction of CO2 emissions. The Company that this research has studied, has stated in several press releases to reduce their GHG emissions according to the Paris agreement goals. However, to continue business as usual will not allow it to reach those targets. A circular economic system is seen as a strategy to close the gap between current - and still increasing - emissions and set goals. So far, the link between circular economy and climate change has been weak when seen from actual corporate practice, and, arguably, even in theoretical discussions. Initial explorations were primarily based on the debates around resource scarcity issues. However, it was mentioned that more recently the climate aspect of such discussions has moved increasingly toward the center of attention. Currently the company is calculating on a possible CO2 emission reduction in relation to their ambitions and planned measures to become a circular business. The strongest link is seen in the potential reduction of raw material consumption, which makes 38% of the company's total greenhouse gas (GHG) emissions.

The prospect of a changing legislative landscape enhances the company's efforts to become more sustainable. Carbon accounting and extended producer responsibility (EPR) are two

[2] Interview with one of the Company's engineering managers; September 2019

schemes, which are expected to frame corporate behavior on the way forward. Further, new environmental legislation might result from the program of the new European commission, which proposes to situate Europe as the first carbon neutral continent or to implement the first climate law (von der Leyen 2019). Even if the realization of those ambitions is unclear at this point of time, a transition towards a circular economy is seen as a preparation to comply with new environmental regulations. Polluting or environmental destructive behavior is expected to be sanctioned and costly in the future. There is a view amongst the interviewees that legal enforcement will drive the transformation towards a circular economy and that political action, such as the plans described by the new European commission, is shaped and pushed for by societal forces.

So are, according to the interviewees, the company's strategic plans. The main driver of change is consumer behavior as society becomes increasingly aware of the causes and effects of climate change. Sustainability as a topic enters the mainstream discourse and shapes the expectation of consumers that corporations should take sustainability seriously. The results of a study conducted on behalf of the Company show, that people, mainly in the mature markets, are starting to value things differently. They do not like being wasteful, and increasingly perceive ownership as a burden, which means they prefer to consume and own less but durable products. This is not consistent with the current business model. The circular economy is seen as a response to these societal changes by allowing "good citizenship" through sustainable consumption. Society, and more specifically the consumer, expects large corporations to apply more sustainable practices. *"Corporations, which are not taking sustainability seriously, will be out of business in 5 years from now."*[3]*, says one interviewee.* The role and agency of consumers are perceived as crucial for the transformation towards a circular economy. Or in short, the pressure to continue generating profit by having the ability to continue to sell commodities compel corporations, such as the Company that I am examining in this study, to seriously explore possible ways of capital accumulation in a different way, such as, in this case, a corporate-driven circular economy.

Most of the interviewees mentioned that the internal sustainability discourse has changed quite recently. Macro impacts such as climate politics shape the company's room to manoeuvre. At the same time, sustainable behavior is seen as consistent with corporate values by coworkers. Also, environmental movements such as Fridays for future are influencing corporate behaviour. Many shared personal experiences and examples from their family life to illustrate increasing awareness.

These are some of the apparent reasons for change that the interviewees for this study explained, which are altering the current pre-requisites of profit making or capital accumulation and link to bigger global dynamics.

Changing pre-requisites: resource scarcity, land use and climate change

According to the interviewees, the future availability of resources is the basis for the company's economic survival. The availability of raw material is put under pressure through a growing demand, which in a finite system, will lead to growing competition, and also through uncertain harvest rates connected to increasingly unpredictable weather events

[3] Interview with one of the Company's business managers, September 2019

caused by global warming. With the current course, raw material consumption is predicted to double until 2060 (OECD 2018a: 3) driven by population growth and the demand of the emerging economies. Technical innovation and a growing share of services can slow down, but so far not compensate for, the increasing resource input in a growing global economy. As a consequence, ecosystems around the globe are shrinking (IPCC 2019: 3). This will lead to, what Korhonen calls a head collision (2018: 38). Martinez-Alier agrees, that this fundamental clash between economy and the environment is caused by population growth and, what he calls, the social metabolism of industrial economies, in which energy can't be recycled and fresh resources must constantly be obtained. He claims, that "…even an economy that would not grow, would need fresh supplies all the time" (2012: 103). The linear economic system was built on the assumption that the means of production are widely available (Bernstein 2010: 25). So far, capitalism was built on cheap nature, which will not be available any longer (Moore 2017: 178). Scarcity will and have already started to rise the costs of production in form of increasing raw material prices. The current conditions of production will worsen more through climate change impacts. With its increasing and unpredictable weather events the availability of raw materials will be even more restricted. O'Connor describes this situation as a problem of under-accumulation or as the Second contradiction of capitalism, saying that the dynamics of overaccumulation are about to erode the means of production, and will force capitalism to reinvent itself (1998: 158).

According to Harvey, limitations of growth were overcome by spatial-temporal fixes (2003: 64). Capital peruses geographical expansion and temporal displacement in order to absorb existing capital and labor surplus and to avoid its own devaluation. Consequently, capital flew into new markets and extracted resources in form of extending global value chains. Specifically, geographic expansion will, in the future, be more and more restricted by competing land-use interests, further exacerbated by the consequences of global warming and climate change. Competing interests are not only based on an increasing demand for raw materials, but also on competing tasks of land for either food production, biodiversity conservation or ecosystem services like carbon sequestration (IPCC 2019: 2). Implying that capital is and will be more and more limited in its geographic expansion, the circular economy offers a theoretical way out by letting capital loop in the economic system. Instead of extracting and producing more, value extraction should be achieved by circulating products or materials and by extending services around those products instead. Mass consumption is meant to turn into mass circulation.

It is of no surprise that a region like Europe with a consistently higher consumption of embodied materials than its extraction rate (Wiebe 2019: 6370) takes a progressive role in changing the current economic system in order to cut dependencies on and tame raw material consumption. Taking a lead in adapting to changing global conditions promises competitive advantages on a global market. In the circular economy package of the European Union competition is outplaying environmental urgency as the dominant narrative.

Changing dynamics: Climate change and consumer, business and state interaction

Moving into a new phase of urgency to accelerate the efforts in climate change mitigation, state and inter-state governance institutions play a key role in compelling and encouraging large corporations to work towards the goals of the Paris Agreement and operate within its frame by imposing limits and opportunities for corporations to maneuver. The state and

inter-state institutions act, or not act, within an area of conflict of their dual function of facilitating economic growth and maintaining legitimacy (O'Connor 1973: 3). At the same time voices in society are getting louder demanding commitment and leadership in climate change mitigation, not only from governments, but also from corporations. Conscious consumerism is growing, and sustainability becomes a variable of ever-more importance for corporations to compete within the market. Mathews talks in this context about consumer sovereignty (2011: 874), which corresponds with the view of the interview partners, who see changing consumer behavior, next to the cost perspective, as the main reason for an altering economic system. However, Gould et al. see limitations in consumer's sovereignty. They argue that "although consumers may be the ultimate purchaser of some of the products of the new technologies, decisions about the allocation of technologies is in the realm of production managers and owner" (2004: 300).

So, the sphere large corporations are acting in is shaped by the interaction between state, inter-state institutions, corporations and society, resulting in a framework of voluntary and mandatory goals and standards. Horvath notes, that the current economic model based on the "illusion of abundance and outsourcing of externalities to developing countries", is coming to an end (2019: 1). The costs of pollution and environmental degradation are predicted to be more and more integrated through extended producer responsibility or product stewardship laws (Esposito et al. 2015: 4), carbon accounting and carbon taxes (von der Leyen 2019: 5) and/or waste policies (COM 2018).

So what?

Corporate behavior is shaped by changing prerequisites of resource scarcity, land-use and by the dynamics between state, consumer and businesses. It is complex and there are many interdependencies. Changing corporate behavior needs to be understood not in isolation, but within these interrelations. Pressure to reduce GHG emissions comes from inside and outside the organization. From inside, growing resource scarcity forces corporations to re-think. From outside, consumers exert on the state pressure in form of social movements to increase their efforts, and to businesses through consumer boycott. The case study shows that significant power to change operational practices of corporations is attributed to the consumer. Further, climate change adds the dimension of urgency. All these dimensions influence why and how the circular economy model is implemented. Capitalism adapts to changing preconditions as increasing resource scarcity, changing consumer behavior and legislation and unsatisfying results in getting control of GHG emissions. The implementation of a circular economy model aims to respond to the changing preconditions as a strategic business decision. The "how" is discussed in the following chapter.

Chapter 4 From theory to practice: What do corporations do?

The corporate-driven circular economy model is growing in popularity amongst businesses. However, Millar notes, that to which extent the concept is taken up in practice is unclear (2019: 13). The abundance of circular economy conceptualizations is not only a challenge for scholars in knowledge accumulation (Kirchherr et al. 2017: 221), but also leaves room for a lot of different interpretations when translated into practice. This paper will first illustrate

how the initial ideas of the concept take root in the corporation's strategies and will then roughly describe the implementation process. Both, the plans and their realization play a key role in a possible GHG reduction.

4.1 Moving away from a linear model

A common view in all interviews is that the linear economic system will not allow for operating a business within planetary boundaries and cannot proceed further. All ambitions to push business into the future are built on the idea of decoupling economic growth as far as possible from raw material consumption. This approach responds directly to the changing pre-requisites of increasing resource scarcity and aims to tackle the main source of GHG emissions in the company, which is raw material extraction and processing. This is aimed for through a number of initiatives.

Only renewable or recycled materials

First, the Company plans to use only either recycled or renewable material, combined with further improvements in material efficiency. This initiative is regarded as the most advanced and there is optimism amongst the interviewees that this ambition is achievable. To use recycled material means to use waste as a secondary feedstock. Renewable materials are bio-based materials with the ability to regenerate. The current share of renewable material in the Company's production is about 60%, based on the company's high consumption of its key materials, namely, wood and cotton. Recycled materials make up about 10% of the company's total material usage. The current possibilities to increase the share of recycled materials differs from one material category to another. In polyester for example the share of recycled material has been increased from 2% to 58% within the last two years. Some other materials, such as ceramics, are not or not yet recyclable. Renewable materials are aimed to come exclusively from responsible sourcing programs, according to the corporate's sustainability strategy. The company's largest material category is wood-based board material. For wood sourcing the company applies the Forestry Stewardship Council (FSC) scheme. There is an ambition to have similar voluntary sourcing schemes for all renewable material categories. The glue used in wood-based board material, which is currently fossil based, is planned to be replaced by a bio-based glue. Next to extracting resources, there are ambitions to also regenerate resources and ecosystem. Material efficiency, a common practice formerly driven from a cost perspective, is seen now to be coherent with the company's environmental ambitions. To shift to renewable and recycled materials is the basis to keep the current cost structure down, as raw material prices are predicted to and have already started to rise.

Prolonging the lifetime of the product

Circularity cannot be achieved with recycling alone. A very large fraction of the materials is accumulated in continuously growing in-use stocks. Designing for circularity includes to increase lifetime, enabling repair and resell, upgrades, modularity, remanufacturing, component reuse (Haas et al. 2015: 774). Amongst all circular initiatives prolonging the life of products is regarded as the most effectful from an environmental point of view. Prolonged product life should reduce the demand for raw materials and its processing and is therefore expected to reduce GHG emissions. Durability is also seen as a prerequisite for the business model *Reuse*. However, this requires in many cases product innovation and/or the use of more material. Also, a prolonged lifetime of the product will be reflected in a reduction of sold

quantities. To finance those costs and lost profits, revenues from new business models and a new corporate financial system are required.

Reuse and repair

As the material direction alone is not seen as sufficient in reaching the Paris Agreement targets, the Company also wants to tackle unsustainable consumption patterns. New business models should enable sustainable consumption and "good citizenship". Out of the different loops described in the circularity concept, the company sees the biggest economic potential in the concept of *Reuse*, which is also seen to have a lower environmental footprint than *Remanufacturing* and *Recycling*. The idea is to earn more profits from the same product, through leasing or repair. This at the same time should enable to lower costs and prices and hence, to reach out for a broader customer base. However, this requires a shift in consumer behavior and consumption patterns. There is a believe that consumption as such will not change, but a shift toward more sustainable consumption is possible and necessary. Following the trend in the car industry, convenience and affordability are viewed as entry points for sustainable behavior on broad customer base in order to create impact.*"To succeed, sustainable behaviour needs to be affordable and convenient"*[4].

Additionally, the Company has planned and officially announced to reduce their GHG emissions from production by 80% until 2030, which should be achieved by shifting towards renewable energy. Overall the company aims for taking a leading position in what they see as an inevitable transition. The circular economy "is seen as a way to reduce conflicts between the competitive and environmental priorities within a company, making it more competitive, while at the same time reducing its environmental footprint." (Gusmerotti et al. 2019: 314). This view is based on two paradigms: decoupling growth from material consumption and equating the circular economy with sustainability.

The complexity of a transition, which Gusmerotti et al. describe on a macroeconomic level, is to a large extent mirrored on a micro level. On a macrolevel it involves multiple interactions between different sectors and countries (2019). On a micro level those multiple interactions need to happen within the entire value chain. An example of a transition process is illustrated in the next section.

4.2 The transition process

Sustainability as a topic has been anchored on the highest strategic level and is part of the strategic landscape and of the Company's business plan. Based on the view that the linear economic system is terminal, the Company decided to transform into a circular business. It was highlighted in the interviews that the transformation is: more than a sustainability activity a business activity. Afterwards, a circular economy team was set-up in the organization to coordinate the transformation, as well as an internal governance structure. The process so far has been described in the following steps:

[4] Interview with one of the Company's material category manager, September 2019

The theoretical concept has been explored and translated into what it means for the operations of the company breaking it down to a practical level. *"We needed to understand, what it really means"*[5]. Based on initial assumptions, the overall goal was set to complete the transformation into a circular business by 2030. Currently, the Company is in the process of *verifying* initial assumptions by different activities in the supply chain in order to decide which business models to implemented. Those can be roughly summarized as setting a material agenda, preparing the range, exploring and testing new business models and revenue streams, creating new business steering models and measuring tools to monitor efficiency and cost structure, preparing the existing supplier base, finding new business partners, active involvement in the creation of a legislation enabling a circular economy and change management.

Investments into new infrastructure and capabilities are expected for the existing supplier base and/or new business networks are explored according to the material agenda and new business model set-up. An important prerequisite for the transformation is seen in the understanding of the legislative landscape and the active or reactive involvement in the creation of new legislation. The current focus encompasses topics like waste definition, labelling of recycled content, product safety or extended consumer responsibility schemes on the level of the European Union (EU). The transition also includes change management activities on an internal level in order to synchronize the understanding of circularity within the organization, as well in regard to the affected business network and finally the customer.

So what?

Corporations currently try to find ways to adapt to changing prerequisites of profit making. The business models explored more in-depth correspond at large with the theoretical concept as described by the Ellen MacArthur foundation or in the European circularity package. Some of the practices are not entirely new to the Company. Resource efficiency has always been strived for in order to keep costs of production low. Others challenge the foundation of an over decades optimized value chain. To implement the strategies of using only renewable or recycled materials, prolonging the lifetime of the product and enable reuse and repair has numerous practical implications and makes a transition a quite complex, costly and time intensive process. The transaction costs of such a transition are high and require financial capacity. Large corporations have an advantage over small businesses because of their scale, which allows them to handle risks and uncertainties. Also, powerful actors in the market can actively influence legislators in the creation of the legal framework and shape the conditions of capital accumulation according to their interests. The implementation process so far illustrates that business decisions depend largely on the validation of consumer perception and new revenue streams. They are embedded in the dynamics of capital accumulation. "…capitalism always needs to find not just new frontiers that can be just as productive, but new and expanded frontiers that can be even more productive" (Moore 2017: 183). Being first in such a transition promises competitive advantages. If the Circular economy and its new business model can in fact deliver to an expansion of the business, is currently explored in a number of tests and trials. The interviews show that it is central to the Company to understand, what is economically feasible, but also what makes sense from an ecologically point of view. What effect will the changes have on GHG emissions? And, is solving one problem, causing another? Those questions are not easy to answer for practitioners - especially under time pressure - and decisions are not easy to make. The next chapter aims to give an overview

[5] Interview with Engineering manager, September 2019

of the key challenges, dilemmas and contradictions that arise as companies try to transform the current economic system into a sustainable one.

Chapter 5 Dilemmas and contradictions of a circular economy

Moore asks: "Is capitalism capable of surviving the present climate crisis…" (2017: 178)? The answer lies in its ability to adapt to or create new preconditions for capital accumulation. Corporations seek on the one hand to secure availability of raw material at low costs or to create profits through other means. On the other, they respond to changing consumer behavior. The emergence of a circular economy model can be seen as a trial of capitalism to "re-established its conditions for growth and accumulation". Those dynamics may conflict with whether the model can achieve a reduction in GHG emission. The outcome is shaped by certain dilemmas and contradiction.

5.1 Producing less & the logic of capitalism

The logic of expanded reproduction of capital is to accumulate profit by producing "an ever-increasing range of goods and services" (Bernstein 2010: 25) in whatever way possible and socially acceptable. This logic fundamentally runs counter to a circular economy which strictly speaking is not supposed to encroach into new frontiers of extraction. Is it possible that the implementation of the Circular economy result in less raw material extraction and processing while delivering economic growth?

Resource scarcity is forcing capitalism to find new ways of accumulation, which are independent from natural resource extraction. Increasing and competing land use interests in times of climate change lead to material volatility in global value chains. The means of production are not widely available any longer. Taking the lead in adapting to those new preconditions of increasingly scarce raw materials and energy implies competitive advantages on a micro and macro level. It is of no surprise that a region like Europe with a consistently higher consumption of embodied materials than its extraction rate (Wiebe 2019: 6370) takes a progressive role in changing the current economic system in order to cut dependencies on, and to tame the growing demand for, natural resources. The Circular economy package of the European Union (COM 2014 and 2015), similarly as the publications of the Ellen MacArthur foundation or the discourse on the corporate level as observed in the case study, mirror two key assumptions of the Neoclassical paradigm, efficiency and scarcity (North 1997: 17). Both are outplaying environmental urgency as the dominant narrative. Environmental degradation and depletion are reducing the first and enhancing the second and are consequently leading to competition and higher costs of scarce resources (North 1997: 17). The circular economy model aims to address both issues. To keep materials and energy as long as possible circulating in the value chain is efficient and minimizes the demand for raw materials, so the theory.[6]

[6] Author's unpublished essay in the course: Agrarian transformation ISS-2018-19, Institute of Social Science, Erasmus University

This is aimed to be done by CE's main business models 'reuse', 'repair', 'remanufacturing' and 'recycling' and by substituting non-renewable by renewable materials. Those strategies trickle down from policy papers of interstate organizations such as the European Commission to corporate sustainability strategies. If the realization of the concept corresponds to the theory, the quantity of goods and production should decrease. However, some considerations speak against the realization on a practical level.

Firstly, creating profits by selling less new products challenges the current logic of the manufacturing and retailing sector. One interviewee explains: *"…this is of course controversial, that we are actually saying that we should sell less products. When we are selling less products, we are circular…"*[7]. A new business model, in which profit comes from services rather than from selling more products, requires a shift in mindset. In the Company, this is seen as one of the bigger, if not the biggest challenge in such a transition. Secondly, a decrease in production is unlikely considering that future growth is anticipated from 1,7 billion people entering middle class between 2020 and 2030 (Pezzini) increasing the demand for goods. Finally, and based on the two previous considerations, there is no evidence yet that in a circular economy the production rate of new goods declines.

Horvath et al. note, that resource scarcity makes recovery of secondary materials, such as materials generated from waste, important in order to sustain growth (2019: 2). Efficiency in material and waste use or in logistical backflow activities play a crucial role here. However, Daly and Farley state that "efficiency is so important in neoclassical economics that it is sometimes taken to be an end in itself" (2010: 4). It does not necessarily lead to benefits for the environment. "The environment, however, does not care about ratios such as our human efficiency, or – which comes to the same thing – the economy's dematerialization. Only real amounts matter, regardless of how much utility we squeeze from our budgeted amounts of resources" (Alcott 2015: 152). Increasing efficiency reduces energy and material costs and, in return, incentivizes its use (2019: 2). The Jevon's paradox adds a central consideration here: "All economic efficiency increases are subject to rebound effects". A reduction in production costs might increase consumption to a level, which "offset the initial environmental gains" argues Korhonen et al. (2018: 43). If it is possible to put the theoretical concept into practice and to minimize the extraction of primary raw materials and energy consumption, and with this GHG emissions, the question remains, what will happen to those environmental gains.

In order to achieve the objectives of the Paris Agreement, it is essential to use the efficiency gains for the restauration and regeneration of nature and not to serve further economic growth. This might collide with expansion and growth plans of the Company. Assuming that material efficiency gains would be contributed to restorative and regenerative purposes, could mean for one company leaving the field to other players in terms of economic growth. Competition creates productive forces, which, even if more sustainable, still have a tendency to overaccumulation. One interviewee explained in terms of this dynamic: *"And this is what all companies struggle with. This is a bit of a chicken game in a way. Everyone is looking at the others. And okay, who is going to start for real?"*[8]

[7] Interview with Development manager for Circular business models, September 2019
[8] Interview with Engineering manager, September 2019

Mol et Spaargaren argue, "…the roots of the environmental crisis are the culture and structure of western industrial society as they were shaped over two or more centuries. All attempts to remedy the problem without basically questioning the overall structure and culture are bound to fail." (2000: 35). Companies operate within the logic of the current economic system, whose structures they shape, and they are shaped by at the same time. Some respondents believe that only legal enforcement evoked by societal pressure can break with this logic. Otherwise, any initiative that reduces production, hence GHG emissions, by one company would be immediately offset by another. State and intergovernmental organizations within this logic are called upon to even out the legal conditions for all players in order to promote environmental initiatives in the corporate sector.

Despite the Company prioritizes the business model reuse over recycled materials, and recycled materials over renewable materials, which are promising environmental improvements, an ever-increasing production of goods is driven by competition and the dynamics of capital accumulation likely. This, however, contradicts the core idea of a circular economy, which should not expand into new frontiers of extraction.

5.2 The circular fix

Spatial-temporal-fixes have been a reliable means through which capitalism has managed its recurring crisis. However, spatial expansion is increasingly restricted due to competing land-use interests. Emerging markets, but also the need for nature conservation sets limits to spatial expansion of new frontiers of extraction. Climate change and unpredictable harvests rates due to extreme weather events might aggravate spatial fixes in the future. The CE offers at least in theory a new way to prevent capital from its own devaluation – a circular fix -, while enabling to reduce GHG emissions at the same time. Though is there such a thing as a circular fix? And, would it replace spatial-temporal-fixes of capital accumulation in the future?

As a response to aggravated geographical expansion of new frontiers of extraction, the cycles in the CE model aim to keep the value of materials as long as possible within the economic system and hence, reduce the demand for primary raw materials and energy. Consequently, more value needs to be extracted from products and from materials compared to in a linear system. Strategies for this are enabling reuse and 'repair' of products and using only recycled and renewable materials in production. The European Commission states that "valuable materials are leaking from our economies (COM 2014: 2). The OECD states "…producing raw materials via recycling, rather than from non-renewable natural resources, can reduce greenhouse gas emissions by as much as 90% (BIR 2008). Even though, the achievable reduction of emissions differs from material to material, it is expected to be significant in almost all cases (OECD 2018b: 6). The European Union aims in its legislative proposal on waste to recycle 65% of municipal and 75% of packaging waste by 2030. Only 10% of municipal waste should go to landfill (COM 2019:4). It is expected that the economic and environmental benefits of recycling wil overlap.

Despite that material recovery and recycling are often in the center of the discourse, they are less important than the extension of product life. For 'reuse' the business model of 'leasing'

or 'product as a service' seems to be the most promising for the Company at this point in time.

This corresponds with the hierarchy of business models in regard to their contribution to circularity, which Cramer proposes (Horvath 2019: 3). *Leasing* means that the ownership of the product remains with the company and revenues are distributed over time. Capital is tied up and accumulation happens here through a temporal fix (Harvey 2003: 64). Vermut notes that product ownership is still culturally preferred by consumers (2019: 894), while market research by the Company has shown, that primarily in the mature markets, ownership is increasingly perceived as a burden due to changing lifestyles. People want to own less, but more durable products. The new business models therefore respond to changing consumer behavior and should enable "good citizenship" by so-called sustainable consumption, which means not to consume less, but less resources.

However, numerous practical challenges are connected to circular fixes: Firstly, in both, reuse and recycling, companies keep control over goods, hence, control over the future means of production. Both models require new logistical streams to allow products and material to circulate. Interviewees mentioned that to set-up of the backflow in a circular system is one of the main challenges. So far, everything in our society is organized and optimized around a linear economy. For reversed logistics exists until now little or no infrastructure. To set such structures up is connected to costs and investments and requires a network of new business partners. Cost and efficiency were mentioned as key determinants, not only from an economic, but an ecological perspective. From an economic perspective revenue streams of new business models are only estimated at this point of time but need to be predictable to pay off the investments. From an ecological perspective, the environmental costs of backflow activities in form of GHG emissions might offset the gains of reusing products and materials.

Secondly, recycled materials not necessarily have the same properties as primary raw materials. This restricts its use, which can in some cases be solved through material innovation or product design. However, the use of recycled material in regard to consumer safety and labelling of material content is hardly covered by the existing regulatory framework. Legislators are confronted with dilemmas in this context. The traceability of the waste content is only possible to a certain extent, which endangers the safety of consumers. This also applies to a possible extension of the life of materials containing hazardous chemicals. Since most recycling technologies are mechanical, chemicals cannot be completely removed during the process and would remain circulating in the economy. At the same time, allowing for some uncertainty in material content is a prerequisite for increasing the amount of secondary material and for reducing waste that would otherwise go to landfill. Currently, the share of recycled material in the overall consumption in case of the Company makes about 10%. The compromise found in the legal framework between consumer protection and increasing the share of recycled materials will affect the extent to which primary raw materials can be substituted.

Thirdly, to substitute non-renewable by renewable materials is an essential part of the circular economy concept. Renewable materials are often associated with sustainability, yet, its usage at large scale is problematic and raises questions of biodiversity conservation and land use. Haas et al. argue that "the inclusion of all biomass as a "circular" material flow implies that biomass is produced in a renewable way and that all waste flows and emissions effectively

re-enter ecological cycles". Else, "net carbon emissions, loss of soil nutrients, or depletion of non-renewable water resources" can be the case, which consequently makes it a non-circular flow (2015: 766). In the case of timber, Näyhä sees "many profound structural changes" for the forest-based sector based on the emerging circular economy and society's wish for more sustainability (2019: 1295). Industrial use and large-scale harvesting face increasing criticism due to related negative impacts on ecosystems such as carbon balances and biodiversity loss, next to the social cost of conflict (Gerber 2011).

Responsible sourcing programs have emerged as a response to this criticism. From the Company's perspective, FCS is considered to be the most appropriate tool to combine economic and environmental interests at the time being. Biodiversity conservation gains increasing attention from an ecological point of view in maintaining ecosystem services but also from an economic point of view, in improving climate change resilience. However, studies have shown that adherence to such regulatory schemes can produce opposite results than the alleged ambitions. Founded in 1994 as a joint response by members of the timber industry and non-governmental human rights and environmental organizations to illegal deforestation and unsustainable forestry practices, the FSC's stated position is to ensure "environmentally appropriate, socially beneficial, and economically viable management of the world forests" (https://ic.fsc.org). However, FSC has been criticized by different scholars for the inclusion of incompatible interests of various actors, the shift of environmental governance from governments to the market, lack of accountability for violations, and issues of procedural and distributional justice (Brockington et al., 2015; McCarthy, 2012; O'Laughlin, 2008; Ponte et al., 2013). Voluntary regulatory schemes such as FSC can enforce power relations and interests that conflict with their declared goals. In some cases, the growing demand for certified wood has also led to higher rates of deforestation (Brandt et al. 2016: 21).

Also, a growing demand for bio-based materials, if following current production and consumption patterns, requires land and is or will be subject to territorial restrictions, whether or not this land is sustainably managed. One respondent in the case study pointed out that availability of resources can be increasingly limited as governments start to prioritize food production over raw material production, if crops are affected by extreme weather events such as droughts or floods. This is seen not only as a corporate but also as a global dilemma.

In this context, there is much to learn from the hype of biofuels, which has led to serious environmental and social problems in various regions of the world (Borras et al. 2010). The politics of access use and control of natural resources may be altered, when the global demand for renewable materials increases. Borras and Franco, discuss the risk of green grabbing or what they call control grabbing in a global land rush. Corporate land deals might impact social relations, nature and land use (2018: 193) and tensions are likely to increase in the face of climate change.

Would large corporations completely abandon spatial-temporal techno fixes while exploring the unchartered territory of CE? The answer for now, is no. The concept is in its infancy and companies are about to explore new forms of capital accumulation in form of new revenue streams. High transaction costs of a shift to a circular model, such as investments and innovation, are financed by revenue streams of current linear business operations. To replace spatial-temporal fixes by circular fixes puts capital accumulation at risk and is therefore unlikely to happen. However, the question is, if a circular fix is possible at all? In the case of the Company, temporal fixes will rather increase through business models such as 'leasing',

in which the company extends its control over the means of further capital accumulation. An increase of renewable materials according to current production and consumption patterns might result in further geographical expansion and is problematic in multiple social and ecological ways but ultimately also in economical. To substitute primary resources by recycled materials meets numerous challenges. While addressing concerns of consumers about sustainability, a circular fix remains a narrative that hardly finds ground on a practical level.

5.3: Growth & legitimacy

In the face of climate change the role of the state is dual and contradictory. The tension is growing between the task of facilitating capital accumulation and the need to maintain legitimacy by compelling or incentivizing corporations to reduce their GHG emissions and other environmental pollution. This dilemma of combining profit and environmental sustainability is partly reflected at the corporate level. This explains the popularity of CE for state and interstate organizations and corporations, as it promises to address both. But can it do both at the same time?

The CE attempts "…to kill two birds with one stone" (Giampietro 2019: 143) by combining economic growth and sustainability. However, several scholars point out that circular economy and sustainability are not necessarily the same. The circular economy "…is viewed as a condition for sustainability, a beneficial relation, or a trade-off in literature" (Geisendorfer et al. 2017: 767). D'Amato et al. claim that the circular economy is "limited in addressing all three sustainability dimensions comprehensively (economy, environment, society) and in questioning the adequacy of the proposed changes for achieving desired levels of sustainability, within either weak or strong sustainability visions". Millar et al. see a contestation as to whether the circular economy can achieve economic growth without degrading the environment (2019: 17).

On a corporate level, sustainable materials or more sustainable production methods are in general associated with higher costs. Here, too sustainability and economic growth are largely in contradiction. However, the case study illustrates that corporations expect environmentally destructive practices to become more costly in the future. In order to facilitate growth policies have mainly been focusing on consumption, so far. However, societal pressure makes governments shifting the focus from consumption more to production. Concepts such as expanded producer responsibility and tighter environmental regulations should compel producers to more environmentally friendly practices. The new European Commission has presented plans for a 'new green deal' to combat the climate crisis (von der Leyen 2019). Those plans aim to incorporate externalities through carbon taxes and similar measures. A shift to a CE is presented as an important component for the realization of those plans.

In the interviews the business potential for the Company was repeatedly highlighted as well as the Company's ambition to take a lead in such a transition. However, being first might also generate competitive disadvantages, at least in the short run. The industrial sector has expressed concerns that new environmental legislation accompanying the implementation of the EU's circular economy package could jeopardize competitiveness if not harmonized on a global or at least regional level (EFIF 2019: 2). Initial investments in more sustainable materials and practices, like adding more material in order to increase the durability of products, result in higher production costs and lower profits. To shift away from an inefficient linear

system into a new material flow model can be perceived as "risky and complex" due to high transaction costs (Harris et al. 1997: 3), such as lack of information, lack of investment capacity or conventional consumer habits (COM 2014:3). State and intergovernmental organizations are called upon by corporations to even out the legal conditions for all players. A harmonized legislation should set the same pre-requisites for all market actors. Otherwise, also any initiative that reduces production and GHG emissions by one company would be immediately offset by another on a global market.

However, macroeconomic implications of a transition are complex as it involves multiple interactions between different sectors and countries. A respondent working with regulatory affairs in the Company explains, that the current legislative framework steering those interactions is built on a linear economic model. In the implementation phase corporations are confronted with old and new mandatory and voluntary requirements at the same time, which shape their room to maneuver and which also differ from country to country. Existing legislation around labelling product content for example restricts the use of recycled materials and is in some countries generally not allowed, while the EU's circularity package promotes an increase of waste as a new feedstock.

State and interstate organizations facilitating a transition of the current economic system have a dual task – combining growth and sustainability in order to maintain legitimacy. Business are involved in the creation of new legislations influencing and striving to secure efficiency, competitiveness and future economic growth. However, circularity does not necessarily equal sustainability. D'Amato et al. argue that a combination of a steady-state or degrowth approach with the CE concept is necessary to be sustainable (2019). Else sustainability remains a mere narrative to legitimate further growth. However, this requires breaking with the logic of capital accumulation.

5.4 Degradation of nature & future profits

The emergence of the CE signals that capital is on its way to creating its own barriers or limits to accumulation by destroying its own production conditions, hence the natural resources on which it depends. Can the circular economy be key in overcoming this dilemma and make it possible to sustain the means of production and at the same time accumulate capital? In short, can the economy grow without destroying, exploiting and degrading nature?

The linear economy and its process of extracting, producing, and dumping has resulted in a crisis of under-accumulation. Rising raw material costs and anticipated costs of waste management, of emission control and of complying with more restricting environmental laws and taxes in the future reduce the productivity of the production conditions. The core of the CE concept is to exactly avoid this loss in productivity by decoupling growth from further material extraction through reuse, repair, remanufacturing and recycling of products. Instead of extracting more resources, more value should be derived from resources circulating in the economy. Consumption of new materials could be reduced by as much as 32% within 15 and 53% by 2050 estimates the Ellen MacArthur foundation (www.ellenmacarthurfoundation.org). In the case of the Company this is aimed for by only using renewable or recycled materials for production, prolonging the lifetime and enabling reuse and repair of products. Reducing primary raw material extraction and processing aims to tackle 38%, and thus the largest share, of the company's current emissions. Considering that an increase in bio-based

materials could aggravate existing tensions over land use, the Company intends to increase the proportion of recycled materials, which today accounts for around 10%.

The increasing use of waste as a new secondary material may or may not influence the reduction of primary resources and thus the further degradation of nature and amount of GHG emissions. Turning waste from a costly externality into new means of production, can be seen as a response of capital to overcome its own barriers (O'Connor 1998: 165). However, to assess the environmental benefits, Bernstein's four questions of political economy could be helpful in observing the commodification of waste on the way forward: Who owns what? Who does what? Who gets what? And what happens with the gains (2010: 22). Depending on the definition and its international standardization, waste will inevitably become a new commodity. "The definition, naturally, decides what flows are addressed in governance, policy and strategic management" (Korhonen 2018: 44). This also might have consequences for the formalization of the, in many areas, informal recycling sector. To move "waste" in global value chains is a prerequisite to reach economy of scale in recycling activities. However, current definitions, although not always successful, were made to prevent waste dumping from industrialized to poorer countries, with less stringent environmental legislations.

On a practical level, the use of waste as a substitute for primary raw materials requires new infrastructures. In the interviews it was mentioned that the recycling infrastructure for some but not all materials is nonexistent or unevenly developed from a global value chain perspective. Even if such an infrastructure can be installed, the law of thermodynamics brings further aspects in: Based on Georgescu-Roegen's *Fourth law of thermo dynamics* "use processes slowly degrade matter by decreasing these two properties: matter dilutes into the environment and loses structure. Recovering the diluted matter (…) would require huge (infinite) amounts of energy, which makes recovery almost impossible" (Ulgiati 2015: 126). Hence, a single cyclic system will never be 100% achievable, at least with the current state of technology and the associated material and energy processes of the CE will "ultimately lead to unsustainable levels of resource depletion, pollution and waste generation" (Korhonen 2018: 42). From this perspective a circular model will in the best case minimize and slow down the material and energy throughput of the economic system, but never fully close the loops.

An increasing number of studies show, that the global economy is about or has already exceeded critical planetary boundaries (Rockström et al, 2013; Steffen et al., 2015) and "is actively reducing natural capital stocks and future capacity to sustain economic activity". Its current throughput goes beyond "all the limits compatible with a steady-state economy" (Farley 2015: 78). Given that the CE could achieve the status of a *steady-state economy*, characterized by a constant throughput rate, Georgescu-Roegen concludes: "even a steady state economy was not viable on a finite planet" (Farley 2015: 76). The CE's different business models 'reuse', 'repair', 'remanufacturing' and 'recycling' are addressing Daly's principals for a sustainable economy to some extent. However, a complete decoupling of economic growth from material consumption is due to theoretical and practical constraints not possible. The "circular bio economy does not address any of the problems pointed out by the neo-Malthusianism in the 1970 and 80s", notes Giampietro, and to "decouple global economic development from finite resource consumption is just a re-emergence of the mantra of cornucopias" (2019: 162). D'Amato et al. argue that as positive effects of decoupling might be offset by increasing economic activity, the circular economy concept needs to be combined with a steady state or degrowth approach in order to be sustainable in long-term (2019: 468), in which "a continuous consumption of resources (…) must be counterbalanced by the work of nature (Giampietro 2019: 154). D'Amato et al. summarize that "…there is no evidence

of absolute decoupling occurring and that the positive effects of relative decoupling are largely offset by increasing economic activity, thereby causing environmental impacts to continue increasing" and argues that a shift towards a circular economy must be combined with critically questioning the total social metabolism of the economy in order to create a relevant environmental impact (2019: 462).

Also, Giampietro criticizes, that the CE does not discuss growth as an issue and suggest adding this dimension to the theoretical foundation of the circular economy (2019: 154). However, continuous consumption is not questioned in the CE discourse. Based on the estimation that the world population grows up to 8,5 billion by 2030 (www.UN.org), consequently, consumption increases. In the case of the Company studied for this research economic growth is anticipated to come from half a billion people, who are expected to move into the middle class. Whether or not it will be possible to serve the needs of an extended customer base while reducing total GHG emissions in line with the Paris agreement targets remains unanswered for the time being.

It is unclear at this point in time, how many GHG emissions are actually connected to backflow activities. Haas et al. note, that energy requirements for recycling can be high, while the quality of secondary materials can be lower and/or can't substitute virgin materials (2015: 766). Similarly, Giampietro points out, that also recycling of products and components does not come at zero biophysical cost (2019: 154). Therefore, the efficiency of recycling needs to be evaluated product by product and material by material in order to avoid unintended environmental costs. Remanufacturing, repair and resell are all loops connected to transport and logistical operations in global value chains, hence, to GHG emissions.

The question occurs, whether logistical backflows require a more local set-up in order to be economic and ecological efficient in collecting waste or end-of-life products from the customer. One interviewee said: *"We try to understand, how it can be integrated in our existing supply chain and is it worth the investment. And can we do it in a way where we can create volume and low cost. So, of course the challenge here is to go to more local set-ups and what consequences will that have"*[9]. This contrasts the principal of economies of scale in a volume driven business. The Company is currently calculating on the potential GHG reduction achievable through a shift to a circular economy to answer this question. In case the gains in GHG reduction achieved by reusing, repairing, remanufacturing and recycling products, compared to a linear flow, are off-set by those GHG emissions, decision makers will be left with the question, if saving resources justifies the environmental costs of GHG emissions in the backflow. Korhonen notes, that "each CE project should be considered for its contribution to global net sustainability" or "what is left as improvement or positive outcome after an individual project or action as comparted to a situation before the project" (2018: 42). However, such an assessment can be difficult.

So, does the CE enable capital to accumulate capital while maintaining the means of production? Neither on the theoretical nor on a practical level can material and energy cycles be completely closed and a decoupling of growth from primary raw material extraction remains wishful thinking. This means that depletion of natural resources and nature will continue if current consumption and production patterns do not change, meaning that overall less is

[9] Interview with Circular economy development manager, September 2019

produced and consumed. At best, the CE could slow down the social metabolism. Therefore, the answer is no.

5.5: A systemic change?

One of the narratives is that the corporate-driven CE implies a systemic change (COM 2015: 6) needed to run an economy within the planetary boundaries. This change comes in form of new business networks allowing logistical backflows to circulate products and materials in the most efficient way. However, does this so-called systemic change enable to reduce GHG emissions according to the Paris agreement?

Although the magnitude of the change is felt to be immense in the Company, some interviewees raised the question of whether the planned efforts and measures would be enough in the face of climate change and environmental degradation. The dilemma of doing a fundamental change versus incremental improvements was addressed in some of the interviews. From the Company's point of view, incremental changes are, by definition, more feasible and much easier to implement on a practical level, but can create a path lock through investments, which make it difficult to change the course at a later stage. A fundamental change is much more difficult to achieve, and decision processes take longer time. They also involve and affect more actors and cannot be taken in isolation. This contrasts with the need to act with urgency. Urgency originates from two sides, the aspect of global warming and changing consumer behavior. The IPCC climate report states that there are 12 years left to act upon a warming above 1,5 degrees. Accordingly targets of GHG emission reduction were formalized in the Paris account. The Company studied committed itself to those targets and set the internal goal to complete a full transformation towards a circular business until 2030. Then, increasing awareness and changing consumer behavior, mainly in mature markets, forces corporations to take measures in order to maintain legitimacy and not lose profits. Due to this urgency, decisions in the Company have to be made while economically, politically and environmentally outcomes are partly unknown. An evaluation on customer perception and future revenue streams or possible GHG reductions have been done only on a theoretical level, so far. Current pilots should give more guidance in estimating the impacts of different circular projects. Right now, the climate footprint of the corporation as well as GHG emissions on a global level are still increasing, and concerns were raised amongst the interviewees that decisions are taken too slowly, and investments are too small. The short- and long-term impact of new business models on the environment need careful consideration, though many of them are still unknown, notes Korhonen (2018: 42). Further different sustainability initiatives can be contradictory, and it is often difficult to assess which ones should be prioritized over the others.

In the midst of this complexity, Kirchherr et al. suggest a careful conceptualization of the circular economy. "If subverted definitions start dominating, CE implementations will only result in incremental improvements at best, with the CE concept then not delivering its promise of fundamental change. The CE concept may then ultimately end up as just another buzzword in the sustainable development discourse" (2017: 229). If incremental improvements are not enough to reach the climate goals, clarity about the definition of a fundamental change is needed. But who gets to decide?

The understanding of a systemic change along the lines of Ecological modernization theory is one of further industrial development as a way out of the ecological crisis including new interorganizational networks to manage and govern material and energy flows. Within this framing, multiple and diverse challenges in the implementation of logistical backflow activities need to be overcome on a practical level. This involves different actors with different interests within and outside the organization, across different sectors and on a regional and global level. For setting up backflow logistics, Parida et al. point out that "no single company can achieve it alone" and an ecosystem-wide orchestration is necessary (2019: 715). Large manufacturing companies can play, in their view, the role of ecosystem leaders and influence other stakeholders in a transition to a circular economy and more sustainable practices. The Company sees, that this influence can go beyond its own value chain and across countries.

From the perspective of ecological modernization theory scale can be sees as an advantage. One example mentioned in the case study is the rapid increase of recycled material from 2%-58% within 2 years in the material category textiles. The scale of the organization and volumes produced allow for immediate impact. However, this also applies for negative impacts. One respondent reflected: *"There is something around how the size can be our advantage, but how it not makes us too slow. I mean every topic becomes too complex"*[10]

Current discourses include the idea that the CE could allow lower-income countries to 'leapfrog' to more sustainable economic, ecological and social practices within global value chains (Schroeder 2019: 77). However, Schroeder expresses concerns about this: A lack of governance could lead to measures that are determined by the strongest actor and do not necessarily take the overall economic, social and environmental outcome into account. Adhering to the assumption that a decoupling from material consumption is the solution, could ultimately silence the discourse on other GHG emission reduction measures.

From a Marxist and Neo-Marxist perspective, a systemic change would require questioning the logic of capitalism itself. Even, if the CE model is not achieving a significant contribution to all three spheres of sustainable development, it has, at least in theory, the potential for radical, ecological improvements through a more efficient use of raw materials and energy. The crucial question is the one of distribution. What will happen with the economic and ecological efficiency gains? Korhonen asks who actually controls the CE and who are the leaders of the new established networks? For him the question of control, decision power and the distribution of burdens and benefits of a transition to a new economic model are crucial (Korhonen 2018: 44). From a Marxist perspective one might stay critical, whether the existing power relations between different classes would change when shifting from a linear towards a circular economy, as the key actors, such as the EU, governments and businesses remain the same.[11]

Those questions are not part of the mainstream debates, but crucial in order to answer upon the question if the corporate-driven CE has the potential to contribute to a significant reduction in GHG emissions. Kirchherr et al. argue that "CE requires a fundamental shift instead of incremental twisting of the current system" (2017: 224). "The operating system needs to change quickly", argues Mathews, else he sees resource wars and climate change

[10] Interview with Design manager, September 2019

[11] Author's unpublished essay in the course: Agrarian transformation ISS-2018-19, Institute of Social Science, Erasmus University

"on a ruinous scale" as a consequence (2011: 877). Though who gets finally to decide what a fundamental shift means?

Chapter 7 Conclusion

This research paper explores the contradictions and dilemmas of the circular economy model and seeks to answer the question whether a corporate -driven circular economy can contribute to solving the climate crisis. While Ecological modernization theory would answer with yes, the Marxist and Neo-Marxist theories used in this paper situate the circular economy within the capitalist system and answer this question with no. The logic of capital accumulation in form of profitability and growth paradigm limits the concept to provide a blueprint for a more sustainable economy.

What then explains the emergence of the circular economy concept and why do corporations change their business model and operational practices? Altering conditions of capital accumulation are shaping corporate environmental behavior such as resource scarcity, increasingly conflicting land-use interests and changing dynamics between state, consumer and businesses in the face of climate change. Changing corporate behavior needs to be understood not in isolation, but within these interrelations. The case study illustrated that corporations are trying to overcome barriers to profit making such as resource scarcity, changing consumption patterns, societal pressure related to GHG emissions reduction and the costs of anticipated and stricter environmental laws by shifting to a circular economy model.

How does capital seek to over-come these crisis? The rise of the CE as a new economic system signals the recognition of the finite nature of the linear economic system and responds to a societal and political demand. Capital is reinventing itself by aiming to decouple growth from further material consumption, which is the ultimate goal of the circular economy. The idea that growth does not necessarily depend on more production is reflected on theoretical and practical level in the hierarchy of business models, which prioritizes 'reuse' and 'repair' over 'remanufacturing' and 'recycling'. However, even if it is assumed that a circular economy allows this, corporations face several practical challenges in the implementation. Creating new conditions in a world built for a linear system is a complicated task, although it is promoted by major players such as the OECD or European Union together with large businesses. An entire new infrastructure, supply chain and legal framework needs to be created for the logistical backflow of goods and materials from consumption back to production.

However, the assumption, which dominates the mainstream discourse, that a circular economy allows for a significant contribution in the reduction of GHG emissions, is challenged by several dilemmas and contradictions: Firstly, it is likely that even within a Circular economy capital will seek for further expansion into new frontiers of extraction. There is no evidence that despite the prioritization of the business model 'reuse' an ever-increasing production of commodities will be stopped. Producing less while making profit contradicts the logic of capital. A growing middle class is increasing the demand for new goods and economic and ecological efficiency gains are likely to be used for expanding the market. This is contradictory to the core idea of a circular economy not to expand into new frontiers of extraction. Secondly, will corporations replace spatial-temporal fixes with circular fixes? No, not in the near future at least. High transaction costs of a shift to a circular model need to be

financed by the current operational business, given, that there is such a thing as a 'circular fix'. Temporal fixes will rather increase through business models such 'product as a service'. The strategy to substitute non-renewable materials might increase the demand for renewable materials. According to current production and consumption patterns, this could result in further geographical expansion of capital and is problematic in multiple social and ecological ways. While addressing concerns of consumers about sustainability, a 'circular fix' remains a narrative that hardly finds ground on a practical level. Thirdly, tensions between capital accumulation and maintaining legitimacy are increasing for corporations, state and inter-state organizations, with growing pressure from society to reduce GHG emissions. Although the CE is celebrated as a solution to this dilemma, its environmental contribution in a finite world is ultimately a question of its scale. As long as the concept is not combined with the notion of a steady-state economy, sustainability remains a mere narrative to legitimate further growth. Fourthly, capital is in the face of climate change forced to reinvent itself. The emergence of the CE signals that capital tries to overcome its own barriers by maintaining its conditions for capital accumulation, hence, to preserve nature. The CE seems in theory a promising concept to do so. However, neither theoretically nor practically can material and energy cycles be 100% closed. This means that depletion of natural resources and nature will continue if current consumption and production patterns do not change. At best, the CE could slow down the social metabolism. Finally, the narratives of the corporate-led CE promise a systemic change in order to run an economy within the planetary boundaries and is referring to new ways of producing and consuming, governing material and energy flows and aiming for zero-waste based on innovation, new business models and inter-organizational networks. However, this framing is not engaging with the question of distribution of ecological gains – and burdens - and socio-economic inequalities of such a transition. From a Marist perspective a systemic change requires to interrogate existing socio-economic power relations and ultimately, the logic of capital itself. From this point of view a transition to a corporate-led CE will not bring systemic change.

A contribution of a corporate-led CE to a substantial reduction in GHG emissions is limited by those manifold dilemmas and contradictions. However, according to my own observations, it opens up a new discourse and raises questions, not only on macro but also on a micro level, which have not been much discussed before.

This paper has explored dilemmas and contradictions of a circular economy, which have been increasingly debated on a macro level, on a micro level. Practical challenges and reflections were linked to bigger global dynamics by observing the case study of one major corporate actor and its transition and implementation process towards a circular economy. The research has focused on the ecological dimension of such a transition and leaves room for further studies on social dilemmas and contradictions. The theories used enabled to understand different viewpoints on corporate behavior related to such a transition and critically interrogate the contribution of the, in the mainstream discourse much-celebrated, circular economy. However, in terms of the urgency of the climate crisis and the remaining 12 years to prevent global warming above 1.5 degrees, they do not provide many answers. In order to achieve the targets of the Paris agreement, the conceptualization of systemic change, as mentioned in the EU's circular economy package, needs to be broadened to include questions of socio-economic equality and the distribution of ecological gains.

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