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## Executive Summary

Circular business models have gained steep increases in attention by practitioners and academics as a lens to understand how firms may conduct business practices in accordance to principles of a circular economy. A circular business model (CBM) is defined as “the rationale of how an organisation creates, delivers, and captures value with slowing, closing, or narrowing flows of the resource loops” (Oghazi and Mostaghel, 2018, p.3). This report contributes to the discourse on CBMs through a review of the literature and empirical research aimed at progressing current shortcomings in knowledge.

The report provides a review of the extant scientific literature in the field of CBMs. This review first considers CBM definitions, the distinguishing characteristics of CBMs, categorisations and the relationship between CBMs and sustainability. Attention then focuses on innovation for circular business models (CBMI) and what is known about how large incumbent firms may revise current linear business to CBMs. The review presents two important shortcomings with the current body of literature. First, while scholars have effectively provided understanding to different types of CBMs there is little empirical insight to the preferred types that large incumbent firms are currently engaging with. Second, studies on the process of CBMI are scant and treat it as a one-off process neglecting how firms transform over long periods of time.

The empirical research of this report aims to provide insight to these two shortcomings. First, a computational text analysis is conducted on the corporate reports of 147 large companies based in Europe. This analysis indicates that large incumbent firms are mostly engaging in CBMs of narrowing resource loops and engaging least with CBMs of slowing resource loops. This finding may be explained by the relative degree of disruption of the CBMs and suggests firms are taking cautious approaches to transforming from the linear to circular economy. Findings also indicate some impact of firms adopting the circular economy discourse on CBM engagement.

Second, the report offers the findings of a single qualitative case study of a large incumbent firm in Europe called Tata Steel in Europe (TSE) that is undergoing revision of its business models. The report uses a narrative analysis combined with a thematic analysis to build an empirical process model of transformation of business models for circular economy over time. Findings of the single case study present that the CBMI revision took place over the course of four dominant phases, and in the form of innovative manufacturing processes and new product launches. In this sense, CBMI revision is progressed through a series of incremental steps rather than a single defined innovation process aimed at overhauling the linear business model in one stroke. Progress was iterative and non-linear but also accumulated to revise the business models in operation. This breaks the dichotomy between incremental and radical innovation (Plowman et al., 2007), and presents the value of continually innovating for CBMs over time.

## List of Abbreviations and Acronyms Used

**CBM** Circular Business Model  
**CBMI** Circular Business Model Innovation  
**CE** Circular Economy  
**CEAP** Circular Economy Action Plan  
**CEE** Circular Economy Efficiency  
**CTI** Circular Transition Indicators  
**D** Deliverable  
**EC** European Commission  
**EU** European Union  
**PSS** Product-Service System  
**TSE** Tata Steel in Europe  
**WP** Work Package

## Table of Contents

<b>1. Introduction .....</b>	<b>8</b>
<b>2. Literature Review.....</b>	<b>11</b>
<b>2.1 Business Models.....</b>	<b>11</b>
2.1.1 Conceptualisations of Business Models .....	11
2.1.2 Business Model Innovation .....	13
<b>2.2 Circular Business Models.....</b>	<b>14</b>
2.2.1 Circular Business Model Definition .....	14
2.2.2 Distinguishing characteristics of CBMs .....	15
2.2.3 Circular Business Models and Sustainability.....	16
2.2.4 CBM Categorisations .....	17
<b>2.3 Circular Business Model Innovation.....</b>	<b>26</b>
2.3.1 CBMI Categorisation .....	26
2.3.2 CBMI process: from linear to circular logic .....	28
2.3.3 Understanding enablers and barriers to CBMI.....	31
<b>2.4 Literature Review Summary.....</b>	<b>35</b>
<b>3. Research Methodology.....</b>	<b>37</b>
<b>3.1 Computational Text Analysis.....</b>	<b>37</b>
3.1.1 Data Collection .....	38
3.1.2 Data Analysis .....	38
<b>3.2 Tata Steel in Europe Case Study.....</b>	<b>40</b>
3.2.1 Research Strategy.....	41
3.2.2 Case Selection .....	41
3.2.3 Data Collection .....	41
3.2.4 Data Analysis .....	45
3.2.5. Research Quality .....	48
<b>4. Findings of the Empirical study.....</b>	<b>50</b>
<b>4.1 Computational Text Analysis.....</b>	<b>50</b>
<b>4.2 Tata Steel in Europe Case Study.....</b>	<b>54</b>
4.2.1 Chronological Narrative: From Acquisition to Zero-carbon emissions target .....	54
4.2.2 Thematic Analysis .....	61
4.2.3 Empirical Model of the Transformation of Business Models for Circular Economy.....	71
<b>5. Discussion.....</b>	<b>76</b>
<b>5.1 Theoretical implications .....</b>	<b>76</b>
<b>5.2 Managerial Implications .....</b>	<b>78</b>
<b>5.3 Limitations .....</b>	<b>79</b>
<b>6. Conclusion.....</b>	<b>83</b>
<b>7. Bibliography .....</b>	<b>84</b>
<b>7.1 Research Report References .....</b>	<b>84</b>

## 7.2 TSE Case Study Findings References ..... 92

### Table of Tables

Table 1. Selected works on CBM categorisation .....	17
Table 2. R-hierarchies Framework.....	18
Table 3. CBMs from a resource loop perspective.....	20
Table 4. Overview of circular business models and key stakeholder examples .....	25
Table 5. Types of CBMI .....	27
Table 6. Process of CBMI Revision.....	29
Table 7. Table of Interviewees .....	42
Table 8. Table of Documents .....	44
Table 9. Tata Steel Europe Circular Economy Events Timeline .....	54
Table 10. Key Concepts of the Transformation of Business Models for Circular Economy ..	62

### Table of Figures

Figure 1. Coding Structure .....	47
Figure 2. CE view and CBM patterns based on resource perspective .....	50
Figure 3. CE language use vs. non-CE language use* .....	51
Figure 4. CE language use vs. non-CE language use* by industry.....	52
Figure 5. Transformation of Business Models for Circular Economy .....	75

## 1. Introduction

This report contributes to the Work Package 4 (WP4) of the ReTraCE project which primarily focuses on informing policies aimed at promoting a circular economy (CE) in a regional context. The first deliverable (D4.1) examines the role of policies to promote a CE transition at a regional level. The report presents the existing regional EU policies, covering the concept of regional resilience, various levels of innovation systems, the place-based approach, and the ‘smart specialisation agenda’. D4.2 proposes a new model for stakeholder mapping in a regional CE context - the CE-centric quintuple helix model. The new model highlights emergence and deployment of trilateral networks, hybrid organisations, and development or cooperation platforms. D4.3 reviews and proposes a framework to measuring CE transition at a regional level. D4.4 provides an overview of drivers and barriers to implement regional policies for a CE transition. D4.5, building on an experimental economics framework, looked at the consumer's side, analysing the gaps between behaviour and intentions in the transition towards circular consumption models. Finally, this deliverable D4.6 focuses on how firms are innovating and transitioning to business models for circular economy.

In recent years, the concept of the circular economy has gained traction among practitioners, scholars, and policymakers, as a promising contribution to decoupling economic activities from resource depletion (Ellen MacArthur Foundation, 2021). For firms, the circular economy requires them to reconsider the business models used to create, capture and deliver value (Geissdoerfer et al., 2020). Conventional business models of a ‘take-make-waste’ linear economy need to be discontinued and replaced by new ones that enable the firms to create value while aligned with principles of circularity. A circular business model (CBM) is defined as “the rationale of how an organisation creates, delivers, and captures value with slowing, closing, or narrowing flows of the resource loops” (Oghazi and Mostaghel, 2018, p.3). By adopting CBMs, firms can contribute to solving environmental and social challenges whilst yielding economic benefits by pursuing regenerative value creation, waste and pollution elimination, and resource retention (Ellen MacArthur Foundation, 2013; Pieroni et al., 2019).

A growing body of scientific studies is emerging on CBMs (Geissdoerfer et al., 2020; Urbinati et al., 2017). Scholars have attended to providing definitions (Kirchherr et al., 2017), constructing typologies and conceptualizations (Lüdeke-Freund et al., 2018b; Rosa et al., 2019; Urbinati et al., 2017) and detailing business practices and strategies (Bocken and Geradts, 2022; Bocken et al., 2016). Prominent ways to categorise CBMs include use of the R-hierarchies that cover pre-use, use, and post-use phases (Zhang et al., 2022), the ReSOLVE Framework of the Ellen MacArthur Foundation (2015), and the business strategies of narrowing, closing and



slowing resource loops (Bocken et al., 2016). Yet, few studies have empirically explored which types of CBMs incumbent firms are pursuing and if certain types are preferred over others.

Scholars have also begun to offer insights into how firms may innovate CBMs, known as circular business model innovation (CBMI) (Pieroni et al., 2019). Studies have begun to unlock approaches such as phased models of sensing, seizing and transforming (Bocken and Konietzko, 2022; Santa-Maria et al., 2022a, 2022b), design sprints (Santa-Maria et al., 2022b) and the tools used for innovation (Bocken et al., 2019). While insightful, much of this existent work focuses on firms creating a new CBM from scratch – the process of designing and bringing a new business model into existence – and have focused on CBMI as singular one-time processes with definable starts and ends. Yet, few studies have attended to how incumbent companies transform from operating traditional linear business models to CBMs over time.

Transformations to CBMs require firms to assess current business models and make decisions on which components they may wish to retain, and which should be discontinued (Frishammer and Parida, 2019). The existent business model(s) operated by the firm may then influence the direction of developing new CBMs and how these come to replace the old ones. For instance, firms may operate linear and CBMs side-by-side in diversified portfolios (Geissdoerfer et al., 2020), directly fully replace business models, or gradually transform business models through phasing in circular components over time.

This deliverable (D4.6) contributes to the series of deliverables of WP4 by providing a business model perspective of circular economy and offers insights to how incumbent firms innovate new CBMs to transform their operations.

This report first provides a review of the extant scientific literature in the field of circular business models (CBMs). The review offers that scholars have to date bestowed much attention to establishing definitions, typologies, and conceptualizations of CBMs (Geissdoerfer et al., 2020; Rosa et al., 2020). Studies have begun to unlock processual understandings of innovating CBMs, but insight to how established incumbent firms may successfully transform their linear business models remains underdeveloped.

Secondly, the report contributes to understanding the process of how firms undergo such linear to circular transformations through two parts of empirical research. It first identifies which CBM approaches incumbent firms are pursuing through a computational text analysis on the corporate reports of 147 large companies based in Europe. Findings offer that firms are mostly communicating CBMs of narrowing resource loops; CBMs associated with only incremental changes to value creation logic. CBMs of slowing resource loops such reuse, refurbishing,

remanufacturing and sharing are least discussed; CBMs associated with more radical changes to value creation logic. These findings indicate that firms are adopting cautious approaches to CBM transformation and that only a sub-set are engaged with innovating CBMs that would likely require full discontinuation of current linear models. The findings also indicate that firms that adopt the language of circular economy seem more prepared to move beyond innovating CBMs of narrowing resource loops.

The second part of the empirical research uses a qualitative approach to conduct a single empirical case study of an incumbent company engaged in a circular transformation. The case study presents how the company is moving through transition phases characterised by different dominant strategies of CBMs. The case study shows how the firm began with CBMs focused on internal resource loops and gradually moved to post-business resource loops, post-consumer resource loops by assisting downstream value chain actors with their CBMI, and finally combined resource loop strategy. The process model contributes to existent understandings by offering the prominent business practices of each transformation phase and insights to enabling factors advancing the firm through its stages of innovation.

Finally, the report draws together its empirical findings with the extant literature to identify some key insights for theory and practice that may that help businesses to implement CBMs.

The structure of the report is as follows. First, it attends to the concept of a business model and offers a foundation to its understanding and provides a detailed literature review on understanding the concept of CBM and CBMI. Section three attends to the methodology to the empirical research. Section four explains the findings of the empirical research in two parts: (a) the computational text analysis, and (b) the single case illustration. Section five, discusses the implications of the findings to theory and practice, offers the avenues for future research and the limitations of the study. Finally, section six closes the report with its conclusion.

## 2. Literature Review

### 2.1 Business Models

Fuelled by the dot.com boom and disruptive macro-level events, such as globalisation, necessitating companies to rethink the way they do business, research on business models has gained significant prominence over the last decades (Massa et al., 2017). This steep interest resulted in multiple definitions of the business model notion, creating a fragmented body of literature (Geissdoerfer et al., 2020). But in recent years this heterogeneity has converged to a more universal understanding of the business model concept as the literature enters a consolidation phase (Wirtz et al., 2016).

This section draws upon scientific literature from management studies to offer a foundational understanding to the concept of a business model and how they are one essential part to the success or failure of a firm's operations. This section is divided into two parts: (2.1.1) Conceptualisations of Business Models; and (2.1.2) Business Model Innovation

#### 2.1.1 Conceptualisations of Business Models

A business model is the conceptual foundation for the implementation of business processes and the business strategy of an organisation (Osterwalder and Pigneur, 2002). It provides an overview of the required architecture of cost, revenue, and profit for creating and delivering value to customers (Teece, 2010). Mendelson (2000) posits that business models demonstrate how a firm organizes and engages in economic exchanges, both within and across firm and industry boundaries. Another prominent definition used in the literature originates from the business model canvas designed by Osterwalder and Pigneur (2011). Osterwalder and his colleagues (2010) introduce nine main elements of a business model: value proposition, key resources, key activities, key partnerships, customer relationship, customer segments, channels, cost structure, revenue streams.

These elements can be subsumed to four constituents, representing the core logic of a business model (Steinhöfel et al, 2016). The first constituent *Offer*, composed of value proposition; referring to the products or services an organisation offers to its customers. The second component *Infrastructure* consists of key partnerships, key resources, and key activities. This constituent focusses on what architecture and resources are required for creating and providing value to customers. The third component *Customer* includes customer relationships, channels and customer segments. This component deals with questions such as: How is value delivered

to the customers? Which client groups should be targeted? How to build and maintain customer connections? The last constituent *Financial viability* involves cost structure and revenue streams, referring to the way organisations generate profit and capture other forms of financial value (Guldmann et al., 2019; Lewandowski, 2016). All together, these different focal areas converge around the notion of how a business works to create, capture, and deliver value (Magretta, 2002). Richardson (2008) proposes a further refinement framework for these components by reconceptualising them into three forms of value management, namely, *value proposition, value creation and delivery, and value capture*.

Business models are generic and can be replicated if found successful (Teece, 2010). For this reason, just developing a business model itself might not suffice to guarantee competitive advantage. The newspaper industry exemplifies this logic. All traditional newspapers had the same business model i.e., low cost of the newspaper, use of advertising to help cover the costs of generating content. However, some were more successful than others. In this case, the business model does not explain why one newspaper company had higher share or better performance than the other. For business models to be financially sustainable and competitive, strategy analysis needs to be accompanied in its design process. The market segment needs to be considered as well as the development of segment specific value propositions. Furthermore, the strategy analysis should also provide ‘isolation mechanism’ (Teece, 2010, p.180) to protect the firm from competitor imitation.

In essence, a business model is an operational logic within business, and it does not consider market dynamics. The two main differentiating factors between business model and strategy is the business model’s emphasis on customer-focused value creation emphasizing cooperation, partnership, and joint value creation. On the other hand, traditional strategy research focuses on competition, value capture and competitive advantage related to performance (Magretta, 2002; Mäkinen and Seppänen, 2007; Mansfield and Fourie, 2004; Zott et al., 2011). Despite this difference, business model scholars also emphasize the complementary nature of business model and strategy, defining business model as “*reflection of a firms’ realized strategy*” (Casadesus-Masanell and Ricart, 2010, p.195).

According to Zott and colleagues (2011) the business model concept has been largely applied in three thematic silos: (1) e-business and the use of information technology in organizations; (2) strategy, revolving value creation, competitive advantage, and firm performance; and (3) innovation and technology management. More recently, environmental sustainability and social entrepreneurship have also gain traction as additional prominent application areas for the business model terminology (Massa et al., 2017). Within this context, business models can be used as a tool to redesign the purpose and activities of an organisation, so that their pursuit of

economic value is simultaneously in alignment with social and environmental value creation (Massa et al., 2017.). Then, not only do business models help companies to seize new opportunities, but to unfold new dimensions of innovation (Zott et al., 2011).

### 2.1.2 Business Model Innovation

Business Models can be seen as a mechanism to capture the value of innovation and revenue streams. By identifying new business opportunities and designing how to implement them, business models can lead to success for an organization. In terms of technological innovation, studies have shown that high-performing companies placed twice as much emphasis on business model innovation as underperforming companies (IBM Global Business Services, 2006). An important role of the business model could be to unlock the potential value contained in new technologies and convert it into market outcomes, unleashing commercial potential that drive change across industries (Zott et al., 2011). Thus, technology is not only part of a business model, but enables it.

Business model innovation can be defined as the process of devising and finding a new way to create, deliver and capture value (Blank, 2005; Govindarajan and Trimble, 2010; McGrath, 2010). Business model innovation is a challenging type of innovation (Chesbrough, 2010; McGrath, 2010), going beyond product and process or organisational innovation (Amit and Zott, 2010). Companies face challenging tasks as they face locked-in management structures and distribution of resources and need to break away from the traditional value creation logic, often without existing knowledge or tools (Guldmann and Huulgaard, 2020). However, if firms can successfully innovate their business models, this can result in creating competitive advantage for organizations and higher returns than product or process innovations (Chesbrough, 2007). In addition, business model innovation can lead to a dynamic long-term competitive advantage for firms (Geissdoerfer et al., 2020; Richardson, 2008; Teece, 2010). The concept is also important in the context of sustainability, as it allows firms to orient their businesses to meet their social and environmental goals (Boons and Lüdeke-Freund, 2013).

The working definition of business model innovation for this report is adopted from the review paper by Geissdoerfer and colleagues (2018), which states that *“the conceptualisation and implementation of new business models that (sic) can comprise the development of entirely new business models, the diversification into additional business models, the acquisition of new business models, or the transformation from one business model to another. The transformation can affect the entire business model or individual or a combination of its value proposition,*

*value creation and deliver, and value capture elements, the interrelations between the elements, and the value network” (p.405-406).*

As successful introduction and innovation of business models allow firms to establish long-term competitive advantage meeting their social and environmental ambitions, business model innovation oriented toward CE transition will play a critical role to enable implementation and scale-up of circular strategies in a regional context. The next section synthesizes the existing literature on definitions and typologies of circular business models and drivers and barriers to circular business model innovation.

## **2.2 Circular Business Models**

The circular economy has gained prominence over the past decade as an alternative way of organising economic activities that do not undermine social-ecological foundations (Kennedy and Linnenluecke, 2022). The circular economy is defined as industrial systems “that are restorative or regenerative by intention and design” (Ellen MacArthur Foundation, 2013, p. 7). To realise circular intensions firms will need to reconfigure business practices and develop new business models that enable economic value creation in line with circularity principles.

The practical and academic relevance of CBMs have been boosted by an increasing number of recently published studies (Bocken et al., 2016; Bocken et al., 2021; Ellen McArthur Foundation, 2015; Ferasso et al. 2020; Geissdoerfer et al., 2017; Guldmann et al., 2019; Lüdeke-Freund et al., 2019). Studies are providing insight to the configurations and types of CBMs available to firms, and while nascent, have begun to offer how firms transform from linear models to CBMs. This section draws upon this developing body of literature to elaborate on the CBM concept. This section is divided into 4 parts: (2.2.1) Circular Business Model Definition; (2.2.2) Distinguishing characteristics of CBMs; (2.2.3) CBM and Sustainability; and (2.2.4) CBM Categorisations.

### **2.2.1 Circular Business Model Definition**

Multiple scholars have defined CBMs with the majority following the pattern of basing definitions on the common logic framework of business model research offered by Osterwalder and Pigneur (2010); value proposition, value creation and delivery, and value capture (Geissdoerfer et al., 2020). Definitions often then combine this value-based framework with principles of CE or approaches that firms can adopt in the pursuit of circularity. For instance, Geissdoerfer and colleagues (2020) define CBM as “business models that are cycling, extending, intensifying, and/or dematerialising material and energy loops to reduce the resource



inputs into and the waste and emission leakage out of an organisational system. This comprises recycling measures (cycling), use phase extensions (extending), a more intense use phase (intensifying), and the substitution of products by service and software solutions (dematerialising)” (p.7). This report adopts the definition of a circular business model (CBM) as “the rationale of how an organisation creates, delivers, and captures value with slowing, closing, or narrowing flows of the resource loops” (Oghazi and Mostaghel, 2018, p.3).

### 2.2.2 Distinguishing characteristics of CBMs

Scholars have contributed to conceptualizations of CBMs through surveying related concepts (e.g. sustainable business models) and defining CBM as an independent stream of research (Nußholz, 2017; Lewandowski, 2016; Urbinati et al., 2017). The classifications and typologies of CBMs also draw upon the existing neighbouring concepts developed long before practitioners and scholars endorsed the CE concept. As commonly referred as origins of a CE concept, Cradle-to-Cradle (McDonough and Braungart, 2010) and Performance Economy (Stahel, 2010) laid out foundational concepts related to CBM. Furthermore, product-service-systems (PSS) concept developed in 1990s (Tukker, 2004) can be referred to as a sub-category of CBM with a narrower focus on service-based business models. With the rapid growth of the literature on CE and CBMs, several review papers have attempted to synthesize the existing conceptualizations of CBM that emerged through best examples and case studies to increase its conceptual clarity (Bocken et al., 2019; Geissdoerfer et al., 2020; Lopez et al., 2019; Pieroni et al., 2019a; Rosa et al., 2019).

CBMs are characterized as a new kind of business model, where the value creation is grounded upon retaining the value embedded in the materials and products for exploitation through new types of offerings (Rosa et al., 2019). CBMs enable firms to follow the principles of CE to perform business activities that are regenerative by design (Ellen MacArthur Foundation, 2013). CBMs facilitate firms to carefully manage two types of material flows: biological nutrients and technical nutrients. The former is designed to re-enter the biosphere safely and build natural capital and the latter are designed to circulate at high quality without entering the biosphere (i.e., remain in the technosphere) (McDonough and Braungart, 2010). CBMs enable firms to maximize material circulation, minimize leakage and cross-contamination while being powered by renewable energies (Ellen MacArthur Foundation, 2013).

CBMs also attend to minimizing the quantity of materials that are used in the business activities, slowing the degradation of the quality of the materials, and slowing the speed in which materials exit their productive use. These features result in many CBMs focusing on how to best leverage the value already embedded with products, components, and materials. They commonly require

some form of reverse logistics involving actions from customers and other supply chain actors, and repeated interactions between the key actors involved in the value chain (Lüdeke-Freund et al., 2019; OECD, 2019).

### **2.2.3 Circular Business Models and Sustainability**

CBMs are commonly viewed by practitioners and scholars to harbour great potential for catalysing a paradigm shift towards sustainable development, bringing together a business case with an environmental case. CBMs are positioned to enable businesses to incorporate transformative practises which capture and create value for the company and society, thus nullifying the dichotomy between societal and economic values (Bocken et al., 2016; Murray et al., 2017; Santos, 2012). Rather than attaching all relevant activities to the pursuit of financial success, CBMs focus on finding an intersection between the economic, social and environmental value generation (Wirtz et al., 2016). The prevailing logic that directs all corporate decisions is thus more systemic in nature, as it does not follow only an economic rationale.

Yet, the relationship between CBMs and sustainability requires careful consideration and scrutiny. Many scholars have been keen to acknowledge that positive environmental, social and economic benefits of CBMs are far from certain (Bocken et al., 2018; Florin et al., 2015; Lüdeke-Freund et al., 2018; Manninen et al., 2018; Nußholz, 2017). Circularity itself may be seen as one of several possible solutions towards sustainable development alongside others such as de-growth (Geissdoerfer et al., 2017). It may also be seen as a one of many conditions for sustainable development, and necessary but not sufficient on its own (Geissdoerfer et al., 2017).

While CBMs are positioned to improve environmental performance through the reduction of material usage, it may still ultimately lead to the similar consequences of environmental degradation (Millar et al., 2019). For instance, reduction of material usage through narrowing strategies can be offset by increases in production levels, or environmental gains from slowing strategies can be offset by large increases in users now having access to the product. The pace in which pressures on the natural environment are reduced may also not be in-line with what is required to avoid crossing critical thresholds or recovering from those already transgressed (Kennedy and Linnenluecke, 2022). For instance, will slowing resource loops be enough to move the use of renewables to within regenerative rates, or other sufficient cuts to carbon emissions? Many assumptions are also made on the behaviour of firms responding to changes in demand. For instance, will firms involved in material extraction respond by reducing their production output or seek ways to maintain and increase current volumes?



CBMs, and the wider discourse on circularity, has also been criticized for under-attending to the social dimension of sustainability. Social aspects such as transparency and social justice in value creation networks, violation of human rights and democratic principles are not discussed and integrated into the concept of CBMs as the concept focuses heavily on economic rationalities and environmental benefits (Antikainen et al., 2017; Bocken et al., 2018; Bressanelli et al., 2017; Hofmann, 2019; Manninen et al., 2018; Murray et al., 2017).

## 2.2.4 CBM Categorisations

Scholars of CBMs have proposed a range of categorisations to help guide research and companies for successful implementation of a circular economy (*see* Rosa et al. (2019) for an overview). Classifications have been formed based on either conceptual work, business model examples found in practice and/or reviewing the empirical and conceptual studies of academic literature. Table 1 offers a summary of selected works on CBM categorisation.

**Table 1 Selected works on CBM categorisation**

Authors	Year	Publication	Citations*	Content
<i>Policy reports, Practitioner-oriented contributions</i>				
Ellen MacArthur Foundation	2015	<i>Growth Within: A Circular Economy vision for a competitive Europe</i>	352	Introduction to fundamental principles and the ReSOLVE framework.
Lacy and Rutqvist	2015	<i>Waste to wealth: The circular economy advantage</i>	775	Framework of five key CBMs.
OECD	2019	<i>Business models for the circular economy</i>	21	Typology of circular business models and examples. Policy implications
<i>CBM conceptualization</i>				
Tukker	2004	<i>Business Strategy and the Environment</i>	2993	Taxonomy of Product-Service System business models.
Bocken et al.	2016	<i>Journal of Industrial and Production Engineering</i>	2490	Overview of business model strategies for CE.
Lewandowski	2016	<i>Sustainability</i>	1203	CBM design conceptual framework and design tool.

Nußholz	2017	<i>Sustainability</i>	312	Definition and typologies of CBMs.
Urbinati et al.	2017	<i>Journal of Cleaner Production</i>	660	Taxonomy of CBMs.

#### *CBM Reviews*

Lüdeke-Freund et al.	2019	<i>Journal of Industrial Ecology</i>	629	Review of CBMs to develop a typology of key patterns.
Rosa et al.	2019	<i>Journal of Cleaner Production</i>	213	Thematic review of the CBM literature.
Ferasso et al.	2020	<i>Business Strategy and the Environment</i>	215	Networks of current and emerging topics within the CBM literature.
Geissdoerfer et al.	2020	<i>Journal of Cleaner Production</i>	267	Review of CBM definitions and conceptual frameworks.

\*Google scholar as of 22 December 2022.

Multiple studies have utilized the R-hierarchies Framework, expanding it from a widely used 3R framework (Reduce, Reuse, and Recycle) to 6Rs (Sihvonen and Ritola, 2015) and 9Rs (Potting et al., 2017; Zhang et al., 2022). The R-hierarchies Framework (Table 2) have been applied by scholars and practitioners to orient their business model innovation in the context of CE or used to develop classification methodologies for defining CBM typologies (Rosa et al., 2019).

**Table 2. R-hierarchies Framework**

R-hierarchies	Strategy definition
Refuse (R0)	Prevention of using a certain product or making a product redundant. In order to achieve refuse, function of the product should be abandoned, or same function should be offered by a distinctively different product.
Rethink (R1)	Making product use more intensive by sharing products or making the products fit for multi-function or use.
Reduce (R2)	Prolonging the lifespan of products by reducing use of raw/natural materials/resources. It allows to upgrade in terms of superior technologies, higher information infrastructure to optimise resources, energy, etc.
Reuse (R3)	Using the discarded product which is still in good condition and fulfils its original function again (e.g., second hand, sharing of products). It allows minimizing the consumptions of resources, energy, and labour.
Repair (R4)	Repairing and maintenance of deficient or damaged products and their parts so, products can be used longer.
Refurbish (R5)	Reviving old products to give them new life so, products are transformed into updated products.
Remanufacture (R6)	Making new product by using a second hand or discarded products with their former attributes.
Repurpose (R7)	Developing a new product from a discarded product by re-establishing its functions or use of purposes.

Recycle (R8)	Redeeming used/waste materials or resources to reuse the materials again for the production with the highest possible value.
Recover (R9)	Recovering embedded energy by incineration of materials and other waste for energy.

*Source:* Adapted from European Commission (2020) and Plotting et al., (2017). Definitions for ‘reuse’ and ‘recycle’ are aligned with the definitions provided in the EU Directive 2008/98/EC on waste.

The Ellen MacArthur Foundation (2015) proposed the ReSOLVE framework as an action-focused guidance for companies and governments during the definition of CE policies (Rosa et al., 2019). The framework identifies key strategies - Regenerate, Share, Optimise, Loop, Virtualize, and Exchange – to foster an active transition to a CE. *Regenerate* focuses on “i) shift[ing] to renewable energy and secondary materials, ii) reclaiming/retaining/restoring health of the ecosystem or iii) returning recovered biological resources to the biosphere” (Ellen MacArthur Foundation (2015, p.25); *Share* emphasizes “i) sharing assets, ii) reuse/second hand or iii) prolonging product lifetime through maintenance” (Fusco Girard and Vecco, 2021, p. 9), design for durability, upgradability, etc. *Optimise* stresses the traditional performance/efficiency of product but also redefines optimisation from the resource perspective by proposing to remove waste in production and supply chains. The Optimise strategy also involves leveraging on technological innovation such as big data, automation, remote sensing and steering. *Loop* touches upon the more widely used CBM strategies such as i) remanufacturing of products/components, ii) recycling of materials, iii) anaerobic digestion of wastes or iv) extraction of biochemicals from organic wastes. *Virtualize* further eliminated resource dependency by focusing on direct/indirect dematerialization of products. Finally, actions set forth by *Exchange* focuses on “i) replacing old materials with advanced non-renewable ones, ii) applying new technologies in traditional processes or iii) transforming products/services” (Fusco Girard and Vecco, 2021, p. 9).

Another contribution from practice is Lacy and Rutqvist (2016) of Accenture that take an explicit business-centric perspective and puts forward five different typologies of CBM: (i) circular supply models, (ii) resource recovery models, (iii) product life extension models, (iv) sharing models, and (v) product service system models. This approach has been also adopted by an intergovernmental economic organization, the OECD, to follow a business-centric perspective and to promote the engagement by business practitioners (OECD, 2019).

In this report, a resource loop perspective is taken to classify different CBM patterns. Since CE principles focus on resource and material flow through various economic activities, the resource loop view offers a clear picture to key characteristics employed by different business models and illustrate how the value of resources of materials are retained in the economic cycle. CBM scholars have commonly applied this perspective (Rosa et al., 2019) and have also sought to

refine and extend it. For instance, Geissdoerfer et al., (2020) draws upon resource loop strategies to classify CBMs as cycling, extending, intensifying, and dematerializing.

The following sub-section illustrates different types of business models under the three original resource strategies: (i) closing resource loops, (ii) slowing resource loops, and (iii) narrowing resource loops. It then adds the recently conceptualized: (iv) regenerating resource loops. Distinguishing between these resource strategies helps companies prioritize and define the product design and architecture of their business and expansion paths, which facilitates the integration of sustainability into the core of their business models (Bocken et al., 2018). While business models are positioned within the most prominent of the four strategies, they will often offer benefits to more than one. Table 3 provides an overview of key CBM typologies based on the resource perspective with business examples.

**Table 3. CBMs from a resource loop perspective**

<b>Resource strategy</b>	<b>Business model types and definition</b>
Narrowing resource loops	<i>Resource efficiency</i> <ul style="list-style-type: none"> <li>- Reducing the resource input per unit of production through product or process redesign</li> </ul> <i>Dematerialization</i> <ul style="list-style-type: none"> <li>- Relacing physical materials with services or digital offerings.</li> </ul>
Closing resource loops	<i>Circular supplies</i> <ul style="list-style-type: none"> <li>- Providing inputs that enable products to be more fully circular by design.</li> </ul> <i>Resource recovery</i> <ul style="list-style-type: none"> <li>- Using otherwise “wasted” materials or resources and use them as feedstock to new value capturing process, exploiting residual values of materials, products, and components</li> </ul> <i>Industrial symbiosis</i> <ul style="list-style-type: none"> <li>- A process- orientated solution that aim to use residual outputs from one process as feedstock for another process</li> </ul>
Slowing resource loops	<i>Classic long-life model</i> <ul style="list-style-type: none"> <li>- Business models focused on durable goods that are designed to deliver long-product life (e.g. white goods, luxury products)</li> </ul> <i>Encourage sufficiency</i> <ul style="list-style-type: none"> <li>- Non-consumerist approach to marketing and sales that emphasize principles such as durability, upgradability, service, warranties and reparability (e.g. Vitsoe and Patagonia)</li> </ul> <i>Extending product value</i> <ul style="list-style-type: none"> <li>- Exploiting residual value of products through reuse, refurbishment and remanufacturing.</li> </ul>

	<i>Access and performance model</i>
	- Providing access to market (products or services) without transferring ownership of physical products or materials.
Regenerating resource loops	<i>Improving natural ecosystems</i>
	- Business models that do not harm natural ecosystems, prevent degradation, and restore previously exploited and degraded ecosystems.

Source: Bocken et al., (2016); Bocken and Geradts (2022); Lacy and Rutqvist (2016)

***Narrowing resource loops.*** CBM types that focus on narrowing resource loops involve improving *resource efficiency* and minimising the resource input per product. Efficiencies in product design are enabled through new digital and manufacturing processes (Bocken et al., 2021). In contrast to the other approaches, these CBMs do not involve service cycles. Rather than being centred on cyclical utilisation of products and materials, it focuses on reducing the resources required per item for production processes, thus enhancing eco-efficient cradle-to-grave material flows (Bocken et al., 2016). The narrowing of resource cycles does not affect the circulation of goods, nor does it affect the rate of circulation. Offering a more fundamental change are CBMs focused on dematerialization. These business models focus on narrowing resource loops by replacing physical resources with providing value through services or digital offerings (Geissdoerfer et al., 2020). For instance, replacing selling CDs with music streaming.

***Closing resource loops.*** CBMs based on this strategy aim to close the resource loop from the end of product cycle to the beginning (Bocken et al., 2016; Brennan et al., 2015; Geissdoerfer et al., 2018; Nußholz, 2017). Leakages of resources from the industrial system can be minimized through *circular supply* business models that enable new product designs and production processes (Lacy and Rutqvist, 2016). These business models centre on a value proposition of enabling products to be fully returned into biological or technical cycles. For instance, by enabling a product to be fully bio-based and biodegradable within the biological cycle. *Resource recovery* business models focus on the wastes currently exiting the industrial system. These business models consider the cycling of internal (within company), post-business (between supply chain actors), post-consumer (after the use phase) and post-societal (after disposal has occurred) resource loops (Wells and Seitz, 2005). For instance, firms can create recycling business models that enable waste to enter back into production processes as feedstock. Specialist firms in waste management and ‘scavengers’ may also perform services for firms or sell the wastes collected (Ghisellini et al., 2016). A third type is *Industrial symbiosis* whereby the business model is designed for its ‘wastes’ to act as feedstocks for other processes (Bocken et al., 2016). For instance, the carbon dioxide emissions of one production process could be linked to a horticulture process that may require it.

***Slowing resource loops.*** CBM types that focus on maximizing the value that may be extracted from materials before they are degraded and technically dissipated. *Classic long-life* business

models focus on offering customers durable goods with high quality production and materials (Bocken et al., 2016). Technological obsolescence and fashion vulnerability (e.g., timeless design) are also considered. These business models are often associated with luxury and premium goods. Closely related are business models that *Encourage sufficiency* (Bocken et al., 2016). These models only encourage consumption when customers need the product, reducing instances whereby resources will fast become waste (e.g., a customer only uses it a limited number of time). They market product attributes aligned with circularity such as the product's durability and its repairability.

Beyond the initial use phase, CBMs of slowing resource loops focus on how materials can enter consecutive lifecycles before they dissipate and no longer hold embedded value. CBMs of *Extending product value* can operate at multiple consecutive lifecycles, with preference to retaining the embedded value of labour and energy when possible. Reuse and redistribution business models involve taking used products and offering them for resale in a marketplace, either with or without slight enhancement or modification of the products (Bocken et al., 2014). Repair and maintenance business models allow damaged or degraded products to be used until their full expected life ends by fixing or replacing defective components. Refurbishment and remanufacturing business models involve reselling previously used products that have been retrieved from users by reverse logistics (Lüdeke-Freund et al., 2019). Refurbishment requires only cosmetic changes to products, while remanufacturing requires more profound dismantling and replacing of dysfunctional components (Lüdeke-Freund et al., 2019). Refurbished and remanufactured business models often have a green value proposition or can have lower price points than virgin products, with labour cost a critical factor. This can enable firms to enter into new markets and not cannibalize on sales of its linear business model (a potential benefit to the firm, but not necessarily circularity). Refurbished and remanufactured business models may also be carried out by third parties, such as is already common for smartphones, though the original manufacturer may often be better placed due to their innate understanding of their own products (Lüdeke-Freund et al., 2019).

As an alternative to the traditional ownership model, product-service system (PSS) models “allow firms to create new sources of added value and competitiveness” (Tukker, 2004, p.247) through offering services rather than products. Based on Tukker (2004), the PSS models can be categorised into three different types. The first main category is *product-oriented services*. In this model, the provider sells product-related services alongside the product to enable its longevity, such as a maintenance contract during the product-use phase or offers advice and consultancy for good care of the products sold. The second category is *use-oriented services*. In this category, there is no transfer of product ownership to the consumer, but instead access is provided through a product lease, renting or sharing, or product pooling. The last category is



*result-oriented* services whereby the customer does not select a specific product to use, but instead a result is agreed on with the provider. For example, in a pay-per-print business model the customer does not select the type of printer (e.g. Xerox, Canon) but just pays per unit of result (e.g. a printed sheet of paper). Sharing platform models offer users access for a limited time to a product shared by another user. Sharing platforms may operate as use-oriented or product-oriented PSS depending on if the user selects the specific product they will use or not e.g., the user may select for to use a specific boardgame or just a box of toys.

Use-oriented and result-oriented PSS (*Access and performance* models) are particularly advantageous for circularity. First, these models enable the intensification of material use as multiple users may be serviced with the same products (Bocken et al., 2016). For instance, one car can service multiple persons that require the product at different points in time. This enables narrowing resource loops as less materials are used to generate value and attends to maximizing the utilization of products before they technically dissipate or become obsolete due to technological and fashion advancement (Lacy and Rutqvist, 2016). Second, by retaining ownership the producer has greater control over the materials and their end-of-life disposal, facilitating recirculation of consecutive lifecycles such as refurbishment and remanufacturing. Yet in practice firms may also operate use-oriented and result-oriented PSS without the intention, competencies, or product design for recirculation of consecutive lifecycles.

Table 4 offers an overview of CBM examples with key stakeholders for closing and slowing resource loop strategies.

***Regenerating Resource Loops.*** Regenerating resource loops is a recently conceptualized fourth resource strategy and refers to CBMs that build cleaner loops and contribute to improving the state of the natural environment (Bocken et al., 2021). At a basic level this first requires CBMs that protect or do not harm the natural environment by switching to renewable energy and eliminating the use of harmful toxic substances (Bocken et al., 2021; Ellen MacArthur Foundation, 2013). For instance, IKEA purchases forests to protect them from commercial development, offsetting the deforestation caused by its furniture products (Bocken and Geradts, 2022). CBMs can then go further to seek ‘net positive’ opportunities to remediate exploited or degraded land and restore biodiversity to deliver greater improvement to the natural environment than the damage caused in its operation. For instance, agricultural firms may switch to regenerative agriculture to restore biodiversity to natural ecosystems. These CBMs are likely to have high complexity and require the formation of network collaborations. By collaborating with other actors with coherent and common goals, additional expertise and skills can be acquired that complement and strengthen the firms’ own capabilities (Bocken and Geradts, 2022). For instance, a firm may partner with an environmental NGO such as WWF.

CBM characterizations offer firms inspiration to how they may innovate and transform business operations to acting in accordance with circularity principles. Firms are increasingly gaining awareness of CBM opportunities within the four resource strategies (Bocken and Geradts, 2022). Firms may create brand new CBMs or seek to transform currently operating linear business models. CBMs can be combined and/or firms may operate multiple ones simultaneously to create synergistic portfolios. For instance, a firm may pursue industrial symbiosis at the same time as operating a use-oriented PSS.

Firms can assess the feasibility of implementing different business models and how does it match their current competencies and assessment of the marketplace. While focused on environmental benefits, firms will also need to keenly address how they offer social and economic benefits as well. For example, refurbishment and remanufacturing is likely to create jobs and firms may be able to employ more persons with a distance to the labour market. CBMs may offer firms economic benefits in material resource cost savings, higher and more stable revenue generation, and more secure material supply.

While scholarly work has attended to delivering practice taxonomies of potential CBM opportunities, few studies have sought to provide insight to how firms adopt and transform to CBMs (Frishammar and Parida, 2018). Some studies also have chosen to focus on circular start-ups that have business models designed for circularity at the outset (Henry, 2020), rather than how incumbent firms can transform. This has left many important questions underattended. For instance, are some CBMs pursued more than others? Do some CBMs offer easier starting places for firms in transition than others? How do firms understand what combinations and portfolios of CBMs they should create? We shall explore current work in this area within Section 4 of this report.



**Table 4. Overview of circular business models and key stakeholder examples**

Resource strategy	Circular business model types	Description	CBM Examples	Examples of key stakeholder involvement
Closing resource loops	Circular Supplies	Replace single-use material inputs with renewable, bio-based, recovered materials	Royal DSM, Dutch aWEARness, Freitag	Virgin material suppliers are crucial actors in the circular supplies business models to shift away from sourcing non-renewable materials to renewable and bio-based materials
	Recycling	Recover resources from waste	Junk Not, Ugly Good, G-Star Raw, Aquafil, Globe Hope	Three main activities are undertaken by different stakeholders: waste collection by local governments; sorting by service providers or local governments; waste processing to transform the sorted waste materials into finished input materials by service providers.
	Cascading and Repurposing	Value recovery by iterative use of physical materials until exhaustion of any higher value products	Mondi, Green Recycled Organics (GRO)	This model requires an unusual collaboration between different actors across sectors or value chains. For instance, in order to grow mushrooms from coffee waste, GRO is sourcing coffee waste from large organizations (i.e. local cafes) that produce vast amount of coffee waste.
Slowing resource loops	Reuse and Redistribution	Offer used products for resell with or without enhancement or modification	Refill, Nudie Jeans, TrendSales	Forward and reverse logistics by logistics providers are the key. The used products need to be collected from consumers and delivered to manufacturers or service providers and put out to a second-hand market for resell.
	Repair and Maintenance	Extend a product life by fixing damaged parts	Giroflex, iRepair, Nudie Jeans	Manufacturers or external service providers who provide stand-alone repair services collaborate with their logistics partners to extend the life of a product.
	Refurbishment and Remanufacturing	Restore products to original working condition, giving a new life	Desso, Fonebank, Fairphone, Renault, Philips	Manufacturers or service providers provide technical expertise and collaborate with parts suppliers and logistics providers to give a new life to products.
	PSS: product-oriented	Extra services are added to the sales of products	Giroflex, Tom Cridland, Nudie Jeans	Manufacturing companies sell products in a conventional way but add additional after-sales service in the value proposition.
	PSS: use-oriented	The product ownership stays with the provider and the product is offered through lease, renting, sharing, or product pooling.	MadThread, Covetella, Swapfits, Mud Jeans, Desso, Mobike, Renault	Consumers opt for leasing or renting products rather than buying them while service providers retain full ownership of the products.
	PSS: result-oriented	The revenue is generated by agreed result or performance	Solar Home, Kaer Air, Atea, Philips, HOMIE	Manufacturers or firms market services or outcomes provided by goods rather than selling them.
	Sharing Platform	Product users share product experience through the sharing platform and maximize the utilization	WeiGongJiao, BlaBlaCar, Resecond, Peerby	Owners of underutilized assets and products as well as consumers who want them are actively involved in this model, converting from buying to sharing.

*Sources:* Bocken et al., (2016); Henry et al., (2020); Lacy and Rutqvist, (2016); Lüdeke-Freund et al., (2019)

## 2.3 Circular Business Model Innovation

Business innovation is the most powerful driver to enable growth and paradigm shifts while disrupting (traditional) industries (Ellen McArthur Foundation, 2021). While firms have traditionally focused on technological innovation for competitive advantage, the business model offers an alternative focus for innovation (Zott et al., 2011). Innovating business models is “the process of devising and realizing a novel way to create and appropriate economic value” (Linder and Williander, 2017, p.2). Innovation may be an overhaul of the complete business model or changes one of more of the building blocks to how it creates, delivers, captures, and proposes value (Geissdoerfer et al., 2018b; Osterwalder and Pigneur, 2010).

Innovation of business models for circularity offers a powerful approach to realising a circular economy to enable firms to place circularity at the core of how they create and deliver value, rather than an add-on to otherwise linear activities. Scholars have now begun to unpack circular business model innovation (CBMI), though the literature is reasonably nascent (Pieroni et al., 2019). CBMI may have a high degree of complexity due to the need to look at materials throughout their lifetime and engage with multiple stakeholders throughout the value chain. Yet, how firms innovate CBMs and transform away from linear business models is currently not well understood (Frishammar and Parida, 2018) and firms are lacking guidance to how they can successfully approach it.

This section reviews the emerging body of literature to elaborate on the CBMI concept. This section is divided into 3 parts: (2.3.1) CBMI Categorisation; (2.3.2) CBMI Process; and (2.3.3) Understanding Enablers and Barriers to CBMI.

### 2.3.1 CBMI Categorisation

Studies have begun to explore and categorise the different ways in which firms may innovate CBMs. As CBMs are opposed to the dominant linear approaches of the existing business practices, which mostly emphasize frequent introduction and diversification of products to increase competitiveness (Hofmann and Jaeger-Erben, 2020), implementation of CBMs require business model innovation to break away from the linear value creation logic (Guldmann and Huulgaard, 2020; Hofmann and Jaeger-Erben, 2020).

CBMI is often described in the literature in a rather simplified form as firms shifting from a linear form of business models to a circular one (Bocken et al., 2018; Linder and Williander, 2017; Rizos et al., 2016). This report adopts the more refined definition of Geissdoerfer and

colleagues (2020); “circular business model innovation can be defined as the conceptualization and implementation of circular business models. [...] This can affect the entire business model or one or more of its elements, the interrelations between the elements, and the value network” (p. 8).

Studies have commonly used CBMI interchangeably with business model transformation (Geissdoerfer et al., 2020), yet this can be viewed as only one possible route that firms may pursue. Cavalcante et al., (2011) offers four main ways in which firms may innovate business models: creation, extension, revision, and termination. Table 5 offers an overview of types of CBMI.

**Table 5. Types of CBMI**

BMI Type	Description	CBMI Types
Creation	Creating a brand-new business model.	Creating new business models either within the company that diversify the current BM portfolio or are set up as stand-alone ventures known as ‘circular start-ups’ (Geissdoerfer et al., 2020).
Extension	Adding components to a business model whereby its core remains unchanged.	Circular adaptations of current BM such as using recycled materials instead of virgin materials as inputs (Hofmann and Jaeger-Erben, 2020).
Revision	Radical changes to how a business model operates.	Transformation of a linear BM to a circular BM (Geissdoerfer et al., 2020) such as offering access not ownership.
Termination	Termination of a dysfunctional linear business model.	Largely overlooked by current studies of CBMI.

Sources: Cavalcante et al., (2011); Geissdoerfer et al., (2020); Hofmann and Jaeger-Erben, (2020); Kennedy and Bocken, (2019)

**Creation** concerns the novel commercialization of an idea for a CBM through innovating one or more building blocks in line with circular economy principles. Firms may innovate new CBMs internally or incorporate them through merger and acquisitions (Geissdoerfer et al., 2020). For incumbent firms the new CBMs may operate alongside linear ones, acting to diversify the current portfolio of business models or be spun-off into separate legal identities (Geissdoerfer et al., 2020). Creation is also the CBMI type for new ‘circular start-ups’ that do not have existing linear models, and research has begun to give insight into what CBM configurations are commonly innovated by new ventures (Henry et al., 2020).

**Extension** refers to making incremental changes to an existing business model that adapt it towards circularity. These are low risk changes that leave the core of the business model intact. For instance, adding a repair service or amending production processes to accept recycled as

well as virgin materials. Hofmann and Jaeger-Erben (2020) further separate this into adjustment whereby the linear logic remains but is optimised (e.g. reduce production waste) and adaptation whereby the firm meets societal demands by slowly infusing circular logic shifting standard value creation practices.

**Revision** refers to a transformation of a linear business model to a CBM. For example, a firm selling bicycles replaces its business model with one that sells access, not ownership of the product. The dominant logic of the linear economy is supplanted by a new circular logic, and the firm pursues how current models can be radically changed. Revision is high risk due to the novelty involved and may require the firm to develop new competencies (e.g., remanufacturing), change existing relationships (e.g., how it interacts with customers), and create new networks (e.g., third party collection agencies).

**Termination** recognizes that some business models are deeply unsustainable (Bocken and Short, 2021) and firms may innovate by discontinuing them. Firms may decide that current linear business models are beyond revision, and they should cease operation as they are not congruent with a circular economy. For example, a firm might find business models centred on selling cluster munitions or coal very hard to revise, and that termination is the best course of action. Yet, very little scholarly attention has been paid to how, why and when firms may choose to discontinue business models due to a lack of circularity congruence.

### 2.3.2 CBMI process: from linear to circular logic

CBMI is an innovation process which embeds CE principles into an organisation's business model. Frishammar and Parida (2018) offer that firms are struggling with CBMI and commonly do not understand the steps involved. They critique the current literature for overly focusing on the business model instead of the process of its formation and implementation, and secondly attending to niche-market pioneers instead of offering guidance to mass-market incumbents. Consequently, there is currently a lack in theoretical insight on the CBMI transformation process for incumbent firms.

Scholars have begun to offer some insights into the process of CBMI revision, though research is nascent. CBMI is characterized as highly complexity and require holistic adjustments to business models, as they span multiple dimensions and require the involvement of multiple stakeholders. A supportive network is essential, as productivity and innovation are strongly influenced by clusters (economic, geographic, institutional, and infrastructural) (Kramer and Pfitzer, 2016). Only through collaboration and networks of multidisciplinary actors can novel and environmentally friendly solutions be successfully realized. However, this makes it a

challenging task for managers as they must consider both interorganizational and intraorganizational reach. Table 6 offers an overview of the stages involved in the process of CBMI revision.

**Table 6. Process of CBMI Revision**

Authors	Stages						
Frishammer and Parida (2019)	Initiation	Audit	Design and Develop				Scale-up
Pieroni et al. (2019)	Sensing		Seizing				Transforming
Santa-Maria et al. (2022a)	Inspire	Understand	Define	Ideate	Decide	Prototype	Test
Bocken and Konietzko (2022)	Vision	Sensing		Seizing			Transforming

Drawing upon the studies that adopt a dynamic capabilities lens, we present the CBMI process in four stages: visioning, sensing, seizing and transforming (Bocken and Konietzko, 2022; Santa-Maria et al., 2022b).

**Visioning.** Scholars identify visioning as a necessary starting point for firms to revise their business models (Bocken and Konietzko, 2022). Visioning concerns firms making a deliberate choice for advancing the circular economy and creates a clear mandate to enter into an innovation process with a deliberate intention to improve circularity (Bocken and Konietzko, 2022). This is important as it should not be understood as a conventional innovation process that produces ‘gratis’ side effects to circularity. This is unlikely to prove effective, and even if it were to be, then it would unlikely produce the same benefits if it were to be repeated. Visioning requires some awareness of circular economy concepts and guidelines (Frishammer and Parida, 2018) and may involve people from across the organization to participate in collaborate visioning workshops and backcasting sessions (Bocken and Konietzko, 2022).

**Sensing.** Sensing concerns gaining an understanding of the internal and external environment to assess business opportunities and generating new initial ideas that may exploit them (Teece, 2018). Sensing will commonly begin with a scan of the context in which the firm operates, analysing trends triggered by “political, economic, social, technological, legal and environmental factors” (Frishammer and Parida, 2019, p.18). This can be done systemically be

firms using tools (such as PESTLE) and will importantly include factors influencing circular economy uptake such as new legislation and changes to social acceptance.

Firms can then move to analysing the ecosystem they are currently part of, to build external sensitivity (Santa-Maria et al., 2022b) to its current role and position in value chains and understanding of the needs of the various important stakeholders. This is particularly important for CBMI as it can often require input and changes to the behaviour of others (Frishammer and Parida, 2019). Special attention is paid to gaining insight of customers, to identify the targeted customer base and its preferences to help ensure that the pursued opportunities are aligned with customer requirements. Lifecycle and systems perspectives are important here for firms to sense opportunities from cradle to grave (or cradle) of its products and recognize the full range of impacts and possibilities that may lay across industries (Santa-Maria et al., 2022b).

The firm may turn to assessing its current business model to detect its current shortcomings and if/how it may be able to be transformed to take advantage of new opportunities (Frishammer and Parida, 2019). Firms may generate first ideas for change, consider how many business model components may change and to what extent they must change (Frishammer and Parida, 2019). A firm may also assess if it has the required capabilities required for transformative change (Bocken and Konietzko, 2022).

**Seizing.** This phase involves the systemic design and development of a revised business model with circular properties. This requires the application of CE design principles and guidelines. Design may begin using mimicry of existing models that can function as archetypes for inspiration. Firms may develop structured ‘playbooks’ of potential options and can draw out lessons for potential challenges and contingencies their own CBM design (Frishammer and Parida, 2019). Firms may utilize conventional business model design tools or those adopted for CBMI (for an overview see Bocken et al., 2019) such as the circular business model canvas (Lewandowski et al., 2016).

To design a viable CBM, firms need to ensure internal and external cohesion and a new network configuration in which multilateral interests are aligned (Frishammer and Parida, 2019). External cohesion refers to the design of the new CBM aligning with customer demand as the consumer desirability and acceptance are pivotal factors for the commercial viability of a CBM (Pieroni et al., 2019; Geissdoerfer et al., 2022). The internal cohesion is pivotal for the success of the transformation because it indicates that the four key components of the business model (value proposition, capture, creation and customer) are aligned.



Designs of new CBMs advance to experimentation, whereby they can be subject to conceptual tests and real-life practical tests (Bocken and Konietzko, 2022). Experimentation is important to learn what may work well and what does not, to validate ideas, and to make decisions between alternate design options. Experimentation can involve multiple key stakeholders including circular economy experts, customers, and other partners in the value chain. Experimentation offers a safe space for things to go wrong and freedom to explore new ways in which the business model can be changed and reconfigured (Bocken and Konietzko, 2022).

**Transforming.** The final stage of transforming concerns taking the selected business model design to a full market launch and entering a process of scaling up. This stage is currently the least well understood by scholars, though studies have offered some insights (Bocken and Konietzko, 2022). Firms will need leadership and change management capabilities, as well as the ability to orchestrate the business ecosystem as CBMs can greatly change how value chains function (Santa-Maria et al., 2022b).

Firms can begin this stage by identifying a set of prioritised actions and develop a transformation roadmap to guide the process (Pieroni et al., 2019). Revision of an existing business model is likely to happen in a slow and risk-adverse way in which the firm builds confidence and validation over time. Firms may decide to operate the revised business model alongside the old linear model for some time, offering the opportunity for stakeholders to slowly adjust and become favourable to the new model (Bocken and Konietzko, 2022). Revisions could also adopt a stepwise implementation whereby parts to the business model are gradually changed instead of all at once. Firms may also choose small-scale rollouts, changing the business model for certain customer types or only for selected geographically locations (Frishammer and Parida, 2019).

### 2.3.3 Understanding enablers and barriers to CBMI

CBMI is understood as a challenging process as firms are required to fundamentally change from linear practices that may be highly institutionalized and have yet to fail commercially. Firms experience a wide range of external and internal factors that either support (enablers) or inhibit them from innovating CBMs (barriers). A substantive body of studies is emerging aiming to identify, categorise and give insight on the variety of enablers and barriers to CBMI experienced by firms (for literature reviews *see* Hina et al., 2022; Tura et al., 2019).

Studies have adopted different terms such as Circular Oriented Innovation (Brown et al., 2019), CBMI (Guldmann and Huulgaard, 2020; Linder and Williander, 2017), and CBMs (Galvão et al., 2022; Vermunt et al., 2019), yet they broadly cover the same issue of exploring the factors

influencing how firms transition from operating linear business models to operating circular ones. Research has also specialized on providing insight to the challenges of small and medium enterprises (SMEs) (Cantú et al., 2021; García-Quevedo et al., 2020; Rizos et al., 2016), firms in developed (Kirchherr et al., 2018) and developing countries (Cantú et al., 2021), and the product-service system category of CBMs (Besch, 2005; Schoonover et al., 2021; Vezzoli et al., 2015). To identify enablers and barriers studies commonly review existent literature (Hina et al., 2022), and then use this as a basis for empirical work such as case studies (Vermunt et al., 2019) or surveys (Kirchherr et al., 2018). Studies have paid greater emphasis on barriers rather than enablers, though some studies attend to both. We offer an overview of the major barriers and enablers identified in the extant literature.

Scholars have categorised factors impeding and facilitating CBMI in a variety of overlapping ways. For instance, Brown and colleagues (2019) differentiate between hard (markets, technical) and soft (social/cultural, institutional/regulatory), Kirchherr and colleagues (2017) group challenges between cultural, regulatory, market and technological issues, and Tura and colleagues (2019) use seven categories of environmental, economic, social, institutional, technological/informational, supply chain, and organizational. We shall adopt the common differentiation between factors that are perceived as external and internal to the firm (Hina et al., 2022). We offer three groupings of external factors: *legislative or regulatory*, *supply chain*, and *market*.

A first group concerns *legislative or regulatory* factors (Guldmann and Huulgaard, 2020). Established policies of governments are commonly found to optimise the linear economy, and do not support firms innovating CBMs. For instance, legislation on waste may hinder its transportation and use as input (Vermunt et al., 2019) and high taxation on labour inhibits labour intensive business models such as remanufacturing. New laws and governmental policies for CE can help push firms to engage in CBMI (Cantú et al., 2021; Geissdoerfer et al., 2022) as they seek to comply or stay ahead of new standards. For instance, the EU has introduced new right to repair laws for electrical appliances that cause firms to consider how products are designed and potentially spur revision of other business model building blocks. Policies may also support the introduction of new CBMs such as the development of labelling standards for CE for customers to better differentiate products (Cantú et al., 2021). Finally, a key role of legislation is through the potential financial support that can be offered. Supportive funds and grants, tax benefits and tax breaks (Cantú et al., 2021; Geissdoerfer et al., 2022, Tura et al., 2019) are among a suite of options available to governmental organizations to help enable CBMI.



*Supply chain* related factors refer to the ability of firms to successfully reconfigure the chain of actors supplying the firm with materials. CBMI may create increasing complexity of supply chains (Guldmann and Huulgaard, 2020) as firms may set up new chains for circular material inputs and reverse logistics chains to recover its products. Firms may experience a lack of partners supplying circular material inputs and face transparency and trust issues as it requires greater knowledge of materials to design for circularity (Vermunt et al., 2019). A key challenge for many CBMs is how the firm deals with return flow challenges and key concerns of quality of materials supplied and consistency of supply (Guldmann and Huulgaard, 2020; Linder and Williander, 2017). Supply chains that already have effective collection and treatment of waste material and can offer guaranteed quantity and quality of recycled material can significantly reduce risks associated with introducing new CBMs (Cantú et al., 2021). Geographical proximity between supply chain partners may facilitate resource exchanges (Hina et al., 2022), alongside supply chains that have open collaboration and communication (Tura et al., 2019). Good inter-firm relations and positioning in a collaborative supply chain (Rizos et al., 2016) will facilitate firms to gain partner support for new CBMs and help orchestrate new configurations.

*Market* related factors concern the challenge for firms to gain market acceptance and sufficient demand for new CBMs. While CBMs may offer strong value propositions to the customers on aspects such as sustainability and product quality, many scholars have identified that they may struggle with price competitiveness against linear alternatives (Kirchherr et al., 2017). Low prices of virgin materials (Vermunt et al., 2019) coupled with the expensive of higher quality manufacturing that enable long life products and sequential lifecycles may make commercial viability difficult. Firms may also encounter a range of consumer related restrictions. Consumers may be resistant to changing behaviour (e.g., paying for access instead of ownership) or hold negative perceptions of second-hand goods (Edbring et al., 2016). Consumers may hold concerns over hygiene, be unfamiliar with the business model concept, and retain the desire for new products and ownership (Edbring et al., 2016). Conversely, customers may drive CBMI by demanding firms improve environmental performance and instilling a preference for ‘green’ products in their purchasing habits (Rizos et al., 2016). Customers can show a willingness to pay a premium for circularity and to change purchasing behaviour (Cantú et al., 2021).

Alongside external factors, firms will also likely face a range of challenges and enablers stemming from inside the company. We identify four groupings of internal factors: *financial*, *organizational*, *organizational competence*, and *technological*.

*Financial* factors may be a core driver for firms to engage in CBMI. Firms may see CBMI as an opportunity to realize potential cost efficiencies (Geissdoerfer et al., 2022) and build new

revenue streams (Tura et al., 2019). CBMI may help firms to protect against price increases and volatility associated with resource scarcity, and potentially build organizational resilience (Kennedy and Linnenluecke, 2022). Yet, financing is also a significant concern to firms transitioning to CBMs with a wide number of challenges to be overcome. Financing the CBMI is a key problem as many types will require high up-front investment costs (Kirchherr et al., 2017) with potentially long payback periods. CBMs may also require firms to accept greater degrees of financial risk. For instance, a firm offering access and not ownership may take long periods of time to recover the capital cost of equipment and hold the risk that the assets will significantly depreciate in value (due to technological or fashion changes). Conventional financing may be difficult for the firm to acquire (Toxopeus et al., 2021) and firms may experience their capital tied-up in assets (Linder and Williander, 2017). Strong access to sources of finance can be a key factor for engaging in CBMI (Cantú et al., 2021).

*Organizational* factors consider how firms' leadership, strategy, culture and internal structures influence CBMI. Firms operating linear business models may not have a clear policy and strategy on CE and teams lack a mandate to innovate CBMs (Hina et al., 2022). Firms may lack employee and management buy-in to CE (Guldmann and Huulgaard, 2020), and CBMI may struggle in a company culture that is hesitant to move away from what is seen as safe and well-functioning linear business models (Kirchherr et al., 2017). Inter-organizational tensions may arise as firms transition from linear business models to CBMs. Prevailing structures within the firm will be oriented to linear economy business models such as the employment of labour, remuneration and bonuses, and how the company organizes its departmental functions. New CBMs may disrupt these structures and cause for new ones to be created. For instance, new teams may need to be formed and space found for reverse logistics. Tensions may arise as new CBMs cause conflict with existing linear ones. For instance, the use of used and recycled material may reduce the amount of manufacturing of virgin raw materials and a loss of labour in that section of the business. Likewise, new CBMs may be seen to cannibalize the sales of virgin products (Linder and Williander, 2017) and result in a fall in virgin production.

The support and commitment from the top management is an important enabler to overcome such tensions alongside change agents dispersed through the organization (Cantú et al., 2021). Integrating CE into company strategy and goals (Tura et al., 2019) helps to align CBMI with the core of the firm's purpose and safeguard its importance. Organizational cultures that already value environmental care can facilitate CBMI (Rizos et al., 2016) as well as cultures that are flexible to adopt new attitudes and commitment to circularity.

*Organizational competence* refers to the know-how and capabilities of a firm to pursue CBMI. Firms may be unfamiliar with CE, CBMs and the process of CBMI. It may also not have the

expertise to implement newly innovated CBMs. For example, a firm may be well skilled and experienced at manufacturing new products but does not possess the expertise in remanufacturing used products (Linder and Williander, 2017). Personal knowledge of founders and top management on CE (Rizos et al., 2016) in addition to innovation teams, and more broadly throughout a firm will be supportive of CBMI. Firms can offer specific employee training to develop new capabilities and skills for CE (Cantú et al., 2021; Tura et al., 2019). CBMI frameworks and tools such as the Circular Economy Business Model Canvas (Lewandowski, 2016) can be introduced and facilitate thinking, design and implementation.

Networking skills may be pivotal due to the collaborative nature of how many CBMs operate involving the customer and value chain partners. The ability to mobilise important partners and attract support for the CBM is important for its implementation (Brown et al., 2019). Firms may need to create awareness and acceptance of CE and CBMs and provide partners with educational opportunities. Finally, firms will benefit from strong expertise in experimentation (Bocken et al., 2021) as CBMI is an iterative process that requires prototyping and piloting. Firms need to be comfortable with failure and have learning mechanisms in place to ensure value is extracted from trial-and-error processes.

Firms may also face *Technological* issues, though these are often not the most significant barriers that firms face (Kirchherr et al., 2017). Firms may face a lack of technology available (Vermunt et al., 2019) or face other issues such as lack of standardization or restrictive product specifications (Geissdoerfer et al., 2022). On the other hand, the transition to the CE is making new technology become available (Geissdoerfer et al., 2022) such as recycling machinery or informational and communication technology supporting building circular supply chains and platforms for resource and solution sharing (Brown et al., 2019).

## 2.4 Literature Review Summary

There is an urgent need for a transition to a paradigm based on sustainable and circular production and consumption patterns. This shift into a new paradigm requires both incremental and radical changes to the way businesses operate. Incumbent firms bear high responsibility in this change process, as they are among the primary drivers of concurrent unsustainable activities. Revising linear business models to become circular through a process of innovation offers firms one route to transforming their operations.

Business model innovation is the process of devising and finding a new way to create, deliver and capture value (Blank, 2005; Govindarajan and Trimble, 2010; McGrath, 2010). The concept of a business model has become a popular way to understand the operational logic within

business and provides opportunities for change beyond conventional product and process innovation. Scholars have developed understandings on what distinguishes a business model to be circular and have ably identified a range of business model archetypes that firms can pursue such as extending product value and access and performance models (Bocken et al., 2016). Yet, it is unclear which types of circular business model firms are most commonly pursuing in their innovation practices and why.

Insight is beginning to accrue on the process of CBMI as a one-off activity, with firms moving through stages of visioning, sensing, seizing, and transforming (Bocken and Konietzko, 2022). It is understood as a highly challenging and iterative processes that is influenced by a wide range of external and internal factors (Hina et al., 2022). Conceptual frameworks and tools such as the CBMI canvas (Lewandowski et al., 2016) assist practitioners in business model design, whilst key practices such as experimentation, continuous learning, and trial-and-error practices enhance the chances of a successful implementation. However, little insight has accrued to how firms engage with CBMI over time and how this transforms incumbent firms from linear to circular activities.

### 3. Research Methodology

Despite the rapid growth of CBM research, empirical research on CBMI is lacking. Studies have identified the types and archetypes of CBMs firms are innovating, providing overviews within the categories of narrowing, closing and slowing resource loops. Yet, studies have yet to provide insight to which are most common to incumbent firms. The logic of CBMs of narrowing resource loops (e.g., resource efficiency) are closely related to linear business models, while those of closing and slowing resource loops are further away yet are seen to offer greater potential to advancing the CE. A first objective of this report is to provide insight to which types of CBMs are incumbent firms innovating and implementing. To address this objective, we conduct a computational text analysis on the corporate reporting of large companies in the EU (Section 3.1).

Second, studies have begun to provide some understanding to the process of CBMI revision. Yet, empirical studies tend to treat CBMI as a one-off process and we lack insight to how firms engage with CBMI over time to transform it from linear to circular business activities. The second objective of this report is to address this shortcoming through a single qualitative case study of a large incumbent firm within the EU (Section 3.2).

#### 3.1 Computational Text Analysis

Computational text analysis is a form of content analysis method that employs the use of computing software and quantitative techniques to analyse digital documents. It is a method that codes pieces of written text into groups based on a predetermined themes (Campopiano and de Massis, 2015). Content analysis is a familiar method in business sustainability research (Campopiano and de Massis, 2015; Lock and Seele, 2016; Landrum and Ohsowski, 2017) and some studies on CE have also begun to apply the method (Opferkuch et al., 2021; Stewart and Niero, 2018).

Computational text analysis allows this report to analyse the intended messages of firms on CBMs, but also messages that are not intended by companies. For instance, by identifying what is not being discussed in the corporate reports. It allows the analysis of a large corpus of unstructured data set, permitting the report to study CBMs and innovation across a multitude of large incumbent firms. Content analysis also holds some strengths over other qualitative methods such as avoiding recall biases that may occur in interviews and offering the potential for replicability (Campopiano and de Massis, 2015).

### 3.1.1 Data Collection

Data was collected from corporate CSR/Sustainability reports downloaded from company websites. If stand-alone sustainability reports for firms did not exist, integrated reports and annual reports are extracted that contain sustainability contents. While corporate disclosure of sustainability activities can take many forms (Campopiano and de Massis, 2015) the use of annual corporate reporting is most common to business sustainability research for studies utilising content analysis (see Unerman, 2000).

Corporate reports are a direct communication by firms and the large number of publicly available reports provides this report the opportunity to analyse how firms are engaging with CBMs (Stewart and Niero, 2018). Using only the annual corporate reporting of firms enables a standardised data set of one document per firm (Unerman, 2000). They are important documents that firms use as a key vehicle to communicate to stakeholders, and it is assumed that much time and care has been taken by firms in their preparation and messaging.

Yet this report recognises that only including annual sustainability reporting may not provide a complete picture on firms' involvements in CBMs. Firms may choose to disclose their activities through other ad hoc mediums such as reports to employees, press releases, brochures, advertisements (Unerman, 2000). Firms may also choose to not publicly disclose CBMI that are on-going and potentially be market sensitive information. It is also assumed that there is a match between the rhetoric of corporate reporting and the reality of the firms' activities, which may not always hold true.

*Sampling.* A sample of 147 large companies based in Europe. All constituent firms listed on FTSE 100 and STOXX 50 in November 2021 were first obtained. The list includes firms with the highest market capitalization at the London Stock Exchange as well as industry sectoral leaders in the 11 Eurozone countries. In total, these firms represent more than 50% market cap in the represented countries and the UK. Large firms were selected to represent incumbent firms under the prevailing linear economy that need to revise existing business models to CBMs. From the list, dual share companies were counted as one and one company was dropped due to data availability. The final sample consisted of 147 companies. Corporate reports were extracted from company websites for the year of 2020 (e.g., containing information on the corporate performance of the previous year) with nine exceptions when the 2019 or 2021 reports were used due to data access difficulties.

### 3.1.2 Data Analysis



To analyse the content of the corporate reports, we used thematic content analysis. Thematic content analysis is a process whereby a unit of meaning is identified and categorised into a predetermined theme (Campopiano and De Massis, 2015; Stewart and Niero, 2018). Individual words or compound words such as ‘circular economy’ or ‘life cycle thinking’ were selected the unit of meaning.

Each company report was scanned for the presence of predetermined keywords associated with CBMs. A predetermined coding scheme of keywords was created to enable the objective thematic analysis of the corporate reports. Keywords were constructed to represent ‘CE view’ and different CBM patterns relating to the resource loop perspective: ‘Slowing’, ‘closing’, and ‘narrowing’ resource loops. The resource loop perspective of regenerative was excluded from the study due to uncertainty over its current conceptualisation and operationalisation. Keywords were generated using the EU Circular Economy Action Plan, CE glossary of WBCSD (<https://www.ceguide.org/>), and scholarly articles on CBM conceptualization such as Bocken et al., (2016), Geissdoerfer et al., (2020) and Lüdeke-Freund et al., (2019). For instance, ‘CE view’ composed of keywords reflecting the CE principles and conceptualizations (e.g., ‘circular economy’, ‘linear economy’, ‘closed-loop’, ‘cradle-to-cradle’, ‘life cycle thinking’, ‘feedstock’, etc.). Compound words were tokenized to only represent one count within the frequencies (e.g., ‘life cycle’ equalled one count). Quantification was in the form of frequency counts of the keywords for each of the 147 firms.

A key assumption of the study is that the frequency of disclosure of CBM types signifies the relative engagement with CBMs by firms i.e., the number of disclosures in words relating to CBMs of closing, narrowing and slowing resource loops signifies the amount the firm is engaged in innovating and operating those types of business models. Due to the large volume of the data set no manual checks were possible to ensure all keywords were correctly identified as being used in conjunction with CBMs.

This report recognises that there are alternative measurement techniques than number of words such as number of sentences or percentage of total keyword frequency relative to the total disclosure (Landrum and Ohsowski, 2017; Unerman, 2000). Using these alternatives may result in different impressions to the disclosures on CBMs (Unerman, 2000). The limitation that typeface size, and non-narrative disclosures such as photographs and charts have not been considered is also acknowledged (Unerman, 2000). Including these aspects may give more insight to the relative importance of firm disclosures on CBMs.

Data were analysed using the statistical computing software R. Using R, the frequency counts on number of words were computed and box plots created that present the medium, the

interquartile range, and the maximum and minimums (excluding outliers).

Three analyses were conducted on the data. First, an analysis of the frequency counts of words per firm relating to CBM types using a resource loop perspective (narrowing, closing and slowing). This analysis also included a frequency count for CE view representing the CE principles and conceptualizations. A second analysis considers if there is an impact of firms adopting language of circular economy on their disclosure of CBMs and innovation. This analysis divides the data between companies that do and do not explicitly mention ‘circular economy’ in their corporate reporting. A final analysis searches for differences of CBM adoption across four primary industries; consumer discretionary, consumer staples, technology and industrial.

The report aimed to further analyse the data to better infer the differences between the engagements of CBMs. However, this was not possible due to unforeseen circumstances of the health of the primary researcher who was pivotal to conducting this analysis.

### **3.2 Tata Steel in Europe Case Study**

To investigate how firms undergo a process of CBMI revision over time, this report conducts exploratory research through a single qualitative case study. The focus of qualitative research is on examining and understanding complex phenomena and analyse dynamics between actors in the social context, which aligns well with the purpose of this research (Creswell and Poth, 2016, Eisenhardt et al., 2016). A qualitative case study has been widely employed by extant CBM research (Bocken et al., 2018; De Angelis, 2021; Jensen and Sund, 2017) and it allows for exploration of the complexity of CBMI (Hofmann and Jaeger-Erben, 2020). It is an approach capable of uncovering processes and therefore lends itself to the analysis of interrelated events over time (Bryman and Bell, 2011).

To develop an empirical model for CBMI revision over time, this report adopts an abductive approach. Following an abductive research approach researchers gained an acquaintance with the extant literature and developed ideas on the limitations to the current state of understandings of the phenomenon (Charmaz, 2006). Abductive approaches are inherently iterative and construct the analysis by conflating empirical data with novel and related phenomena (Dubois and Gadde, 2002). An abductive approach is deemed suitable as while a body of knowledge on CBMI is beginning to form, it has yet to mature. There remains much opportunity for providing empirical insights that both utilizes extant research but also seeks to offer new conceptual insights from data (Richardson and Kramer, 2006).



### 3.2.1 Research Strategy

Employing a single case (Eisenhardt and Graebner, 2007), the study investigates how a large incumbent firm is innovating circular business model(s) over time. A major benefit of employing a single case study is that it offers more in-depth understanding of the phenomena. This design allows for an examination of current events in their real-world setting while preserving their holistic and relevant aspects. When time and resource constraints are considered, a single case study can provide extremely detailed insights into organizational transformation processes such as CBMI revision over time (Yin, 2009).

### 3.2.2 Case Selection

This report has selected to study the case organisation *Tata Steel in Europe*. Tata Steel in Europe is one of the largest steel producers in Europe with production facilities in the UK and the Netherlands. Although Tata Steel in Europe separated to form two independent branches of Tata Steel UK and Tata Steel Netherlands in 2021, they are still part of the same Tata Steel conglomerate and this report will use the name Tata Steel in Europe, hereafter TSE. They operate in a wide range of sectors, supplying high-quality steel products to markets including construction and infrastructure, automotive, packaging and engineering (Tata Steel Europe, 2022a).

This case was theoretically sampled for its strategic engagement with the CE and CBMI over time (Yin, 2009). TSE has a history of engagement with CE since before it was acquired by Tata Steel, and regularly makes public announcements through corporate communication channels about its work. TSE are also selected due to its support of the aims of this project and existing close connections as an industrial partner within the ReTraCE consortium.

### 3.2.3 Data Collection

To investigate the case study, data was collected from a variety of primary and secondary data sources. Primary data was collected through online interviews with key informants that followed a semi-structured approach.

Interviewees were purposively sampled, whereby individuals are selected based on their familiarity with the phenomenon of interest. This purposive sampling was enabled by a gatekeeper that offered the names and contact details of individuals that would be able to provide insight. In total four initial interviews were conducted with five interviewees. This was

later followed by two further validation interviews with Interviewee A. The first validation interview served the purpose of validating the narrative analysis and timeline. During the second validation interview details pertaining the thematic analysis were validated. Written comments were also received from the informant on these analyses. Table 7 offers an overview of the interviews.

**Table 7. Table of Interviewees**

Interviewee Identifier	Role	Date	Duration (min)	Format	Interviewee-Interviewer
A	TSE	05-24-21	67	Online	One-to-one
	Sustainability	12-14-22	44	Online	One-to-two
	Manager	12-20-22	40	Online	One-to-two
B	TSE Sustainability Manager	05-28-21	90	Online	Three-to-one
C	TSE Sustainability Manager	05-28-21			
D	Industry Association Director	10-18-21	54	Online	One-to-one
E	TSE Engineer	02-03-22	57	Online	One-to-one

Interviews lasted from 40-67 minutes, which accounts to a cumulative amount of 352 minutes. Interviews were conducted by members of the project team of this report, except one which was conducted together with other researchers of the ReTraCE project. All the interviews were recorded with verbal consent, and the initial four interviews were transcribed for coding. Interviewee B and C were provided an opportunity to correct the interview transcript to ensure the accuracy of information and request removal of data from the transcript if needed.

The interviews were conducted online and unfolded the form of conversations that allowed participants to address the topics they felt were important (Longhurst, 2009; Yin, 2009). This technique captured nuanced details of individual experiences and perspectives, allowing for an in-depth understanding of the complex phenomenon (Edwards and Holland, 2013). Interviews were semi-structured in design with a pre-prepared interview guide and open-ended questions (Saunders et al., 2007). Since the researcher did not have to follow the prepared guide exactly,

the interviewer was free to ask alternative questions based on the particular characteristics of the interviewee or their responses. To obtain rich data, the questions focused on effective organizational practices and invited participants to provide personal reflections on relevant events (Charmaz, 2006).

All interviews were conducted with open-ended questions. The interviewer avoided steering the responses in any particular direction and continued to focus on giving the interviewee space to express personal experiences. The researcher's goal was to understand the underlying meanings and circumstances that led to the specific developments, so not all of the newly modified questions needed to be asked in subsequent interviews.

Interviews comprised of 4 main parts. In the first part the conversation was initiated with a short introduction and then with some open questions regarding the sustainability and CE activities of the case company and how the interviewee is involved. In this way, the interviewer wanted to give participants the freedom to share their stories and interpretations without feeling constrained by the interviewer's perspective (Charmaz, 2006). Furthermore, this open exchange of information aimed to gain extensive and meaningful knowledge about organizational practices related to the implementation process of disruptive circular business models (Edwards, and Holland, 2013). In the second part the interviewer kept asking follow-up questions to probe implicit and unspoken meanings and go further in detail with the phenomenon of interest (Charmaz, 2006). Common questions were directed towards how such events or processes reflected the principles of CE. In the third section, the interviewer asked more generic questions, for instance pertaining barriers and facilitators to CBMIs and current market trends affecting such circular transformations. In the last section, the interviewer asked open-ended questions about the role of the case company in this macro-level transition process and how or if further action is needed to accelerate this transition.

Secondary data was collected by accessing publicly available information obtained on the internet. The secondary data includes corporate website contents, media coverage, annual company reports, and other publicly available information. Table 8 provides an overview of the secondary sources collected. Collection of secondary data began at the inception of the case study research and helped interviewees to both formulate interview questions and engage with interviewee responses. Secondary data helped to corroborate the responses of interviewees and provide factual details. Secondary data also acted as data incidents, as will be described below in the data analysis sub-section. In total 385 pages of secondary documents were brought forward for data analysis.

**Table 8. Table of Documents**

Document	Date	Type	Pages
A.SPIRE2050 Website. Sustainability Toolkit for easY Life-cycle Evaluation	2023	Project Launch Release	3
Auto Recycling Nederlands Website. Steely strength: Tata Steel commits to new recycling methods	2022	Media Blog Release	5
De Telegraaf. Tata Steel en Schiphol grootste uitstoters van stikstofoxiden	2022	Newspaper Release	3
Hughes et al. Tata Steel: A century of CSR	2014	Teaching Case Study	22
Matthew. The Tata Group: Integrating Social Responsibility with Corporate Strategy.	2006	Teaching Case Study	15
NL Times. People living around Tata Steel exposed to many harmful substances: RIVM	2021	Newspaper release	2
Tata Steel Website. Corporate News	2012	Media Release	2
TSE Website. Corporate News	2010	Media Release	1
TSE Website. Corporate News	2012a	Media Release	3
TSE Website. Corporate News	2012b	Media Release	4
TSE Website. Corporate News	2014	Media Release	3
TSE Website. Home. Construction	2015a	Media Release	2
TSE Website. Corporate News	2015b	Media Release	2
TSE Website. Blog	2017	Corporate Blog Release	3
TSE. Tata Steel Corporate Story brochure UK 2018	2018a	Corporate Brochure	25
TSE CE Report	2018c	Corporate Report	10
TSE Website. Blog	2019a	Corporate Blog Release	4
TSE Website. Construction Blog	2019b	Corporate Blog Release	1
TSE Website. Construction	2020a	Corporate Brochure	2
TSE Website. Construction Blog	2020b	Corporate Blog Release	3
TSE Website. Construction Blog	2020c	Corporate Blog Release	4
TSE Website. Construction Blog	2020d	Corporate Blog Release	3
Tata Steel in Europe Sustainability Report 2019/2020	2020e	Corporate Sustainability Report	12
TSE Website. Corporate News	2020f	Media Release	2

TSE Website. Blog	2021a	Corporate Blog Release	2
TSE Website. Corporate News	2021b	Media Release	2
Tata Steel Europe Annual Report 2020-21	2021c	Corporate Annual Report	89
TSE Website. Corporate News	2021d	Media Release	3
TSUK Sustainability Report 2021	2021e	Corporate Sustainability Report	23
TSE Website. Corporate Strategy	2022a	Corporate General News	2
TSE Website. Circular Economy	2022b	Corporate Blog	1
TSE Website. Corporate News	2022c	Media Release	3
TSE Website. Zeremis	2022d	Corporate Website	3
TSE Website. Corporate News	2022e	Media Release	3
TSE Website. Construction Blog	2022f	Corporate Blog Release	4
TSE Website. Construction Blog	2022g	Corporate Blog Release	4
TSE Website. Seismic	2022h	Project Launch Release	4
TSE Website. Optemis	2022i	Project Launch Release	4
TSE Report. Tata Steel Europe Limited accounts 2022	2022j	Annual Report	94
TSE Website. Celsius	2022k	Product Information Release	2
World Steel Association Website	2023	Project Launch Release	6

### 3.2.4 Data Analysis

Data analysis comprises of three main parts: (1) narrative analysis, (2) thematic analysis, and (3) empirical model building. In this sub-section we offer an explanation to the process.

*Narrative analysis* emphasizes sensemaking and early theoretical interpretation, as well as maintaining the integrity and narrative value of the data (Langley, 1999). This technique involves the creation of a detailed narrative, with the aim to understand organizational phenomena through the experience of a real context in all its richness and complexity (Langley, 1999). To create a narrative, interviews and documentary sources were scanned to identify narrative vignettes that act as building blocks to identify significant patterns of activities, relationships, and impacts. Guided by these identified vignettes, a member of the research team conducted further information collection, particularly on the company website, that would underscore these patterns. Key moments, projects or activities relating to CBMI were identified

from the period when Tata Steel acquired the Corus Group (2007) until the present day (2022). Thus, there was not an active search for actions prior to this period, yet it has been noted when some historical activities were relevant. A timeline was created, and data incidents used to support narrative vignettes. The timeline and narrative were used in a validation interview and sent to the gatekeeper. Small modifications were made for material accuracy and inclusion of some further important events.

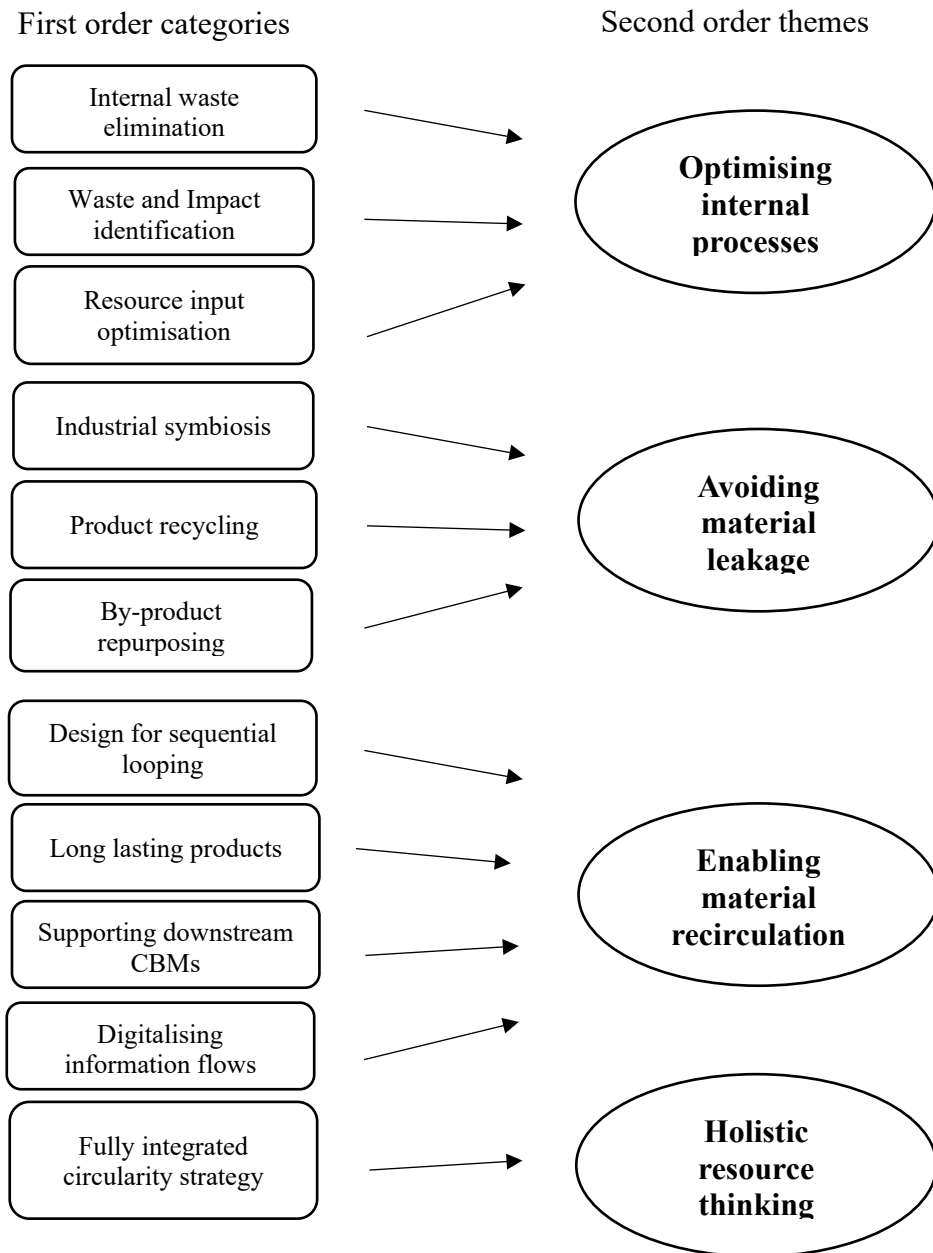
*Thematic Analysis* was conducted consisting of a process of coding data incidents within the interviews and documents (Saldaña, 2021). Coding was supported using the qualitative data analysis software, atlas.io. Coding consisted of conducting a line-by-line examination of sources (e.g., interview transcript, company press release), selecting sections of text from a source and labelling them with terms and phrases. Through this process, data incidents were identified for the empirical themes on the firm's engagement with CBMI. Similar data incidents were coded under the same label to arrive at first order categories and second order themes.

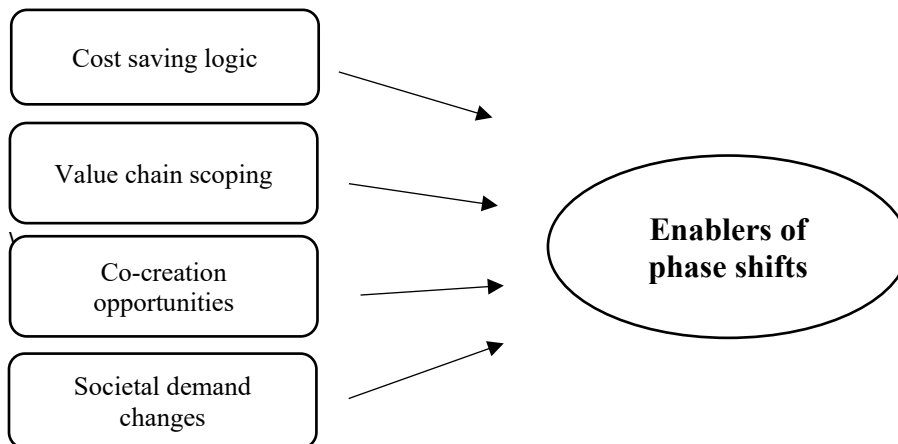
The creation of first order categories and second order themes began by utilizing the narrative analysis that was developed in parallel. The narrative analysis helped to identify potentially relevant constructs that represented how the firm engages with CBMI and its changes over time. The narrative informed the initial constructs for many the second order themes and aided initial ideas of some of the first order categories. Thus, the thematic analysis is founded in the empirical data without any pre-determined coding structure imposed on the data (Charmaz, 2006). Yet, consistent with abductive approaches, researchers were familiar with extant literature before data analysis, and this influenced construct creation.

Coding was characterized by flexibility and continuous iterations that allowed new codes to be added or existing codes to be modified (Saldaña, 2021). New categories and themes were added as groupings of data incidents were identified. For instance, a fourth second order theme of 'holistic resource thinking' was added once it became clear that it was a distinct from 'enabling material recirculation'. First order categories were subsumed under second order themes based on the patterns and relationships between them. First order categories were open to re-positioning as second order themes took further shape. For example, deeper engagement with the construct 'digitalising information flows' led to its re-positioning under 'enabling material recirculation' from 'holistic resource thinking'. Codes were also adjusted and re-termed during the process and after discussions between researchers. Following an abductive logic, extant literature was used to help term and mould the constructs that were being identified in the data, comparing, and contrasting them with the different themes already established by other researchers (Gioia et al., 2012, p. 20). Figure 1 offers the two-tiered coding structure.



**Figure 1. Coding Structure**





*Empirical Model Construction* ensued concurrent to the thematic analysis. Initial models were developed as the coding structure emerged and through discussions among the researchers. The final model comprises of four dominant phases which the firm moved through in its transformation toward CBMs: (1) Internal cycling of materials (2) Post-business loops, (3) Post-consumer loops, and (4) Combined looped strategies. Literature on CBMI and CBM transformation was considered to understand these phases (Antikainen and Valkokari, 2016; Bocken et al., 2018; Bocken and Ritala, 2021; Wells and Seitz, 2005). These phases were re-termed multiple times and adjusted through the input provided in the validation interviews.

### 3.2.5. Research Quality

To ensure the quality of the case study research we followed guiding criteria on reliability, validity and transferability (Saunders et al., 2007).

*Reliability* concerns the ability of researchers to replicate the study and find consistent results (Saunders et al., 2007). The report has outlined its goals and the rationale behind some of its procedural decisions. The report has aimed to provide high transparency on its methodological approach through explaining the research process. Steps of the data analysis including coding have been detailed, and a full list of secondary data has been provided.

*Construct validity* concerns the integrity of the findings. The report has strived for the inferences made to represent well the construct under investigation – the firm’s engagement with CBMI over time. Interviewees were chosen based on their familiarity with the project under inquiry and conducted with the purpose of discussing CBMI. Secondary data sources were selected based on their potential to reveal insights on the phenomenon. Data triangulation

was employed to help ensure the validity of the study (Bryman and Bell, 2011). The thematic analysis developed constructs using multiple data incidents across multiple sources. The interview outcomes were triangulated with secondary data sources including press releases, archival materials, and sustainability reports. By using primary and secondary data sources, triangulation was further strengthened (Hammarberg et al., 2016) and the possible impact of respondent bias in interviews was reduced.

*Transferability* refers to the extent to which the results may be applicable to other organisations. The aim of this research was not for statistical generalization to populations, but rather to offer new and novel insights into the process of CBMI over time. The report has offered a thick description in the form of a narrative analysis for readers to understand the case well and the occurrences over time (Yin, 2009). Constructs have been identified within the thematic analysis that may be transferable to other established large companies undergoing revisions of their business models towards CBMs.

## 4. Findings of the Empirical study

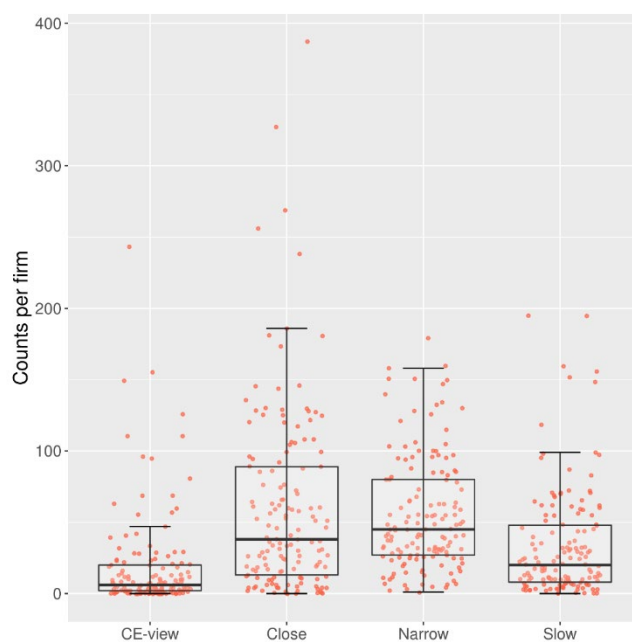
This section offers the findings of the empirical study in two sections: (4.1) computational text analysis; and (4.2) Tata Steel in Europe Case Study.

### 4.1 Computational Text Analysis

The Computational Text Analysis consisted of three analysis that shall be presented sequentially: CE view and CBM patterns based on resource perspective, CE language use vs. non-CE language use, and CE language use vs. non-CE language use by industry.

The first analysis consists of the frequency counts of words per firm relating to CBM types using a resource loop perspective (narrowing, closing and slowing). This analysis also included a frequency count for CE view representing the CE principles and conceptualizations. Figure 2 presents the box plot for this analysis.

**Figure 2. CE view and CBM patterns based on resource perspective**



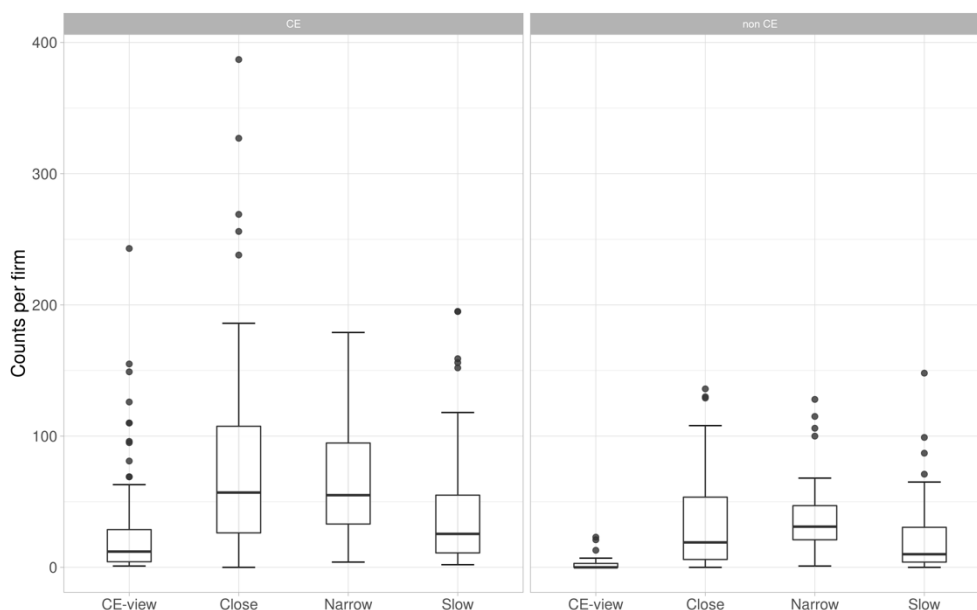
The findings firstly offer that not all firms in the sample are using language reflecting CE view in their corporate communication disclosures. 64% of companies (94/147) mention ‘circular economy’ or a closely associated term in their reporting. This is far from universal adoption from large companies in Europe.

To further interpret this finding, it is important to consider the sample of reports used. 43 annual reports are included in the sample of 147. It is expected that annual reports contain a restricted content on non-financial disclosures, and firms will choose to mainly include only the issues that are most financial material to the company. These firms may be pursuing CE strategies yet decide that it is not important enough to warrant attention in the annual report. A more detailed investigation of the finding would be needed to understand the effect of including annual reports within the sample. Yet, it can be interpreted from the finding that only 64% of firms either engage with a CE view or believe it is important enough to be disclosing through corporate reporting.

The second finding of this analysis concerns the engagement of firms relating to CBM types using a resource loop perspective: narrowing, closing and slowing resource loops. Findings present that narrowing resource loops are mostly discussed followed by closing resource loops. CBMs of slowing resource loops for product life extension such as reuse, refurbishing, remanufacturing and sharing are least discussed in the corporate disclosures. On the assumption that corporate disclosure represents firm engagement with CBMs, this finding offers that CBMs of slowing resource loops are least engaged with by the large incumbent firms.

The second analysis considers if there are differences in engagement in CBMs between firms explicitly using language of CE and those that do not. The language of CE is used to indicate that a firm engages with the CE discourse. Figure 3 presents the box plot for this analysis.

**Figure 3. CE language use vs. non-CE language use\***



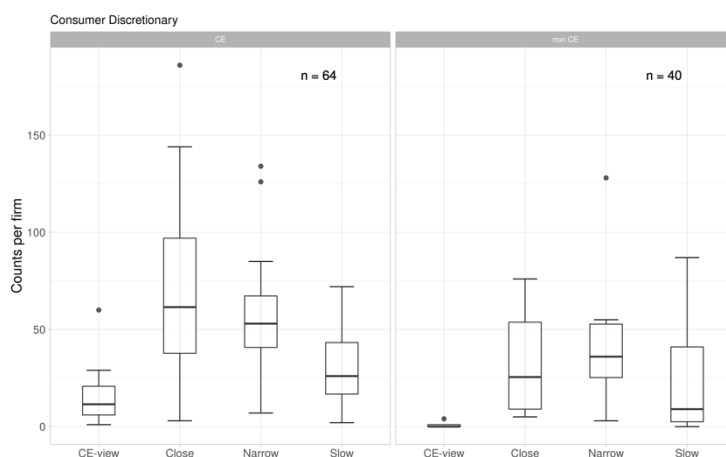
*\*Note: Companies who do not directly mention ‘circular economy’ to describe their approaches but still employ different languages to describe their ambition and strategies (e.g. biomimicry, life cycle thinking, etc.)*

Findings offer that firms explicitly mentioning CE have a larger frequency counts of words per firm relating to all three CBM types. This suggests that engaging with the discourse of CE may be correlated to greater engagement with all CBM and CBMI types. Yet, it should also be noted that this finding could be solely related to language use and not differences of actions. Firms that adopt the language of CE may also just be more familiar with the language of many of the CBMs and are using these more to explain their activities.

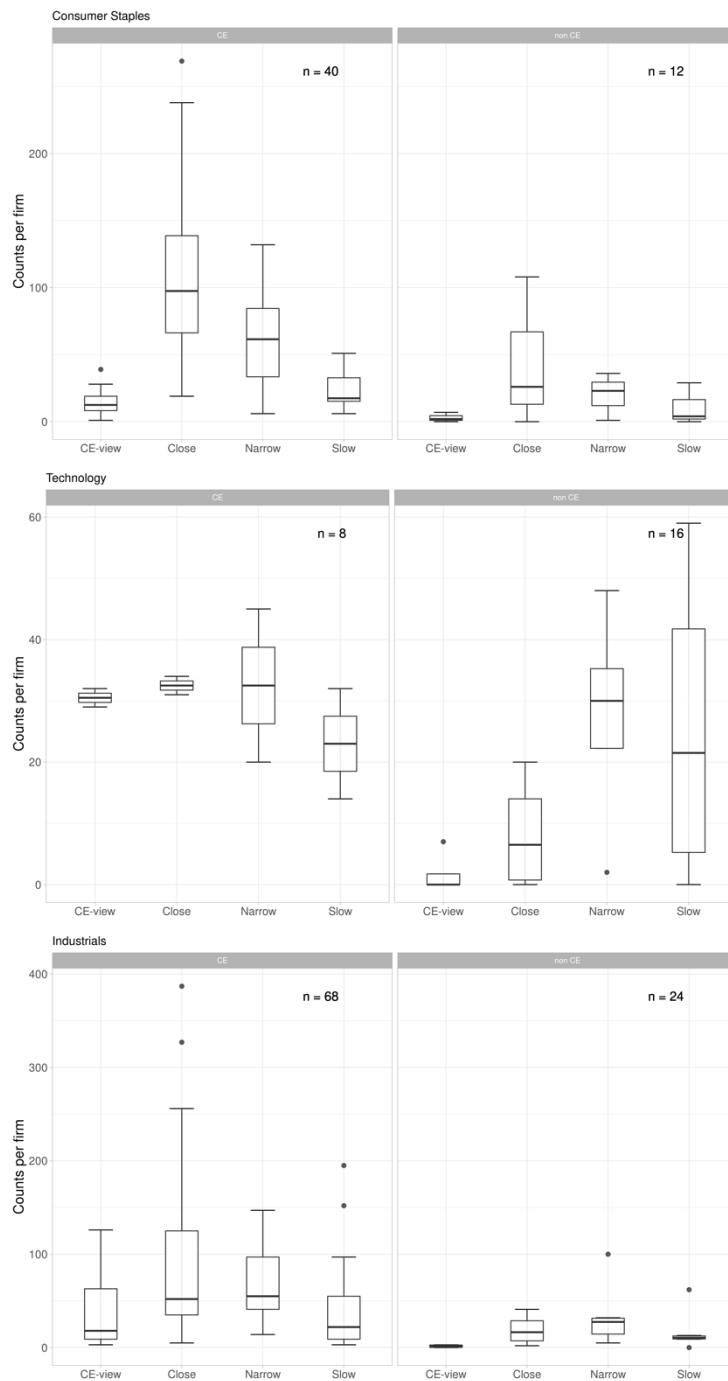
The findings also present that CBMs related to closing resource loops had the highest median for firms utilising CE language, while CBMs related to narrowing resource loops had the highest median for firms not utilising CE language. As narrowing resource loops is most associated with the linear economy, its highest engagement for firms not engaging with the CE discourse is to be expected. The shift to closing resource loops as the highest median for firms utilising CE language suggests that there could be an impact on a firm engaging with the CE discourse.

A final analysis searches for differences of CBM adoption across four primary industries; consumer discretionary, consumer staples, technology and industrial. Figure 4 presents the box plots per industry.

**Figure 4. CE language use vs. non-CE language use\* by industry**







The findings firstly offer that engagement with different types of CBMs is not equal across industries. For instance, consumer discretionary and consumer staples have a seemingly much higher engagement of CBMs related to closing resource loops for firms adopting CE than for the technology and industrial industries. Yet, the findings do offer similar patterns across the four industries. Aligning with the previous analysis firms that do not engage with CE have CBMs of narrowing resource loops as the highest medians in the consumer discretionary, technology and industrial industries. Findings indicate that adopting the CE discourse may

create a difference to the engagement in CBMs of closing resource loops in the consumer discretionary and consumer staples industries. Findings suggest large difference in CBMs of closing resource loops between firms engaging and not engaging with the CE discourse for these industries.

CBMs of slowing resource loops is the least engaged with across three of the industries, though interestingly not for the firms that do not engage with CE in the technology industry. Yet, this finding is based on a small sample size of only 16 firms and the overall frequency counts on CBMs is far lower than for the other industries. Thus, this finding suggests that these firms likely do not engage with CBMs of slowing resource loops more than other industries but may have greater relative engagement versus the other CBM types.

## 4.2 Tata Steel in Europe Case Study

In this sub-section we provide the findings of the single qualitative case study on Tata Steel in Europe. Findings are provided in three parts: (4.2.1) a chronological narrative analysis, (4.2.2) a thematic analysis, and finally (4.2.3) an empirical process model.

### 4.2.1 Chronological Narrative: From Acquisition to Zero-carbon emissions target

We first offer a chronological account of Tata Steel in Europe's (TSE) engagement with Circular Economy over the 15-year period since its acquisition. Table 9 captures the main events.

**Table 9. Tata Steel Europe Circular Economy Events Timeline**

Period	Event
2007	Tata Steel acquire British-Dutch <i>Corus Group</i> Corporate strategy: ensure safety and environmental sustainability
2010	<b>Corus Group renamed Tata Steel Europe (TSE)</b> Certification for responsible sourcing of construction products, BES 6001 Launch of pilot plant with smelting reduction technology (the <i>HIsarna process</i> ) that enables higher use of steel scrap and recovery of zinc
2012	Collaboration between Centre for Process Innovation (CPI) Tata Steel's Teesside Technology Centre enables thermal processing innovations Mr Hans Fischer joins TSE as Chief Technical Officer
2014	Formation of strategic partnership with the Engineering and Physical Sciences Research Council (EPSRC) in the UK to develop a range of innovations, focussed on graphene-coated steels (boost energy efficiency) and waste recycling process improvements

2015	<p>Launch of <i>STYLE</i> collaborative project on sustainability assessment tools, methodologies, and approaches</p> <p>Development and construction of the Fokker 7/8 cradle-to-cradle distribution centre at Schiphol together with the Delta Development Group (DDG)</p> <p><b>Launch of EU's Circular Economy Action Plan (CEAP)</b></p>
2017	<p>Innovation of polymer coated steel for easy recyclable packaging of canned food (Protact® laminated steel)</p>
2018	<p><b>Start of ReclaMet project</b></p> <p>RandD project to reuse zinc from process dust into zinc production</p> <p>Launch of <i>Product Development Sustainability Assessment Tool</i> and (Building Information Modelling (BIM) and product data tool for all of its European construction brand products</p> <p>Multi-stakeholder steel recycling promotion campaign to customers</p> <p>Collaboration with EU funded ReTraCE research project</p> <p>Mobile canning innovation using Protact® allowing canning of food at source.</p>
2019	<p><b>Start of the REDUCE project</b> (Re-use and Demountability Using steel structures and the Circular Economy)</p> <p>Innovating tools and technology to facilitate the re-use of composite steel structures.</p>
2020	<p>Commencement of €300 million Roadmap+ program reducing environmental pollution of IJmuiden plant</p> <p>Start of the <i>Seismic II</i> collaborative project for low-carbon and modular construction</p> <p><b>Collaboration within Steel E-Motive project</b></p> <p>WorldAutoSteel project to enable Mobility as a Service solutions</p>
2021	<p>Separation of Tata Steel Europe to Tata Steel UK and Tata Steel Netherlands</p>
2022	<p>Innovation of <i>PACI</i> tool that supports life cycle thinking</p> <p>Improved water and waste management at Tata Steel's Shotton site (recovery of around 90% of onsite waste)</p> <p>2022 Lettinga Award for pilot project to turn Blast Furnace gases into commercially viable products in collaboration between the University of South Wales' Sustainable Environment Research SERC</p> <p>Introduction of <i>Optemis Carbon Lite</i>, a flexible, certificate-based steel solution</p> <p><b>Launch of Zeremis and Optemis projects</b></p> <p>2045 zero-carbon emissions target and plan for first plant powered by green hydrogen in 2030</p>

*Corporate change and restructuring.* TSE is a large steel producer located in the UK and Netherlands. Founded as the Corus Group in 1999 as a British-Dutch collaboration, the firm was acquired by the Indian conglomerate and renowned steel producer Tata Steel in 2007 and renamed Tata Steel Europe in 2010 (Tata Steel Europe, 2020a). In 2021, TSE separated to form

two independent branches of Tata Steel UK and Tata Steel Netherlands. In this report we will continue to use the name Tata Steel in Europe (TSE) to represent the organization of focus.

Over the last decade TSE has undergone multiple refocusing phases. For instance, to improve its long-term commitment to the European steel industry, TSE changed the organisation of its sales and marketing activities in 2010 (Tata Steel Europe, 2012a). Tata Steel executives recognised that better product performance and higher utility value were increasingly in demand in European steel markets. The most demanding sectors, such as automotive, engineering and construction, were particularly affected by this trend. The need for change was further fuelled by the economic uncertainty and stagnation that Europe was facing in 2012.

To address this trend and remain competitive, TSE changed its strategy by transforming its product offerings (Tata Steel, 2012). Starting with a new CTO Hans Fischer, TSE embarked on a journey with operational changes that emphasised a strategy of optimising product quality in the service of improved customer focus. As described by Mr Hans: “Modern steelmaking, especially in mature markets, is about extracting the best from operating assets in ways that bring most benefit to customers, and I look forward to helping realise that ambition for Tata Steel” (Tata Steel, 2012, para 4).

TSE progressively increased the percentage of differentiated products in its portfolio from 2012 to 2016 by over 50% and adopted a strongly customer-focused business approach, leading to the development of new products developed in close collaboration with customers (Tata Steel Europe, 2012a). TSE reports that the new customer-centric course led to mutually beneficial partnerships that resulted in improvements in product performance, processing efficiency, light weighting and sustainability (Tata Steel Europe, 2012a). Moreover, the company believes that its broad product range, integrated steel mills and extensive distribution and processing networks enabled the company to seize growth opportunities in all market segments (Tata Steel Europe, 2012a).

*Historical commitment to societal responsibility.* The Tata Group conveys environmental sustainability and social responsibility as two of its integral values (Matthew, 2006) and presents that it has made consistent efforts to embed them in its overall corporate strategy since its establishment in 1868 (Hughes et al., 2014). Based on this value and purpose-based logic, similar values have also been adopted by its subsidiary TSE. As communicated by TSE, the company's key aspirations include creating value for the planet and the communities in which it operates (Tata Steel Europe, 2021c). In addition, responsible and sustainable sourcing of raw materials and production and transportation of steel are also among its key focal areas (Tata Steel Europe, 2022a).

TSE considers itself to be a value-driven firm, with an affinity for collaboration and strategic partnership building, and strive for innovation (Tata Steel Europe, 2018a; 2021c). It sees that this recipe has successfully enabled the firm to maintain its position as one of the leading steel producers in Europe (Tata Steel Europe, 2018a; 2021c). In particular, the close partnerships TSE has forged with players along the entire value chain are seen as playing a very important role in securing its leading position (Tata Steel Europe, 2020e; World Steel Association, n.d.).

*Minimizing environmental impact through Life Cycle Assessment.* Since the early 2000s, TSE has used life cycle assessments (LCA) to understand and minimise the environmental impact of its products. This was first triggered by customers from the packaging industry who showed interest in using data to evaluate the impact of their products and processes (Interviewee A). Yet obtaining data, according to a standardised method proved difficult (Interviewee A) and the company joined with other steel companies under the International Iron and Steel Institute to “create some basic data sets that you can use for the steel products that we make as an industry. And they make that data available to either academia, customers, or consultants doing their own studies” (Interviewee A). After 5 years the consortium released a methodology for calculating life cycle inventories measurements that could be used for LCA (Interviewee A).

Further momentum in their efforts to minimize environmental impacts through assessment tools was achieved in 2015 when TSE launched Project STYLE. Project STYLE is an industry-led consortium involving multidisciplinary partners (academia, research institutions, specialist consultancy organisation) from all parts of the value chain with the aim of developing and delivering a practical “toolkit” (A.SPIRE2050, 2022, p. 2) for environmental impact assessment. This toolkit provides a consistent and easy-to-implement approach with broad applicability across sectors to assess the sustainability impacts of products and processes across the value chain. Simultaneously, this tool helps stakeholders and industry in the EU to make informed decisions regarding their strategies to improve resource and energy efficiency (A.SPIRE2050, 2022).

*Transparency through Environmental Product Declarations.* The firm began using LCA for steel with construction and automotive applications and made data and models publicly available to promote the discourse (Interviewee A). TSE continues to use LCA and conducts new data collection to inform LCA on an annual basis (Interviewee A). LCA data feeds the Environmental Product Declarations (EPDs) that provide transparency to the environmental impact of many of its products (Tata Steel Europe, 2019b, 2020c).

*Finding ways to close loops and enable material recirculation.* Besides its LCA endeavours, TSE has also put great emphasis on its recycling endeavours over the years. In 2012, TSE opened its Teesside Thermal Technology Centre as the culmination of its collaboration with the Centre for Process Innovation (CPI) (Tata Steel Europe, 2012b). The purpose of this centre was to function as an open access facility that develops innovative ways to enable material recirculation. As a result, technologies such as a multi-mode gasifier and a batch pyrolyser in the form of demonstration-scale assets were offered by the centre (Tata Steel Europe, 2012b). By providing such offerings, the centre strengthened TSE's competitiveness in "developing products and processes for the process, energy, construction and materials, metallurgical and recycling and reclamation sectors" (Tata Steel Europe, 2012b, para 5).

In 2014 TSE formed another strategic partnership with the UK Engineering and Physical Sciences Research Council (EPSRC) to advance its technological innovations (Tata Steel Europe, 2014). Among its key research areas were finding ways to improve waste recycling processes and viability of coating steel strips (Tata Steel Europe, 2014). In collaboration they developed innovations such as graphene-coated steels and highly durable next-generation sensors that can operate in extreme environments (Tata Steel Europe, 2014). With these products TSE hoped to enable their customers access to more sustainable solutions, thus slowly transforming the market (Tata Steel Europe, 2014).

*Moving from recycling to reuse of steel.* TSE saw particular potential in the construction sector for applying the inherent circular nature of steel for changing the industry (Tata Steel Europe, 2020d). In 2015 TSE worked with the Delta Development Group to leverage their combined expertise and experience as suppliers and circular project experts to design a logistics distribution centre called the Fokker 7/8 development. The centre is designed to be easy to disassemble with nearly all steel connections of the mainframe bolted, not welded, enabling the whole and its parts to be reused (Tata Steel Europe, 2019a). For ensuring transparency and material efficiency, data on all used materials were saved on a so-called material building passport (Tata Steel Europe, 2020d). This circular construction project was initiated in conjunction with Coert Zachariass, the CEO of the Delta Development Group (Tata Steel Europe, 2015)

To further enhance the reuse of materials in the construction sector, TSE launched the pioneering BIM (Building Information Modelling) model and a product data tool in 2018 (Tata Steel Europe, 2015a). These tools can be utilised in combination with material passports by architects, engineers and facility managers to optimise smart data management during programming, design and construction, as all components of the building become fully traceable; the tool "shows where each material and product is located in the building, in what



quantities, how it is processed and how it can be dismantled for reuse.” (Tata steel Europe, 2019a, p.2)

In 2019, TSE engaged in further projects to enhance the reusability of steel in the construction industry and move beyond the current norm of recycling (Tata Steel Europe, 2021d). Among their efforts, TSE worked on a project called REDUCE (Re-use and Demountability Using steel structures and the Circular Economy), which was initiated in conjunction with the Steel Construction Institute (SCI) and other partners. Together they developed tools and technological solutions for demountability of composite floor decks to facilitate re-use at the end of life of buildings and structures (Tata Steel Europe, 2021d). As a result, solutions such as demountable shear studs, option injection bolts to decrease slip, and light steel angles were invented. These tech-solutions alongside with calculation tools for environmental assessments of re-use and BIMs ([www.tatasteeldnaprofiler.com](http://www.tatasteeldnaprofiler.com)) to store project/product data for future reuse applications, are helping to change the construction landscape (Tata Steel Europe, 2018b; 2020b; 2021; 2022f).

In 2020, TSE continued its collaboration for circularity in the construction sector by joining the Seismic II consortium that aimed to rethink conventional construction manufacturing through building platforms. Rather than taking the traditional approach, where design innovations are not transferable to other projects due to their project-specific adaptations and have limited transferability due to their “prototype” or “one-off” nature (Tata Steel Europe, 2022g, p.1), the consortium advocates a “platform approach to Design for Manufacturing and Assembly (P-DfMA)” (Tata Steel Europe, 2022g, p.2) that embraces a more systemic view. By using a platform approach, design decisions can be tailored to considerations that evaluate the entire life cycle of the building and go beyond the traditional use-phase silo perspective. Simultaneously, these building platforms consist of standardized sets of parts that can be assembled in a “predictable and repeatable manner” (Tata Steel Europe, 2022g, p.2), yet allow designers the freedom to create buildings of any type and style. As a culmination of the Seismic II consortium's efforts, TSE has worked with its partners to develop a demonstration building consisting of a standardized lightweight steel frame, ensuring full interoperability of the building components (Tata Steel Europe, 2022g).

*Launch of Roadmap+ plan to reduce waste emissions.* In 2019, the nitrogen crisis in the Netherlands came to the fore of the public agenda as the Dutch government sought stronger actions to meet its EU commitments (*see Dutch Review, 2022*). TSE, as the single largest emitter of Nitrogen Oxide in the Netherlands (de Telegraaf, 2022) faced mounting societal pressure to reduce its nitrogen emissions, alongside criticism for other environmental concerns such as toxins released to nearby communities of the IJmuiden plant (NL Times, 2021). In

response, TSE launched its environmental improvement programme called ‘Roadmap+’ in December 2020 to significantly reduce water emissions from production (Tata Steel Europe, 2021e). With this €300 million ‘Roadmap+’ plan, TSE aimed to initiate several projects to enhance the environment at the IJmuiden plant in the Netherlands. In line with circularity principles Roadmap+ seeks to eliminate the leakage of nutrients into the biosphere that may cause ecosystem and societal harm. It includes measures to reduce dust emissions to the surrounding community by 65% by 2023; reduce odour pollution by 85% by 2022; and build new facilities by 2025 to reduce nitrogen oxides, fine dust and heavy metals from a pellet plant (Tata Steel Europe, 2021f). Another ambition stated by TSE, is to reduce its CO<sub>2</sub> emissions by five million tonnes a year by 2030 in its IJmuiden plant (Tata steel Europe, 2021b).

To further accelerate these ambitions, TSE announced its adaptation of a hydrogen route for its IJmuiden plant in 2021. Currently, TSE is working on a direct reduced iron (DRI) technology that uses natural gas or hydrogen for its iron processing activities (Tata steel Europe, 2021b). Other solutions that are also being explored by TSE are technologies focused on the capture and storage of CO<sub>2</sub> (Tata steel Europe, 2021b). TSE also made significant modifications to its Shotton site in the UK to reduce its environmental impact and improving its waste management site (Tata Steel Europe, 2022f). Various projects have been initiated resulting in 99.8% of the supplied paint being used or recovered, and 90% of its onsite waste being recovered (Tata Steel Europe, 2022f). Another process incorporating the CE approach can be found in its zinc recovery processes. At the Shotton plant, galvanising zinc dross is reclaimed, recovered and remanufactured into prime grade alloys, whilst reducing raw material requirements (Tata Steel Europe, 2022f).

*Steel facilitating functionality not ownership business models.* In 2020 TSE began collaborating in a new project of the automotive industry as one of 18 steel companies commissioned by WorldAutoSteel. The aim of the project is to “demonstrate that steel’s extensive product and fabrication portfolio could solve the design and engineering challenges of mobility as a service (MaaS), so that fully autonomous and connected electric vehicles could be manufactured across the world using Advanced High-Strength Steels” (World Steel Association, n.d., para 3). The front-end of the innovation process is highly collaborative with several automotive companies involved in creating lists of requirements from a constructed vehicle (Interviewee D). These requirements are considered cumulatively, and in combination with assessments of market trends and lifecycle (with a focus on the use and end-of-life phases) (Interviewee D; World Steel Association, n.d.). The launch of the final virtual concepts is expected in 2023.

*Targeting Net Carbon Zero.* In 2022 TSE publicly announced its zero-carbon emissions target and their aim to ‘fundamentally transform their liquid iron and steel production processes’ (Tata

Steel Europe, 2022d, para 3). Driven by growing demand from its customers for low-CO<sub>2</sub> steel, Tata Steel Netherlands has launched its Zeremis program - short for zero emissions. The goal of this program is to reduce Tata Steel Netherlands CO<sub>2</sub> emissions by 35% to 40% by 2030, and to become CO<sub>2</sub> neutral by 2045 (Tata Steel Europe, 2021b). To achieve this goal, TSE is investing in further innovative green steel and scrap processing solutions to transition towards a more circular world. The first new product to be announced is the Zeremis Carbon Lite, which enables up to 100% reduction in carbon footprint (Tata Steel Europe, 2022c). In parallel, Tata Steel's UK business launched a similar program called Optemis in 2022 with the aim of becoming a net zero steel producer by 2045. The interim target is to reduce CO<sub>2</sub> emissions by at least 30%, using 2018 levels as a benchmark (Tata Steel Europe, 2022i). To realise their ambitions TSE is working in conjunction with the British government and are involved in multiple projects, which for instance are exploring hydrogen-based solutions. Similar to Zeremis Carbon Lite, Tata Steel's UK business has also introduced Optemis Carbon Lite, which is a certified low CO<sub>2</sub> steel offering, enabling TSE's customers to achieve scope 3 emissions savings (Tata Steel Europe, 2022b; 2022i). By empowering other supply chain actors to contribute to their decarbonisation journey, TSE is decarbonising their supply chain as well.

In 2022, TSE also launched a pilot project focused on enhancing circularity in its production processes. In collaboration with the Sustainable Environment Research Centre (SERC) at the University of South Wales, it is looking at ways to convert blast furnace gases into commercially viable products. It is also working on technologies to convert surplus industrial waste gas streams into saleable products using a bioreactor (Tata Steel Europe, 2022e). This pathway offers a circular and sustainable alternative to concurrent production activities that rely on fossil fuels such as gas and oil (Tata Steel Europe, 2022e). In addition, TSE claims that significant changes have been made to processes throughout the supply chain, including raw material procurement, liquid iron production, steelmaking, processing, and logistics (Tata Steel Europe, 2022d).

#### **4.2.2 Thematic Analysis**

In this section the findings are presented of the thematic analysis of Tata Steel in Europe's revision of its business models for CE. Table 10 provides an overview of the key concepts of the transformation of business models for circular economy with a supporting data illustration. The analyse revealed four second-order themes: 'optimising internal process', 'avoiding material leakage', 'enabling material recirculation', and 'holistic resource thinking'. Additionally, four enablers of phase shifts are offered: 'cost saving logic', 'value chain scoping', 'co-creation opportunities', and 'societal demand changes'. This section shall explain the four

second-order themes with support from representative data, while enablers shall be explained later with the empirical model in Section 6.3.

**Table 10. Key Concepts of the Transformation of Business Models for Circular Economy**

Concept	Definition	Data Illustration
<b>Cost saving logic</b>	Belief that CE offers cost savings with environmental benefits.	“Because we have such a massive amount of by-products, with a high cost, first of all, it is also an economic model. We want to minimise waste because of the environment, of course. And that goes hand in hand. I think. So, we always try to see how we can add value to our products. The economic side is always there” (Interviewee B)
<i>Optimising internal process</i>	Improving the efficient use of resources of internal activities.	“Of course, there is always the maintenance but that is unplanned. We try to optimise it as good as possible. And have a minimum stock.” (Interviewee B)
Internal waste elimination	Minimize waste generation throughout production activities and reprocessing scrap production material	“Then you have yield discussion and waste reduction throughout the plant where you start closing the loop in every single plant. And well if you have cuttings, scraps, things that you have to cut off because it's a funny shape, you can take that and it doesn't become waste that goes back into the system internally.” (Interviewee E)
Waste and impact identification	Determining where and when waste is generated.	“Within the impact assessment you have to consider, well what happens at that very last cycle stage what happens at the end of the life cycle stage, and then you can decide what happens, whether something would go to the landfill, whether something will be able to be recycled.” (Interviewee E)
Resource input optimisation	Reducing resource input-output ratios through changes to production processes.	“From a social point of view, we just want to be as efficient as possible with all our raw materials. So, the less you can use, the more you can recycle. That is better. So, you do not put much pressure on the system.” (Interviewee B)
<b>Value Chain Scoping</b>	Looking beyond closed processes – expanding processes and improving production efficiency by exploring synergies with other value chain stakeholders	“Tata Steel is investing £1.3 million in a new processing and distribution centre in Scunthorpe to take advantage of anticipated growth in the wind power sector and help realise the UK's ambitious renewable energy programme over the next decade.” (Tata Steel Europe, 2010, para 11)

<i>Avoiding material leakage</i>	Preventing the loss of materials from the industrial system.	“At both of its steelworks, the Group is keen to investigate options to increase the amount of steel scrap it recycles alongside the fresh iron it makes in its blast furnaces. In IJmuiden it has investigated a scheme to retain as much heat as possible in liquid iron as it is transported from the blast furnaces to the steel plant, enabling it to increase the amount of scrap uses.” (Tata Steel Europe, 2022j, p. 18)
Industrial symbiosis	Connecting industrial processes across firms to use ‘waste-as-food’.	“For instance, we deliver 1.2 million tons of granulated blast furnace slag to the cement industry. We supply steel slag as an aggregate to the civil industry.” (Interviewee C)
Product recycling	Developing ways to reprocess old products from other value chain actors into new production processes.	“we will recycle the outer panels sourced from end-of-life cars to produce new outer panels. By improving our separation processes, we can ultimately approach a 100% recycling rate.” (Auto Recycling Nederlands, 2022, para. 11)
By-product repurposing	Identifying and optimising use of by-products from production processes as input for new products.	“We are currently in a project with a university [Netherlands] to upgrade that low-grade aggregate into a higher added value product as a binder or a filler for the cement and concrete industry. So, by that, for instance, replacing materials that will not be available in the near future, such as fly ash from coal-fired energy plants and power plants. So, we have always had usage for our by-products. We are just trying to move them up the circularity ladder by going from a low-grade product to a higher-grade product.” (Interviewee B)
<b>Co-creation opportunities</b>	Seeking new opportunities through increased stakeholder engagement and collaboration across the value chain and thereby sharing the financial burden which comes from the more cost intensive green solutions.	“So we are working with [Company X] and some other partners to design a level 5 autonomous vehicle - level 5 that's just sort of the most challenging architecture - we will be electrified.” (Interviewee D)
<i>Enabling material recirculation</i>	Facilitating products to be retained within the technical cycle at the highest level of circularity preference through CBMs of slowing resource loops.	“So that's more around, not necessarily setting up a reuse model where we buy back steel, but thinking about how you facilitate reuse in the future through provision of data. And that's being driven by the CE concept. By building in information. Modelling and material passports, so when you put stuff into a building, how do you then make that information available for others?” (Interviewee A)

Design for sequential looping	Designing products for more than one use phase.	“In the 3 year REDUCE (Re-use and Demountability Using steel structures and the Circular Economy) project, tools and technologies to facilitate the re-use of composite - steel structures were developed.” (Tata Steel Europe, 2021a, p.1)
Long lasting products	Designing products that retain their embedded value for as long as possible.	“So basically the role of the company is to [sic] provide long lasting products that ideally will also support some of that closing the loop in a sense. Producing products that are recyclable and easily separable.” (Interviewee E)
Supporting downstream CBMs	Collaborating to help enable downstream value chain actors to innovate CBMs.	“And you see various levels of enthusiasm about this idea of servicing. There was a real boom of automakers acquiring mobility companies. Still a lot of effort is still going on there. Some subscription services, start-ups. Even here in [Location X] there is one local car dealership that offers a subscription business model, you don't own a car anymore. There is a realisation, this is the way the world is going. Whether anybody likes it or not, we better be ready for it.” (Interviewee D)
Digitising information flows	Enabling the digital flow of information that supports CBMs across value chains	“Getting more functionality from the same (or less) resource is critical to environmental improvement over the whole life cycle. A key enabler in this and other strategies for greater circularity is having the right information available at the point of making a decision about the optimal use, now and in the future, of products and materials. Industry 4.0 is one concept covering the exchange of digital data across many manufacturing technologies and industrial systems, not just steel.” (Tata Steel Europe, 2018c, p.33)
<b>Societal demand changes</b>	Demands from society for net carbon zero business activities.	“There's lots of policies that are already out there. Some are more applicable to some products than others. but I think policies are probably the biggest drivers. And what drives policies are social preferences of society. So hopefully that is true. Social movements drive policies over time. We've seen that's true.” (Interviewee E)
<i>Holistic resource thinking</i>	Thinking broadly on how the firm may assist on CE throughout the value chain and lifetime of the product.	“So that's more around, not necessarily setting up a reuse model where we buy back steel but thinking about how you facilitate reuse in the future through provision of data. And that's being driven by the CE concept. By building in information” (Interviewee D)



Fully integrated circularity strategy

Adopting strategies that fully encompass all types of resource looping.

“So yeah, I think both all avenues are being explored in that sense, because we want to be seeing as the as a European steel business to be successful, we need to differentiate ourselves from other steel players across the world as a brand places a lot of emphasis on sustainability, I would say, and going forward, and that that's part of the brand the brand values.” (Interviewee A)

### Optimising internal processes.

Optimising internal processes concerns TSE’s efforts to improve internal activities to achieve the most efficient use of resources. This is based on a win-win logic whereby efficiencies will generate cost savings as well as environmental improvements. It involves identifying and addressing resource waste and inefficiency within the company's operations. For example, TSE stated in a Sustainability report, “We have made substantial strides over recent years towards zero landfill and optimised resource utilisation at our sites as the case studies below demonstrate (Tata Steel Europe, 2021e, p.18). We identify three practices that changed business model components: *Waste and impact identification*, *Internal waste elimination*, and *Resource input optimisation*.

*Waste and impact identification* refers to determining where and when waste is generated through a life-cycle perspective. Life cycle thinking has a long history at TSE and has supported the firm to identify waste and environmental impacts with the help of life cycle assessment (LCA). Interviewee A explains “LCA was always about finding that hotspot in the supply chain, in terms of environmental impacts”, and that by conducting LCAs “valuable advice and hints to where the environmental impact is” could be obtained.

*Internal waste elimination* concerns efforts to modify production activities to stop waste resources being generated and reprocessing scrap production material. This includes the introduction of new production technologies. Interviewee C explains the introduction of filters to internally recycle dust: “In the last ten to twenty years, we have installed, and we will continue to install more and more filters to decrease our impact on the environment. A large part of the dust captured in the filters is recycled internally and by that also minimising the waste.” Prominent instances of internal waste elimination are exemplified by the Llanwern site, which “has become a zero landfill operation after we found a new recovery solution for chloride-containing filter cake, a residue from one of our wastewater treatment processes” (Tata Steel Europe, 2021e, p.18) or the Trostre packaging steel site which “has now nearly achieved

its goal of zero waste to landfill, by focusing on two high-volume waste substances.” (Tata Steel Europe, 2021e, p.18).

*Resource input optimisation* refers to TSE’s efforts to improve resource input-output ratios through changes to production processes to require fewer material inputs. Interviewee C links this business activity far back historically: “I think from the beginning to over 100 years ago, as we are a steel site or a country with no raw materials from ourselves, so to say, there has always been a drive to maximise efficiency and efficient use of input materials.”

### **Avoiding material leakage.**

TSE seek to prevent the loss of materials from the industrial system beyond only what could be achieved within its own organizational boundaries. This involves cooperation and action with other value chain actors, to search for solutions whereby waste generated either from its own production processes or by actors further downstream in the value chain could be harnessed back into the technical system as an input. Interviewee C offers an example of integrating forward and reverse logistics: “On the other hand, when we get other shipments of alloying elements or whatever, say a big bag on a pallet, we work with companies. For example, they can bring back coils by truck. Then we directly deliver the return freight.” We identify three ways in which the firm pursue avoiding material leakage; *industrial symbiosis*, *product recycling*, and *by-product repurposing*.

*Industrial symbiosis* refers to connecting industrial processes across different firms to use waste from one process as inputs for another through regular interactions. TSE explores new ways to work with actors both within and outside their value chains to make use of resources that would have otherwise exited the industrial system. For instance, TSE’s collaboration with EnAlgae exemplifies such a multidisciplinary value chain effort. “The project is analysing the capacity for natural algae to use carbon dioxide as a nutrient for growth. The project contributes to Tata Steel’s commitment to reducing unavoidable carbon dioxide emissions from manufacturing operations.” (Tata Steel Europe, 2015b, p.1). As stated by Dr Alla Silkina, from Swansea University, one of the lead researchers in this project: “This collaboration with EnAlgae is an important example of how working closely with industry can yield practical results for researchers and businesses. We have been able to use the Port Talbot by-product streams as an algal growth nutrient. In addition, a biomass is cultured which can be used for energy (biomethane) production or potentially as a fish feed.” (Tata Steel Europe, 2015b, p.1). In addition to the benefits to environmental performance of closing resource loops, industrial symbiosis helps TSE to strengthen and build new relationships with multidisciplinary actors.

*Product recycling* concerns developing ways to reprocess old products from other value chain actors into new production processes. Steel is a product that firms have historically sought to recycle due to its appealing economic market value and relatively simple technological process. TSE progresses product recycling by further developing its relationships with customers and progress its ability to retrieve used products from value chain actors. Interviewee A offers how product recycling was supported by attention of its C-suite and importantly its customers: “the concept of the CE got the attention of management and our customers. And that's inspiring us to see how we can optimise recycling but also what does that mean in terms of the circularity of our products. [...] It's nice to have these kinds of concepts, you get people thinking.” By developing its product recycling, TSE was able to reduce its own use of virgin materials in its production processes: “Used (end of life) refractory materials are used as input materials / aluminium oxide source for the blast furnace. As a result of this, we do not need to buy bauxite (a virgin raw material) and we don't need to dispose the refractory materials” (Interviewee C).

*By-product repurposing* involves finding new uses for materials that are generated as a by-product of industrial processes or finding new users outside of the company for the by-products. For instance, Interviewee C offers that, “Minimising waste means that we use all our by-products we create.” Important to this activity is understand how the by-product can be of value for other processes, and how the by-product can be developed into a higher economic value. Interviewee B explains developing value for internal use: “So, you could say that we try to add value to all our by-products. So, our iron ore, we want to make that into our main products, steel coils. But all of our by-products, waste, gases or slag, like [colleagues name] said. We try to add value to that. So, it becomes a product.” To develop by-products for repurposing TSE also worked with external research parties; “We are currently in a project with a university [Netherlands] to upgrade that low-grade aggregate into a higher added value product as a binder or a filler for the cement and concrete industry. [...] We are just trying to move them up the circularity ladder by going from a low-grade product to a higher-grade product” (Interviewee B).

### **Enabling material recirculation.**

These business practices of TSE focus on facilitating products to be retained within the technical material cycle at the highest level of circularity preference through slowing resource loops. TSE concentrates on understanding how its product and processes enables the application of circularity practices. This involves considering how the product can be better designed to enable circularity, but also thinking through how the highest option on the R-hierarchies Framework may be realised. Interviewee C offers an example of thinking about the options across the value chain:

“how should we deal with the production scrap of our customers? Should we take back production scrap from, let us say, German carmakers, which is our steel? Taking this material back would lead to extra CO2 emission due to the transport back to our plant in IJmuiden or should we leave that to the German steel producers? And should we, I do not know, use scrap from offshore structures, which are coming to the Dutch harbours for demolition? Or is it circularity wise better that we upcycle scrap from waste incinerators, which is a low-grade scrap that then turns into a high-end product? Is that circularity wise better than to become circular with our own products? There are things which we are looking at now.”

This work further shifts TSE’s thinking about circularity from materials beyond the more conventional recycling and repurposing of Steel (that are least preferred in the R-hierarchies Framework), to how to proactively innovate other CBMs. This requires close collaboration with downstream actors and working with them to innovate CBMs that they may operate and be responsible for: “With that piece of material, which is now scrap, you might reuse it again by making another product out of that. Then, you actually reuse that type of product, but that is more in the responsibility of the car manufacturer. I mean, they see another added value to it.” (Interviewee C). Enabling material recirculation is pursued through four ways: *Design for sequential looping*, *Long lasting products*, *Supporting downstream CBMs*, and *Digitalizing information flows*.

*Design for sequential looping* involves designing products in such a way that they can be easily disassembled, repaired, refurbished, or recycled at the end of their useful life. Steel has favourable characteristics for such CBMs of slowing resource loops such as a long product lifetime and retaining a high value. TSE seeks to enable its customers to take advantage of these characteristics through the design of the steel, and how the steel is designed within its application. This can involve using modular designs, standardising components, and creating repair and refurbishment networks. By designing for sequential looping, it is possible to extend the life of products and keep materials in circulation for longer periods of time, beyond only a single use phase. TSE has particularly applied such strategies for its offerings to its clientele operating in the construction sector. For example, its work within the Seismic II consortium on standardised building designs. By offering design solutions for buildings that are reusable, encompassing easy assembly and disassembly, TSE hope to facilitate a CE shift in the construction sector. The company explains its aim to facilitate a new market regime:

“With the advent of increasingly circular economic approaches to construction design, steel has an important role to play beyond recycling. Again, the durability of steel means that it is extremely well suited to refurbishment or reuse. More work is required

across the supply chain to ensure we are maximising the resource opportunity available (design for disassembly, standardisation and so on), however steel really can be the ‘engine of the circular economy’ (Tata Steel Europe, 2017, para 11)

*Long lasting products* is a core characteristic of steel that enables the operation of different types of CBMs, but also critically reduces the need for new products if the first use phase can be lengthened. Interviewee E explains it as the key role of TSE for its product design alongside recyclability: “the role of the company is to provide [sic] long lasting products that ideally will also support some of that closing the loop in a sense. Producing products that are recyclable and easily separable.” TSE develops product offerings that have special material properties (higher quality) that have made them easier to repair and maintain. For instance, TSE’s structural hollow section, called Celsius exemplifies such an offering: “Celsius is available in a range of grades, including the popular S355NH and weight-saving high strength S460NH as well as in weathering grade steel for the ultimate durability in long-life, low-maintenance structures” (Tata Steel Europe, 2022k, p.1).

*Supporting downstream CBMs* refers to forming collaborations with downstream value chain actors to innovate CBMs of slowing resource loops. Some customers of TSE are actively pursuing circularity through new CBMs and are calling on steel suppliers to provide products that will better enable these. For instance, in the automotive industry design decisions that leverage the properties of steel to incorporate a higher degree of circular economy into the business model are being explored. Interviewee D explains, “We talked about recycling, for example. Is there a way to design parts so they can be reused? Some are easy, of course, wheels, for example. But we really looked for ways to see if there were other ways and components we could design them.”

As an actor early in the value chain, TSE recognises that it may not be the most suitable actor to operate many CBMs relating to slowing resource loops. For example, it is preferable for circularity for steel used in automobiles to return directly to automobile manufacturers for reuse, refurbishing, and remanufacturer rather than returning materials to TSE. In such instances, TSE seeks to be involved with multi-partner and industry wide collaborations that experiment and seek to solve the challenges that are impeding downstream actors to innovate new CBMs. An example is TSEs collaboration as part of the Steel E-motive project that seeks to develop Mobility-as-a-Service CBMs. Interviewee D explains:

“Because so many different aspects of the market are changing. The product itself is changing and the materials it is made of, the electrification and those things. Things like autonomy and the market is changing, right? with mobility as a service and ride



hailing. Just different ways and different usage. Different ways the consumer uses the car, such as car sharing, or do you buy the car? And the infrastructure is changing. There is increasing urbanisation. So all of those things interact with each other, so the typical solution is to make your best guesses and perform a lot of sensitivity analyses about what if this assumption is not right. There are some aspects that we are pretty sure of, some level of autonomy.”

*Digitalising information flows* concern enabling the flow of digital information across value chains that supports the CBM innovation and functioning. Downstream actors in value chains have traditionally not had full accessibility to material information, as value chain actors seek to preserve their own value chain positions. TSE recognises transparency and traceability of materials and products as important enablers for firms to start designing and functioning CBMs. For instance, when firms have a strong understanding of the composition of products that are empowered to identify how they may be repaired, remanufactured or how components may be repurposed. At other times, data may be available but not at the right time or in cohesive format that allows it to be easily applied. TSE explain: “Getting more functionality from the same (or less) resource is critical to environmental improvement over the whole life cycle. A key enabler in this and other strategies for greater circularity is having the right information available at the point of making a decision about the optimal use, now and in the future, of products and materials. Industry 4.0 is one concept covering the exchange of digital data across many manufacturing technologies and industrial systems, not just steel” (Tata Steel Europe, 2018c, p.33).

TSE is particularly active supporting digital information flows within the construction sector and have helped create “digital platforms such as Buildings Material Passports (BMP) and Buildings Information Modelling (BIM)” (Tata Steel Europe, 2018c, p. 33). TSE states that these tools “are becoming widely used through the design, manufacture, and operation of a building, including for future reference regarding suitability for reuse. New initiatives in the sector are also seeking to integrate environmental information (such as LCA) about construction products into BIM, so that choices can be made on environmental criteria as well as others” (Tata Steel Europe, 2018c, p. 33).

### **Holistic resource thinking approach.**

To further CBMI, TSE needs to think broadly on how the firm can assist throughout the value chain and lifetime of the product. This requires holistic thinking about how products and value chains currently function, how they may in the future, and what can be the role of TSE. This necessitates circularity to be a core business consideration and central to strategy. It involves thinking comprehensively about how the firm may assist across entire value chains,



incorporating thinking on how TSE can stimulate market transitions toward circularity. Interviewee A explains how premium pricing supports further circularity and decarbonization efforts for market transitions: “If you want these greener products there is a premium, you have to pay for it. And that that would then be reinvested in our decarbonization program. So we make a commitment to reinvest money that we get through the Carbon Lite offering back into our the environmental performance of our plants an operations. So it's about creating a market for green steel” (Interviewee A). We identify a holistic resource thinking approach being pursued through a *fully integrated circularity strategy*.

*Fully integrated circularity strategy* refers to adopting a new strategy that fully integrated all types of resource looping with full connected with decarbonisation efforts. TSEs Optemis and Zeremis programmes target CO<sub>2</sub> neutrality by 2045. Further advancing its efforts on CBMs will play an important role in being able to achieve this climate target. As such, TSE commonly communicates climate action and progressing towards a CE in unison: “Together towards a zero-carbon emissions, circular world” (Tata Steel Europe, 2022d, page 7). A fully integrated circularity strategy requires the firm to be engaged with CBMI on narrowing, slowing and closing resource loops and continuous learning efforts in this field. Interviewee A explains: “also in circularity. We constantly try to balance education with our advocacy. We sort of talk from our journey form awareness to employment. But first we have to make sure we understand, so we constantly try to educate ourselves. But that’s always the first step in the advocacy process. You know assessing their level of knowledge and doing what we can to sort of get it to the level to where they understand how and what to employ.” It will increasingly require TSE to adopting a multi-focal approach to resource looping concerning internal, post-business, and post-consumer resource loops. TSE is involved in multiple concurrent partnerships to facilitate CBM innovation across value chains such as ReTraCE, REDUCE, Steel E-Motive projects.

#### 4.2.3 Empirical Model of the Transformation of Business Models for Circular Economy

The prior sections have provided an account of TSE’s transformation of business models for circular economy from 2007 until the present. The key concepts have been identified and explained relating to the practices that the firm has engaged in across four themes of: *Optimising internal process*; *Avoiding material leakage*; *Enabling material recirculation*; *Holistic resource thinking*. Based on this analysis an empirical model is offered that presents how a firm engages with CBMI over time (see Figure 5).

The model uses the four identified themes to build a temporal model of four phases of time whereby different CBMI practices were most prominent. The characterisation of Wells and Sietz (2005) is used to discern that the firm focused on different resource loops in each of these

phases, moving from: *Internal cycling of materials*; to *Post-Business loops*; to *Post-Consumer loops*; and finally, *Combined loops*. Hereby, it is important to note that the practices identified in prior phases do not cease but the focus of the firm has changed. In this sense, the firm's engagement with CBM grows in magnitude and scope over time. The shifting from one phase to the next is supported by four enabling factors: *cost saving logic*, *value chain scoping*, *co-creation opportunities*, *societal demand changes*. These enablers are increasing in scope as CE increasingly comes into the mainstream business and society agenda. The model shall now be explained in more detail.

The first phase of transforming business models for circular economy concerns the internal cycling of materials. In this starting period between 2007-2010, the company focuses on practices that optimise internal processes. The phase is led by the firm's operations team that are seeking to optimise production processes. The firm pursues CBMI activities associated with narrowing resource strategies such as seeking resource efficiencies and closing resource strategies of reprocessing internal waste. These practices are incremental, involve few parts of the organization beyond operations and not disruptive to the extant linear business models in operation.

This initial phase is enabled by the firm realising the cost saving logic of altering business models for circularity. Activities to optimise internal processes have a clear and simple business case of saving costs through reducing virgin material usage for the same level of production. Interviewee A explains this business logic: "the steel industry is quite cost-sensitive, so costs have always been a big driver. And typically, things that you might do to improve environmental performance would, might also have a cost benefit, so you know, reduction in energy use; if you're reduce waste to landfill that has a cost benefit as well." (Interviewee A).

The second phase of our model shifts the focus of activities from internal processes to post-business loops of resources from 2011-2016. In this phase the firm takes a boarder perspective on CBMs and considers how resources can be collected and returned between firms in the value chain to stop them from leaking from the industrial system (Wells and Seitz, 2005). The phase is primarily concerned with developing CBMs associated with closing resource loops such as industrial symbiosis. The firm develops its product recycling capabilities and looks beyond current value chains to identify partners that it can connect with to use the waste and by-product it cannot eliminate.

This second phase is enabled by value chain scoping, whereby the firm's search heuristics are expanded from internal processes to across the different value chains of its products applications. Activities on CBMs becomes "very multifunctional" (Interviewee A) with an

expanded set of internal actors involved in CBM due to the wider understanding needed. For instance, a strong technical understanding of the options for the use of the firm's waste in different processes. The firm becomes more oriented toward forming external partnerships and working to find synergies with activities happening to pursue circularity within value chains.

The third phase identified in our CBM transformation model concerns activities focused on post-consumer loops (Wells and Seitz, 2005). In this period between 2017-2021, the firm pursued a role of supporting its customers to develop CBMs that close their post-customer loops i.e., CBMs such as refurbishment that requires obtaining the used products from the end-user at the end of the first use phase. As TSE is a firm early in the value chain it is commonly far from eventually end-users and not well placed for CBMs that involve return flows. Instead, TSE realised that its customers are normally better placed and customers in some of these sectors such as automotive are increasingly interested in CBMs of slowing resource loops. TSE can still help with how steel enables these models through characteristics such as long lasting, being transparent on product configuration and helping with circular designs that use steel.

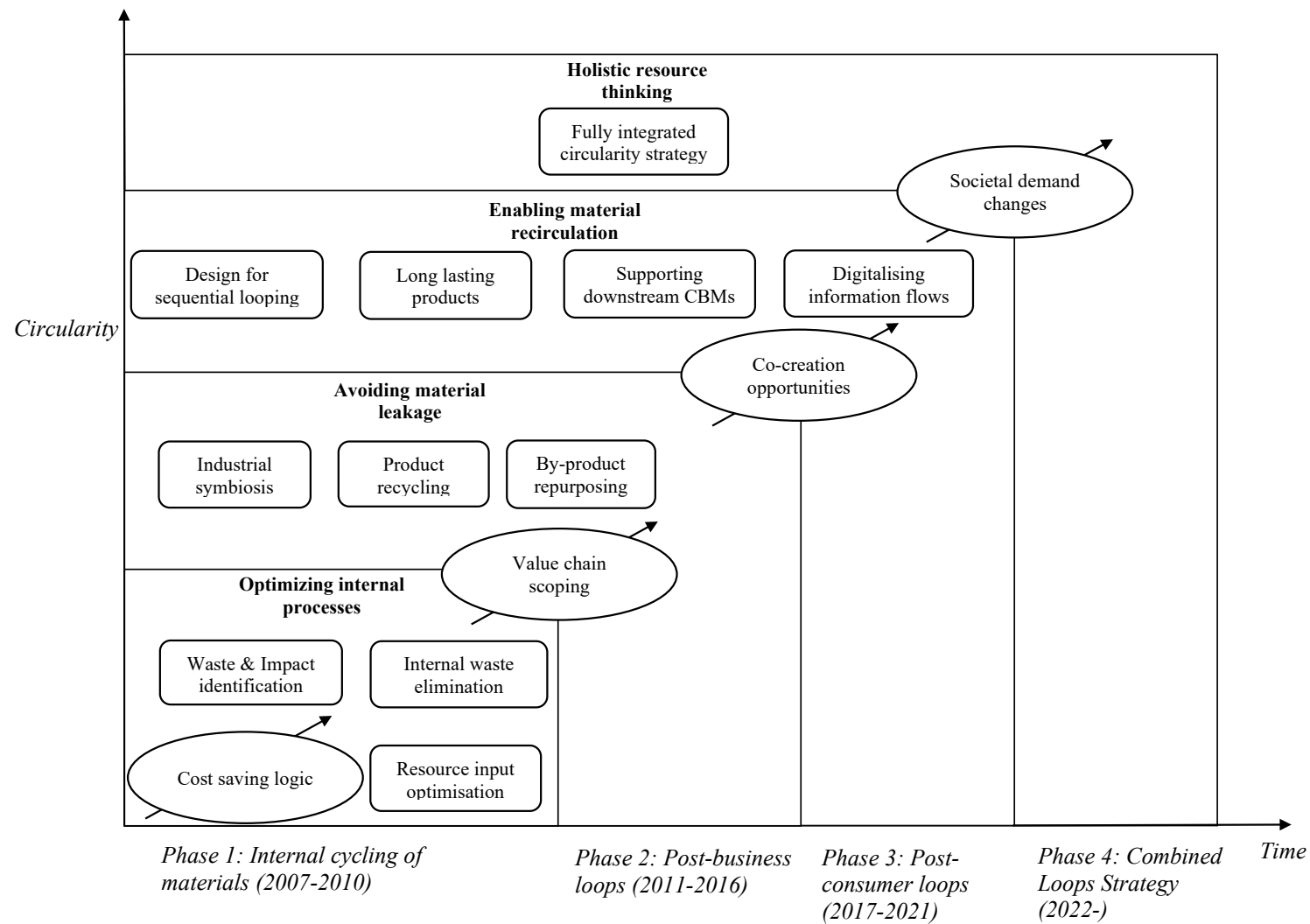
Enabling the third phase is the firm's attitude for seeking *co-creation opportunities*. CBMI begins to utilise customer facing departments of sales and marketing to receive signals from customers calling for upstream partners to facilitate their creation and implementation of CBMs. For TSE, these external partnerships also represent an opportunity to spread the financial burden of technological innovation and ensure there is a marketplace for more circular products. Interviewee A explains the importance of marketing department to find and create the right conditions: "if customers are ultimately not prepared to pay for it, because the Society isn't prepared to pay for it. Then the challenge as to how we reconcile that when we are a very cost-sensitive business that operates in a global market".

The final phase concerns moving to a strategy of combined resource loops whereby the firm is actively pursuing CBMs of narrowing, closing and slowing concurrently. Furthermore, CBMI is well integrated into the wider firm strategy and its pursuit of other sustainability aims such as climate action. TSE is entered this new period in 2022 with the release of a new sustainability strategy and targets and increasing pursuit of circularity on multiple fronts.

This final phase is catalysed by *changes to societal demand*. The implications of the linear economy are becoming more evident to European stakeholders, including its effects on changes to the climate. Stakeholders are increasingly calling on firms to improve sustainability and circularity performance, including notably sectors such as steel that have a high environmental impact. Interviewee B indicates new pressure from stakeholders to accelerate action on circularity: "I also think a challenge for the future is the speed of the requirements, the speed of

that society wants sustainability, and the society wants circularity. And the government wants sustainability.” New societal demand also provides opportunities in the marketplace for products with enhanced circularity characteristics as TSE’s customers also face the same societal demands. Interviewee A offers the changing dynamics of the marketplace: “the dynamics changes a little bit in that companies now trying to recognize the value of the greener products and trying to orient around those. I suppose, those greener products, have been driven by society.”

**Figure 5. Transformation of Business Models for Circular Economy**



## 5. Discussion

In this section, the report shall discuss the implications of the empirical findings and the contribution of the study to the field of CBMs. The discussion is presented in three parts: Theoretical implications, managerial implications, and limitations. Suggestions for future research are infused throughout the discussion.

### 5.1 Theoretical implications

*Empirical model of Transformation of Business Models for Circular Economy.* This report contributes to the existing literature on CBMs by offering an empirical model of CBMI revision based on the findings of a single qualitative case study. Scant empirical studies currently provide insight to CBMI revision. The model of this report offers how a firm gaining in maturity moves its focus to different types of resource loops (e.g., internal, post-business, post-consumer) and engages in different CBM practices. Moving from one phase to the next is stimulated by a key enabler that can be internal or external to the firm. Increasing maturity moves the firm to action on combined resource loops as the firm increases its engagement throughout the process over time. By identifying these phases and elucidating the activities of each phase provides new insight to how incumbents engage with CBMI revision. Further research may consider the factors that may accelerate or hinder the progress through the phases such as organizational culture and top management support. Studies may seek to understand if phases are conditional on certain factors such as firm competencies and link phases of the process to the environmental performance of the firm.

*Revision by innovation accumulation.* The few existing studies treat CBMI as a singular one-off process within firms whereby they must pass through a series of process steps to achieve the CBM outcome (e.g., Bocken and Konietzko, 2022; Frishammer and Parida 2019). The empirical model of this report offers an expanded view on CBMI revision, presenting it as a series of practices that firms engage with that accumulate to transform the company over time. As a large incumbent firm, radical innovation as a one-off process is likely to be very risky and highly challenging, not least due to the scale and scope of its operations and the bravery required (Nadler, 1995). Findings of the single case study present that the CBMI revision took place over the course of four phases, and in the form of innovative manufacturing processes and new product launches. In this sense, CBMI revision is progressed through a series of incremental steps rather than a single defined innovation process aimed at overhauling the linear business model in one stroke. Progress was iterative and non-linear but also accumulated to revise the business models in operation. This is in line with Hofmann and Jaeger-Erben's (2020) category of 'adaptation' of slowly infusing circular logic. It breaks the dichotomy between incremental



and radical innovation (Plowman et al., 2007), and presents the value of continually innovating for CBMs over time.

*Frequency of CBM(I) types.* Extant literature has identified diverse types of CBMs firms are innovating, yet empirical evidence on which are more commonly being engaged with is scant. Findings of the computational text analysis indicate that firms are mostly engaging with CBMs of narrowing resource loops and engaging with CBMs of slowing resource loops the least. The single qualitative case study also presented that the firm mainly engaged with CBMs of slowing loops after experiences with CBMs of narrowing and closing resource loops. This finding supports the study of Stewart and Niero (2018) that found much greater corporate disclosures related to activities of narrowing (e.g. energy efficiencies) than of slowing (e.g. design for extending product life).

The finding may be explained by the radicality of the innovation. CBMs of narrowing resource loops are closely associated with a linear economy and require only incremental innovation within a firm (Bocken et al., 2016). CBMs of narrowing resource loops do not require a distinct change of logic within a firm and have a very clear and easy business case for managers and employees to understand e.g., do more with less. CBMs of slowing resource loops require the most radical innovation within firms and a substantive change to the value creation activities of incumbent firms that may have been operating the same business model for long time periods. While CBMs of narrowing resources can mean that current linear business models can continue with small alteration, CBMs of slowing resource loops can require much bolder commitment and action.

*Value chain position and CBMI type.* Findings of the single qualitative case study present that the firm was unsuitably placed to pursue many CBMs of slowing resource loops. Instead, it supported the development of these business models in upstream partners but only after they signalled intent and demand. Much of the existent CBMI literature has been ambivalent to value chain positioning while there is cause to suggest that it is an important factor. Future research may seek to investigate the impact of value chain position on CBMI revision through multiple case study research.

*Impact of engaging with the CE discourse:* Findings of the computational text analysis indicate that firms adopting the language of CE may have greater engagement with CBMI. Although this report does not address the causality of the relationship, it may indicate that engaging with the discourse of CE leads to progress on CBMI within the firm. Yet, CBMs of slowing resource loops remains low for the group adopting the language of CE and by far the least engaged with. Notwithstanding the difficulties expressed above on innovating slowing resource loops, this

finding may also indicate that the concept of R-hierarchies is not being followed well. R-hierarchies offer a preferential structure to CBMs (Potting et al., 2017; Zhang et al., 2022) whereby activities related to slowing resource loops is preferable to some activities of closing resource loops such as recycling. Future research may seek to understand when and how are incumbent firms using the R-hierarchies framework for CBMI. Findings of the computational text analysis also offer that there are some far outlying companies that are engaging heavily on slowing resource loops, particularly in the industrial sector. Future studies may identify these firms and conduct case study analysis to understand why and how these companies have achieved this level of engagement.

## 5.2 Managerial Implications

The findings of this report have multiple implications for managers of large incumbent firms aiming to revise business models to CBMs.

*Adopting language of CE.* Findings from the computational text analysis offer engagement with CE for incumbent firms in Europe is far from universal. Only 64% of firms deemed it significant enough to disclose within the annual or sustainability corporate reporting. This indicates that more work is needed to further educate firms on CE within Europe and for it to achieve high status on corporate agendas. It is also a cause to note that incumbent firms in Europe are now at vastly different starting points and require more tailored support for making CBM progress. Managers of incumbent firms may also use the finding that firms that adopt the language of CE may have greater engagement with CBMI as a stimulus to encourage learning on CE within the firm and create internal policies and strategies that support it being embedded within the firm and its culture.

*Conducting a CBM assessment.* This report prompts managers to make assessments of their firms on what type of CBMI does it currently engage with. Findings of the computational text analysis prompt questions such as: Is the firm translating CE action to solely mean action on narrowing resource loops? Or does the firm pursue innovation across the three different CBM types of narrowing, closing and slowing resource loops? By conducting such an internal audit, managers are better positioned to understand where the company is on its transformation journey to CE.

*Furthering CBM transformation.* Findings of the qualitative case study prompts questions on how the firm can progress its engagement with CBM. While the report does not provide a blueprint for CBMI revision it does identify activities and phases that managers may draw upon as a sensemaking device. Managers may draw parallels to their own experiences or draw insight

to how their firm may progress through accumulative CBMI activity over time. Challenges and reasons why certain types of CBMs are not being pursued can be assessed, and managers may consider what types of enablers are needed. For instance, being able to co-create opportunities with value chain actors through new internal parties such as sales and marketing being involved with CBMI.

Firms primarily engaging with CBMs of narrowing resource loops may also consider if it is helping or hindering further CBMI, such as on slowing resource loops that may lead to larger advances of environmental performance. Managers may ask if CBMs of narrowing resource loops are perfectly optimising the wrong business models making transformative revisions harder (McDonough and Braungart, 2010) or if they are used as a steppingstone to engage with more transformational CBMI.

### 5.3 Limitations

This report has important limitations that need to be acknowledged. Limitations will be used alongside the contributions of this report to offer directions for future research.

*Computational text analysis.* Computational text analysis was performed using corporate reporting to infer the engagement of firms with CBM and CBMI. An important limitation with this dataset is if corporate rhetoric is not well coupled to corporate action. Corporate disclosure may not reflect substantive initiatives but can be merely symbolic or used to placate demanding stakeholders e.g., a form of greenwashing. Future studies using corporate reporting as a dataset may seek how data incidents may be triangulated with other secondary and primary sources of data.

Analysis used a dictionary-based approach and frequency counts of keywords to infer engagement with CBM. A limitation of this approach is that frequency counts did not discern the use of the keywords (Landrum and Ohsowski, 2017; Stewart et al., 2018). For instance, is the firm detailing active pursuit of the CBM, mentioning it as a matter of concern, or as a discontinued project? Furthermore, it is possible that some companies may purposefully avoid jargon and be misrepresented by keyword searches. Future studies may seek to utilise advances in computing and engage in training computing software to understand context of keywords, and ways to identify relevant data incidents without keywords. Future studies may also seek more refined capturing of CBM types beyond the resource perspective such as identifying business models such as functionality-not-ownership or sufficiency (Bocken et al., 2016).

The analysis of this report used only cross-sectional data of a single year of corporate reports. Thus, findings present only a snapshot in time. Studies may seek to build on this report by capturing how language and CBM patterns change over time. This type of study can provide insight and support to the findings of the case study conducted by this report. Studies may seek answers from interesting questions such as “does the CBM engagement of industries mature over time?” Answers to such questions may reveal how industries mature and evolve their engagement with different CBM types.

The report used a mixture of corporate reporting for its dataset. This included 43 annual reports and 12 integrated reports within the 147 reports in total. This may have impacted findings as these reports may use different language to corporate sustainability reports. For instance, an industry with a high number of annual reports used may show less engagement with CBMs than reality. Though, the absence of sustainability/ integrated reporting for these firms may itself offer an indication that the firm may not be significantly engaging with CE. Additional analysis may be conducted removing these reports from the dataset. Future studies may seek to further take into account these reporting type differences.

Relatedly, firms engaged with corporate sustainability reporting are influenced by mandatory reporting guidelines and voluntary guidelines such as the Global Reporting Initiative or the Value Reporting Foundation. The study of Opferkuch et al., (2021) found that “the majority of the sustainability reporting approaches reviewed have no mention of the concept of CE” (p. 9). This indicates that the selection of which voluntary guidelines a firm chooses to follow may not have large implications on their disclosure of CE. Future studies could investigate this and critically seek to understand if and how the different guidelines are stimulating firms to engage with CBMs.

This report focused on large incumbent firms within Europe. European firms are perceived among the leaders in corporate sustainability for large firms. The findings of this study could be followed by studies seeking comparisons with firms in different parts of the world. This may reveal differences in extent of CBM engagement, and potentially differences in CBM types that are being followed. Studies could seek to investigate the reasons for such differences. Studies may also seek to collect data on incumbent small and medium size firms that also need to transition. Research methods will need to consider that corporate sustainability reporting is unlikely to be available, and other data collection methods such as surveys may be needed to collect large datasets.

*Single Qualitative Case Study.* The report offers insight into the transformation of a single incumbent company. Findings are not intended to be generalisable but may be transferable to

offer large incumbent firms (Yin, 2009). It does not intend to be transferable to small and medium sized companies. The empirical model itself also does not intend to be a blueprint for transformation, nor is it accompanied by guidelines for application. Transformations of firms may be different under different conditions such as size of the firm, industry type, company competencies, institutional factors, etc. Instead, the single qualitative case study design enabled deep engagement with how a firm is transforming over time and reveals a narrative and business practices that may help to develop theory and practice. Future research may seek to investigate when the empirical model is transferable, and under which conditions it is different. Multiple case study designs can be employed selecting a diverse sample of large incumbent companies to identify different approaches to CBMI revision. Furthermore, studies may expand the focus to companies with CBMs primarily on the biological cycle of CE to search for differences with the case of this report that investigate a firm with CBMs primarily on technical cycle.

Analysis of the case study was based on interviews and secondary documents. While the report aimed for theoretical saturation it is acknowledged that adding further interviews may have revealed further insights (Saunders et al., 2007). Adding further documentation not authored by the firm in focus may have offered different perspectives on the transformation. Further information relating the changing institutional context and operating environment would have also strengthened the study. As presented in the case study CBMI transformations can be highly collaborative and thus a more holistic view is needed to fully understand the transformation of a single company.

Data collected from interviews is recognized to have limitations such as the possibility for interviewer and interviewee bias. For instance, interviewee responses may have omitted information or have been oriented to satisfy interviewer expectations. While steps were taken to avoid such biases (e.g., triangulation, validation interviews etc as detailed in the methods section), the report acknowledges their potential impact. Data was also collected at a single moment in time to build a retrospective account that offered interviewees the benefit of hindsight. Future studies may seek to study CBMI revision longitudinally by collecting data either continuously (such as by ethnography) or at set intervals over time.

The report selected to study a current market incumbent transforming to CBMs. This implies a survivor bias in the case representation. The firm is seemingly implementing CBMs with enough commercial success to continue operating and continue its transformation to CBMs. Yet, the report also acknowledges that important learnings may also be derived from investigating cases of failure whereby companies cease CBM activities or cease trading completely. It is recommended that future studies may seek to identify and pursue such case studies.

Finally, the report did not investigate the calibre and degree of effectiveness of the identified circular activities and practices. No assessment was made of the firm's environmental performance over time and no claims can be made on the suitability of the firm's transformation for addressing global environmental challenges. Future studies may seek to integrate such data to inform how CBM engagement impacts firm's environmental performance.



## 6. Conclusion

Business activities of large incumbent firms contribute significantly to global environmental challenges including climate change and biodiversity loss. These firms are being increasingly called upon to revise linear business models operating ‘take-make-waste’ philosophies to CBMs founded upon an intention to be regenerative (Ellen MacArthur Foundation, 2013).

This report offers that CBMs are attracting much scholarly attention. Studies are effectively determining their characteristics, types and offering categorisations that can be used by managers as a source of design inspiration (*see* Rosa et al., 2019). This report furthers this work by providing insight to which types of CBMs large incumbent firms in Europe are engaging with. Findings indicate most engagement with CBMs of narrowing resource loops and least engagement with CBMs of slowing resource loops. Thus, findings indicate firms’ preference for CBMs that require only incremental, low risk change to extant business models. Analysis also indicates to an impact of firms engaging with the CE discourse on their activities with CBMs, presenting this as a potentially useful way for managers to accelerate firm action.

The report also attends to the innovation of CBMs (CBMI). Extant studies on the process of CBMI are found to be scant, and only narrowly consider it as one-off process whereby the firm follows through a series of process steps (e.g., Frishammer and Parida, 2019). This report contributes to understandings on CBMI by offering a broader examination of how a large incumbent firm undergoes revision of its business models for circularity over time.

The main contribution of this analysis is a process model that presents shows how the CBMI transformation process evolves over time through four dominant phases. Each phase is characterised by distinct dominant practices that move the firm from addressing internal resource loops, post-business resource loops, post-consumer resource loops, to finally a combined resource loop strategy (*see* Wells and Seitz, 2005). The model presents how a firm can accumulate and build upon knowledge and experience with CBMI and enter new phases due to enabling internal or external factors. For instance, new opportunities for co-creating CBMs led the firm into a phase of helping downstream value chain actors to design CBMs for slowing resource loops.

Much effort is needed for large incumbent firms to transform to CBMs and at a speed necessary to suitably address the climate and ecological emergency. This report intends to help accelerate that process and invites scholars and practitioners to utilise its findings to further this aim.

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