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12 Finance and accounting in the circular economy

Abstract: This chapter discusses finance and accounting in the circular economy transition. Strategic decision-making in organisations is determined mostly by financial ratios to maximise financial profits. When companies adopt a circular business model, creating a positive environmental impact becomes part of the strategy and needs to be accounted for. Unfortunately, accounting for circular business output and impact is at odds with classical accounting, which is based on linear business models. By using data from three business cases that are in the process of creating a viable circular business model, we show opportunities and bottlenecks of financial accounting and financing for companies with circular business models.

The inability of current accounting principles and structures to register the additional value of circular business models, coupled with the lack of understanding surrounding the risks involved, is a major hurdle for valuing and funding these business models.

Keywords: Circular Economy, Sustainable finance, circular accounting, business model innovation, circular business models

Introduction

Circular business models (CBMs) are characterised by their value creation through circular activities and strategies designed to close the loop by reusing resources and materials. Design for longevity, modularity, refurbishing and recycling are all examples of company strategies to create financial value without harming the planet and its inhabitants (Bocken et al., 2016). For a company in transition towards a CBM, it is important to know how to capture and report the multiple values it aims to create with its CBM (Lahti et al., 2018). Understanding all costs and benefits of economic, environmental and social value created, and connecting them with the decision-making process, will support businesses that aspire to a CBM (Dewick et al., 2020).

It allows companies to integrate economic, environmental and social value and report on their multiple value creation. However, current managerial and financial decision-making is primarily informed by financial profits. This results in a situation where companies delivering high financial returns are favoured by capital providers even if they generate negative impacts and cause social and environmental harm. This creates an imbalance where companies that generate positive social and

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environmental but have relatively low financial returns have difficulties raising enough capital to grow or survive. In short, externalities of business activities (i.e. the positive and/or negative social and environmental effects) are not sufficiently considered in decision-making because their impact is not expressed in financial terms.

Understanding the differences in financial and accounting valuation of linear and circular business cases could bring us closer to creating a level playing field to assess all companies by the same standards. This could result not only in accounting for financial value, but integrating financial, environmental and social costs and benefits (Aranda-Usón et al., 2019). Adding climate change and other environmental and social risks into the economic context would require mapping of and accounting for the externalities of creating products and services. The next step would be to incorporate them into the production and selling costs. (Albuquerque et al., 2019). This way, companies that generate the highest overall positive impact will become most attractive for investors in their pursuit to receive return on their investment (Elkington, 2017; Garcés-Ayerbe et al., 2019).

Creating a level playing field is easier said than done. The financial sector focusses on optimising financial profits (Musinszki & Suveges 2019) and neglects positive environmental and social impact (Galletta et al., 2020). This paradigm is not a matter of bad intention: it finds its origin in the industrial era in which large amounts of natural and human resources were available. Currently, society is facing the consequences of human and natural exploitation, and the damage to biodiversity and the onset of climate change (Salvioni & Brondoni 2020). The effects of climate change on living conditions require society to move to a new paradigm in order to stay within our planetary boundaries (UNESCO, 2013). In this chapter, we make the case that financial profits can no longer be the measure of success, but that economic prosperity depends on balancing financial, environmental and social returns (Wijkman & Skanberg 2014), and on executives who steer on maximising positive overall impact instead of financial profits. The case studies presented in this chapter show how businesses aim to develop CBMs that balance these returns. At the same time, these cases illustrate the hampering effect of current financial and accounting rules and frameworks.

With all societal and environmental challenges, companies and financiers have become aware of the economic costs of externalities and are changing their strategies. Companies with circular strategies create value for society and are the type of companies in which we ought to invest in order to avoid more and larger damages in the future (Ghisetti & Montresor 2020). The lack of understanding of CBM value creation and the vacuum of investment strategies hinder recognising and valuing the full potential of companies with CBMs (Aranda-Usón et al., 2019). Financial institutions are inclined to finance business models that they are already familiar with. This means that financiers are more likely to invest in CBMs that are familiar, such as recycling (Djuric et al., 2017), and reluctant to invest in CBMs taking a more

radical approach: redesigning entire products or selling services connected to products (i.e. Product Service Systems (Tukker, 2004, 2015) (Stumpf et al., 2020)). More radical CBMs can deliver more substantial environmental and social benefits. But because they are different in terms of how and what value is created, financiers and accountants have difficulties understanding the strategy and the financial incentives behind them (Ozili & Opene 2021). Depending on the type of revenue model of a CBM and how circular incentives and activities are included in the agreements, the financial reports of CBMs – the main informants of financial decision-making – will differ from the reports of their linear counterparts. Hence, CBMs will encounter major obstacles in attracting necessary funding.

Structure of this chapter

We have used empirical materials from three cases to explain the current perspective of financiers and accountants on (the value of) CBMs, and how the financial sector is challenged to rethink assumptions and principles needed to better understand value creation by and financial funding for CBMs.

Methodology

Empirical data have been gathered by the authors in the Coalition Circular Accounting (CCA) (Coalition Circular Accounting, 2020a, 2020b, 2020c). This coalition was initiated by Circle Economy and the Dutch association of chartered accountants (NBA) with the aim "to identify and overcome accounting-related challenges that hinder the transition to the circular economy." The coalition is characterised by its pre-competitive environment through which experts and scientists in the fields of finance, accounting and law work on practical cases. Our case study focuses on three CCA cases: (A) road-as-a-service (RaaS), (B) facades-as-a-service (FaaS) and (C) valorising residual resources (VRR), spanning from 2019 to 2020. The three CCA case trajectories were organised with an interactive format in which a real-life circular business case was the focal point. Workshops and thematic deep dives were organised to discuss specific topics such as the value proposition, valuation and reporting issues, risk perception and financeability issues of the CBMs.

The three case trajectories have been fully recorded, and afterwards were transcribed, coded and analysed. Also, financial models of the CBMs that were created and discussed during the case trajectories were used in our analysis. These data provide detailed accounts of how CBMs are developing their value propositions and why financiers and accountants experience difficulties correctly interpreting and valuing these CBMs within their current professional frameworks.

This chapter is written as a position paper. Based on the empirical materials, ideas and concepts that are relevant for scholars and practitioners interested in the interface of CBM creation and finance and accounting are explained and discussed. The next section provides key concepts regarding CBMs in relation to accounting and finance.

These concepts are further clarified by using an illustrative business case[1] to compare accounting and finance results for circular and linear BMs. Then, three empirical business cases are introduced, and results are presented that show difficulties regarding understanding, valuing and financing CBMs. The preliminary section discusses what changes can be considered to better understand and support CBMs and create a level playing field. The final section of this chapter provides a brief conclusion.

Circular business models, accounting and finance

Circular business and value creation

In the circular economy, institutions and companies take a more long-term perspective on value creation. Instead of the linear take-make-use-waste trajectory of a product, a CBM aims at using products and materials in continuous loops where products are managed in ongoing cycles (Geissdoerfer et al., 2017). To get the most out of the value of raw materials, each product life cycle phase should be extended as much as possible, by applying the circular principles of cascading, e.g. staying in the inner loops as long as possible and finally reaching the last loop of material recycling (Ellen MacArthur Foundation, 2013). Bocken et al. (2016) describe these fundamental circular strategies as slowing, closing and narrowing the loop. Figure 12.1 visualises the cascading activities that can be used to slow, close and narrow the loop.

One-directional linear supply chains must develop to multidirectional value chains with products and materials going back and forth. They will have many different interactions between supply-chain partners and have to be supported by IT and software and supporting services to organise and manage the system effectively (Genovese et al., 2015). In a circular value chain, companies can capture the value of products and materials not just by selling them once, but also by selling them and buying them back at a later stage or even by retaining total ownership. There are three general ways for a company to make their products or materials available to a client and generate revenue, sometimes referred as revenue models (Lüdeke-Freund et al., 2019). The revenue models that we distinguish are:

1. **Sale:** A sale is a transaction between two or more parties in which the buyer receives tangible or intangible goods, services or assets in exchange for money. A

1 Given the confidentiality of the financial figures of the three cases, which are based on business cases for actual investment proposals, the insights from these cases have been incorporated into an illustrative case study, washing machine-as-a-service case study. In this illustrative case, financial figures can be shown and the insights from a business case, financial and accounting perspective can be shared.

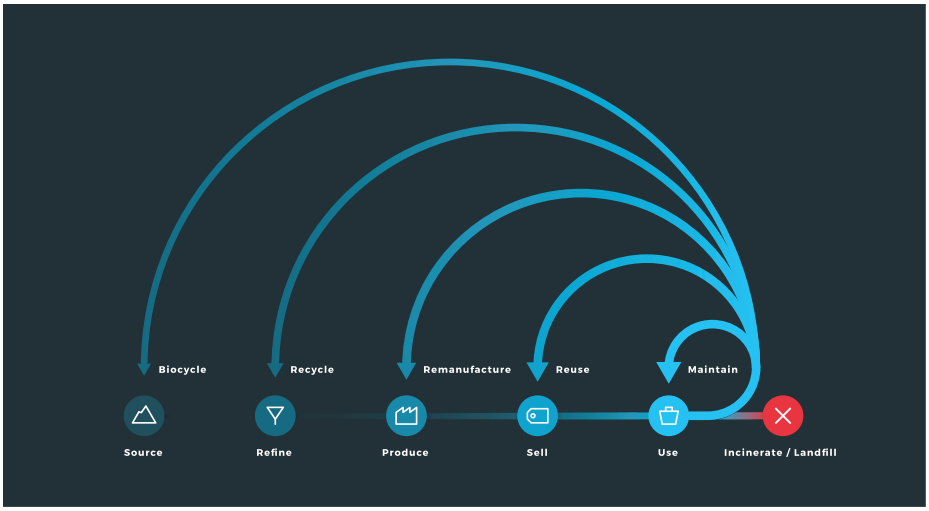

Figure 12.1: Circular 'cascading' activities (i.e. maintain, reuse, refurbish, recycle) can be used to slow, close and narrow the loop.
Source: Circle Economy (2016).

classic example is a company that sells a product to a client. By far, most economic transactions are sales transactions. In a sales transaction, the ownership of and the responsibility for a property is transferred (Ritzén & Sandström 2017).

2. **Sale and buy-back:** In a sale and buy-back transaction, the producer sells the product to the user with the aim (and potentially a formal agreement) to buy it back at end-of-use. There can be an agreement on a price upfront or the agreement can be made at the point of buy-back. Since the seller does not know what the state and value of the returned product will be, agreeing on a price beforehand can be a risk. However, if resource prices turn out substantially higher at the point of return, an upfront agreed price can be a benefit. When a sale and buy-back is formalised in a contract, this provides clarity and obliges both parties to adhere the contract. Without a formal agreement, a sale and buy-back becomes facultative. The sale can fall through in a situation where there is no formal agreement and the producer does not want to pay the price at the time of buy-back, or when there is another party that offers a higher price (Peace, 2014). In 2020, the Swedish furniture company Ikea started a large buy-back programme in 27 countries without a contractual agreement with its customers. They can get up to 50% back for their old Ikea furniture.
3. **Product-as-a-service (PaaS):**[2] In a PaaS business model, a product is not sold, but rather the performance of the product is sold. An example is the 'pay-per-

2 Note: There are many ways to combine products and services. Please see the extensive literature on product service systems (PSS) for a complete overview.

lux' business model from Philips. Philips maintains ownership of and is responsible for the fittings and light bulbs, while the client pays a periodic fee for enjoying the light (lux). PaaS is characterised by an ongoing contractual agreement – a service agreement – between the producer (and service provider) and the client. Moreover, since all products are returned to the producer after their use, the producer will benefit from creating a sustainable product that can easily be maintained, repaired, remanufactured and recycled (Romero & Rossi 2017).

These three revenue models each have certain effects on accounting structures of a company and are perceived differently by financiers. The longer the time horizon and the more control over products and materials (through buy-back agreements or service agreements), the more challenging for accountants and financiers to value circular companies. The reason behind this will be further explained below.

Circular business and accounting

The accounting process includes recording, summarising, analysing and reporting financial transactions pertaining to a business. The **financial statements** used in accounting are a concise summary of financial transactions over an accounting period, summarising a company's operations, financial position and cash flows. These financial statements include (1) the balance sheet, (2) the profit and loss statement (or income statement) and (3) the cash flow statement.

Balance sheet

The **balance sheet** shows the assets of the organisation, which must be in balance with the equity and debts of the company to finance the assets (Atrill & McLaney 2006). The **profit and loss statement** (P&L) shows the costs and revenues, and the profit (or loss) made.[3] The **cash flow statement** shows the cash flows of an organisation, consisting of profits and cash flows from operations, investments and financing. Transactions are recorded in the general ledger – the structure of accounting, each of which has a relationship with the balance sheet or P&L account (see Figure 12.2). Based on the relationships within this common structure, analysts and financial institutions can assess the vitality and the continuity of an organisation compared to

3 Definitions matter. Profit (loss), for instance, can relate to ongoing operations only, but can also include one-off transactions such as acquiring a firm or changing a firm's reserve position. Usually, profit (or loss) focuses on earnings before interest, taxes, depreciation and amortisation (EBITDA).

other organisations in the sector. The financial statements are subject to accountancy and other rules and guidelines set by financial and accountancy authorities such as the International Financial Reporting Standards Foundation (IFRS) or the Generally Accepted Accounting Principles in the United States (US-GAAP). Figure 12.2 presents a stylised picture of how the balance sheet, P&L and cash flow statements are related.

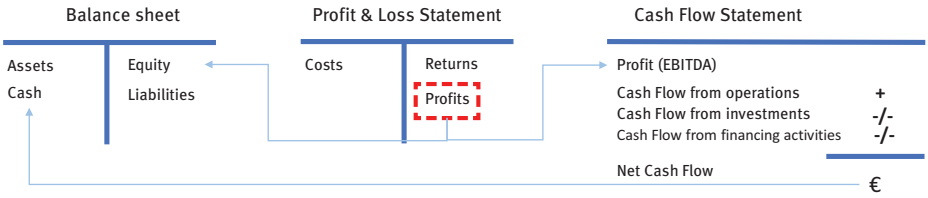

Figure 12.2: General accounting structure and relationships between the balance sheet, P&L and cash flow statement.
Source: Authors.

Accountants are responsible for the financial accounts and reports. The reports may include additional (non-financial) information to the financial data provided. In order to rightfully assess the activities and assets that a CBM represents, auditors have to understand the value created by companies that apply circular strategies and activities (Goretzki, 2013). Depending on the type of revenue model of a CBM and how circular incentives and activities are included in the agreements, these reports will differ from the reports of their linear counterparts. CBMs base their revenue on the multiple values created through circular activities (e.g. maintain, reuse, refurbish, recycle). Their aim is to use circular economy principles to create insight in the multiple value creation – optimising the use of products and materials and closing materials loops for continuous reuse of materials. Extending value creation beyond one product use cycle implies a long-term perspective. Moreover, this manner of managing products and materials in ongoing cycles implies a decrease in resource depletion, hence a decreasing environmental impact.[4] Exactly two benefits of circular business – (1) taking a long-term perspective, and (2) taking external benefits into account in production processes, and hence into price – are also visible in their accounting structures and are currently not well perceived by financiers. The reason for this is that when compared to reports from linear companies, the reports of circular businesses will show additional burdens due to holding on to

4 In reality, this is more complex. There is a trade-off between reducing resource depletion and increasing logistic movements. We assume that the impact of resource depletion is substantially more severe than the impact from increasing logistics. Moreover, organising logistics in a sustainable manner can further support this argument.

products and materials for a longer time span and performing circular activities that may yield return on investment only in the long run. Moreover, CBM activities that generate external benefits can entail extra costs that appear in the financial statements of the company.

Future financial results of CBMs are uncertain because they have strategies and revenue models that go beyond traditionally assumed time horizons and their control over products and materials. Because of their novelty, there are no long-term historical data available for CBMs, which makes it difficult for external auditors and financiers to assess their performance. Besides this lack of historical data, investment patterns often differ from their linear counterparts, because some CBMs choose to maintain ownership of, and responsibility for, products and materials over a longer period instead of buying materials and selling products following a rapid sequence, as is the characteristic of linear supply chains. Hence, companies with CBMs seem the odd ones out when they are benchmarked against their linear counterparts. Why and how financial reporting of CBMs is so different from linear ones will be discussed below.

Asset valuation and depreciation

Composing a balance sheet involves listing all the assets of a company. Assets contain economic value and/or future benefits and can be converted to cash. There are two broad asset categories: (1) Current assets can be converted into cash within one fiscal year. Examples are cash, accounts receivable and inventory. (2) Fixed assets are used to produce goods and services and have a lifespan of more than one year. Examples are land, buildings and machinery. Assets are depreciated throughout their useful life, meaning the asset value declines over time. This enables spreading the initial price of the asset over its useful life (i.e. economic lifespan). When an asset is no longer used, it is depreciated to zero, meaning it no longer has value for the company. In a circular economy, however, products and materials are managed in ongoing cycles. Therefore, one could argue that in a circular economy, we must take a different perspective on depreciation (Korse et al., 2016).

Circular business and financial assessment

Companies need financial capital to start and develop their business. Their financial structure reflects the mix of debt and equity that a company uses to finance its operations. Financial structures differ from company to company and from sector to sector. To increase the comparability of companies, financial ratios have been developed. Financial ratios are calculated with specific formulas and based on the numerical values taken from the financial statements. They provide a quantitative

analysis to assess a company's solvency, liquidity, leverage, growth, margins, profitability, rates of return, valuation and more. Related ratios, explained in some detail below, have been developed over many centuries and are designed to give the capital providers insight into the risks they are taking by investing in the firm.

Financial ratios

Here the focus lies on three commonly used ratios that will turn out different for linear and circular business models: liquidity, solvency and profitability:

- The *liquidity ratio* indicates whether a company has sufficient cash in hand to meet all its payment obligations in the short term and is calculated based on cash and cash equivalents and short-term borrowed capital. Quick ratio and current ratio are both indicators for cash flow and liquidity. Quick ratio is defined as the ratio between quickly available or liquid assets and current liabilities. The current ratio measures whether a firm has enough (financial) resources to meet its short-term obligations.
- The *solvency ratio* indicates whether a company can repay all its debts if it ceases to exist or goes bankrupt. This ratio looks at the long-term debts and is the ratio of equity capital to loan capital or total assets. An example of a solvency ratio is the debt-to-equity (D/E) ratio.
- *Profitability* ratios are used to assess a business's ability to generate earnings relative to its revenue, operating costs, balance sheet assets or shareholders' equity over time. The most-used ratio is the gross profit ratio. It is the profit a company makes after deducting the costs associated with making and selling its products, or the costs associated with providing its services.

A company that is financially healthy can (1) meet its short-term financial obligations with the liquid assets available to it (e.g. liquidity), (2) pay off its long-term debt (solvency) and (3) generate a profit (profitability). Historical data have been collected over many decades, resulting in clear brackets for ratios (for instance, with mining companies or consumer appliances companies). When a company that has traditionally been a manufacturing company wants to create a CBM and wants to increase its control over its assets (products) (for instance, in a PaaS model), this impacts the ratios. These ratios will likely fall outside the 'commonly accepted brackets', hence are difficult to accept within the current finance and accounting rules and regulations.

Risk

An important reason for applying the financial ratios is to calculate the risk profile of an organisation, or, if an organisation or investor is engaged in multiple activities, of an investment portfolio. One of the reasons management accounting was introduced is to monitor continuity perspective and therefore indicate the risk profile of a company (the continuity principle) (Vámosi, 2000). For investors and other financial stakeholders, the risk that a company will not continue to exist to meet its financial obligations is being assessed by financiers while using the commonly accepted accounting structures. When business models are altered to become more circular, the financial flows of an organisation will change as well (Larrinaga & Garcia-Torea 2022). The above-mentioned ratios will turn out differently in the financial reports of many circular businesses with a CBM. This results in a difficulty comparing these companies with their linear counterparts. From a financier's point of view, a company with a CBM is perceived to have a higher risk profile, since the upside benefits are long-term (often beyond financial assessment time horizon) and uncertain (due to the lack of historical data). Such a company will have to pay higher risk fee for its funding, if it's able to attract funding at all.

Application of concepts to an illustrative case

Having introduced basic and essential concepts related to accounting and finance for CBMs, we can now apply some of these concepts in a fictive case. This fictive case has been created based on the financial models that were developed during the real case trajectories and is a comparison of a linear and a circular scenario. For the sake of simplification and to protect sensitive company-specific data, the authors have created a dummy model for a sales model (the linear scenario) and a PaaS model (the circular scenarios) for washing machines.

Illustrative case: washing machines' business model – linear versus circular

For this illustrative case, we assume there is a washing machine producer that wants to move from selling the products (i.e. the linear scenario) to providing the washing machines in a PaaS model (i.e. the circular scenario). In the circular scenario, customers will pay a fee for every time they use their washing machine. The financial assumptions were modelled in a simplified balance sheet, income statement and cash flow statement for both scenarios to explain the differences between the two and to pinpoint the challenges to change from a linear to a circular business model.

The company currently sells 5,000 washing machines per year for a selling price of €750 each. These washing machines have a lifespan of approximately 10 years. In the proposed new circular model, washing-as-a-service (WaaS), the company will charge the customers for a unit price of €1.50 per wash, which amounts to a variable fee received by the producer every month. First, the balance sheet of the fictive linear and circular washing machine company is provided in Figure 12.3 (linear) and Figure 12.4 (circular).

Balance Sheet (linear)	Year 1
Assets	1,500,000
Machines to produce washing machines	1,000,000
Cash	500,000
Liabilities	1,500,000
Equity	500,000
Debt	1,000,000

Income statement (linear)	Year 1
Turnover	3,750,000
Costs overhead and retail	2,500,000
Depreciation	100,000
Interest	50,000
EBT	1,100,000

Figure 12.3: Linear scenario balance sheet: Selling washing machines for a fixed price (*€).

Balance Sheet (PaaS)	Year 1
Assets	3,500,000
Machines to produce washing machines	1,000,000
Rented washing machines	2,500,000
Cash	0
Liabilities	3,500,000
Equity	500,000
Debt	1,000,000
Extra debt	2,000,000

Income statement (PaaS)	Year 1
Turnover	1,260,000
Costs overhead and retail	2,500,000
EBITDA	–1,240,000
Depreciation	350,000
Interest	150,000
EBT	–1,740,000

Figure 12.4: Circular scenario balance sheet in year 1: washing-as-a-service (WaaS) (*€).

In the balance sheet, the equipment (machinery) to produce the washing machines are reflected as fixed assets, which will be depreciated to zero within 10 years and fully financed by debt. In the case of a linear business model, the organisation will make a profit every year. Based on the CBM, the asset-base (the amount of assets owned by a company) of the company will be expanded by the amount of washing machines that are being 'serviced' to customers that pay a variable monthly fee (# wash cycles * €1.50). The circular company will make a yearly loss in the first few years and will need additional working capital to finance the production of the washing machines and to survive as a company in the first few years.

The washing machines, which have been produced by this company, are valued against the cost price on the balance sheet for €500 each, which results in a total of 5,000 washing machines, hence a valued asset-base of washing machines for €2,500,000. This extended balance sheet results in a solvency ratio of 14% (equity/total liabilities), which implicates a higher risk profile for this company than the linear business model, that has a solvency ratio of 33%.

The amount of rented washing machines will increase in the years to come, since per year 5,000 new units will be produced and provided to customers in a service agreement. In the second year, the company provides services of 10,000 units and the third year of 15,000 units. Based on the price per wash of €1.50 times 14 wash cycles per month, the business model will become more interesting over time. Figure 12.5 shows that the circular scenario starts to generate more revenue that the linear scenario in year 4.

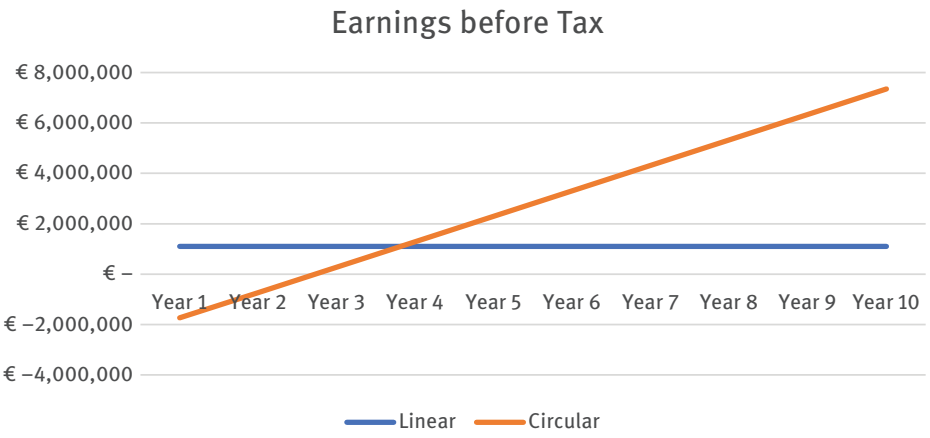

Figure 12.5: Earnings before tax – linear and circular business model comparison washing machines (*€).

The financial results of the linear sales-business model will be more stable in the short run since sales transactions imply cash coming in quickly and this satisfies the short-term horizon of investors. However, the CBM has more future potential since the amount of assets increases over time and the revenue grows. Moreover, a circular asset base implies longevity of the assets; hence, more cash can be generated per asset. The perceived higher risk profile, based on a lower solvency rate and negative income in the first few years, marks an investment that results in a higher potential for the longer term.

Based on this simplified financial model, a cash flow forecast was generated to explain the financial differences between the linear and circular scenario. To start this CBM, additional cash is necessary to invest in an asset base. When revenue increases, based on a growing number of washing machines, the cash potential will strongly increase as well.[5] Figure 12.6 shows that the circular scenario will become more financially attractive than the linear scenario after year 5.

5 For simplicity, possible maintenance costs or other costs to support this business model are excluded from the financial model assumptions.

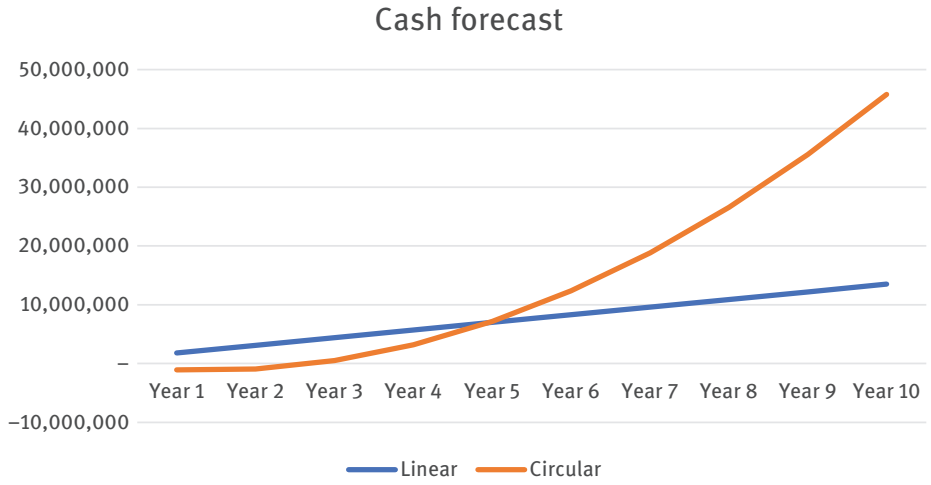

Figure 12.6: Cash forecast linear – circular business models washing machines (*€).

The profitability of the CBM will further increase by closing the loop and reusing old washing machine materials, since this saves on raw material costs. Using high-quality materials, which will lengthen the technical lifespan of the product, can result in an increased long-term profitability. Adding more services to the WaaS business model such as including the energy in this service model and therefore incentivising adding energy-reducing techniques to the washing machines, can further strengthen the network of sustainability and circularity businesses, provide incentives for both producers and users and can strengthen relationships between producers and users of the washing machines.

Financiers who were asked to invest in such a circular scenario were focussed on the solvency ratio (33% in a linear and 14% in a circular business case), which makes the linear case more attractive from a solvency point of view. Moreover, in years 1 to 5, the circular business case requires more cash, and the cumulative earnings will be higher in the linear business case. However, in the long run, the circular business case yields higher cumulative earnings.

Key accounting and finance challenges for CBMs

This section starts with an introduction of the three empirical cases that were analysed. The case introduction is followed by the analysis, supported with anecdotal examples of the difficulties these CBMs encountered regarding accounting and convincing financiers to invest.

Case A: Road-as-a-service

The road-as-a-service case revolved around the idea to (1) create a circular road, and (2) exploit this road as a service. The two main parties involved were a road building company (RBC) and a regional government (RG). The RBC has been experimenting with reusing materials from their old roads into new roads. This has resulted in a more sustainable road that can be used longer and can be taken apart to be reused. Under certain circumstances, the circular road could be demounted completely to be installed elsewhere. The RBC wants to explore the possibility of changing from a 'sales' revenue model to a 'product-as-a-service' revenue model. This implies that, instead of selling the road to the RG, the RBC stays owner of the road and remains responsible for the quality and safety. The RBC must maintain the road's optimal condition through monitoring, maintenance, and repair activities. The RG does not buy the road from the RBC, but instead pays a periodic fee for the services of the RBC (access to a road that is maintained to meet the standards of Dutch public roads). In this case, we focussed on the financial reality (accounting) and financeability (the ease of attracting funding) of a PaaS business model.

Case B: Facades-as-a-service

The facades-as-a-service case revolved around the idea to (1) create a circular façade, and (2) exploit this facade as a service. The main parties involved were a facade building company (FBC) and a real estate developer (RED). The FBC has developed a modular facade system that can be demounted and reinstalled. In this case, the focus lies on the contractual and financial structuring of a PaaS business model in the built environment. This case shows that the built environment is subject to a legal arrangement that complicates PaaS. In this case, so-called accession was a legal obstacle from real estate law that had to be overcome. Accession is a legal figure in which a smaller, independent physical object becomes part of a larger physical object. The FaaS case provides a clever contractual solution in the form of combining a rental agreement with a service contract. This provides a way to use contract law to bypass the issue of accession. From a financial perspective, however, no mortgage rights can be established in the case of a PaaS contract. This results in a misfit between contractual and financial structuring. Figure 12.7 shows the structure of the facades-as-a-service business model.

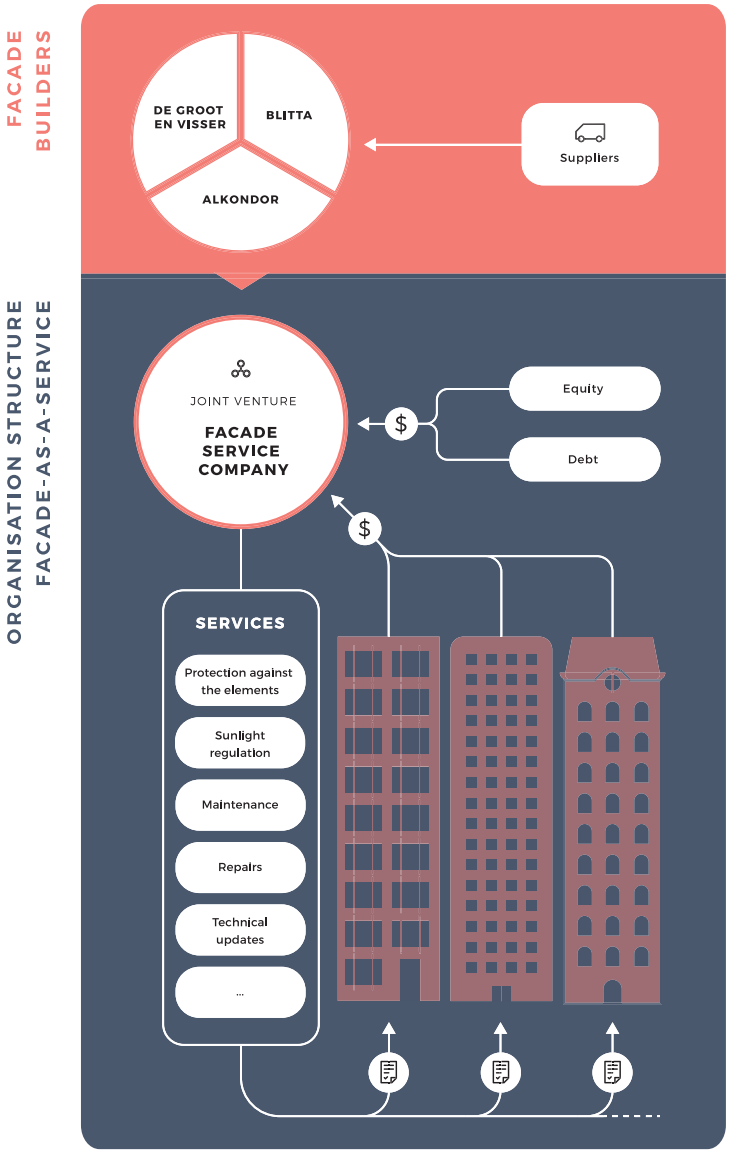

Figure 12.7: CBM structure of facades-as-a-service.
Source: The Circular Facade; Building a sustainable financial reality with facades-as-a-service[6] (2020).

6 https://www.circle-economy.com/resources/facade-as-a-service.

Case C: Valorising Residual Resources

This case revolved around a company that started a cooperative structure to use and valorise leftover resources from a food manufacturing process into new food products for human consumption. This enables higher value use of the leftover food that would otherwise be downcycled into animal feed. This company takes the lead in organising a supply chain that brings parties together with the aim of making new products from residual flows earlier in the supply chain. The profit is divided among the parties in the supply chain in proportion to their contributions. Specific challenges of this case were:

- How do we value the assets of this company when all parties involved have a stake in the cooperative and the main resource of the new food product is a waste product from another food production process of one of the parties involved?
- How do can we create incentives within this cooperative to pursue win-win situations where every collaborating party is rewarded fairly for its contribution?

This case led to a vibrant discussion about how to value residual resources, an important topic for circular economy that is based on cycling resources continuously. Various viewpoints were exchanged, leading to a range in the valuation of the residual stream. Figure 12.8 shows how residual resource flows are managed by the company, IntelligentFood.

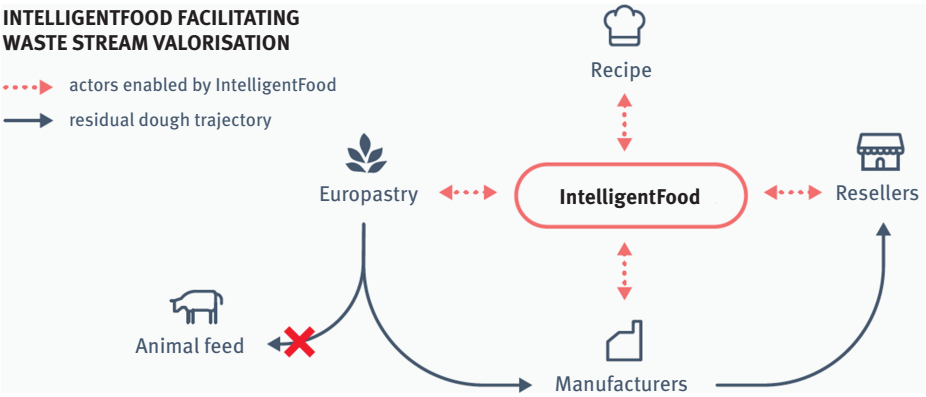

Figure 12.8: CBM structure of the Valorising Residual Resources case.
Source: Valorising Residual Resources; Mitigating food waste – How cooperatives can boost the circular economy[7] (2020).

Each case provided a different challenge in terms of finance and accounting. In Case A, the challenge was to create incentives for long-term usage of the materials within the CBM. Moreover, there were discussions on how to structure the service contract for the circular road on specific terms that reuse by the road building company would be guaranteed while staying within the brackets of what is acceptable

7 https://www.circle-economy.com/resources/valorising-residual-resources-mitigating-food-waste-how-cooperatives-can-boost-the-circular-economy.

for financiers. Case B zoomed in on the uncertainty in valuation of real estate when this real estate is being developed in by circular principles. The lack of historical data on separating material value from overall real estate value posed a challenge to valuation and to financial decision-making. Case C focussed on the pricing of residual (e.g. waste) streams, and on how to incentivise higher value reuse of residual resources. Creating a secondary market for residual resources resulted in discussions about how to correctly value these resources. Moreover, this CBM aimed at sharing profits by using a distribution key that was dependent on the value of these resources. A discussion about attributing value to resources before or after the sales of the final product was the result. The idea of sharing risks by dividing revenues in a later stage instead of paying a set price for resources and or services at the outset of a production process is interesting for incentivising circular supply chains, yet leads to discussions amongst accountants and financiers. This complexity translated in an additional identified risk.

Accountants, auditors and other financial professionals are trained to view organisations through the lens of risk and return. The illustrative case in the previous section has shown substantial differences between linear and circular CBMs. The structures and guidelines that financial professionals use to assess organisations are based on linear principles rather than circular ones. This section will show how linear accounting guidelines are an obstacle for a company to create a CBM. By using exemplary evidence from the three empirical cases, we illustrate that the current lenses are not equipped to fully understand and appreciate the value created with CBMs.

Financiers, investors and shareholders are informed on how a company is performing by a combination of non-financial and financial information. Financial assessment criteria presented above are the main data that inform financial decision-making. Financial ratios of circular businesses differ from their linear counterparts because of their circular business' strategies and activities and their different relationship with products, materials and the value chain. In CBMs, the value of resources is recognised and optimised before, during and after being used in products.

A company with a CBM aims to continuously reuse materials. For such a company, it is important to keep control over its assets, products and the embedded materials to ensure the continuity of a circular company. For a circular company, value lies in being less dependent on the availability of raw materials and less affected by price fluctuations of different resources. This goal of controlling the assets shifts the focus from assets to a combination of being in control of the assets *and* the management (controlling) of the value chain. The quality and continuity of the products and materials that flow back and forth through the value chain define partly the value of individual companies. Moreover, services become a more important part of the value proposition, especially when producers want to retain ownership of their products and make their use available in a PaaS model.

Balance sheet extension and ratios

In both PaaS cases (road-as-a-service and facades-as-a-service), the fact that companies wanted to remain owner of their products posed issues. Financial modelling of these cases showed that when a company owns a vast amount of assets, this results in an 'asset heavy' balance sheet. Based on the financial statements, financial ratios were calculated and discussed to assess the financial 'healthiness' of both projects. Perspectives of an accountant, a banker and a controller (i.e. internal accountant) provide insight in the perceived difficulties.

> Financing is difficult, balance sheet extension has been mentioned in this regard, including ratios that will be completely different [for PaaS]. (Accountant_PH_RaaS1)

> Preferably, I do not want it [the asset] on my balance sheet. But you notice that in the conversations we have with banks and other financiers that they are also struggling with this problem. Suppose 100 million [euro worth of assets] is added onto our balance sheet, then you see that it lowers the [solvency] ratio. Well then it probably wouldn't be financed by a bank. (Controller_AK_RaaS1)

> We are looking into how we, as a bank, can play a role in this and find a solution in the case of balance sheet extension. (Banker_IA_RaaS1)

CBMs and new securities

The revenue model behind a PaaS model is first and foremost about generating income by providing an ongoing service with an asset. It would be simple to compare selling a product with providing it as a service and earning a periodic fee. However, the activities that are taking place at the backend of a PaaS model – e.g. organising take back and logistics, monitoring software systems such as track and trace, maintenance, and repair, allocating products, elements and materials to the right value chain partners in order to add value again by circular cascading activities (refurbish, remanufacture, recycle) before products enter a new use cycle – create the *real* circular value potential. These elements also add substantial complexity to the system and to the exercise for accountants and financiers to judge its viability. The shift from selling products to PaaS models can be translated into financial structures – changing one single financial transaction (selling a product) into multiple and more frequent transactions (selling a service). The underlying contracts between companies and their customers on the one hand and between companies and their supply chain partners on the other hand can serve as new securities for financiers. These agreements secure ongoing cash flows (client contracts) and a smooth operation of the service (supply chain contracts). To guarantee cash flows with PaaS, the service provider must be sure there will be enough clients to use (and pay for) its service. The FaaS case shows how this uncertainty is perceived by financiers.

> The more certain the cash flow is, the better. We did talk about vacancy [of the apartments], but we also indicated that this risk is very limited. But they [financiers] do take that into account, so you have to show this in your scenarios and in your sensitivity analysis. (Controller of real estate developer_SV_FaaS3_model session)

Another bottleneck occurred relating to securities. Providing FaaS implied that mortgage rights – a well-known security used in real-estate – could not be established. A lawyer proposed to circumvent the issue altogether by creating an alternative contractual structure: a combination of a rental contract and a service contract. From a financial perspective, the underlying securities of this contractual structure are not mortgage rights, but step-in rights (in case of default, the bank can step in) and the right of removal (the FaaS company has the right to remove the facade if the user stops paying).

> We developed a rental structure that can be enforced by the owner of the façade. This is based on new case law, and it gives a legally enforceable right to take away the façade in case of non-payment [step in right]. Of course, this is undesirable, but it also gives the opportunity to say to the trustee in case of bankruptcy of the building owner, "are you going to fulfill the obligation? If not, then I will remove it, you are left with a building without facades." That would probably be enough pressure for the curator to continue to pay. Then you would have also secured those cash flows and could base financing on that. (WR Lawyer, CCA FaaS, 1)

However, current risk models assume mortgage rights, not step-in rights nor the right of removal. The financial sector currently has no framework or reference point for assessing this new contractual structure. This typically results in an increased risk premium, hence higher financing costs if such a CBM succeeds in obtaining financing at all.

> Establishing rights of superficies is from a legal point of view a somewhat less strong position than in case of mortgage rights, so you have to rely mainly on securing the cash flows as a security for the bank. (MO Banker, CCA FaaS, 1)

This example shows how circular businesses encounter many challenges due to the need to operate within the current linear financial metrics and ruleset. What is seen as a promising legal structure by pioneering businesses and legal experts can be interpreted as a liability by financiers. It shows how the conditions of the financial system and the (perception) of the risks in new CBMs lead to difficulties in valuing and financing CBMs.

Value, depreciation and risk allocation

Another challenge in the financial structures and valuation of CBMs is the uncertainty of estimating the value of a product during and after use phases. Roads (RaaS case) and buildings (FaaS case) will last for a long period and estimating the future value and application of materials is difficult because they depend on several

variables such as future technical developments (e.g. new technologies such as self-driving cars) and geographic developments (e.g. how areas develop over the years). It is important to look at these issues from an accounting and valuation point of view, because in a circular economy, being able to retain and control the value of materials and resources is the main goal. Current accounting rules are designed to do the opposite – to depreciate their assets as quickly as possible.[8]

The introduction of a circular product may require more preparation, innovation and development. The purchase price can therefore be higher. On the flip side, being able to reuse components and materials harvested from used roads to compose a new road means production will require fewer virgin resources and potentially lower manufacturing costs if elements can be reused without much processing activities. After every use cycle, value is added again by circular activities such as maintenance, refurbishing and recycling.

During the RaaS case trajectory, it was discussed to stop *depreciation*, and start with the *appreciation* of materials. After all, these materials can be used indefinitely in continuous cycles. Current accounting rules do not allow for the full implementation of this residual value due to insufficient availability of practical examples and historical data. Due to insufficient data about the potential future value of products and materials in a CBM, depreciation stays the norm. This means the actual residual value remains 'nice to have' at the time of harvest (i.e. when the road is dismounted after, let's say, 35 years). However, to take this upside value into account in financing CBMs, we need to assume this 'future value' from the start. Several options of how to go about the value throughout the lifespan of the road were discussed.

> You could agree contractually that you have an annual or ten-yearly reassessment of the value of the entire property and then adjust the fee accordingly. We expect that the property will increase in value and thus the needed securities for the financier will decrease [over time]. (DZ_GaaS3)

Depreciation is still applied to these materials due to a lack of experience data of the value of raw materials over a long period and for reasons of prudence. Even if there are second-hand markets and a futures market for steel, concrete, bitumen, wood and other reusable materials in construction, valuing these materials 30 years from now is tricky because it needs insight in future economic developments. Moreover, assuming a higher residual value of products and materials in the future entails certain risks because of uncertainty. Contract parties must decide and agree beforehand how they will allocate these risks.

> Both [service provider] and [client] have to think very carefully, 'do I want certainty or am I also prepared to accept a minus in 30 or 40 years if the value turns out lower than expected. Or do I prefer to pay a little more periodically and have certainty that I do not have to pay

8 This is supported by current taxation schemes. Hence, tax is an important lever to discuss, yet remains out of scope in this chapter.

> extra in 30 or 40 years in case that the value has collapsed.' That is what you should take into consideration. (RaaS_4)

In the Valorising Residual Resources (VRR) case, the aim was to use excess resources (for instance, from production processes) in high-value products. A resource flow that until recently was marked as a waste stream would become a valuable input for creating new products (in the case, the topic was making high-quality cookies from leftover dough that used to be sold against bargain prices to the animal feed industry).

A cooperative structure has been created to incentivise all stakeholders to collaborate and to benefit by sharing the profits from selling the new product. This inventive cooperative structure poses some challenges for valuing the residual resources ($t = 1$), since their value depends on the profit margin after sales ($t = 2$).

> For accounting we do not have many choices on valuation methods. It is regulated in the law and in accounting standards. Cost price or lower market value is applicable if you talk about inventory. If you receive the dough from the supplier, then there is the discussion on: what is the valuation on the balance sheet. When it is waste there is a valuation of 0, and if you must pay something then it's the cost price. If you feel that we might sell this product with the lower price, then you have a lower market value. This is not the case here I presume. However, the cost price is not known initially because the cost price can be considered as the 40% profit sharing which can be calculated only afterwards. That is a difficulty or challenge in this case study which is very interesting. (PH_VRR3)

Also, in the VRR case, there were discussions on how to take the value of the residual resources into account from the outset and not just as a nice to have after the sale of the final products. Being able to make this value explicit in the balance sheet signals a higher value of the business and makes it easier for a company to attract funding.

> The company really wants it [the value of the resources] on the balance sheet or at least somewhere to be visible because it provides a proof of actual value. When it is seen as 0 value it is seen as a waste stream. You want to signal that it does have a value towards financiers and other stakeholders. (AF_VRR2)

This section has shown that CBMs represent possibilities for adding and managing value through circular strategies and activities. The empirical materials from the three cases exposed the misfit between current finance and accounting practices and rulesets and CBMs. The following section presents solution directions for accounting and finance to better support of CBMs.

Finance and accounting for CBMs as the new default

A fresh perspective on accounting and finance practices and rulesets is needed to better understand and assess the value and risk profile of companies with a CBM. The current misfit has profound consequences for adopting and diffusing CBMs in both new and existing companies and for the wider circular economy transition. We argue that there is a need for an adjustment of the financial frameworks to acknowledge long-term sustainable value created by CBMs. Moreover, it is important to judge all companies with these adjusted frameworks in order to create a level playing field.

In the first section, key accounting and finance concepts were presented. Accounting is used to report the financial situation of a company in its financial statements. Financial ratios are calculated based on the financial statements. They enable comparing companies among one another and with historical data of similar companies. Moreover, financiers use these ratios to calculate a companies' risk profile – the likeliness a company will be able to fulfil its short-term and long-term financial responsibilities. The previous section showed that due to the newness of CBMs, historical data is often not available. Moreover, their tendency to generate value over a longer time horizon, and often by taking increased control (and potentially ownership) of their products and materials, causes the financial ratios to be outside the accepted brackets. This results in CBMs being perceived to be more risky than linear BMs, which makes it more difficult and more expensive to finance these CBMs, if possible.

How do we get out of this reinforcing cycle of not funding CBMs due to a lack of track record, which instigates the continuation of the lack of data? The answer lies in assessing the risks of not transitioning to a circular economy.

Mitigating climate risk and raw material risk

Financial professionals primarily assess organisations based on financial risk. Taking a long-term perspective, circular economy enables mitigating risks that occur at a different level than at the company level towards considering climate risk and the risk associated with scarcity of materials (Durán-Romero et al., 2020). Climate and resource risks will affect the continuity of businesses. Contributing to the circular strategies and activities can mitigate these risks and can support the long-term continuity of businesses.

Climate risk is increasingly recognised in annual reports, but has not yet found its way into the accounting guidelines. Since the year 2000, an increasing number of listed companies have started reporting on their carbon emissions, mostly according

to the guidelines of the Greenhouse Gas (GHG) Protocol, with its scope 1, 2 and 3. The GHG protocol has become the reporting norm also in the legislation on corporate sustainability reporting and is used by governments to account for carbon emissions on a country level. Certain industries have already been subject to carbon pricing, but because of the complex calculations and thresholds, the financial costs of carbon pricing are not immediately recognisable in the financial accounts. The integrated annual reports of listed companies show their emissions, but not the related costs and not the direct and indirect risks related to carbon emissions. That is why, in 2015, the Task Force for Climate-related Financial Disclosure (TCFD) developed a framework for listed companies and financial institutions to disclose their physical and transition risks related to climate change.[9] Research shows that even though carbon accounting is still in its infancy, investors are already making their own assessments of the carbon risks of listed companies and pricing them in (Aswani et al., 2021). Companies that fail to take climate risk into account will likely drop in value when newly announced legislation such as carbon pricing becomes the norm. When this happens, the cost of carbon emission will show up in the financial accounts as a cost (as priced by the emissions trading system (ETS)).

Raw material risk. The impending scarcity of raw materials is not yet visible to many companies within the short-term horizon on which they manage their business. However, price volatility has increased over the years and there are prognoses of increasing material scarcity. Resource shortages and increasing prices will create a need to deal with raw materials differently. A company that anticipates this by creating circular strategies and activities that enable ongoing resource cycling will have an important competitive advantage over companies that fail to control their resource streams. These upsides of CBMs and risks of linear BMs are not sufficiently recognised in the accounting guidelines and remain out of scope for financial decision makers. These risks are not yet included in risk assessments, although they threaten the continuity of companies. The *continuity risk* in the longer term means that these risks do need to be clarified. CBMs do so by focusing on the long-term continuity of their own business, by preserving materials, reducing waste and environmental pressure (Gaustad et al., 2018).

Rethink depreciation and appreciate residual value

Rethinking depreciation in the circular economy can have an important positive effect on the financial attractiveness of CBMs. When a company owns assets that are

9 https://www.fsb-tcfd.org/.

no longer (fully) depreciated, this means they will end up having a higher *residual value* when compared to their linear counterparts that are fully depreciated. This is the case because in a CBM, products are designed so that they are easy to disassemble (modular), and they consist of durable materials that can be recycled. These products (and parts) are designed to be able to be used in multiple use cycles. A linear product made without these features is less easy to reuse and more likely to break down and be discarded. With its design for many use cycles, the circular product will likely have a higher *residual value* than the linear product. A higher residual value is beneficial to the owner of the product or materials. As explained above, the residual value of products and materials is currently seen as a 'nice to have' at the end of a product lifespan and cannot be taken into account as a real value from the outset of building the circular business case. If the residual value of the product or material can be priced in at the moment the product is created, it will likely have a positive effect on the value proposition of a company: lower costs, higher profits. At the same time, the future residual resource can be valued as an asset.

Valuation of materials and products is currently determined based on historical prices and knowledge. Because of physical and transitional changes in the economy, these historical data are no longer reliable or sufficient; it would require a review of calculation and valuation models, structures and methodologies currently used by financial professionals. At the same time, capturing ecological and social value of companies and insight into how companies capture value over different periods demand changes in risk management. Adapting to or mitigating climate change risks and continuously reusing raw materials would change the risk profile for a company and improve its license to operate and its continuity. A complicating factor that requires further research is the fact that value is determined by supply and demand, hence the existence of a market. When residual material markets are non-existent or supply and demand disconnected, the price of residual materials will be subject to uncertainty. The development of transparent (second-hand) markets is therefore a key leverage point for actual circular value creation and convincing financiers of accepting residual value as a security.

Longevity and increased control over assets as key risk mitigants

Above it was shown that a company that wants to transition towards a CBM in the form of a PaaS model encounters financial obstacles due to the growing amount of assets on the balance sheet. Companies with many assets are considered to be risky, because too much capital is tied up and its cash flow can be a problem. For financiers, that falls beyond their commonly accepted brackets.

However, if accountants and financiers would also consider the financial risks of the above-mentioned climate, raw material and continuity challenges and can assume a higher price and attribute less uncertainty to a future residual value, CBMs are mitigating risks for themselves and their financiers. As we have shown, CBMs are able to put value of reusing products and materials in multiple use cycles and make sure to keep control over their assets.

If we systemically start reusing products and materials and incentivise to produce and manage production in a sustainable way by scarcity and increasingly stringent policy measures, we can expect a higher market value for these products and materials in the future. With new policy measures in the pipeline especially in Europe, slowing, narrowing and closing the loop will increasingly become cost-effective. Companies that postpone the transition to CBMs will be confronted by extra costs, through carbon pricing, tax measures or scarcity. If this trend becomes apparent, companies with a CBM will turn out to be lower-risk investments than their linear counterparts.

Conclusions

CBMs focus on long-term continuity and limit negative environmental impact by optimising product and material reuse. Externalities are currently not considered in product prices, nor are they visible in the financial statements or risk assessments of a company. We propose accounting and finance practices, and frameworks must be adjusted to correctly value the upsides and risks of CBMs and Linear BMs.

This chapter has shown that the financial and accounting frameworks have been developed for an economic system, where depreciation is a leading principle and investment decisions are based on short-term financial profit rather than long-term value for society. Investors and financiers have become better in assessing environmental, social and governance performance of companies and have started changing their investment strategy and policy. But their assessments are still an overlay on old-fashioned financial assessments and fail to understand and value CBMs. The short-term focus and perceived higher risk profiles impede a rapid adoption of CBMs.

The current system of depreciation and reduced *residual value* is not reflecting the value of products and materials in CBMs that are maintained at their highest possible level throughout their lifespan. Depreciation costs reflect the diminishing value of materials and reduced profitability of the business case. A key element in CE is striving to keep the materials in a continuous loop of usage by recognising their usability and value. CE would require an alternative accounting standard for the value of materials used in a circular business model.

CBMs create new financial structures in balance sheet, cash flow and profit and loss statements. In the current system, this leads to a higher risk perception of financiers and investors, based on their interpretation of the financial ratios. At the same time, these new CBMs enable incorporating *climate change risks* and *raw material risks*, which are currently missing in the linear business models. Depending on the trade-off between the different risks, CBMs could therefore be perceived as lower-risk business models. New standards for accounting structures and financial ratios will be necessary to reframe and recalculate the risks and truly appreciate the long-term value of CBMs.

Understanding all aspects of CBMs and how value is created is key. Moreover, this requires multiple disciplines to tune in to one another's value proposition and collaborate in developing circular activities that optimise and strengthen the value chain. Understanding the potential upsides of CBMs regarding climate and raw material risk mitigation and increased residual value of products and materials is key; accountants must include this information in their financial statements, and financiers must recalibrate financial ratios and consecutive financial decision-making.

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