

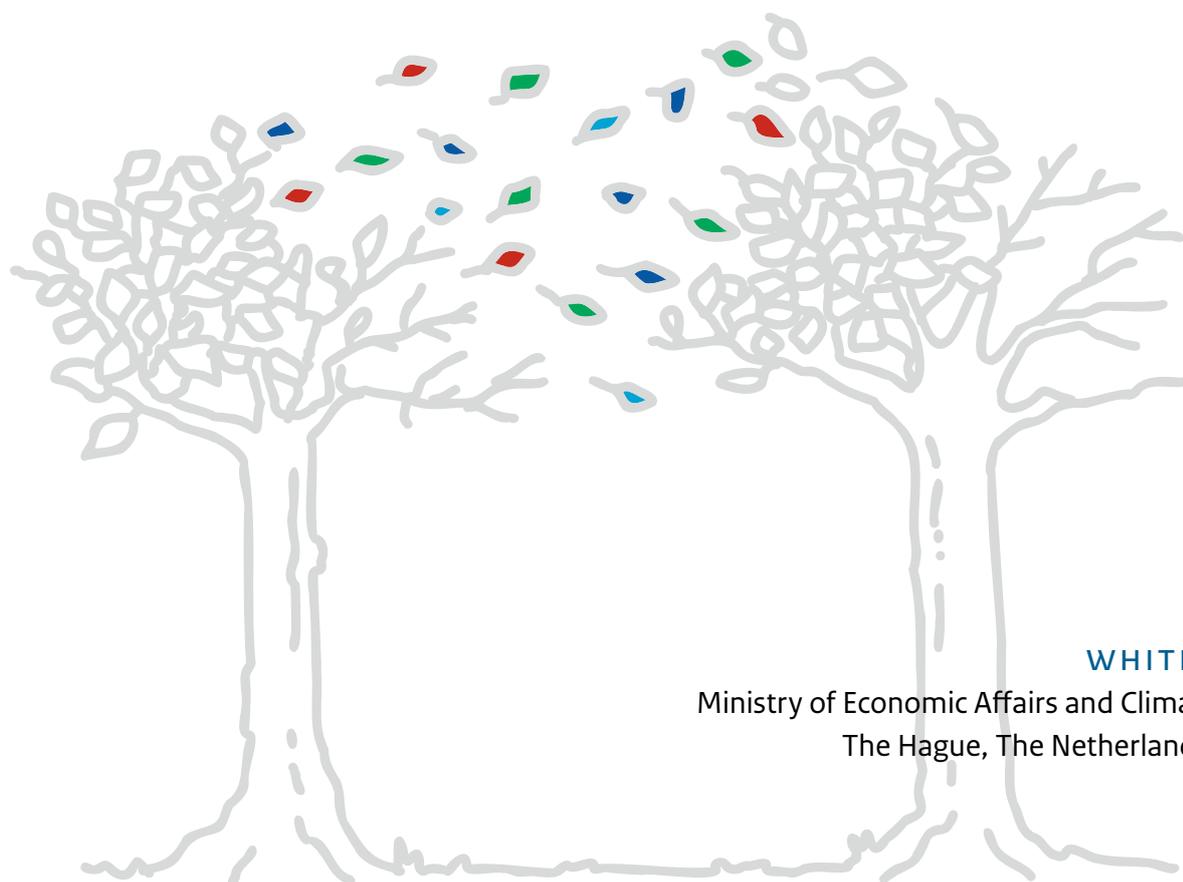


Ministry of Economic Affairs and
Climate Policy of the Netherlands

Circular Business Models

*A study to classify existing and emerging forms of value
retention and creation*

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WHITEPAPER

Ministry of Economic Affairs and Climate Policy
The Hague, The Netherlands (2022).

The Dutch Government is committed to accelerating the transition to a climate-neutral and circular economy by 2050. In addition to other policies, we do this in the government-wide Circular Economy Implementation Program 2021–2023, where we collaborate with various ministries, local authorities, knowledge institutions, the business community and NGOs.

Combating climate change and environmental degradation is absolutely necessary for the future of Europe and the world. The European Green Deal, roadmap to a sustainable European economy, underlines this. In 2019, the EU member states agreed that the European Union will become climate neutral by 2050 at the latest.

As part of the Green Deal, in March 2020 the European Commission presented the Circular Economy Action Plan and 'Fit for 55' in July 2021, the roadmap to reduce greenhouse gas emissions in the EU by 55% by 2030 in comparison with greenhouse gas emissions in 1990. These plans will also have major consequences for the Netherlands.

“We are in a time of fundamental change. We have a climate crisis, and we are in an industrial revolution. The way we work and produce, everything is going to change.”

FRANS TIMMERMANS

Circular economy focuses on our use of raw materials and the optimal use of products and raw materials in closed production cycles. The circular economy makes a significant contribution to the climate challenge, to reducing environmental pollution, to halting the loss of biodiversity and to increasing security of supply. Worldwide, 45% of greenhouse gas emissions are related to the use of raw materials. TNO and Ecorys have calculated that the circular economy can make a substantial additional contribution of 7.2 megatons of CO₂ reduction. This requires a significant change in the way we work, produce and consume. But the circular economy also offers new opportunities, such as new business opportunities.

To be able to produce and consume differently, a new way of thinking and new business models are needed. This publication offers guidance to entrepreneurs. That is why we are enthusiastic about this publication. Because the entrepreneurs will shape the transition to a circular economy.

Therefore, we hope that this publication will inspire and support entrepreneurs in making their circular business models leaner and better. The Dutch government will continue to actively support you where your enterprise will find that useful.

For now, we would like to wish you a lot of success and opportunities with your current and future circular business models!



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SUMMARY

- The circular economy (CE) is a complementary alternative to the current linear economy and has attracted growing political and economic attention in recent years.
- At the heart of the CE is the quest to organise value retention resulting in the extension of the lifetime of products, components and raw and processed materials in loops.
- The ambition of the CE is to have a lower negative impact, less use of ‘virgin’ materials and higher efficiency of use over the entire lifecycle of products.
- In principle, this should lead to the possibility of using products (etc.) in their current or refurbished form in several loops.
- Organising a system of interrelated loops is one of the, if not *the* central challenge of the CE. Realising this system – an ecology of loops – leads to a system transition.
- This system transition is not limited to the CE but simultaneously requires a radical sustainification of the present dominant linear economy.
- Given the fundamental *economic* nature of both the linear and circular economy, the project undertaken is based on the premise that changing existing business models or creating new ones is essential in shaping the underlying process of change.
- In 2021, the Ministry of Economic Affairs and Climate Policy (The Netherlands) commissioned research as part of the CESI/UPCM programme, which should lead to a practical classification of existing and future business models for the CE.
- Business models provide the logic for strategic organisational concepts to give shape and substance to value creation and retention. A range of concepts is possible.
- The research examined what business models are already available for the CE and the extent to which these fit with emerging developments around Extended Producer Responsibility (EPR) and Producer Ownership (PO).
- The research output resulted in a classification of seven basic types of circular business models, divided into three groups (raw materials, smart use and extended responsibility). These types are described and illustrated in Knowledge Maps.
- These knowledge maps also form the basis for a specially developed paper-based Quick Scan (available in Dutch and English at: <https://circulairremaakindustrie.nl>) and an interactive application (available in Dutch and English: <https://businessmodellab.nl/tools>).
- In addition to the Quick Scan as an output of this research, there is also a short video with an explanation (tinyurl.com/y6z8rez8), and this Whitepaper. All materials are available in two languages (Dutch and English) and are Open Access, so free to use for anyone.

This Whitepaper presents the essence of research into existing and emerging circular business models (CBMs). This results in the identification of seven basic types of CBM, divided into three groups that together form a classification.

This Whitepaper consists of three parts.

- The first part discusses the background and explains the circular economy (CE), the connection with sustainability, business models and an overview of circular business models.
- In the second part, an overview is given of the developed classification of CBM, and each basic type is described based on its characteristics. This has resulted in seven knowledge maps. Finally, the last two, more future-oriented models are further explained and illustrated.
- The third part looks back briefly at the reliability of the classification made and then at the aspects of change management in working *on* and *with* a CBM.

The CBM classification has been used to develop a Quick Scan. This can be found in a Dutch and English paper version at <https://circulairemaakindustrie.nl>. An interactive application can be found at <https://businessmodellab.nl>. This last version is bilingual (Dutch and English). Regardless of the version, it can be used to develop a new CBM or adapt an existing business model based on a qualitative approach. The starting point is that better design and organisation of a CBM contributes to the transformation and transition towards a sustainable and circular economy.

Abbreviations

The following abbreviations are used in this text:

CBM: circular business models

CE: circular economy

‘Product’, ‘component’ or ‘raw and processed material’ refers to the totality of possible physical states to which the CE applies. In some cases, only ‘product’ is mentioned to make it easier to read, but in all these cases, it can also refer to components or raw and processed materials.

PART 1

Background

In the first part of this Whitepaper, the nature and status of the CE is discussed. After an explanation of what a business model is and when it is circular, the design of the study is explained. This is followed by a brief presentation of the developed CBM classification, and the organisational choices required to make it concrete.

1.1 Reason: arguments and motives

Political and economic attention for the CE has increased sharply in recent years. At the heart of the CE is the organisation of the value retention of products, components and raw and processed materials in loops. The aim of organising them in this way is to achieve a lower negative impact and greater efficiency of use throughout the life-cycle. This leads to value retention. Business models offer a range of strategic approaches to shape this. They are therefore an important element in achieving the CE. In this respect, the societal context provides several meaningful arguments:

- Attention to the climate is no longer a matter for discussion: we are moving from voluntary eco-efficiency in the margins to a society-wide necessity.
- Responsibility: leaving the world a better place for future generations.
- Risks: rising raw material prices, inability to deliver, liability, environmental impact.
- External pressure from customers (etc.): produce according to new requirements, because otherwise, customers will go elsewhere.
- Reputational damage and lawsuits (e.g. Holland, France, Germany).

- Requirements of financiers or banks (ensuring continuity).
- Increasingly explicit legislation and regulations (including the EU ‘Green Deal’, Extended Producer Responsibility (EPR) and the consequences of the ‘Fit for 55’ policy).

‘With Frans Timmermans’ Green Deal for Europe, the solutions are there for the taking. We can no longer pass it on to future generations. The costs are simply too high. The health effects, the extreme weather, the conflicts it will cause – in short, businesses must include all the social costs of climate change in the decisions they make. As a company, simply take responsibility.’

TOOS HOFSTEDE, CEO VIASTORY, INTERVIEW IN CHANGE INC, RETRIEVED 21.07.2021.¹

1.2 What is the circular economy all about?

The CE stands for an economic system focused on more efficient and effective use of products, components and raw and processed materials, while minimising the influx of new (‘virgin’) raw materials and the creation of negative impact. The underlying ambition of the CE is a radical reduction in,

¹ A number of quotations from third parties have been included in this report for illustrative purposes only. The texts come from public sources. As far as possible, the ‘50-word limit’ has been applied so that no formal permission is required for use.

or preferably zero, direct (Scope 1, 2 and 3²) over the entire lifecycle (across multiple loops). The pursuit of this ambition by companies and organisations leads to the organisation of value retention in loops rather than linear chains. The CE can be characterised based on seven principles:

- *Value retention*: at the heart of the CE is the systematic organisation of value retention in loops of raw and processed materials, components and products. Value retention leads to or is the basis for lifetime extension. By using the same product for longer, the initial impact of raw material use, energy, etc. is reduced.
- *Lifetime extension*: the organisation of keeping products, components and raw and processed materials in use for as long as possible, preferably in their original quality and function, and otherwise with replenishment, substitution or refurbishment. To do this as (eco)efficiently as possible (i.e. with minimum use of raw materials, labour, transport, etc.) requires different designs, smarter maintenance (e.g. based on digitalisation) and an approach for the end-of-life phase that is included in the design.
- *Organisation*: realising value retention with the consequence of lifetime extension results in an organisational task. Organisation can be done in various ways: (1) within one's organisation, (2) in value chains (and partly based on relevant horizontal and vertical integration), (3) in one or more loops and the related supporting processes, or (4) in a system of value chains and loops. These four forms of organisation are not separate. They are connected in all possible ways (digitally, institutionally) at different levels.
- *Loops*: the theoretical premise of a loop is that, among other things, the material, energetic input equals the output. This premise is never

valid because the use of products consumes raw materials and causes wear and tear. What can be done is to minimise the use and consumption in the loop as a whole or, if desired, to compensate for it. Six phases are distinguished in a loop: (1) design, (2) make, (3) function, (4) maintain, (5) reuse and (6) recover.

- *Value creation*: this is about organising the creation of value that is simultaneously economic, social and ecological.³ This is also called *multiple value creation*. There are three main forms of value creation: (1) transforming, (2) recycling and (3) circularising. *Reuse* is often also mentioned in this context. However difficult it may be, there is always a relationship between creating social values and fostering biodiversity.

‘Circularity contributes to reducing the use of raw materials, the related environmental impact and the retention of strategic materials, thus reducing dependence on international supply. An associated strengthening of the manufacturing industry facilitates regional loops. The Netherlands is leading the way in this field and can continue to do so by coupling sustainability to innovation, entrepreneurship and employment.’

BUILDING BLOCKS FOR A SUSTAINABLE GOVERNMENT
POLICY (BOUWSTENEN VOOR HET DUURZAAM
REGEERAKKOORD) 2021–2025, RETRIEVED 30.07.2021.

2 Scope 1, 2 and 3 emissions refer to emissions that are linked to the specific use of raw materials. Scope 1 emissions are direct emissions, i.e. emissions that are directly related to the use of raw materials. Scope 2 emissions are indirect emissions that are, for example, linked to purchased energy. Finally, scope 3 emissions refer to emissions that are not directly related to the company's own activities and choices, but which do arise as a result of these activities, such as employee mobility, transport of goods, etc.

3 Value creation forms a pair with value retention. By working on value retention and lifetime extension, several opportunities arise following on from that in time for multiple transactions that form the basis for value creation. Because the same product (etc.) lasts longer, it can be sold or leased several times, and at the same time is reducing negative impact and creating jobs.

- *Business and revenue models*: value creation and retention take shape in seven groups of basic types of CBMs. These can be combined with a range of revenue models. The match between CBMs and revenue models is more ‘loose’ than imperative; much depends on the search for the best suitable combination given the product–service combination in a specific context.
- *Impact*: the overall ambition of the CE is to organise less (or preferably no) negative impact in production, use and disposal – i.e. the entire lifecycle – and to reduce or (sustainably) replace the use of raw materials in all stages of the lifecycle. It is about the *total* or *integral* value that is created. Sustainability and circularity are complementary in achieving this ambition.

The realisation of a CE is still in its infancy. Even though the first publication on the subject dates from the 1970s, more than fifty years on we are still mainly discovering, exploring and experimenting with the meaning and conceptual and organisational reach of the concept. Institutional impetus has certainly been given that should eventually lead to a CE, such as the creation of Green Deals, sector agreements (e.g. concrete, plastics, textiles, e-waste), in some cases flanking legislation (e.g. the recent legislation for deposits on bottles and cans, the ban on plastic bags etc.). In addition, recent National legal lawsuits make the realisation of emission reduction impacts in Scope 1, 2 and 3 an increasingly compelling task for organisations and value chains. In addition, the signals about scarcity of raw materials – both rare metals and water – are getting louder. Despite this, we observe no real scale, let alone breakthrough, of configurations of parties who organise value preservation in cycles.

1.2.1 About loops and value retention

Loops are intentional organisational constructions by and between different parties, aimed at keeping products, components and raw and processed materials (with various time horizons) in functional circulation. Within the loop, the same product

is used several times. As a result, it eventually becomes part of several loops, allowing several transactions throughout its lifecycle. This creates a *circular economy*; an economy in which the same product or part thereof is part of a transaction several times. Crucial in this respect is the principle that a transaction is not, or not necessarily based on the transfer of ownership but provides access to the function. In other words, the function of products, components and raw and processed materials can be offered as a service during a loop or an entire lifecycle.

Ideally, loops can be characterised by six phases. In outline, this looks like the diagram in Figure 1. In practice, however, it is a lot messier. Phases do not follow each other neatly, but are mixed up and repeated.

‘Over 20 percent of the solar panels that are being replaced are still usable. Yet these panels end up on the waste heap. Therefore, solar company Sungevity starts an online platform for offering and buying used solar panels. On the platform Zonnext ‘homeless’ solar panels are offered, so they get a second life. The number of solar panels is growing explosively. In 2020 alone, more than 11 million new panels were installed in the Netherlands. On 12 percent of all roofs in the Netherlands there are now solar panels and it is expected that this will grow to 80 or 90 percent in the coming decades.’

SABINE SLUIJTERS, CHANGE INC, RETRIEVED 15.07.2021.

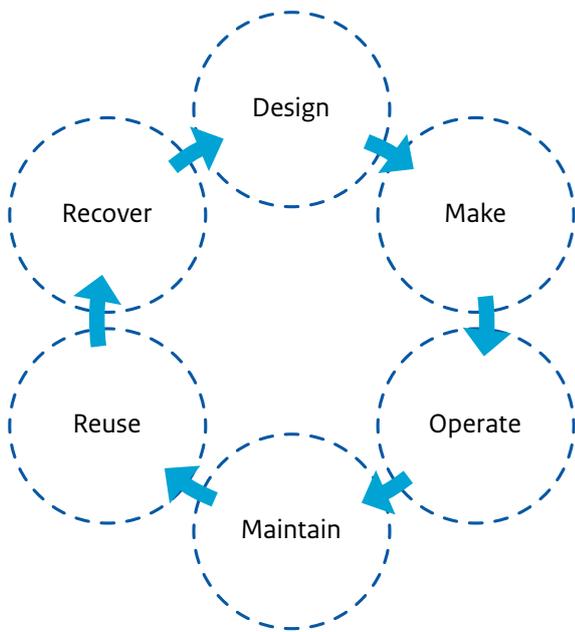


FIGURE 1 Loops in stages

The principle underlying the organisation of loops is the aim to reduce the negative impact and the use of raw materials during production and in the function phase. This is only possible by striving for value retention. This concept, in turn, is closely linked to value creation. *Value retention* is the central principle of the CE. At its heart is the endeavour to safeguard (through design, maintenance, refurbishment, substitution etc.) functional and material value so that products, components and raw and processed materials have the longest possible lifetime. Working on value retention is the basis for various moments and forms of *value creation*. On the one hand, this means that there are multiple revenue moments during the lifecycle of a product. On the other hand, it means that there is value creation that is intended to be simultaneously economic, social and ecological. Think, for example, of CO₂ reduction or the fostering of biodiversity as an ecological value. The sharing of tools or the creation of jobs for people who, because of perceived or physical deficiencies, have more difficulty gaining access to the labour market must also be seen as value creation. This is commonly referred to as *multiple value creation*.

Provided that quality/ies and properties remain intact, organising value retention in loops leads to:

- More efficient use of raw/processed materials, components and products (resource efficiency).
- Less use of ‘virgin’ raw materials when making and using products.
- Lower impact through increased use/reuse.
- Multiple forms of ‘profit’ (ecological, economic and social).
- Less risk in the supply chain.

However, organising this does require energy, raw materials (substitution), manpower, mobility, etc. This requires close attention to the balance between sustainability and circularity. A product can be recycled with all the right intentions, but that does not necessarily make it sustainable, because of, for example, the amount of energy that the recycling requires. The reverse may also apply.

‘I want to contribute to the circular economy because I want to pass the earth on better to our children and grandchildren. Not just mine, but yours too. Because we take more than we give, because it cannot go on like this. Of course, this is not a message that lands comfortably ... because we prefer to bury our heads in the sand. That is why I find it so distasteful that measures to reduce CO₂ emissions are portrayed in the media as negative. Tell the positive story. Set a good example. And embrace those who are taking the right steps to help us achieve our goals.’

ELLYNE BIERMAN, BOSS BLOEMEN (CEO) AT REFLOWER,
RETRIEVED 26.07.2021.

1.2.2 Sustainability and circularity

Nevertheless, talking about circular entrepreneurship often makes one talk about sustainability in the same breath. Sustainability is about reduced use of raw/processed materials, fossil energy, water and the reduction of negative emissions and impact (environmental or otherwise) etc., during the process of making, functioning and disposal of a product, its components or raw or processed materials. Working on sustainability can be seen as working on improvements under the condition that production must take place within the production and absorption capacity of the earth. Sustainability can be implemented within the linear economy but is just as much a part and task of the CE. The latter is not necessarily sustainable without setting that as a concrete goal. Circularisation is rather a raw material, design and organisational challenge that has the ambition to make use and consumption of raw materials more sustainable. It is important, however, to take this challenge as the starting point in all phases of a lifecycle.

Circularity is about organising the retention of value of raw/processed materials, components and products in loops, what leads to lifetime extension, and less use of virgin raw materials, and resultingly has a lower environmental impact as an objective. Organising in loops leads to such a fundamentally different economic structure – a different system – that this can be seen as a transition.

‘Companies will have to take the step towards sustainability to retain their right to exist in the medium and long term. A growing number of companies recognise the need to become more sustainable. Various Dutch industrial companies, together with their suppliers, customers and small and medium-sized enterprises, are working on the necessary solutions to achieve climate neutrality. In many sectors, however, the necessary change at companies is still in its infancy.’

LIDEWIJDE ONGERING, SECRETARY-GENERAL MINISTRY OF ECONOMIC AFFAIRS AND CLIMATE POLICY, ECONOMISCH STATISTISCHE BERICHTEN (ESB), RETRIEVED 21.01.2021.

1.2.3 Thinking differently about time

The time factor also plays a vital role in organising circularity. Product groups have different time horizons, from minutes to decades (and longer), with various impacts in the making and functioning. This has a major influence on the nature and design of the business model. To illustrate, a classification into three time horizons is shown below.

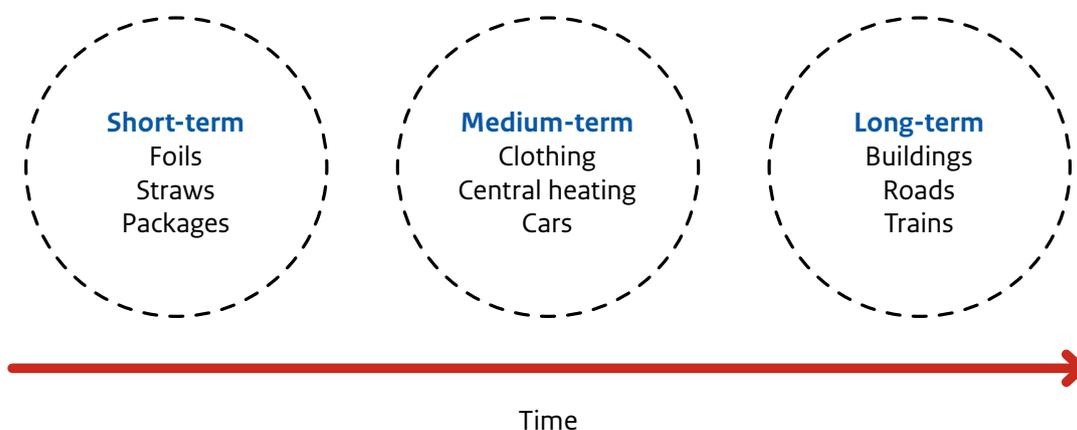


FIGURE 2 Different time horizons

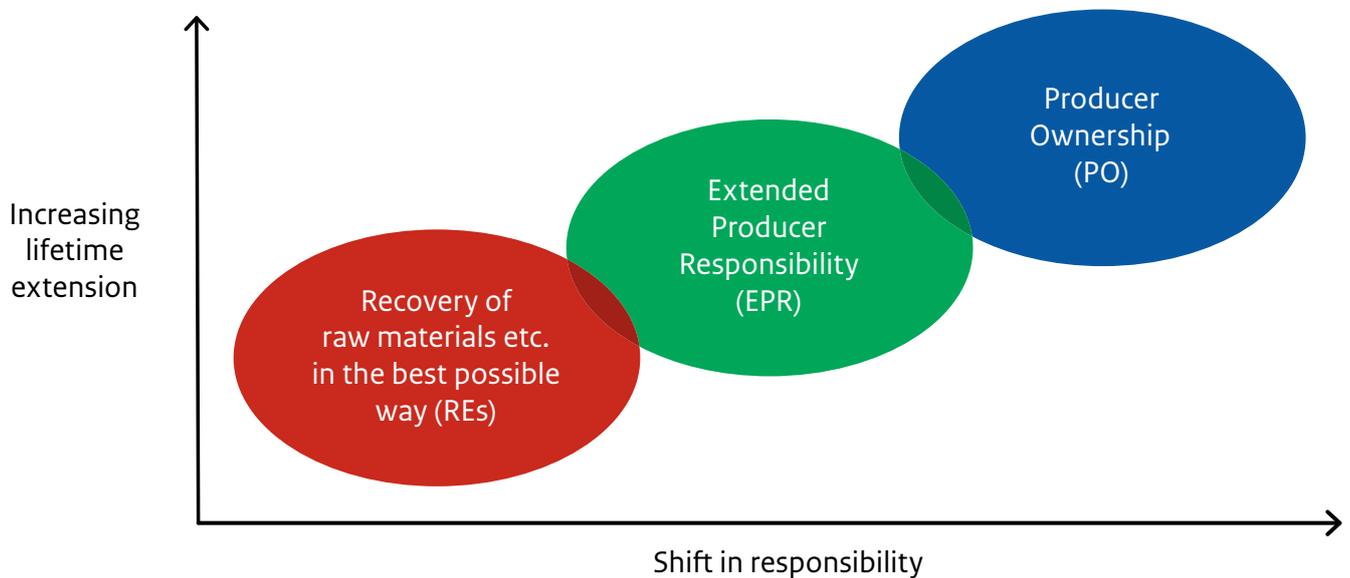


FIGURE 3 Changing responsibilities

1.2.4 Shift of responsibility

The research which forms the basis for the CBM classification shows that in the coming years the responsibility for a product will shift more and more towards the producer. A movement is visible whereby we move from ownership by the consumer (customer), via increasing responsibility for the disposal phase (extended producer responsibility, circa 2024/2025), to producer responsibility for the entire lifecycle (circa 2030?). The latter is called ‘Producer Ownership’ (PO) by the EU, which should actually be called ‘Producer Lifecycle Ownership’. It is about ownership during the entire lifecycle of a product, in multiple, different loops. This has far-reaching consequences for certain products and product groups. Because of the changing responsibility, the producer in principle becomes the manager (and indirectly the supplier too) of the raw materials of his own products. This is different in each sector (construction, mobility, fashion, greenhouse horticulture, etc.). This is only possible if the composition of a product (specifically in relation to the choice of components and materials), its use and its maintenance in the lifecycle are recorded and dynamically monitored from design to ‘end of life’. The importance of keeping track of information related to the various phases of the lifecycle of a product is therefore increasing. The route taken means that digitalisation, sustainability and

circularity must be dynamically linked. It seems logical that this trend towards digitalisation and increased responsibility should also be reflected in the underlying business models.

‘Lack of raw materials does not yet usually play a major role in the decision to start circular production. But the supply risks are increasing, especially for companies in the manufacturing industry that depend on rare materials. The European Commission (EC) calls the supply risk very high. The total number of critical materials on the list issued by the EC every three years is constantly growing and has now reached 30. The high prices of raw materials make the reuse of materials extra profitable. Yet progress in waste reduction and recycling is stagnating. Bigger steps are required to become more circular.’

ING, RETRIEVED 18.06.2021.

The quoted R-strategies (reduce, reuse, recycle, etc.) in the above schedule are explained in section 1.6.1. EPR stands for Extended Producer Responsibility and is a policy tool that extends the producer's financial and/or operational responsibility for a product to include the management of the post-consumer stage, especially for the take-back, recycling and final disposal. See, among many sources: <https://www.oecd.org/env/tools-evaluation/extendedproducerresponsibility.htm>.

For the emerging concept of Producer Ownership, information can be found at: <https://www.sitra.fi/en/articles/the-eus-sustainable-product-policy-framework-and-producer-ownership-models-are-key-to-mainstreaming-circular-business-models>.

1.3 The core of business models

A business model⁴ provides a logic for value creation and retention – a way in which and with whom an organisation, a chain or a loop of parties can organise value or value retention. It consists of several building blocks: (1) the value proposition (the logic to value creation), (2) the organisational model

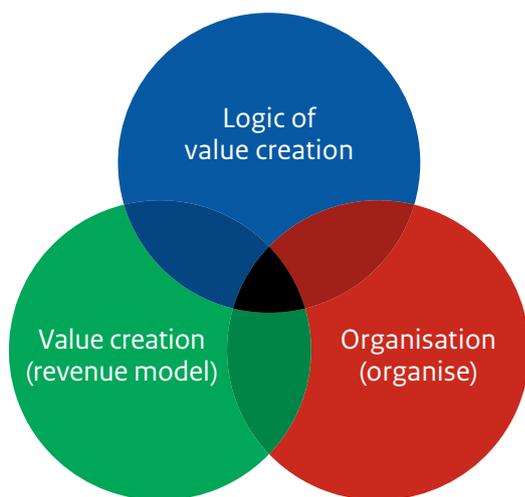


FIGURE 4 Business model building blocks

4 We have chosen to use ‘business models’ rather than ‘organisational models’. The latter can also refer to an organisational structure or other forms of organisation, such as logistics or administration.

including the parties involved and (3) the revenue model. Figure 4 shows this schematically.

‘Circular business models are expected to deliver the most environmental benefit and would therefore belong at the top of the R-ladder. These are business models in which products are offered as a service. However, these business models can be designed in different ways, which also result in different environmental gains. Producers can use a product-as-a-service model that gives them incentives to design a product to last as long as possible; the longer the product lasts, the longer it can be used as a service. Product-as-a-service models can also incentivise users to be as frugal as possible with the product.’

KISHNA, RED AND PRINCE, 2019.⁵

Business models form the basis for a transaction that is seen as of value between parties. There is an exchange, of a performance and a quid pro quo. Values are subjective and context (place and time) and person dependent. What is of value is determined by the parties involved and is not intrinsically linked to a good, service or event. So, what is of value to one person is not necessarily of value to another, even though they are all part of the same transaction.

5 Kishna, M., Rood, T., & Prins, A.G. (2019, January 23). Background report to Circular economy in map. The Hague: PBL. Retrieved 27.07.2021, <https://www.pbl.nl/publicaties/achtergrondrapport-circulaire-economie-in-kaart>

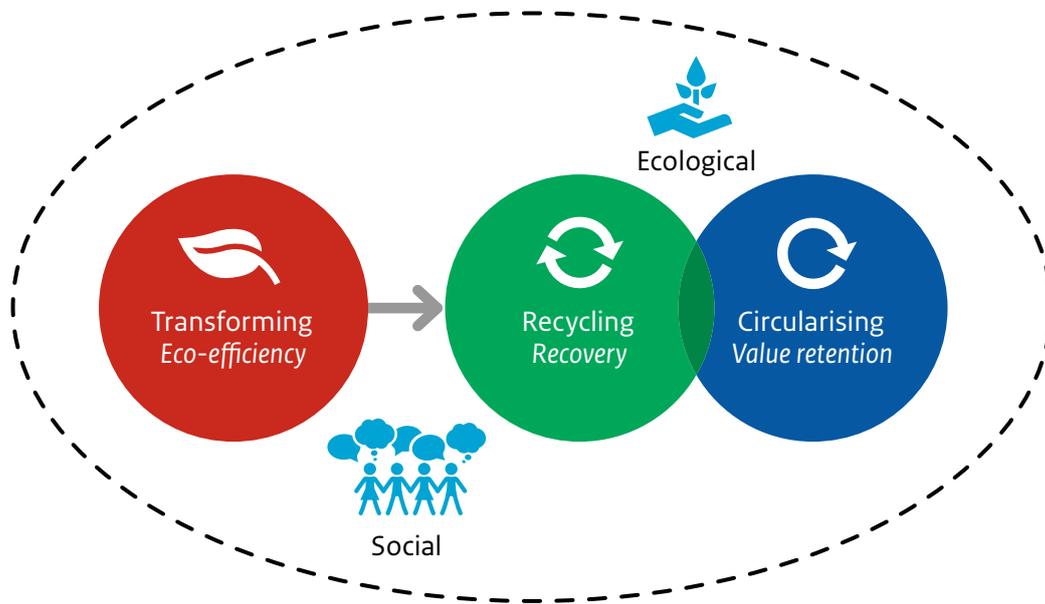


FIGURE 5 Forms of value creation

In the process of value creation, several values are always created simultaneously for and by the parties concerned (the aforementioned ‘multiple value creation’). The diagram above distinguishes three forms of value creation: transforming, recycling and circularising. Each of these three forms has its own goal or ambition: eco-efficiency, recovery and value retention. These forms of value creation do not exclude each other but rather overlap. Value creation always takes place in a valuable social and ecological context. The process of value creation should at least respect this context and leave it intact, i.e. not damage, exhaust or pollute it.

1.3.1 When is a business model circular?

Several characteristics can be cited that may not be exclusive, i.e. more than one can be valid at any given time:

- The organisation works to retain the value of raw/processed materials, components and products and can use them repeatedly in multiple loops.
- The ambition is to organise one or more loops (as a company, or in cooperation with companies and other organisations).
- Strategic work is being done to reduce impact compared to linear alternatives.
- There are forms of service provision.

- There is both horizontal and vertical chain integration (use of own waste in new packaging).
- A choice has been made for revenue models, or a set of models, that fit in with this aim.

‘I have noticed that the topic of circular business models still raises many questions among companies. The practical implementation and feasibility of circular business models are therefore not evident. The large upfront investments it entails, and the relatively long useful lifetime of building products, coupled with the difficulty of determining their residual value are just a few examples that complicate the transition from linear to circular for many companies. Also, setting up ecosystems as intended within the circular economy mindset often seems to be forgotten to make the whole picture work.’

KLAAS HOLSTERS, WOOD.BE (B), RETRIEVED 26.07.2021.

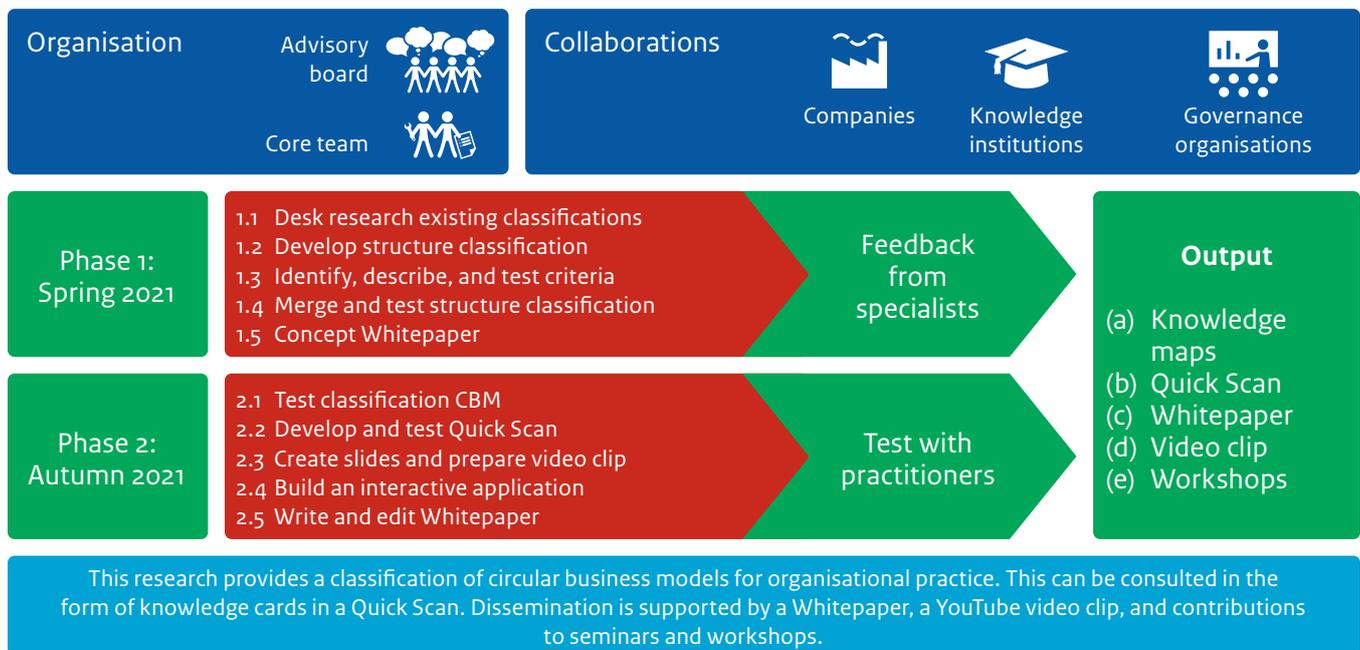


FIGURE 6 Structure of research into classification of business models for the circular economy

1.4 Background and design of the study

The Ministry of Economic Affairs and Climate Policy in the Netherlands is working on a Circular Manufacturing Industry Implementation Programme (UPCM/UPCE).⁶ Within this, an acceleration approach (Circular Economy and Smart Industry – CESI) has been formulated for the period 2021–2023. In March 2021, a study into business models and revenue models for the CE was started within the framework of this programme, commissioned by the Ministry of Economic Affairs and Climate Policy. The assumption is that since the first publications on BMCEs (2014e), a whole series of (innovative) CBMs has been developed about which there is little or no coherent knowledge. The ambition of the research should lead to the identification of a number of basic types of CBMs and possibly related revenue models. Users can use this

to develop a new CBM or adapt an existing one. This is done based on a qualitative analysis. This classification is intended to be available in various forms (including knowledge maps, meetings and a dynamic application). The overarching assumption is that a more thoughtful design and organisation of a CBM will contribute to the transformation and transition towards the CE.

1.4.1 Literature research into existing classifications

In the first phase of the study, a literature review was conducted. A collection of publications was built up (mainly professional and to a lesser extent academic) between 2014 and 2021. It primarily concerns practice-oriented material (Whitepapers, research reports, etc.) from a professional angle (private and government – the Netherlands and the European Union) and from applied research. It was decided not to consider academic classifications. This resulted in the 21 existing classifications that are used in this study. These are listed below sorted by year of publication. Appendix C provides an additional overview of the CBM typology found per author(s).

⁶ The focus on the manufacturing industry results in a focus on the materiality of the CE: raw materials, in other words. This does not mean, however, that directly related themes like the restoration of biodiversity, the climate challenge or social inclusion are subordinate or of less importance.

No.	Year	Author(s)	Title	Institute or Publisher	Country
1	2014	Bakker, C., Den Hollander, M. and Van Hinte, E.	Products that Last	BIS Publishers	Netherlands
2	2014	Bocken, N. et al.	A literature and practice review to develop sustainable business model archetypes	Elsevier	Netherlands
3	2014	Lacy, P., Keeble, J. and McNamara, R.	Circular Advantage	Accenture	England
4	2015	Lacy, P. and Rutqvist, J.	Waste to Wealth	Palgrave Macmillan	England
5	2015	Morlet, A., et al.	Delivering the circular economy	Ellen MacArthur Foundation	England
6	2016	Guldman, E.	Best Practice Examples of Circular Business Models	The Danish Environmental Protection Agency	Denmark
7	2016	Kraaijenhagen, C., Van Oppen, C. and Bocken, N.	Circular Business	Circular Collaboration	Netherlands
8	2017	Braam, G. et al.	Circular Route, a roadmap for a circular business model	Royal Van Gorcum Publishers and Printers	Netherlands
9	2018	Hofmann, F., Jokinen, T. and Marwede, M.	Circular Business Models	Fraunhofer IZM	Germany
10	2018	Larsson	Circular Business Models	Palgrave Macmillan	Sweden England
11	2019	Haugland, M., Arponen, J. and Töndevold, A. B.	The Circular Economy Playbook	Nordic innovation / Sitra / Accenture	Norway Finland Sweden
12	2019	OECD	Business Models for the Circular Economy	OECD Publishing	France
13	2019	Van Muiswinkel, J. et al.	Circulaire verdienmodellen	KPMG Advisory N.V. / Copper8 / Kennedy van der Laan	Netherlands
14	2020	Circular Economy Initiative Germany	Circular Business Models	Acatech / SYSTEMIQ	Germany England
15	2020	Haffmans, S. et al.	Products that Flow	BIS Publishers	Netherlands
16	2020	Mosangini, G. and Tunger, B.	Circular Economy Business Strategies	The Switchers	Spain
17	2020	Pieroni, M. P. P. et al.	Circular Economy Business Modelling	Technical University of Denmark	Denmark
18	2020	Smith-Gillespie, A.	Defining the Concept of Circular Economy Business Model	Carbon Trust	England
19	2020	Takacs, F., Stechow, R. and Frankenberger, K.	Circular Ecosystems	Institute of Management & Strategy	Switzerland
20	2021	De Mey, N. and Shahbazi, K.	The circular economy	Board of Innovation	Belgium
21	2021	Gillabel, J. et al.	Business Models in a Circular Economy	European Topic Centre on Waste and Materials in a Green Economy	Belgium

TABLE 1 Overview of publications with existing CBM typologies concerning the period 2014–2021 used to arrive at the classification.

These existing publications were then analysed, compared and condensed. This revealed that many classifications have the same objective, albeit with different wording or slightly different accents and intentions. Moreover, not all classifications are equally clear in their scope, definition or operationalisation. In addition, explicit attention was paid to recent publications commissioned by the European Commission. Last but not least, the classification that gradually emerged was presented to various respondents. All in all, this process of collecting and classifying resulted in a classification of seven basic CBM types. For the sake of readability, we chose to speak of ‘basic types of circular business models’, but in fact, there are groups of basic types, as each basic type conceals several subtypes.

1.5 Classifying circular business models

Seven different basic CBM types emerge from this research focussing on grouping the various typologies that already exist. This results in a classification that provides an overview of existing and future CBMs. Below, this classification is listed and briefly explained by way of introduction.

- 1 *Resource models*: the essence of these models is the recovery of products, components and raw/processed materials at the end of the lifecycle (discard phase).
- 2 *Design models*: the essence of design models is to design products to fit within the logic of circularity. This includes: design for repair and maintenance, design for recovery and recycling and design for lifetime extension.
- 3 *Lifetime extension models*: the essence of these models is to extend the lifetime of products, components and raw/processed materials.
- 4 *Platform (sharing) models*: the essence of platform (sharing) models is to increase the use of the existing functional capacity of assets (products) that are already in circulation.

- 5 *Product-as-a-service models*: these models focus on providing access to the function of a product to a user. The user no longer automatically becomes the owner of the product.
- 6 *End-of-life models*: the essence of these models is that producers and importers retain responsibility for the collection and safe and appropriate processing of products they have made or imported at the end of the lifecycle.
- 7 *Lifecycle models*: the essence of these models is that producers retain ownership of the products they make throughout the entire lifecycle.

A further elaboration of this classification based on a number of characteristics can be found in the second part of this Whitepaper.

1.6 Organisational choices to make a business model concrete

To realise a CBM, there are four other (organisational) choices to be made, in addition to choosing a basic type of CBM. These choices relate to the characteristics of a CBM. These are: strategic choices, organisational form, supporting processes and revenue models. Each of these choices is discussed below.

1.6.1 Strategies

What is an appropriate strategic choice for a given basic type of CBM? Here we start from the so-called R-strategies. This is a list of ten strategies that are increasingly helping to shape circularity. The higher up the ladder, the more circular the strategy is.

1.6.2 Forms of organisation

The realisation of a CBM often requires a modified form of organisation: from purely organisational focus, to more and more attention for stakeholders, to working on co-creation (and shared revenue models) instead of competition. Achieving this requires different organisational forms, as distin-

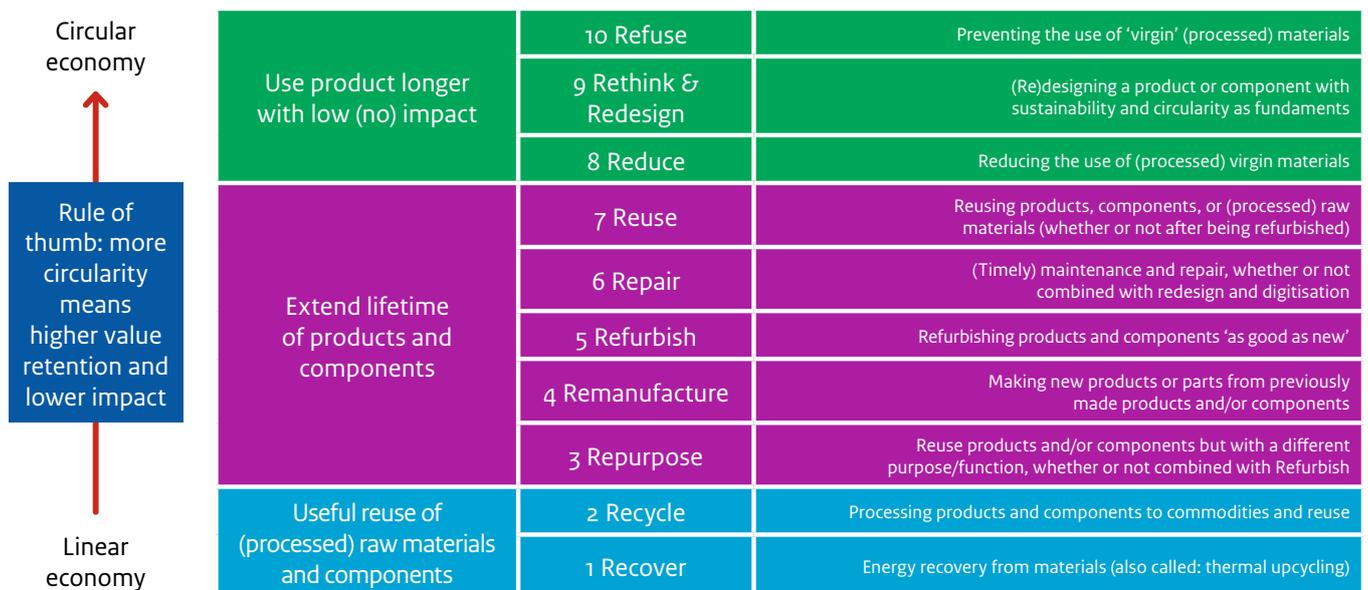


FIGURE 7 The R-Ladder of strategies

guished below. The complexity of these choices is increasing all the time:

- 1 *The classic organisation.* As we still very often know, this form of organisation is based on a (usually) hierarchical functional structure in which processes, functions and tasks are divided. The basis for this type of organisation can be found in the industrial way of production.
- 2 *Horizontal and vertical value chain integration.* Products are manufactured in value chains. To maintain control over the supply (raw materials) and recycling, companies can buy or acquire other companies in the chain, both upstream and downstream. This is usually called forward and backward or horizontal and vertical integration.
- 3 *A loop with multiple parties.* The essence of organising in loops is to use raw materials, components or (refurbished) products several times, with a view to retaining quality. Working in loops goes beyond (one-time) recycling; it requires a design in which the lifecycle idea has been included from the start. As an aside, but relevant to note, a loop rarely stands alone, but is often part of a cluster of interrelated loops.
- 4 *A system of loops (also called 'organisational ecology').* This text assumes, on the one hand, that we will have to organise in a radically sustainable linear way. On the other hand, we will have to

organise in a circular way – i.e. in loops – wherever this is appropriate, possible and relevant. This creates a 'hybrid' system of value chains and loops of which the ultimate task is to do this in a sustainable way.

'By applying circular strategies that go beyond recycling and focus more on preventing waste, manufacturing companies can extend the lifetime of products. For example, through increased reuse, repair or overhaul of modules and parts, or the use of sharing or rental models instead of or in addition to a sales model. To achieve real efficiency in material use, lifelong circularity requirements must be taken into account from the very first design of products. The key is to design as much as possible on the basis of renewable and reusable materials and also to design products that consist of replaceable parts.'

DUURZAAMNIEUWS, RETRIEVED 29.06.2021.

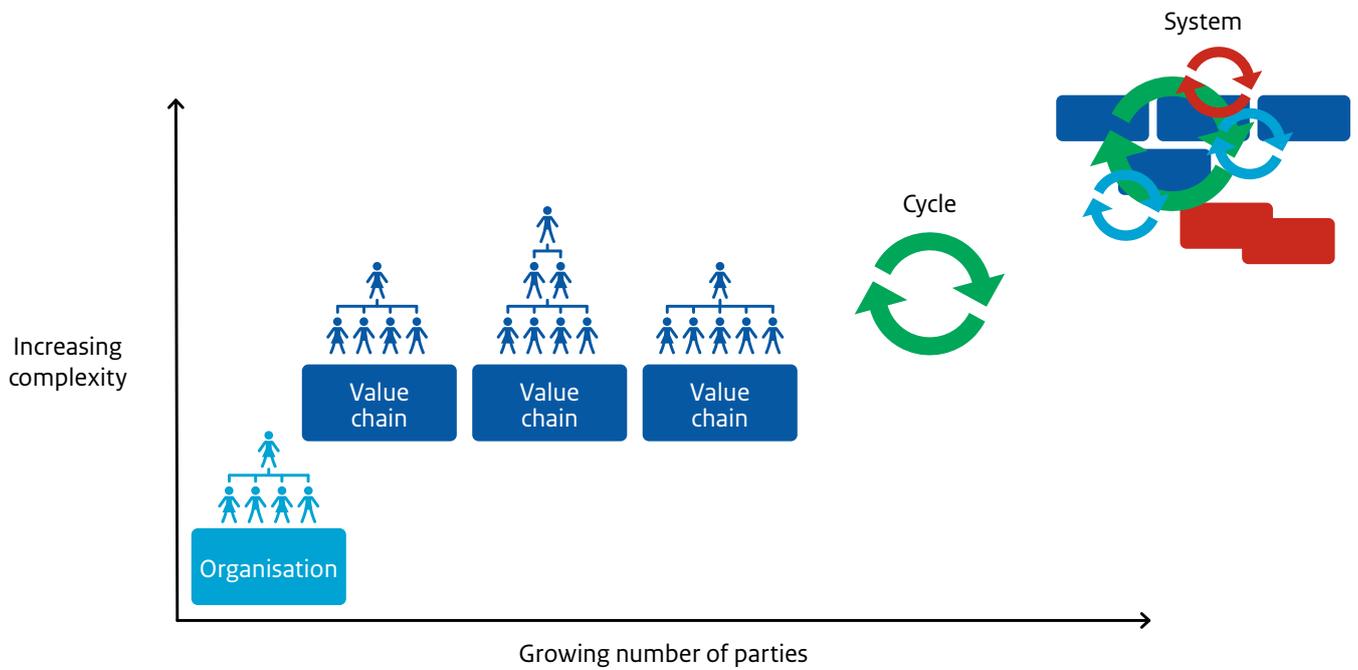


FIGURE 8 Overview of organisational forms

This overview of organisational forms is based on the use of raw materials; a product is made and then remade etc. What may be left out of consideration is the network phenomenon. After all, a great deal of our economic activity is made possible by social and digital networks. It goes without saying that digital networks such as the Internet of Things (IoT), the Internet of Services (IoS) and (if it is up to the authors of this Whitepaper) the Internet of Materials (IoM) will and must play an increasingly important role in the realisation and/or organisation of a CE. However, these networks are not linked to a specific organisational form, but play an important, if not crucial, role in all of the aforementioned organisational forms.

1.6.3 Supporting processes

By definition, organising requires supporting processes. It is useful to know which supporting processes are crucial for each business model. Another critical question is whether an organisation has the knowledge and competency itself or whether it can call on competencies in its chain or network. Some processes are mentioned here that are crucial for a particular type of CBM. However, this overview is not exhaustive.

1.6.4 Revenue models

Last but not least, a CBM requires careful consideration of the underlying revenue model. This may involve a 'revenue stream' (often referred to as the 'business case') but also brings into play considerations such as the reduction of CO₂ emissions.

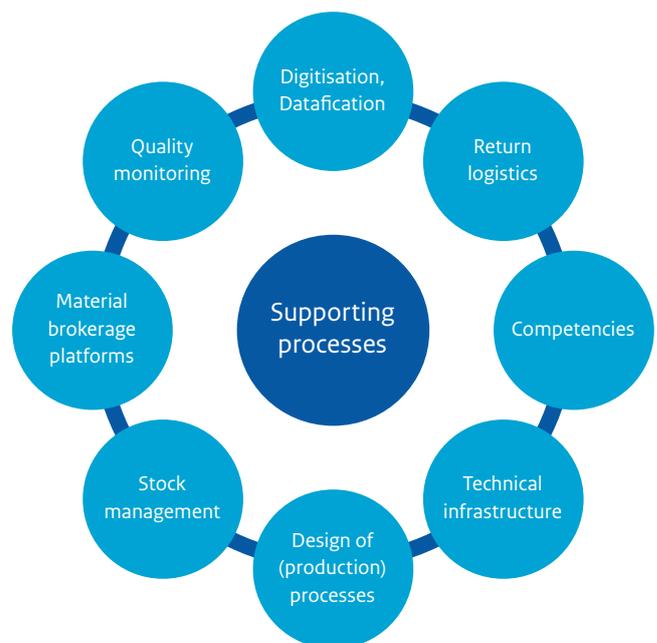


FIGURE 9 Supporting processes

On top of that, choices can be made that underlie the revenue model, such as working with True Price.

Revenue models show how an organisation, a value chain or a loop (or a system of them) generates income, the nature of that income, and for whom it generates income (obviously customers but also stakeholders). This is often referred to as the ‘business case’. What is more confusing is that the business model (the logic of value creation) and business case (Where is the revenue stream? Can this be done?) are often referred to as one and the same thing, while the revenue model is a part of the total business model, but not the same as the whole. Conventionally, the revenue model is purely financial. However, there is more than just turnover or

margin. Increasingly, additional requirements are being imposed on activities, such as emission-free construction or contributing to CO₂ reduction. But a contribution towards enabling reuse is also part of this. For this reason, many business models have not just one, but a combination of several revenue models, which together can realise and cash in on the total value to be created. It is all about finding the right mix and match that fits a particular situation. The art is in choosing revenue models that make this possible. When choosing revenue models, it is crucial to weigh up and combine the various forms of value creation. No standard combinations can be given. Apart from exceptions, the research shows that there is no obvious link between CBMs and revenue models.

Access (based on e.g. freemium, one-time registration fee or subscription)	Product-as-a-service (PAAS), analytics-as-a-service (AAAS) including remote monitoring and diagnostics, data-as-a-Service (DAAS) and the many variants, such as fashion-as-a-service (FAAS), mobility-as-a-service (MAAS) etc.
Barter (goods against goods, services against services or a non-monetary combination)	Production on demand (Just in Time: JIT) – works as a cost reduction in, among other areas, stock management. Can be combined with other revenue models
Bonus Malus arrangement	Rental (e.g. use per time unit)
Buy-back (with and without guarantee of repurchase value)	Sales (transaction with a transfer of ownership)
Circularity contribution (formerly the disposal contribution)	Shared ownership – in whole or in part
Compensation (such as ETS or tree planting)	Sharing concepts without ownership (partial and full)
Cross-selling (easy to combine with Freemium)	Smart pricing (depending on usage, behaviour, governance, quality at the end of usage etc.)
Deposit	Subscription (to time, performance, access, etc. with or without a usage component)
Emission reduction such as CO ₂ impact reduction, PFAS reduction or emission-free production	True price is the passing on in retail of so-called hidden costs or impacts. This is more a choice of principle than a revenue model. However, it can (also) be used as a distinguishing feature (and then contributes to profiling and positioning, among other things)
Extended lifetime (with or without warranty – e.g. with the possibility to buy additional warranty time)	Use of recyclates (legally required, or used voluntarily independent of legislation)
Freemium model (with limited scope services, for example)	Use of residual flows (legally required, or used voluntarily independent of legislation)
Lease (financial and operational)	Voucher discount on trade-in/new purchase (branded/non-branded)
Maintenance and inspection (whether or not based on datafication and digitalisation – see DAAS)	Warranty (extended, extra, lifetime)
Marketplace (C2C, B2B, B2C and C2B)	Settlement based on less (operational) use of raw materials.
Open Access (paying revenue in advance and then releasing it)	
Pay-per-performance, performance-as-a-service or pay-per-use – paying for actual performance	
Pooling (owned, leased, partial, full etc.)	

TABLE 2 Overview of revenue models

Non-monetary performance

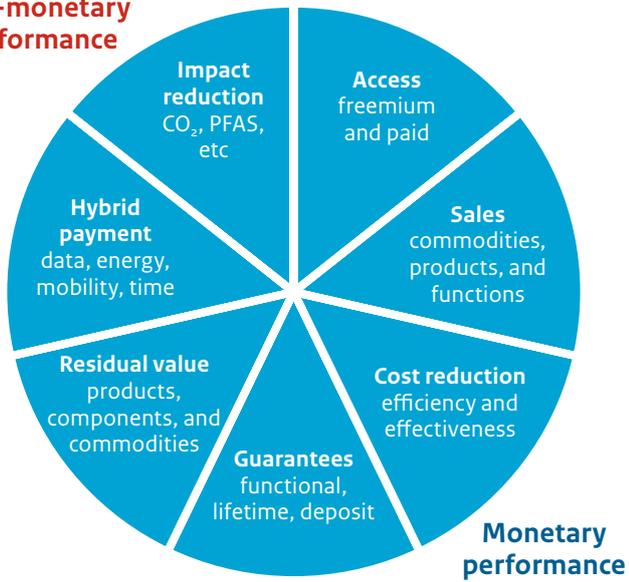


FIGURE 10 Classification of revenue models

How or when these revenue models can be applied in a specific basic CBM is not bound by iron rules or clear agreements. It essentially entails cleverly combining one or more revenue models in a particular context or the value proposition of a product–service combination. Developing a suitable revenue model for a particular business model is first and foremost, therefore, a question of entrepreneurship.

1.7 Synthesis to conclude

In conclusion, the development of a CBM always involves five interrelated organisational choices that must be made. These are:

- a Basic type of CBM
- b Choice of strategy
- c Organisational form
- d Supporting processes
- e Revenue models.

These five choices are used as building blocks for the developed Quick Scan. In the first part, a quick and concise analysis is made of an organisation regarding sustainability and circularity. In the second part, these five choices are then discussed. This Quick Scan is free to use by anyone and can be found in Dutch and in English at <https://circulaire-maakindustrie.nl>.

Finally, to round off the first part of this Whitepaper, the diagram below attempts to visualise the overarching line of reasoning. The structure can be read from bottom to top. It is a descriptive overview. The essence of a CBM is (1) value creation

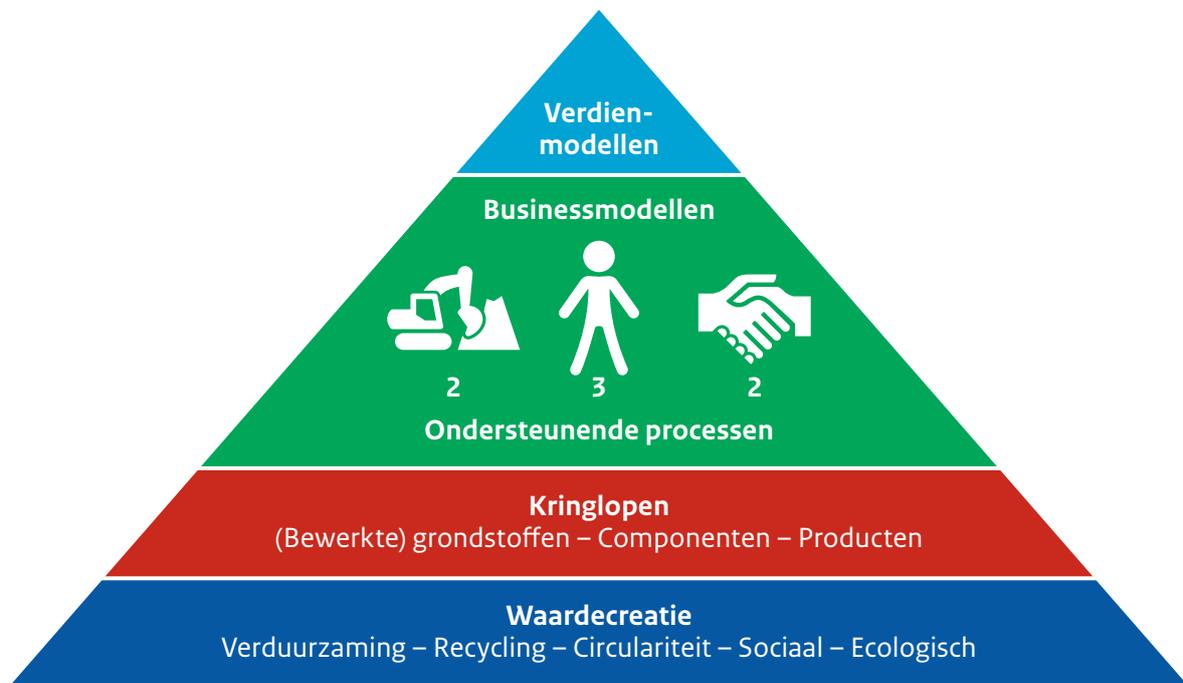


FIGURE 11 Circular Business Models Pyramid

organised in (2) loops, which are made concrete in (3) supporting processes, (4) business models and (5) revenue models. But we can also read it in the opposite order, i.e. with revenue models, or a mix of revenue models, linked to or incorporated in a basic business model type and, if useful and necessary, elaborated in supporting processes. We call the result of this visualisation the *Circular Business Models Pyramid*.

PART 2

Classifying circular business models

The second part of this Whitepaper focuses on explaining and elaborating on the classification of seven CBMs. These are divided into three groups, each with an increasing degree of circularity. Further elaboration is done on the basis of a number of characteristics. Finally, two more future-oriented models – ‘End-of-Life’ and ‘Life-cycle’ models – are given extra attention.

2.1 The classification in a nutshell

In the second part of this Whitepaper, we go into more detail about the classification of the CBMs introduced in the first part. The CBMs are divided into three groups, in order of their increasing contribution to circularity.

- The first group of CBMs consists of resource models and design models. The first basic type focuses on the recovery and reuse of raw and processed materials and components. The second basic type looks at the design of a product (etc.), so that both the production and the use of products are designed with minimum use of virgin materials. As many materials as possible are substitutable, and there is the least possible negative impact in terms of polluting emissions, depletion or social and ecological destruction.

- The second group of CBMs includes lifetime extension models, platform (sharing) models and product-as-a-service models. These three basic types share a common focus on the characteristics: longer, smarter, and better use. This group ideally assumes designs that provide extended product lifetimes. However, a longer lifetime not only requires smart designs, but also (or especially) timely maintenance (including preventive maintenance), fast assembly and disassembly, and data and digitalisation. For platform (sharing) models, the starting point is that we rarely use the full capacity of many products. There is always therefore a greater or lesser degree of ‘idle capacity’. With the help of social and digital networks, this residual capacity can be better utilised. The product-as-a-service models are about access to and provision of a service. Sales or ownership are not central to transactions, but providing services such as heat, mobility or a chemical function is.
- The third group of CBMs – end-of-life models and lifecycle models – exhibit a growing de-

gree of responsibility. End-of-life models involve the retrieval of raw/processed materials, components and products in the end-of-life phase. Lifecycle models are about producer responsibility for the entire lifecycle of a product, component or even raw/processed materials. These two CBMs make the highest contribution to circularity.

These seven basic types can be explored through a set of seven characteristics. These characteristics look at the different organisational aspects of a business model. They are introduced and briefly described below.

2.2 Characteristics of circular business models

The classification of a CBM is characterised below based on a number of organisational characteristics that are considered relevant in the context of organising a business model. This list is based on

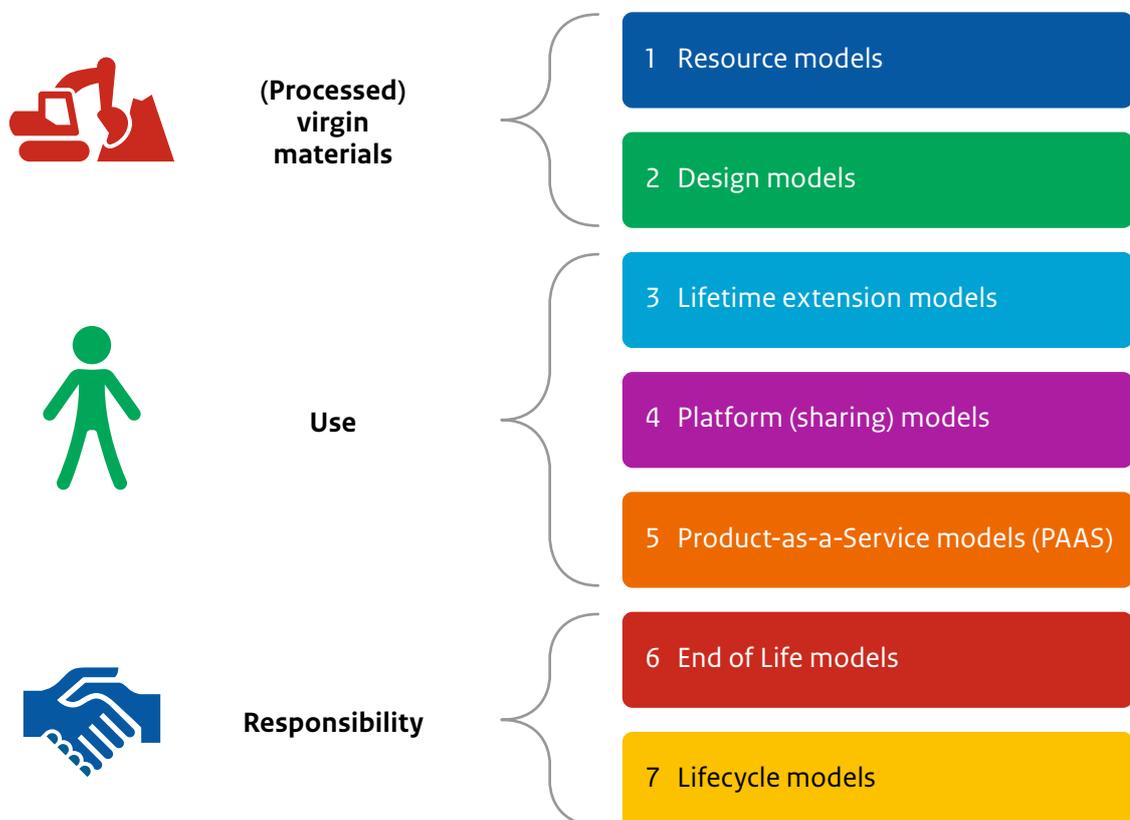


FIGURE 12 Classification of CBMs

an analysis of existing classifications, input from various workshops held as part of the study, and individual feedback from respondents. This list of characteristics is described below. We have tried to keep the list as compact as possible. The following pages describe these characteristics for each basic type of CBM.

- 1 **Focus:** what is the primary focus of the CBM? On designing, making, functioning, maintaining, reusing, and/or recovering products, components or raw/processed materials?
- 2 **Value creation (ambition):** what value(s) does this CBM create and for whom? Is it a combination of transforming, recycling, circularising, and social and/or ecological value? The starting point is value creation with a lower (preferably zero) negative impact.
- 3 **Organisation:** what is the nature of the organisation that the CBM requires? Is it an organisation-internal approach, a (value) chain approach, organising a loop or an organisation that includes an entire system? The form of organisation is becoming increasingly complex. The more complex the form, the more complicated it is to realise, and the lower the impact.
- 4 **Strategy:** several so-called R-strategies are developed over time: the R-ladder. These are the ten most common strategies, ranked from low to high impact: Refuse (refuse raw materials/output), Rethink (redesign), Reduce (refuse certain raw materials when making or using products), Reuse, Repair, Refurbish, Remanufacture (make new), Repurpose, Recycle, and finally Recover (often mainly heat recovery). The question is, which strategy or combination fits the CBM best? The higher a strategy is on the R-ladder, the lower the impact.
- 5 **Support:** which supporting processes are crucial for this CBM? Digitalisation/datafication, (reverse) logistics, competencies, (technical) infrastructure, design of processes and production processes, stock management, material mediation platforms, quality assurance.
- 6 **Revenue model:** which revenue model – or combination of models – fits best for this CBM? The previous section explained that this is first and foremost a question of the best ‘mix-and-match’, given the product–service combination in a value proposition. More and more often, consideration is being given not only to purely monetary models but also to working with integral pricing such as ‘True Price’, CO₂ or other forms of emissions pricing. By incorporating this in the value proposition, a form of revenue model is created. The broader the scope of a revenue model and the more factors it includes, the greater the impact on sustainability and circularity.
- 7 **Impact:** what is the impact of this CBM? Is it about risk reduction, raw material security, material savings, CO₂ reduction, nature recovery, job creation and/or a combination of these? The more of the latter, the greater the impact. This can be deduced from the determinations given above under (2), (3), (4) and (6).

2.3 Knowledge Maps for circular business models

The previously outlined research into existing typologies and the developed characteristics together form a framework to systematically elaborate on the introduced classification of a CBM. This is done below. We call these systematic elaborations Knowledge Maps.

2.3.1 Resource models

The essence of these models is the recovery of products, components and raw/processed materials at the end of the lifecycle (discard phase). These can be given a new purpose (eventually, after being refurbished). Raw materials can also be processed into higher or lower value options (upcycling and downcycling). Once all these possibilities have been exhausted, the only remaining option is to recover thermal value, the so-called ‘recovery’ of energy.

- 1 *Focus*: disassemble, recover, repurpose, remanufacture.
- 2 *Value creation*: primarily recycling for products in the value chain with indirect social (job creation) and environmental (reduced raw material footprint) impact.
- 3 *Organisation*: (end of) value chain and (possibly) a new loop.
- 4 *Strategy*: recycle, repurpose, reuse and recover.
- 5 *Support*: reverse logistics, technical infrastructure, disassembly protocols, quality assurance.
- 6 *Revenue model*: use of residual flows, sales (recyclates).
- 7 *Impact*: material and raw material savings, job creation, CO₂ reduction.

2.3.2 Design models

The essence of design models is to design products in a way that fits within the logic of circularity. This involves design for repair and maintenance, design for recovery and recycling and design for lifetime extension. This is at odds with the linear economy principle of 'planned obsolescence'. Circular design means designing for (1) longevity, (2) the possibility of easy repair, (3) modular composition and easy disassembly, (4) use of reusable materials and (5) use of bio-based materials. Design models for the CE focus on delivering designs for new products, redesigning existing products and designing (or redesigning) production, distribution and take-back systems that close loops for circular products.

- 1 *Focus*: design (products and production processes).
- 2 *Value creation*: transforming, circularising and recycling.
- 3 *Organisation*: organisation-internal, value chain and loop.
- 4 *Strategy*: rethink, redesign, reduce.
- 5 *Support*: competencies, design of (production) processes, reverse logistics.
- 6 *Revenue model*: extended lifetime, compensation, smart pricing.
- 7 *Impact*: material savings, usage savings, better raw material recovery, CO₂ reduction.

2.3.3 Lifetime extension models

The essence of these models is to extend the lifetime of products, components and raw/processed materials. This basic type of business model focuses in particular on (1) repair, (2) maintenance, (3) refurbishment, (4) replacement/substitution of components, (5) remanufacturing, (6) repurposing and (7) reusing. The aim is to retain a product, its components and the materials used in it in their original states and functionality for as long as possible. Working to extend the lifetime (refurbishment, remanufacturing, etc.) is closely related to – and can therefore be very well combined with – providing access to the function of a product. In other words: product-as-a-service (see below). In a product-as-a-service model the maker/producer remains financially responsible for the product, so he or she will want to lose as little value as possible after the function phase.

- 1 *Focus*: (timely) maintenance, reuse.
- 2 *Value creation*: transforming, circularising.
- 3 *Organisation*: organisation-internal, value chain and possibly loop.
- 4 *Strategy*: reduce, reuse, repair, refurbish, remanufacture, repurpose.
- 5 *Support*: appropriate designs (see different design models), competencies, digital, technical and logistical infrastructure.
- 6 *Revenue model*: use of recyclates, maintenance and inspection, buy-back, lease, rental.
- 7 *Impact*: raw/processed material savings, job creation.

2.3.4 Platform (sharing) models

The essence of platform (sharing) models is to increase the use of the existing capacity of assets (products) that are already in circulation. The assumption is that there is much overcapacity available. The intensity of use can be increased by providing a digital mediation function through a website (platform). On average, consumer products are used for a short (or even very short) period of time (e.g. 8 to 12 minutes for a drilling machine). Platform (sharing) models aim to increase the efficiency of use of the product, its components and

the raw materials it contains. Platform (sharing) models focus on providing access to products. An important effect is that fewer products are needed to meet the needs of the functionalities by providing access to products.

- 1 *Focus*: function, maintain and reuse.
- 2 *Value creation*: transforming.
- 3 *Organisation*: network.
- 4 *Strategy*: reduce.
- 5 *Support*: digitalisation & datafication, material mediation platforms.
- 6 *Revenue model*: open access, shared ownership, access, subscription, pay-per-use, deposit.
- 7 *Impact*: material savings.

2.3.5 Product-as-a-service models

Product-as-a-service models focus on providing a user access to the function of a product. The user no longer automatically becomes the owner of the product. Agreements are made concerning (1) the permission to use a product (access), (2) with a certain performance in terms of functionality, (3) a predetermined fee under a number of conditions, including the quality of the functioning. Product-as-a-service leads to performance arrangements, resulting in fewer products being needed in total. Dematerialisation can be achieved in this way. This type of CBM is often accompanied by lifetime extension because this is in the provider's interest.

- 1 *Focus*: function.
- 2 *Value creation*: transforming (through better utilisation), circularising.
- 3 *Organisation*: network.
- 4 *Strategy*: reduce, refurbish, remanufacture, reuse.
- 5 *Support*: digitalisation and datafication, competencies.
- 6 *Revenue model*: subscription, pay-per-use, rental, lease.
- 7 *Impact*: material savings.

2.3.6 End-of-life models

New European legislation concerning obligations for producers has led to the implementation of 'Extended Producer Responsibility' (EPR). Produc-

ers and importers retain their responsibility for the products they make even after the functionality phase or disposal phase. This means that producers and importers retain responsibility for the collection and safe and proper processing of the products they make or import. End-of-life models give meaning to this by registering and tracking products and raw materials (passively and interactively) in a detailed and increasingly digital manner. To realise this, these business models are characterised by the use of data and digitalisation of products and raw materials. This also creates insight into the (future) raw material supply and its quality. This can be supported by a material passport that records the composition of a product during design and production. In addition, 'track and trace' systems are used to follow products during the function phase, and producers/importers gain insight into the development and location of the raw materials stock over time. In essence, end-of-life models facilitate impact reduction for other companies by enabling circularity.

- 1 *Focus*: function, maintain, reuse, recover.
- 2 *Value creation*: circularising.
- 3 *Organisation*: value chain, loop (system).
- 4 *Strategy*: reduce, reuse.
- 5 *Support*: digitalisation & datafication, technical infrastructure, stock management.
- 6 *Revenue model*: analytics-as-a-service, data-as-a-service.
- 7 *Impact*: material savings, reuse, CO₂ reduction.

2.3.7 Lifecycle models

The basic principle of lifecycle models is that producers retain ownership of the products they make throughout the entire lifecycle (the Producer Ownership principle). Therefore, these business models aim to provide access to the entire lifetime of a product. Producers achieve maximum control over the raw materials they use in their products, including the recyclates recovered from them, and can thus close the entire loop. The ambition to fully close loops is leading in the choice of raw materials, product design, service organisation and supporting processes such as product take-back systems and digitalisation.

- 1 *Focus:* design, make, function, maintain, reuse, recover.
- 2 *Value creation:* transforming, recycling and circularity, social, ecological.
- 3 *Organisation:* loop, system.
- 4 *Strategy:* rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle.
- 5 *Support:* digitalisation & datafication, reverse logistics, competencies, quality assurance.
- 6 *Revenue model:* subscription, use of residual flows, maintenance and inspection, pay-per-use, lease, rental.
- 7 *Impact:* material savings, CO₂ reduction, job creation.

In practice, different CBMs can be combined, given the organisational ambition. Rarely is one model dominant.

2.4 Elaborating ‘End-of-life’ and ‘Lifecycle’ models

End-of-life models and lifecycle models are seen as the most circular of business models. In these

models a closed loop is worked towards either by one company (lifecycle model) or by enabling a closed loop for another company (end-of-life model). Both models could be seen as an extension of the first five models. This section gives two examples of what such models might look like in practice as an extra explanation. An example case is elaborated and supported by a case study. This is done for both a company that works according to an end-of-life model and a company that works according to a lifecycle model.

A company that works according to an end-of-life model ensures a closed loop, but the ownership of the product lies with an external party. The end-of-life model company ensures that other companies can close their loop. This is achieved by ensuring, for example, that companies are aware of where their raw/processed materials, components or products are located and by providing insight into their state of repair. By ensuring that products are collected at the end of their function phase, end-of-life model companies can offer a helping hand to companies that wish to close the loop together.

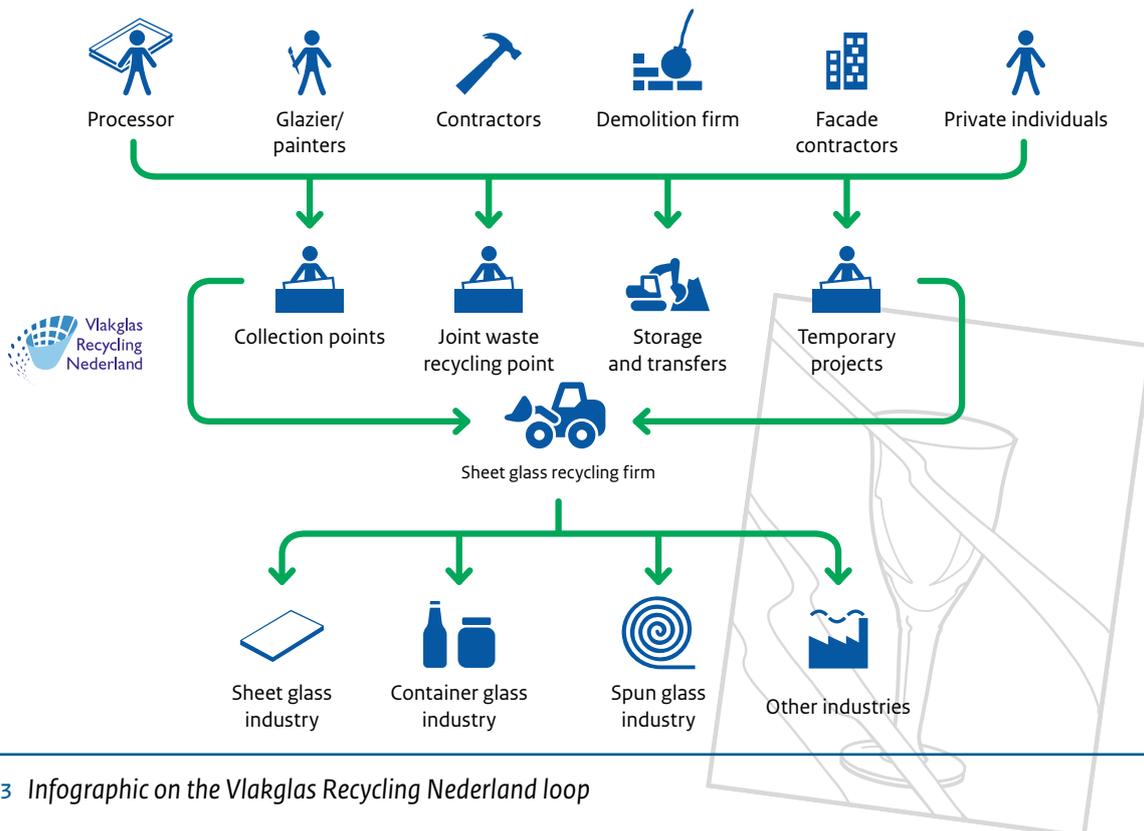


FIGURE 13 Infographic on the Vlakglas Recycling Nederland loop

Figure 13 shows the loop of Vlakglas Recycling Nederland (VRN). The infographic shows how VRN stands beside the loop but maintains the overview and offers tools to the companies in the loop to make circularising possible. VRN collects sheet glass waste and takes it to a recycling company to become processed into new glass, such as double glazing, mirrors and interior glazing.

A lifecycle model occurs in practice when a company is responsible for closing the loop itself and when it does not outsource this to an external company. For example, in the design phase, it develops products that take account of the possibilities of repair and recycling (design model). In the function phase of the product, the company rents the product instead of selling it (product-as-a-service model). After the function phase, the company uses the product itself to remanufacture or refurbish it (lifetime extension model) to give it a new life. When all this is no longer possible,

the company itself takes the products back to recycle them (resource model) and thus gives them a new life as raw materials. These raw materials can then once again start the process of remanufacture. Therefore, this is a closed loop. We call this a lifecycle model, and this is, together with an end-of-life model, the most circular business model.

Figure 14 shows the loop of the company Logge. This company works according to a lifecycle model with office furniture. Logge only uses renewable materials and wants to eventually bring all products back into the material loop, so that there is no more waste. Logge uses different ways for circular interior construction for this: (1) design circular interior, (2) circular interior with buy-back warranty (buy-back), (3) circular interior as a service, (4) material passport and (5) True Price. Besides circular projects, Logge also focuses on projects where existing materials are reused or refurbished.

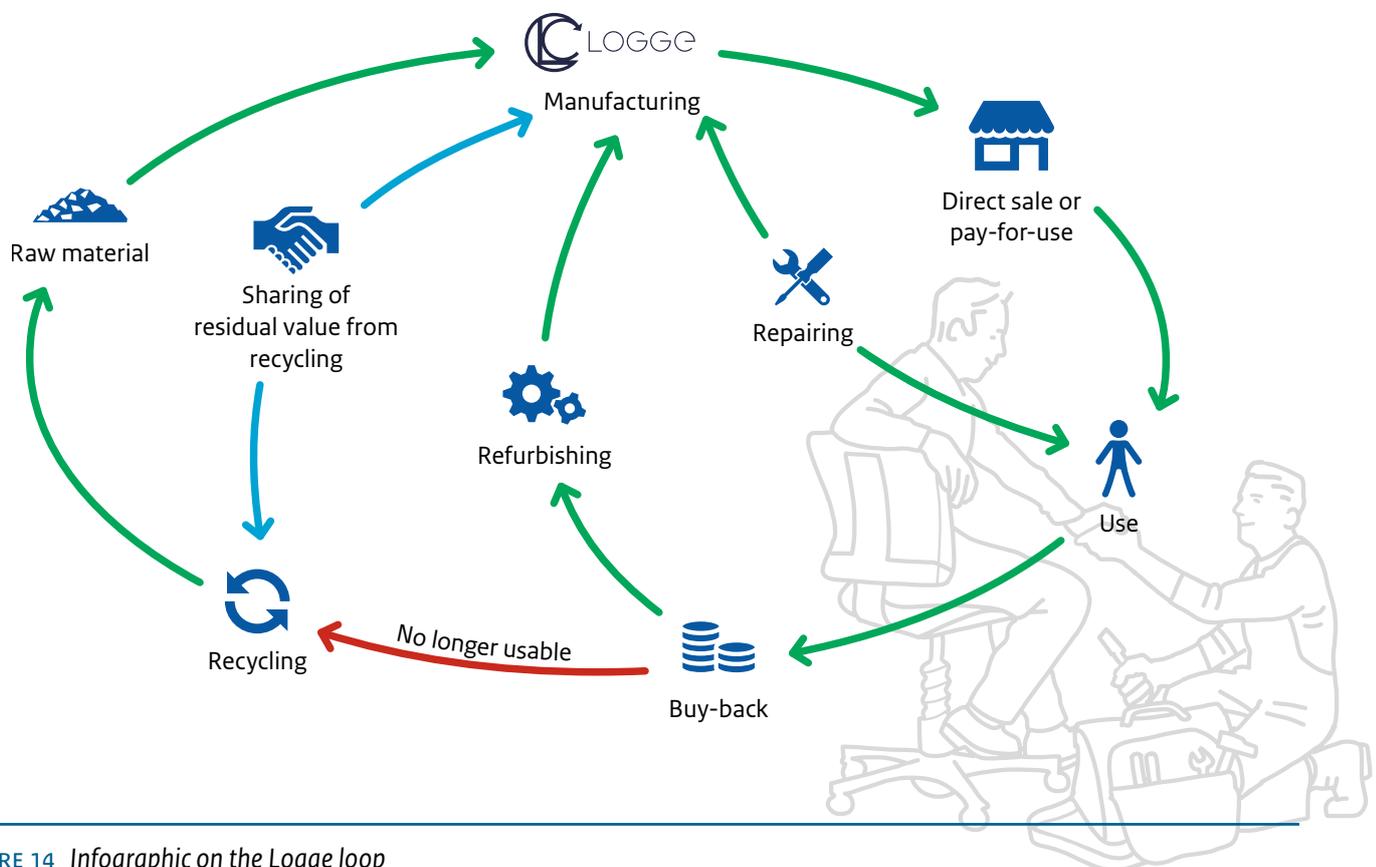


FIGURE 14 Infographic on the Logge loop

PART 3

Enhancing transition

The third part of this Whitepaper starts with a short report and a reflection on the occurrence of the classification of CBMs in practice. To this end, additional research was carried out based on existing case studies. Finally, we consider the change management side of working with and on CBMs in practice.

3.1 Case analysis: representation and reliability

Based on a case analysis (N = 253), it was examined how often the CBMs as described in Part 2 occur in practice. This inventory is based on various public sources. It concerns so-called ‘second-hand material’ that was collected and compiled by third parties at an earlier stage and with different ob-

jectives.⁷ Consequently, the descriptions of cases vary widely in structure and information density. A format has been developed based on the existing classifications to describe these cases in a systematic way. From the entire collection, 232 were entered into the format. Some of these cases contained more than one CBM. Therefore, a total of 253 CBMs was found in the cases. The size of this collection is such that it can be assumed that it provides an accurate picture of current practices. An additional collection of 231 cases from a single European source⁸ has not therefore been included in the collection. Figure 15 shows how often the CBMs occur in the collected cases.

This overview shows that resource models (recycling) and lifetime extension models together account for more than half of all business models. This percentage for resource models is not surprising; after all, we have been promoting recycling for

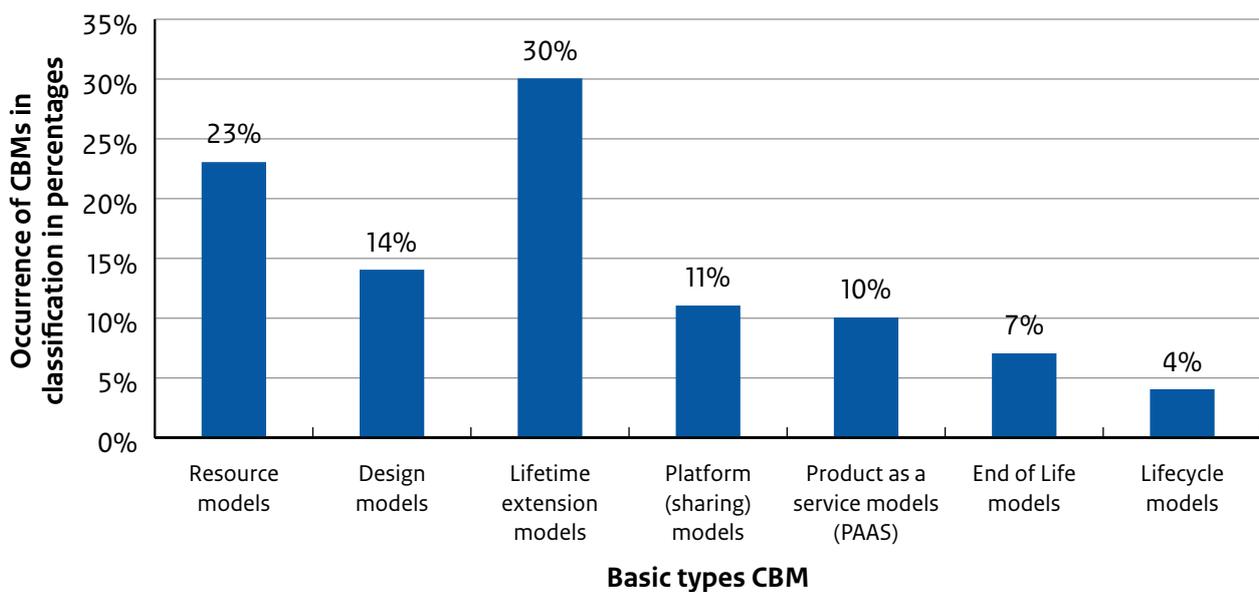


FIGURE 15 Occurrence of CBMs in classification based on existing cases in percentages

7 A critical reflection on these case collections is appropriate here. People often submit their cases based on different motives. Authors also include cases to illustrate a particular point of view. This creates a distorted picture of the actual situation in the empire.

8 <https://circulareconomy.europa.eu/platform/good-practices> retrieved 01.07.2021.

over a quarter of a century. But what is striking is the high percentage of lifetime extension models. We think this outcome is somewhat inflated. After all, the study is based on so-called ‘second-hand’ source material. This means that existing sources are used that were originally constructed for a different purpose. This sometimes makes it difficult to distinguish the classifications made in this Whitepaper. Therefore, it is wise to keep an open mind when interpreting this diagram and regard the percentages as indicative rather than absolute.

3.2 Reflection on the circular business model classification

First of all, the CBM classification shows a synthesis of existing concepts and practices. Based on the analysis of this material, two dominant CBMs emerge: the resource model and the lifetime extension model.⁹ What is further remarkable is that these two CBMs are both models that are counted among the less circular CBMs. In contrast, the two least common models are the two most circular models. Based on the findings from the case studies, we can state that the more circular the CBM is, the less common this basic type is (with lifetime extension models being the exception to this rule). In other words, working on circularity as a systemic and economic task is still in its infancy.

This Whitepaper, and the Quick Scan based on it, provide first and foremost an overview of what business and revenue models are available. By making conscious and strategic choices, companies can take control and take steps towards a sustainable and circular economy. Help seems to be welcome. A first step is to fill in the Circular Business Models Quick Scan. This self-assessment helps companies to consider where they stand

⁹ The basis for lifetime extension in this classification remains implicit. It is not clear whether this is done on the basis of repair, refurbishment, remanufacturing or otherwise.

with regards to the CE. The Quick Scan also shows possible next steps based on the companies’ ambitions. This Quick Scan can be consulted and downloaded free of charge via the website <https://circulairremaakindustrie.nl>. But whatever step is taken individually or collectively, there will always be change, to a greater or lesser extent. In the next and last section of this Whitepaper, we will conclude by considering this change.

3.3 About change and transition

The realisation of a CE with the existing (linear) economy as a starting point leads to three – undeniably interrelated – forms of organisational, technological, economic and institutional change within organisations, between organisations and within systems. These changes can be categorised according to how far-reaching they are or according to their impact:

- 1 *Organisational change*: the focus is the organisation (possibly with part of the value chain) of improving the status quo to varying degrees.
- 2 *Transformation*: the focus is on arriving at new (partial) solutions based on existing technology and competencies supplemented with new ones.
- 3 *Transition*: the focus is on arriving at a new system (or subsystem) design from radically new starting points (paradigm shift).

This leads to companies integrating their value chains up- and downstream. This means, for example, that a major retailer buys up and incorporates a waste processor at the back end of the value chain that processes both material and biological waste or that it takes over a packaging manufacturer at the front end of its value chain. It follows that:

- Working on sustainability and circularity in one’s own organisation or in the value chain will inevitably involve several questions relating to change.

- These questions may have more or less change impact.
- If it only involves changing the existing situation, then it is considered as improvement – even if some people call it *innovation*.
- When it comes to creating a new business proposition but based on existing procedures and competencies, there is *transformation*.
- We can speak of a transition if there is a radical change in the way we work, with new procedures, agreements in the chain and government rules.
- Working on transforming can be seen as an improvement or as working on a transformation. Working on the CE is working on a (system) transition.

These changes affect the design of business models in various ways. The X-Curve below has been used to try to visualise these developments.

This assumes that the central ambition of the linear economy is to *sustainify*, and the central task within the CE is to *preserve value*. Ideally, these two ambitions will meet somewhere in the middle given a specific context and/or object/subject. In practice, the most appropriate balance has to be found for each product (group), with a whole range of factors coming into play. Last but not least, this is a dynamic balance that changes over time. These two ambitions can be seen as drivers over time leading to improvement, via transformation, towards transition.

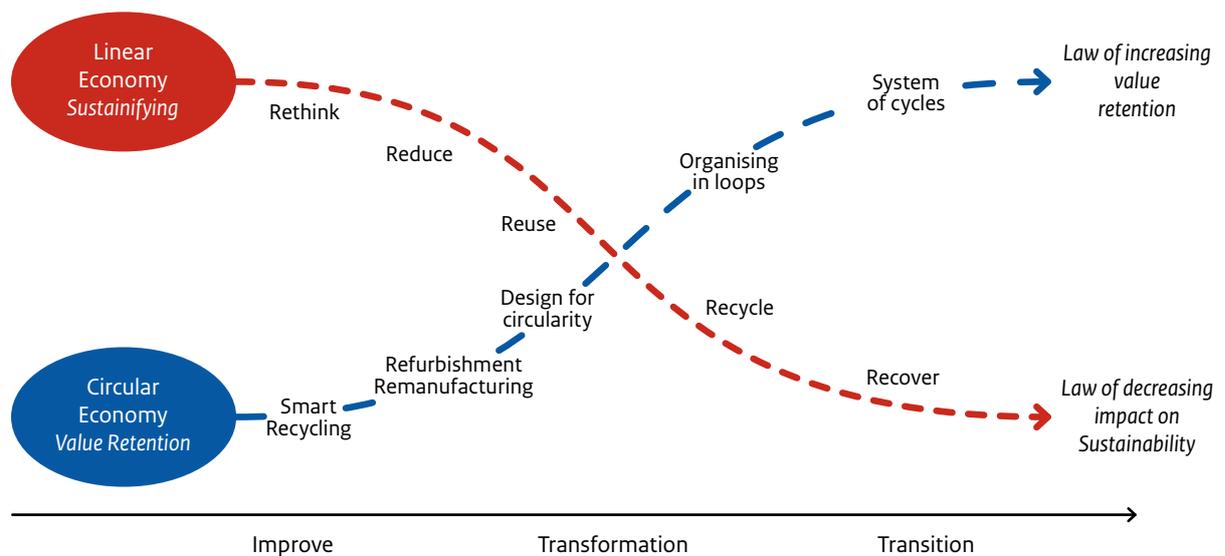


FIGURE 16 X-Curve change, transformation and transition

APPENDIX A: THESAURUS

Circularity is about organising value retention of raw/processed materials, components, and products in loops, which leads to lifetime extension and lower impact.

Datafication is bringing a phenomenon into a quantified form so that it can be systematically recorded and analysed to realise value (and value creation) based on this data.

Eco-efficiency is the aim of producing goods and services with a lower consumption of raw materials coupled with lower waste production and pollution (sustainability).

Ecology of loops (system) is a combination of different organisational forms (organisation-internal, value chains, networks and loops).

European Green Deal is a programme to combat climate change. With the Green Deal, Europe should become a climate-neutral continent by 2050, with no greenhouse gas emissions, and economic growth without depleting raw materials. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

Extended Product Responsibility (EPR) is a set of measures to ensure that producers of products take financial or financial and organisational responsibility for managing the waste phase of a product's lifecycle. <https://www.uu.nl/sites/default/files/White-paper-on-Pathways-for-Extended-Producer-Responsibility-on-the-road-to-a-Circular-Economy.pdf>

'Fit for 55' is a package of measures taken by the European Commission to reduce greenhouse gas emissions in the EU by 55 percent by 2030 compared to 1990. <https://www.consilium.europa.eu/en/policies/green-deal/eu-plan-for-a-green-transition/>

Impact is the effect (often powerful and sometimes lasting) that an event, action or choice has on people, their environment (natural, institu-

tional and/or social) and thus on the course of events, which in the long term arise from that effect. Impact can be measured by the nature of the change that takes place as a result of an event, action or choice made.

The Implementation Programme Circular Manufacturing Industry ('Uitvoeringsprogramma Circulaire Maakindustrie' – UPCM) is a partnership of industry, government and knowledge institutions that is committed to the circular transition of the Dutch manufacturing industry. Circular Economy and Smart Industry (CESI) shows that digitalisation and new technologies offer many opportunities for the efficient use of resources and high-quality reuse of products. <https://circulairmaakindustrie.nl/themaproject/smartcirculair/>

Lifecycle is the route that a product takes from development to decay. Among other things, reuse and recycling can extend the lifecycle of products.

Lifetime extension is the aim to design products that last (or last longer), using less 'virgin' materials such as fossil fuels, and that can be maintained smarter by using alternative and refurbished materials and resources.

A *loop* is a (closed) process in which a particular complex of raw materials in various compositions or functionalities succeed each other, but in which the initial state is reached again. Schematically a loop can be drawn as a circle or circular movement.

A *network* is a collection of interconnected organisations, across both sectors and value chains, which work together to extract raw materials, process them and ultimately make products from them. The collection of organisations carries out activities collectively to create value.

Producer Ownership means that the producer retains ownership of a product or service and is responsible for ensuring that products and materials are used efficiently throughout their lifecycle.

cle, and are reused and recycled if appropriate. <https://www.sitra.fi/en/articles/the-eus-sustainable-product-policy-framework-and-producer-ownership-models-are-key-to-mainstreaming-circular-business-models/>

R-ladder indicates the degree of circularity based on various *R-strategies*. From high to low on the R-ladder: Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover. The higher the R-strategy on the R-ladder, the lower the use of virgin raw materials. <https://circulareconomy.europa.eu/platform/sites/default/files/pbl-2019-outline-of-the-circular-economy-3633.pdf>

Sustainability is about reduced use of raw/processed materials, fossil energy and also the reduction of negative (environmental) impact and emissions etc. during the process of making, using and disposing of a product, its components or raw/processed materials.

Substitution is the aim to replace raw materials with sustainable or bio-based raw materials.

Value chain is a chain of organisations working together to extract raw materials, process them and ultimately make products from them. The chain of organisations collectively carries out activities to create this value.

Value creation is the result of working to retain value, and arises at different times and in different forms. The first means that there are multiple revenue moments during a product's lifecycle. The second means that value creation is eco-

nomical, social and ecological. This is commonly referred to as multiple value creation.

Value retention is the central principle of the circular economy. The aim is to safeguard (through design, maintenance, refurbishment, substitution, etc.) the functional and material value of products, components and raw/processed materials for as long as possible.

APPENDIX B: ABBREVIATIONS

B2B	Business-to-Business
B2C	Business-to-Consumer
CBM	Circular Business Model
CE	Circular Economy
CESI	Circular Economy Smart Industry
C2B	Consumer-to-Business
C2C	Consumer-to-Consumer
EC	European Commission
EPR	Extended Producer Responsibility
EU	European Union
IoM	Internet of Materials
IoS	Internet of Services
IoT	Internet of Things
PO	Producer Ownership
UPCM/ UPCE	Uitvoeringsprogramma Circulaire Maakindustrie (Implementation Programme Circular Manufacturing Industry)

APPENDIX C: OVERVIEW OF CIRCULAR BUSINESS MODEL TYPOLOGIES BY AUTHOR

No.	Author(s) and year	Types of circular business model
1	Bakker, Den Hollander & Van Hinte (2014)	<ul style="list-style-type: none"> · Long lifetime · Hybrid model · Filling gaps in the market · Access · Performance
2	Bocken et al. (2014)	<ul style="list-style-type: none"> · Maximising material productivity and energy efficiency · Value creation from waste · Replacement by renewable raw materials and natural processes · Delivering functionality instead of ownership · Assume the role of administrator · Encouraging sufficiency · Focus the company on society and the environment · Developing solutions on a large scale
3	Lacy, Keeble & McNamara (2014); Lacy & Rutqvist (2015)	<ul style="list-style-type: none"> · Circular resources · Recovery of resources · Extending the lifetime of a product · Sharing platforms · Product as a service
4	Morlet et al. (2015)	<ul style="list-style-type: none"> · Regeneration · Share · Long lifetime · Maximising resource efficiency
5	Kraaijenhagen, Van Oppen & Bocken (2016).	<ul style="list-style-type: none"> · Functionality, not ownership · Extend product value · Long lifetime · Encouraging sufficiency · Extend resource value · Industrial symbiosis · Maximising material and energy efficiency
6	Ewen et al. (2017)	<ul style="list-style-type: none"> · Input · Product · Market proposition (sales, service, platform model) · Use · End of use
7	Hofmann, Jokinen & Marwede (2018)	<ul style="list-style-type: none"> · Long lifetime · Modularity · Upgrade · Access · Service model
8	Larsson (2018)	<ul style="list-style-type: none"> · Share resources · Biological materials · Local production and distribution systems · Standardisation and modularisation · Recycling and upcycling · Transport systems, renewable fuels and energy efficiency
9	Haugland, Arponen & Töndevold (2019)	<ul style="list-style-type: none"> · Circular inputs · Sharing platforms · Product as a service · Extension of product use · Resource recovery
10	Circular Economy Initiative Germany (2020)	<ul style="list-style-type: none"> · Circular resource suppliers · Service provider for process molecules · Machines / components 'as new' · Remarketing of machines / components · Patented material loops · Product 'as new' · Remarketing of used products · Out-of-warranty repair service · Upgrades, spare parts and accessories · Maximum product uptime · Retailer as cycle manager · Retail remarketing & remanufacturing · One-stop-shop · Operator of repair gap · Support system for consumers · Reverse logistics material · Renewed logistics services · Spare parts management · Revitalised products · Informal collection coordination · Recycling platform · Platform for used goods and sharing
11	Mosangini & Tunçer (2020)	<ul style="list-style-type: none"> · Clean and resource-efficient production · Zero waste production · Design for dismantling, remounting and recycling · Collection and recycling · Upcycling · Design for sustainability, longevity and modularity · Collection and recycling · Recover and upgrade · Reuse and resale · Renting by subscription · Leasing by subscription · Product as a service: selling functionality · Alternative low impact value chains · Slow-moving products and services with full control of value chains
12	Pieroni et al. (2020)	<ul style="list-style-type: none"> · Resources and purchasing · Production · Product use and operation · Recirculation of components and products · Recirculation of materials · Results and performance · Access and availability · Long lifetime

13	Smith-Gillespie (2020)	<ul style="list-style-type: none"> · Remake · Circular procurement · Recover · Recovery of by-products · Access · Performance · Resource recovery
14	Takacs, Stechow, & Frankenberger (2020)	<ul style="list-style-type: none"> · Closing the loop · Improving loops · Making money with loops · Stimulating loops
15	De Mey, & Shahbazi (2021)	<ul style="list-style-type: none"> · Service · Share · Exchange · Lock-in · Product-service systems
16	Gillabel et al. (2021)	<ul style="list-style-type: none"> · Longevity and sustainability · Access · Collection and resale · Recycling and material reuse

APPENDIX D: ORGANISATIONS AND NETWORKS

This appendix provides just a brief and at-random selection of CE organisations and networks across Europe. At present the number of organisations has exploded in such a way that it is impossible to provide a current or compact overview. In any domain, a multitude of organisations can be found. A regularly updated overview of national networks across Europe can be found at the European Circular Economy Stakeholder Platform, an initiative of the European Commission and the European Economic and Social Committee. The website provides 153 CE networks and their websites. More information can be found here: <https://circulareconomy.europa.eu/platform/en/dialogue/existing-eu-platforms>

Netherlands

	Name of organisation/network	Website
1	BOOST	https://boostsmartindustry.nl/
2	Circle Economy	https://www.circle-economy.com
3	CIRCO Creating Business Through Circular Design	https://www.circonl.nl
4	Circulair.com	https://circulair.com/
5	Erasmus Platform for Sustainable Value Creation	https://www.rsm.nl/erasmus-platform-for-sustainable-value-creation/
6	Futureproof Community	https://futureproof.community/
7	Holland Circular Hotspot	https://hollandcircularhotspot.nl
8	Knowledge Hub Circle Lab	https://knowledge-hub.circle-lab.com

Belgium

	Name of organisation/network	Website
1	Board of Innovation	https://www.boardofinnovation.com/
2	Circle Sector	https://www.circlesector.com/
3	School of Commons	https://civi.timelab.org/project/school-commons
4	Sharepair	https://www.nweurope.eu/projects/project-search/sharepair-digital-support-infrastructure-for-citizens-in-the-repair-economy/

5	Smart Loops	https://www.smarthubvlaamsbrabant.be/projecten/smart-loops
6	The Circular Kickstart	https://circularkickstart.be/
7	Vlaanderen Circulair	https://vlaanderen-circulair.be/nl
8	VLAIO	https://www.vlaio.be/nl

European Union

	Name of organisation/network	Website
1	Acatech – National Academy of Science and Engineering	https://en.acatech.de/
2	Circular Economy Initiative Deutschland	https://www.circular-economy-initiative.de/english
3	Ecopreneurs	https://ecopreneur.eu
4	Ellen MacArthur Foundation	https://ellenmacarthurfoundation.org/
5.	European Circular Economy Stakeholder Platform	https://circulareconomy.europa.eu/platform/
6	European Topic Centre on Waste and Materials in a Green Economy (ETC/WMGE)	https://www.eionet.europa.eu/etcs/etc-wmge/
7	Europees Milieu Agentschap	https://www.eea.europa.eu/nl
8	Green Growth Knowledge Partnership (GGKP)	https://www.greengrowthknowledge.org/
9	SYSTEMIQ Ltd	https://www.systemiq.earth/
10	The Organisation for Economic Co-operation and Development (OECD)	https://www.oecd.org/
11	The Circular Economy Club (CEC)	https://www.circulareconomyclub.com/

Nordic countries

	Name of organisation/network	Website
1	NordForsk	https://www.nordforsk.org/
2	Nordic Circular Hotspot	https://nordiccircularhotspot.org/
3	Nordic Co-operation	https://www.norden.org/en
4	Nordic Innovation	https://www.nordicinnovation.org/
5	Nordic Swan Ecolabel	https://www.nordic-ecolabel.org/
6	Norsus	https://norsus.no/en/
7	PlanMiljøe	https://www.planmiljoe.dk/?lang=en
8	SITRA	https://www.sitra.fi/en/
9	SUSTAINIA	https://sustainiaworld.com/

APPENDIX E: COMPLEMENTARY TOOLS

What count for the vast number of organisations and networks (see Appendix D) also count for available tools. A variety of organisations and networks have commissioned or developed a broad range of tools, both paper-based or digitised. The overview below provides just the tip of the Iceberg of avail-

able Open Access tools. At the early stage of the research (Spring 2021) on which this Whitepaper is based, a preliminary inventory of tools in the EU was made leading to an unsorted collection of approximately 250 items. Until today, to our knowledge no rigorous work of assessment and classification has been undertaken to make this undoubtedly rich and inspiring collection accessible. What a pity.

	Name Tool Open Access	Website
1	A framework for enabling circular business models in Europe	https://www.eea.europa.eu/publications/a-framework-for-enabling-circular/a-framework-for-enabling-circular
2	Board of Innovation, Circular Business Models explained	https://www.boardofinnovation.com/circular-economy-business-models-explained
3	CIRCit Nord	https://circuitnord.com
4	Circle City Scan Tool	https://www.circle-economy.com/digital/circle-city-scan-tool
5	Circulab Toolbox	https://circulab.com/toolbox-circular-economy/
6	Circular Design Guide	https://www.circulardesignguide.com/
7	Circular Economy Playbook	https://teknologiateollisuus.fi/fi/circular-economy-playbook
8	Circular Economy Practitioner Guide	https://www.ceguide.org
9	Circular Transitions Indicators (CTI) Tool	https://ctitool.com/
10	Circular X	https://www.circularx.eu/en/tool
11	Circularity Calculator	http://www.circularitycalculator.com/
12	Circularity Check	https://ecopreneur.eu/circularity-check-landing-page/
13	Circulator, The Circular Business Model Mixer	https://www.circulator.eu
14	Circulytics	https://www.ellenmacarthurfoundation.org/resources/apply/circulytics-measuring-circularity
15	Eco-Management and Audit Scheme (EMAS)	https://ec.europa.eu/environment/emas/index_en.htm
16	Ecopreneur Circularity Check	https://ecopreneur.eu/circularity-check-landing-page/
17	Edinburgh Reuse Map	https://community.changeworks.org.uk/reusemap?utm_source=-Case%20study&utm_medium=CW_website&utm_campaign=CW%20web
18	European Remanufacturing Network (ERN)	http://www.remanufacturing.eu/case-study-tool.php
19	LOOP Ports	https://www.loop-ports.eu/circular-economy-tools/
20	MATChE	https://www.matche.dk/en/group/13/Our+tools
21	Material Circularity Indicator (MCI)	https://www.ellenmacarthurfoundation.org/resources/apply/material-circularity-indicator
22	Raw Materials Information System (RMIS)	https://rmis.jrc.ec.europa.eu/
23	ResCoM	https://www.rescoms.eu/index.html

24	Saxion Businessmodel Lab	https://businessmodellab.nl
25	Sustainability Guide	https://sustainabilityguide.eu/methods/circular-business-models
26	The EU Circular Economy Tools and Instruments	https://ec.europa.eu/environment/green-growth/tools-instruments/index_en.htm
27	The European Resource Efficiency Knowledge Centre (EREK) Self-assessment Tool	https://resourceefficient.eu/en/self-assessment-tool?pk_vid=4c86cd4a2898d69516206517774b7bae
28	Venturely.io	https://venturely.io/

The short list of references below is not used academically, with the intention of illustrating the various arguments. Instead it provides some and very introductory background on sustainability, circularity and business modelling. The overview of sources used to classify the various existing typologies of circular business models can be found in Table 1, providing an overview of publications with existing CBM typologies.

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Thomas Hobé has an interdisciplinary background with sustainability, (circular) economy and our planet

as recurring themes. He believes it is important that circular and sustainable entrepreneurship is made attractive in order to work towards achieving the climate goals more quickly. As a research assistant to this study on the classification of circular business models, he hopes to make a significant contribution to the field at the beginning of his career.

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ACCOUNTABILITY

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