The circular economy: towards a new business paradigm with support from public policy


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Abstract

Today, we live in a linear economy and the current situation is a product of past ideas on effective markets, legal concepts and legal culture, business models and ideas on ownership and consumer culture. For us to move to a more circular economy, we need to start questioning how we look at products, markets, ownership and resources.

As a foundation for this process, this report highlights what the circular economy is about and some key issues we need to address to move towards a circular economy. It also highlights the need to connect the business and policy developments related to the circular economy to other sustainability fields, such as climate change and chemicals, and to place it within the broader context of sustainable consumption. A circular economy is not only about taking care of our resources; we must also ensure that all humans have access to the resources they need to live a decent life. Thus, the social dimensions of the circular economy should not be neglected: it must be an economy that benefits all humans.

Key messages

- Our language is a means for change –we must pay attention to terms we use and how they affect our thinking and actions.
- Circular economy is a vision of an economic system based in a systemic approach to maintain a circular flow of resources, by regenerating, retaining or adding to their value, while contributing to sustainable development.
- The circular economy principles are: systems thinking, value creation, value sharing, resource availability focus, resource traceability and ecosystem resilience.
- Nothing is 100% circular even in a circular economy
- A new mindset is needed for design of circular economy solutions, and there is a need for an extended life cycle perspective
- We must change current perceptions on consumption and ownership; develop a standardized nomenclature and common concepts in legal frameworks, and; support circular business models through laws and public procurement

BACKGROUND PAPER

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1 Introduction

1.1 A need for new logic

> *The greatest danger in times of turbulence is not the turbulence; it is to act with yesterday's logic.*
>
> Peter Drucker (1909–2005)

Societies and policymakers have long focused on improving and making various societal processes **more efficient**; in times of turbulence and uncertainty, with escalating environmental problems, this focus has only increased. In principle, a focus on efficiency is good, since it is generally related to a wish to use fewer resources. However, the starting point should not be efficiency. First, we must determine what is the **effective thing to do**, or in other words, what is the right thing to do. Once this is identified, we should try to do the effective thing as efficiently as possible.

We are currently in a huge environmental crisis, amid turbulence that manifests itself through climate change, resource depletion and rapidly declining biodiversity. We must abandon the logic that we have constantly used to become more efficient and which has brought our society to this abyss. Instead, we need to find the effective ideas and approaches that can safely take us into the future and allow us to travel beyond our deadly, self-created void.

This report highlights some thoughts and recommendations that can guide a transition to more sustainable and circular logic.

1.2 A brief history of consumption

For almost a century, the consumption of products has been the dominant paradigm, mindset and business model (Baden-Fuller & Morgan, 2010; Magretta, 2002), strongly supported by academia and policymakers, but how did we end up here? To answer this briefly, let us go back in time.

Humanity has always longed for a good life, and humanity has tried to do its best to use its limited accessible resources as intelligently as possible. Such constraints have stimulated humanity to constantly try to invent and develop to obtain a better life.

In the past, the things we had and needed had to be created with our own hands, but first, we had to collect the resources and then transform them into the needed product(s) – something that was time-consuming and required much energy (e.g. food for ourselves or for our horse that did the job). Because of this, we did our best to craft durable, resource-efficient products that were easy to repair and reuse, and to reuse resources from products that were no longer repairable or needed.

An important booster for the historical development of today's world was the advent of the art of book printing at the end of the Middle Ages. This made it possible to build and share knowledge faster and more cheaply than ever before. This facilitated/contributed to the emergence and diffusion of new technologies that, since the industrial revolution, have completely transformed our society and way of living – technologies that enabled us to access new and greater quantities of resources than we had ever experienced in the history of humanity. Suddenly, resources seemed unlimited, with no constraints on expansion and progress.

At the beginning of the industrial revolution, we continued to hold on to the ideas of developing and producing products that were durable, resource efficient, and easy to repair and reuse. However, this soon led to saturated markets and increased concern among politicians and factory owners about the risk of social collapse and disorder if people lost their jobs (London, 1932; Whiteley, 1987).

Action was called for to solve this problem, and several of the greatest thinkers and economists of the time were consulted, among them John Maynard Keynes, who had a deep impact on modern macroeconomics and the economic policies of governments in the mid-20th century. Another economist, not as well-known as Keynes but very influential and active in the US and UK automotive industry, was Victor Lebow (1955). In an article from 1955, he summarized his ideas as follows:

> *Our enormously productive economy ... demands that we make consumption our way of life, that we convert the buying and use of goods into rituals, that we seek our spiritual satisfaction, our ego satisfaction, in consumption ... we need things consumed, burned up, replaced and discarded at an ever-accelerating rate.*

Companies started to copy and implement the idea that we should be consumers and consume products. They started to apply measures to make products reach the end of their lifespan and become obsolete faster, for example by changing fashions more frequently and making products less durable and of lower quality, and did their best to carry them out as efficiently as possible (Krajewski, 2014), a trend that has continued into our time (Cooper, 2010; Whiteley, 1987). Examples of measures to achieve obsolescence include the following (Cooper, 2010; Valant, 2016).

- **Incompatibility** – Products no longer work properly once an operating system or needed consumables (e.g. batteries or toner cartridges) are changed and/or updated.
- **Indirect** – Components required for repair cannot be obtained, or it is not practical or cost-effective to repair the product.
- **Planned or built-in** – Products are deliberately designed to fail after a certain time or a certain number of uses.
- **Premature** – Products last less than their normal lifespan compared to customers' expectations.
- **Style obsolescence** – Leads customers to believe that their products are out of date although they are still perfectly functional.

Consumption has become our mantra and focus. Our society's legal frameworks, infrastructure and mindset have been formed to promote and facilitate the above ideas and logic.

The result is that we have stuffed our homes with an increasing number of products. Two questions to ask are how many products do you have at home, and how many of these you are using more than once a week, once a month and once a year? One book is one product, and so is a kitchen knife. Most likely, you will realize that you are surrounded by an excess of products that you do not use. For example, you do not normally select from the bottom of the pile of shirts in your wardrobe but from the top. You can also ask yourself why you bought the products you do not use, how much money you have spent on your products, and how much you pay monthly to store the products you do not use. Regardless of the answers to the questions above, we can

conclude that Victor Lebow, with his fellows, has been successful in his intentions – to transform us into consumers.

Victor Lebow and his colleagues lived in a society transforming from a world with limited resources to one that seemed to be without limitations. They did not see or experience any negative consequences from this increasing use of resources. However, today, the drawbacks following an ever-increasing consumption of materials and products (Sanne, 2002) are obvious, and a move towards more sustainable solutions based on circular economy thinking is needed (Ellen MacArthur Foundation, 2012; Tukker & Tischner, 2006).

The conclusion is that we need to get back to some of the old logic and habits that served us well, in other words, to design and produce products that are durable, resource efficient, easy to repair and reuse, and from which we can reuse resources when they are broken or no longer needed. However, we must do this smartly and effectively while learning from our past and seeing what can be effective to do[1]. It is important to stress that we do not think we should repeat the past; instead, we should learn from it. This should be done to build on what has served us well and do that while we identify how new logic can further contribute to those ideas and strengthen them. For example, during product use, AI and data-driven value creation logic can contribute to the creation and development of a better and more sustainable society.

1.3 Our language is a means for change

Assume that you need a pair of towels, and you get an offer to buy some nice, new, fluffy white ones, and the price is right – then, most likely, you would buy them. However, if the salesperson tells you they are second-hand, but the towels are still the same, would you still buy them? Would you buy them for the same price, or, most likely, would you ask for a much lower price? Some of you would most likely start to consider if they are clean, for example. To conclude, many questions and doubts suddenly arise just because the towels are second-hand. Why is this so? It is interesting, because most people who have these types of doubts have no problem staying in hotels, using towels that have been used by many others. By definition, you could call these towels second-hand, but I have yet to see a hotel guest coming down to the reception complaining that they have been provided with second-hand towels and asking for a lower room price.

This example illustrates how our language affects our way of thinking and, therefore, acting. We have always used our language to communicate, tell stories and exchange ideas and knowledge about our surroundings, future and so on. To improve communication, we have developed our language over time, often to promote certain ways of thinking – often without thinking about how our language affects our way of thinking and acting. As highlighted above, the art of book printing was the start of knowledge building and sharing, faster and more cheaply than ever before, and these trends have escalated in our time and have also boosted how we influence each other – for example, via today's influencers.

1. This will involve a lot of engineering and systems thinking to handle various trade-offs, e.g. durability versus resource efficiency – see later parts of this report – to avoid suboptimization. For instance, new plastic packaging might need less plastic, but the solution used, e.g. laminates, may mean it will not be recyclable. A better solution from a systems perspective might be to use more plastics (heavier bottles), but then the bottles will be easier to reuse and recycle – and over time, fewer resources will be used per function. In another example, making a product possible to repair might require more resources and make it less durable. A better solution might be to make the product impossible to repair (avoiding the need for repair) and instead give it a longer life and increased durability..

Victor Lebow and his associates wanted us to be consumers and think in a certain way: we should look for new products and abandon old ones. Furthermore, an interesting thing to note with terms is that we prefer those that represent positive things and feelings (Fredrickson, 2001). We prefer to talk about things that we consider positive and avoid those that are negative. The words we use in our discussions have different unspoken feelings and values attached to them. For example, we generally consider terms such as 'old', 'waste' and 'second-hand products' as less attractive terms than 'new', 'resources' and 'products'. If we have an old product, we treat it less carefully than if we know that the product is new.

To conclude, if we want to create change, it is important that we become more concerned about the terms we use and how they affect our thinking and actions, especially those that have brought us into the current problematic situation. We should try to find terms that focus on what we want to achieve and abandon what leads us into old ways of thinking – the logic we want to move away from. We also need to think about what perspectives we need to focus on, ones that are needed to make us progress towards a more sustainable and circular economy. Examples of such (valuable, central) perspectives are the total cost of solutions over time and life cycle perspectives.

Figure 1 shows some old linear economy-focused terms and ones that might be more useful in a circular economy future.

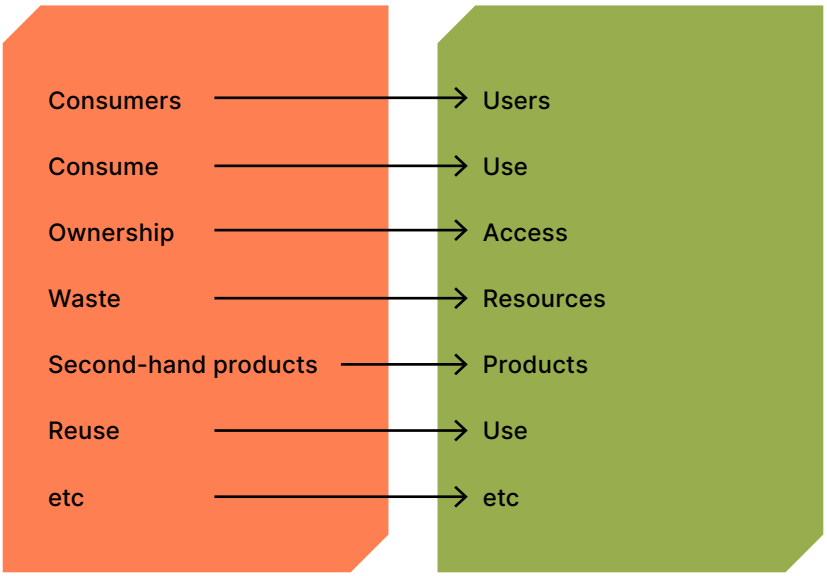

Figure 1: Old linear-focused terms in relation to potential more neutral ones.

2. What is the circular economy?

2.1 What does the term mean?

To do something effectively and efficiently, we need to come to a common understanding about what we want to do. A starting point in this context is 'What is the circular economy?' The circular economy is a concept that has been shown to have great merits in mobilizing many different actors and professional groups to contribute to a more effective and resource-efficient, sustainable and circular society. At the same time, there is no unambiguous, generally understood definition of a circular economy; this was shown in a meta-study that analysed 114 different circular economy interpretations (Kirchherr et al., 2017).

The fact that there are different interpretations is not necessarily a problem in a general dialogue. However, differences in interpretation may be a major problem for developing a consistent political framework introducing policy approaches that require clear definitions and delimitations. The same applies if companies that are to collaborate – in value chains and value networks – have different interpretations, as this reduces the potential for the successful joint development of sustainable solutions and measures. A product or material declared to have circular potential can create expectations among other actors that cannot be realized, for instance, because the 'circular' solutions, as will be discussed below, are constrained by laws that are influenced by 'linear' thinking. In addition, companies risk being criticized if they define something as circular and are contradicted by another actor.

To resolve this situation, or at least provide a partial solution, the ISO has started a standardization process related to the circular economy within a new technical committee (TC323). The work is still in progress, but the current, unofficial definition from the forthcoming standard (ISO 59004) Circular Economy – Terminology, Principles and Framework for Implementation (version 2021-10-22) is as follows:

> *an economic system that uses a systemic approach to maintain a circular flow of resources, by regenerating, retaining or adding to their value, while contributing to sustainable development.*

The focus is on value creation and the use of resources (stocks and flows). An economic system is the 'system by which a society organizes and allocates resources within a geographic region or country'. The system can vary depending on the geographic region or governmental jurisdiction, and it can include the regulation of resources (including land, capital and labour) and the production, use and disposal of these resources.

A resource is defined as an 'asset from which a solution is created or implemented'[2]. An asset, in this definition, refers to 'natural resources, virgin resources and recovered resources', and a resource can be either renewable or non-renewable. Depending on the context, reference to 'resource' includes 'raw material', 'feedstock', 'material' or 'component'.

2. A resource includes the energy content or energy potential of materials.

A solution is a combination of a product and a service that fulfils a need. In this context, 'need' concerns the satisfaction of an organization's or stakeholder's interests while also considering human needs. A product is a 'physical-based object designed or utilized with a purpose', and it can be, for instance, goods of any type, hardware (e.g. engine mechanical part, spare parts, consumables) or processed materials (e.g. lubricant). A service is an 'activity designed or executed with a purpose'. The provision of a service involves, for example, an activity performed on a customer-supplied tangible product (e.g. an automobile to be repaired or the income statement needed to prepare a tax return), but it can also have intangible elements such as contributing to the creation of ambience for the customer (e.g. in hotels and restaurants).

'A circular flow of resources' is defined as a 'systematic cycling of the provision and use of resources within technical or biological cycles'. 'Value' is defined as 'gain(s) from satisfying needs and expectations, in relation to the use of resources'. The gain can relate to the specific function and performance of a product, and the value is relative to and determined by the perception of the interested party or parties. Furthermore, value is dynamic over time and can be financial or non-financial, such as social value. Examples of values are, for example, revenues, savings, productivity, sustainability, satisfaction, empowerment, engagement, experience and trust.

One can question the definitions above, but we must have a reference that we can relate to in our discussion so that we know what we are talking about. Therefore, we will use the above definitions in the rest of this report.

2.2 Circular economy principles

A linear economy logic is one that is based on the 'take-make-dispose' idea, in which raw materials are extracted and collected and then transformed into products that are used until they are finally discarded as waste. Today's society is mainly based on such linear economy logic and principles, which have neglected the fact that our resources are not unlimited and that our use of resources, especially our ways of using them, cause numerous unwanted and negative environmental effects. The logic and principles for the future need to be designed to prevent those negative effects.

The above-mentioned standard draft (ISO 59004) also contains a proposal for circular economy principles, which are based on an understanding of the interactions between the environmental, societal and economic systems and their interrelationships, as shown in Figure 2. The economic system is understood as embedded in the societal system, and both rely on and are embedded in the environmental system.

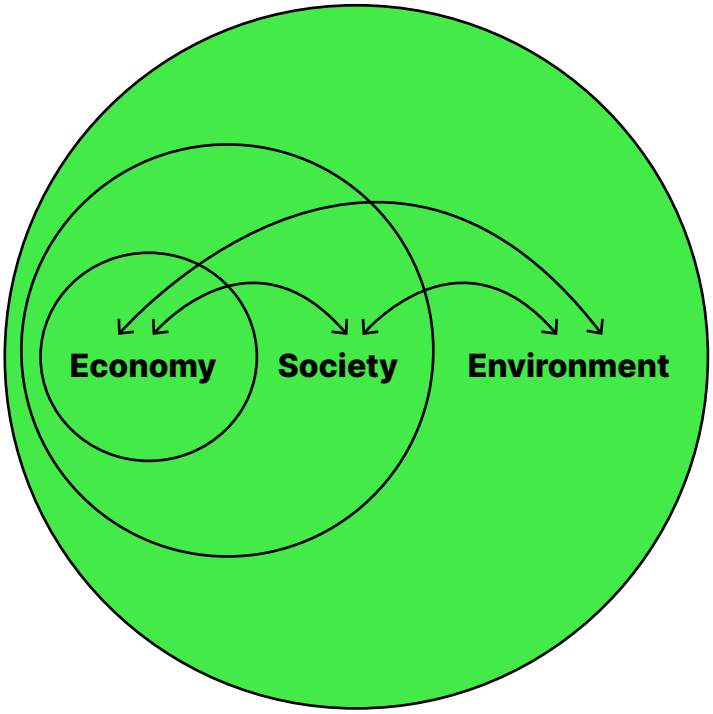

Figure 2: . Illustration of the interactions between the environmental, societal and economic systems. Note that the length of the arrows has no significance. .

In line with the definition of the circular economy, the economic system should be designed based on a systems thinking approach and the following interlinked set of principles. Each principle focuses on a specific dimension of the system that in combination makes a more sustainable economic system.

The circular economy principles are as follows.

- **Systems thinking** – Apply a systems perspective considering the long-term impacts of interactions among environmental, social, and economic systems, while considering solutions from a life cycle perspective.
- **Value creation** – Regenerate, retain or add value by providing effective solutions that efficiently use resources and contribute to meeting the needs of society.
- **Value sharing** – Organizations and stakeholders collaborate along the value chain or value network inclusively and equitably for the benefit and well-being of society by sharing the value created by different solutions.
- **Resource availability focus** – Manage and regenerate stocks and flows of resources in a sustainable way to contribute to their availability for present and future generations and continue to regenerate, retain or add value while securing the quality and resilience of ecosystems.
- **Resource traceability** – Manage and track stocks and flows of resources in a transparent and accountable way so that they continue to regenerate, retain, or add value while maintaining the circular flow of resources.

- **Ecosystem resilience** – Develop and implement practices and strategies that protect and contribute to the regeneration of ecosystems and their biodiversity, considering the planetary boundaries.

The principles above are short and clear; it is now up to us to implement them and break with yesterday's logic.

2.3 Nothing is 100% circular

It is thus important to remember that circular economy principles are based on systems thinking and therefore need to be managed as an interlinked set of principles. Due to the second law of thermodynamics, there will always be losses in the system. Simplified, this means that 100% circularity is not possible or even desirable from an environmental perspective. Figure 3 illustrates why this is the case:

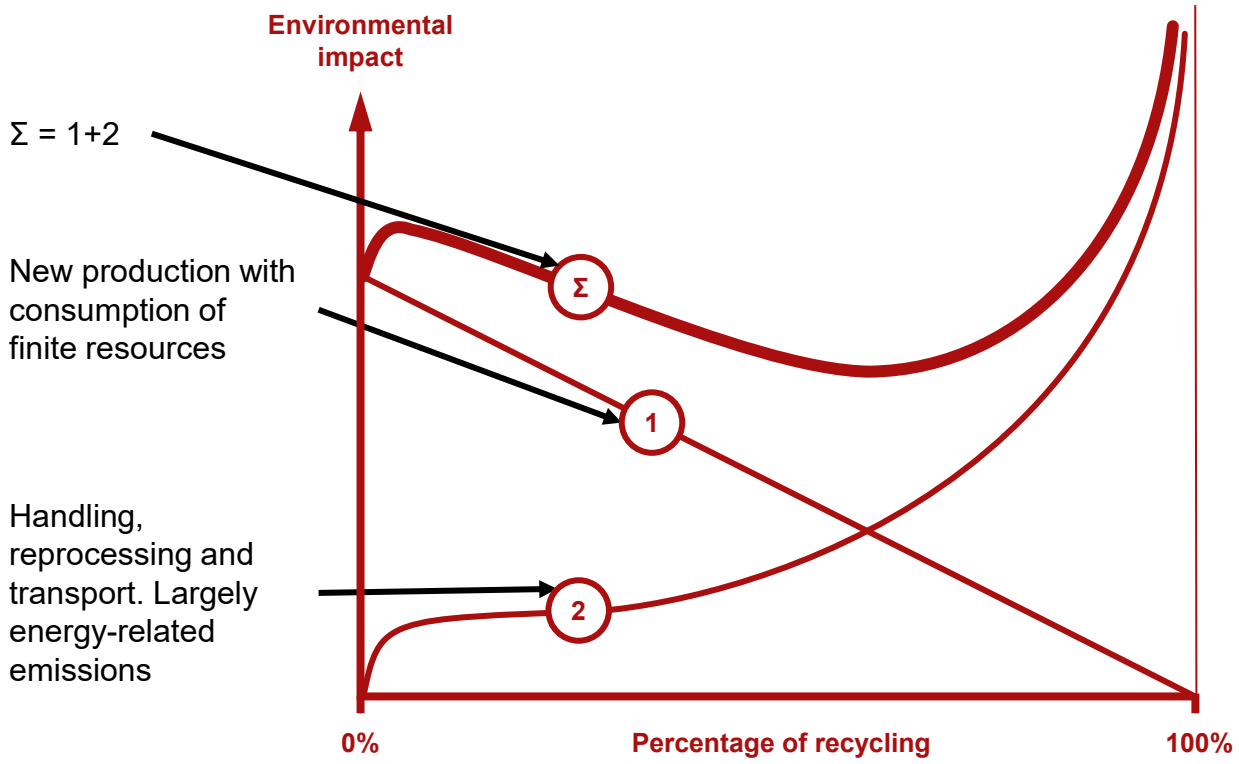

Figure 3: The total environmental impact as a function of recycling. This illustrates why 100% recycling is not possible or preferable from an environmental perspective.

Let us assume that we produce tyres. We can have 100% new production, as seen on the left side of the figure. Theoretically, we can also have 100% reuse of tyres, as seen on the right side of the figure. However, in reality, it is not that simple. Setting up a reuse system will require resources, such as for handling, reprocessing and transporting used tyres, as seen in the curve starting from zero in the figure. The closer we get to 100% recycling, the more resources will be needed, and this curve will continue to increase towards infinity. The explanation is that when a tyre is used, parts of it are lost along the road, becoming dust particles of rubber. To achieve 100% reuse would require that we collect all those particles down to every single atom, which is not feasible. This is important to bear in mind when developing solutions for a more circular and sustainable society.

However, we should try to find the optimum, represented by the lowest point on the curve at the top of the figure, which is the sum of the curves below, and furthermore, try to move that optimal point towards the right, as far as we can. This can be done by making the product easier to reuse and collect and avoiding losing parts of the product during its use and processing, and by coordinating different systems to save resources for such things as handling, reprocessing and transporting. An important part of such processes is developing business models that stimulate this move towards the right of the figure.

What are those business models, then? They include business models that are usually based on one or more of the 'components' listed below (Bocken et al., 2016; Bocken et al., 2014; Hansen et al., 2021).

- **Long-lasting products**. Such products are premium quality and are expected to have a long life span. Often, original equipment manufacturers offer extended commercial warranties for these products (Cooper, 2010).

- **Integrated product-service offerings**, where the user pays for the function offered. Such solutions are quite common in business-to-business (B2B) markets (Lindahl et al., 2014), as seen in Figure 4, but less common in private customer markets. With such business models, the original manufacturers have incentives to design more durable and upgradeable products, as they are paid for the function, not per product sold. Such offerings could also make sense in private customer markets. One example concerns carpooling. Carpooling makes a lot of sense in a resource-constrained world, as individual car ownership is problematic. The latter is incredibly inefficient, as cars are parked most of the time and not in use, parking spaces take up valuable living space in cities, and we also face resource challenges if the developing world adopts similar car ownership patterns to the developed world. Further, there is now some evidence that carpools have started to require cars that are more durable than conventional cars, as it can be very expensive to service them during use, and while they are being serviced they generate no income for the carpool.

- **Repair, reuse and remanufacturing activities**, which allow products and components to be in use longer (Milios, 2021; Sundin et al., 2008).

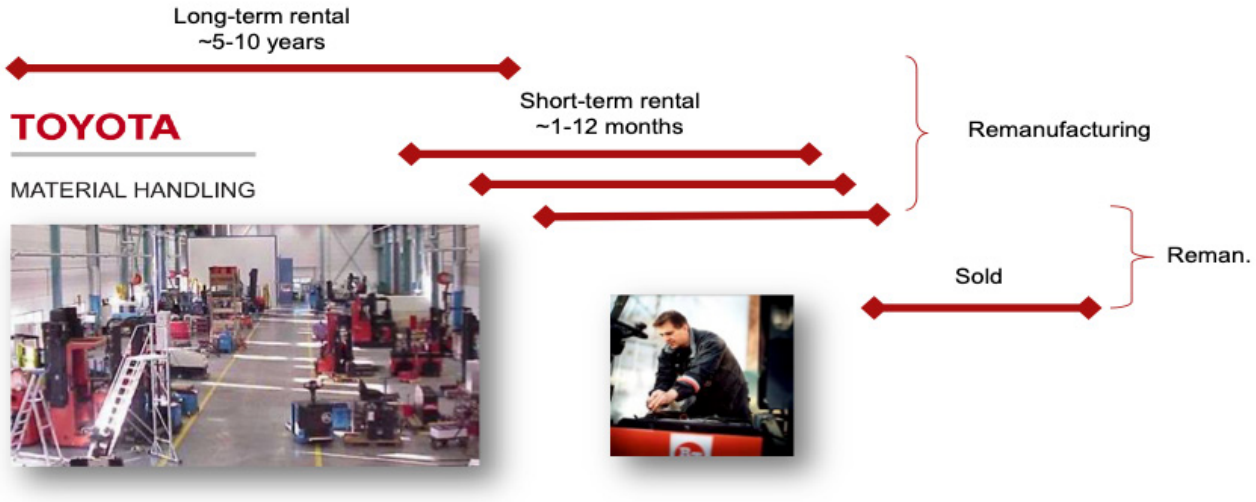

Figure 4: Toyota Material Handling provides forklift trucks as a service – the customer pays for the function. When the customer no longer needs the forklift truck, it is taken back and, after remanufacturing, used for new customers, for example, in short-term rental contracts or sold

Source: Sakao and Lindahl (2015)

2.4 Mindset needed for design of circular economy solutions

A circular economy requires a design mindset with an extended life cycle perspective and a focus on solutions that are in line with circular economy principles (value creation, value sharing, resource availability and resource traceability). Circular economy principles stress the importance of developing products that are easy to reuse as products or components, with a view to maintaining positive value within the overall system(s) (Lindahl, 2018).

The mindset needed for circular economy solutions differs significantly from that required by the traditional linear economy. It often necessitates that business models change from upfront payment regarding, for example, a product, to payment for the performance (value). This turns much of the traditional business logic, and therefore design logic, upside down. In other words, a circular economy calls for a new design mindset in the following ways (Lindahl, 2018).

- First, in contrast with the traditional sale of products, a provider with a circular economy solution normally does not want the customer to come back after a while and ask for a replacement or a new solution. Instead, the provider wants the customer to use the solution for as long as possible, as revenue is based on the provision of value and not on the use of products and services. Furthermore, if the use phase is prolonged, then the income during that phase can potentially increase, since the product can be used for longer, and therefore the ratio between the total initial environmental and economic cost to produce the product(s) and the total income during use decreases. This means that the longer the use phase, the more the provider can potentially earn and the lower the total environmental impact in the use phase.

- Second, providing services and selling spare parts and consumables traditionally constitute an important income for manufacturers. However, if these are included in the offered solution, they become an unwanted cost – something that ought to be avoided or reduced (e.g., by more durable products and a reduced need for consumables).

- Third, if the customer no longer needs the solution, the used products should be easy to repair, reuse, remanufacture, refurbish or upgrade so they can be used by other customers. Thus, a business model based on providing functions, performance and reliability can provide better incentives for being wise with resources. We see the increasing use of such business models in business-to-business (B2B) relations, partly because many businesses today prefer not to make big capital investments and thus prefer to purchase functionality.

But even when a product is used and the user no longer wants it, it still may have residual value, which can be realized either by the original manufacturer or by other actors. They can then engage in various 'R' activities, for example, rethink, reuse, reduce, repair, remanufacture, repurpose, refurbish, recycle and recover (Jawahir & Bradley, 2016; Lindahl, 2018) to realize this value. Some of these are explained in Table 1.

Reuse	Activity of recovering components and materials for further use without reprocessing (ISO 21070:2017(en), 3.1.6)
Repair	Action to restore a product to a condition needed for the product to function according to its original purpose. Actions can include the renewal or replacement of worn, damaged or degraded parts of the product
Remanufacturing	Industrial process which produces a product from used products or used parts where at least one change is made which influences the safety, original performance, purpose, or type of the product (ISO 14009:2020(en), 3.2.29)
Reprocessing	Restoration or modification of the functionality of a product or part
Recycling	Activity in a production process to process waste materials for the original purpose or for other purposes, excluding energy recovery (ISO/TR 20736:2021)

Table 1. Five 'R' examples

Source: ISO (2021) and EN 45553:2020

Table 2 presents some product attributes and how they are linked to remanufacturing and the different steps in this process. Depending on the type of product, these steps can be of more or less importance and emphasized to varying degrees. Even in the design process, it is important to consider these steps in the remanufacturing process and the product attributes that are needed to make the solution and its products more sustainable and circular.

Product attribute	Remanufacturing process step						
	Inspection	Disassembly	Cleaning	Reprocessing	Assembly	Testing	Storage
Ability to be identified	X					X	X
Ability to locate access points and fasteners		X			X		
Accessibility of parts		X	X	X	X	X	
Ability to be disassembled/assembled		X			X		X
Wear and damage resistance during the remanufacturing process steps	X	X	X		X	X	X

Table 2. Product attributes and how they are linked to remanufacturing and the different steps in this process

Source: EN 45553:2020

Circular economy solutions thus require a change in design mindset. Besides the focus on resource-efficient and effective solutions, this new/changed design mindset is based on an extended life cycle perspective.

2.5 An extended life cycle perspective

In line with circular economy principles, the design of a circular economy solution requires that an extended life cycle perspective is integrated into the design process with a focus on lowering the total provider's and customer's life cycle cost via a prolonged use phase or reuse, rather than a focus on achieving a low production cost for used products. The 'R' activities above – for example, repair and remanufacturing – can be used as an integral part of this or as a stand-alone means to prolong the life cycle of products, components and materials.

The inclusion of the use phase means that the 'solution space' increases when designing a solution. This is positive since it results in increased possibilities to optimize the total life cycle cost/minimize the environmental impact of the solution. Costs are often associated with the use of a resource, which in turn can create a negative environmental impact.

In traditional design processes, services are often developed after the product is developed. As the work on the product progresses, knowledge is increased. At the same time, the degree of freedom of action decreases for every decision taken, as time and cost drive most projects. Economic costs are related to environmental impacts. Figure 5 illustrates the cumulative environmental impact over the solution's life cycle and the influence of different life cycle phases on the environmental impact.

The duration of each life cycle phase differs since all solutions are different; for example, some take longer to design, and some are used for a shorter time than other alternative solutions. In most cases, however, the use phase is the longest, and the cumulative cost of a solution is often closely linked with the cumulative environmental impact.

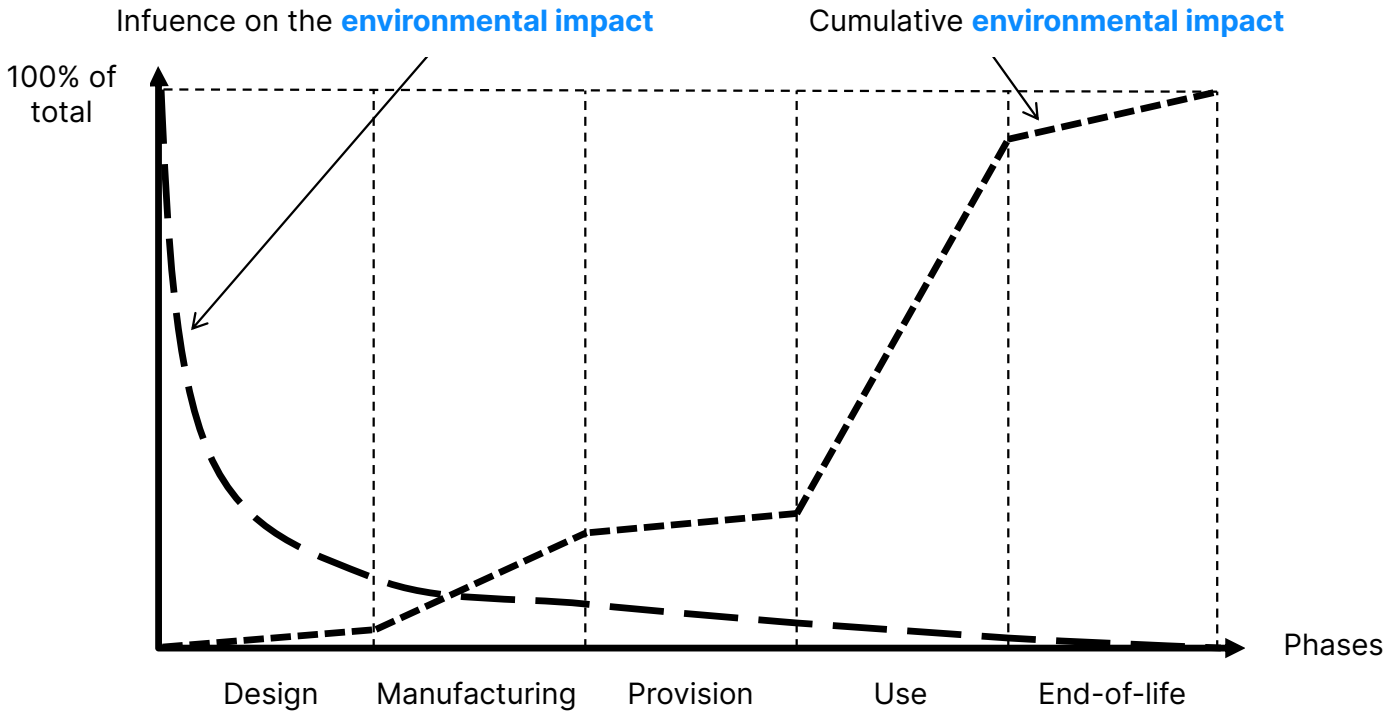

Figure 5: An illustrative example of the cumulative environmental impact over the solution's life cycle and the influence of different life cycle phases on the environmental impact.

Sources: BSI (2017); Lindahl and Sundin (2012).

Figure 5 shows that the design phase has a major influence on the total environmental impact. It is in the early phases of the design processes that the solution's specification is defined, including what parameters must/should be focused on; for example, how the solution will be used, how long it will work, the type and amount of consumables that will be used during the normal use phase, and the lifetime of the solution and its products.

Measures that can be taken to prolong the use, such as maintenance, repair, reuse, remanufacturing, refurbishing and recycling, are also generally preferable from a circular economy perspective, since the total environmental impact in relation to the use phase will decrease.

3 Necessary changes in perceptions and regulatory frameworks

3.1 Change current perceptions on consumption and ownership

We can indeed see how we can design more resource-efficient societies: citizens can join carpools instead of owning a car, people can use the tool library instead of buying tools, and so on. But such solutions only work if people are ready to accept them. And this will most likely be necessary, as the truth is there will not be enough resources for all the people on the planet to own all the things they want to.

This means that we need to challenge a number of 'beliefs' and 'norms', including the following.

- **It is better to own things than to purchase functions:** Of course, there are things we like to own ourselves. But there are also things we can share or lease, focusing on the function. This can also have benefits. For instance, many of the things we own require space in our homes. Further, if we borrow or rent a tool – such as a drill – when we need one, we can afford a better product with higher quality than we get when we purchase it.

- **New things are always better:** New things are not always better. Many markets are flooded with poor-quality products, and obtaining a reconditioned, quality product may provide better value for money.

Furthermore, one problem is that private customers have limited information about and knowledge of the 'total cost of ownership' when they purchase products (Dalhammar, Milios, et al., 2021). It is easier to buy a cheaper product than a high-quality one, even if the latter provides better value regarding the life cycle cost and the cost per year of ownership. Even in mature markets like the EU, where many customers are price-oriented, there are rules to ensure that all products are of reasonable quality. European countries also perform market surveillance to ensure all products on the market comply with the rules. In contrast, rural markets in developing countries are often flooded with poor-quality products, and there is limited market surveillance.

There is a need to better inform and educate customers to look at the life cycle costs when purchasing products. Such efforts, however, are often undermined by marketing practices that aim to associate purchasing products with positive emotions (selling a 'lifestyle') rather than promoting rational customer behaviour.

Further, there is a need to change customer behaviour and customer norms. For example, in countries with high gross domestic product (GDP) per capita, customers increasingly opt to buy a new product instead of repairing a broken one. Several factors influence such decisions, including cost and convenience, but we also see a lack of norms that promote repairs.

Introducing a repair norm in Sweden?

Swedish private customers are known to be quite ecologically oriented, and many consumers look for sustainable products. They also make use of various sustainability labels in their purchasing decisions and are often prepared to pay more for eco-labelled and organic products. However, if we exclude housing and cars, Swedish citizens spend less than three euros per year on repairs of private customer goods. One contributing reason for this is that, in general, attitudes and social norms about repair do not encourage repair behaviour: repairing a broken electronic product is seen as positive, but not as something people must do, nor necessarily the normal thing to do. This is in strong contrast to previous generations who bought durable items and repaired them. This points to the importance of strengthening social norms to shape repair habits, so that repair is the expected solution for broken personal electronics.

Source: López Dávila et al. (2021)

3.2 A need for standardized nomenclature and concepts in legal frameworks

Above, we discussed the need to standardize certain definitions and concepts to progress towards a circular economy and the need for standardization activities that can contribute to this objective. In this section, we discuss the need to also investigate existing legal frameworks that can constitute a barrier to circular solutions. We primarily focus on how waste laws can impede reuse, repair and remanufacturing.

In our attempts to move towards a circular economy, we must realize that we live in a linear economy: mindsets, business models, customer behaviour and existing legislation often reflect this fact (see, e.g., Hansen et al. (2021). If we are to move up the waste management hierarchy and promote reuse, remanufacturing and repair over recycling, such barriers must be overcome. The current waste hierarchy should also be turned upside down and be called the ‘resource hierarchy’, as seen in Figure 6. This is relevant since reuse is generally preferable from a resource perspective in relation to, for example, energy recovery.

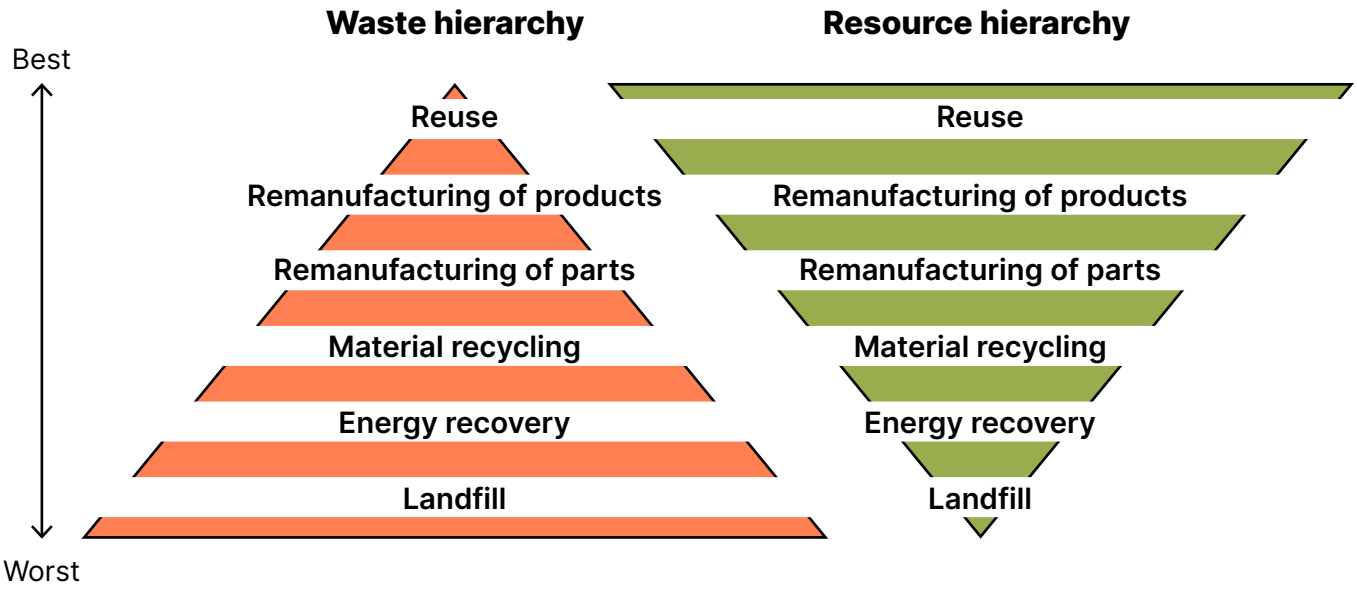

Figure 6: The current waste hierarchy should be turned upside down and called the 'resource hierarchy'.

Existing legislation is often a key barrier to reuse, remanufacturing and repair, and also to progressive recycling efforts (Dalhammar, Wihlborg, et al., 2021; Gustavsson et al., 2021; Hansen et al., 2021; Karvonen et al., 2017; Rizos et al., 2021; Svensson-Hoglund et al., 2021; Van Barneveld et al., 2016). Examples of common barriers are listed below.

- Current waste legislation, and rules on the shipment of waste, act as barriers to reuse, remanufacturing and repair practices.
- Current waste legislation, and the way producer responsibility schemes are adopted, mean that recycling waste is promoted at the expense of reuse, remanufacturing and reconditioning. Further, low taxes on landfills and historical investments in incineration capacity can act as barriers to material recycling.
- Rules on substances may act as a barrier to repair, remanufacturing and recycling, for example, if remanufactured products and spare parts do not comply with chemical laws.
- Intellectual property laws – such as patents, trademarks and copyrights – can be a barrier to repair and remanufacturing, for instance, by making it harder to reuse products and spare parts or hindering repair services from accessing repair manuals.

While some of these barriers should be addressed through changes to national regulatory frameworks – and in the case of the EU, also changes to the EU regulatory framework – several of these barriers also have an **international dimension**, which may require more coordinated international cooperation.

One example concerns **remanufacturing, reconditioning and refurbishment**. Many corporations engaged in circular economy activities employ global networks to distribute their finished products into markets around the world and make use of complex reverse-logistics systems to recover valuable parts and components. These activities face various legal barriers. Some barriers are grounded in terminology and definitions.

A fundamental problem is the lack of clear legal definitions, which can lead to confusion, lack of clarity, and the law being incompatible with circular economy activities. For instance, some countries do not distinguish between 'used' goods and multiple service life goods (e.g. parts or finished remanufactured products) in their import laws (US International Trade Commission, 2013). This may lead to a situation where a remanufactured product, which may be as good as a new product, is effectively prohibited because it is not meaningfully differentiated from a used good and is governed by the same import laws that were created to prevent the dumping of outdated technology (Kojima, 2017; Saavedra et al., 2013).

Another problem is that laws can create administrative burdens for circular business models. Even in cases where the import of remanufactured goods is permitted, they are often subject to extensive licensing and product inspection requirements in some jurisdictions (US International Trade Commission, 2013). **Thus, it would be good to work towards international harmonization of definitions for these goods, harmonization on import rules, and cooperation so desirable economic activities are not impeded.**

Another example concerns trade in used products, especially electrical and electronic products. As waste electrical and electronic products are considered hazardous, there are often restrictions regarding whether – and if so, how – they can be shipped between countries. This is also the case within the EU. Internationally, an advanced set of rules to regulate such trade exists, for example, in the Basel Convention (Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal). While there is good reason to control hazardous waste, there is mounting evidence that the rules impede beneficial reuse activities (Milovantseva & Fitzpatrick, 2015).

Also, within the EU, such rules may be a barrier to reuse, as reuse is mainly profitable in jurisdictions with low labour costs. Furthermore, while the rules aim to stop the export of dangerous waste to countries with poor waste management practices, some of the underlying numbers and the logic of how the Basel Convention operates have been called into question (Lepawsky, 2015; Lepawsky et al., 2015). It would be unfortunate if legitimate reuse operations in developing countries are stopped, especially if the alternative is that the people there cannot afford the products at all or that they instead rely on cheap, poor-quality new products.

There are proposals on how a better balance can be struck between the objectives of controlling dangerous waste flows and allowing export for reuse and reconditioning (Milovantseva & Fitzpatrick, 2015), for instance, by streamlining and changing existing laws to better support transport for reuse, establishing a comprehensive international legislative database to help harmonize variations in e-waste regulations among different countries and developing a green channel whereby regulated destinations and logistics channels that are independently audited to be operating to best practices get a 'green light' to import certain wastes.

Can digital product passports support new practices?

In the EU, there are plans to introduce digital product passports for some product groups. One potential use for such passports is to be better able to trace products throughout value chains and thus also trace them when they are reused. Such passports could help ensure that products end up where they should. They could also support other positive developments. In the EU, producers must pay a fee to a producer responsibility scheme when they put a new electrical or electronic product on the market. That fee is to cover the costs of collecting and recycling the products at their end of life. If the product, after its first use phase, is exported for reuse outside the EU, one idea could be to transfer that money to the export country, to support better waste management practices in developing economies.

Another issue of relevance concerns how intellectual property rights – such as patents, copyrights and trademarks – can be a barrier to product repairs. For instance, these rules can be used to stop imports of cheaper spare parts or to prevent independent repairers from accessing repair manuals. The EU and US have started to adopt policies to address these issues, promoting 'right-to-repair' (R2R) (Svensson-Hoglund et al., 2021), and more international cooperation on these matters would be desirable.

Above are just some of the many examples of areas where more international cooperation to support circular economy developments would be useful. Furthermore, policymakers should also investigate what regulatory and legal changes could discourage the implementation of conventional business models. For instance, by only allowing durable, energy-efficient and high-quality products in a market, 'bad choices' are simply not allowed. In addition, if producers must provide mandatory information on the expected lifespan and 'repairability' of a product, we can assume that some products will not be purchased once consumers learn how to use this information (Dalhammar, Milios, et al., 2021). Further, by setting progressive sustainability criteria in public procurement (discussed below), some linear products will not pass the test.

4. A need to support circular business models through laws and public procurement

Finally, we address another important issue: Circular business models are not likely to succeed without public policy support, as they compete with more linear business models in what is still a predominantly linear economy.

Thus, while we want to change the overall macroeconomic framework to enable the circular transition (for an example from the EU, see, e.g., Hartley et al. (2020), certain industrial sectors may also need targeted public policy support to aid new emerging business models (for an overview see, e.g., Milios (2021)). This support can range from beneficial loans to changes in tax frameworks and waste laws.

The use of public procurement is increasingly seen as a 'lever' to reach various sustainability objectives[3]. It can also be a key tool for innovation policy and aid in 'market creation', an approach to supporting emerging technologies and solutions (often referred to as 'niches'). Thus, public procurement can act as the first customer for emerging new solutions and support them to gain a foothold in the market, where they will eventually be able to compete with conventional solutions (e.g. Mazzucato (2016)).

Public procurement[4] (Larsson et al., 2018) represents a large part of global GDP, and an increasing number of researchers, for example, Brammer and Walker (2011), Uttam and Le Lann Roos (2015) and Witjes and Lozano (2016), as well as policymakers, have highlighted that it can play an important role in this change. Public procurement refers to the purchase by governments and state-owned enterprises of goods, services and works (OECD, 2021). Public procurement is thought to represent around 12% of GDP (usually 10–20% of GDP) and one-third of government expenditure in the OECD area (OECD, 2018), and, when carried out by publicly controlled authorities or companies owned by a society, it can play an important role in changing society (see, e.g., Brammer and Walker (2011); Uttam and Le Lann Roos (2015); and Witjes and Lozano (2016)). Recent empirical research on emerging circular business models indicates that public procurement is a very important policy to support them in scaling up their businesses (Milios, 2021).

The interactions between actors within public procurement are, in many countries, governed by the laws on public procurement. A properly performed procurement will help achieve a suitable balance between the three pillars of sustainable development – social, environmental (ecological) and economic sustainability – when purchasing goods, services or works.

Until recently, public procurement has fundamentally been in line with the common business model, that of buying and selling goods or services, but now we can see some movement towards more circular and sustainability-focused public procurement. To support this, for example, the Swedish National Agency for Public Procurement has published useful information about how to procure more circular solutions (Upphandlingsmyndigheten, 2021).

3. Note that among the SDGs, Target 12.7 aims to 'Promote public procurement practices that are sustainable, in accordance with national policies and priorities'.

4. Public procurement, accounting for 15–20% of global GDP, represents a substantial portion of the EU economy and the economies of many countries around the world. Public procurement commitments under the World Trade Organization's Agreement on Public Procurement (GPA) have been estimated at around €1.3 trillion (https://ec.europa.eu/growth/single-market/public-procurement/international-public-procurement_en), and in Sweden, SEK 683 billion annually (Larsson et al. 2018).

One example is that a municipality procures the function of 'lighting' rather than buying lamp posts and electricity or procures 'floor covering' for an office or school instead of a carpet. Other examples are that, for example, municipalities procure ICT and furniture as a function instead of as products.

Brighteco AB

Brighteco AB is a small to medium-sized enterprise (SME) that provides indoor lighting as a function, for example, to school buildings, as in the example from Bollnäs municipality presented by Jacobson et al. (2021). In their paper, they present legal, environmental and economic issues with this type of circular business model. Two different techniques for acquiring lighting representing traditional product sales and functional sales that are based on circular economy principles are compared. The case for functional sales is based on the legal foundation of an existing public procurement, while the case for product sales is a likely alternative for lighting purposes. The study shows that there is a trade-off between environmental consequence and economic benefit and that qualitative aspects can be difficult to include in the contract and evaluation.

The conclusion is that the ordinary purchase is supported by long-established rules and regulations so that such a legal transaction (acquisition) is quite conventional and uneventful. However, if the business model changes without a proper legal foundation, the parties of such contracts will find themselves in a legal wilderness, where the outcome of civil litigations is unpredictable. There are ways to circumvent these difficulties, which are demonstrated in this article, as well as the principal advantages of this type of more circular business model.

The two business models are illustrated in Figure 7 below. From a legal and contractual perspective, there is a significant difference between the alternatives concerning the ownership of the products delivering the desired service. In the traditional product sales model, the provider sells a product, the luminaires, to the customer, who in turn becomes the owner and is responsible for ensuring that the function of the desired lighting is fulfilled. The relationship between the participants in this kind of contract is short-term and normally comprises the transfer of products and payment, including a guarantee period. In a circular business model (functional sales), the product is the service of lighting, while the provider is the owner of the luminaires and is responsible for ensuring that the desired lighting is provided. The customer pays a periodic subscription fee for this service. This business model is accompanied by a long-term, bilateral relationship, represented by the overlapping boundaries. As part of that relationship, recurring evaluation of the fulfilment of the agreement, the contract, is performed, which can lead to changes in the service when necessary.

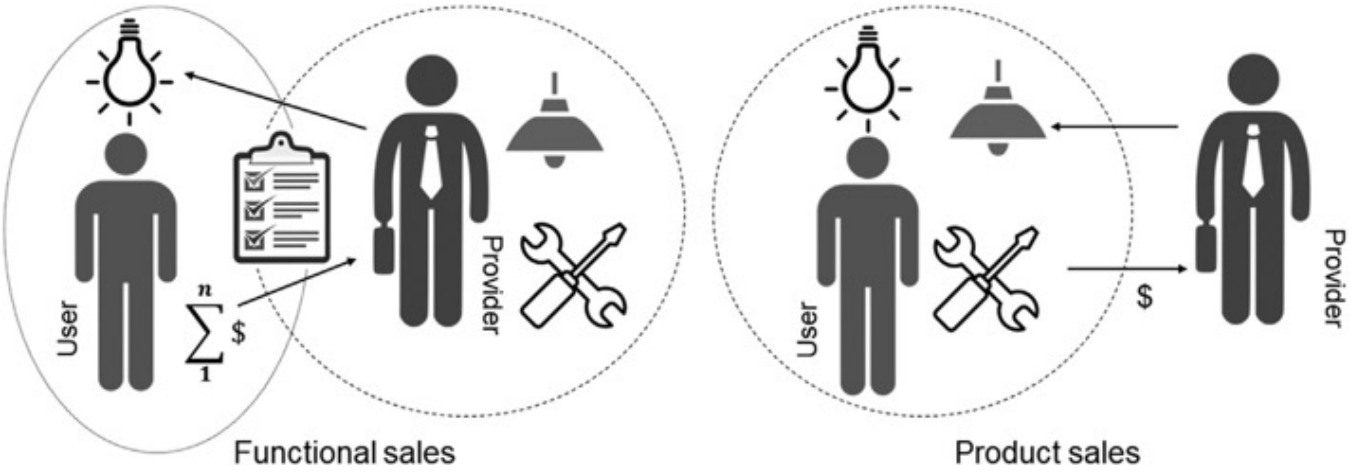

Figure 7: The system boundaries of functional sales and product sales
Source: Jacobson et al. (2021).

If the public starts to procure more sustainable and circular solutions, it will also create a foundation for companies to innovate and grow new, more sustainable and circular business models and solutions. Public procurement can aid new companies to achieve quick growth as it can guarantee larger sales volumes, thereby creating space for investments. When doing this, it is important not to forget the small to medium-sized enterprises (SMEs). SMEs make up over 99% of all companies, and in EU countries especially, they are key to ensuring economic growth, innovation, job creation and social integration (Eurostat, 2015). They face specific challenges, and when it comes to the public sector, there is little history of engagement. Yet the benefits of having a vibrant and growing SME sector are well reported (Niska & Vesala, 2013; Simón-Moya et al., 2016; Thurik & Wennekers, 2004).

The production, provision, marketing, use and recycling of goods and services results from the activities of cooperating actors. This cooperation and these activities take place within the context of legal rules, which are effective tools to achieve the goals of the business, as well as a means to limit the number of available choices that market actors have (Agell et al., 2016; Strömholm, 1996). The legal system is usually reactive; it adapts in response to changes that have already occurred in society. These may be caused by new technologies, business practices, distribution methods or forms of cooperation. For example, the (Swedish) lawyers did not take any position on the form of financing called leasing until it was well introduced in the market (SOU 1994:120). Another example can be found in the effects of the digital revolution. For a long time, an unanswered question in law was whether a digital document could legally be an original or if it should always be perceived as a copy (Koktvedgaard & Levin, 2002).

This reactive nature of law is a challenge and weakness in relation to a transition towards a more sustainable and circular society. It means that the current legal situation, in general, is not designed to fit the new type of more sustainable and circular business models. This is the reason why there are no legal rules to regulate, for example, which rights and liabilities parties carry when entering a contract that promises to deliver results instead of transferring ownership or commissioning a service. Consequently, there are today no certain answers to legal questions relating to, for example, contract issues, ownership rights and tax rules when providing solutions over time. This will require more research and an active collaboration between corporations, lawyers and policymakers.

Furthermore, it has become increasingly apparent that the process of public procurement does not work as efficiently as the policymakers might have thought. This is partly because many people concerned with the procurement process lack the proper knowledge to 'open up' the process to new sustainable solutions, but it may also be that it is difficult to formulate the desired specifications using traditional business models. At the same time, it is important to understand what requirements to include and how to state them in a public procurement process so this does not cause problems, for example, extra costs and environmental impacts (Lidestam et al., 2018). To manage this, there is a need for better education for those who work with public procurement, one that teaches how to set requirements and compare linear and circular business models with each other. Today, few universities offer this type of education.

As highlighted in Section 3.1, policymakers need to better educate customers to look at the life cycle costs when purchasing products, but they also need to do it themselves via their huge public procurement process. They need to act as a good example. Besides the above, they need to tighten their requirements on the solutions that they procure and to request and support providers that supply effective and resource-efficient solutions over time. To do that, they need to increase their use of a life cycle perspective in their procurement.

5. Concluding remarks

Today, we live in a linear economy. This economy is no longer viable, as it cannot provide for the needs of all humans while maintaining the ecological integrity of our planet. The current situation is a product of past ideas on effective markets, legal concepts and legal culture, business models and ideas on ownership and consumer culture. These concepts and ideas have emerged together over time and influenced each other. For us to move to a more circular economy, we need to start questioning how we look at products, markets, ownership and resources.

As a foundation for this process, this report highlights what the circular economy is about and some key issues we need to address to move towards a circular economy. It also highlights the need to connect the business and policy developments related to the circular economy to other sustainability fields such as climate change and chemicals and to place it within the broader context of sustainable consumption. A circular economy is not only about taking care of our resources; we must also ensure that all humans have access to the resources they need to live a decent life. Thus, the social dimensions of the circular economy should not be neglected: it must be an economy that benefits all humans.

As a final word with some positive focus, we have created a linear economy-based society that we experience as not sustainable or fruitful. At the same time, if we have managed to develop this unsustainable economy over the last few centuries, what can we achieve with the knowledge we now have? We have the ability to develop a more sustainable and circular society. We have the knowledge of what is needed. What we need is a rapid kick-start of the work before it is too late.

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