Capgemini invent

INTELLIGENT INDUSTRY: THE RISE OF CIRCULARITY

A paper in partnership with changeNOW

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FOREWORD

For its fifth edition of the summit, Capgemini joined forces with ChangeNOW to co-publish a report on the circular economy that aims to provide an overview on the state of play of circularity in the global economy, its integration into companies' strategy, and how to speed up the transformation of this new business model.

Although the circular economy has recently garnered much interest across industries, the mass adoption of circularity is yet to be achieved. Transitioning to this new paradigm is complex, requiring profound changes in business strategy and operating methods, particularly when it comes to product design and operations. The transformation can therefore only take place at speed and scale if industries develop an eco-systemic approach that will inevitably reshuffle traditional value chains. By connecting start-ups, major organizations, academics, and public authorities, the ChangeNOW Summit provides an ideal arena in which to encourage the creation of these new innovation ecosystems in favor of the circular economy.

This paper is a new step in Capgemini's journey in the circular economy space and will be followed by complementary industry focus. For the purpose of this report, we analysed over 50 businesses and conducted over 30 interviews with companies of various sizes and from different sectors to obtain a comprehensive overview of the circular economy with patterns for business disruption. Some of the conversations held with business executives and use cases are thus provided throughout the report to illustrate the circular economy trends.

On behalf of both Capgemini and Change NOW, we would like to warmly thank all the contributors to this report.

They all shared passion and solid convictions, demonstrating that circularity is a concept that goes beyond theory to become an industrial reality.

EXECUTIVE SUMMARY

Despite the deeply rooted social pressure and acceleration of resource depletion in the next decades, the circular economy revolution has not (yet) taken place and its adoption remains timid. Indeed, the global economy circularity stagnates at 9% (i.e., 91% out of 100 billions of tonnes of the raw materials consumed each year are never cycled back in the economy)[1].

The latest IPCC report unveils that the humanity has a three-year window to meet the 1.5°C target which exacerbates social pressure regarding environmental concerns. Moreover, the recent succession of crises such as sanitary crises, supply chain disruptions (e.g., Suez Canal blockage, semiconductors shortage) or war in Ukraine confirms that companies need to cope with a new business paradigm.

To grasp these market dynamics around circular economy, we conducted a study in collaboration with ChangeNow including an analysis over +50 companies and +30 interviews with actors of various sizes across industries.

We identified four driving forces **pushing for the adoption of circular economy** as a consistent lever: (1) Growing intolerance to any pollution type, (2) Lack or absence of waste recovery, (3) Scarcity or difficulty in sourcing raw materials, and (4) CO2 emissions relating to the business activity in general. While the first two have crystalized most of the initial and ongoing efforts and regulations for several years (targeted recycling, plastics management, management of unsold food or non-food items), the current and forthcoming conditions give considerable prominence

to the last two. Depending on their level of exposure to these threats, companies have a heterogeneous level of adoption and implementation.

Players pushed to adopt Circular Economy have been implementing new business models that go far beyond recycling (e.g., Product-as-a-Service, Product Life Extension, Sharing Platforms, Sell and Buy-back, Repair and Maintenance services, Second-hand Platforms), representing new playfields that deliver proven economic value and consumer desirability (e.g., clients' acquisition and loyalty, turnover increase, brand image improvement). Resulting from these benefits, **new players are also pulled in the integration of circular economy** within their business activity.

Whether industries are pushed to circularity (e.g., automotive, high tech, construction, consumer goods manufacturers) or pulled by circularity, triggering market disruptions (e.g., luxury, consumer goods retailers) or a mix of both, the journey toward circular economy is inevitable. Regardless of the trigger, we see industry leaders in each sector launching initiatives or making circular economy one of their strategic pillars.

Subsequently to our analysis, we determined five fundamental convictions for the implementation of circular economy:

1. **The scarcity economy is prevalent in strategy definition.** Strategy is no longer just a matter of competitive positioning, but must also provide a long-term vision on raw material sovereignty and sourcing risks, in order to demonstrate business resilience in the next decades.

2. **Product design is the cornerstone of circular economy at scale.** While initial Circular Economy approaches were focused on lowering sudden value loss of product at the end-of-life or environmental impacts, a new era is opening up with sustainable product design enabling the implementation of end-to-end circular strategies through products that are fit-for-purpose through sobriety, dematerialization, durability, modularity, recoverability, or recyclability.

3. **Large pools of value sources are still untapped between end of use and recycling.** There is an ocean of opportunities by reusing, repairing, remanufacturing products that are widely unexplored. This implies an in-depth reflection on the reverse logistics and the smart factories in charge of maximizing the use of circular products and their components.

4. **From the extended enterprise to circular ecosystems.** While the shift to Circular Economy obviously implies collaborating with the entire traditional value chain, it also implies having an even more ecosystemic approach, by also partnering with competitors or with players in other industries (e.g., to maximize raw materials value, to achieve the critical size for efficient recycling).

5. **Two major innovations will fuel disruptions**
   a. Emergence of **biomaterials and synthetic biology** can provide economically viable alternatives to scarcity of resources (e.g., insect-based proteins), and high planet-impact processes (e.g., chemical recycling, precious metal recovery).

   b. **Merge of digital and physical worlds** enables the implementation of the product digital passport, materials traceability, exchange platforms, decision-making tools, or design and simulation capabilities.

Implementing economically viable circular models at scale involves for industry incumbents major upheavals at the core of their strategy and operational processes. Therefore, it requires a holistic approach combining products, processes, ecosystems and business models. This will mobilize multiple disciplines (design, data science, marketing, engineering, procurement, …) to jointly overcome the circular economy transformation challenges.

In this long journey, early circular economy adopters will earn a competitive edge by creating and/or ripping off market shares.

With the urgency of the environmental situation, the global supply chain reconfiguration, and the opportunity offered by the avalanche of technologies powered by data, Circular Economy experiences an exceptional momentum to expand its footprint in all industries.

A new chapter is opening, let's Change Now to Get the Future We want!

Roshan Gya
Global Head of Intelligent Industry, Capgemini

Kevin Tayebaly
Co-Founder, ChangeNOW

Circular economy: where do we stand?

CIRCULAR ECONOMY: WHERE DO WE STAND?

A long-standing virtuous concept struggling to break through

One of the key lessons of the COVID-19 crisis is that all industries are being pushed to challenge conventional wisdom. The dire battle against climate change has moved into the action phase, as organizations around the world coordinate a strategic response. For too long, our economic model has been chasing short-term growth with a focus on optimizing linear value chains and encouraging fast consumption.

All organizations, industries, and governments have therefore, set their targets to achieve net zero targets at different timescales that need to be ambitious and realistic at the same time. However, to be implemented effectively, the sustainability transition must rely on a set of levers where the circular economy has a role to play. According to (Capgemini Research Institute's 2021 report) on the topic, four out of the top ten sustainability accelerators identified by Executives are circular economy approaches[3]:

- Disposal, recycling and breaking down of toxic material (80%).
- New processes that consume less energy/resources (76%).
- Utilizing biodegradable plastics (74%).
- Zero landfill technologies/process (70%).

But first, what do we mean by circular economy? According to *"Ellen Mac Arthur Foundation"*, it refers to an economic model that makes optimal use of resources by avoiding waste over a product's lifetime, maintaining products at their highest value, and regenerating raw materials to their initial state back to nature[4]. It aims at significantly reducing the material footprint of companies, products and their users. This concept relies on three main principles.

1. **Design out waste and pollution:** For a circular economy, it is essential to recycle materials from waste in order to "close the loop." The recovery of energy from waste also plays an important role. Waste disposal should be phased out and, where it is unavoidable, it must be adequately controlled to be safe for human health and the environment.

2. **Keep products and materials in use:** A circular economy favors activities that preserve value in the form of energy, labor, and materials. This means designing for durability, reuse, remanufacturing, and recycling to keep products, components, and materials circulating in the economy.

3. **Regenerate natural systems:** A circular economy avoids the use of non-renewable resources and preserves or enhances renewable ones, for instance by returning valuable nutrients to the soil to support regeneration or using renewable energy as opposed to relying on fossil fuels.

In contrast to the linear "take-make-waste" model, a circular economy is regenerative by design and aims to gradually decouple growth from the consumption of finite resources[5]. The linear model is a sales-oriented business model where value is only created during the production process, before the products reach their optimal value during the "use" stage. Once quality and utilization levels are no longer optimal, product value continues to decline until it becomes non-functional and the product is disposed. By contrast, the circular economy implies value recovery mechanisms to ensure that the value of products and materials is preserved after the use phase leading to "added-value" creation. Thus, moving to a more circular economy aims to increase resource efficiency and reduce primary resource inputs by design, maintain products and materials at their highest possible value for as long as possible, and eliminate waste at the end of life.

As it stands, the amount of energy and natural resources that are consumed is phenomenal but, more importantly, the processes currently in place do not ensure the reusability of these resources, which too often end up as waste and pollution. In fact, the materials cycle is responsible for more than two-thirds of global greenhouse gas emissions (i.e., 32 Gt) with collateral damage on other natural resources such as land, water and biodiversity (OECD, 2017). Finally, less than 20% of waste and 6% of materials are collected and recycled each year (Spring Nature Limited).

The state of the linear economy

- To satisfy all global needs and wants, we emitted 59.1 billion tons of GHGs in 2019.
- In 2020, 100 billion tons of materials entered the global economy – the highest volume ever.
- The global generation of e-waste is projected to attain 74.7 Mt by 2030 – almost doubling in only.
- A third of the food being produced is lost or wasted throughout the supply chain and during.
- Around 73% of all clothing is sent directly to landfill or to incineration (87% in the EU).

Sources: **Circularity Gap Report, 2021 - The Global e-Waste Monitor, 2020 - Ellen MacArthur Foundation & Google - Delt University**

The human population has been growing at a rapid pace and this is likely to continue. When compounded with our capitalistic model, it puts even greater stress on resources and production structures of all kinds. For instance, manufacturers in the retail segment have had to massively increase their production capacity to meet consumers expectations which constantly look for new products at the most affordable cost.
CPR is not the only sector to be affected by population increase: with 55% of the global population expected to live in urban areas[6] by 2050, the construction sector will also experience an upsurge in demand for housing, which is a primary concern as by nature the sector is very energy and material intensive (regardless of whether we are looking at private or public housing, offices, new or renovation projects). Transportation needs are also higher than ever, and likely to increase further. This requires major adjustment to reduce the material and carbon footprint emitted from vehicle production and usage as well as infrastructures. Simultaneously to all this, the need to decarbonize the economy has intensified the development of renewable energy solutions aiming to move away from fossil fuels through electrification. This centralization of supply needs across raw materials alters their quality, accessibility, and price.

Consequently, circular business models appear to offer attractive alternative solutions for companies as they deliver large pools of diverse benefits that go beyond positive environmental outcomes. For instance, solely in the industrial space, Material Economics estimates that circularity applied to four main sectors (cement, aluminium, steel and plastics) could reduce the EU's carbon footprint by 56% by 2050[8].

Some circular economy benefits

Resource sovereignty: Although benefits vary per product, component, or material, reused products, one of the circular economy practices, are estimated to boost resource saving by 80% to 95% for the first extension of life compared to a new product (number of life cycles can vary from 2 to 9 lives)[9].

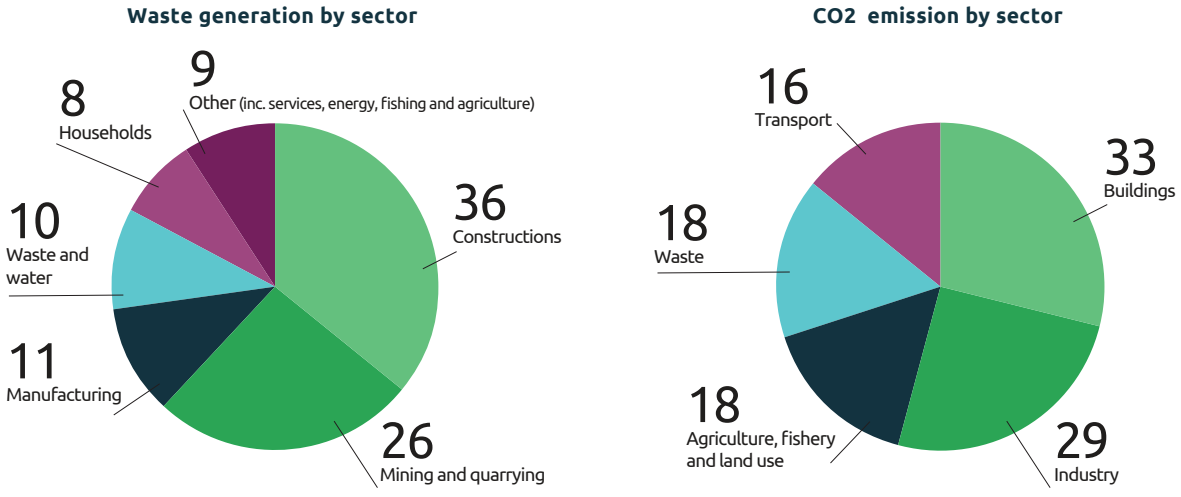
Environmental friendliness:
The circular economy has the power to shrink global GHG emissions by 39% and cut virgin resource use by 28%[10].

New revenue streams:
The circular economy is estimated to increase the European Union's GDP by 0,5% by 2030 from new revenues sources, increased profitability and sheltering against resource price fluctuation[11].

Job creation: The circular economy is estimated to create 700,000 jobs in the EU alone by 2030[12].

Innovation & enhancement:
Products made from recycled plastics can be around 80% cheaper than those using new materials[13].

Waste generation and CO2 emission by sector and main materials in industrial waste in Europe (2018)[7]



Main types of material representing the majority of waste and industrial emissions

Cement	Iron & Steel	Aluminium	Plastics
• **7%** of CO2 global emissions • **Usage:** Construction mainly	• **~7%** of CO2 global emissions • **Usage:** Construction (52%), Mechanical equipment (16%)	• **~1%** of CO2 global emissions • **Usage:** Transport (36%), Building (26%), Packaging 17%	• **~4,5%** of CO2 global emissions • **Usage:** Packaging (47%), Textile and CGP (~14% each)

Source : Barclays Research, Circular Economy: the next frontier to decarbonise industrials, Dec. 2021

Obstacles to its implementation at scale and global adoption

Complexity in the implementation: Today there is a general alignment on the need to shift to more circularity in day-to-day business activity. However, the circular economy is perceived as a broad and even sometimes elusive topic which makes it very difficult to articulate within the corporate strategy in a structured manner. In fact, more than 70% of the companies interviewed for this paper reported complexity in the implementation of circular business models as one of the main obstacles. The scope of the transformation and the need for a large set of skills mean mobilizing various parts of a company's ecosystem, in particular the upstream and downstream segments of its value chain. That challenge also explains why leaders in the circular economy are among those that have a strongly integrated value chain. Finally, the circular economy is not a not a one-size-fits-all template that can be replicated easily, but rather a customised approach that needs to be coordinated at industry level to be scaled up.

Lack of effective financial support: Most circular business models are service-oriented compared to linear ones that usually rely on large volumes of sales. This means that breakeven is attained over a longer period of time, thus requiring specific financial support to secure a company's transition. As financial services are not necessarily adapted, absorbing the investment for transition creates a real dilemma for companies if there are to provide affordable products. This cost barrier prevents the circular economy from scaling up.

For Kasper Nossent Commercial Director at Dyecoo "There will be an impact on prices, due to the required investments in the value chain to transform into a viable circular economy. A successful transformation requires an understanding in the supply chain and at consumer level, that there is a fair price to pay."

Anne-Valérie Goulard, chief VP Sustainable Development for SUEZ Recycling & Recovery France , also claimed that "Among the obstacles to the implementation of the circular economy on a large scale, the development of recycling channels and their competitiveness with regard to ultimate waste treatment channels are key; to support the demand for recycled raw material and its price compared to virgin material, one of the levers is to impose a minimum incorporation rate in manufactured products".

Binding legal framework: Growing societal pressure combined with the urgency to change current ways of operating have led to an acceleration in the application of the law. However, this fast-paced change is more complicated to implement than it seems, for both organizations and for regulators who do not have the tools to measure and apply. This process, which relies on metrics that are not well established across industries, discourages initiatives because of the significant effort seemingly required.

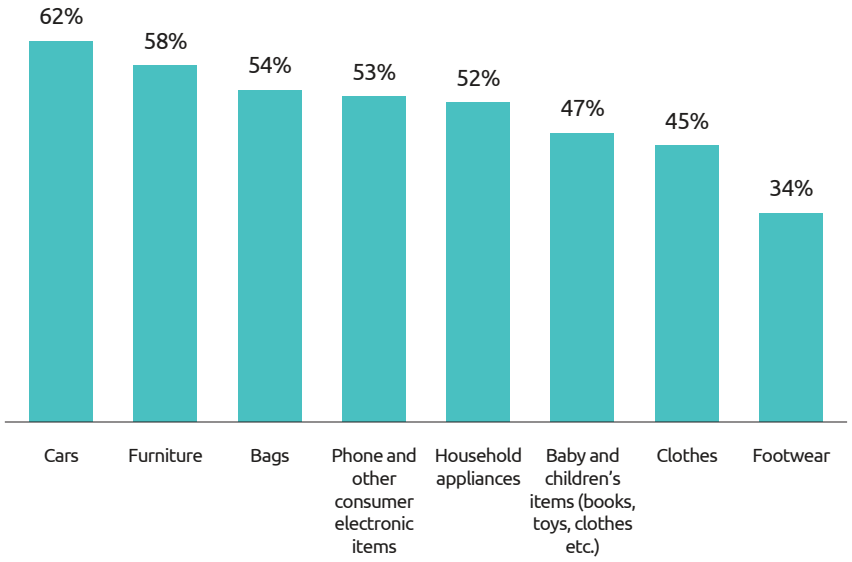
According to Jean Moreau, CEO & Co-founder at Phenix (start-up fighting food waste), "Today only remedial solutions are put forward, but we need to go up the value chain to develop a more preventive approach using data. There are no controls associated to anti-waste laws, no emblematic fines, even though we have the means to do that. What is most likely to make the big players move is the fear of reputational repercussions caused by a bad buzz on social media."

A new business environment that redefines the rules of the game

Whether through voluntary initiatives or change forced by exogenous factors, actors of various kinds are emerging or taking the lead to initiate transformations at their scale. Feeling the business environment change, certain actors have embarked on their transformation early, for different reasons and objectives. However, a set of influential drivers is encouraging companies to transition towards the circular economy, as described below.

Waste and pollution: In a recent study from the Capgemini Research Institute, 63% of consumers surveyed are aware of the global plastic waste problem and are thus willing to adopt mindful consumption practices. This growing societal pressure has a tremendous impact on brand image, which is a primary concern as waste and pollution are no longer acceptable for consumers. Therefore, two third of these same consumers expect organizations to be responsible when advertising products and to discourage excess consumption; meanwhile, 65% think that companies should be accountable for products even after they have been taken back – to ensure that they are handled responsibly and do not end up in landfill. This opens the door for the development of circular models and practices especially since, *"For the younger generations, consumption habits are no longer the same: accumulating assets has become old-fashioned, freedom means buying the right to use them on an ad hoc basis according to their actual needs." explains Fabrice Bonnifet, Sustainable Development & Quality, Safety, Environment Director at Bouygues Group".*

Percentage of consumers who are comfortable with using second-hand/pre-used/shared products

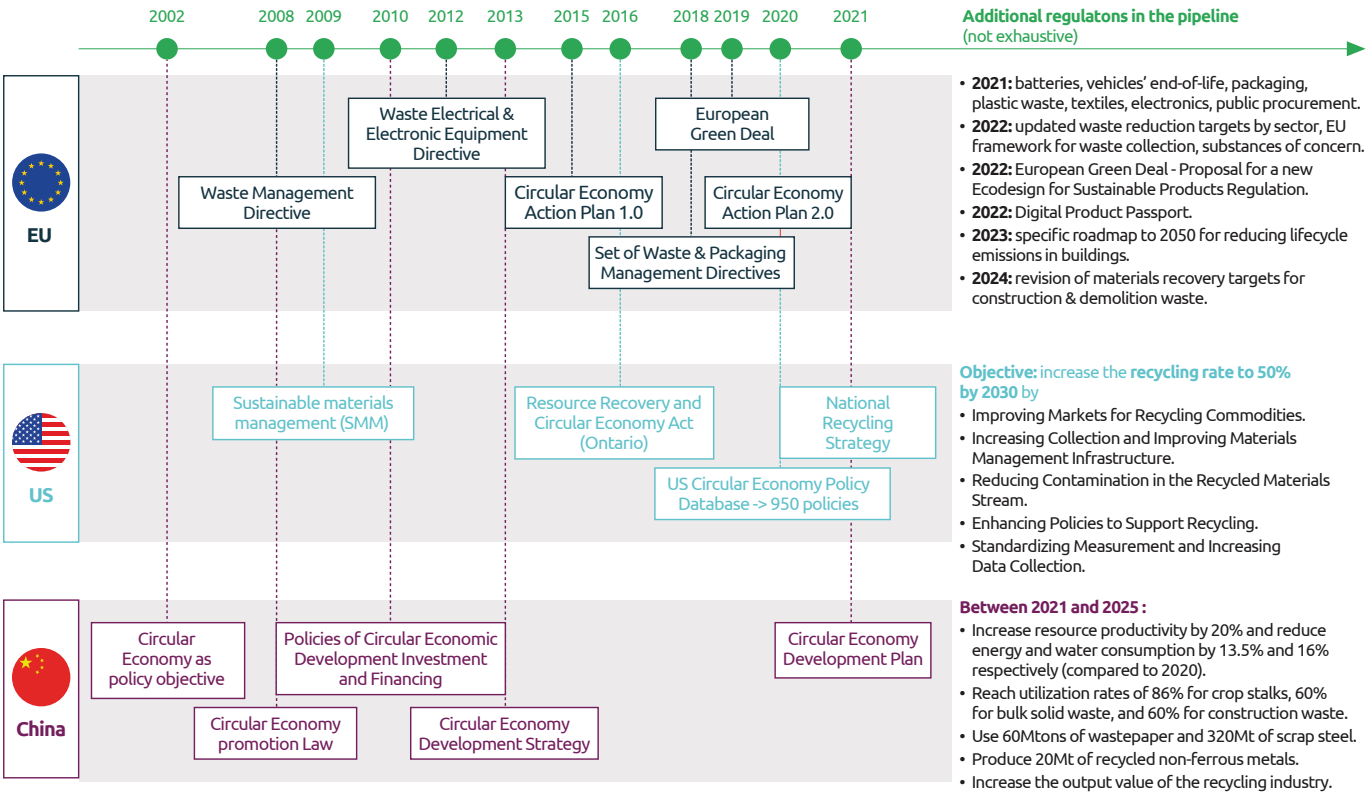


Source: Capgemini Research Institute, circular economy survey, August–September 2021, N=7,819 consumers.

In line with society, legal enforcement is targeting wasteful and polluting companies with more restrictions regarding how they run their current business.
This social pressure causes a knock-on effect on politicians who are forced to take actions through new legal frameworks imposed on companies, making them responsible for sustainable production. What is more, companies are not undergoing these legal changes at the same pace, depending on their sector and location as the illustration below demonstrates.

"The pressure of public opinion plays a role in the company's trajectory. General awareness has an impact on elected officials, which means that the awarding of certain projects depends on the environmental image conveyed by the company." *comments Benjamin Michel-Wertheimer,*

Evolution map of the legislation about circular economy



Additional regulatons in the pipeline
(not exhaustive)

- **2021:** batteries, vehicles' end-of-life, packaging, plastic waste, textiles, electronics, public procurement.
- **2022:** updated waste reduction targets by sector, EU framework for waste collection, substances of concern.
- **2022:** European Green Deal - Proposal for a new Ecodesign for Sustainable Products Regulation.
- **2022:** Digital Product Passport.
- **2023:** specific roadmap to 2050 for reducing lifecycle emissions in buildings.
- **2024:** revision of materials recovery targets for construction & demolition waste.

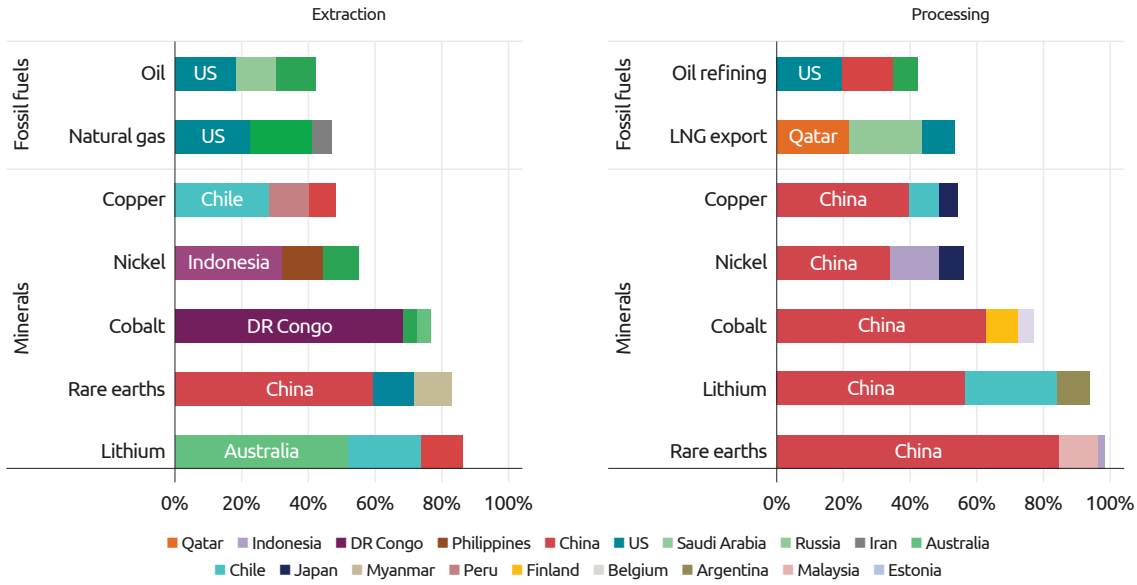
Objective: increase the **recycling rate to 50% by 2030** by

- Improving Markets for Recycling Commodities.
- Increasing Collection and Improving Materials Management Infrastructure.
- Reducing Contamination in the Recycled Materials Stream.
- Enhancing Policies to Support Recycling.
- Standardizing Measurement and Increasing Data Collection.

Between 2021 and 2025 :

- Increase resource productivity by 20% and reduce energy and water consumption by 13.5% and 16% respectively (compared to 2020).
- Reach utilization rates of 86% for crop stalks, 60% for bulk solid waste, and 60% for construction waste.
- Use 60Mtons of wastepaper and 320Mt of scrap steel.
- Produce 20Mt of recycled non-ferrous metals.
- Increase the output value of the recycling industry.

Share of top three producing countries in production of selected minerals and fossil fuels



Notes: LNG = liquefied natural gas: US = United States. The values for copper processing are for refining operations.
Sources: **IEA (2020a), USGS (2021), World Bureau of Metal Statistics (2020), Adamas Intelligence (2020).**

Director at Hesus – company providing waste management services)

Resource scarcity and convergence towards similar raw materials are leading to geopolitical tensions in countries. Collateral damage of the raw material scarcity situation includes issues concerning resource price, accessibility, and quality. For some players, in the automotive or packaging industries for example, this is now a reality, and recent events have shown the limitations of the existing globalized supply chains.

"The covid first, and now the invasion of Ukraine, are challenging the access to raw material for all industries including the food and beverage industry. More and more companies wish to relocate their supply chain; however, it requires a systemic change and profound investments. Forests and paper mills cannot be relocated overnight." says Christine Leveque, (Global Vice President Collection & Recycling at TetraPack).

In addition, the concentration of the countries able to extract and process the raw materials required to build decarbonized solutions is even higher than for fossil fuels. This will mean increased dependency on the very few resource-rich countries, which will exacerbate geopolitical tensions (e.g., three-quarters of lithium, cobalt and rare earth element production is covered by just three countries in the world).

Although there is domestic production of certain critical raw materials within the EU, in most cases this region is dependent on imports from non-EU countries.

This same level of dependency applies to production of the components built using these materials (e.g., 77% of electric vehicle batteries are currently produced in China[14]). In addition, the supply of these raw materials comes from countries with low level of controls applicable to working conditions (e.g., the Democratic Republic of Congo is responsible for more than 70% of the global cobalt production).

Carbon footprint: In recent years, and even more so since the Paris Agreement in 2015, organizations have been joining the race to decarbonization. To meet the targets set by the scientific community, various solutions, beyond switching to renewables, are required to achieve net zero as early as possible. Considering that materials - from extraction to end of use - account for 70% of global GHG emissions, it is critical to identify the levers to reduce our dependency on the consumption of large volumes of resources[15].

The world operates with finite resources, so those who struggle to understand the urgency of reinjecting value once products reach their end of life will not succeed. It is thus more urgent than ever to shift from linear models to a "closed loop" circular economy, where waste and pollution are minimized, products and materials are kept in use for longer, and natural systems are allowed to regenerate. All the indicators suggest that companies are now entering an accelerated phase to mitigate the risks that may have irreversible consequences on their business continuity.

A transformation initiated with differing levels of progress and maturity

Today, many industrial players have already started their circular economy journey with differences in terms of maturity levels, transformation pace, or even strategic prioritization. This heterogeneity can also be attributed to the increased difficulty in accessing resources, as well as the level of financial and regulatory support provided by public authorities to secure the transition successfully.

We have distinguished three trends according to companies' exposure, illustrated in the table below. This shows how the market is evolving where companies are not necessarily affected by just one of these trends.

Trend	Description	Market examples
Chasing raw materials	For these businesses, resource scarcity is a growing concern. They have no other option than to find alternative models that help secure resource access from remaining stocks/new alternatives. The most frequently considered alternative solutions are those that let them recover their products for life extension, reuse and recycling purposes. **Most exposed sectors:** Transportation, Energy & Utilities, Technology & Electronics, Construction.	• **BMW:** Launched more than 2,800 return points in 30 countries to step up the recycling and return of end-of-life vehicles to keep control of existing resources[16]. • **Apple:** Set to launch a Self-Service Repair program in early 2022; will finally provide individual customers with access to genuine Apple OEM parts and manuals for DIY iPhone (and eventually Mac) repairs[17]. • **Stellantis:** Developing referencing, traceability, and accessibility activities for returned spare parts to renovate vehicles. This initiative enabled to save up to 80% of new raw materials and reduce energy consumption by 50% in the production of refurbished engines[18].
Fighting pollution	The intensification of the legislation to reduce waste emissions and pollution affects companies in the scope of their business activities. This is particularly the case within industries where products (and packaging) are scattered widely once sold. This changing framework forces them to take action and find alternative solutions such as reducing pollutant usage (e.g., in plastic packaging) or integrating recycled materials. **Most exposed sectors:** Transportation, Fashion, Consumer Products, Construction, Chemicals.	• **Vinci:** Investing in low-carbon concrete[19] and certified wood to comply with net zero targets. • **Unilever:** with the "less, better, no plastics" program, it aims to rethink the entire life cycle of packaging, from design to end-of-life management, to reduce plastic use[20]. • **Tesco:** through its 4Rs program, the retailer refuses to promote brands with products that contain excessive packaging or hard-to-recycle materials[21]. • **H&M:** The group sustainability ambition consists in becoming climate positive by 2040 through fabric recycling, sourcing exclusively sustainable materials[22].
Circularity as a business	These organizations don't necessarily suffer from any structural externalities but look for any opportunity to generate additional revenues through complementary business models or to reach their net zero targets at a faster pace by leveraging the circular economy (with clear potential to reduce scope 3 downstream emissions especially). Completely new entrants that either operate as intermediaries within existing linear value chains, or new competitors applying circular principles and creating new value chains through disruptive business models or innovations. **Most exposed sectors:** all.	• **Phenix:** platform proposing unsold goods from supermarkets originally intended for landfill[23]. • **Back Market:** the refurbished electronics marketplace has developed product diagnostics software to determine the reparability of returned items and what needs to be repaired[24]. • **Patagonia:** promotes a product that "never dies", made from sustainable and circular material. Further investments in second-hand and clothing-as-a-service markets have reduced the carbon footprint of their supply chain by 97%[25]. • **IllyCaffè**: through a lifecycle assessment, the company discovered that 63% of their CO2 emissions comes from coffee bean growing. They thus decided to invest in new technologies to tackle this and deploy them as a part of their circular economy strategy. • **Kering:** The luxury group started their circular journey with a plastic-free program. Today they have defined a holistic approach and lean towards the second-hand market through the partnership with the resale platform Vestiaire Collective[26].

All the companies surveyed for this report acknowledge that they are exposed to these trends. There is a high degree of heterogeneity between sectors and companies, depending on their level of exposure (e.g., geography, regulations) and the speed at which these trends will reach them, which determines whether the circular economy is considered a tactical or strategic issue.

Transformation in motion

TRANSFORMATION IN MOTION

Highway to circular economy 2.0: a fast-growing adoption of new business models

What tomorrow's world could look like

The linear model as we know is running out of steam, and the socio-economic context, along with growing societal pressures, show that this way of doing things is no longer desirable nor sustainable.

Business transformation is necessary for all players, whether to avoid losing market share at the expense of first movers in the circular economy, being "uberized" by new entrants, or suffering from externalities (such as resource scarcity and law enforcement). This implies the creation of a new business environment that embraces the following switch:

From…	…To
• A model based on large volumes of single unit sales	• A service economy based on a usage-oriented logic
• Globalized value chains	• Regional trading blocks
• Product obsolescence	• Product resilience
• In-house R&D driven by production cost	• Open innovation driven by added-value creation to close loops

Hence, the traditional ways of doing things that value products with short lifecycles are no longer sustainable. The linear model is a sales-oriented business model where value is only created during the production process, before the products reach their optimal value during the "use" stage. Once quality and utilization levels are no longer optimal, product value continues to decline until it becomes non-functional and the product is disposed of. By contrast, the circular economy implies recovery mechanisms to ensure that the value of products and materials is maintained after the use phase, leading to "added-value" creation (examples include resale/second-hand sale, repair, refurbish, remanufacture, recycle). Thus, moving to a more circular economy aims to increase resource efficiency and reduce primary resource inputs by design, maintains products and materials at their highest possible value for as long as possible, and eliminates waste at the end of life.

According to the value hill framework[27], organizations should put more emphasis on the development of business models that respond to two main objectives:

- Extending the product use stage through repair and maintenance to help maximize their utilisation level.
- Decelerating the value depletion phase by integrating strategies after the product use stage (like reuse, remanufacture, recycle) in order to get the maximum value out of products.

Value hill framework: Introduction to added value creation with the circular economy

Source: Circle Economy, 2016

Circular business models are now embraced by major industry players

As a result of all the endogenous and exogenous factors, the risk of not adopting circular business models is too high, with various level of impacts depending on the industry. The circular economy is no longer a matter for start-ups only, which is why some big names in the industry are leading the change by deploying new business models with the aim to decouple the economic growth from production and resource use.

Circular procurement aims to produce sustainable products that limit the impact from resource extraction and reduce waste production, hence making the right purchase decision is the bedrock of the circular transformation. It can be the driver for balanced consumption, the sourcing of the right suppliers, and shared value creation. Indeed, a company's commitment to circular procurement can be a source of added value at several levels: valued long-term relationships with your supplier panel will enable improved quality, collaborative development, risk management, efficiency and innovation.

E.g., Illycaffè is working with agronomists and suppliers to develop a regenerative productive model in Guatemala and Ethiopia that sequesters carbon from the air and regenerates the soil with organic matter, making it more fertile and boosting its natural defences[28].

Sharing / Product-as-a-Service: Over the past few years, product ownership has been replaced by services relying on accessibility to product usage. In a sharing business model, organizations keep ownership of their product and are responsible for their availability, maintenance, and end-of-life. This trend towards servitization has flourished thanks to the commoditization of connected products and platforms.

E.g., Michelin decided to no longer sells tyres, but instead takes charge of the lifecycle of its products by renting and guaranteeing them for a give mileage instead. The concept is to integrate a pressure-monitoring system into the tyres to facilitate and anticipate maintenance. Customers thus only pay for what they use[29].

Bouygues wants to develop modular buildings as "material bank", with potentially shareable spaces to increase the intensity of use and a design that allows for self-production and consumption of renewable physical flows. This is a revolution.

Reuse / Resell: Product reusability is the innovation that makes it possible to create life alternatives for products and/or their components by identifying other types of use. It is about optimizing product value on the second-hand market or a different marketplace once the product can no longer be upgraded (i.e., when the cost of repair is more than the cost of resale). This business model option brings significant added value with no major effort on the product before entering its second life cycle.

E.g., Vestiaire Collective is a marketplace/platform enabling individuals to buy and sell second-hand fashion items in order to increase garment reutilization (over3 million items are listed on the platform today). Average saving per piece of clothing: 1kg waste, 3,040L of water, 22kg CO2[31].

Repair/ Refurbish: Repair refers to the operation by which a defective good or component is returned back to its original state of performance. It can be a step in the refurbishment process, which is more complete. It can include cleaning, replacement of consumables, software and specific parts reset or upgrades, cosmetic improvements, new packaging, etc., but the final value proposition is similar: bringing a product back to the market. Providing repair services is a great opportunity for extending the product life at a lower price. This is especially interesting given that 70% of consumers are keen to maintain and repair products to increase their use lifetime, while 54% would like to repurpose and reuse old products[32]. Similarly, it helps create additional touchpoints with the end-user that increase the intimacy of the relationship over time, for greater customer loyalty. Repair services are particularly efficient for technical products comprising electronics or mixed materials that are difficult to recycle.

E.g., Through their Worn Wear service, Patagonia encourages its customers to bring in their damaged Patagonia clothes for repair, and also offers customers a trade-in option. The old clothes are then cleaned ready for second-hand sales or may be upcycled to make new garments[33].

FNAC/Darty has set up of a subscription model where the company undertakes free repairing of household appliances. To do so, Darty has created its own reparability index for each of the items they sell. Support is provided at no extra charge for as long as the manufacturers guarantee the availability of spare parts[34].

Repurpose/Remanufacture: Remanufacturing can be located between second life and recycling. While recycling tends to break down the product entirely to repurpose its parts as raw materials, remanufacturing processes involve dismantling the product, or upgrading it, or sending its components elsewhere in the value chain. Remanufacturing results in products in the same state of performance as new ones and comes with a warranty that is equivalent or better than the original one. The use of remanufacturing loops means there is no need to extract new resources and reduces CO2 emissions from mining and manufacturing activities. Similarly, repurposing implies the partial or total disassembly of goods for repurposing a part of it in a new role. For example, batteries can be partially dismantled to reuse their viable cells within a new storage solution, combining cells and parts from several batteries at the end of their life.

E.g., ,Through the capabilities of its circular economy factory called Re-FACTORY, Renault extends vehicle and component (such as gear boxes and turbo compressors) life by offering advanced remanufacturing services[35].

Recycle: At the product end-of-life, the ultimate objective is to minimize waste from residual components and materials. Applicable to many types of goods from a large range of sectors, waste valorization focuses on the transformation of waste, by-products or leftovers into a new valuable resource. However, the construction of recycling chains can be complex or even unprofitable, depending on the inherent characteristics of the product and material types it has to deal with. In general, a recycling process comprises three steps:

- Collection: products, components, and materials are retrieved from customers.
- Sorting: materials are categorized by type to optimize recycling rate.
- Processing: materials are regenerated to their initial form as raw materials, ready to be used to create new products[36].

E.g., With its start-up WETURN, LVMH Group aims to recycle its unsold, logo-protected fashion items, fabric rolls and other scraps. WETURN is working with five fashion houses to help them reuse these recycled materials in new products.

As more and more players are considering the adoption of these business models, there is less and less doubt about the interest in investing in them (see detailed benchmark in appendix). However, achieving optimized performance outcomes implies a more profound change in the ways of working, where new norms must be shared among stakeholders. In the current context, two questions remain to be addressed:

- Is the pace of transformation fast enough?
- To what extent are circular solutions viable based on their economic value, environmental benefits, and timescale?

“We need to resynchronise the industry and the economy with planetary boundaries”

– FABRICE BONNIFET, *SUSTAINABLE DEVELOPMENT & QUALITY, SECURITY, ENVIRONMENT DIRECTOR AT BOUYGUES GROUP*

What transition should organisations make to minimise their carbon footprint?

Investing in an economy where one person’s waste becomes another person’s resource is essential to reduce pressure on raw materials, but relying solely on this will encourage organisations to remain in a *‘volume’* economy. Above all, what is needed to reduce the carbon footprint is to encourage the sobriety of use and product reuse so that recycling takes place as late as possible in the lifecycle of products.

The service economy, which aims to intensify the use of products through reuse, offers a multitude of opportunities that benefit both companies and their customers. Through this model, manufacturers are responsible for the products they put on the market from upstream to downstream. *“In tomorrow’s economy, consumers will be able to enjoy everything, without necessarily owning everything.”* While this process may seem counter-intuitive to manufacturers, lowering product production volumes (and therefore related materials) through the sale of a usage service is our best ally in achieving our Net Zero targets, while maintaining a positive cash flow for the company as well as a material comfort for customers. *“At Bouygues, we use suppliers who have offered for a long time this kind of common-sense model that is under-deployed.”*

In order to achieve this, sustainable product design is the prerequisite for the circular economy. The key is to find ways to design products without programmed obsolescence. *“Products that last longer with more users per product must become the norm.”*

Fabrice Bonnifet
Sustainable Development & Quality, Security, Environment Director at Bouygues Group

Continuous improvement methods combined with technology will make it possible to put efficiency at the service of sobriety if and only if we agree to “cap” (setting a maximum limit not to be exceeded) the consumption of resources and energy that take planetary boundaries into account. Energy efficiency without setting a limit leads to rebound effects, and claiming the opposite is a mathematical nonsense.

What are the challenges to overcome?

Although most companies are aligned with the need to move towards more service-oriented models, their current business model is still, unfortunately, inherently dependent on a sales volume approach that needs to augment constantly. And using more and more raw materials with resources that are in finite supply is a strategic incompetence and environmental irresponsibility! But tomorrow, if companies have to finance their resources without selling their products but by choosing to rent them, the revenues will not be able to cover the cost of raw material sourcing from the very first rentals. Hence the need to involve financial partners to balance the treasury flows for the companies that will switch to the service economy.

"Circular economy must be an area of innovation and creativity. Fashion is not only about the newest collection anymore, but more about the creative universe of the House and its ability to offer something new, converging with consumers' values."

– MARIE-CLAIRE DAVEU, *CHIEF SUSTAINABILITY AND INSTITUTIONAL AFFAIRS OFFICER AT KERING*

What are the main drivers encouraging luxury brands to adopt circular economy?

The main driver for innovation in the luxury sector has proven to be the requirement of artisanship and excellence combined with modernity to build long lasting client relationships. *"The trust of customers is a key ingredient for any kind of success. They need to be convinced by the quality of the product, whether the material is new or recycled. And because the greater public is conscious of the environmental emergency we face as a society, clients will be asking for more and more sustainability and traceability in their products. This will encourage all fashion players to change their practices for the better."*

Marie-Claire Daveu
Chief Sustainability and Institutional Affairs Officer at Kering

This is achieved by maintaining high standards in product quality, desirability, and experience, as well as adopting sustainability best practices across luxury's ecosystem.

This is particularly challenging as the frameworks – and the very foundation - of luxury and fashion have to be rebuilt in order to adapt to both the industry's responsibility in the world today, as well as consumers' emerging expectations in terms of sustainability.
These new expectations can be addressed by placing creativity and innovation at the heart of a brand's product strategy. This is one of the main drivers of change and why several of Kering's Houses have already launched collections made from recycled materials, receiving tremendous success.
To best respond to the challenge of scaling circularity, Kering has embraced a holistic approach across its value chain. For instance, the Group has committed to transitioning 1 million hectares of land producing raw materials in luxury and fashion's supply chains to regenerative practices under its 'Regenerative Fund for Nature' with Conservation International.
As other examples, the Group is working to upcycle leftover materials from manufacturing, as well as reducing plastic in packaging, looking for substitutes that are more sustainable. To deploy more scalable solutions, further investments in circularity need to be made in processes and products.

What tactics luxury brands should apply to accelerate their journey?

Adopting and accelerating a circular economy approach for luxury is about innovation and creativity – to not only limit the use of new raw materials and resources, but to continue offering beauty and uniqueness to customers.
Kering's Chairman and CEO, François-Henri Pinault, believes that collective action and sharing sustainable innovations should be the status quo across the industry. Kering has supported this philosophy for many years now; open sourcing its breakthrough solutions and technologies in order to help create systemic change within the industry.

Kering has also established numerous stakeholder partnerships to explore circularity and innovate for the benefit of the industry. Mandated by French President Emmanuel Macron, François-Henri Pinault launched the Fashion Pact in 2019 to bring fashion players together to focus on key challenges, whereby membership currently equals over 30% of the industry.
Kering also promotes a holistic vision of circularity defined by the Ellen MacArthur Foundation, from recycling and reusing materials, to extending the life of Kering's Houses products. To support these efforts, Kering has invested in innovative platforms such as Vestiaire Collective to champion the resale model and partners with start-ups like Worn Again for closed loop recycling technologies.

Luxury companies need to be an example for the entire fashion industry, playing a leading role in innovating and investing for the future of the circular economy. Furthermore, commitment and action must be authentic, and not only because regulation demands it: *"It is not regulation alone that pushes the boundaries of our industry, but rather a set of factors such as the demand from consumers and from society at large. It is also thanks to the creativity of the designers in the luxury sector, who are the real trendsetters, that this becomes possible in practice. The circular economy must go beyond sustainability criteria, and also be an area of exploration where creativity and innovation are nurtured."*

“Based on the principle that a certain number of products are repairable, it becomes possible to recover them. It is a combination that allows both to reduce the carbon footprint and to gain control over the supply of resources.”

– LAURENT BATAILLE, *CEO AT SCHNEIDER ELECTRIC FRANCE*

– HÉLÈNE MACELA-GOUIN, VICE-PRESIDENT STRATEGY AT SCHNEIDER ELECTRIC FRANCE

What were the triggers to commence your circular journey?

Schneider Electric has an historical positioning on sustainability, so the question of managing CO2 footprint came early in the company strategy.

Second trigger was the issue of resources accessibility. In terms of costs, of scarcity, of complexity, we will face a growing difficulty to find the right resources for classic products. *“The Circular economy is first and foremost an economic issue that needs to be treated like any other business ones. With regulation enforcement and growing challenges in raw material supply, it becomes paramount to optimize value without impacting the quality of the provided products and services by leveraging circular models.”*

In addition, the demand for recyclability is exploding, and the products complexity makes it currently almost impossible to achieve decent recycling levels. It was thus essential, for economic and sovereignty matters, to start searching for alternative materials and ways of production, as well as new services. The shortage situation is an opportunity to envision the delta on the price between first and secondhand products. We will see more and more client calls for tender with requirements of refurbished products.

That’s why, Schneider Electric started to offer repair services with the ambition to implement the change globally, from the revision of contracts with suppliers to add maintenance to the sensibilization of consumers. This holistic vision of circular transformation is intrinsically linked to the conception of value which now lies in the usage of the product. The main axis is thus to work on the reuse part of the circular model, privileging the small loop. *“We also stay humble and acknowledge that we are just at the very beginning of a long journey on the circular economy.”*– Hélène Macela-Gouin

Laurent Bataille
CEO at Schneider Electric France

Hélène Macela-Gouin
Vice-President Strategy
at Schneider Electric France

How is it implemented in practice?

This is a real business transformation as the company's initial business model is to make new products. This will require important shifts and time to install new business models.

The first challenge to overcome is operational: recovering the products. A profound change needs to be initiated in upstream processes, to transform the relationship with suppliers in order to implement new traceability mechanisms. The same dynamic must be applied to factories, for repair operations, when it is economically viable. The second challenge to address is the product design. We must shift to a design that allows reparability, while guaranteeing the same quality standards. A change is necessary firstly to extend the life of the product and then to anticipate its second life (through reuse and dismantling), generating new standardization issues. Developing repair capabilities is the most suitable option for Schneider Electric due to the large product range but also their inherent complexity that usually contain a lot of electronics. *"For many products, there is a proliferation of design typologies that are not always intended for repair. This legacy represents a problem requiring a more standardized design. The key is to ensure circular continuity, moving from design for manufacturability, to design for serviceability, and now design for reparability."*

How do you monitor progress in your journey?

Being able to measure and track progress is a major stake in order to value circular economy as a true differentiating asset. There is a need to establish a new set of KPIs to measure the success of circular economy initiatives, such as a percentage of integration of recycled materials. Schneider Electric has also created its own label for circular products to offset the lack of standards to certify that products are repaired, reused, recycled following Schneider's quality standards.

Another key stake is to build new relationships with its partners ecosystem (clients, retailers, suppliers) based on transparency and trust, requiring a shift in the way business functions are governed across the enterprise. *"Circular transformation cannot be coordinated by a single business unit because there are too many links to be managed between product design, operations, and repairing services that rely on different and specialized skill requirements."*

Our convictions to accelerate transformation

The growing level of uncertainty in the business environment described in the first section is driving the need to identify alternatives to ensure industrial continuity. To tackle the challenge of resource scarcity, today's circular economy pioneers are armed to become tomorrow's leaders. Starting the journey is no easy task, but activating the following five acceleration pathways will set organisations on the road to achieving a circularity framework at scale.

Reserve depletion in the next decades at current growth rate

Source: **USCS (2011 data), Barclays Research.**

1- Business resilience in a finite world relies on a long-term strategy

The fact that the rules of the game are different forces companies to rethink the way they play. Performance will be a matter of resilience in order to meet the planetary boundaries in terms of natural resources, entailing a different approach regarding business strategy. It is time to embrace the return of long-term strategic planning to weather the turmoil ahead.

Economy of scarcity: With the difficulties in raw materials procurement, advanced countries are inevitably forced to reconsider the way they envision the economy in an era of resource scarcity. Today, only a few elements have recycling rates above 50%, with an even smaller number can be recycled at 75%[37]. Equally, more than thirty elements cannot be recycled or only recyclable to a very limited extent. This means that a large range of materials are used in products and immediately thrown away with no solution for recovering them. At the same time, as we live in a finite world, it is crucial for organizations to anticipate the potential depletion and extinction of specific raw materials in a not-too-distant future. According to a study from USGS[38], current growth and the consumption rate will lead to the depletion of most elements used in the current high-tech equipment – mainly metals – within the next 30 years. Failing to establish a prospective strategy, notably through R&D investment for alternative materials and processes to mitigate such risks, could have severe operational consequences. This economy of scarcity will trigger the shift from a Business of Volume to a Business of Value.

New performance measures: Steering the transformation to deliver the long-term strategy requires changes to how financial models and governance are structured. The definition of new KPIs is key to measuring the success of circular initiatives, building new relations with investors and shareholders, and valuing long-term investments alongside long-term ROI. *According to Jules Coignard Co-founder of Circul'R (a start-up connecting companies to develop circular economy solutions), "the notion of financial success for executives in large organizations needs to be redefined with KPIs that fit circularity requirements. Traditionally, ROIs and dividends are calculated in the short term (quarterly) whereas circular models' results are generally achieved in a longer-term."*

That's why, many companies like Carrefour or Holcim have indicators at group level on which variable remunerations are indexed, from the CEO down to operational managers.

"Today 60% of the infrastructures that the population will need in 30 years do not yet exist, it will be necessary to build the equivalent of one New York City per month to face the acceleration of urbanization. The concrete market is going to boom, so we can't continue to operate as we are currently doing."

– MAGALI ANDERSON, *CHIEF SUSTAINABILITY AND INNOVATION OFFICER AT HOLCIM*

What makes circular economy a strategic topic to address at Holcim?

At Holcim, circular economy is not only a key to tackle environmental matters, but a strategic axis anchored in the core of the company's business. We have started our transformation some time ago, with a strong strategic emphasis on circular economy due to resource and environmental critical matters. From a business environment perspective, global population is expected to keep growing, which will ultimately lead to additional construction needs and therefore cement. Being aware that the total build environment is responsible for 37% of the global CO_2 emissions (1/3 of it is related to the construction phase and the remaining 2/3 to the use phase), we have the responsibility as one of the main providers to rethink the way we produce in order to decrease the sector's environmental footprint.

In 2020, we valorized 54 million of tonnes of waste from various sources to generate cement that is fit for construction work. Our ambition is to reach the 100 million of tonnes landmark by 2030 to continue to reduce our dependency against virgin resources. Therefore, beyond Construction & Demolition Waste (CDW), Holcim has been looking for decades to develop new capabilities in municipal waste

Magali Anderson
Chief Sustainability and Innovation Officer at Holcim

collection where the regulation permits it. Leveraging what urban mines in developed economies can provide is the key to accelerate this transition to use waste as the main resource.

We also put product at the core of our strategy to increase our circularity and the use of recycle content, while making sure that recycled materials offer the same performance as new ones.

How is your circular economy strategy implemented in practice?

Circular economy is integrated in the corporate strategy with a long-term view. In the implementation process, the overall value chain is recalibrated thanks to processes that integrate recovered waste from the design phase and that encourage the use of recycled water and waste as a source of energy.

Holcim is working on the set-up of entirely new ecosystems as local as possible to recover waste while minimizing their traffic. *"We have the technology, the problem is the access to the resource in terms of supply chain, the idea is not to go looking for waste located 2000km away. We've also been continuously creating plants with co-processing solutions so that waste is used at the expense of fossil fuels which allows us not only to reduce our CO2 emissions by 30%, but also our exposure against energy inflation cost."*

Regarding product innovation, 80% of R&D investments are dedicated to Sustainability which for instance helps to develop construction materials with greater recyclability that keep the same level of quality and mechanical properties. This enabled Holcim offer a new product line of low carbon cements integrating as much recycled waste as possible. *"One of the main problems is that innovation is moving faster than the evolution of standards. We find ourselves held back by regulation and standards in the development of innovative products with a positive ecological impact, such as the re-use of construction demolition waste in cement which is only allowed on the Swiss market."*

To ensure circularity objectives are achieved, Holcim has diffused a sustainability and innovation culture across the enterprises with dedicated governance and KPIs to incentivize decision-makers and monitor progress. *"Since the announcement of our new 2025 strategy in November last year, we have as many sustainable indicators as financial ones. A third of our executives' variable salary depends on long-term performance measures that are linked to sustainability with 25% of it is focused on water, 50% on CO2 emission and 25% on circular economy."*

2- Product design is the cornerstone of the circular strategy

The eco-design phase is crucial in implementing a circular economy strategy at scale, through the design of more environmentally friendly products. It aims to maximize environmental, social, and economic benefits over a system's lifecycle while minimizing associated social and environmental costs. This is the most important step, as design drives up to 80% of a product's environmental impact over its lifecycle[39]. It is the starting point in enabling the circular transformation for scalable outcomes. According to our study, 66% of consumers expect organizations to ensure that the products designed to be durable, reusable, repairable, and recyclable are also affordable[40]. Effective sustainable design addresses future business risks, fosters innovative solutions, and appeals to today's evolving consumer demand. It also increases differentiation from competitors and the development of new opportunities for long-term success.

Products must respect sobriety frameworks to extend value through multiple lives

Designers need to apply a set of guidelines and principles aligned with the sustainability objectives and requirements while ensuring that products respect the legal, operational and consumer expectations. This means having greater control over resources, the usability and the recoverability of the final product. Moving from design theory to practice implies bringing together stakeholders with various expertise (digital experts, date scientists, engineers, recyclers, etc.) from upstream and downstream, but also integrating product design with conception methods and manufacturing processes.

Sobriety: Designing products with resources that consume less energy and water and generate less waste during manufacturing, logistics and use. Research must accelerate to provide rapid access to safe and environmentally friendly materials (bio-based, recycled and especially recyclable) that will encourage businesses to move away from the use of hazardous components like plastics. Similarly, legislation is pushing organizations to integrate a fair percentage of secondary resources as part of their products composition to reduce the impact on raw materials. SEB, for instance, has invested in eco-design pots and pans, which are 100% made from recycled aluminium. They measured that this reduces the carbon impact at the end of the production line by 60%[41].

Dematerialization: Dematerializing infrastructures, products and components by finding processes that reduce the size, weight and variety of materials. Additive manufacturing provides a great opportunity to build lighter components with lighter materials or even to produce tailored spare parts to encourage repairing practices.

Modularity is essential to ensure life extension and end-of-life management of products since it facilitates disassembly and reassembly processes. Using parts that fit multiple products will even improve product reusability.

Durability is all about designing products whose performance is assessed primarily in terms of their resilience. Developing long-lasting products is a major challenge for designers that want to extend the "first life" of products as long as possible physically, functionally and aesthetically, to limit the replacement rate.

Recoverability: Depending on the characteristics of their products, companies may decide to develop a product strategy that applies recoverability levers favouring an extension of product lifespan (e.g., for complex products like electronics, vehicles, buildings) and/or its recyclability (e.g., for perishable and widespread products like food or cosmetics). With "reuse", the objective is to design solutions that can activate all the recovery mechanisms offered by the circular economy, such as repairing, refurbishing, remanufacturing, or retrofitting. Although the benefits vary per product, component or material, reused products are estimated to save 80-95% of resources for the first extension of life compared to a new product (the number of life cycles can vary from two to nine lives)[42]. *That is why IKEA has developed a tool to assess the circularity level of their +9500 products, so that they can be reused, repaired, disassembled and recycled instead of ending up in landfills[43]. As a next step, they are now proposing a new business model to rent furniture[44].*

Recyclability: Encouraging mono-material options and lowering the number of components and materials helps mitigate the level of dependency on suppliers and makes recycling technically, economically and environmentally feasible. Such practices can massively facilitate the recycling process by accelerating sorting processes and applying recycling solutions that are faster, less energy- and cost-intensive, and more efficient so that the quality of the recycled output is increased.

Connected products to deliver superior value

The deployment of digital and physical technologies has enabled the massification of smart products that can create but also collect, process and transfer data. Digitization helps strengthen the value of a company's asset portfolio by offering not just products, but *'products + services'*. Leveraging connectivity and the power of data, smart products and systems helps harness the full potential of servitization to deliver superior value.

Enhanced customer experience: While hardware defines the original customer experience in terms of design and feel, continuous software development creates more features over time and continuously improves the product's performance, extending the

customer experience and being sure to match consumer expectations over time. In recent years, the automotive sector has undergone a profound change driven by digital transformation to improve the global driving experience. The shift of preferences, from mechanical capabilities to driving experience, has led manufacturers to adapt their business models, putting the sentimental connection with customers at the centre of their value proposition. A wide range of recent car features are designed, implemented and updated by software applications. Similar to smartphones, embedded software in cars, combined with data, enable OEMs to continuously improve their customers' ride experience, and to respond to current market needs. *As an example, in 2019 Volkswagen announced its goal to boost their competences in innovative software development, automated driving and user experience by 2025[45]. Also, its new car software unit, labelled CARIAD, focuses on in-house software development expertise, with the ambitious target of achieving a single standard operating system offering all the basic functions in all their vehicles[46].*

Predictive maintenance: Embedded solutions (like AI/machine learning, IoT, TinyML), compounded by the generalization by Cloud and connectivity infrastructures, support the collection, analysis and transfer of large volumes of data in real-time. Intelligence leveraging sensors helps to assess product and infrastructure health and detect breakdowns in real time. Ultimately, integrating preventive maintenance capabilities into product design is a key factor in extending the life of products.

Update and upgrade: With the pressing consumer demand for mass customization, many products are evolving on the lines of the smartphone. This means that the hardware doesn't change much, but the software can be updated several times, not only augmenting the product's capability over time, but more importantly boosting the product's appeal at the same time and thus extending the customer experience as systems evolve.

Accelerated dematerialization: Digital technology has enabled the dematerialization of a large number of processes over the last few decades, leading to a reduction in the carbon and material footprint of companies (e.g., via paperless business processes). In the same vein, companies delivering services can step up their environmental efficiency by separating services from their physical media (e.g., credit card digitization, digital music platforms). This approach, although opportunistic, is in line with circularity and the urgent need to shift towards a low-carbon world, and serves as a catalyst for digital transformations of a similar kind.

Continuous product enhancement: Access to data in the use phase leveraging connected products presents a unique opportunity to foster innovation and new business models. For instance, detecting patterns of product use or of defection using Product Lifecycle Management (PLM) tools can drive continuous product improvement based on real-world information that the design team can integrate into the process and its virtualization tools.

Traceability and digital continuity: As circular products are designed to last longer and to be reused and recycled over time, leveraging traceability capabilities (such as RFID, IoT, tinyML, Blockchain) is key to operationalizing circular business models by preserving all the necessary information throughout the lifecycle. Deploying reliable digital continuity for products is a prerequisite for delivering end-to-end business value, as it enables to scaling up of collection processes for closed-loop supply chains, improve performance tracking (that can also help address scope 3 emission targets), improve customer services, or even help predict future consumer demand. However, in practice around 60% of manufacturers are struggling to ensure "digital continuity" throughout product lifecycles[47]. This explains why the European Commission plans to introduce a "digital product passport" to boost the circular economy as part of its new Circular Economy Action Plan. The sectors in which this will be applied initially are consumer electronics, batteries, ICT, fashion, furniture, but also "high-impact intermediate products" such as steel, cement and chemicals.

3- The most significant untapped value sits between end-of-use and recycling

Making the most of the circular economy means staying at the top of the value hill for as long as possible (cf. Value hill framework in section III.1.1), which delivers the following two benefits:

- Increase in product value and utilization by maximizing lifespan, which also mitigates raw material dependency due to lower production needs.

- Easier exploration of new business models relying on long-lasting client relationships.

For businesses, this implies finding the right processes and mechanisms to avoid product and material depletion between end-of-use and recycling i.e., where most of the untapped values lies compared to the linear model. The real challenge is to develop manufacturing chains that can integrate used products and waste in the same way as it deals with new resources, but also to create operations that cater for product interactions that are decentralized as regards the rest of the value chain (e.g., suppliers, resellers, repairers, or consumers). Considering the investment this requires, it is then essential to identify the recovery strategy that best matches the products' characteristics.

Lay the operational foundations to close the loop

Regional capabilities for operational resilience. The recent succession of logistical tensions has highlighted that the global supply chain as we know it today is no longer the most resilient, predictable or even cost-effective solution to meet the challenge of new circular business models. This means that a collective effort is required to develop regional alternatives that can balance production and supply chain capabilities with new consumption patterns. This transition will be a long and expensive journey but is vital in ensuring business agility and resilience in an economy that will continue to be disrupted and increasingly deprived of resources. Governments and multinationals have launched reindustrialization schemes that aim not only to secure material sourcing but, more importantly, to build the capabilities for activating the reuse and recycle loops. In the automotive sector, for instance, some firms already cluster major production segments in a handful of sites within key trade blocs and then export certain intermediate materials and finished goods to markets in other blocs, based on the actual demand, in order to mitigate risks. The biggest question is to understand where and how reuse, remanufacturing and recycling should take place.

Technology and data enablement. For as long as industry has existed, it has constantly sought to improve efficiency and performance in order to produce more and faster. Technologies have now reached the level of maturity, accessibility and interoperability required to support the various sectors and industries in their large-scale digitization in support of circularity. Digital technology can link the various components of the linear value chain to transform them into a circular one. Across the entire system, the supply chain is the stage with the highest potential as it currently concentrates more than 95% of a product's carbon emission impact[48]. In a tech-enabled environment, those who harness the potential of data gain a significant competitive edge. For instance, leveraging technologies to transform manufacturing operations has already reduced waste by 15% over the past two years[49], and data leaders achieve 22% more profitability than the average in their sector[50]. Although technology is not a miracle solution for tackling climate change, it is one of our best allies for accelerating the transition to a more sustainable world. By leveraging digital technologies, the aim is to reduce overproduction, production scrap, production lapse time (and therefore energy consumption), and recover used products wherever applicable. In a nutshell, it is all about establishing Industry 4.0 to serve the circular economy.

Supply chain optimization: The technology mix of cloud, IoT, 5G and AI/ML plays an integral role in adding intelligence to supply chain facilities to help solve highly complex optimization problems in real time, or even before they occur, via predictive maintenance. This is done with the help of sophisticated algorithms and sensor technologies.

Advanced supply chain data analytics: Machine learning, graph networks, and HPC are key enablers for advanced data analytics in the supply chain, leveraging internal data in conjunction with external macroeconomic data or other data sources. This helps provide an end-to-end view of the supply chain, supplier performance monitoring, real-time demand and forecasting, scenario simulation, automated incident monitoring and solutioning.

Factory automation with robotics: Robotics leverage factory automation by engineering repeated manual processes at greater accuracy and speed than humans. In terms of energy-efficient production, error and waste can be reduced with improved automated quality assurance. Today, 73% of manufacturers use automation as the centrepiece of their sustainability operations and other data-driven solutions are yet to be exploited.

Virtualization and modelling with digital twins: The next-gen supply chains are powered by digital twins that create a virtual replica of physical products, systems, or processes. The digital version can be used to monitor, control, and optimize all aspects of its physical twin. Digital twins of factories that are part of the same supply chain can be connected to lead and optimize operations at a system level.

Product collection as a preliminary step. Capturing products before they are discarded is critical in enabling organizations to close the loops and thus create added value in the circular economy. When products are widely distributed, the collection process is particularly challenging. This requires building closer client relationships to understand how, when and where products are used but also implies making the collection process as convenient as possible for the end-user by different means:

- Combine traceability and Product Lifecycle Management (PLM) tools integrated during the design phase to track the interactions of products as they are used. More specifically, blockchain provides total data visibility and a single source of truth that facilitates the secure sharing of data on products from origin to end-of-life. Also, connectivity, cloud and sensor-based technologies (5G/IoT/Edge Computing) enable the creation, collection and analysis of information in real time through sensors. These connected objects and infrastructures allow for the deployment of tracking systems to optimize asset management, material flows, and product use and, more importantly, product collection.

  E.g., Stellantis is working to enhance their referencing, traceability, and accessibility of returned spare parts to renovate vehicles. This initiative has so far enabled savings of up to 80% of new raw materials and reduced energy consumption by 50% when producing refurbished engines.

- Due to the geographical distribution of used products, local networks and ecosystems embracing all stakeholders in the value chain are being created (including manufacturers, retailers, suppliers, repairers, etc.). This paves the way for an operational approach to the collection and sorting of goods with the potential for reintroduction into the economy. Whether companies want to insource or outsource this process depends on whether it represents a strategic opportunity they can implement.

Minimize waste throughout the lifecycle

Scrap reuse/co-product. Although scrap reduction has always been a key objective for manufacturers, it represents a valuable substitution resource that suppliers can leverage. Scrap generated during the production process is relatively pure with properties equal to virgin raw materials or almost. Deploying the right technology stack can facilitate its collection and its refining (such as shredding or melting) if required in order to re-insert it into the earlier stages of the process.

Defective product reworking. The aim here is to create a loop by linking design–production–logistics together so that defective products can be easily reworked during the manufacturing process. This means setting up checkpoints in the chain to allow the diagnosis, dismantling and reconditioning of a product at any point in the assembly process. In this way, defective products are reused in the production chain by repairing them through reverse engineering. In the event of a manufacturing defect, the use of digital twins, for instance, would make it possible to identify the remediation process required to optimize reuse at the lowest possible cost and in the shortest time possible. From the product design stage onwards, it is therefore essential to think not only about assembly processes, but also about disassembly processes.

Mechanical recycling enhancement. When products attain this part of their lifecycle, it means that all the other recovery strategies that may have been applied before are ineffective or not viable. The amount of products and processed materials available in our environment turn waste streams into what we call an "urban mine". However, recycling activities remain highly technical, with a range of associated dynamics that mean they are not always profitable nor environmentally friendly, depending on the type of materials to treat.

This is why further investments are required to increase the efficiency of waste management facilities that are the final solution to avoid landfilling. Basically, this means working on:

- Collection systems that assemble larger volumes of waste to make recycling profitable (more details in the section III.2.4).

- Sorting capabilities that leverage technologies to enhance dismantling and separation of materials that are not compatible in the same recycling process. Optimized sorting helps recuperate larger volumes of waste and increases the overall quality of the recycled material at the end of the chain. Having products where the mix of materials is easily separable is key to the recycling outcome. Technologies such as robotics can help to perform more extensive collection and sorting operations (e.g., using laser, computer vision, etc.).

- Processing treatments to deliver recycled materials of a higher quality and redistribute them to manufacturers for reinsertion into the economy. It is the role of regulators to ensure demand for recycled materials meets the supplied volume by imposing a minimum percentage of recycled materials in product design per product type.

E.g. Stellantis is developing a production process that takes easy dismantling and recycling into consideration by limiting the diversity of materials to avoid the loss of quality associated with mixed compositions.

Enable reverse logistics to make products reusable

Reverse logistics are the operations that move goods from customers back to the sellers or manufacturers for the purpose of securing added value from products and materials that are available on the market. This covers activities such as collection and transport for returns, repairs, refurbishment, recycling, reuse or remanufacturing. In practice, reverse logistics is very challenging for multiple reasons such as the unsteady supply of returned goods, the uneven quality level of the returned goods, and the recovery action plan that is difficult to standardize across the range. Items that are too deteriorated and do not meet economic criteria are sent for recycling. As such, organizations need to work on the business model to ensure that reverse logistics, which is a capital-intensive concept, is tailored by product category and depending on their deterioration level. From the interviews conducted for this report, business leaders indicated that this transformation is incremental, starting with the development of expertise in chosen products,

Definition of two main traditional recycling methods: upcycling and downcycling

Recycling methods	Closed-loop recycling (i.e., upcycling)	Open-loop recycling (i.e., downcycling)
Definition	• Product can be recycled back into its original material state	• Product will be recycled into other types of products
Example	• *Recycled aluminium from a beverage can is used to produce another beverage can*	• *Recycled plastic from bottles is used for another product with degraded functions*

materials and/or processes. In short, to operate closed-loop supply chains, manufacturers do not need to be good at everything but need to master a few critical points first of all.

Global supply chains are perceived as too sophisticated and not sufficiently agile to run reverse logistics (updating processes in global supply chains can take from 6 months to 2 years). This explains why industry players tend to invest in dedicated regional facilities in strategic areas that are smaller in size and where recovery activities can be performed. There, technologies can be applied to develop digital lean remanufacturing facilities that can perform recovery activities at speed and scale. *For instance, Apple has developed fully automated disassembly lines equipped with robots with 29 arms able to dismantle a discarded iPhone in 11 seconds and separate its components into reusable materials (results: 61 million pounds of reusable materials captured for a value of $40 million)*[51]. Likewise, digital twins can model returned products to optimize dismantling and thus increase the efficiency of the recovery processes in the circular economy. Finally, once recovered, product passports relying on blockchain can be updated with the last information on the reconditioned product (for guarantee, contracting and resale). Ultimately, developing a broad set of standards from the design phase of certain products will provide a reference framework for developing effective processes in the after-use phase of the lifecycle.

In practice, the applicability of reverse logistics differs widely depending on the sector, the product type and the customer segment. The feasibility of recovery depends on the product condition, the expertise needed, and the repairability of the product (covered in the design phase against market indexes), which often require manual support. Organizations are therefore developing networks of repairers, reconditioners and remanufacturers either in-house or via external partners to ensure time and quality standards are met. Kering, for instance, trains local handcrafters, designers, and product & material specialists in regions with high client concentration (like in China and in the US) to guarantee the same level of quality, excellence, and experience to their clients when repairing/remanufacturing luxury goods while limiting the emissions generated by transport.

4- Beyond extended enterprise: an ecosystemic transformation

Since 65% of consumers expect organizations to be accountable for products even after they have been taken back (i.e., ensure that they are handled responsibly and do not end up in landfills), the question is not "why" but rather "when" organizations will adopt circular models[52]. However, there is no single organization that owns the capacities and a sufficient volume of goods within any industry to deliver this transition alone. The role and responsibility of businesses will therefore evolve to address the concerns of their key stakeholders, their consumers, and society as a whole. This means that they need to create new ecosystems that foster innovative environments, develop industry standards in line with circular principles, and work collectively on the definition and establishment of applicable regulatory frameworks. This will require the integration of the actors from both horizontal and vertical value chains to create meaningful ecosystems to ensure industrial durability, and in some cases, new industries will be created from scratch following the same principles *(e.g., for electric vehicle batteries).*

Extended Producer Responsibility, the adoption of a new corporate purpose

Corporations must rethink their strategy and their legacy value chains to unleash the true potential of the circular economy. This entails an evolution of their overall role and responsibility as well as partners engaged in their ecosystem to achieve their vision about circularity and sustainability. Policies on waste management and circular initiatives have received particular attention in the last few decades to reduce waste and pollution (cf. section II.2), and this has led to the creation of a new approach called Extended Producer Responsibility (EPR). This is a mandatory step towards generating traction on this topic, with measurable tools that can be deployed within and between sectors.

"The circular economy must include the entire value chain. Manufacturers need to eco-design their products to enable easy repair and reuse and, in a second step, ensure easy selective collection, sorting and recycling. The circular economy calls for new economic models to remunerate the use or life span rather than the volume of products. French regulation with the extended producer responsibility model, European Green taxonomy and the upcoming European regulation on eco-design might be key steps for the circular economy including all lifecycle of products."

Anne-Valérie Goulard, VP Sustainable Development for SUEZ Recycling & Recovery France.

Launched in 1972, EPR is defined as an *"environmental policy approach in which a producer's responsibility for a product is extended to the waste stage of that product's lifecycle*[53]*"*. This legal initiative suggests that companies should bear the costs related to the pollution that their products engender. This preventive financial support is then converted into measurable solutions in order to preserve the environment. For the producer, it also implies including environmental considerations from the design stage to the product's end-of-life, as well as anticipating take-back systems. Indeed, producers can contribute individually to general waste management costs, but also delegate the operations to Producers Responsibility Organisations (PROs) and encourage the creation of new collective flows including collection, transport, sorting and processing of disposed products and materials. *E.g., Citeo, the French EPR player, is financed by companies to take charge of the end-of-life of household packaging and paper, including recycling. The company has developed eco-design, collection, sorting and recycling*

services thanks to the mutualized action of its clients who were behind the creation of these solutions, and in partnership with local authorities as well as sorting and recycling professionals.

The fulfilling of EPR obligations promotes collaboration and the creation of new alliances aiming to improve the circularity of products and achieve cost-effective waste management (see detail below). For instance, organizations and industries have recently been aligning on repairability and recycling indexes to ensure these activities are technically, environmentally and economically viable for producers. Beyond the establishment of new standards, industrial actors are urged to encourage education and training (for employees, consumers, and society) to optimize the operationality of these after-sales activities. EPR systems apply to different types of products (such as packaging, electronics, tyres, batteries, unused medicines, etc.) and have been proven extremely efficient: the collection rates of WEEE and batteries have increased from almost 0 to 53% and 49% respectively over 20 years.

A new partnership and collaboration model is needed to scale up

Closing loops and rethinking the ways of generating both environmental and economic value is pushing industrials to widen their vision and to secure a new position within the business community. The central idea of collaboration is to share the effort and pools of individual competences to develop general standards and new practices that accelerate the cycling of material and energy flows. Partnerships act as an enabler to make better use of resources, as an accelerator for innovation, and as optimisers for supply chains.

Industry coalitions & consortiums: Establishing a common industry-wide approach to address the challenges involved in the transition to a circular economy. This can involve collaborating with direct competitors to propose circular alternatives and foster innovation at scale. According to Violante Avogadro (Global Communication Director at IllyCaffè), *"IllyCaffè works in consortium with other companies in the sector to implement solutions together. For example, we are collaborating with Nespresso and other third parties on a project to improve used capsule recycling."* Also, Christine Leveque (Global Vice President Collection & Recycling at TetraPack) says that *"TetraPak collaborates with other packaging converters and food and beverage companies to collect and recycle the carton packages produced. This is beneficial for everyone, as consumers cannot differentiate products from one company vs another, when choosing the collection bin in which to throw the empty package."* In addition to alliances on innovation projects, major companies within a dedicated sector can partner to set industry standards to encourage the development and application of sustainable practices by the majority *(such as the Flexible Plastic Fund bringing together five consumer goods brands, the Fashion Pact in the textile and beauty industries, the Sustainable Apparel Coalition in the apparel industry, or the EcoBeautyScore in the beauty industry).*

Collaborative project development: In the linear model, contract awarding and operations tend to be segmented along the timeline, between clients and suppliers. The circular economy offers the opportunity to design technical requirements hand-in-hand with all stakeholders in the value chain for better incorporation of environmental considerations involving suppliers, brands, retailers and consumers. This leads to the creation of an open innovation ecosystem that can respond to the challenges of the next-gen value chains. For instance, Vinci is partnering with 'La Ressourcerie du BTP' to perform on-site diagnosis of construction plants to identify valuable waste, stock it until there is demand to match the supply of the revalorized construction waste[54].

Institutional project involvement: Similar to the importance of public participation in the governmental decision-making process, the business community has a huge role to play. Participating in national and regional initiatives and decision-making enable organizations to anticipate and steer the future regulations to make sure they are adapted to the industrial reality. They also provide accurate data from their operations to give decision-makers a clear picture, and indirectly operate as a way of accelerating the adoption of circular practices. For instance, the UN Member States endorsed a historic resolution in March 2022 to end plastic pollution and forge an international legally binding agreement by the end of 2024[55]. There, businesses will contribute to the implementation of the roadmap by addressing the full lifecycle of plastics, setting governance and monitoring methods, and establishing partnerships to ease the access to technology, infrastructures and expertise.

Local cross-industry initiatives: As explained in the previous section on the new responsibilities for producers, the circular economy promotes the creation of systems that are beneficial for the largest number of actors in the value chains, including those that are from a different sector (e.g., shared take-back schemes, collection systems, repair facilities, waste revalorization). One of the most popular approaches of this model, called Industrial symbiosis, brings together companies from different sectors located in similar industrial parks in an effort to promote the valorization of waste, improvement of resource efficiency and reduction of environmental impact through the mutualization of operations[56]. The collaborative support that emerges from industrial symbiosis stimulates the development of a circular economy with a closed-loop industry chain. *For example, the Yeji economic development zone achieved incredible results between 2014 and 2017 with a 2.8% increase resource output rate, a 60% increase in the comprehensive utilization rate of industrial solid waste, and a 100% increase in the reuse rate of industrial water.*

Collaboration with start-ups and academics: Generating disruptive innovation and thinking out of the box often requires new skills or external vision. Academics and entrepreneurs are both drivers for effective R&D and offer great adaptability. They also make it possible to explore innovative possibilities while conducting feasibility studies at a reasonable price. Finally, organizations should look at partnering with academics or start-ups to cover value proposition and expertise gaps within their circular value chain. *For example, the French food and beverage brand Danone through its fund–Danone Manifesto Ventures–invests in food technology start-ups like Phenix to combat food waste.*

Data sharing practices are yet to be defined

The extension of the value chain and the increased interaction with partners calls for the deployment of intelligent support and services to connect the players in a new ecosystem. The ultimate objective is to encourage cross-fertilization, traceability and transparency across the range to be able to deliver a richer customer experience and drive new revenue streams for organizations. By leveraging data platforms and systems, transparent communication can be orchestrated between actors in order to:

- Facilitate the integration of market intermediaries.
- Manage the collection, repair and/or resale of products, components, and materials.
- Monitor primary and secondary material supply needs, and adjust supply and demand in real time.
- Anticipate volumes per material to be produced, stored, and redistributed.
- Collect data that can be leveraged for the creation of business cases in order to obtain additional financial support.

5- Innovation as a lever to achieve circularity at speed and scale

In order to secure their business continuity by fully deploying circular models, organizations need to reduce their dependency on scarce resources whilst minimizing waste, pollution, and CO2 emissions. To meet these new expectations and the resulting process requirements to implement circular economy solutions, the entire value chain needs to change. From designing products to include new functionalities to their end-of-life management, it is mandatory to scale up the solutions offered by the circular economy to guarantee an economically viable model. This can be addressed by leveraging;

- Physical (3D printing, Robotics, Nanotechnologies, etc.) and digital (AI/ML, Cloud & Edge, IoT, Blockchain, Digital Twins, etc.) technologies to develop reusability solutions in product design and operations.
- Biological technologies (Synthetic Biology, Bio-Based Materials, Bioenergy, etc.) to create alternative materials and accelerate the standardization of chemical recycling.

Being able to deliver this long-term strategy therefore implies positioning R&D and innovation in such a way as to meet environmental targets while maintaining the business pace. *According to David Brussa, Global Total Quality and Sustainability Director at IllyCaffè, "human factors are enablers for fighting climate change, and innovation is the propeller."*

Accelerating circularity with physical and digital technologies

Product augmentation with the rise of softwarization: As mentioned in the section III.2.2, the deployment of digital and physical technologies has enabled the massification of smart products that offer 'products + services'. With embedded software, they can unleash the power of data, leveraging connectivity to deliver superior value such as an enhanced customer experience, predictive maintenance, updates and upgrades, accelerated dematerialization, continuous product enhancement, or traceability and digital continuity. In addition, new monitoring metrics that respond to the challenges of circularity need to be considered from the design phase to optimize the level of use of the final product at all times, along with its recoverability. Coupling modelling technologies with product lifecycle management technologies improves the ability to develop better products faster and accelerate innovation, but also to track progress towards sustainability goals, which can be used for reporting obligations–such as metrics to track:

- Material use (e.g., overall reduction of resources used, percentage of non-renewable, renewable, and recycled materials used).
- Recovery (e.g., volume of material collected for recycling).
- Reuse (e.g., percentage of recycled materials that are reused).

"No single actor possesses significant waste flows and volumes to operate on its own. Circular solutions are economically and environmentally viable leveraging more collaborative ways of working through partnerships or joint ventures with peers from their sector and beyond."

– ANTOINE ROBICHON, *DEPUTY CEO AND COO AT CITEO*

The current value chains are not adapted to circular ways of doing. How does it need to evolve?

Maximizing capabilities to deliver effective circular models cannot be executed by one company due to the inherent complexity of this concept and the wide range of topics that needs to be addressed. In fact, *"the development of circular economy practices at scale require the implementation of new ecosystems integrating all actors involved in both vertical and horizontal value chains in order to mutualize the materials' flow"*. We need to explore new ways of working, whether it is with competitors that become partners to overcome the main obstacles, or academics and experts to develop new groundbreaking technologies. Most importantly, unleashing the full potential of circularity starts with a responsibility that is refocused on industrial actors instead of consumers, including all those who intervene during the product lifecycle. *"Citeo, in collaboration with Adelphe, has set up Tree, an on-line digital tool based on a common definition of recyclability for companies to evaluate the recyclability of their packaging in order to encourage them to reduce household packaging pollution at the origin and improve recycling."*

Antoine Robichon
Deputy CEO and COO at Citeo

What should be done from a legal perspective to support these new ecosystems?

The current situation shows that the regulatory framework should be rethought in collaboration with the industry in order to better consider its real-life applicability for each sector. Companies need to be involved in the making of these regulations, as they are the ones who understand best the subtilities of their products and processes. In addition, adopting standards that are mutually shared for supply chain and logistics processes would facilitate downstream operations to secure a more fluent interaction between all parties. *"The objective is to let industrial actors organize themselves through an incentivizing regulatory framework that sets standards in the use of virgin materials at the beginning of the chain and the recyclability of packaging and products at the end of the chain"*. An incentivizing, positive regulation will give better tools to the actors to succeed in their transformation to encourage product reuse and recycling. It is the role of regulators to work collectively with organizations to set those indicators that enable to monitor progress and measure quality standards of used goods through a same lens.

What will be the main catalyzers for circularity in the coming years?

Both the adoption of the newly established standards by most actors within sectors and a new leadership mind of executives mixing business singularity and cooperation sectors will facilitate and accelerate the implementation of circular models. It can be an even stronger lever if we accept that in order to gain in interoperability, materials functional properties should be minored, or at least adapted to a circular economy. The future will probably show simpler products that are easily interchangeable and repairable allied with new business models.

Regarding packaging specifically, the reuse will be developed when LCAs make sense, and mechanical recycling will be supported by the bio-industry that will offer biomaterials and chemical recycling solutions. This will foster the development of efficient alternatives polluting materials, the reduction of hazardous material use, but also the improvement of recycling capabilities economically and environmentally across a variety of products.

“For retailers who recently experienced products shortages, a second-hand model enables to create a new supply chain”.

– ANTOINE BAGUR, *FOUNDER OF CIRCULAR X AT RECOMMERCE GROUP*

How is Circular Economy transforming the value chain?

The circular economy is evolving from a simple matter of recycling materials at product’s end of life to a new paradigm of reusing products as much as possible, thus giving them new lives. This economic switch has recently speed-up through the influence of four main factors: clients’ demand asking for less impact in consumption, more constraining regulation (e.g., AGEC in France), economic opportunities by making additional business in new sectors, and corporate internal levers (e.g., talents retention via dedicated sustainability programmes). Second life models will also push for a more sustainable product design to prepare products for multiple lives. It may also drive clients to accept less customization of their products to simplify the refurbishment process.

Circular Economy by giving several lives to a given product presents the opportunity to reduce resource scarcity issues, raw materials dependency and the product’s carbon footprint. For retailers’ business in particular, who recently experienced several products shortages, a second-hand model through the implementation of a buyback offer enables to create a supply chain with its own customers, thus alleviating the tensions in the standard supply chain.

Antoine Bagur
Founder of Circular X at Recommerce Group

New supply chains will be more local. Where the sector and the product permit, some companies are already working to build local networks of suppliers, thus creating greater resilience and generating lower impact. In the building sector for instance, it can be smarter to find local suppliers for materials like cement, glass, or even pre-assembled elements. But the future will be to have extended this local approach to all types of products, with new circular supply streams with customers to buyback used products from them, then repair and refurbish them to start their second life. CircularX is a SaaS platform aiming at promoting and easing circular loops on products through the interconnection of retailers and industrial refurbishment players.

How to bring those new second-hand business to the market?

1. **Network & partners.** Circular model implies building new networks through all actors: logisticians who will collect the products, buybackers who will endorse the products within its stock, and industrial players who will strengthen product testing or repair.
   A key challenge is to build and orchestrate this new network within efficient workflows, with the collective target to reduce the distance products will travel. Companies can leverage their own capabilities and those from their partners to create these new workflows. Many of them already have repair offers through after-sales services for instance, but they don't necessarily have the capacity to carry out maintenance for all of their products, on all of their sites. This is why building an ecosystem with new partners is critical.
2. **Quality.** The key for a successful second-hand business model is to ensure product quality. Today, there is no official regulation to assess the quality of reconditioning. Within the RCube federation, we created a label certified by an independent authority that guarantees both quality control and standards' application from the retailer, hence engaging customer's trust.
3. **Marketing & Go-to-market.** Finally, the challenge will also be to reach out the consumers, raising awareness, proposing new offers and delivering the right message to drive this mindset shift. A great marketing effort is needed to deliver the right information at the right time to customers in order to maximize the efficiency of products' buybacking schemes for retailers.

As a conclusion, some actors already rely massively on second-hand: in the automotive sector, the used car market weights for 70% of the sales. Circular Economy has an enormous potential. For the retailers we are working with in the Consumer goods market, circularity represents today approximatively 2% of their sales. Tomorrow, it could be 20 to 25%.

Smart processes and operations, including product design: Scaling up circularity implies developing expertise in data technologies and capabilities that offer greater control and traceability of assets (products, materials, infrastructures) and services throughout the entire lifecycle. As mentioned in the section III.2.3, technologies have reached a level of maturity and interoperability to be able to leverage the benefits of Industry 4.0 for supply chain optimization, advanced supply chain data analytics, or factory automation with robotics. Overall, this offers much greater efficiency in achieving the 3Rs of the circular economy (reduce, reuse, and recycle) by massifying automation across the chains. In addition, to support innovation at scale in product design and operations, virtualization tools like product modelling, digital twins and 3D prototyping have received particular attention recently. These tools help make the design as lean as possible while taking into consideration the factors of circularity and their implications during the entire product lifecycle. They also play an important role in monitoring assets, processes, services, and data flows which helps reduce complexity in operations. Coupled with AI/ robotics capabilities, industrials can automate and optimize supply chains for manufacturing, remanufacturing, and recycling. Finally, prototyping components and products using the minimum amount of resources is made easier and faster with 3D printing for technical products.

E.g., Through its PEHB project (i.e., Positive Economy Hybrid Building), Bouygues Construction exploits the capabilities of virtualization technology (like Building Information Modelling – BIM) to optimize operations during the design, construction and use of the buildings. This encourages the implementation of circular economy practises throughout the building lifecycle, leading to ecological, financial and societal value creation.

Chemical recycling: Chemical recycling is a formidable weapon in tackling the pollution of certain products and materials at end-of-life. It overcomes the limitations of mechanical recycling and maximizes waste revalorization. For instance, according to the OECD, global plastic waste generation more than doubled between 2000 and 2019 to reach 353 million tonnes: only 9% of it is being recycled while 22% is 'mismanaged'. The difficulty is that plastics come in different forms to cover various uses from packaging to pipes in the construction sector. This makes it extremely difficult to recycle it fully using mechanical recycling techniques only. According to the latest Polyvia report[57], while the global chemical recycling industry is still at the testing phase, there is strong potential for investment, particularly in Europe.

E.g., Eastman invested €850 million in France to build the world's largest molecular plastics recycling plant with the objective of recycling 160,000 tonnes of plastic waste per year (including textiles).

E.g., Loop Industries' depolymerization technology transforms PET plastic and polyester fibre waste, which was previously unrecyclable, into virgin-quality building blocks. This process is also based on a low energy intensive process.

Achieving circularity at scale means adopting a holistic approach involving the five convictions mentioned above, bearing in mind that the holy grail in the circular economy is a shift away from the largest loop (offered by recycling) to develop small loops that maximize the value of the products, components and raw materials over the longest period of time possible, through repair and reuse. As mentioned by Marie-Claire Daveu (Chief Sustainability and Institutional Affairs Officer at Kering), "moving away from the conventional model of "take-make-waste" is not only about recycling, but about rethinking the way we produce, use and extend the life of resources and products. Our circularity approach is completely aligned and in tune with our climate and biodiversity strategies. The three work together to create our framework for action."

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Case study: Renault's Re-FACTORY

With the Re-FACTORY, Renault will build Europe's first circular economy factory dedicated to mobility between 2021 and 2024. The objective is to achieve a negative CO2 balance by 2030, leveraging a large network of multisectoral partners including start-ups, academia, major groups, and local authorities.

The Re-FACTORY is structured around four interconnected and complementary activities:

- **RE-trofit:** Enable vehicle lifecycle extension by ensuring efficient management of the flow of used parts and materials within the same site (reconditioning, repair services, design improvement during use).
- **RE-energy:** Develop the potential of applications arising from electric batteries (throughout their lifetime) and new energies to an industrial scale.
- **RE-cycle:** Promote the supply of parts and materials in short loops and integrate a growing share of recycled or reused materials (dismantling, remanufacturing extension, reuse, and recycling).
- **RE-start:** Enhance and develop industrial know-how and accelerate research and innovation in the circular economy leveraging incubators, university and learning centre facilities.

Following the same logic, Renault vehicles are now conceived so that they can easily be dismantled, remanufactured, and recycled within the Re-FACTORY. For example, in October 2021, Renault will launch Mobilize, a car-sharing service where individuals can rent Renault or Dacia electric vehicles that can be 100% retrofitted or recycled in the Re-FACTORY. The fleet is adapted to all users' needs, as vehicles exist in different sizes and can be booked for periods ranging from a few hours to one month. Home charging costs will be optimized, leveraging smart charging from artificial intelligence solutions.

Key figures

- Storage capacity of 45,000 used vehicles by September 2021.
- Repairing capacity of 20,000 batteries per year by 2030.
- Dismantling capacity of 10,000 electric vehicles per year in 2024.
- Second-life batteries sold by Renault between 2021 and 2030 will deliver 200 mwh per year.

“New technologies like the digital twin are revolutionizing our ways of working in bringing all the stakeholders to work together. The de-compartmentalizing of the conception allows to take a significant step towards eco-conception.”

– FLORENCE VERZELEN, *EXECUTIVE VICE PRESIDENT IN CHARGE OF INDUSTRY, MARKETING AND SUSTAINABILITY, MEMBER OF DASSAULT SYSTÈMES EXECUTIVE COMMITTEE*

What is the next techno-revolution?

Innovative technologies like digital twins or the digital passport will allow companies to take a big step forward in promoting the traceability and recyclability of their products.

Achieving state of the art in digital twins requires significant investments in connectivity, data management, simulation capabilities, human-machine interface, and digital continuity. But it is clear that this type of technology is the future of circular economy. In the automotive sector, for instance, the digital twin technology allows the constructor to optimize the design of its product to offset every consequence. It multiplies its capacity to run tests to anticipate accidents, obsolescence, carbon emissions, and to envision what could be the second, third life, and so on, of the car and each of its parts. The digital twin also allows to integrate the dismantling process in the product design phase, and to answer the ultra-customization demand, without generating more waste.

This technology is also revolutionary in creating new ways of working: with the one single source of truth model, all the parties of the value chain to work and communicate simultaneously on the product. *“The decompartmentalizing of the design phase allows the software engineer, the mechanical engineer, the designer, to work in synchronization. They can understand the implications of their choices in terms of efficiency, sustainability, and compatibility with the logic of the product as a whole.”*

Florence Verzelen
Executive Vice President in charge of Industry, Marketing and Sustainability, Member of Dassault Systèmes Executive Committee

What are the enablers to accelerate the development and use of these technologies?

There is a high demand for circularity, and in many sectors, and urgency to act, facing problematics like resources scarcity, or law reinforcement. Innovative technologies such as the digital passport are the future of traceability and strong enablers to monitor the carbon footprint of a product, evaluate its composition, and anticipate its future lives. But the speed of the circular economy is very uneven depending on many factors such as the sector, geography, or the ecosystem in which a company evolves. There is a major stake in the coordination of all the actors and the communication inter-sector.

In Europe, for instance, companies are constrained to take actions because of the law, which will give them a competitive advantage on the international scene when other regions will take same measures.

Depending on the sector, also, the regulation is still unequal, even in Europe. The automotive sector, or mass market sectors, or instance, are already under high pressure due to the existing strong legislation, whereas for construction or textile, it is coming progressively.

"Innovations like the digital passport in Europe coupled with technologies like the digital twin allows to have a vision, from the design phase, of what will be the second, third, or even fourth life of the product."

Finally, circular economy adoption can rely on the constitution of an ecosystem. If there is a strong leadership of some actors, that invest in technologies like Renault in the digital twin, it will be of service to its competitors and accelerate circularity in the automotive sector. Another stake is to adapt to the degree of complexity of a sector. In the automotive sector, the value chain integrates many actors, many stages in production and after sales activities, which require a more complex rethinking and remodeling of processes.

Investing in the bio-industry, the next frontier

The bio-industry has properties that can tackle issues at the two extremes of the lifecycle to overcome resource scarcity by inventing alternative materials and dealing with pollution (from plastics in particular) through solutions like biodegradable materials and chemical recycling. In a nutshell, the bio-industry is the next frontier in material selection and waste management processes, with novel enzymes, bio-based materials, and new products with tunable properties.

New biomaterials: Bio and synthetic technologies are used to develop better alternatives to materials and processes by miming biological processes at an accelerated pace. The development of new secondary materials has skyrocketed in the last few years with fast progress in bio-made materials produced by enzymatic and other biological engineered processes that can be industrialized (such as biofuel, bioplastics, etc.).

E.g., Dyecoo has invented a CO2 dyeing process for the fashion industry which prevents significant water waste during the process.

TetraPak has created a carton made from paperboard and responsibly sourced sugarcane-based plastic. This fully plant-based product offers an easy recyclable solution that also reduces CO2 emissions by 35% compared to standard packaging.

Chemical recycling: Chemical recycling is a formidable weapon in tackling the pollution of certain products and materials at end-of-life. It overcomes the limitations of mechanical recycling and maximizes waste revalorization. For instance, according to the OECD, global plastic waste generation more than doubled between 2000 and 2019 to reach 353 million tonnes: only 9% of it is being recycled while 22% is 'mismanaged'.

The difficulty is that plastics come in different forms to cover various uses from packaging to pipes in the construction sector. This makes it extremely difficult to recycle it fully using mechanical recycling techniques only. According to the latest Polyvia report , while the global chemical recycling industry is still at the testing phase, there is strong potential for investment, particularly in Europe.

E.g., Eastman invested €850 million in France to build the world's largest molecular plastics recycling plant with the objective of recycling 160,000 tonnes of plastic waste per year (including textiles).

E.g., Loop Industries' depolymerization technology transforms PET plastic and polyester fibre waste, which was previously unrecyclable, into virgin-quality building blocks. This process is also based on a low energy intensive process.

Achieving circularity at scale means adopting a holistic approach involving the five convictions mentioned above, bearing in mind that the holy grail in the circular economy is a shift away from the largest loop (offered by recycling) to develop small loops that maximize the value of the products, components and raw materials over the longest period of time possible, through repair and reuse. As mentioned by Marie-Claire Daveu (Chief Sustainability and Institutional Affairs Officer at Kering), "moving away from the conventional model of "take-make-waste" is not only about recycling, but about rethinking the way we produce, use and extend the life of resources and products. Our circularity approach is completely aligned and in tune with our climate and biodiversity strategies. The three work together to create our framework for action."

“The key is to constantly challenge ourselves and our vision to offer the best possible alternatives to the market.”

– ANTOINE HUBERT, *PRESIDENT & CEO OF YNSECT*

What is the strategic vision behind the birth of Ynsect?

By 2050, global food production will increase by 70% to face population growth, with only 5% more agricultural land. To address this challenge, Ynsect has been working since 2011 on an efficient, natural and sustainable solution to produce more food with less resources. They invested in insect farming to produce high-end insect proteins for animals and humans food. A system that requires, for 1kilo of proteins, 100 times less farmland than for animal proteins , and without antibiotics. At the moment, they are focusing on B2B activities, but they foresee a rise in particulars’ demand in the next few years.

Ynsect disrupts the whole food value chain by offering a solution circular by design, from the ground to the plate. They complete the loop by first feeding insects with food leftovers and organic waste, that will then be used to feed animals, humans and plants. At the end of the process, even soils can benefit from food waste as a fertilizer. Ynsect also uses techniques like methanization for the regeneration of soils, in order to maximize the benefits of circularity. The company aims to offer quality products made in a quality manufacturing process, respecting high standards.

Ynsect has already prospered from its investments. They sold their production for the next 2 to 3 years, have 150 millions $ of sales ongoing and a growth under discussion that is about 6 times the size of their current sales. This rapid growth

Antoine Hubert
President & CEO of Ynsect

is the result of about a hundred millions of dollars invested.

The major challenges now are to accelerate their production and improve their time-to-market to capture market growth. *"We now face the problematic of accelerating our production. Everything is sold, we need to increase our capacity and time to market. The challenge is really in getting to the next level of delivery."*

What are the key success factors to build and scale circular innovations?

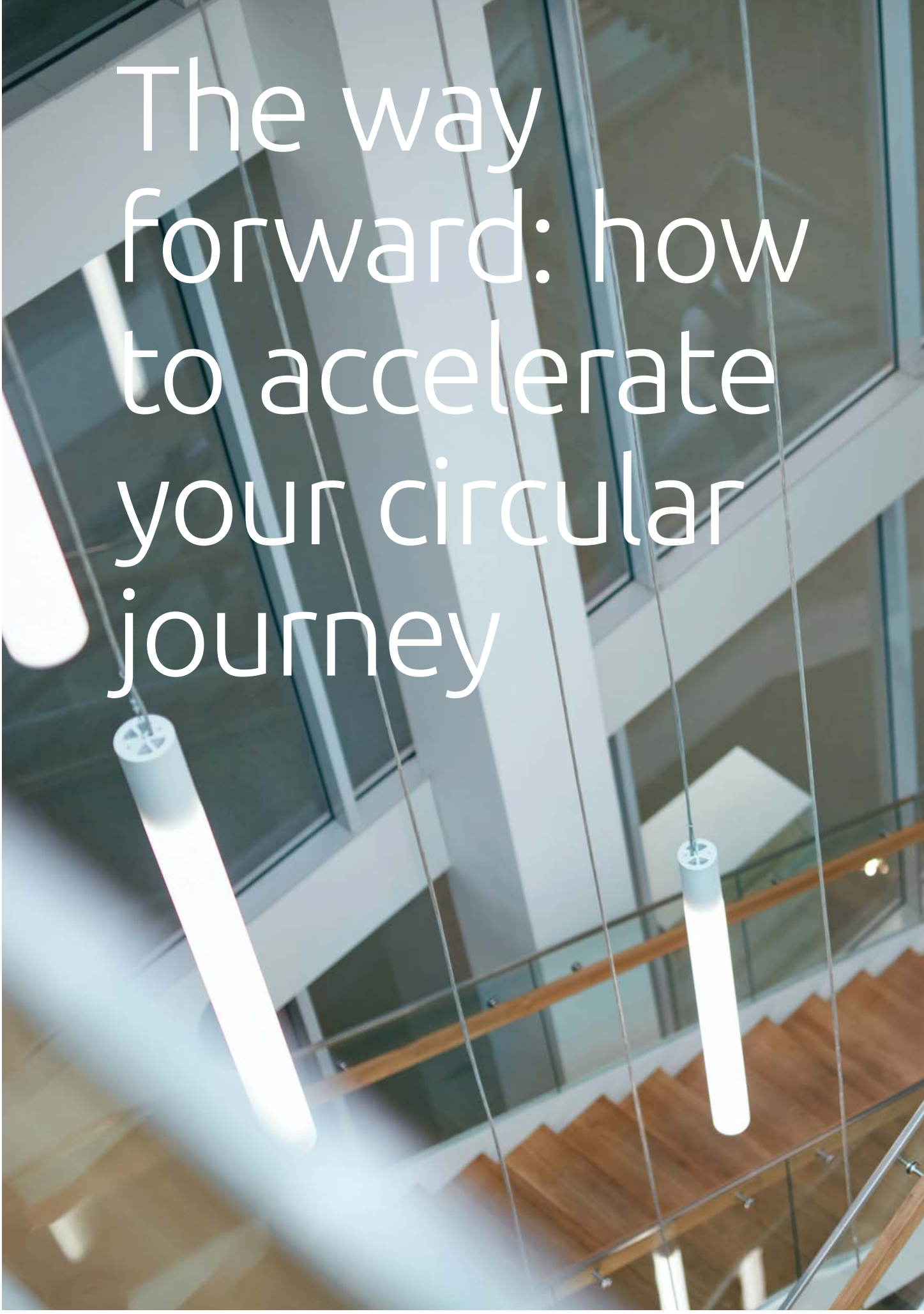
There is a growing demand in the sector of alternative food in general, whether it is around insects, mushrooms, seaweeds… The conjunction of industrial, commercial and legal maturity with a favorable context emerging following various crisis has made circular economy, as well as local economy, more and more visible and important. But the cornerstone of a sustainable business strategy remains large investments in technology and research.

For years, Ynsect has invested in research with experts, professionals, academics, progressively building a new ecosystem of actors, promoting alternative food, and constantly searching for new opportunities to innovate. *"We had to invent everything with suppliers, service providers and public research labs: 10 years of research to achieve an industrial scale-up. A hundred million of investments to get to this stage."*

To secure the constitution of legitimate, universal knowledge is the key to implement new practices, and it is built in consortium: several insects farmers have gathered in Brussels in order to join forces to work on the legislation with common priorities and ethics. All these actors are working together to define new standards for all kinds of organic proteins, based on ethics and quality.

Today, the scope of products is reduced because even though the legislation, especially at the European level, is supportive, there is still a lack of knowledge on how other waste categories can be used. That is why today Ynsect is strictly focusing on food leftovers and side streams, but the future of the industry lies in a lot of knowledge production and evolution towards other categories of food waste, to make sure quality and sanitary matters are still the top drivers. There is a key market opportunity in managing to define the legislation that will set the standards for this new economy.

The way forward: how to accelerate your circular journey



THE WAY FORWARD: HOW TO ACCELERATE YOUR CIRCULAR JOURNEY

As organizations suffer from ever-decreasing visibility of resource stocks, more sustainable alternative models, leveraging added value from product reuse, have been emerging. This is especially prevalent in an increasingly complex geopolitical situation combined with a need for more local economies and the development of a tailored consumer experience through servitization.

Whether industries are pushed by external threats or pulled by the benefits of this framework, the circular economy will become a business imperative. As the level of exposure to these triggers will continue to rise, and given the inherent complexity of manoeuvring this transition, companies are urged to embark on this long journey now to avoid disruption further down the line (e.g., uberization, loss of market share, scarcity economy, etc.).

This systemic and complex transformation means integrating the circular economy at the corporate strategy level, applying a holistic approach combining products, processes, ecosystems and business models. Over and above this impetus, the five convictions set out above lay the foundations for scalable solutions to achieve the goals of the circular economy in an increasingly challenging business environment.

"It is change, continuing change, inevitable change that is the dominant factor in society today. No sensible decision can be made any longer without taking into account not only the world as it is, but the

world as it will be. This, in turn, means that our statesmen, our businessmen, our everyman must take on a science-fictional way of thinking.[58]*" Isaac Asimov, "My Own View" in The Encyclopedia of Science Fiction, 1978.*

Understand the market dynamics

The circular economy is a complex topic with sectoral specificities that necessitates market intelligence before getting started. This preliminary step is essential to:

- Identify market trends.
- Develop a broader understanding of the extended value chain.
- Embrace an ecosystem approach through an extended collaboration model (e.g., with competitors, public authorities, NGOs, start-ups, academics, etc.).
- Anticipate evolutions in the legal framework.
- Foresee newcomers that will disrupt traditional ways of doing.

E.g., Back Market, the electronics reconditioner and circular economy disruptor, recorded an increase in sales revenues from €3 million to €230 million between 2014 and 2018[59]*, while reducing the carbon footprint for second-hand phones by 90% compared to new ones*[60].

At the same time, an assessment of the long-term risks and the level of exposure to them is needed to anticipate the biggest challenges that businesses will face and at which timescale (notably in terms of raw material sourcing, as well as alternative processes and solutions). The findings will have far-reaching repercussions on the corporate strategy, requiring executives to:

- Define a new mode of governance with indicators to monitor progress with the transformation and to facilitate decision-making.
- Steer the company's trajectory with regard to this long-term strategy by setting financial and environmental objectives evaluated over a longer timescale.

E.g., BMW is launching new initiatives. Via its Circular Lab, the German carmaker promotes and stimulates circular thinking and shares awareness of new, sustainable courses of action. The group has also developed the I Vision Circular Prototype, a fully electric vehicle entirely made from recycled materials and fully recyclable[61].

Set a circular economy ambition

The circular economy is not one-size-fits-all. However, some of the levers and accelerators that can be applied to develop circularity at scale are now known. After their preliminary strategic analysis, organizations need to set an ambition for their transformation journey. Successfully completing a circular economy transformation depends on the organization's capacity to embrace a holistic approach that recognizes the interdependencies and thus encompasses the product, operations, ecosystem and business model dimensions all at once.

We recommend decision-makers leverage the Circular Economy Matrix suggested in this report to help select the initiatives that will bring most circular value for their businesses, regardless of where they are in their journey.

Circular Levers	Product design	Operations	Business models
REDUCE	• Design sobriety (less energy/water/ waste, use of environmentally friendly materials, less functionality for increased usage). • Design for durability (long-lasting products, robustness) • Dematerialization (lower size & weight, mono-materials).	• Industrial symbiosis (lower energy and material needs). • Digital lean manufacturing/ remanufacturing (supply chain optimization, advanced analytics, automation, virtualization & modelling).	• Circular procurement (recycled materials, biosourced & biodegradable materials).
REUSE	• Product recovery strategy (design for life extension and/or for recycling). • Modular design. • Connected products (softwarization, traceability, digital continuity).	• Industrial symbiosis (waste revalorization). • Scrap reuse/ co-product. • Defected product rework. • Collection and sorting. • Reverse logistics/ Closed loop supply chain (repair, dismantle, remanufacture).	• Product sharing. • Product-as-a-Service (software updates and upgrades). • Extended life businesses (repair, refurbish, remanufacture, retrofitting). • Reuse/2nd hand platforms. • Labels and standards.
RECYCLE	• Design for recycling (dismantling, recyclable materials).	• Collection and sorting. • Mechanical recycling (dismantling, shredding and breaking. • Chemical recycling.	• Waste revalorization. • Resource recovery.

Secure enablers for implementation

Once the vision is set and roadmap defined, organizations must build transversal enablers that will help accelerate their implementation of the circular economy:

Set the baseline and monitor progress: After having prioritized the initiatives that will bring most circular value, a monitoring system relying on dedicated KPIs should be put in place to measure progress with the transformation at corporate level. This needs to be mapped against the company's circular economy ambition, which means first establishing the starting point (i.e., the level of circularity before the transformation). E.g., metrics to track material use (e.g., overall reduction of resources used, percentage of non-renewable, renewable, and recycled materials used), recovery (e.g., volume of material collected for recycling), and reuse (e.g., percentage of recycled materials that are reused)[62].

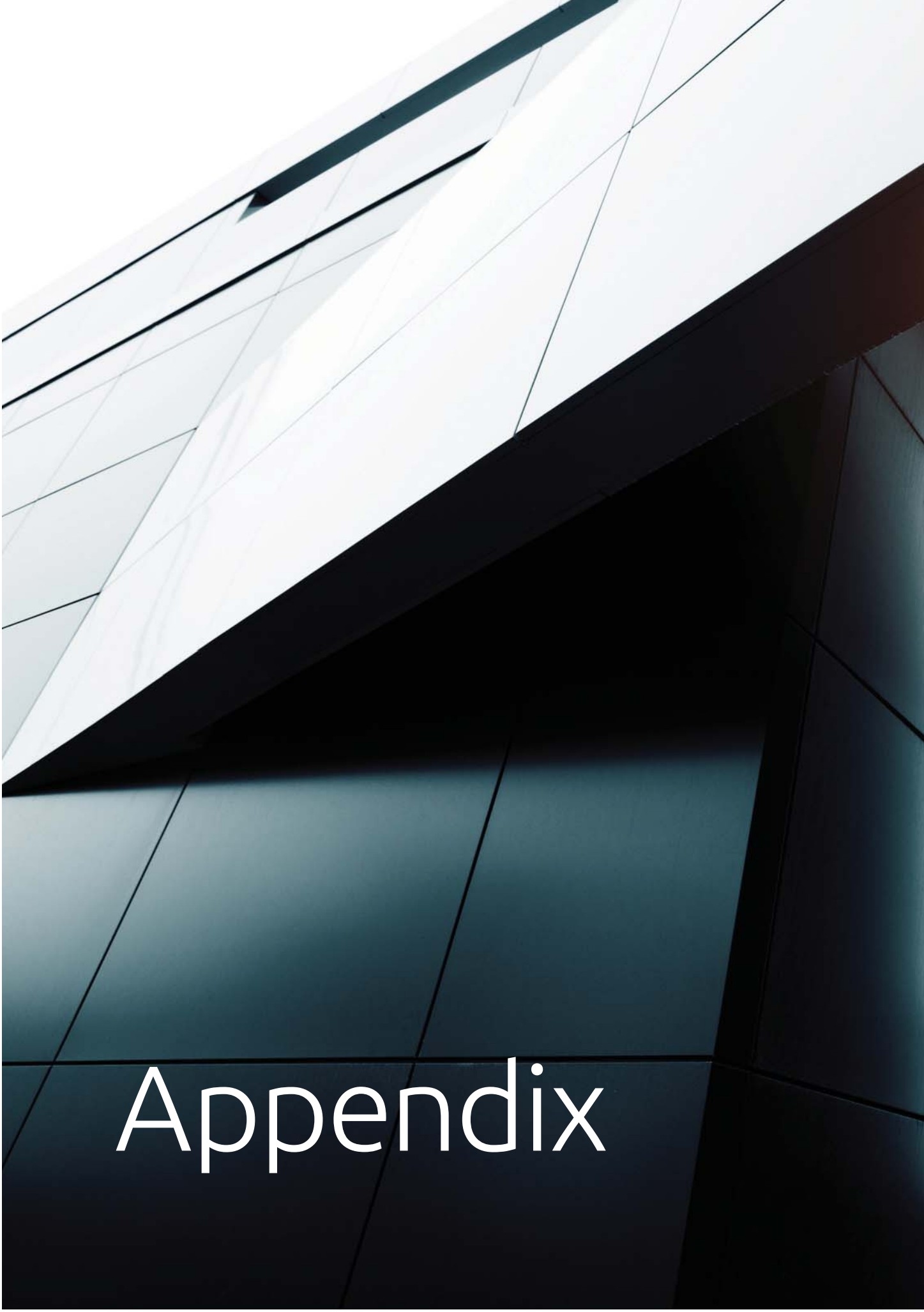
Shift organizational mindset and culture: The workforce must be prepared to embrace the change ahead and the top management needs to support dedicated communication and training programmes to educate people within the organization. This approach should foster a culture around the need to adopt circular ways of doing. Alongside that, responsibilities must be shared with a governance structure that make leaders and investors accountable for this transition by evaluating the company's performance against longer-term objectives that go beyond financial criteria.

Stimulate innovation through multidisciplinary teams: To successfully develop circular economy solutions, we need to bring experts from various backgrounds to the table (e.g., sustainability experts, engineers, data scientists, logistics and construction technicians). Building capacity around multidisciplinary teams is paramount for product design, product management, or service management. For instance, designing circular products means connecting experts in design, procurement, marketing, engineering and manufacturing– and the same applies to all the initiatives listed in the Circular Matrix.

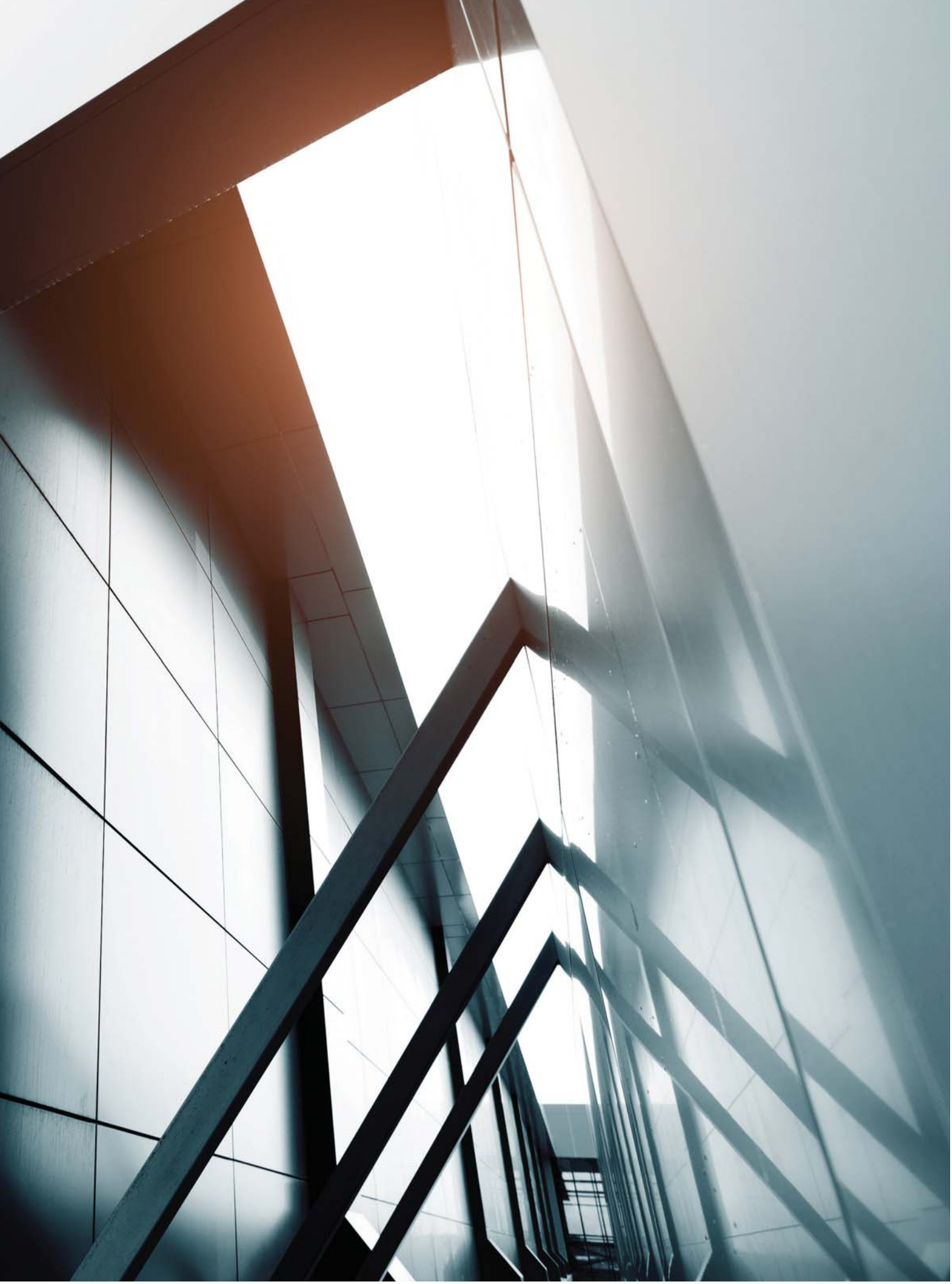
Create new collaborative ecosystems: Given the complexity and breadth of the challenges involved in implementing the circular economy, organizations are urged to develop new partner ecosystems that match their circular ambition. This means integrating stakeholders from the vertical and horizontal value chains including competitors, policymakers, start-ups, universities and think tanks to accelerate the transition to a circular model.

Build long-term consumer relationships: Education is the starting point for a new consumer relationship in the circular economy era. Consumers need to understand the positive impact of their purchasing and user behaviours when engaging in circular practices. Traceability and transparency are therefore key to building trust-based relationships and guiding these new consumption patterns (e.g., via specific communication activities, product labelling, etc.). What is more, although consumers all agree about consuming better, change needs to happen in the most convenient way, with viable alternatives and financial incentives to help close the loops. Organizations will benefit from this, as developing services and solutions that embrace circular economy principles is a great opportunity to step up and extend the duration of the client relationship through additional touchpoints and an augmented user experience over time.

Leverage technology and data: It is all about a holistic approach where technology and data help interconnect products, operations and ecosystems in economically and environmentally viable circular business models. To define all the processes to be put in place, everything starts with product design. This industrial revolution is spurred by the capabilities resulting from the avalanche of technologies enabling virtualization/modelling (via digital twins), traceability of materials and product flows (via RFID, blockchain, IoT), or operation optimization (via robotics, sensors, AI/ML).



Appendix



Benchmark of circular business models being adopted across sectors

	SUSTAINABLE DESIGN	PRODUCT-AS-A-SERVICE	EXTENDED LIFE BUSINESS	CREATING WASTE VALUE	CIRCULAR SOURCING
Definition	Developing products and services that consider ESG impacts throughout the entire lifecycle	Being responsible for products marketed to the end-users once they have finished using them with them (includes ease to access and to take back)	Building the products, capabilities, and infrastructures that help maintain products at their highest value as long as possible	Organizing flows that maximize recoverability and minimize waste throughout the lifecycle (waste becomes someone's food)	Returning valuable nutrients to the soil to support regeneration, or using renewable energy as opposed to relying on fossil fuels
Business models	• Design for Rs • Sustainable packaging	• Sharing economy • Renting / Leasing • Servitization	• Upgrade/update • Do it yourself • Repairing • Reuse / 2nd hand • Refurbishing • Remanufacturing	• Zero waste manufacturing • Retrofitting • Recycling (components, materials)	• Responsible mining • Circular procurement • Regenerative cropland • Managed grazing • Composting
Market examples	IKEA, Timberland, Chanel, BMW, Adidas, Hermès, LVMH, H&M, Clarios, Tesla, Northvolt, Carlsberg, Seb, Unilever, Michelin, L'Oréal, P&G, Holcim, Schneider Electric, Illy, Ynsect, Citeo, DyeCoo, Verkor, Tetra Pak.	Bouygues Construction, Uber, Leroy Merlin, Renault, IKEA, GM, Stellantis, BMW, Xerox, Carrefour, Cirul'R, Hilti, Volkswagen, Michelin, Circular, Bocage, Saint-Gobain, L'Oréal.	Caterpillar, Renault, SNCF, Bouygues Construction, Fnac Darty, Levi's, Mud jeans, BMW, Safran, Patagonia, Unilever, Apple, Schneider Electric, P&G, Kering, Dassault Systèmes	SNCF, Renault, Patagonia, Kering, LVMH, Vestiaire Collective, Vinted, Aigle, Dell, Carrefour, Stellantis, Levi's, Volkswagen, Too Good To Go, H&M, Loop, Holcim, Suez, Unilever, Coca-Cola, Ynsect, Seb, Vinci, Phenix, Circular, Citeo, Tetra Pak, Back Market.	Danone, Nespresso, SNCF, P&G, Volkswagen, Kering, Nestlé, Ynsect, Carrefour, Stellantis, Illy, L'Oréal, Unilever, Suez, Schneider Electric, Tesco, Coca-Cola, Hocim, Vinci, Walmart.

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Study panel distribution by industrial sector and geographical region

Sector	Distribution
Manufacturing	25.8%
Consumer Product & Retail	22.6%
Construction	16.1%
Energy & Utilities	12.9%
Transportation	9.7%
Technology	6.5%
Services	3.2%
Life Science	3.2%

Country	Distribution
France	58.1%
Netherlands	9.7%
USA	6.5%
Canada	6.5%
Italy	6.5%
Chile	3.2%
Spain	3.2%
Switzerland	3.2%
Germany	3.2%

TOTAL: 31 interviews

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