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SUSTAINABLE PRODUCTS IN THE CIRCULAR ECONOMY

IMPACT ON BUSINESS AND SOCIETY

Edited by
Magdalena Wojnarowska, Marek Ćwiklicki
and Carlo Ingrao

Sustainable Products in the Circular Economy

This book explores how the Circular Economy influences product design in today's business and society. Drawing on contributions from a wide range of expert thinkers, this book assesses the existing approaches, strategies, and tools which facilitate socially and environmentally responsible production and consumption systems. It then goes on to highlight the ways in which the Circular Economy conceptual framework could be implemented effectively at both micro-level (product policy) and macro-level (sustainable consumption) in order to alter the industrial landscape and increase its interconnectedness with materials and scarce resources. Highlighting the pros and cons of transitioning to this new model, the book also cautions that it will only be made possible via significant behavioural change at both industry and consumer levels. *Sustainable Products in the Circular Economy* will be of great interest to students and scholars of sustainable manufacturing, sustainable consumption, corporate social responsibility, and business ethics. It will also be relevant to industry professionals whose work dovetails with these areas.

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Preface

In the current era of transformation, the conceptual framework of Circular Economy (CE) is increasingly becoming meaningful and relevant in terms of the future and competitiveness of enterprises, which are the after-effects of the Fourth Industrial Revolution. Programmes of integrating the concepts of the CE with industrial activities encompass alterations in manufacturing processes intended to mitigate their impact upon natural environment, the development of new ecological products, and redesign of existing business models. Alterations in manufacturing and distribution paradigms may be considered in terms of diverse aspects; however, they require participation and engagement of various groups of stakeholders. Thus, the primary aim of the intended book is to answer the following research question: what is the role of sustainable product in the CE?

The CE is, in fact, different from the linear economy, because it is essentially based upon slowing and closing resource loops: two features that can be considered to be complementary, rather than alternatives, to each other. In particular, slowing happens when long-life goods and product-life extension solutions are designed. Therefore, the utilisation time of products is extended and/or intensified, thereby contributing to the slowing down of resource flows, whereas closing happens when the loop between end-of-life and production is closed, with the consequence that post-use products are recirculated within the life cycle as zero-burden resources to produce secondary raw materials (Moraga et al., 2019). The CE plays a number of key roles in enabling industrial economics to pursue Sustainable Development. It is, indeed, acknowledged to be capable of harmonising ambitions favouring not only economic growth but also environmental protection, thereby opposing the conventional high-impact linear model of the economy (Hysa, Kruja, Rehman, & Laurenti, 2020).

In the twentieth century, environmental problems were often viewed just on a local scale due to the impact associated with product life cycles. However, today it is becoming clearer that these problems are much more complex and concern all phases of those cycles, from the extraction of material to waste or waste product management (Berkhout & Smith, 1999). Both product design and manufacturing processes have been developed already in the past to meet the needs of producing high-quality products at minimal cost in order to promote the company's competitiveness. Thus, recycling and recovery were taken into account, but they had

to compete on purely economic terms with the use of primary raw materials and disposal (O'Brien, 1999).

Transition towards CEs will be feasible only after the operating model of all market players has been rearranged. Gradual transition from the linear to the CE is a strategic goal at the European level, which is dependent upon coordinated efforts of both authorities and society, since such transformation results in significant changes to the market. Therefore, the success of CE is reliant on active involvement of authorities in the creation of relevant legal frameworks, taking into account that CE will become a reality only when the intensification of research and development has been reflected in subsequent implementation of both technologies and relevant strategies.

As a consequence of the aforementioned explanations, the core content of the proposed book centres on the characteristics of resources management compliant with the CE principles. The adopted general assumption is that such a transformation determines the change from the current model of the linear economy into the CE at the level of consumers and enterprises.

This book addresses the impact of sustainable manufacturing in compliance with key principles of the CE. It focuses on exploring how CE influences product design in today's business and society. Respective chapters assess existing approaches, strategies, and tools, thus facilitating creation, promotion, and support of socially and environmentally responsible production and consumption systems. Services are incorporated as an inherent part of product design.

The book was conceived to fill a research gap in the extant scholarship. An analysis of both the advantages and disadvantages of applying the CE in the context of product policy with respect to sustainable manufacturing is missing in current literature. The integration of CE and sustainable product policy becomes crucial, inter alia, due to technological and social progress, as well as the adverse impact of current economic models. This lacuna translates into the requirement for behavioural change in the entire environment. Therefore, this book aims to fill the identified gap by integrating sustainable product design with CE principles, thereby providing a real chance to alter the industrial landscape and its interconnectedness with materials and scarce resources.

The content of this book comprises 16 chapters prepared by 35 authors specialising in areas related to sustainable products, including design, manufacturing, marketing, business models, and consumption.

In the first chapter, an explanation of sustainable products is provided based on manufacturing strategies, which have been launched in Europe, focusing in particular on Italy and Poland. Chapter 2 presents guidelines for eco-design, which require consideration before the commencement of integrated product manufacturing. Next, the third chapter demonstrates the use of Life Cycle Assessment. It shows how calculation assumptions impact the final result. Chapter 4 presents the most popular environmental certification schemes that can be applied in line with CE principles. Chapter 5 refers to environmental labelling as a communication tool for CE solutions. It thus serves to potentially inform e-customers. The sixth chapter depicts relations between sustainable manufacturing and the CE based on

an example from the building sector. Chapter 7 identifies the enablers and barriers to transit towards a circular business model. Chapter 8 develops previous topics by focusing on the costs and benefits of such change. Chapter 9 is about the role of digitalisation in fostering the implementation of sustainable manufacturing. Chapter 10 shows how sustainability is being introduced in inter-firm networks. In the following Chapter 11, the exemplary case of a recycling company is discussed in terms of using deliberation as a tool for communication with stakeholders. The issue of cooperation among companies is also a topic of the next chapter. Chapter 12 presents the theme of how to integrate CE principles with supply chains. Chapter 13 focuses on consumer behaviour by addressing how young consumers perceive sustainable consumption. The same topic is undertaken in Chapter 14; however, in this case, from an economic perspective. Chapter 15 refers to the role of universities in the diffusion of CE in society. The last chapter (Chapter 16) raises the issue of the resilience of the CE as a concept.

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Abbreviations

AHP	Analytic Hierarchy Process
AIJ	Aggregation of individual judgements
B2B	Business-to-business
CBM	Circular business models
CC	Cleaning company
CE	Circular Economy
CR	Consistency ratio
CSC	Circular supply chains
EC	European Commission
EDIMS	EcoDesign Integration Method for SMEs
EEFP	Environmental Evaluation Tool for Food Packaging
EOD	Environmental Objectives Deployment
ERPA	Environmentally Responsible Product Assessment Matrix
EU	European Union
FGIO	Online focus group interview
FND	Function Network Diagram
FSC	Forest Stewardship Council
GTBE	Glycol tertiary butyl ether
HTC	HydroThermal Carbonisation
IoT	Internet of Things
IS	Industrial symbiosis
ISO	International Organization for Standardization
LCA	Life Cycle Assessment
LCAM	Life Cycle Asset Management
LOHAS	Lifestyle of Health and Sustainability
R&D	Research and Development
RDF	Refuse-Derived Fuels
RES	Renewable energy sources
SBD	Sustainable Behaviour Design
SD	Sustainable Development
SSC	Sustainable supply chains
SSCM	Sustainable supply chain management
TBL	Triple bottom line
WSC	Water and sewage company

1 Characteristics of sustainable products

Magdalena Wojnarowska, Mariusz Sołtysik, and Carlo Ingrao

Introduction

The economy of the last 150 years has been based upon a one-way track model (take, make, use, and dispose) that was characterised by the extraction of resources for production and consumption and by no plans for reutilising waste or actively regenerating the economy (Venkata Mohan, Modestra, Amulya, Butti, & Velvizhi, 2016). Over time, that linear model of the economy has been shown to be responsible for a number of problems, mainly related to the fact that:

- Virgin materials are extracted faster than the capacity for their replenishment;
- Post-use products are often land filled or are treated in incineration plants, with the consequence that valuable and scarce natural resources are extracted anew – and so the original resources are lost for the manufacturing of new products;
- The unsafe way in which waste is managed, which is often characteristic of the linear economy, leads to hazardous substances that leach into soil, water, and air and thus generates alarming conditions of environmental pollution;
- The manufacturing and the transportation of products are responsible for extensive energy usage and environmental pollution.

Hence, linear economies can be considered to be totally unsustainable from each of the environmental, economic, and social dimensions of sustainability (Ingrao, Arcidiacono, Siracusa, Niero, & Traverso, 2018; Korhonen, Nuur, Feldmann, & Birkie, 2018).

In this context, the Circular Economy (CE) may represent a valid alternative, as it would help to maintain products, components, and materials at their highest level of utility and value (Ingrao, Arcidiacono, Siracusa, Niero, & Traverso, 2021; Webster, 2020).

A sustainable CE involves the design and promotion of products that last and that can be reused, repaired, and remanufactured before being recycled. This aspect is a priority when implementing CE models, as it best retains the functional value of products, rather than just recovering the material or energy content and continuously making products anew. The CE, in fact, outlines how to reuse,

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repair, and recycle items, thereby reducing waste and, overall, increasing sustainable manufacturing and consumption. In addition to this, the approach contributes to saving energy and helping to avoid irreversible environmental damage due to the extraction and usage of resources at a rate that exceeds the aforementioned capacity of the earth to renew them (EU, 2019).

The CE is, in fact, different from the linear economy, because it is essentially based upon slowing and closing resource loops: two features that can be considered to be complementary rather than alternatives to each other. In particular, slowing happens when long-life goods and product-life extension solutions are designed. Therefore, the utilisation time of products is extended and/or intensified, thereby contributing to the slowing down of resource flows. Whereas closing occurs when the loop between end-of-life and production is closed, with the consequence that post-use products are recirculated within the life cycle as zero-burden resources to produce secondary raw materials (Moraga et al., 2019).

In an eco-design-based CE, consumable products such as food, drinks, cosmetics, and detergents should be produced with the minimum impact on resources and should be consumed generating as little waste as possible. While meeting these requirements, actions should be taken to minimise the emissions into the environment and impacts on the climate across the whole life cycle (EU, 2019). According to the EU (EU, 2019), this would result in less usage of resources, less waste, more jobs in repair and recycling sectors, and monetary savings, while maintaining the services provided by products.

Products that are obtained from such CE-based production systems can be considered to be more sustainable than the conventional ones (EU, 2019). So, in the light of the aforementioned points, there is evidence of the potential of CE to contribute to enhancing the sustainability of products and services from a life-cycle perspective. This can be considered as one main reason why CE has been receiving a lot of attention from researchers, decision- and policy-makers, and managers (Hysa, Kruja, Rehman, & Laurenti, 2020). As a matter of fact, Geissdoerfer, Savaget, Bocken, and Hultink (2017) highlighted that the CE is a condition for sustainability, as it acts like a regenerative system that minimises material and energy inputs as well as emissions and wastes. It is, however, desirable that CE-oriented measures are tested using tools like Life Cycle Sustainability Assessment (LCSA) and Life Cycle Assessment (LCA) already in the design phase, so that the CE can be truly effective in making material and energy commodities holistically sustainable from a life-cycle perspective (Ingrao et al., 2021).

So, it is in the light of this understanding that CE and sustainability are intricately connected and feed off each other. It is this interaction leading to the manufacturing of sustainable products that this chapter wants to explore with a focus on the Italian and Polish strategies in this area, in line with the overall objective of the book project that this chapter is a part of.

After an in-depth analysis of the state of the art in the CE, the chapter includes a section dedicated to exploring the ways the application of CE measures can enable products to be made sustainably.

At the end, in the second part of this chapter, CE strategies for sustainable product manufacturing are explored at the European level with a focus on those implemented by Poland and Italy.

Circular Economy: analysis of the state of the arts

The interest towards CE has led to a divergence in views on the methods of assessment and measurement of implementation of the CE and an overwhelming number of different definitions that currently dominate the specialised literature on the subject. This results in a lack of conceptual clarity and of any accepted definition of the CE, as has also been documented by several studies in the literature.

All of these definitions relevantly address the different facets of the CE, with the consequence of generating discrepancies.

However, what those definitions seem to have in common is the vision of the CE as a sustainable economic model where economic growth is decoupled from material consumption through the reduction and recirculation of natural resources (Corona et al., 2019; Ingrao et al., 2021). In the CE, goods at the end of their life cycle as well as the waste generated during the manufacturing and use/maintenance of those goods are in fact reutilised as zero-burden resources. The latter are utilised as material inputs in recycling processes for the production of secondary raw materials that, then, are manufactured into value-added commodities (Ingrao et al., 2018, 2021).

Recent reviews of the literature seeking to identify the key conceptual elements of the CE and their relationships to other concepts, like Sustainable Development, point to the CE as an alternative model of production and consumption and even a growth strategy that allows resource use to be decoupled from economic growth, thus contributing to Sustainable Development (Geissdoerfer et al., 2017). Therefore, both Sustainable Development (SD) and the CE have now become key concepts for creating a sustainable, low-carbon, resource-efficient, and competitive economy. The relationship between SD and the CE is confirmed by a research done by González-Ruiz, Botero-Botero, and Duque-Grisales (2018), who indicated eco-innovation, eco-design, and waste management as the main trends in CE research, as well as the relations of the CE to Sustainable Development. Cecchin, Salomone, Deutz, Raggi, and Cutaia (2021) and others add that the concept of the CE proposes a rebuilding of the production and consumption system into a regenerative system by closing the entry and exit cycles of the economy, which could help in the transition to a sustainable future. Thus, the concept of the CE follows an evolutionary path similar to that of SD, but at a much faster pace (Cecchin et al., 2021). It should be emphasised that integrating Sustainable Development and the CE with industrial activities should include changes in production processes with a view to minimising their impact on the environment. This involves the development of new ecological products and even the redesign of the business model, which has several environmental and socioeconomic benefits (Kallis, 2011). Despite numerous studies on the relationship between the CE and SD,

as noted by Millar, McLaughlin, and Börger (2019), it is still unclear how the CE promotes economic growth while protecting the environment and ensuring intra- and intergenerational social equality (Millar et al., 2019). Due to numerous doubts raised by authors in the literature on the subject, one can also find more critical voices regarding the CE, which questioned the potential attributed to the CE (Hobson, 2013; Lazarevic & Valve, 2017). The 2011 UNEP Report "Decoupling natural resource use and environmental impacts from economic growth" also reveals that related Sustainable Development concepts and approaches, such as industrial ecology (IE), eco-efficiency, and cleaner production (CP), have contributed to achieving relative but not absolute decoupling from production (UNEP, 2011). Also, according to Kiser (2016), economic growth clearly contradicts the concept of resource efficiency in the supply chain, because the goal of selling more materials and using fewer resources is an environmental paradox (Kiser, 2016). In addition to this, other authors have also questioned the thermodynamic parameters of the CE and emphasise the need to consider environmental impacts and resource consumption when implementing a CE strategy to avoid overestimating their benefits, which is not often done in practice (Bianchini, Rossi, & Pellegrini, 2019; Korhonen, Honkasalo, & Seppälä, 2018). Research by Zink and Geyer (2017) shows how separation can be weakened by the rebound effect (Zink & Geyer, 2017). The social consequences of implementing the CE, an often overlooked aspect in research to date, also need to be addressed (Murray, Skene, & Haynes, 2017; Sauvé, Bernard, & Sloan, 2016; Schulz, Hjaltadóttir, & Hild, 2019).

Sustainable products

Increasing pressure to adopt a more sustainable approach to both product design and manufacturing is one of the key challenges facing industries in the twenty-first century. This situation is moreover influenced by the growing total number of products, the increasing diversity of products and their functions, new types of products being created as a result of innovation, global product turnover, and increasing product complexity (Thorpe, 2015). According to Garg (2015), the manufacturing sector accounts for almost half of the world's total energy consumption, which has doubled over the past 60 years. These are reasons why manufacturers are not only under enormous pressure to be competitive on the one hand through increased productivity, but, on the other hand, under enormous pressure to deliver more sustainable products (due to an increased awareness of environmental responsibility) as well.

Previous research combining the concept of Sustainable Development with products, however, focussed mainly on an ecological product, that is one that is beneficial for the environment (Bhardwaj, Garg, Ram, Gajpal, & Zheng, 2020; Biswas & Roy, 2015; Nuryakin & Maryati, 2020; Qiu, Jie, Wang, & Zhao, 2020; Sdrolia & Zarotiadis, 2019; Tezer & Bodur, 2021). According to Sdrolia (Sdrolia & Zarotiadis, 2019), there are around 50 definitions of green products. On the basis of these definitions, it can be concluded that ecological products aim

to protect or improve the condition of the environment by saving energy and/or resources and limiting or eliminating the use of toxic agents, pollution, and waste (Ottman, Stafford, & Hartman, 2006). Undoubtedly, product research in the context of their environmental impact has made significant progress in explaining how companies can develop greener products that should allow companies to be successful in this area, although this is not always the case (Hofenk, van Birgelen, Bloemer, & Semeijn, 2019).

It is emphasised that products manufactured in the production process interact directly and indirectly with the society (employees, business owners, community, and customers) throughout their life cycle. Therefore, it is necessary to optimise not only the environmental impacts, but also the economic and social ones in an integrated, holistic approach to sustainability (Lin, Belis, & Kuo, 2019).

The concept of developing sustainable products is, in fact, evolving as a key element in cleaner production and in the CE. In response to the shift in environmental policy and legislation (through initiatives such as Integrated Product Policy and Extended Producer Responsibility for packaging cars and electronics), there is an increasing legal, market, and financial pressure on the manufacturing industry to develop sustainable products (Maxwell & van der Vorst, 2003). Since 2001, the European Commission has been putting emphasis on promoting its Integrated Product Policy (IPP) which, as defined by the European Commission, aims at supporting the development of environmental product innovations to achieve a broad reduction in all environmental impacts throughout a product's life cycle (Commission of the European Communities, 2001). It will be important to harness the Green Markets Policy Toolbox through greening on both the demand (consumption) and supply (product development) sides. The IPP is in line with the growing trend in environmentally advanced European countries, towards a product-oriented environmental policy (Charter, 2001).

Research into the definition of sustainable products shows a lack of understanding of the fact that our planet itself is not a sustainable system. Only by adopting this assumption can a sustainable product be defined as:

> a product, which will give as little impact on the environment as possible during its life cycle. The life cycle in this simple definition includes extraction of raw material, production, use and final recycling (or deposition). The material in the product as well as the material (or element) used for producing energy is also included here.
>
> (Ljungberg, 2007)

Whereas Shuaib et al. define a sustainable product through the prism of Sustainable Development as: "Sustainable products are those that provide environmental, societal, and economic benefits while protecting public health, welfare, and the environment over their full commercial cycle". The authors of this definition also point out that the design and production of sustainable products must be based on a comprehensive approach that simultaneously takes into account the economic, environmental, and social aspects of the TBL. To achieve this, you

need to focus on all phases of the product life cycle. Such a holistic approach also often requires the adoption of the 6Rs (reduction, reuse, recycling, recovery, redesign, and remanufacturing) which must be applied throughout the product life cycle to achieve a circular material flow (Shuaib et al., 2014).

According to (Ljungberg, 2007; Zhou, Yin, & Hu, 2009), in order to develop sustainable products, it is required to follow rules such as:

- Reducing the consumption of materials and energy in a product, including services, throughout its useful life;
- Reducing the emissions, dispersion, and toxin formation throughout the product life cycle;
- Increasing the amount of recyclable materials;
- Utilising renewable resources for production;
- Extending the useful life of the product;
- Minimising environmental impact throughout the product life cycle;
- Replacing products with services;
- Utilising "reverse logistics";
- Increasing the performance of the product during the use phase;
- Using materials with low environmental pollution;
- Limiting the use of rare materials;
- The choice of clean materials for the production process;
- Avoiding the generation of hazardous and toxic materials;
- The use of materials with low energy consumption.

In fact, it is extremely difficult to meet all sustainability demands throughout the entire life cycle (Anex & Lifset, 2014). Therefore, in practice, different types of sustainable products emphasise different aspects in relation to different stages of the life cycle. Assuming that a sustainable product is one that meets the challenges of Sustainable Development, that is generates ecological, economic, and social benefits, contributing to the protection of public health, welfare, and the environment throughout the entire life cycle, it can be concluded that it is a form of excellence, an ideal that manufacturers can constantly strive for, perfecting selected aspects of the product (Sanyé-Mengual et al., 2014).

A detailed analysis of selected instruments related to a sustainable product is presented in the following chapters, including:

- Eco-design;
- LCA;
- Management systems;
- Environmental labelling;
- Market contacts and product phases in the marketplace;
- Legislation and precautions;
- Cultural aspects;
- Fashion and trends.

A review of CE-oriented strategies on the European, Italian, and Polish scales for sustainable product manufacturing

The information reported here has been taken from the report titled "Circular economy strategies and roadmaps in Europe: Identifying synergies and the potential for cooperation and alliance building" developed by the European Economic and Social Committee (Salvatori, Holstein, & Bǒhme, 2019). The report reviewed 33 CE strategy documents in support of the European Circular Economy Stakeholder Platform (ECESP).

Strategies were documented to be more effective when the CE was addressed comprehensively and broad partnerships were included in the spirit of the five elements of Sustainable Development (i.e. planet, people, partnership, peace, and prosperity). The inclusiveness of partnerships takes into account the number and type of the different players in strategies and the ways and opportunities for interactions between them. In this regard, the report highlighted that CE strategies have different degrees of inclusiveness in terms of transversal tools and policies, sectors approached, and partners involved. Involvement is considered through specific objectives that depend upon the country making the strategy and its priorities through governance structures or through a combination of the two.

All strategies developed at the European level have aimed to further the transition to a sustainable CE model through a strategic plan that clearly defines objectives and desired outcomes and to include milestones at the end of key-step developments. The transition is addressed comprehensively by considering all of the main stages in value supply chains, namely production, consumption, waste management, secondary raw materials, and innovation and investments. To pick up on what has been said earlier in this regard, Salvatori et al. (2019) emphasised that comprehensiveness is a key added value in the reviewed strategies and so should be taken into consideration in the subsequent, new CE strategies and/or should be maintained in the strategies currently in existence that, however, will be improved in the future. In addition to this, all the reviewed strategy documents were found by Salvatori et al. (2019) to:

- Provide overarching frameworks for in-progress initiatives in different sectors, by different actors, and at different steps in the value chain or development;
- Provide a common objective for each provided activity;
- Describe ways and approaches for transitioning towards a sustainable CE model by defining tools and roles to make the transition clear and transparent for the stakeholders; and so
- Effectively contribute to inspiring other actors to get involved in the transition.

Differences were recorded by Salvatori et al. (2019) based upon the territorial context, as territories can have different opportunities and challenges in making the move to the CE, such as density, industrial clusters, and natural resources.

Strategies were found to follow the approach of closing the material loops in specific supply chains and, alternatively, that of focussing upon integrated, horizontal approaches.

In the light of this, Salvatori et al. (2019) categorised the strategies reviewed, making a distinction between integrated strategies, restricted strategies, and broader strategies with a clear set of priorities.

Integrated strategies, like the ones of Italy, Poland, and other EU countries, represent around 30% of all strategies reviewed. They are politically driven, generally top-down, and focussed on larger geographic scopes. They are typical of territories where the concept of the CE is relatively new to the public debate, as their aim is more to steer public opinion than to provide tools for implementing a full-fledged CE model.

Restricted strategies do not address a wide range of sectors but rather are restricted to only one sector. By contrast, broader strategies represent the major group of strategies in numeric terms, with 19 documents out of a total of 33, and are to be found at all territorial levels and at different levels of CE development.

Among the economic sectors that were analysed in the strategies reviewed, those which recurred the most frequently are manufacturing, construction, waste processing, and the production of foods and feeds.

In addition to this, horizontal themes were addressed to introduce new innovative concepts and practices that contribute to the enhancement of circularity in the aforementioned sectors. The themes which recurred most were found by Salvatori et al. (2019) to be repairing, reusing, and refurbishing; public procurement; design and eco-design; and urban planning and development.

Manufacturing is taken into consideration as it presents some of highest potential for circularisation due to the large quantities of materials consumed and of waste generated. The aim is to ensure that waste is "designed out" of products and that product and process design is done in ways that enable the recycling, recovery, and remanufacture of materials.

Another sector that was found by Salvatori et al. (2019) to be extensively considered in CE strategies is construction, mainly because it is the largest consumer of resources and generates huge amounts of heterogeneous waste. In this regard, ensuring circularity of material flows is one of the key features of the CE that can contribute to enhancing the sustainability of the waste management system.

In the conclusion to their report, Salvatori et al. (2019) highlighted that the reviewed strategies provided a wide range of approaches in many different sectors that can most benefit from application of the CE. Overall, they found those strategies to touch upon the key aspects of the CE and to provide a very good understanding of the challenges and ways forward.

The review report did, however, highlight that there is an urgent need for strategies to develop approaches that are inclusive not just with regard to the value chain but also to the range of partners that Salvatori et al. (2019) recommend should be the widest possible.

Like many other member states, Italy and Poland have also developed a strategy for introducing the concept of a CE to the domestic economy. The CE strategies

that two governments have put together appear to have the features recommended by Salvatori et al. (2019); they are reviewed in the following two sections.

A focus on the Italian strategy

In 2017, the Italian government released the report titled "Towards a model of Circular Economy for Italy" (MiSE-MATTM, 2017), with the aim of providing a general framework on the principles of the CE and of defining the Italian strategic position on such an issue. This section is dedicated to reviewing and building upon the content of that report. The report is part of the process of implementation of the wider strategies that Italy has made for Sustainable Development by the Italian government and specifically contributes to defining objectives like efficient resource consumption and sustainable production and consumption.

In this regard, the "National Action Plan on Sustainable Production and Consumption", set out by Italian Law 221/2015, represents the essential point of departure and is also one of the effective tools available for implementing the national CE-oriented policies and strategies. Six macro-areas of intervention were addressed by the aforementioned Action Plan, as they were identified to form the base of the Italian production system and, also, identified to be highly burdening from an environmental point of view; they were as follows: small- and medium-sized enterprises (SMEs), production chains and districts, agriculture and food production, built environments, tourism, organised distribution, and sustainable consumption and behaviour.

This CE strategy framework was developed around the important challenge for Italy to adequately and effectively respond to the complex environmental and socio-economic dynamics, while maintaining the competitiveness of its production system. In this regard, the document highlighted the importance of making policies that are oriented towards sustainable innovation and, at the same time, increasing the competitiveness of the Italian production and manufacturing system. Therefore, Italy is required to initiate a paradigm shift that is based upon rethinking and redesigning the ways to consume and do business, taking it as the opportunity to develop new business models that maximise the value of "*Made in Italy*" and the role of SMEs.

In this regard, the report highlights that transitioning towards CE means culturally and structurally triggering a radical change that provides a profound revision of the Italian patterns of consumption to abandon the conventional, unsustainable linear model of the economy and establish a well-rooted trend in innovation.

An important part of the report was the one dedicated to an analysis of the Italian context, highlighting the importance of transforming necessities into opportunities. Key necessities were identified as improving both the efficiency and sustainability of resource consumption and waste management: the latter was identified by the Italian government as being central to the process of transitioning to a sustainable CE.

Opportunities are based upon designing products in a way that, when they reach the end of their useful life, they are treated as zero-burden resources to feed into

downstream production cycles. From this perspective, Italy is a technologically advanced country, with a strong background in innovation and sustainability, which must necessarily move to adopt the current European vision of transition towards sustainable CE models by using opportunities to create and promote concrete initiatives.

As is known to be the case, the CE brings many environmental and social benefits and allows natural capital to be preserved by reducing pressure on resources and on land by reducing its use for the disposal of waste in landfills. This was highlighted in the report to be an issue of considerable importance for a country like Italy where the natural factor is actually one of the main levers of economic development, as shown by the growing demand for sustainable and cultural tourism prior to the COVID-19 pandemic.

In the report, it was highlighted that, from an economic point of view, building a CE means stimulating the creativity of Italian entrepreneurs as a function of the economic value embedded in the reuse and recovery of materials that, in this way, never become waste. In this regard, the report puts due emphasis upon the need to rethink the concept of "waste" and states that one of the key challenges that the transition poses to all stakeholders, from politicians to citizens, is to consider what is now waste as an element from which value can be extracted, "*a brick for a new production cycle*".

In this regard, Italian SMEs are being called upon to invest effectively in research and development, with the aim of rethinking and changing their production models and of consolidating their presence in the global value chain. In addition to this, implementing and spreading the CE throughout the country would help to transform the current well-known problems of the Italian production and manufacturing system into opportunities for sustainable forms of innovation, improvement, and growth. According to the report, waste recycling and recovery in line with the principles of the CE to produce value-added material and energy commodities can help to make countries like Italy, which are poor in raw materials, less dependent upon foreign procurements, with lesser vulnerability to the volatility of market prices. The reduction of the dependence on foreign countries should be, however, coupled with the rationalisation of the production and consumption systems in order to optimise the costs of production activities with benefits for both businesses and citizens. This would increase the Italian competitiveness on the international scale, thanks to the higher quality at lower prices, and, to achieve that, the market for secondary raw materials needs to be developed and consolidated, as also recommended by Potting et al. (2017).

At the end, the importance for all CE-based actions to be measurable by indicators was highlighted in the report, as being essential to give substance to those actions to be pursued towards greater transparency for the market and for consumers, as well. From this perspective, the Italian government is making quite a lot of effort to identify suitable indicators that enable the circularity of the economy and the efficient usage of resources to be measured and monitored at the macro- and micro-level.

A focus on the Polish strategy

The Polish CE strategy was adopted by a resolution of the Council of Ministers in September 2019. Over 200 social and economic partners as well as representatives of central and local government administration participated in the development of the Circular Economy (CE) strategy for Poland. It should be emphasised that in the work on the strategy, existing experience related to the implementation of other CE-related concepts was used, such as Sustainable Development, green economy, or cleaner production. This procedure was deliberate, with the aim of achieving greater coherence of measures in the field of CE with measures in other areas of socio-economic development in Poland. As a result, the Circular Economy Road Map is one of the projects of the Strategy for Responsible Development, fitting into the overall vision of the country's development (Kuzincow, 2018).

Basically, it can be said that the Circular Economy Road Map, like that of Italy, is a document that contains a set of tools aimed at creating conditions for the implementation of a new economic model in Poland. The proposed activities relate primarily to analytical, conceptual, informational, promotional, and coordination tasks. The Polish Circular Economy Road Map is based upon the CE model, commonly used in the EU, and developed by the Ellen MacArthur Foundation, that is it assumes the existence of two biological and technical cycles (Webster, 2020).

The Polish Circular Economy Road Map consists of five chapters.

Chapter I "Sustainable Industrial Production" emphasises the important role of industry in the Polish economy and new opportunities for its development. It is noted that in Poland there is a great potential for improvement in the field of industrial waste, in particular from mining and quarrying activities, industrial processing, as well as energy generation and supply. Running a production activity that generates less and less waste as well as the management of as much industrial waste as possible from this activity in other production processes and in other sectors of the economy may significantly contribute to increasing the profitability of production in Poland and reducing its negative impact on the environment.

Chapter II "Sustainable Consumption" discusses actions aimed at consumers as part of the transformation towards a CE. Among them, attention is paid to ensuring the availability of information on repair and spare parts, better enforcement of warranties, eliminating false claims about environmental impact, and determining the maximum shelf life of a product without harming the consumer and the environment.

Chapter III "Bioeconomy" concerns the management of renewable resources (the biological cycle of the CE), which seems to have unexploited potential in Poland. The Circular Economy road map focuses, on the one hand, on general activities aimed at creating conditions for the development of the bioeconomy in Poland and, on the other hand, on activities related to the development of bioeconomy in selected areas, that is in the area of creating local value chains in industry and in the energy sector.

Chapter IV "New Business Models" indicates the possibilities of reorganising the ways of functioning of various market participants based on the idea of the CE. In this part of the Circular Economy Road Map, it mainly refers to business models of enterprises, understood as the sum of resources and activities that simultaneously serve to provide value for the customer and to "close the loop".

At the end, Chapter V concerns the implementation, monitoring, and financing of the CE. It should be emphasised that the concept of CE is firmly established in the country's strategic documents, including the SRD, the draft Productivity Strategy and the draft National Environmental Policy. As the basis for the country's development policy, these documents are, and will continue to be in the future, a reference point for directing the support system in the area of CE, including in particular the Cohesion Policy and the Common Agricultural Policy (Rada Ministrów, 2019).

In line with European practice, the goal of the Circular Economy Road Map is to indicate horizontal measures that would concern the largest possible segment of socio-economic life. It also prioritises areas whose development will make it possible to take advantage of the opportunities facing Poland and, at the same time, will address the currently existing or expected threats. Poland's priorities within the CE include innovation, strengthening cooperation between industry and the science sector, and the implementation of innovative solutions in the economy as a result; creating a European market for secondary raw materials in which their circulation is easier; ensuring high-quality secondary raw materials that result from sustainable production and consumption; and development of the service sector (Smol, Kulczycka, Czaplicka-Kotas, & Włóka, 2019).

Conclusion

One of the key factors determining Sustainable Development is the ability to associate the laws of ecology and economy in decision-making processes (Fernandes, Limont, & Bonino, 2020). It is essential that this process takes place at all institutional levels, both at the level of policy of states and enterprises and at that of households. Therefore, balancing economic goals with environmental and social goals is a big challenge not only for modern producers and consumers, but also for governments, social organisations, and other economic actors (Eisenmenger et al., 2020).

Environmental protection requirements have a significant impact on enterprises, including due to the applicable legal regulations that regulate it (Jose et al., 2020). However, environmental protection is perceived as a source of additional costs, because, for example, enterprises have to budget for the growing costs of using the environment and outlays for environmental protection in their budgets. Therefore, modern company management should perceive environmental protection as an integral part of the management process (Haldar, 2019).

To this end, it is necessary to change the current linear model of the economy into a sustainable circular one. The objective is to achieve the highest possible level of recovery and recycling of waste and then its re-management in production.

Creating a CE model requires meeting certain conditions while promoting a policy based on renewable resources in natural processes.

The key task will also be to develop products focussed on the production of products and services that are safe for the environment. It is possible to implement this principle by giving products ecological features already at the design stage. It is therefore important to design in a way which allows the transfer of waste with certain properties back to the production process or for its use by other entities. At the design stage, it is also recommended to use one of the models of operation within the CE, that is the ReSOLVE model or the R strategy. The ReSOLVE model is implemented through six paths of action, that is regenerate, share, optimise, loop, virtualise, and exchange. The R strategy is to reduce the consumption of resources and materials throughout the entire life cycle. It allows for the formulation of a CE strategy while maintaining the basic function of the product. It is therefore important to stimulate innovation in the field of environmentally safer products, not only through the development of cleaner technologies but also cleaner products through the dissemination of a life-cycle approach.

It is also worth returning to re-examine new phenomena in the sphere of consumption. Not only the state but also other market participants, including consumers (Tunn, Bocken, Van Den Hende, & Schoormans, 2018), must undertake activities with the aim, *inter alia*, of promoting environmental protection. That is why it is so important to raise environmental awareness and shape a modern image of effective economic processes based on ethical and ecological components (Nikolaou, Tsalis, & Evangelinos, 2018). The condition for the functioning of the CE model is reliable knowledge resulting from the high environmental awareness of all market participants. One of the key challenges, therefore, is to develop a system that not only educates consumers about the environmental impact of products throughout their life cycle, but also, at the same time, gives producers the opportunity to inform consumers about the benefits of their products. One such solution is eco-labelling, which is considered to be one of the key tools of consumer education in the field of environmentally friendly products (Bertrandias & Bernard, 2017; Buelow & Lewis, 2010; Martino, Nanere, & Dsouza, 2019). One of the undoubted benefits of buying organic products is that it reduces the negative impact of humanity on the environment and thus helps us achieve the main goals of sustainable production and consumption. It depends, however, on the increased environmental awareness of consumers. Consequently, environmental education is a key communication and information tool, and its aim should be to make the consumer able to consciously interpret the eco-label and make the right product choices based on it. If this condition is not met, an overabundance of information from advertising and marketing campaigns will lead to target audience members misinterpreting messages from senders. However, if they are to have a positive effect, the eco-label must be scientifically standardised and the environmental awareness of consumers raised.

Another challenge is to implement an effective strategy of replacing traditional products with sustainable products. A key element of the strategy should be to set

the prices of sustainable products at the right level. The customer will be interested in such a product if he or she experiences a direct financial benefit. Preferential prices for this type of products can be achieved, for example, through differentiated taxation (applying a reduced VAT tax on biodegradable products). Therefore, it is important to create and support markets for more environmentally friendly products using, for example, preferential pricing and tax policies, a well-functioning environmental labelling system, and an administratively strong system of standardisation.

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