What's in a name? The rising star of the circular economy as a resource-related concept for sustainable development

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Abstract

The most popular definition of sustainable development, which can be found in the Brundtland Report, sets an ideal goal but does not provide a clear direction for the implementation of sustainable solutions. Other related concepts and approaches have emerged as means to progress towards sustainability in a more pragmatic way, such as the circular economy. The circular economy has risen to prominence at a rate and on a scale to rival the idea of sustainable development itself. This is despite the fact that there is relatively little about the circular economy that is entirely original – it draws heavily on precursor concepts such as industrial ecology and industrial symbiosis. These ideas have received renewed impetus even whilst being eclipsed in both academic and policies debates. In order to address this paradox and help establish the identity and contribution of these fields, this article presents the concepts of circular economy, industrial symbiosis and sustainable development, summarizing their complex and often intertwined evolutionary paths, focusing on relevant developments and implementation challenges. In addition, the authors point out the divergences and interrelations of these concepts, and link them to other adjacent concepts and research fields, such as ecological modernisation and the green economy. Additionally, the potential contribution of industrial symbiosis and the circular economy to sustainable development and to the Sustainable Development Goals set in the United Nations Agenda 2030 is briefly discussed.

Keywords: Circular Economy, Sustainable Development, Sustainable Development Goals, Industrial Symbiosis, Industrial Ecology, Green Economy.

1. Introduction

The growing interest in sustainability issues and in how to build a resilient, fair and environmentally responsible economy made the sustainable development (SD) concept an overarching and driving ideal goal in many

international and national policy agendas, academic research, and company strategies. There is little room to doubt the prominence of the sustainability discourse from international institutions (e.g., United Nations, European Union), while national responses are more heterogenous. However, the appropriateness and sincerity of individual initiatives, as well as how to make the SD concept more operative and less vague [1, 2], can and should be debated.

The UN-sponsored Brundtland Report [3] popularised the term SD, providing the definition which remains the benchmark for many policy makers and scholars: SD is the development that "*meets the needs of the present without compromising the ability of future generations to meet their own needs*" [3 p. 8]. Arguably, what was inspirational about this definition was that it shifted the focus of the discussion from "*what should not be done to stressing what should and can be done*" [4 p. 315]. Earlier approaches to incorporating resource management and environmental quality into economic considerations included the deployment of economic models as rationale for the need to restrain development in response to Malthusian concerns for the effects of unrestricted growth - e.g., prominently the Club of Rome [5, 6]. These concerns coincided with pressure from less wealthy countries for a share of the benefits of economic growth. Perhaps unsurprisingly, the term that captured the imagination of policy makers and academics alike was one that stressed there was a positive route to be taken, requiring a balance between the three pillars of SD: environment, economy and society. To date, many academic definitions of SD have been produced [7]. Furthermore, the term is variously used (or abused) by policy makers and companies to justify their actions [8], although arguably a consensus is beginning to emerge [9]. However, although the Brundtland report offers numerous suggestions, the term itself is an ideal goal and not a road map showing how that positive vision can be achieved. Rather, SD quickly became a buzzword [10], contributing to deaden the most revolutionary aspects embedded in the core of this novel idea.

Alongside the development of SD, a number of concepts have emerged that address various aspects of the field of ambition it covers. The circular economy (CE) is but the latest of these. The precise meaning and scope of CE remains subject of debate, but is in its origins a strategy for resource management. In this it follows closely a particular thread of sustainability initiatives, notably the closely related concepts of industrial ecology (IE) and industrial symbiosis (IS).

In this context, this article aims to summarize the complex evolutionary path of SD, recalling both developments and implementation challenges and charting the emergence of IE, IS and CE. Indeed, these three concepts are becoming fundamental for promoting a more pragmatical pathway towards sustainability. As we will discuss, however, the CE has become a dominant term in academic and policy discourse, far outshining the related concept of IS.

First, various concepts that have been identified as supporting SD are identified, considering the co-development of policy and academic approaches and pointing out the divergences and interrelations of these concepts (and other related research fields), in order to highlight the interconnection between those approaches and concepts. Then, the emergence of CE is examined, followed by an analysis of its relationship with first IS and then SD, also identifying critical issues and trade-offs, as well as gaps in research and application, especially relating to the social component of sustainability. Particular attention is given to the connections to the Sustainable Development Goals set in the United Nations (UN) Agenda 2030, as the current yardstick of sustainability.

This article is an updated and expanded version of a previous contribution published by the authors [11] in the book "Industrial Symbiosis for the Circular Economy" [12].

2. The changing faces of sustainable development

Over the last thirty years the challenges of implementing SD have become increasingly apparent. An example of this struggle can be found in the changing rhetoric from the UN, where the initial ambitions set during the first Earth Summit (1992) were reconsidered after becoming more aware of the complexities entailed in the SD challenge (see the statements following the 2002 and 2012 Earth Summits).

In addition, over the time new terms have been coined (and areas of research explored) to boost the implementation and/or the theoretical understanding of SD, variously influencing the policymaking sphere: ecological modernisation (EM), green economy (GE) and green growth, industrial ecology, and, more recently, CE.

The Rio Summit in 2012 promoted the idea of GE – i.e., not just that economic development should be environmentally benign, but that the environmental agenda itself can generate growth. A further expectation of the GE is that it should fulfil social sustainability criteria as well as economic and environmental ones. Even though the GE concept was firstly coined in 1989 [13], both GE and green growth received increasing attention in political agendas over the past ten years [14]. The OECD issued the Green Growth Declaration [15] and the Green Growth

Strategy Package [16], while the UNEP championed the GE concept between 2010 and 2011 and defined it "*one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities*" [17 p. 5, 18]. However, also in this case lively debates emerged on the interpretations of the concepts, their implementations, and their multidimensional nature [14].
The GE has itself become a major area of academic research [19, 20], building on and expanding the academic concept of EM. The latter term refers to the potential (to some extent observed) for innovations to bring simultaneously economic and environmental benefits [21-23]. Thus, regulatory implementation of environmental measures opens economic opportunities as well as potentially increasing costs. Social issues are most typically not considered, or it is assumed that social and economic benefits come together.
EM originated with the main aim to introduce a more analytical and sociological concept compared to the Brundtland's SD concept and reform the environmental policy discourse with a technology-based approach [24-25]. It has then developed with a great diversity, causing that the concept has been used in different ways by different authors [25]. Therefore, EM became a substantial area of academic debate [26], but although arguably EM is the hallmark of European Union (EU) environmental policy, the EU itself refers to its aims as SD [27]. Both these terms fell a little out of favour, however, driven perhaps by the need of academics to say something new in a world where the issues are depressingly familiar. But SD has once again received a major boost as a subject for academic research (alongside research relating to issues connected to, but not necessarily labelled as SD, such as environmental management, or sustainability transitions) as a result of an intervention by the UN. Following the mixed success of the Millennium Development Goals, the debates around and announcement of the Sustainable Development Goals [28] has put the SD firmly back on the academic agenda. The SDGs themselves are subject for debate -- e.g., [29] -- as well as providing a holistic framework for the myriad activities covered by the targets underlying the goals.

Another area of theoretical and applied research that has contributed to identify new ways to combine economic development with a sustainable resource management is IE. IE is an interdisciplinary field of research that aims to learn from the organizational and regulating mechanisms of natural ecosystems and apply them to industrial systems, by closing material loops and searching for an improvement of the economic and environmental profile of the organizations involved [30-33]. Under the IE umbrella the IS concept emerged as a business focused approach to promoting sustainability by recovering residues from one entity for use in another [34]. It has been described as "*a strong ally for the achievement of environmental, economic and social objectives*" [35 p.23], though of those social objectives are perhaps the poor relation. Many open questions still remain on which future research on IS should focus, e.g. circumstances that favour IS, incidence of spatial and temporal variants, stakeholder engagement, etc. [35-37].

In more recent years, a new term – CE – has risen to a swift and remarkable prominence to become one of the most widely debated and researched approaches to the implementation of SD [38-39], as well as an essential strategy within EU policy [40]. Indeed, the CE concept proposes a regenerative and restorative system of production and consumption by closing the input and output cycles of the economy that could help the transition to a sustainable future. However, its sustainability implications are still under construction and debate [40], and efforts to research and apply the social aspects of the CE are at their early stages.

3. Emergence of the circular economy concept

The CE concept follows an evolutionary path similar to the SD's one, but at a much faster pace. It is not, to a large extent, a new idea. The roots of the concept can be traced to prior concepts and fields of study including not only IS and IE, but also cradle to cradle, regenerative design, cleaner production, life cycle management, ecological economics, performance economy, zero waste management, sharing economy [40-45]. However, the formalisation and subsequent popularisation of the CE, has rapidly outstripped that of any of the contributory concepts.

The crucial contribution of the policy making sphere to the rise of the CE has had a significant impact on the academic world as well, which has rapidly attempted to fill the apparent knowledge gap and create some specific theoretical and operative frameworks to support the decision-makers' work. Policy activity provides an object for study for academics, who are increasingly under pressure to show not just policy relevance, but effect [46]. Such influence of policy on academic activity becomes quickly evident by cross-checking the key milestones of the CE regulation with the scientific production on CE. China introduced the concept of CE in 2002, but only in 2009 the "Circular Economy Promotion Law" took effect and was incorporated in the 11th (2006-2010) and 12th (2011-2015) five-year plans for National Economic and Social Development [47, 48]. However, the use of the term CE

in the Chinese policy is essentially as an equivalent to IE [49]. The explosion in academic and policy interest outside of China has followed the adoption of a more broadly defined concept by the EU. In 2015, the European Commission launched its ambitious initiative "Closing the loop: An EU Action Plan for the Circular Economy Package" [50], which was fully completed in 2019 by identifying and, to some extent, implementing 54 measures aimed at achieving a CE within the European Union [51]. CE has also been incorporated as a key element of the European Green Deal which provides an action plan to boost the efficient use of resources by moving to a clean and circular economy [52]. Lieder and Rashid [53] conducted a literature review on CE considering the major contributory fields and geographical focus of research. They found that the number of publications in the field started growing at an almost regular pace since 2009 -- also confirmed by [42] -- and that in the period of 2005-2015 the predominant geographical focus was China, while European research started showing a significant increase from 2015 [42]. Furthermore, the breadth of the concept has attracted not just those involved in the component fields, but other diverse social science backgrounds - e.g., [54]. Friant et al. [40] developed a circularity discourse typology: by taking a holistic interdisciplinary perspective, they found more than 70 CE-related concepts and highlighted that the term is much older and much more diverse than is usually imagined.

One of the strongest criticisms of the concept of SD is that it has not aimed at creating a clear alternative to the dominant development strategies. Rather it has provided a generic adjustment in order to include social and environmental aspects in the established models, without setting clear criteria and paths [55]. CE seems to provide a better-defined alternative model to the current pattern of production and consumption, at least from a theoretical viewpoint. It proposes a radical shift from the dominant linear model (take-make-use-dispose) to a cyclical and restorative model [41, 56]. Therefore, building a CE entails the adoption of a systemic approach in designing, planning and managing production and consumption systems, with the purpose of using resources (materials, energy, water) the longest time possible within the system itself, and minimising the need for raw materials and non-renewable resources. This is the reason why CE has the potential of becoming an effective operative strategy to pursue a SD. CE can identify and build a path to reach sustainability, a key element that the core concept of SD has never clearly outlined [57]. This reasoning, however, also applies to the precursor concepts of CE. IE draws on a metaphor with ecosystems, asserting that taking lessons from nature can make economic systems more energy and material efficient ('life cycle' thinking, system scale optimisation, conceptualising material recovery as the closing of loops) [31, 58].

3.1 Circular economy and industrial symbiosis

IS is a prominent sub-field of IE which focuses on the closing of pre-consumer (i.e., industrial) loops by capturing the residues from one entity as the inputs for another - e.g., [34]. Thus, both can be seen as forms of EM (innovation with economic and environmental benefits), and promoting aspects of SD [59]. But whereas the broad definition of SD implies the possibility of maintaining the present economic system (but more benign socially and environmentally), and EM suggests financial advantage (at least to some), IE and IS have a specific set of actions attached [59]. IS was taken up at first largely by engineers as offering a solution to problems of industrial waste. Other works subsequently began to consider the economic, regulatory barriers to IS. This combination of political acceptability, economic desirability and deceptively simple technological requirements led to a large body of academic research and widespread policy interest in IS, which fed off each other – just to mention an example: the UK government's support for the National Industrial Symbiosis Programme (2005-2012), which inspired implementation efforts abroad [60] as well as research [61, 62].

However, the terms IE and IS never captured the policy, public or academic interest in the way that the CE already has. This may partially lie in the efforts of the Ellen MacArthur Foundation (EMF) to promote the CE, backed by an extraordinary array of corporate sponsors. Although purely speculative, the terms "ecology" and "symbiosis" may be more off-putting to non-academic audiences than "economy", though hardly more difficult to understand. Potentially, the far broader nature of the term "circular economy" enables a preoccupation with recovery, rather than emphasis on less positive sounding waste, and also offers the tantalising prospect that with the aid of design we can avoid resource/pollution problems altogether. In addition, the advantages of IS in terms of providing a specific route to SD proved difficult to accomplish, requiring high levels of collaboration, information exchange and a technical match between the inputs and outputs of diverse organisations [63]. However, it should be highlighted that also building a CE means introducing innovative patterns of interactions between actors based on cooperation and sharing mechanisms [38]. It remains to be seen whether the greater policy drive and present enthusiasm for CE is sufficient to overcome such challenges. Potentially, other CE options require less

specific collaboration than IS. For now, CE is perhaps the ultimate SD concept, incorporating optimism, potential economic gain, and such a wide variety of potential actions that for academics and other stakeholders alike there is something for almost everyone, whilst avoiding too much scrutiny on any one option.

3.2 Circular economy and sustainable development

In line with SD, CE aims at generating an overall system shift towards a more responsible and efficient way of managing natural and technological resources. However, although it would appear that the CE offers approaches to development that would meet the criteria of SD (at least allowing economic activity that is arguably less material and energy intensive than non-circular alternatives), the conceptual relationship between CE and SD remains unclear [42, 64]. Although, as above mentioned, the CE is referred to as a tool for sustainability (which by definition includes social considerations), the proposed social benefits of a CE remain untested [65].

Many scholars and policymakers do not explicitly consider SD in their definitions of the CE. The EMF's list of CE principles in their guide for CE implementation [66] does not include a social principle. In their analysis of 114 definitions of CE in peer-reviewed and other works, Kirchherr and colleagues [67] could establish an explicit connection between the CE and the notion of SD in only 12% of the definitions, while 13% mentioned all three components (environmental, social and economic) commonly associated to SD. The most common element between the 114 definitions was resource efficiency, which fits the widely perceived origins of CE in concepts which do explicitly relate to that, such IE. An extensive quantitative review of CE studies indicates that work considering social aspects of the CE remains marginal [64], with the vast majority considering management and/or technical aspects relating to beginning or end of life strategies. In their systematic literature review of sustainability assessment approaches applicable within circular inter-firm networks, Walker et al. [68] found that the social dimension is the least integrated into the sustainability assessment. It therefore remains a matter of debate to what extent the CE should be seen as an EM concept as opposed to a GE concept – i.e., essentially, does it incorporate social aspects of sustainability?

The question arises as to whether a precise and agreed definition of CE would be beneficial. Blomsma and Brennan [69] conceptualize CE as an umbrella concept, that is a broad concept that is used loosely to encompass previously unrelated concepts by focusing on their shared characteristics [6, 70]. This approach may help protect the concepts that feed into CE, and avoid the term becoming either deeply contested or so broad that it is simply a synonym for SD.

In contrast to EM policy and academic approaches, though, there are elements of degrowth in CE strategies [71], which is arguably a connection to the GE. Approaches to circularity like repair and reuse, or sharing practices, will not only keep goods out of the waste stream, but would be expected to also reduce demand for new ones. However, it must be stressed that shifting from manufacturing goods to providing services may not necessarily mean degrowth. The employment implications of that are uncertain, though there will likely be geographic consequences as the centres of manufacturing are offset from the loci of affluent western consumers who tend to be the target of degrowth visions. Whether their lower-income neighbours are content with repaired cast offs also remains to be seen.

The "CE era" is still at its early stages, and multiple issues and trade-offs related to spatial, temporal and scale impacts of applying the CE's principles to the current production and consumption patterns have not been yet extensively explored. There are still multiple potential "unintended consequences" from implementing a CE that need to be properly addressed [48]. For instance, boosting a CE-oriented market in a given region can generate negative socioeconomic and environmental impacts in a different geographical context. Such issues can - to an extent - be addressed, or at least monitored, by the life cycle assessment tools. These need to be refined to be suited to the principles of the CE, including the consideration of social aspects [72, 73]. However, there may be limited opportunities for those measuring life cycle impacts to influence the geographic outcome of economic activity. Such wider social/geographic and development issues have been discussed with respect to IE [74], and apply equally to the CE. A notorious example is related to some unsustainable dynamics of global supply chains, such as the flow of some types of waste from developed to developing countries, shifting the environmental burden of a product life cycle outside the main market, while eventually receiving the final benefit of the recovering process (e.g. recycled raw materials). It is worthwhile noting that this conflictual dynamics at global scale is still a key problem in the broader field of SD, in particular when dealing with relations between developed and developing economies. Thus, identifying CE strategies that are able to responsibly address spatial and multiscale interactions would greatly contribute to SD at the global scale as well.

4. The interlinked contribution of circular economy and industrial symbiosis to the Sustainable Development Goals

As mentioned, IS is a strategy for recovering unused resources for use by another entity. Although the concept of IS originated and developed within the field of IE, it has from the early CE literature been identified as essential element of the CE [75], which is now well recognised at international level [49, 76-79]. Indeed, IS provides the definition of what can be considered the meso-level perspective of circularity[1]. Geographically, IS is often seen as a local to regional scale initiative, though in practice loop closing may occur at any scale up to global [84]. The whole CE scholar community - in an explicit or implicit way - acknowledges the key role of IS in shaping and implementing the concept of CE - among others: [38, 39, 48, 53, 85-88] - and so too the policymakers [47, 50, 89, 90]. For instance, in the European context the New Circular Economy Action Plan [91] sets the target of launching an industry-led IS reporting and certification system by 2022. At international level, in September 2018, the ISO (International Organization for Standardization) launched the Technical Committee 323 (ISO/TC 323) on Circular Economy, which is organized in 4 main working groups:

- Framework and principles for implementation
- Guidelines on business models and value chains
- Measuring circularity framework
- Performance-based approach – Analysis of cases studies.

Within the ongoing ISO TC 323 discussions, IS plays a crucial role as a recognised approach for the implementation of the CE at industrial and territorial level. Works are currently ongoing and the final main outputs are expected to contribute to, among others, multiple United Nations' SDGs, such as SDG 8 (Decent work and economic growth), SDG 12 (Responsible consumption and production), SDG 13 (Climate action), and SDG 15 (Life on land).

Attempts to identify the contribution of CE to SDGs and Targets have already been made in literature (e.g., [92]). However, the CE is still an in-progress field of study from both theoretical and pragmatic perspectives, which make the CE-SDGs matching exercise a difficult task to perform. IS provides a better-defined CE sub-field to start looking into the ties between CE and SDGs. The potential of IS in contributing to SD can be seen fairly clearly as promoting resource efficiency (material, energy, water but also services and knowledge) for industry, which has been argued to generate cost savings, with increased competitiveness and consequent potential for social benefits (primarily envisaged as job-related) [93]. In a recent publication, Schroeder and colleagues [92] identified a list of potential contributions of IS to the UN SDGs [28]. More specifically, the authors found a strong association between IS and SDG 3 "Good health and well-being" (Target 3.9), SDG 6 "Clean water and sanitation" (Target 6.3), SDG 8 "Decent work and economic growth" (Target 8.2), SDG 9 "Industry, innovation and infrastructure" (Target 9.4), and SDG 12 "Responsible production and consumption" (Target 12.4). It is our opinion that IS can contribute to achieving even more SDG's Targets - in particular within the SDG 9 and 12 - and further SDGs as well (Table 1).

[1] Many authors -- such as: [49, 80, 81] -- pointed out that there are three perspectives in the implementation of CE strategies:

- the *macro level* perspective aims to adjust the global and/or national economy structure promoting sustainable production and consumption activities through efforts in designing and implementing proper public policies;
- the *meso level* perspective refers to closing resource loops mainly developing industrial symbiosis initiatives and eco-industrial parks;
- the *micro level* perspective focuses on products, companies and consumers.

Some authors identify a fourth level of circularity -- e.g.: [82, 83] -- the *nano level*, proposing it as the lowest level of analysis possible referred to products and components, while at the micro level refers to companies and consumers.

Table 1. IS potential contribution to the United Nations' SDGs (Sources: [28, 93], authors' elaboration).

Sustainable Development Goal	Specific Target*
SDG 2 ***End hunger, achieve food security and improved nutrition and promote sustainable agriculture***	2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality
SDG 3 ***Ensure healthy lives and promote well-being for all at all ages***	3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination
SDG 6 ***Ensure availability and sustainable management of water and sanitation for all***	6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
SDG 7 ***Ensure access to affordable, reliable, sustainable and modern energy for all***	7.2 Increase substantially the share of renewable energy in the global energy mix by 2030
	7.3 By 2030, double the global rate of improvement in energy efficiency
SDG 8 ***Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all***	8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors
	8.4 Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead
SDG 9 ***Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation***	9.2 Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries
	9.3 Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets
	9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities
	9B Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities
SDG 12 ***Ensure sustainable consumption and production patterns***	12.2 By 2030, achieve the sustainable management and efficient use of natural resources
	12.3 By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses
	12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment
	12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse

* Underline added by authors. The extent of the potential contribution of IS to meet the SDG Targets can vary, from a very limited impact (e.g. Targets 7.2 and 7.3) to a more significant contribution (e.g. Targets 12.4 and 12.5).

5. Concluding remarks

A brief introduction on the origin and evolution of the CE has been presented in this article, highlighting its close relationship with contiguous SD-related fields of research such as IE, EM and GE. Particular emphasis was given to contextualize CE and IS (one of the CE key operational strategies) in the light of the current debate on SD and to explore the reasons for the greater policy drive and enthusiasm for CE respect to IS and IE. This is further analysed also pointing out the potential contributions of IS and CE to the achievement of the SDGs proposed by the United Nations [28].

Understating the nexus between these three concepts – CE, IS and SD - is essential to coordinate policies and actions towards the common goal of a sustainable society. That said, will the CE be able to deliver the promise of a truly sustainable production and consumption system? Will IS be the leverage of this "CE revolution"? The answer to these questions is probably taking shape in this very moment, through the implementation phase of the CE principles across the globe. Although the first major policy frameworks and initiatives took place in Europe and Eastern Asia, the CE is rapidly becoming a global experiment. From Latin America to Africa and across Asia, CE scholars and practitioners have been establishing networks, developing policies and launching local and regional projects [95]. By bringing in different cultural perspectives and frames, this fast-growing global movement will most likely challenge the neoliberal growth paradigm that is still embedded in most CE definitions and bring into the debate some post-development insights. We are becoming more aware that if the main roots of the CE concept are mostly techno-centric, the substrate that allowed them to develop is much more complex and diversified [40]. The CE is not only a technological and business-oriented issue, social and institutional contexts matter. Analysing and discussing the CE principles through the lenses of diverse socioeconomic and cultural environments will also give us a clearer view of the social dimension of the CE and, hopefully, accelerate the debate on this topic. As theorized by Schröder and colleagues [96], if we can combine the CE and the human development approach in a unique framework, CE might be able to directly contribute also to those SDGs that are more tied to the social component of the SD, such as SDG 1 (No poverty), SDG 3 (Good health and well-being) and SDG 10 (Reduced inequalities). Nonetheless, we argue that the CE should not lose sight of its beginnings as a resource efficiency strategy akin to IS – one reason for the rise of CE being the strategies it offers. Sliding into a more amorphous, if comprehensive, concept would simply make CE ripe for replacement by something else.

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