

The private sector's role in Colombia to achieving the circular economy and the Sustainable Development Goals

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Abstract

The circular economy (CE) and the Sustainable Development Goals (SDGs) are two well-known initiatives to address issues like social injustice, environmental pollution, and resource scarcity. While these two initiatives have received the support of the Colombian government through plans and strategies, little is known about the involvement of private companies. The aim of this study was to examine the CE and SDGs' implementation in the Colombian private sector. The entities linked with the United Nations Global Compact served as the study population, which was assessed by a semi-structured survey whose data was handled by descriptive and non-parametric statistics. Findings indicate that 75% of the entities are supporting the SDGs and adopting the CE model simultaneously. The food and transportation sectors show the highest levels of alignment towards CE, followed by mining and manufacturing. Waste management is the most implemented type of CE practice (65%), while supply chain management is the least (20%). The SDGs that receive the most attention are SDG 17, SDG 6, SDG 16, and SDG 12. Conversely, SDG 2 and SDG 5 receive the least support.

Keywords: 2030 Agenda; SDG; organizations; sustainability reporting; circularity; project management.

El rol del sector privado en Colombia para alcanzar la economía circular y los Objetivos de Desarrollo Sostenible

Resumen

La economía circular (EC) y los Objetivos de Desarrollo Sostenible (ODS) son dos iniciativas conocidas para abordar problemas como la injusticia social, la contaminación ambiental y la escasez de recursos. Si bien estas dos iniciativas han recibido el apoyo del gobierno colombiano a través de planes y estrategias, poco se sabe sobre la participación de empresas privadas. El objetivo de este estudio fue examinar la implementación de la EC y los ODS en el sector privado colombiano. Las entidades vinculadas al Pacto Mundial de las Naciones Unidas sirvieron como población de estudio, la cual fue evaluada mediante una encuesta semiestructurada cuyos datos se manejaron mediante estadística descriptiva y no paramétrica. Los hallazgos indican que el 75 % de las entidades están apoyando simultáneamente los ODS y el modelo de EC. Los sectores de alimentos y transporte muestran los niveles más altos de alineación, seguidos por los sectores de minería y de manufactura. La gestión de residuos es el tipo de práctica de EC más implementada (65 %), mientras que la gestión de la cadena de suministro es la que menos (20 %). Los ODS 17, ODS 6, ODS 16 y ODS 12 son los ODS que reciben más promoción. Por el contrario, el ODS 2 y el ODS 5 son los menos respaldados.

Palabras clave: Agenda 2030; ODS; organizaciones; informes de sostenibilidad; circularidad; gestión de proyectos.

1 Introduction

The execution of the conventional concept of economic growth results in social and environmental imbalances [1].

Negative effects of human activity on the climate, ecosystems, and planetary boundaries have raised the possibility of environmental changes that are harmful to human well-being [2]. By 2050, it is anticipated that the yearly global raw material

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exploitation will quadruple, resulting in a 90% loss of biodiversity [3]. Future shortages of agricultural land, fossil fuel sources, and minerals may drive up prices and cause issues that worsen a worldwide catastrophe [4]. As a result, one of the key goals of government policies is to support activities that encourage an economy that is socially just and environmentally conscious, which gives rise to sustainable development [5].

One of the most well-known sustainable initiatives in recent years is the Sustainable Development Goals (SDGs). The United Nations oversees the SDGs. They aim to have 169 goals that are divided into 17 SDGs accomplished by 2030 [6]. The SDGs are balanced across the three pillars of sustainable development to have an influence on mankind and the environment in five key areas: alliances, prosperity, peace, people, and the planet [7]. The SDGs acknowledge that the private sector actively contributes to the accomplishment of the targets [8]. Private groups can implement initiatives, programs, and patents pertaining to environmental concerns and the enhancement of social conditions [9,10].

The circular economy (CE) is an alternative to the economic model of linear extraction, manufacturing, and disposal because it states that production systems must be integrated into nature's cyclical system, in which nothing is wasted [11]. Waste management, resource scarcity, unsustainable food systems, biodiversity loss, and climate change are among the global challenges addressed by CE [12].

Many industrial activities can benefit from circularity practices. Ecological and fully recyclable garments made from regenerated fibers are used in the fashion industry [13]. Circular food systems are being promoted in the agricultural sector, which redesign production using biowaste, bioenergy, biomass, sustainable materials, and automated greenhouse technologies [14,15]. The implementation of CE in the construction sector involves industrial symbiosis through upcycling, downcycling, and tertiary recycling processes to provide new sustainable materials [16]. Furthermore, CE has been proposed as a means of achieving the SDGs and is a private-sector-led initiative [17].

Colombia has made the SDGs and CE its sustainability roadmap. The country's guidelines are the launch of CONPES 3918, titled "Strategy for the Implementation of the Sustainable Development Goals (SDGs)," and the National Strategy of Circular Economy [18]. Although the two initiatives have been

implemented as part of entities' sustainability and social responsibility efforts, there is limited knowledge in the academic literature that describes them. The private sector is essential to achieving the SDGs and CE by interacting with societies, governments, and other stakeholders [19,20]. Mappings of the adoption of these two initiatives to identify challenges in companies have been carried out in the Netherlands, Spain, Italy, and China [21-23]. Therefore, the objective of this study was to investigate the adoption of the SDGs and CE in the private sector in Colombia.

2 Theoretical background

The SDGs are a set of 17 global goals adopted by the United Nations in 2015 as part of the 2030 Agenda for Sustainable Development. The SDGs are offshoots of the Millennium Development Goals (MDGs). The United Nations adopted the MDGs in 2000, establishing eight goals with a 2015 deadline to reduce extreme poverty and infant mortality; improve education, gender equality, and environmental sustainability; and promote a global partnership for development [24]. The SDGs seek to consolidate and broaden the scope of the MDGs, addressing issues such as climate change, gender equality, health, quality education, and biodiversity protection [25] (Fig. 1a).

The SDGs were freely endorsed by all United Nations members. Annually, countries report their progress and develop their own strategies. For example, Sweden is one of the world's leaders in advancing the SDGs. It has implemented several novel policies and developed a strategy centered on approaches to well-being and equality. Finland has set lofty goals for sustainable development and is working hard to meet them through innovative policies and increased international cooperation [26]. Germany has been a leader in environmental policy, setting ambitious targets for reducing greenhouse gas emissions and promoting renewable energy. Canada has established a national sustainable development strategy and has worked to incorporate the SDGs into all areas of government policy [27]. Many challenges face the SDGs in South America, where Uruguay is one of the few countries consolidating the most tangible results [28].

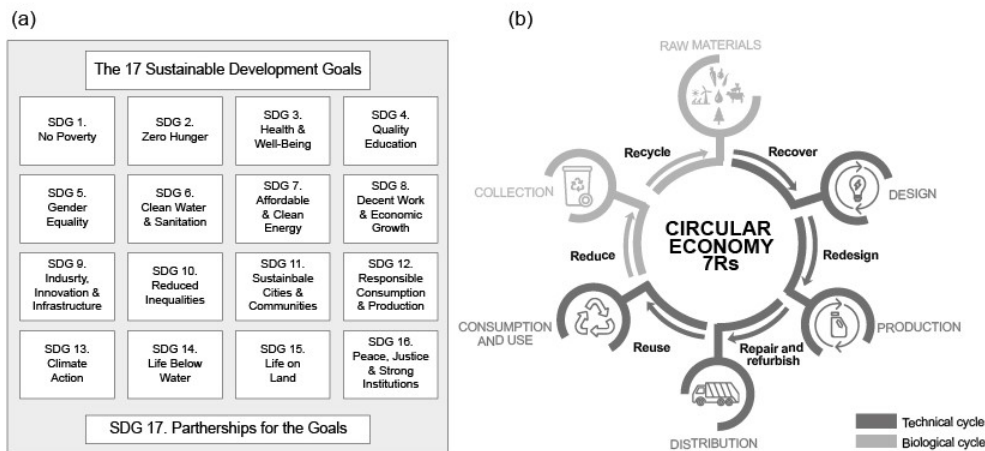


Figure 1. (a) The United Nations 2030 Agenda for Sustainable Development and (b) a theoretical model of CE operation. Source: The authors.

In Colombia, the implementation of the SDGs has been a government priority. Some progress has been made in terms of quality education, population health and well-being, gender equality in the labor field and in rural areas, and clean and affordable energy [28].

The United Nations Global Compact is an initiative that encourages private, public, and civil society commitments to human rights, the environment, labor standards, and anti-corruption. The Global Compact encourages the attainment of the SDGs. The organizations that have signed the Global Compact share the belief that business practices based on these four aspects lead to a more stable, equitable, and inclusive global market. This allows the development of more prosperous societies [10].

The CE is an economic model that aims to maximize efficiency in the use of natural resources and minimize the generation of waste. The CE disrupts the "take, make, dispose" linear model by focusing on reusing, repairing, renewing, and recycling products and materials [29]. The CE requires a shift in how products are designed, manufactured, and consumed, as well as how waste is managed. Instead of using natural resources to manufacture disposable goods, the CE promotes the use of renewable and durable materials that can be repaired or recycled when their useful lives are over [30].

The CE makes a distinction between technical and biological cycles [31]. Through steps such as collection, processing, production, purchase, and consumption, the technical cycles seek to ensure that the design of the goods allows them to be reusable over time. Biological cycles are concerned with the acquisition of raw materials and the regeneration of waste in such a way that it is reintegrated into nature, in which research, innovation, and development play a critical role [32] (Fig. 1b). The combination of both cycles increases efficiency on both an economic and ecological level [33]. Supply chains, circular business models, and circular product design are the primary application areas of CE [34-36].

CE adoption is viewed by countries and corporations as the best opportunity for economic growth while maintaining market competitiveness [37]. In the European Union, the CE has promoted new business models and new markets with the potential to create 700,000 jobs by 2030 [38]. The application of CE in companies has the potential to increase resource efficiency, increase product and service innovation, and improve the company's image [39].

1 Methodology

The methodological approach of this study had an exploratory and descriptive scope, using a semi-structured survey as an assessment instrument. The study population was the 468 entities affiliated with the United Nations Global Compact Network Colombia. The set of organizations includes foundations, academic institutions, non-governmental organizations, public entities, and private companies (i.e., hydrocarbons and gas, chemicals, construction, manufacturing, food, health, retail, telecommunications, public services, tourism, and financial services) [40]. All entities were contacted and received the survey. Of these, 65 agreed to participate in this research, representing the study sample. According to [41], this sample size corresponded to a 90% confidence level and a 10% margin of error. The survey questions were the following:

Table 1.
Typology of CE practices.

CE practices	Description
Waste management	It focuses on the four R's (reduce, reuse, recycle, and recover) of waste generation in a process.
Product management	Focused practice on any improvement or long-term action taken on the product to be marketed, such as eco design, eco innovation, and circular sustainable design.
Resource management	It refers to efficient optimizations that reduce the use of nonrenewable resources.
Supply chain management	Acquisition of equipment and sustainable infrastructure, industrial symbiosis, polygeneration systems, and the use of biochemical raw materials are all part of the strategy.
Clients and community	It is the social impact associated with the incentive for responsible consumption and community participation in circular processes, as well as the recovery of products that have reached the end of their lifetime.

Source: [42].

- (i) According to the following options, how has the entity incorporated the SDGs and the CE model into its corporate strategy?
 - Implementation of the SDGs.
 - Implementation of the CE.
 - Implementation of the SDGs but not of the CE.
 - Implementation of the CE but not of the SDGs.
 - There is no implementation of the SDGs or the CE.
- (ii) What do you understand by CE?
- (iii) According to Table 1, what CE practices have you put in place?
- (iv) Of the 17 SDGs, which ones does the entity emphasize in its decision-making?
- (v) What actions are you taking to support each SDG?

The first and third questions presented several response options, but with the possibility of selecting only one. The second and fifth questions were open answers, that is, the person in charge of the entity wrote the answer. The fourth question had several response options, which were the 17 SDGs, but with the possibility of selecting one or more options.

The SurveyMonkey online survey tool was used to create the survey. The data was collected between June and November 2020. The questions with open answers were reviewed and discussed by all the authors to systematize their descriptions. Data from single-choice questions were analyzed using descriptive and non-parametric statistics, such as the Friedman test combined with quintiles, as suggested by [43]. Finally, the data was organized and presented for easy comprehension. SPSS 22.0 (SPSS Inc., Chicago, IL, USA) and Prism 8 (GraphPad, San Diego, CA, USA) statistical software were also used.

2 Results and discussion

The 65 organizations involved in this study come from 13 different economic sectors (Fig. 2). With 19 organizations, the consulting sector had the highest participation. The education sector came in second with seven participants, including universities and educational foundations. Four organizations represented the construction sector as well as the manufacturing sector and the retail sector. Three organizations remained in the transportation and food sectors. Finally, the mining, forestry and paper, and financial sectors each had two organizations.

The survey showed that 84% of organizations incorporate the SDGs into their corporate strategy, and 83% have implemented CE as a model in their processes (Fig. 3a). Similar findings were found by [43], who noted that some organizations practice the 4 R's (reduce, reuse, recycle, and recover) as a CE model. However, the level of impact of the 4 R's can be low. They recommend that organizations strengthen their 4R efforts to contribute to CE by better connecting theory and practice in a more holistic way, for example through better collaboration with stakeholders [44].

It was found that 75% of entities are aligned with the SDGs while also implementing the CE model. These are the entities that are capitalizing on the inherent relationship between CE and the SDGs, resulting in greater benefits. The CE model directly contributes to the achievement of several SDG targets, including SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 8 (decent work and economic growth), SDG 12 (responsible consumption and production), and SDG 15 (life on land) [45]. Moreover, municipal waste generation per capita, municipal waste recycling rate, circular material use rate, and people in charge of CE all have a significant impact on SDG compliance in European Union countries. The use of CE has the potential to reduce greenhouse gas emissions by more than a third by 2100 [17]. The CE model has been proposed as a potentially significant catalyst for improving the current global climate crisis response [46].

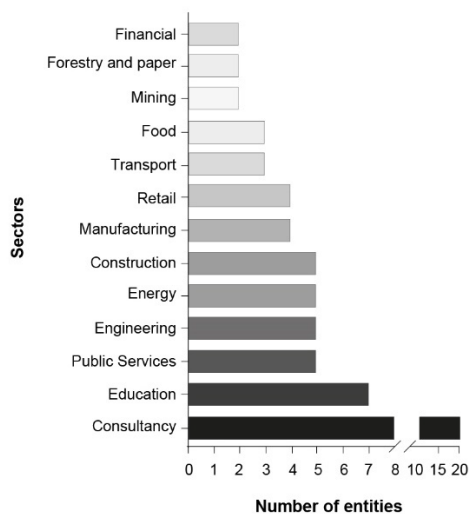


Figure 2. Number of entities participating in this study that are members of the Global Compact Network Colombia, by economic sector. Source: The authors.

Next, it was observed that one tenth of the entities included the SDGs without implementing CE practices, prioritizing other tools and initiatives for sustainability. Furthermore, 7% of entities do not include either the SDGs or the CE. Some entities presented a CE misconception. These envision CE as a massive recycling or reusing process rather than a closed-loop system based on resource sufficiency. The CE is more than just recycling and does not represent individual actions but rather a collective effort. CE draws on the interdisciplinary experience of actors along the value chain as well as the experiences of stakeholders affected by system change [30]. Implementing CE in organizations necessitates regenerative and systemic thinking with its own cyclical processes [11].

According to [44], organizations anticipate primarily economic benefits from alignment with CE and the SDGs, followed by environmental and social benefits. As a result, it has been suggested that human-centered sustainable development and CE be strengthened [47]. The inclusion of circularity indicators in the Human Development Index has the potential to address the shortcomings of the current human development approach, which lacks long-term environmental sustainability criteria to preserve nature as the foundation of human existence [48].

The responses obtained from the entities also indicated that that waste management is the most widely used CE practice, with a predominance of 65% (Fig. 3b). Less than half of the remaining CE practices are used by entities. Customers and the community demonstrated a 35% adoption rate. Resource management received 33%, while product management received 30%. Supply chain management is the least used and represents 20%.

Various researchers have demonstrated that many entities lack a sustainable circular vision. Non-systemic actions in processes are carried out by organizations with the primary goal of improving their indicators [40,44]. A comparative study of energy companies revealed that waste management practices, resource efficiency, sustainable procurement, energy recovery techniques, and low-carbon generation are prevalent in most cases. However, few organizations include the CE concept in their business models. There was no mention of a holistic approach to end-of-life planning for plants and products, as well as multi-stakeholder collaboration for resource reuse [43]. As a result, corporate strategies must be aligned with CE, which necessitates methodological support for decision-making and policy formulation that contributes to the corporate mission and vision.

The application of CE practices by economic sectors in this research was distributed by quintiles, revealing that the food and transportation sectors applied the most practices (Fig. 3c). With more than 50%, these two occupied the first quintile. The mining, manufacturing, and retail sectors comprise the second quintile, with a range of 40% to 50%. The forestry and education sectors account for between 30% and 40% of the practices employed in the third quintile. The financial, energy, construction, and energy sectors comprise the fourth quintile. The consulting industry used the fewest CE practices. The economic sector may have a significant impact on the use of CE strategies. For instance, most of the entities in this study are in the consulting industry, which does not involve raw material transformation or product development, but waste management can be used in corporate management. Furthermore, in the manufacturing and construction sectors, product management and supply chain management are more common practices.

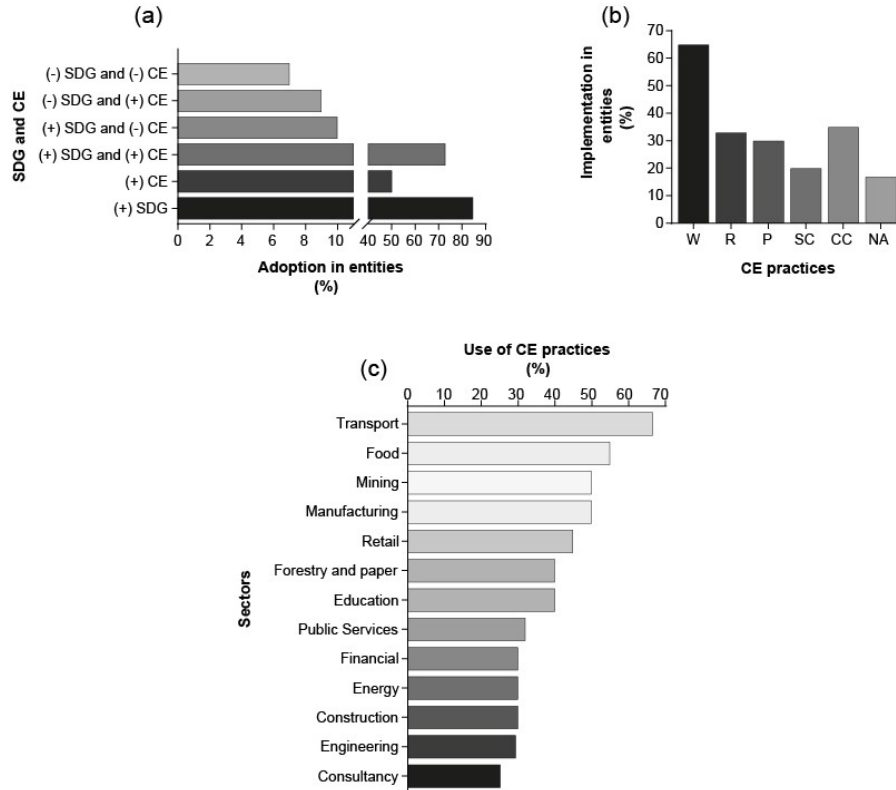


Figure 3. Alignment of the SDGs and CE in the 65 organizations under study. (a) The application of the SDGs and CE together with their practices. (+) indicates that it is implemented. (-) indicates that it is not implemented. (b) Use of CE practices. "W" indicates waste management. "R" indicates resource management. "P" indicates product management. "SC" indicates chain and supply management. "CC" indicates communities and clients. "NA" indicates not applicable. (c) Distribution in quintiles of the average use of CE practices by economic sector using the Friedman test. Source: The authors.

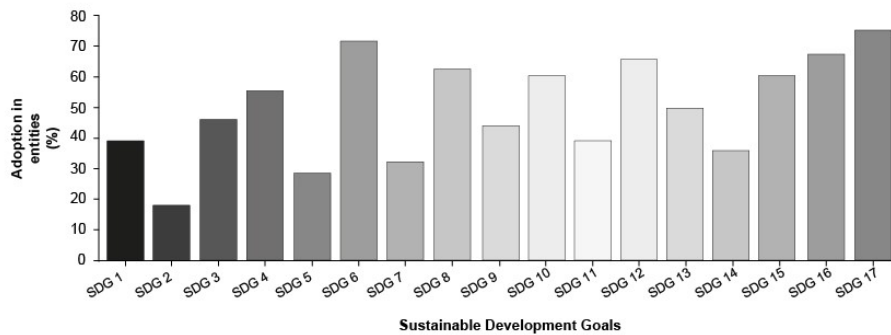


Figure 4. Adoption of the 17 SDGs by the entities. Source: The authors.

Although spreading and implementing CE is necessary for a radical change in human and environmental health, it must be stated that circularity does not guarantee sustainability [49]. According to [50], circular processes reduce waste and the use of nonrenewable resources while increasing air pollution or the production of new waste with unknown consequences. As a result, each case must be assessed on its own merits. Moreover, a combination of tools must be considered to avoid task duplication, such as life cycle tools and multi-criteria analysis for decision-making [51].

To improve the long-term impact of CE, entities should develop multidimensional indicators based on political, economic, social, and environmental factors. These are the so-

called second-generation indicators, which stand out for being binding and synergistic, allowing for the transformation of an organization's thinking or the foundation of its functioning [52]. Multidimensional indicators can be representative of a sector and thus promote industrial symbiosis.

Another myth that needs to be dispelled to encourage CE is that sustainability is not profitable or brings financial benefits. Several researchers and company directors have reported that the CE solves the problem of raw material scarcity, reconfigures the value chain of market-produced goods and services, reduces waste disposal costs, creates jobs, and opens new market niches [53]. In Colombia, reincorporating at least 70% of waste into

the supply chain via CE would generate the equivalent of 77 million dollars [54].

Finally, the data captured by the survey suggested that the most promoted SDGs were SDG 17 (Partnerships for the Goals), SDG 16 (Peace, Justice, and Strong Institutions), and SDG 12 (Responsible Production and Consumption) (Fig. 4). SDG 6 (clean water and sanitation) and SDG 8 (decent work and economic growth) complete the top five. On the contrary, SDG 2 (zero hunger) and SDG 5 (gender equality) are the least promoted.

The entities revealed that one of the most common actions they carry out to achieve the SDGs is to mobilize financial resources and form alliances in technical capacities, which is specifically related to SDG 17. Financing initiatives and multipurpose social projects are also highlighted for vulnerable populations on the national territory that have an impact on both SDGs 1 and 4. SDG 6 is being addressed through massive programs for wastewater treatment, safe reuse, and improved efficiency in water use, as well as SDG 12 through waste reduction and the promotion of sustainable practices. Measurement of greenhouse gases and reduction goals in organizational activities are increasingly being used to integrate climate change measures into the business strategies for SDG 13. Launching policies to create jobs, ensure universal labor rights, and support local business growth is a common action taken by organizations to strengthen SDG 8. SDG 16 is also strongly supported by the implementation of anti-corruption policies, mechanisms for reporting human rights violations, and codes of ethics or conduct [55]. On the contrary, few efforts were made in support of equal gender opportunities and participation in management positions, and no organizations explicitly mentioned CE as an SDG-related initiative.

It is necessary to mention that the results presented here are not indicative of the entire country and that different dynamics can occur in organizations that are not affiliated with the Global Compact. Although the approach of this study was theoretical and descriptive, it represents a reference for the private sector to seek continuous improvement in sustainability. Moreover, it serves as the basis for future research with an explanatory and correlational scope that seeks to deepen the opportunities between CE practices and the SDG targets by industry using economic, environmental, and social indicators.

1 Conclusions

The study's findings shed light on the status of entities affiliated with the Global Compact Network Colombia in terms of support to achieve the SDGs and CE. Most entities have put these two initiatives into practice. The food and transportation sectors are the most aligned towards CE. However, several entities, mainly from the financial, retail and forestry sectors, are unaware of the existence of CE or misunderstand its meaning. Waste management is the most used CE practice, while supply chain management is underutilized, presenting opportunities for innovation. Incentivizing CE requires national programs that encourage greater collaboration among supply chain actors, such as manufacturers, suppliers, retailers, consumers, and local governments.

The most promoted SDGs are SDG 17, SDG 16, SDG 12, SDG 6, and SDG 8. Nonetheless, SDGs 2 and 5 are overlooked,

which represents a challenge to address. Private organizations are increasingly considering the SDGs and CE, but to fully reap their benefits, their conceptual and practical implications must be strengthened. Given the importance of the private sector in achieving the SDGs and CE, it is important to promote companies' ability to influence how goods and services are produced and consumed in society.

References

- [1] Bartelmus, P., The future we want: green growth or sustainable development?. *Environmental Development*, 7, pp. 165-170, 2013. DOI: <https://doi.org/10.1016/j.envdev.2013.04.001>
- [2] Jorgenson, A.K., Economic development and the carbon intensity of human well-being. *Nature Climate Change*, 4(3), pp. 186-189, 2014. DOI: <https://doi.org/10.1038/nclimate2110>
- [3] Hirschnitz-Garbers, M., Tan, A.R., Gradmann, A. and Srebotnjak, T., Key drivers for unsustainable resource use—categories, effects and policy pointers. *Journal of Cleaner Production*, 132, pp. 13-31, 2016. DOI: <https://doi.org/10.1016/j.jclepro.2015.02.038>
- [4] Barbier, E.B. and Burgess, J.C., Sustainable development goal indicators: analyzing trade-offs and complementarities. *World Development*, 122, pp. 295-305, 2019. DOI: <https://doi.org/10.1016/j.worlddev.2019.05.026>
- [5] Silvestre, B.S. and Țircă, D.M., Innovations for sustainable development: moving toward a sustainable future. *Journal of Cleaner Production*, 208, pp. 325-332, 2019. DOI: <https://doi.org/10.1016/j.jclepro.2018.09.244>
- [6] De Neve, J.E. and Sachs, J.D., The SDGs and human well-being: a global analysis of synergies, trade-offs, and regional differences. *Scientific Reports*, 10(1), pp. 1-12, 2020. DOI: <https://doi.org/10.1038/s41598-020-71916-9>
- [7] Biermann, F., Kanie, N. and Kim, R.E., Global governance by goal-setting: the novel approach of the UN Sustainable Development Goals. *Current Opinion in Environmental Sustainability*, 26, pp. 26-31, 2017. DOI: <https://doi.org/10.1016/j.cosust.2017.01.010>
- [8] Van de Waal, J.W.H., Thijssens, T. and Maas, K., The innovative contribution of multinational enterprises to the Sustainable Development Goals. *Journal of Cleaner Production*, 285, art. 125319, 2021. DOI: <https://doi.org/10.1016/j.jclepro.2020.125319>
- [9] Escher, I. and Brzustewicz, P., Inter-organizational collaboration on projects supporting sustainable development goals: the company perspective. *Sustainability*, 12(12), art. 4969, 2020. DOI: <https://doi.org/10.3390/su12124969>
- [10] Pacto Global Red Colombia. El Pacto Global [Online], 2022, [date of reference February 26th of 2023]. Available at: <https://www.pactoglobal-colombia.org/pacto-global-colombia/que-es-pacto-global-colombia.html>
- [11] Prieto-Sandoval, V., Jaca, C. and Ormazabal, M., Towards a consensus on the circular economy. *Journal of Cleaner Production*, 179, pp. 605-615, 2018. DOI: <https://doi.org/10.1016/j.jclepro.2017.12.224>
- [12] Kirchherr, J., Reike, D. and Hekkert, M., Conceptualizing the circular economy: an analysis of 114 definitions. *Resources, conservation and recycling*, 127, pp. 221-232, 2017. DOI: <https://doi.org/10.1016/j.resconrec.2017.09.005>
- [13] Jacometti, V., Circular economy and waste in the fashion industry. *Laws*, 8(4), art. 27, 2019. DOI: <https://doi.org/10.3390/laws8040027>
- [14] Duque-Acevedo, M., Lancellotti, I., Andreola, F., Barbieri, L., Belmonte-Ureña, L.J. and Camacho-Ferre, F., Management of agricultural waste biomass as raw material for the construction sector: an analysis of sustainable and circular alternatives. *Environmental Sciences Europe*, 34(1), art. 70, 2022. DOI: <https://doi.org/10.1186/s12302-022-00655-7>
- [15] Salinas-Velandia, D.A., Romero-Perdomo, F., Numa-Vergel, S., Villagrán, E., Donado-Godoy, P. and Galindo-Pacheco, J.R., Insights into circular horticulture: knowledge diffusion, resource circulation, one health approach, and greenhouse technologies. *International Journal of Environmental Research and Public Health*, 19, art. 12053, 2022. DOI: <https://doi.org/10.3390/ijerph191912053>
- [16] Benachio, G.L.F., Freitas, M.D.C.D. and Tavares, S.F., Circular economy in the construction industry: a systematic literature review. *Journal of Cleaner Production*, 260, art. 121046, 2020. DOI: <https://doi.org/10.1016/j.jclepro.2020.121046>

- [17] Rodríguez-Antón, J.M., Rubio-Andrada, L., Celemín-Pedroche, M.S. and Alonso-Almeida, M.D.M., Analysis of the relations between circular economy and sustainable development goals. *International Journal of Sustainable Development & World Ecology*, 26(8), pp. 708-720, 2019. DOI: <https://doi.org/10.1080/13504509.2019.1666754>
- [18] Romero-Perdomo, F., Carvajalino-Umaña, J.D., Ardila, N. y González-Curbelo, M.Á., Contribución de la economía circular a los objetivos de desarrollo sostenible de la Agenda 2030 [en línea], Medellín, Instituto Antioqueño de Investigación, 2022. [date of reference Feb 26th of 2023], pp. 463-475, *Ciencia Transdisciplinaria en la Nueva Era*. Available at: <https://fundacioniai.org/index2.html>
- [19] Owojori, O.M. and Okoro, C., The private sector role as a key supporting stakeholder towards circular economy in the built environment: a scientometric and content analysis. *Buildings*, 12(5), art. 695, 2022. DOI: <https://doi.org/10.3390/buildings12050695>
- [20] Rashed, A.H. and Shah, A., The role of private sector in the implementation of sustainable development goals. *Environment, Development and Sustainability*, 23, pp. 2931-2948, 2021. DOI: <https://doi.org/10.1007/s10668-020-00718-w>
- [21] Ma, W., Hoppe, T. and de Jong, M., Policy accumulation in China: a longitudinal analysis of circular economy initiatives. *Sustainable Production and Consumption*, 34, pp. 490-504, 2022. DOI: <https://doi.org/10.1016/j.spc.2022.10.010>
- [22] Walker, A.M., Opferkuch, K., Lindgreen, E.R., Simboli, A., Vermeulen, W.J. and Raggi, A., Assessing the social sustainability of circular economy practices: industry perspectives from Italy and the Netherlands. *Sustainable Production and Consumption*, 27, pp. 831-844, 2021. DOI: <https://doi.org/10.1016/j.spc.2021.01.030>
- [23] Marco-Fondevila, M., Llena-Macarulla, F., Callao-Gastón, S. and Jarne-Jarne, J.L., Are circular economy policies actually reaching organizations? Evidence from the largest Spanish companies. *Journal of Cleaner Production*, 285, art. 124858, 2021. DOI: <https://doi.org/10.1016/j.jclepro.2020.124858>
- [24] Sachs, J.D., From millennium development goals to sustainable development goals. *The Lancet*, 379(9832), pp. 2206-2211, 2012. DOI: [https://doi.org/10.1016/S0140-6736\(12\)60685-0](https://doi.org/10.1016/S0140-6736(12)60685-0)
- [25] Halıççelik, E. and Soytaş, M.A., Sustainable development from millennium 2015 to sustainable development goals 2030. *Sustainable Development*, 27(4), pp. 545-572, 2019. DOI: <https://doi.org/10.1002/sd.1921>
- [26] Caiado, R.G.G., Leal-Filho, W., Quelhas, O.L.G., de Mattos-Nascimento, D.L. and Ávila, L.V., A literature-based review on potentials and constraints in the implementation of the sustainable development goals. *Journal of Cleaner Production*, 198, pp. 1276-1288, 2018. DOI: <https://doi.org/10.1016/j.jclepro.2018.07.102>
- [27] Schmidt-Traub, G., Kroll, C., Teksoz, K., Durand-Delacré, D. and Sachs, J.D., National baselines for the sustainable development goals assessed in the SDG index and dashboards. *Nature Geoscience*, 10(8), pp. 547-555, 2017. DOI: <https://doi.org/10.1038/ngeo2985>
- [28] Salvia, A.L., Leal Filho, W., Brandli, L.L. and Griebeler, J.S., Assessing research trends related to sustainable development goals: local and global issues. *Journal of Cleaner Production*, 208, pp. 841-849, 2019. DOI: <https://doi.org/10.1016/j.jclepro.2018.09.242>
- [29] Korhonen, J., Honkasalo, A. and Seppälä, J., Circular economy: the concept and its limitations. *Ecological Economics*, 143, pp. 37-46, 2018. DOI: <https://doi.org/10.1016/j.ecolecon.2017.06.041>
- [30] Geissdoerfer, M., Savaget, P., Bocken, N.M.P. and Hultink, E.J., The circular economy – A new sustainability paradigm? *Journal of Cleaner Production*, 143, pp. 757-768, 2017. DOI: <https://doi.org/10.1016/j.jclepro.2016.12.048>
- [31] Murray, A., Skene, K. and Haynes, K., The circular economy: an interdisciplinary exploration of the concept and application in a global context. *Journal of Business Ethics*, 140(3), pp. 369-380, 2017. DOI: <https://doi.org/10.1007/s10551-015-2693-2>
- [32] Navare, K., Muys, B., Vrancken, K.C. and Van Acker, K., Circular economy monitoring—how to make it apt for biological cycles?. *Resources, Conservation and Recycling*, 170, art. 105563, 2021. DOI: <https://doi.org/10.1016/j.resconrec.2021.105563>
- [33] Carvajalino-Umaña, J.D., Romero-Perdomo, F., López-González, M., Ardila, N. y González-Curbelo, M.Á., Economía circular en Colombia: panorama y estrategias para acelerar su implementación. [en línea], Medellín, Instituto Antioqueño de Investigación, 2022. [Consultado: Feb 26 de 2023], pp.187-200, *Ingeniería y Desarrollo en la Nueva Era*. Disponible en: <https://fundacioniai.org/index2.html>
- [34] Govindan, K. and Hasanagic, M., A systematic review on drivers, barriers, and practices towards circular economy: a supply chain perspective. *International Journal of Production Research*, 56(1-2), pp. 278-311, 2018. DOI: <https://doi.org/10.1080/00207543.2017.1402141>
- [35] Bocken, N.M., De Pauw, I., Bakker, C. and Van Der Grinten, B., Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering*, 33(5), pp. 308-320, 2016. DOI: <https://doi.org/10.1080/21681015.2016.1172124>
- [36] Bakker, C., Wang, F., Huisman, J. and Den Hollander, M., Products that go around: exploring product life extension through design. *Journal of Cleaner Production*, 69, pp. 10-16, 2014. DOI: <https://doi.org/10.1016/j.jclepro.2014.01.028>
- [37] Bressanelli, G., Adrodegari, F., Pigosso, D.C. and Parida, V., Towards the smart circular economy paradigm: a definition, conceptualization, and research agenda. *Sustainability*, 14(9), art. 4960, 2022. DOI: <https://doi.org/10.3390/su14094960>
- [38] Friant, M.C., Vermeulen, W.J. and Salomone, R., Analysing European Union circular economy policies: words versus actions. *Sustainable Production and Consumption*, 27, pp. 337-353, 2021. DOI: <https://doi.org/10.1016/j.spc.2020.11.001>
- [39] Walker, A.M., Opferkuch, K., Roos-Lindgreen, E., Raggi, A., Simboli, A., Vermeulen, W.J., Caeiro, S. and Salomone, R., What is the relation between circular economy and sustainability? Answers from frontrunner companies engaged with circular economy practices. *Circular Economy and Sustainability*, 2(2), pp. 731-758, 2022. DOI: <https://doi.org/10.1007/s43615-021-00064-7>
- [40] Jaimes-Muñoz, D., Evaluación del desarrollo histórico de las iniciativas encaminadas al cumplimiento de los objetivos de desarrollo sostenible de carácter ambiental por parte de las empresas adheridas a pacto global en Colombia, BSc. Thesis, Department of Engineering, Universidad Distrital Francisco José de Caldas, Bogotá, Colombia, 2019.
- [41] Singh, A.S. and Masuku, M.B., Sampling techniques & determination of sample size in applied statistics research: an overview. *International Journal of Economics, Commerce and Management*, 2(11), pp. 1-22, 2014.
- [42] De Selliers, D. and Spataru, C., Corporate strategies for a circular economy: a comparative study of energy companies, *Proceedings of the 2nd International Conference on Applied Research in Management, Economics and Accounting (IARMEA 2019)*, 2019.
- [43] Lozano, R., Analysing the use of tools, initiatives, and approaches to promote sustainability in corporations. *Corporate Social Responsibility and Environmental Management*, 27(2), pp. 982-998, 2020. DOI: <https://doi.org/10.1002/csr.1860>
- [44] Barreir-Gen, M., and Lozano, R., How circular is the circular economy? Analysing the implementation of circular economy in organizations. *Business Strategy and the Environment*, 29(8), pp. 3484-3494, 2020. DOI: <https://doi.org/10.1002/bse.2590>
- [45] Schroeder, P., Anggraeni, K. and Weber, U., The relevance of circular economy practices to the sustainable development goals. *Journal of Industrial Ecology*, 23(1), pp. 77-95, 2019. DOI: <https://doi.org/10.1111/jiec.12732>
- [46] Romero-Perdomo, F., Carvajalino-Umaña, J.D., Moreno-Gallego, J.L., Ardila, N., and González-Curbelo, M.Á., Research trends on climate change and circular economy from a knowledge mapping perspective. *Sustainability*, 14(1), art. 521, 2022. DOI: <https://doi.org/10.3390/su14010521>
- [47] Clube, K. and Tennant, M., The circular economy and human needs satisfaction: promising the radical, delivering the familiar. *Ecological Economics*, 177, art. 106772, 2020. DOI: <https://doi.org/10.1016/j.ecolecon.2020.106772>
- [48] Schroeder, P., Lemille, A. and Desmond, P., Making the circular economy work for human development. *Resources, Conservation and Recycling*, 156, art. 104686, 2020. DOI: <https://doi.org/10.1016/j.resconrec.2020.104686>
- [49] Blum, N.U., Haupt, M. and Bening, C.R., Why “circular” doesn't always mean “sustainable”. *Resources, Conservation and Recycling*, 162, art. 105042, 2020. DOI: <https://doi.org/10.1016/j.resconrec.2020.105042>
- [50] Van Ewijk, S., Stegemann, J.A., and Ekins, P., Limited climate benefits of global recycling of pulp and paper. *Nature Sustainability*, 4, pp. 180-187, 2021. DOI: <https://doi.org/10.1038/s41893-020-00624-z>
- [51] Romero-Perdomo, F. and González-Curbelo, M.Á., Integrating multi-criteria techniques in life cycle tools for the circular bioeconomy

- transition of agri-food waste biomass: a systematic review. *Sustainability*, 15(6), pp. 5026, 2023. DOI: <https://doi.org/10.3390/su15065026>
- [52] Shmelev, S.E. and Shmeleva, I.A., Global urban sustainability assessment: a multidimensional approach. *Sustainable Development*, 26(6), pp. 904-920, 2018. DOI: <https://doi.org/10.1002/sd.1887>
- [53] Rosa, P., Sassanelli, C. and Terzi, S., Circular business models versus circular benefits: an assessment in the waste from electrical and electronic equipments sector. *Journal of Cleaner Production*, 231, pp. 940-952, 2019. DOI: <https://doi.org/10.1016/j.jclepro.2019.05.310>
- [54] Van Hoof, B. and Duque-Hernández, J., Supply chain management for circular economy in Latin America: RedES-CAR in Colombia. [en línea], Springer Cham, 2020 [date of reference Feb 26th of 2023], pp. 103-118, *Industrial Symbiosis for the Circular Economy*. Available at: https://link.springer.com/chapter/10.1007/978-3-030-36660-5_7
- [55] Lozano, R. and Barreiro-Gen, M., Organisations' contributions to sustainability. an analysis of impacts on the sustainable development goals. *Business Strategy and the Environment*, pp. 1-12, 2022. DOI: <https://doi.org/10.1002/bse.3305>

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