# A Review of Circular Economy Index from Many Perspective

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***Abstract*—The concept of a circular economy began to be launched worldwide due to the impact of increasing sustainability. The advancement of technology certainly makes it easier to implement a circular economy, especially in Industry 4.0. Several industries have implemented the concept of industry 4.0, but implementing a circular economy in the industry has yet to go well. The problem is that there needs to be a measurement of the circular level of the industry. This study aims as a literature study on determining the formulation of the circular economy index. The existence of gathering perspectives from various countries is expected to provide the application of the indicators that have the most influence on the measurement of the circular economy.**

***Keywords*— Circular Economy Index, Industry 4.0, Perspective.**

## I. INTRODUCTION

ACCORDING to the Ellen McArthur Foundation, an organization devoted to promoting the adoption of circular practices, the circular economy is "a framework for an economy that is restorative and regenerative by design." The phrase "restorative and regenerative" refers to building an economy that recovers its goods, parts, and resources while also rejuvenating its natural systems (Figure 1) [1].

In the past, John Lyle, Michael Braungart, and Walter Stahel offered early ideas to Pearce and Turner that eventually evolved into the circular economy (CE) idea. The 1990s saw this idea's most significant development and popularity, particularly in China. This approach is based on the notion that limited natural resources can be managed while yet generating economic growth [2–3]. This idea is growing in acceptance in China as a reaction to the beneficial effects of China's rapid economic development, which are counterbalanced by a rapid increase in greenhouse gas emissions. China produces significant exhaust emissions compared to other producing nations due to its businesses' supremacy in manufacturing techniques [4].

The conceptual level of CE then developed into a more practical approach, starting from the macro to micro levels. The practical approach to CE varies in different countries. Germany, one of the advanced industrial nations, has a more robust environmental management strategy focused on natural resource management to continue sustainable economic growth [5]. China has a method for managing


Figure 1. The three principle of a circular economy.

industrial internal waste based on closed-loop recycling [6]. Japan and South Korea are two industrialized Asian nations that strongly emphasize consumer accountability for resource use and trash generation [7]. In North American countries (USA & Canada), CE application focuses more emphasis on the micro (corporate) approaches such as 3R programs (reduce, reuse, & recycle) production materials to research goods. Lifetime to lessen waste brought on by industry overproduction [8].

The application of circular economy (CE) in a strategic framework must be relevant to the sector's Key Performance Index (KPI). It can be applied to all industries with different chemical processes and industrial dynamics, and neither the government nor the businesses within the SOEs are responsible for it. The KPI aligns with the idea that an organization must take action to help national development in infrastructure, the environment, and local economies. These policies and practices are undoubtedly influenced by various natural elements, such as weather, environmental damage, the difficulties of replenishing natural resources, and human attitudes and behavior. There is little doubt that these risky elements will have a detrimental effect on future use and expenses.

Along with the times, technological advances are based on industry 4.0. certainly helps all aspects of life. The production line in a business process can be integrated with various network elements, both internet and artificial intelligence. It should also be underlined that in terms of materials and tools, it is possible to have waste that, of course, needs to be processed or reused to maintain the sustainability of a business. As regulated in the Indonesia Industry 4.0 Readiness Index (INDI 4.0), there are five leading indicators for companies to implement 4.0-based industries. Organizational management, people and culture, products and services, technology, and factory operations are indicators. It is necessary to have and achieve the KPI compiled in general with global accumulation and specifically in each company. The KPI is influenced by various internal factors, such as the company's internal conditions, and external factors, such as state conditions, culture, market prices, and global conditions that affect various social and financial aspects.

The circular economy is related to waste management and includes a series of holistic interventions from upstream to downstream to improve resource efficiency in the production cycle. The implementation of the circular economy has spread to various industries. However, there has yet an index that can measure this both from companies and the government, which will undoubtedly help determine the basis for different policies and strategies related to implementing the circular economy. Researchers estimate the absence of this standard or index to be an obstacle for the government in releasing policies and providing incentives that support the implementation of the circular economy, specifically in companies, as well as the related impacts on achieving the SDGs. Therefore, this research was conducted with the aim of creating a review of the circular economy index which can become a strategic standard for industry.

## II. A REVIEW OF CIRCULAR ECONOMY INDEX

The existence of a circular economy leads to the creation of by-product innovations or a system that can handle the waste from the production and consumption processes. The waste from the production and consumption processes is one of the main problems throughout the world. Waste is the last point the industry or company takes in the work process. The implementation of the circular economy is considered promising and impacts global development. The existence of a circular economy system causes sustainability and affects the achievement of the SDGs in 2030. The creation of sustainability with the existence of a circular economy has an impact both directly and indirectly on economic, social, and environmental aspects [9–12]. Therefore, it is stated [9] that the relationship between the three aspects of the circular economy could be measured by Exploratory Factor Analysis (EFA). This EFA can determine the relationship level of the circular economy with related indicators. Before the EFA, researchers collected laws, policies, and previous studies to facilitate reading clear indicators. After collecting the data, the EFA will display several pretty clear indicators to find a formulation for calculating the circular economy index. The formulation for the circular economy index can be calculated by the correlation between one and another indicator.

In addition to determining the circular economy with EFA, Moraga et al. suggested that the monitoring of a macro-scale circular economy such as an industry or company can be carried out using the Material Flow Analysis (MFA), Energy Analysis, and Input-Output Analysis methods. The study of Moraga et al. stated that the circular economy indicators with the BS 80001:2017 standard from the British Standard Institute (BSI) in the form of restore, regenerate, maintain, utility, maintain financial value and maintain non-financial value, as well as complementary aspects such as resource efficiency, climate, energy, and sufficiency are still assessed as limited. This causes the absence of indicators capable of measuring the progress of the circular economy. Therefore, Moraga et al. classify indicators for measuring the circular economy (CE) into three types of measurement. The three types of measurement include direct CE with specific strategies, direct CE with non-specific strategies, and indirect CE. Direct CE with a specific strategy can focus on one or more of the easily identifiable CE strategies such as recycling rates. Direct CE with non-specific strategies focuses on more than one CE strategy and is unlikely to be easily identified, such as water extraction. CE is not directly used to evaluate aspects of the CE strategy but with additional approaches such as linking performance with other countries.

The CE concept also is closely related to technological developments. The existence of technology can accelerate waste reduction, minimize environmental impacts and encourage the creation of a green industry (zero waste). Technological developments led to the formation of the industrial 4.0 system. Industry 4.0 is an industry that implements nine pillars including Autonomous Robots, Simulation, Systems Integration, Industrial Internet of Things, Additive Manufacturing, Cybersecurity, Big Data &Analytics, Augmented Reality, & Cloud Computing. These nine pillars certainly lead to the concept of a circular economy [10]. Dantas et al. found that industry 4.0 is related to the circular economy concept and has an impact on the achievement of the SDGs. This is due to the creation of a link between innovative technology and circular production and business models, thus providing opportunities for achieving the SDGs targets.

## III. CONCLUSION

Many perspectives show that the circular economy principle influences Sustainable Development Goals. The urgency of this circular economy index affects three essential aspects of the world, such as economic, social, and environmental. The results of this review study found that industry 4.0 can continue measuring the circular economy index by considering several indicators that have a direct or indirect measurement. From that measurement, several indicators will relate to the kind of industry. The index needs to integrate environmental, economic, and social impact. However, the social impact needs to analysis further because there is yet an indicator showing the implementation of CE in this aspect. CE index developed in macro, meso, and micro levels. Integration for level with several indicators showed the comprehensive measurement for CE index.

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