AJCD
journal.amca2012.org

AMCA JOURNAL OF COMMUNITY DEVELOPMENT
e-ISSN 2774-6178
Vol 3, No 1, January 2023, 19-24
DOI 10.51773/ajcd.v3i1.211

Application of circular economy in manufacturing industry in Indonesia

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KEYWORDS
Circular Economy
Manufacturing Industry

ABSTRACT Circular economy is an economic activity that emphasizes the use of resources aimed at reducing emissions and energy released. The benefits of implementing a circular economy are absorbing labour, reducing waste, reducing pollution, and preserving nature. The circular economy system is the opposite of the conventional economic system. The conventional economic system only exploits nature to produce goods for use and after that is discarded. The five activities that are at the core of the circular economy concept are reduce, reuse, recycle, recover, and revalue. Circular economy will generate benefits from both economic, social and environmental aspects. From an economic perspective, this concept will use waste products from previous production processes or other economic actors to end waste treatment globally. From a social aspect, this concept can create new job opportunities, encourage community participation, and use collective goods and services more efficiently than individually. From an environmental aspect, by utilizing waste from product sharing, it will reduce the environmental burden from the exploitation of raw materials and pollution. The circular economy system will create benefits not only making the environment healthier but also having a positive impact on the economy, absorbing labour and creating long-term economic resilience.

1. INTRODUCTION

In Indonesia, it is known for several types of industries, one of which is the manufacturing industry. Economically, the manufacturing industry in Indonesia absorbs a lot of labor, thereby helping to improve people's welfare. According to its activities, the Indonesian economy is divided into 3 sectors, namely: the primary sector, the secondary sector, and the tertiary sector. These sectors are certainly related to one another. The primary sector provides raw materials through extraction and collection of natural resources. This sector includes agriculture, forestry, mining, and fisheries. While the manufacturing industry is in the secondary sector which produces finished products that can be used or involved in construction. While the tertiary sector is a sector that includes the service industry, its activities include the transportation, distribution and sale of goods.

The manufacturing industry is known as an industry that provides the products needed by the market. The greater the market demand, the more production processes that will be carried out by the manufacturing industry. The production process in the manufacturing industry involves various factors, ranging from human resources, natural resources, to machines and equipment. The manufacturing industry is broadly defined as any industry that transforms physical or chemical materials into new products, regardless of process (machine or hand), location (factory or home), or method of sale (wholesale or retail). In the processing process, the manufacturing industry operates machinery, equipment and labor in one medium. All processes and stages carried out in manufacturing activities refer to the Standard Operating Procedures (SOP) owned by each work unit.

In Indonesia, companies engaged in manufacturing are often referred to as factories, which refers to a place description. Factory is used to refer to a place used for manufacturing or fabrication processes. The manufacturing industry sector contributes significantly to Gross Domestic Product (GDP) in Indonesia. Ministry of Industry data shows that manufacturing is the industrial sector that contributes the most to Indonesia's GDP in 2022. This is shown in the macro performance table of the industrial sector below: (table 1)

In Indonesia there are several areas designated as industrial areas. However, the distribution of the manufacturing industry in Indonesia is not evenly distributed. Only a few provinces had a proportion of the added value of the manufacturing industry sector to GDP that was higher than the national value (20.61), namely the provinces of Riau, Riau Islands, Bangka Belitung Islands, Banten, West Java, Central Java, East Java, Central Sulawesi, and West Papua. The proportion of added value of the manufacturing industry sector to GDP in each province is shown in the following table:

The Government of Indonesia through the Ministry of Industry continues to strive to optimize industries that in their production processes prioritize the efficiency and effectiveness of sustainable use of resources. This step is expected to be able to balance industrial development with

Table 1. Contribution of the Industrial Sector to Indonesia's GDP (Quarter II, 2022)

No.	Industrial Sector	Contribution (%)
1	Manufacturing	17,84
2	Mining	13,06
3	Agriculture	12,98
4	Trading	12,71
5	Construction	9,14
6	Transportation & warehousing	4,79
7	Finance & insurance	4,14
8	Information & communication	4,10
9	Government administration	3,14
10	Education	2,84

Source: (Kusnandar, 2022)

Table 2. The Proportion of Added Value of Manufacture Sector to Regional GDP (2021)

No.	Province	Value
1	Aceh	4.59
2	North Sumatera	17.88
3	Riau	32.07
4	Riau Islands	41.96
5	West Sumatera	9.50
6	Jambi	10.21
7	Bangka Belitung Island	21.44
8	Sumatera Selatan	18.58
9	Bengkulu	5.81
10	Lampung	18.76
11	Banten	33.60
12	Jakarta	11.64
13	West Java	42.36
14	Central Java	33.41
15	Yogyakarta	11.81
16	East Java	30.25
17	Bali	6.74
18	West Kalimantan	16.10
19	Central Kalimantan	15.65
20	South Kalimantan	12.79
21	East Kalimantan	19.86
22	North Kalimantan	8.78
23	West Nusa Tenggara	4.66
24	East Nusa Tenggara	1.17
25	West Sulawesi	10.40
26	South Sulawesi	12.83
27	Southeast Sulawesi	7.09
28	Central Sulawesi	29.11
29	Gorontalo	4.24
30	North Sulawesi	10.97
31	Maluku	5.11
32	North Maluku	17.65
33	West Papua	30.60
34	Papua	1.80

Source: (Statistics Indonesia, 2022)

environmental preservation, as well as provide more benefits for the community. Industrial development is one of the pillars of Indonesia's economic development which is directed by applying sustainable principles and is based on aspects of economic, social and environmental development.

The direction of Indonesia's industrial development is contained in the 2020-2024 National Medium-Term Development Plan (RPJMN), one of the targets of which is the development of a green industry with the application of a circular economy in sustainable industrial development. In addition, the 2020-2024 RPJMN also states that the management of national wastes which is still not optimal, both in terms of supporting infrastructure, management, human resource capacity, institutions, and law enforcement requires an integrated system from upstream to downstream. The direction of Indonesia's industrial development is intended to realize the Vision of Indonesia 2045 which is built on 4 pillars of development, one of which is Sustainable Economic Development. Where in this pillar it is stated that commitment to the environment is continuously maintained for sustainable development.

Indonesia's commitment and efforts in tackling economic, social and environmental problems through industrial development are expected to meet the Sustainable Development Goals (SDGs) targets as set out in the 2030 Agenda for Sustainable Development. Circular economy is one approach that can be used to implement the 12th SDGs (Permana, 2020). Responsible Consumption and Production is the 12th goal of the 17 SDGs targets. This target states that Indonesia encourages industry, business and consumers to recycle and reduce waste towards a sustainable consumption pattern by 2030. In order to realize the application of green industry principles, Indonesia applies the 5R concept, namely reduce, reuse, recycle, recover and repair in its manufacturing activities. The recycle element is a priority, both at the stages of raw material processing, production, and after production. Thus, all aspects of manufacturing are involved in implementing the green industry.

Indonesia is implementing the circular economy concept in the development of its manufacturing industry. The application of a circular economy can provide many benefits for the manufacturing industry, such as raw material efficiency, increased production of recyclable goods, reduced emissions, and job creation. Thus the circular economy is a model of the Indonesian economy in the future that needs to be develop (Ilhamsyah & Hakim, 2021).

The circular economy concept is closely related to one of the policies rolled out by the Ministry of Industry, namely the green industry. The implementation of the green industry is seeking efficiency and effectiveness in the use of resources in a sustainable manner. Through a circular economy, the manufacturing industry is expected to be able to make the most of recycled materials, thereby reducing waste. In implementing the circular economy concept, the Ministry of Industry determines sectors that are priority areas for circular economy implementation, including: the

plastics industry, the rubber industry, the lubricants industry, and the textile industry.

Circular economy is a roundabout economic system approach by maximizing the use and value of raw materials, components, and products, to reduce the amount of waste that is not used and thrown away. The application of a circular economy will be able to drive higher green economic growth compared to business as usual. The circular economy aims to generate economic growth by keeping the value of products, materials and resources in the economy as long, thereby minimizing the social and environmental damage caused by the linear economic approach. More than just waste management, the circular economy includes a wide range of interventions across all sectors of the economy.

In a circular economy, economic activity is carried out by building and improving the overall system. This concept emphasizes the importance of the economy at all scales of business, be it small, large, individual, organizational, local or global businesses. Changes at the circular economy do not only carry out adjustments by reducing the negative impact on the linear economy. However, in a circular economy it is necessary to make systemic changes in order to generate economic value and provide positive benefits both to the environment and socially. Therefore, the concept of a circular economy does not only design an industrial model with the principle of zero waste, but also focuses on social factors and the provision of sustainable resources and energy. The circular economy concept has the principle: produce, use and reuse. This is different from the concept of linear economics which has principles: production, use and throw. The focus of the circular economy is the maximum utilization of goods and the reuse of used goods. The circular economy has the slogan "waste = food" which means that waste from a production or consumption process can be an input to be used in the next process and continues perpetually (Zahra, 2022).

In a circular economy, systems are designed to be restorative and regenerative. That is, the materials used keep rotating in a closed loop system. Products that are made are not only used once and then thrown away. But products that are obsolete will be reused as materials for the same type of product or reused as materials for other types of products. This eco-friendly economic system seeks to maintain product value so that it can be used repeatedly with zero waste through 3 ways, namely: recycle, reuse and remanufacture.

The circular economy concept can be applied to the manufacturing industry using the 5R approach (reduce, reuse, recycle, recovery, and repair). The concept of reconditioning and remanufacturing of capital goods, as well as the reuse of raw materials is expected to reduce the use of manufacturing industry resources. In addition, circular economy applications in the manufacturing industry must also be based on 3 main principles, namely waste design, pollution, storage of products and materials that will be or have been used and perform system regeneration. Thus, the circular economy can increase the economic value of the manufacturing industry. However, in practice it needs to be done in stages by designing economic activities from limited resources and designing the use of waste from the system.

2. METHOD

This research is a literature study. Many benefits can be obtained from the study of literature, one of which is bringing up the latest ideas in research. By studying the literature, research ideas, novelty of research, and sharpening of research ideas can be obtained. Literature study is a way to solve problems by exploring written sources that have been made before. Theories that underlie the problems and areas to be studied can be found by conducting a literature study. In addition, information can also be obtained about similar research or related research, as well as research that has been done before. By conducting a literature study, information and ideas that are relevant to the study under study will be obtained.

3. RESULTS AND DISCUSSION

The Government of Indonesia through the Ministry of Industry continues to encourage the manufacturing industry sector to transform towards sustainable development. One of the steps is through the implementation of the circular economy concept, with the principle of using efficient, reusable, environmentally friendly and sustainable resources and utilizing waste as alternative energy.

The recycling business has long been known in Indonesia. Various sectors of the recycling industry such as plastics, lubricants, paper, textiles and metals have so far contributed to reducing waste and helping to create a circular economy process. The application of the circular economy in Indonesia uses the 5R approach (reduce, reuse, recycle, refurbish, renew). The industrial sectors that are a priority in implementing the circular economy concept in Indonesia include: the plastics industry, the rubber scrap industry, the lubricants industry and the textile industry. Other industries that have great potential to implement a circular economy are the food and beverage industry, construction, electronics, as well as wholesale and retail trade.

Meanwhile, the plastics industry in Indonesia has an important role and is closely related to other industries, such as the food and beverage, cosmetic, pharmaceutical, electronics, agriculture, automotive, and household goods industries. The plastics industry in Indonesia is a production supply chain for other strategic sectors.

Indonesia is a country that produces a lot of plastic waste. Every day Indonesians generate 0.8 kg of waste per person or a total of 189 thousand tons of waste/day. Of this amount, 15% is in the form of plastic waste or around 28.4 thousand tons of plastic waste/day. The business opportunity in terms of handling plastic waste is of course an amazing. The circular economy allows plastic waste to be recycled into new products. In fact, the circular economy concept is claimed to be able to encourage environmentally friendly economic growth (Murti et al., 2022).

The recycling business is a form of circular economy towards responsible plastic waste. Recycling plastic waste is very influential in driving the people's economy, because the production chain involves many parties, from scavengers, collectors, to large industries that recycle plastic waste.

Data from the Ministry of Industry show that as much as 913,000 tons of plastic waste is processed annually into various value-added products with an economic potential of more than IDR 10 trillion per year and an export potential of recycled plastic derivative products reaching US$

141.9 million. In addition, data from the Ministry of Industry also shows that the population of the plastic recycling industry in Indonesia is around 600 large industries and 700 small industries with an investment value of up to IDR 7.15 trillion with a production capacity of 2.3 million tons per year. By optimizing the recycling industry, it is projected that jobs in this field will continue to increase. Currently there are 3 million scavengers, 160,000 collectors and grinders, around 100,000 workers at large suppliers, and 60,000 workers working in the plastic recycling industry (Ayu, 2021).

Various processing of plastic waste has been carried out by the plastic recycling industry in Indonesia. Starting from recycling plastic waste into wallets or bags that have a higher economic value, to recycling plastic waste into filament yarn for 3-dimensional printer ink. This activity is carried out through a program where people can exchange plastic bottle waste for various products. Recycling companies take plastic waste from people. The collected plastic bottle caps are chopped by machine, then made into filament yarn. This filament is used as 3D printer ink and is used to print various three-dimensional objects, ranging from key chains, action figures, to household furniture.

In the plastic waste processing industry, recycling of Polyethylene Terephthalate (PET) is no less important. This material is a type of high-quality plastic that can be recycled many times, thereby saving production raw materials. The need for PET continues to increase every year, therefore PET has a high economic value and has a crucial role in the circular economy.

Attention to PET recycling was carried out by one of the bottled water producers in collaboration with the Indonesian Plastic Recycling Association (ADUPI) and the Indonesian Scavengers Association (IPI) in encouraging the circular economy movement through the initiation of the National Circular Economy Movement pilot project. This multi-stakeholder collaboration aims to increase the national PET plastic recycling rate above 20%. This collaboration also educates and supports waste management at home and in the community.

Due to the high economic value of PET, the Ministry of Industry continues to encourage the implementation of a circular economy through the application of the PET-recycled Production Guidelines for food packaging. In addition, the Ministry of Industry also took the initiative to implement Recycled Component Level regulations on plastic finished goods to be used in the procurement of goods and services by the government, as well as incentives to reduce Value Added Tax for the plastic recycling industry. This effort is expected to encourage the creation of a circular economy concept in the plastics industry.

As for the lubricant industry, there are 44 companies with an investment of around IDR 40 trillion that are capable of processing 175,000 metric tons of used lubricants per year. About 65% of used lubricants can still be reused into lubricant products to meet around 15% of Indonesia's lubricant needs, which reach 1.15 million metric tons per year. Currently there are 2 companies that process used lubricants using high-tech refineries and lubricating oil mixing plants. Products of this sector are used by automotive, factory machinery, ships and trains (Ministry of Industry, 2021a).

In the textile industry, scrap and yarn waste can be recycled into textile fibers that can be spun for knitting or into open-ended yarn, bulk yarn, and mop yarn. The textile industry is also encouraged to make optimal use of waste. Currently, there are 9 textile waste processing companies in Indonesia with a capacity of 113,000 tons per year. In the paper recycling industry, currently there are 48 waste paper processing companies in Indonesia with a production capacity of 8.2 million tons per year which absorb 125 thousand workers. The total need for recycled paper in Indonesia is 6.4 million tons per year, of which 50 percent is from domestically. Meanwhile, the rubber scrap industry plays an important role for the tire industry. Currently in Indonesia there are 5 rubber scrap recycling industries that carry out rubber recycling with a capacity of 10-15 thousand tons per year (Nurcaya, 2021).

Meanwhile, the circular economy potential in the metal industry is in the aluminum processing industry, which is a metal that can be produced in repeated recycling cycles. Currently, the need for aluminum scrap in Indonesia reaches 18,000 tons per month (Ministry of Industry, 2021b).

The informal sector also plays an important role in implementing 5R in Indonesia. For example, in the electrical and electronic equipment sector, those who reuse and recycle electronic products are dominated by small and informal players. Elsewhere, there are companies that provide repair and refurbishment of used electronics and household appliances. The circular economy can build on the progress achieved by the informal sector, for example by upgrading the skills of informal workers which can substantially increase the economic value associated with electronic products that have expired and recovered electronic waste.

The application of a circular economy to the recycling industry is not only able to reduce manufacturing industry waste, but can also meet the demand for raw materials for the industrial sector. In order to realize a circular economy in the manufacturing industry, the Indonesian government has prepared various efforts such as policy formulation, increasing the capacity of institutional agencies through research and development, testing, certification, and promotion. The Indonesian government has also carried out standardization of raw materials and energy, as well as production processes, products, utilization and waste management. In addition, the Government of Indonesia is also seeking to provide facilities to support the application of circular economy principles.

In addition to the application of the circular economy in the manufacturing industry as mentioned above, the Ministry of National Development Planning of the Republic of Indonesia/National Development Planning Agency (Ministry of National Development Planning/Bappenas) has also identified 5 sectors with high potential for implementing a circular economy in Indonesia, namely: food and beverages, textiles, construction, wholesale and retail, and electrical and electronic equipment. This high potential is driven by economic analysis, the ease of production systems to adopt a circular approach and the level of stakeholder support in advancing circularity in these sectors.

The Ministry of National Development Planning/Bappenas has mapped the potential and opportunities for 5R circularity in each sector. These opportunities were identified based on available evidence that they have the potential to make a major impact in the sector. For example, for the food and beverage sector, reduce and re-

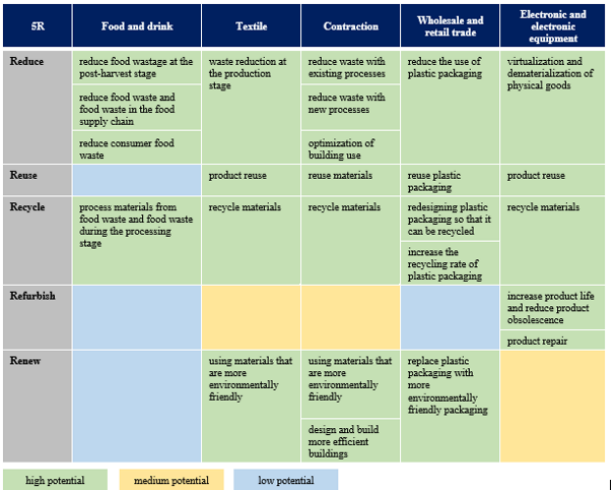

Figure 1. Circular Economy Opportunities in Each Sector Based on 5R Source: (Bappenas Indonesia, 2021)

cycle have the greatest opportunities. As a result, there are 4 prioritized opportunities, namely: (1) reducing wastage of food after harvest; (2) reduce wastage and waste in the food supply chain; (3) reduce food waste generated by consumers; and (4) reduce wastage and food waste in the production process. Opportunities in each sector based on the 5R circularity potential are shown in the Figure 1.

The Ministry of National Development Planning/Bappenas has also identified several obstacles that hinder business actors from implementing a circular economy. A survey conducted by the Ministry of National Development Planning/Bappenas of 57 companies in Indonesia revealed that the main obstacle to implementing a circular economy for companies is the difficulty of changing habits. In addition, other obstacles are: lack of infrastructure, implementation problems, unintended consequences of existing regulations, insufficient market, unclear targets and objectives, insufficient legal framework, non-profit making, lack of information, and lack of capital. The top ten obstacles in adopting a circular economy for companies in Indonesia are shown in the following Table 3:

Table 3. Ten Obstacles to Implementing a Circular Economy for Companies in Indonesia

No.	Contraint	% of Firm
1	It's hard to change habits	51
2	Lack of infrastructure	47
3	Implementation and execution issues	42
4	There are unintended consequences of the applicable regulations	38
5	No enough markets	38
6	Unclear targets and goals	37
7	Insufficient legal framework	36
8	Not making a profit	28
9	Lack of information	21
10	Lack of capital	18

Source: (Bappenas Indonesia, 2021)

4. CONCLUSIONS

The development of the manufacturing industry is one of the pillars of Indonesia's economic development which is directed by applying sustainable principles and is based on aspects of economic, social and environmental development. The application of the circular economy concept is considered to have the potential to boost the manufacturing industry sector in Indonesia. This strategic step is expected to boost the growth and competitiveness of the manufacturing industry in Indonesia. However, Indonesia still needs stronger and firmer strategies and action plans to implement a circular economy. It is very important to bring together related parties from industry, government and society to change the linear economy to a circular economy through building back better. By building a strong circular economy concept, it is hoped that the manufacturing industry in Indonesia can grow better.

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