Proceedings of the International Conference on Industrial Engineering and Operations Management
Manila, Philippines, March 7-9, 2023

Review on Sustainable Energy Implementation in Indonesian Cement Industry

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Abstract

Energy, both renewable and non-renewable energy, are increasingly used in every sector of life. Manufacturing sectors, especially, account for the largest share of annual industrial energy consumption by 81% in which it consumes two general types of energy source, fuel and nonfuel. Cement industry is one of the industries that plays an important role in the construction process and requires a large amount of energy in its production process. The use in this process contributes to a different amount of carbon emission. Furthermore, this increase in energy consumption is not in line with the availability of energy sources. Therefore, the Indonesian government ordered energy-efficient strategies to maintain sustainability. A review on the implementation from secondary data was conducted and analyzed. The review result shows even though strategies and policies are implemented by the companies, a reduction of energy consumption within the past 3 years from the cement industry in Indonesia does not necessarily obtain a decrease of carbon emission.

Keywords
Energy Consumption, Carbon Emission, Sustainable Energy, Cement Industry.

1. Introduction
Energy plays an important role in human life, whether for household demand or business sectors, where almost all equipment that helps people requires energy to operate. There are two sources of energy in the world, non-renewable energy and renewable energy. Currently, the use of energy continues to increase unproportionally compared to the increase in the availability of energy sources (Abas et al. 2015). This raises the potential for an energy crisis in the future. The industrial sector is one of the largest energy users compared to other sectors. According to the U.S. Energy Information Administration - EIA (2022), industry or manufacturing sectors in 2021 hold accounts for the largest share of annual industrial energy consumption by 81% in which it consumes two general types of energy source, fuel and nonfuel. Fuel consumption energy is heat and/or electricity generated from the use of a combustible energy source for its own usage within the industry.

Cement industry is one of the industries that plays an important role in the construction process. Cement production requires a large amount of energy, in which a massive consumption of energy has the potential to contribute to environmental problems such as carbon emissions and air pollution. To overcome the occurrence of an energy crisis due to the use on a large scale and continuously from the industrial sector, strategic steps from company's management are needed in the utilization and saving of energy. Sustainable Development Goals (SDG) is designed so that an industry can contribute to overcome the global crisis, one of which is energy.

According to the Ministry of Energy and Mineral Resources (ESDM) of Indonesia, the government ordered all industries to improve energy-efficient management. In fact, this obligation was emphasized in a circular letter which was circulated to all industries to comply to save energy. This policy will prevent non-renewable energy sources derived from fossils such as coal, oil and natural gas from running out quickly, and can be used by future generations. This study will analyze the energy consumption within the cement companies in Indonesia and its impact on carbon emissions. Furthermore, a discussion on implementation of the sustainability strategy of the Indonesian cement

industry to reduce energy consumption and carbon emissions produced by the production process carried out by the industry.

1.1 Objectives

The aim of this research is to study and review the energy consumption and carbon emission produced by Indonesia cement industry. Furthermore this study will review the policies implemented by the company in order to contribute to sustainable energy.

2. Literature Review

2.1 Energy Management

According to Schulze et al. (2016), energy management comprises the systematic activities, procedures and routines within an industrial company including the elements strategy/planning, implementation/operation, controlling, organization and culture and involving both production and support process, which aim to continuously reduce the company's energy consumption and its related energy costs. According to ISO 50001:2011, an energy management system is defined as: a set of interrelated or interacting elements to establish an energy policy and energy objectives, and processes and procedures to achieve those objectives.

2.2 Solar Energy

Solar cells are a set of modules for converting solar energy into electrical energy. Photovoltaic is a technology that functions to change or convert solar radiation into electrical energy directly. PV is usually packaged in a unit called a module. A solar module consists of many solar cells that can be arranged in series or parallel (Safitri et al, 2019). Meanwhile, what is meant by solar is a semiconductor element that can convert solar energy into electrical energy on the basis of the photovoltaic effect. Solar cells are gaining popularity recently, apart from the depletion of fossil energy reserves and the issue of global warming. The energy produced is also very cheap because energy sources (sun) can be obtained for free.

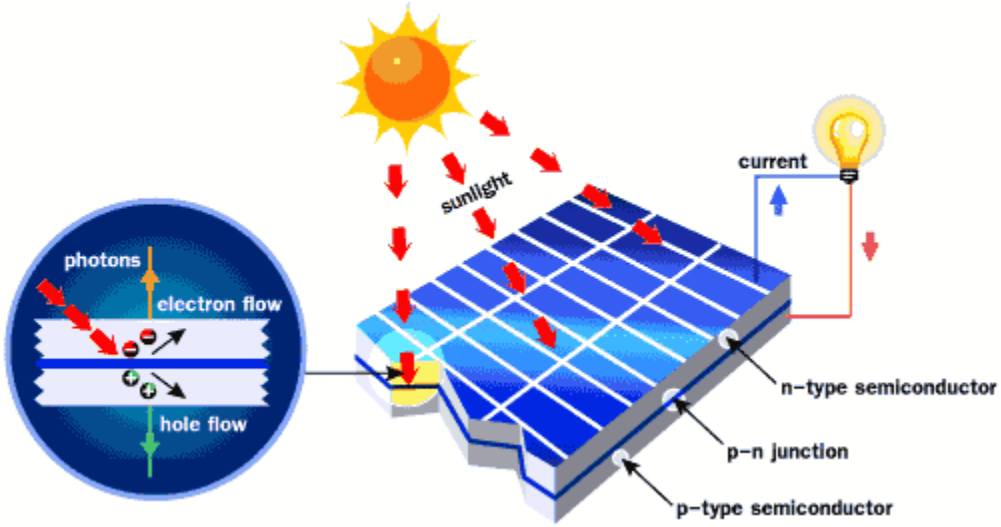

Fig 1. Solar Cell Schematic

3. Method

This research was conducted using secondary data from several cement companies in Indonesia which implemented efficiency programs to reduce the usage of energy within their production process. This research was conducted in four stages as can be seen in Figure 1. In the first stage, we conducted a literature review related to the energy consumption in the cement industry in indonesia. The second stage is to analyze the Annual Reports of selected companies from 2020 & 2021 period. The third stage, identification of the energy consumption and carbon emission produced by each company. The final stage is to analyze the implementation of each company's strategy about saving energy and contribution for sustainable energy.

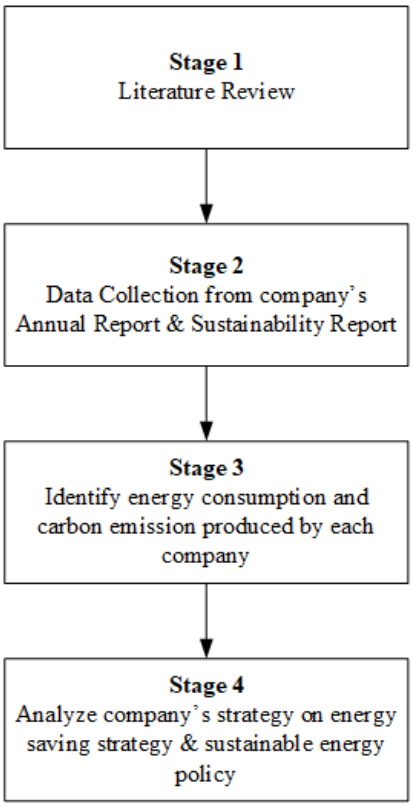

Figure 1. Research Methodology

4. Data Collection

This research focuses on 6 major cement companies in Indonesia, which are PT Indocement Tunggal Prakarsa, PT Semen Baturaja (Persero) Tbk, PT Semen Indonesia (Persero) Tbk, PT Solusi Bangun Indonesia Tbk, PT Wijaya Karya Beton Tbk, and PT Waskita Beton Precast Tbk. Information regarding data of energy consumption on non-renewable and renewable energy was obtained from the company's Annual Report and Sustainability Report. The energy consumption of each company is shown in Table 1.

Table 1. Energy Consumption in Indonesian Cement Companies

Company	Energy	Energy Consumption per Year (in GJ)		
		2021	2020	2019
PT Indocement Tunggal Prakarsa	Non Renewable	42,723,451	41,118,435	48,291,875
	Renewable	5,069,172	3,646,272	3,313,401
	Total Energy	47,792,623	44,764,707	51,605,276
PT Semen Baturaja (Persero) Tbk	Non Renewable	5,230,741	4,722,807	5,779,583
	Renewable	0	0	0
	Total Energy	5,230,741	4,722,807	5,779,583
PT Semen Indonesia (Persero) Tbk	Non Renewable	103,216,736	107,899,808	95,350,286
	Renewable	5,307,297	4,043,158	4,043,158

Company	Energy	Energy Consumption per Year (in GJ)		
		2021	2020	2019
	Total Energy	108,524,033	111,942,966	99,393,444
PT Solusi Bangun Indonesia Tbk	Non Renewable	32,578	32,746	
	Renewable	7	7	
	Total Energy	32,585	32,753	
PT Wijaya Karya Beton Tbk	Non Renewable	145,497	99,338	135,582
	Renewable	0	0	0
	Total Energy	145,497	99,338	135,582
PT Waskita Beton Precast Tbk	Non Renewable	70,140	55,765	72,076
	Renewable	0	0	0
	Total Energy	70,140	55,765	72,076

Furthermore, the carbon emission produced by each company is shown in Table 2.

Table 2. Carbon Emission in Indonesian Cement Companies

Company	Scope	CO2 Emission per Year (in Ton CO2)		
		2021	2020	2019
PT Indocement Tunggal Prakarsa	Scope 1	11.10	10.64	12.14
	Scope 2	0.97	0.86	1.04
	Total Scope 1 & 2	12.07	11.50	13.18
PT Semen Baturaja (Persero) Tbk	Scope 1	1,226,428.00	1,137,443.00	1,258,741.00
	Scope 2	134,562.00	130,114.00	235,670.00
	Total Scope 1 & 2	1,360,990.00	1,267,557.00	1,494,411.00
PT Semen Indonesia (Persero) Tbk	Scope 1	24,455,835.00	25,359,445.00	27,959,111.00
	Scope 2	2,178,559.00	2,164,828.00	2,601,828.00
	Total Scope 1 & 2	26,634,394.00	27,524,273.00	30,560,939.00
PT Solusi Bangun Indonesia (Tbk)	Scope 1	7,149.69		
	Scope 2	846.20		
	Total Scope 1 & 2	7,995.90	0.00	0.00
PT Wijaya Karya Beton Tbk	Scope 1	6,852.00	4,028.12	7,926.02
	Scope 2	1,755.13	1,530.13	1,680.04
	Total Scope 1 & 2	8,607.13	5,558.25	9,606.06

PT Waskita Beton Precast Tbk	Scope 1	4,528.69	635.77	894.91
	Scope 2	3,004.08	12,294.72	15,597.71
	Total Scope 1 & 2	7,532.77	12,930.49	16,492.62

5. Results and Discussion

Based on collected data, the trend of total energy consumption from mentioned companies shows a majority of reduction which can be seen on Figure 2.

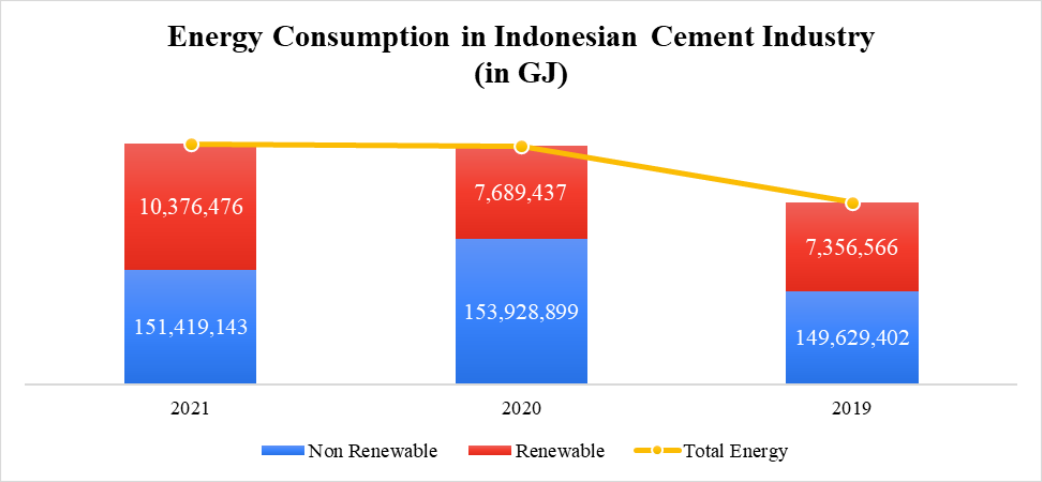

Figure 2. Trend of Energy Consumption in Indonesian Cement Industry

On the other hand, the carbon (CO2) emission produced by each company for the production process, containing both 1st and 2nd scope of CO2 emission, are experiencing an increase for the past 3 years which can be seen in Figure 3.

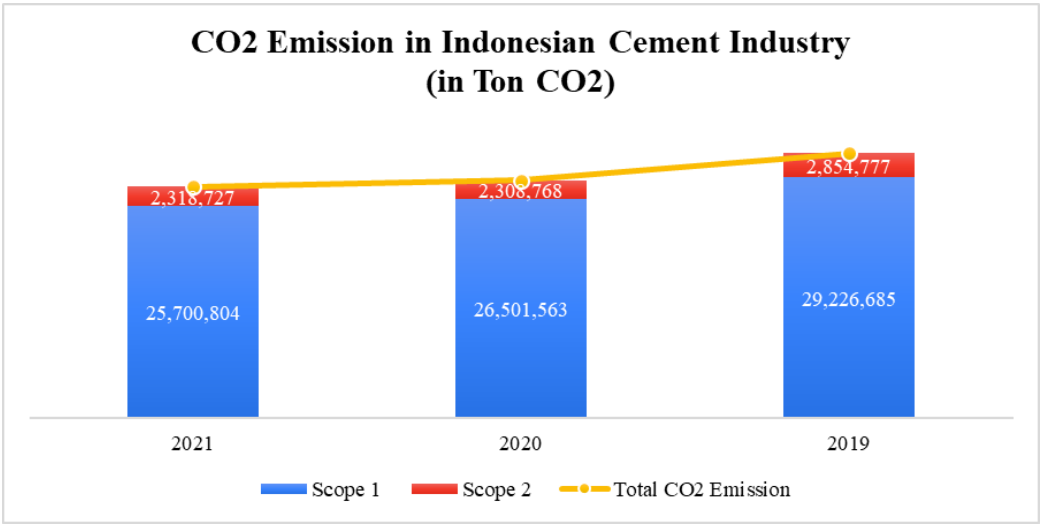

Figure 3. Trend of CO2 Emission in Indonesian Cement Industry

According to each company's sustainability report, strategies and policies are implemented and planned to increase the company's contribution to sustainable energy. Strategies and policies from each company are stated in Table 3.

Table 3. Company's Strategy and Policy Implementation on Sustainable Energy

Company	Strategy
PT Indocement Tunggal Prakarsa	a. Establish fossil fuel reduction roadmap through "Green Cement" campaign. b. Increasing alternative fuel usage to 25% by 2025 c. Introducing Portland Composite Cement (PCC), Portland, Pozzolan Cement (PPC), Slag Cement, and Hydraulic Cement (Green Cement) to replace Ordinary Portland Cement (OPC). d. Using renewable energy as a source of electricity (gas turbine and solar panel).
PT Semen Baturaja (Persero) Tbk	a. Establish Green Cement Based Building Material Company. b. Set a target for reducing thermal energy consumption (Heat Consumption) and electricity (Electrical Consumption) c. The Company currently only uses energy from non-renewable sources such as coal and electricity for operational and other supporting activities sourced from State Electric Company. d. The Company has initiated several studies related to the use of New Renewable Energy, such as the use of solar energy as a 20 MW Solar Power Plant.
PT Semen Indonesia (Persero) Tbk	a. Commitment includes Greenhouse Gas (GHG) emissions efficiency and the utilization of renewable energy b. Utilization of biomass & solar panel energy implementation for operational purpose. c. develop renewable energy through the implementation of solar panels at 3 SIG plants (Indarung, Tuban and Tonasa). d. Utilization of eco-friendly materials. e. WHRPG (Waste Heat Recovery Power Generation) to reduce carbon emission.
PT Solusi Bangun Indonesia Tbk	a. Reducing clinker factor: ● Substitution of clinker with alternative materials. ● Advocacy for the use of performance based cement which has a lower clinker factor. b. Increase use of alternative fuels: ● Improved pre-processing facilities and alternative fuel feeding. ● Replicate RDF initiatives across cement plants. c. Optimization of specific heat energy consumption: ● Digitization and optimization to increase plant efficiency. ● Exploration of innovative technologies, including hydrogen injection. d. Future technologies related to carbon capture utilization and storage: ● Exploration of potential technologies. ● Study on the use of algae for carbon capture ● Multi-stakeholder collaboration. e. Reducing electricity consumption from coal power steam power plant: ● Installation of solar panels in plants. ● Digitization and automation for efficient use of electrical energy.
PT Wijaya Karya Beton Tbk	a. Start utilizing renewable energy and build rooftop PV that can generate at least 9.3 GW of energy so that it can potentially reduce up to 45%; b. Replace 100% of fuel oil (biodiesel) in the entire fleet of equipment and vehicles, which has the potential to reduce emissions by up to 11%; c. Up to 10% of emissions can be reduced by implementing other energy efficiency and electrification initiatives such as centralizing refrigeration, switching to low GWP refrigerants, converting LED lighting, and utilizing electric vehicles.
PT Waskita Beton Precast Tbk	a. Campaign about energy savings and an appeal to turn off unused lights and electrical equipment (computers, air conditioners, televisions, fans, etc); b. Increase the number of glass panels in the office space, so that sunlight can be used as lightning source during the day; c. Replacing TL (Fluorescent Lamp) lamps with LED (Light Emitting Diode) lamps, which are more energy efficient.

6. Conclusion

This research provides a review and insight of the implementation in the cement industry in Indonesia. Based on data collected and reviewed, it can be concluded that companies within the cement industry in Indonesia have already implemented strategies and policies to maintain the sustainability of energy. Their programs resulted in a decrease of energy consumption in the past 3 (three) years. But this reduction in energy consumption does not come with a reduction of carbon emission as per expected. An increase is shown within the past 3 years of the industry.
The limitations of this research lies in the lack of data collected limited from the company's sustainability report for the past 3 years. This limits the research on the bigger evaluation of energy consumption, carbon emission production, and strategy implementation in the industry. Further research is recommended to gather more detailed data on the review of energy sustainability in the cement industry in Indonesia.

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