

SUSTAINABILITY OR FALSE SOLUTION? A CRITICAL VIEW OF CARBON CAPTURE, UTILIZATION, AND STORAGE (CCUS) AND THE FUTURE OF ITS IMPLEMENTATION IN INDONESIA

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Abstract - *This study aims to evaluate the effectiveness of carbon capture as a carbon emission reduction strategy in the oil and gas sector in Indonesia. In an effort to reduce carbon emissions from the oil and gas industry, the Government of Indonesia through the Ministry of Energy and Mineral Resources (ESDM) has begun to take the development of Carbon Capture Storage (CCS)/ Carbon Capture Utilization and Storage (CCUS) technology seriously. This seriousness can be seen through the creation of 16 CCUS projects that are currently under development. This effort is not only to reduce greenhouse gas emissions, but also so that Indonesia is able to utilize CO₂ waste and methane gas to be developed as useful products. This research attempts to examine the application of CCUS as a policy solution towards net zero emission 2060 and the sustainability that Indonesia wants to achieve. Adopting a qualitative approach, this study analyzes sustainability claims in the implementation of CCUS projects. The*

results show that although CCUS is promoted and considered as a solution to reduce emissions and develop new investments for the state, its presence tends to act more as a greenwashing strategy than as an effective step towards sustainability. In addition, other findings show that the presence of CCUS is actually an obstacle to the green transition efforts that are trying to be achieved. The urgency of this research lies in the effort to see the effectiveness of the CCUS policy which is claimed to be the main way to deliver sustainability policies and Indonesia net zero emission 2060.

Keywords: *CCUS, Climate crisis, Indonesian Government, Greencapitalism.*

I. INTRODUCTION

The shift in global attention to non-traditional security threats, including climate change, economic crises and pandemics, reflects the complexity of non-traditional security challenges in the 21st century. In

general, non-traditional security highlights the importance of international cooperation and multidisciplinary approaches in responding to threats that do not recognize national borders (Patel, 2021). One of the most alarming non-traditional security challenges today is the climate crisis. Even the Secretary-General of the United Nations has highlighted the multifaceted impacts of climate change, ranging from worsening inequality and displacement, to increased risk of conflict (United Nations, 2021b). The climate crisis, exacerbated by increasing carbon dioxide and greenhouse gas emissions, requires a rapid and effective global response, especially in the energy sector, which is a major contributor to global carbon emissions. Similarly, the profound implications of climate change on global security have been recognized by world leaders and security experts, who underscore the importance of integrating climate considerations into security and peacebuilding efforts (United Nations, 2021a, 2022).

The global urgency in reducing carbon emissions is basically an effort to prevent the impacts that will occur on the climate crisis, such as human activities, burning fossil fuels and deforestation that cause an increase in the concentration of greenhouse gases in the atmosphere which in turn causes global warming (Dodman, 2009). The impacts of global warming have resulted in increased global temperatures, melting of ice in the north and south polar regions, rising sea levels, and changes in extreme weather patterns. In addition, carbon emissions also contribute to increased air pollution that is detrimental to human health. Pollutant particles generated from burning fossil fuels can cause respiratory problems, cardiovascular health, and increase the risk of developing diseases (Chen et al., 2023). The domino

effect of the climate crisis also affects the social and economic aspects of the world (Leal Filho et al., 2023). This is because communities that are most vulnerable to climate change, such as poor communities in developing countries or remote areas, are often unable to adapt quickly to the changes. As a result, climate change can exacerbate social and economic inequalities and increase the risk of conflict and forced migration.

Seeing the magnitude of the problems caused by the climate and environmental crisis, efforts to reduce carbon emissions are now increasingly taken seriously by all countries in the world, including Indonesia. Indonesia's seriousness in pushing the decarbonization policy can be seen from the Jokowi administration's big target of reducing greenhouse gas emissions by 31.89 percent with its own efforts and 43.20 percent with international support by 2030, as well as the target of zero emissions by 2060 (Limanseto, 2022). One of these policy scenarios is the 2016 Paris Agreement, in which the reduction of the earth's CO₂ emissions is targeted to reach up to 26 percent (Zaemi & Rohmana, 2021). To pursue this, while still maintaining the running of the fossil energy industry that produces large pollution and waste, the Indonesian government encourages the presence of carbon emission management and capture methods in the form of Carbon Capture, Utilization, and Storage (CCUS), whose application is marked by the Minister of Energy and Mineral Resources regulation number 2 of 2023 concerning the implementation of carbon capture and storage, as well as carbon capture, utilization and storage in upstream oil and gas business activities (Pribadi, 2023). In addition, PERPRES number 14 of 2024 on the implementation of carbon capture and storage activities was also issued by President Joko Widodo (Rosa, 2024).

CCUS itself is a new technology to mitigate the greenhouse gas effect caused by burning fossil fuels, and at the same time to increase oil production by applying Enhanced Oil Recovery (EOR) technology (Sugihardjo, 2022a). An additional advantage of this project, besides being able to store CO₂, is that natural resource management businesses can get added value because the captured carbon dioxide can then be delivered and stored below ground or used for various commercial purposes. Several studies have found that CCUS has the potential to significantly reduce GHG emissions and help mitigate climate change (Sugihardjo, 2022b). Through the implementation of CCUS, it is expected that the world's carbon emissions can be reduced by up to 1.5 degrees Celsius.

Due to the huge potential benefits, the trend of using the CCUS method is now being actively pursued by countries around the world. By the end of 2016, according to the 2016 Global Status statistics, there were 38 large-scale CCS and CCUS projects in operation or under construction and planning. Among them, 17 projects are located in North America (12 projects in the United States and 5 in Canada); 12 projects in Asia (8 in China, 2 in South Korea, 1 in Saudi Arabia, and 1 in the United Arab Emirates), 5 in Europe (2 in Norway, 2 in the United Kingdom, and 1 in the Netherlands), 3 in Australia, and 1 in Brazil (Liu et al., 2017). Meanwhile, the Director General of Oil and Gas (Dirjen Migas) of the Ministry of Energy and Mineral Resources, mentioned that Indonesia currently has 15 Carbon Capture Storage (CCS) and Capture Utilization and Storage (CCUS) projects in the country that are under pilot study where one of the projects, claimed to have met the standards (Setiawan, 2023).

Various studies that have been carried out by previous researchers, such as (Burton, 2014; Xu & Dai, 2021) found that CCUS used to capture carbon dioxide from large point sources, such as industrial sites or power plants that use biomass or fossil fuels is considered the best option for CO₂ emission reduction. While in Dahowski (2018) and Michelle (2017) their articles concluded that CCUS can store more than Ashworth et al. (2018) found that due to the technical nature of CCUS, the public has a relatively poor understanding of CCUS, so public acceptance and support has a strong impact on large-scale implementation of CCUS (Ashworth et al., 2018). In an article by (Filemon Patra, 2022), it was found that the process of working on CCUS at PT Pertamina in collaboration with various oil companies from Japan aims to share the carbon generated from the production process of GAS between the Indonesian and Japanese governments. While an article by Chatterje (2023) found Indonesia in 2023 to be in the leading position in the commercial CCUS landscape in Southeast Asia comprising 55% of the total projects, followed by Malaysia with another 33% in the total CCUS development in Southeast Asia (Chatterjee, 2023).

Departing from the findings of the various literacy studies described above, it can be seen that almost all of these studies are still limited to discussing the form of CCUS implementation in general in the global scope and how effective it is. We found that not many have used social and political perspectives in looking at the application of this carbon emission reduction method, especially in developing countries such as Indonesia. This is important because the implementation of CCUS methods requires large space, funds, and facilities, so the implementation will be very burdensome for developing countries. Not to mention, the application of CCUS as a solution to the

carbon emission problem is not in line with the Indonesian government's efforts to reduce dependence on fossil resources. This can be seen from how Indonesia has so far been very minimal in implementing an energy transition strategy from fossil energy to renewable energy. In fact, in some journalistic investigations, it was found that the Indonesian government is increasingly issuing mining business licenses (Izin Usaha Pertambangan (IUP)) in Indonesia where to obscure this fact, the Indonesian government tried to apply CCUS as a solution to carbon emissions, which in fact, is still very questionable in its effectiveness. Therefore, through this article, the author tries to see how the potential of Carbon Capture, Utilization, and Storage (CCUS) to be a solution for reducing carbon emissions in Indonesia.

II. RESEARCH METHOD

This research will adopt a qualitative approach with a focus on desk research. Data will be collected through document analysis covering both primary and secondary sources. Primary sources include official policies, regulations, and government reports, as well as relevant CCUS project documentation from the Ministry of Energy and Mineral Resources (MEMR) of the Republic of Indonesia. Secondary sources will consist of academic journals, industry analyses, and publications related to CCUS implementation, decarbonization strategies, and sustainable energy transition. The research will uncover how CCUS is being implemented around the world and evaluate the extent to which CCUS practices are contributing or hindering the green transition. A comprehensive assessment will be made of sustainability claims in CCUS project implementation, reviewing both the

potential economic and environmental benefits, as well as the risks and challenges. In addition, the research will also involve discourse analysis to understand the representation and framing of CCUS in public policy. As a result, this article will reveal the application of CCUS technology and how it implies solutions to Indonesia's carbon emission reduction targets.

III. RESULT AND DISCUSSION

Green Capitalism

In recent years, the theme of green capitalism and its related issues, such as green growth, green economy, and green stimulus, have become increasingly popular among corporate and capitalist groups, in line with the increasing discussion about the environmental crisis (Ponte, 2023). This concept was born from the growing urgency of the environmental crisis, which inspired not only various nature protection movements, but also inspired capital owners who wanted to continue to expand their business operations while still obscuring the fact of environmental damage produced by their business. To find a middle ground, the concept of green capitalism was born. For capitalist groups, green capitalism is used as an answer to the increasingly worrying environmental problems as well as their fear of the direct and indirect impact of the crisis on business operations (Yang & Yang, 2022). Therefore, it is appropriate to see green capitalism as a combination of capitalist and ecological systems, which aims to provide solutions for the sustainable development of capitalism. There are three main characteristics of green capitalism practices, namely the use of renewable energy, avoiding hazardous chemicals, and recycling and reusing used goods (Chotimah & Winanti, 2018).

As mentioned above, green capitalism is related to the strengthening of the sustainability discourse, in the sense that industries are not only present to maximize profits, but also think hard about how to contribute to environmental protection. According to Adrienne Buller in *The Value of a Whale: On the Illusions of Green Capitalism*, the narrative of environmental protection promoted by the environmental and climate activism movement is today used by corporations to strengthen their business position. The strategy of promoting the narrative that the fossil and mineral industries are also concerned about the climate crisis is intended to mask the disruption to their production processes that are actually harmful to the environment with the presence of green propaganda and campaigns (Buller, 2022). The impact of this, according to Benson and Kirsch, is the term "corporate oxymorons" (Benson & Kirsch, 2010), where companies can present false solutions in the form of sustainable companies that are now widely adapted by large corporations in the world. This strategy is very dangerous, because it gives the Company "permission" to continue to maintain their destructive status quo in exchange for development programs that are only intended to slow down the pace of the environmental and climate crisis (Mahardika, 2023).

CCUS Project Implementation in Indonesia

Globally, CCUS deployment has seen a significant increase. The International Energy Agency (IEA) notes that projects have tripled over the past decade (IEA, 2020). It should be noted that CCUS projects have been initiated as early as 1972, but due to the controversy surrounding these projects, the growth period has been very slow. The growing magnitude of the climate crisis and the

advancement of technology have given CCUS momentum again. Available data shows that global carbon capture capacity is expected to increase at least threefold between 2020 and 2030, and possibly reach a 12-fold increase by 2030 when considering the increased activity in the last two years (McKinsey & Company, 2024). Bloomberg, meanwhile, reports that the capacity for carbon capture globally by 2030 will increase six-fold from current levels, to 279 million tons of CO₂ per year (Henze, 2022).

Up to this day, there are a total of 51 CCUS projects in operation that were first implemented in 1982 in the United States (IEA, 2024). At least 744 projects will be built by 2060. The country with the most projects is the United States with 20 operating projects spread across all states, followed by China with 10 operating projects (IEA, 2024). This demonstrates significant progress and global commitment to the development and implementation of CCUS technologies as part of a comprehensive strategy to reduce carbon emissions and combat climate change. This surge in the number of projects reflects technological advances, increased awareness, and growing support from governments and the private sector for sustainable solutions and green technologies. In addition, the procurement of these projects also relates to the urgent need at the global level to reduce carbon emissions which also aims to avoid the effects of the climate crisis (United Nations, 2021a, 2021b, 2022) as a result of human activities, such as the burning of fossil fuels and deforestation have increased the amount of greenhouse gases in the atmosphere, which in turn leads to global warming (Bui et al., 2018; Pratschner et al., 2023).

As a country that still relies on the fossil industry, Indonesia is also undertaking the development of CCUS projects under the command of the Ministry of Energy and Mineral Resources (MEMR). Indonesia has

This commitment is in line with the Paris Agreement, where Indonesia seeks to meet the ambitious target of reducing Greenhouse Gas (GHG) emissions by 31.89 percent by 2030, and reaching zero emissions by 2060 (Limanseto, 2022). As a developing country, Indonesia is taking this step not only to comply with international standards, but also to play an active role in global decarbonization efforts. Indonesia produces around 700 million tons of carbon per year, equivalent to 1.96% of all carbon emissions in the world (ourworldindata.org, 2022), so this project is considered important by the government. With carbon emissions continuing to rise along with the development of the fossil industry, the implementation of CCUS regulated through the latest regulation emphasizes Indonesia's seriousness in implementing a responsible environmental strategy. Data shows that countries such as the United States and the European Union have collectively contributed significantly to the accumulation of CO₂ emissions, emphasizing the importance of each country's role in reducing the global carbon footprint.

Reflecting on Global CCUS Implementation and Indonesia's Decarbonization Future

Although the trend of using CCUS is new as a solution to reduce carbon emissions in the world, this method has actually been present as far back as 1972 (Ma et al., 2022). The Chevron Company was the first in that year to successfully start the world's first CCS project, where they managed to channel CO₂ from Colorado to the oil fields in Scurry County, Texas for the Enhanced Oil Recovery (EOR) process which allowed for greater oil extraction (Ma et al., 2022, p.

35). This fact shows that carbon capture is a viable method to produce more oil as well as increase the production of other goods. Since its commercial implementation in 1972, the CCS method has been slow to be adopted due to a lot of skepticism about its impact on the environment. However, in the decades since, the carbon capture process has continued to trend, and is now considered a leading solution by a group of international GAS companies, as seen in the timeline below (Rowell & Stockman, 2021a).

Academics, activist groups such as Greenpeace and organizations that focus on researching the impacts of fossil fuel use, such as Oil Change International, see the CCUS effort as another way for oil and gas corporations to increase their business while deceiving the public with sustainability and carbon emission reduction jargon. Rejection of this project was also carried out by more than 500 organizations concerned with environmental issues by stating their position that CCUS is a false solution imposed so that oil and gas entrepreneurs can continue to run their business and prevent the renewable energy transition process from being hampered (Jessica, 2021). Even the press releases of these environmental organizations show that the application of CCUS is actually a new tool to further increase the production of extractive businesses of oil and gas companies with the finding that 80 percent of the carbon captured by the CCUS method is used to pump more oil out of the ground through increased oil recovery. CCUS is then presented as a sustainability myth to obscure the fact that their dirty business continues to be harmful to the climate and society.

Timeline of Carbon Capture: Five Decades of False Hope, Hype, and Hot Air

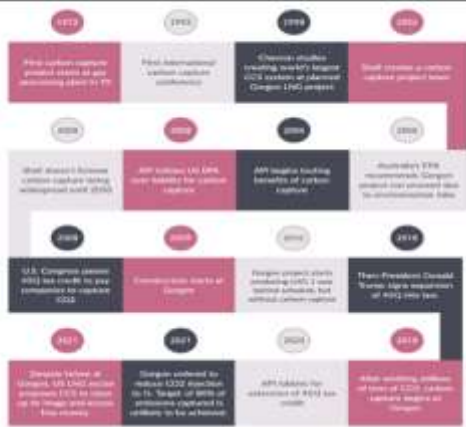


Figure 3. Timeline of Carbon Capture: Five Decades of False Hope, Hype, and Hot Air
Source: Rowell and Stockman, 2021

The implementation of CCUS, which has been touted as a solution to reducing carbon emissions, has also fallen short of expectations. Several findings show this. Research findings from the Institute for Energy Economics and Financial Analysis (IEEFA) in 2021 showed that 13 CCUS projects around the world only managed to capture 39 million tons of CO₂ per year or about 1/10,000 of the total 36 billion tons of emissions released into the atmosphere in 2021 (Piri, 2023). In line with IEEFA's findings, the International Energy Agency (IEA) report in 2022 showed that the project capture of 26 CCUS projects worldwide reached 40 million tons of CO₂ annually. In comparison, the world emits 36.4 billion tons of CO₂ annually. This means that with all the support for CCUS development, tax breaks, and intensive support for CCUS projects, CCUS projects in the world today are only able to capture approximately 0.1 percent of the total carbon emissions produced. This data is further reinforced by the fact that carbon emissions are trending upward even after the 2016 Paris Agreement came into effect (Weyler, 2022). Chevron's Gorgon project, which is claimed to be the world's largest CCUS project and has been running for

more than twenty years, has also not shown satisfactory results. Despite receiving an injection of up to A\$60 million for CCUS implementation, only three years later, the CCUS project was able to run. Not to mention that data from the Western Australian Environmental Protection Authority concluded that Gorgon's target of reducing emission levels by 80 percent seems difficult to realize (Rowell & Stockman, 2021b).

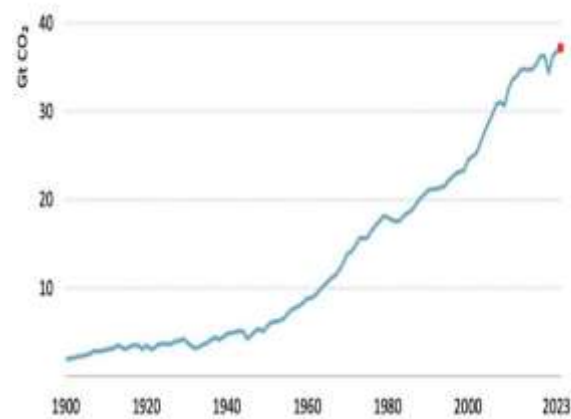


Figure 4. CO₂ Emissions Report in 2023
Source: IEA, 2023

Other than that, there are still project safety issues that must also be considered, namely the problem of technology leaks which of course endanger the environment and humans around the project. This risk occurred in 2022 in Satartia, Mississippi, where a CO₂ pipeline exploded causing a massive explosion in the area. The impact of the explosion was poisoning that caused residents to become seriously ill, characterized by victims experiencing nausea, confusion, difficulty breathing, and foaming at the mouth (Zegart, 2021).

Another problem with CCUS implementation is the high energy demand of the CCS/ CCUS process and the need for large infrastructure, making CCUS technology costly with uncertain targets (IPCC, 2023). As a result, many CCUS projects have failed and

had to be discontinued (Lebling et al., 2023). In the US, the Mississippi CCUS project was delayed from the original schedule, causing the funding budget to exceed the target and had to be closed. Similarly, the Petra Nova CCUS plant in Texas, which was targeted to capture 1.6 million tons of CO₂ annually, only reached its annual target in its third year of operation and had to be shut down in 2020. The CCUS project at MIT also had to be shut down for causing ecological and economic damage in 2016 (Weyler, 2022). Recent data shows that more than 80 percent of CCUS projects in the US have failed to proceed for various reasons, such as low technological readiness, very risky financial benefit analysis, and high dependence on government incentives (Cameron & Carter, 2023). In a study by Abdulla et. al. it was found that out of 149 projects planned to be built and start storing carbon by 2020 worldwide, more than 100 projects were canceled and suspended indefinitely (Abdulla et al., 2021). Furthermore, Babiker's research results in the report (Cameron & Carter, 2023, p. 8) , showed that CCS is the most expensive decarbonization method as well as the least effective in reducing emissions compared to other methods as shown in the graph below (see figure 5).

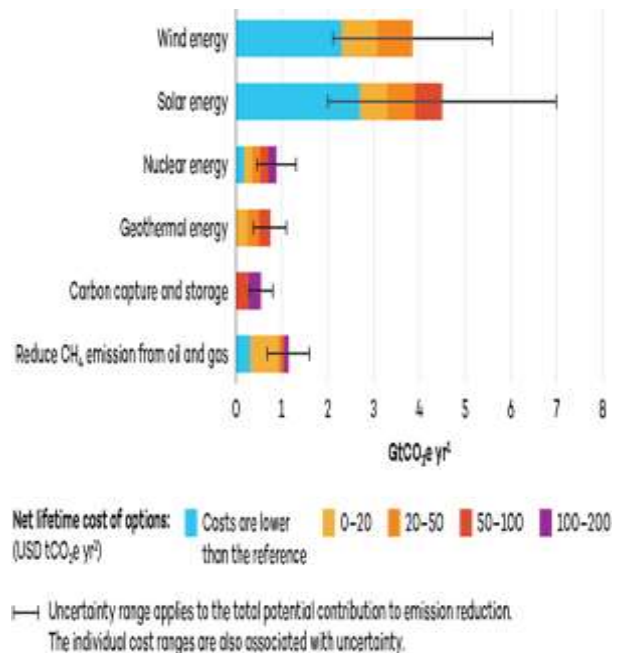


Figure 5. Post and Potential Efficiency by CCS, Methane Reduction, and Renewable Energies
Source: Carter and Cameron, 2023

In the debate on the feasibility of green capitalism, many see that by nature, the conceptions of green and capitalism are contradictory, and efforts to limit economic development at all costs are at odds with the logic of capital (Yang & Yang, 2022, pp. 749–750). This argument is corroborated by Forster's thoughts in his book entitled, "Ecology Against Capitalism" (Foster, 2002) which sees that there is a fundamental contradiction between ecology and the development logic of capitalism, which cannot be integrated. This is because the abuse of nature is the norm of capital because it is the basis of capital's pursuit of profit. Ultimately, green capitalism cannot effectively solve the global ecological crisis and ensure sustainable economic growth within the framework of capitalism (Brand, 2016).

The many challenges, high costs, and high risks of implementing CCUS, do not outweigh its potential as a solution in reducing carbon emissions, as the author found above. It is not wrong, then, to be skeptical of CCUS

implementation in Indonesia. The effort to present CCUS as a solution when it has a controversial level of effectiveness, makes this project a way to obscure efforts to implement Indonesia's energy transition towards renewable energy. The author feels that. This is not too far-fetched, given the government's lack of effort to reduce the issuance of Mining Business Licenses (IUP) and Industrial Business Licenses (IZI) for corporations in Indonesia as seen in the data below. Although after 2015 there was a downward trend, in some years, such as 2020, 2023, and 2024, the number of IUP holders was seen to increase, although not as in 2015. The decline was attributed by Arifin Tasrif, Minister of Energy and Mineral Resources, to the revocation of IUPs because IUP holders were deemed to have ceased their activities or did not implement and submit the Company's work plan and budget (RKAB) to the government (Santika, 2024), not as an effort to suppress the exploitation of natural resources in Indonesia.

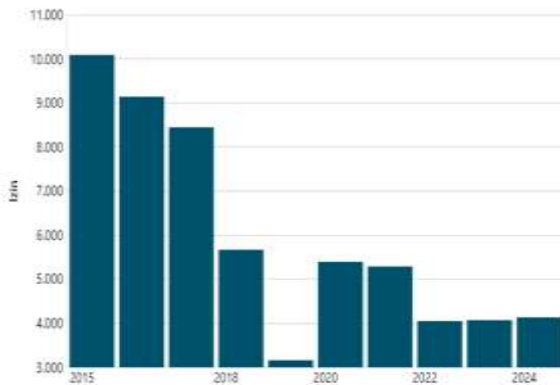


Figure 6. Number of mining business licenses/IUP in MODI Ministry of Energy and Mineral Resources (2015-2024)

Source: Santika, 2024

It is important to note that the industrial sector is one of the highest greenhouse gas emitting sectors in Indonesia along with other sectors, such as electricity, transportation, buildings, and agriculture.

The volume of greenhouse gas emissions from the industrial sector can be seen in the figure below (see figure 7).

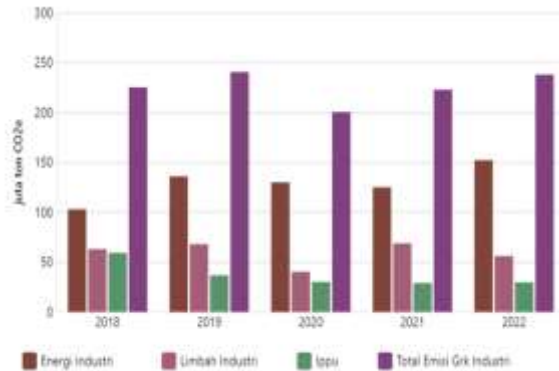


Figure 7. Industry sector greenhouse gas emission volume by component (2019-2022)

Source: Santika, 2023

When evaluated based on the SDGs, research (Mikunda et al., 2021) shows that the implementation of CCUS can hinder several sustainability targets. The process of capturing CO₂ from power plants and industrial processes has a negative impact on the environment. The main cause of these negative environmental impacts is waste and emissions in the coal supply chain, the majority of life cycle assessments show emissions to air and water and the production of waste through the use of CCS. These emissions mean that the technology has great potential to hinder sustainability efforts, especially against environment-related Goals. The risks faced in various countries in the implementation of CCUS, such as the example above, will also certainly be experienced by the implementation of CCUS in Indonesia. This challenge is something that needs to be considered, lest the government's focus on financing CCUS projects that actually have no real evidence of reducing carbon emissions, becomes an obstacle to renewable energy transition efforts in Indonesia, which so far, its renewable energy capacity is still very far

behind (13,155 Megawatts (MW) when compared to the ten countries with the largest level of renewable energy capacity in the world. In fact, as a tropical country with a large area, the application of renewable energy in Indonesia has enormous potential. The problem is that implementing renewable energy means reducing profits from the utilization of natural gas and mineral resources, which is the main reason why corporations are starting to look at CCUS projects.

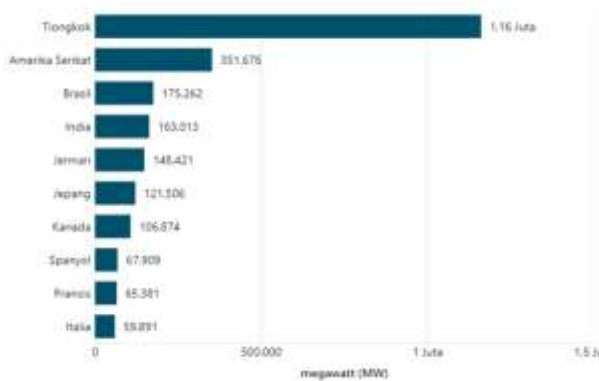


Figure 8. 10 countries with the world's largest renewable energy capacity (2022)

Source: Santika, 2024

It is no exaggeration to say that the future of Indonesia's decarbonization will be in limbo if it relies solely on the CCUS project. The findings and research results of various environmental and renewable energy organizations, as described above, illustrate this statement. With that, Indonesia's target to reduce greenhouse gas emissions by 31.89 percent with its own efforts and 43.20 percent with international support by 2030 will be very difficult to achieve. Indonesia's seriousness in promoting zero emissions must be accompanied by the government's commitment to reduce the use of fossil fuels, the granting of mineral mining licenses, and the omission of illegal mining, all of which are the causes of high carbon and greenhouse gas emissions in Indonesia. The CCUS should not be just another

political strategy by governments and businessmen to enable the fossil fuel industry to maintain its status quo. This claim has been substantiated by reports of fossil fuel companies revealing that they spend huge amounts of capital lobbying for actions and regulations that are pro CCUS implementation (Medha, 2023, p. 13). This is because it is much easier to utilize CCUS projects than to invest in renewable energy to achieve carbon emission reduction targets. As a medium of green capitalism, CCUS is ultimately only practiced by global fossil industry entrepreneurs to make them appear to be contributing to carbon emission reduction efforts, but it is actually a form of greenwashing that only serves to keep their industry relevant today.

IV. CONCLUSION

The findings in this article, show that despite an increasing trend of implementation, CCUS in the oil and gas sector is costly, energy-intensive, and has no proven benefit in reducing carbon emissions in the fossil industry. The goal of CCUS implementation, which according to the IPCC is targeted to reduce global warming by 1.5 degrees Celsius, seems to be difficult to realize. On the contrary, CCUS has been found by environmentalists and independent organizations concerned with the impacts of fossil energy to be used to further maximize oil and gas production. Thus, instead of being a solution to the alarming climate and environmental crisis, CCUS has become a means to multiply the profits of the fossil energy industry and obscure the damage they do to nature.

Indonesia's efforts as a country that agreed to the Paris Agreement to reduce the level of carbon emissions and global warming, will fall short of expectations if it only relies on the implementation of CCUS in Indonesia, which is currently in the process

of development. Expensive costs, high leakage and security risks and dubious effectiveness will also be experienced by Indonesia, as experienced by other countries that have already relied on this project. Not to mention, the potential for political games between oil and gas and mineral industry entrepreneurs to continue to develop their businesses will be very large, which is contradictory to domestic energy transition efforts. Therefore, the seriousness of reducing carbon emissions must be accompanied by serious efforts to transition energy to renewable energy, which is still very minimal in Indonesia, and not only rely on CCUS technology, which in this study, is very questionable in its effectiveness. In addition, the seriousness to reduce carbon emissions and global warming must be accompanied by strict policies to reduce the granting of business licenses for the mining industry, which today is also a contributor to environmental damage in Indonesia. Policies to restrain exploration and exploitation of non-renewable energy and mineral resources must be taken seriously, if Indonesia really wants to reduce climate and environmental damage, and not just present green projects that are not substantive. The shortcoming of this article is the lack of supporting data on the results of CCUS implementation in Indonesia, due to our focus on the reality of CCUS implementation globally and the future of Indonesia's decarbonization efforts through CCUS implementation, in addition to the lack of data on CCUS in Indonesia. Therefore, it is hoped that future researchers can see our shortcomings and make it the goal of further research, so that the knowledge of CCUS technology in Indonesia will grow, as well as the decarbonization strategy in Indonesia.

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