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Singapore's Intentions in Signing the Decarbonization Cooperation Framework with Indonesia through Carbon Capture Storage

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Abstract

This paper examines Singapore's intentions in signing the Carbon Capture Storage (CCS) cooperation framework with Indonesia. A qualitative descriptive methodology combining primary and secondary data sources was applied to get informative results. The concept used in this research is the international regime, alongside the cooperation theory by Holsti. The analysis shows that Singapore has the decarbonization roadmap to reduce the greenhouse gas emissions they have produced through cooperating with another country in CCS. The results reveal that the commitment reflects Singapore's responsibility in accordance with the Paris Agreement as an international regime. Singapore's rationalization in cooperating with Indonesia is based on the geography of Indonesia's reservoir that is close to Singapore's central industrial and power plant, Jurong Island. Singapore could cut costs by transferring carbon through pipelines to Indonesian sediment. This research underscores the significant role of bilateral cooperation in shaping the future trajectory of climate change amidst increasing global pressures through the Paris Agreement.

Key Words: Singapore, Carbon Capture Storage, Paris Agreement, International Regime.

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INTRODUCTION

Carbon mitigation is one of the vital efforts carried out and is being intensively encouraged by countries in an effort to achieve Net Zero Emissions (NZE) by 2060. In the context of realizing sustainable development, countries that ratified the Paris Agreement in 2015 have reached an agreement to maintain the increased global average temperatures below 2°C above pre-industrial levels this century, and further to seek to limit the rise to 1.5°C (IPCC Climate Change, 2014). Countries and companies are setting aggressive net-zero emissions targets, and Singapore is one of the leading pioneers in Southeast Asia in ensuring that Carbon Capture Storage (CCS) is available as one of the tools needed to achieve NZE targets. CCS is an activity that involves capturing, transporting, and storing greenhouse gas emissions from fossil fuel power plants, energy-intensive industries, and gas fields by injecting the captured greenhouse gases back into the ground (Climate Council, n.d.).

In 2021, Singapore's carbon dioxide (CO2) emissions increased 9.3% on year to 57.7 million tonnes, compared to 52.8 million tonnes in the previous year (National Environment Agency, n.d.). In 2018, Singapore was the 27th highest CO2 emitting country in the world (Tham, 2020). The three sectors that produce the most CO2 emissions are electricity, industry and transportation. As a country that does not have its own fossil fuels or renewable energy resources, Singapore must depend on imports of oil and natural gas, which will later be processed in the oil refinery refining industry (European Commission, 2023). The refining sector contributes the majority of Singapore's industrial CO2 emissions (Tan, 2019). Realizing this situation, the Singapore government has made industry the main target for carbon capture.

This research will focus on CCS efforts undertaken by Singapore in terms of bilateral cooperation. In February 2024, Singapore and Indonesia signed a Letter of Intent (LoI) to collaborate on cross-border matters (CCS). This follows the Indonesian Presidential Regulation on CCS issued on 30 January 2024, which will allow CCS operators to set aside storage capacity for international carbon dioxide (Ministry of Trade and Industry Singapore, 2024). The researcher intends to examine Singapore's intentions in signing the CCS bilateral cooperation with Indonesia.

This research is important to discuss considering that every country has an interest in contributing to preventing and stopping global warming from getting worse, which is a goal that must be carried out collectively by all countries. Singapore has ratified the Paris Agreement on September 21 2016, which means it is obliged to fulfill its commitment to reduce greenhouse gas emissions through Nationally

Determined Contributions (NDC). The problem is that even though countries collectively have aligned goals for sustainable development, countries still have their own interests. Researchers want to deeply analyze Singapore's interests in signing an LoI with Indonesia, which is the first step in committing to bilateral cooperation. Furthermore, the signing of this document marks the first collaboration in the field of carbon capture and storage in the ASEAN corridor.

Literature Review and statement of art

There are several previous studies that also discuss the framework of decarbonization efforts carried out by Singapore. Such as research by Lau et al (2021), which discusses the implementation of decarbonization and several policy suggestions for Singapore. This research is divided into 4 frameworks for implementing decarbonization that Singapore can carry out, such as carbon capture and storage, hydrogen production, modernization of the refinery sector which can produce renewable biofuels and biochemicals, and transition of the transportation sector to renewable energy. The policy implications that can be implemented within the decarbonization framework in this research are imposing a carbon tax, energy transition using hydrogen power, and cooperation with the ASEAN corridor, especially in the carbon capture and storage program.

Then the next research discusses the decarbonization framework in Singapore which includes reducing carbon emissions by up to 50% by 2050 and continuing by 10% periodically until NZE. This research comprehensively discusses the implications for Singapore regarding decarbonization, such as implementing carbon capture storage projects, using pipes or ships as transportation to carry carbon dioxide. This research also discusses the importance of geological factors in selecting suitable carbon storage sites. Apart from that, this research also emphasizes the potential of the 4th Industrial Revolution (4IR) or the 4th Industrial Revolution where the use of technology for recovery and prevention of conflict in the future is needed, in this case climate change Lau et al (2022).

In relation to CCS development, other research has found that there are challenges in developing CCS in Indonesia, namely unclear government regulations, costs required for development, infrastructure and the surrounding environment which will be used as a place to store CO_2 (Prasetyo and Windarta, 2022). Suryani (2024) also found that Indonesia, with its large CO_2 storage potential, has the opportunity to play an important role in the development of CCS technology. However, Indonesia has technical, financial and regulatory challenges that need to be overcome so that CCS can be implemented widely and sustainably in Indonesia (Suryani, 2024). Apart from that, there is research that discusses the situation in

Indonesia as a whole, awareness and support for CCS in Indonesia and international collaboration regarding CCS including gatherings in Indonesia, where CCS may still be considered too expensive for Indonesia, so there is reluctance to assume responsibility for covering it considering low CO2 emissions per capita. Therefore, the researcher assesses that Indonesia's current priority is to increase and maintain energy security and provide affordable energy for the community. Without international financial support, Indonesia may only be interested in CCS if it contributes to energy supply or energy security goals (Best et al., 2011). This research is different from various studies, where previous research focused more on aspects of development and challenges. This research further highlights aspects of cooperation between Indonesia and Singapore regarding CCS as well as looking at how the Singapore government came to provide financial support to Indonesia as an answer to the challenges facing Indonesia as written by the previous researchers.

METHOD

This article will focus on research questions related to Singapore's intentions in signing a bilateral decarbonization cooperation framework with Indonesia. This research uses a descriptive qualitative approach and uses literature studies to obtain data relevant to the topic. The theories and concepts used by researchers include: (a) international regime and (b) international cooperation according to Holsti.

a. International Regime

Stephen Krasner, through his book International Regimes (1983), defines regime as a term that can refer to a set of norms, rules, principles and policy-making processes that discuss an area in international relations. Regime theory in the study of international relations is a theory that sees that international institutions can have an influence on the activities of international actors, both state and non-state (Ebaye et al, 2023). This theory also sees the possibility of cooperation even in an anarchic state system, so that the international regime in international relations can be said to be a form of international cooperation. In most cases, international regimes are organized by states (Bradford, 2007). Even so, there are quite a few other international institutions such as non-governmental organizations and individuals who participate in the international regime and can guide or influence the attitudes of countries and other non-state actors such as companies.

In international relations, it is not uncommon for many experts to differentiate between regimes and international agreements. In this case, Robert Keohane sees that regimes are often formed when there is potential benefit from an agreement, even though the agreement is difficult to achieve or expensive to carry out

(Bradford, 2007). According to him, an agreement can be added to the regime because it is more comprehensive and can provide facilities for the agreement. Especially when there are many issues raised and each issue is related and important to one another. Between the regime and international agreements, Keohane sees that the regime tends to raise issues with high density. Meanwhile, international agreements focus more on raising issues on a low density scale. Regime theory also confirms that international regimes can facilitate cooperation between countries and have the ability to pressure or exert influence on countries (Ebaye et al, 2023). The existence of an international regime can influence the anarchic situation that usually occurs in international relations.

In general, many international regimes raise multidimensional issues such as trade cooperation issues, security issues, humanitarian issues, and even environmental issues. For example, in environmental issues, the international regime exists to address global environmental problems effectively and efficiently with policy makers who also form a system containing rights and obligations as well as decision-making procedures in international environmental policy (de Vos et al, 2013). Initially, the international regime was a forum for international cooperation with final targets to be achieved, but now it can also take the form of a commitment with certain protocols to continue to encourage international actors to fulfill these cooperation targets (Hori, 2015).

Implementation in the international environmental regime includes the implementation and promotion of regulations (Hori, 2015). This also includes several other steps such as collective sanctions, data collection, trade, and both technical and financial assistance. International law recognizes the importance of collective commitment and control through much negotiation as well as implementation through collective sanctions, as does the international regime. Even so, collective sanctions are rarely implemented because not everyone who follows the international regime, in this case developing countries, cannot fulfill these obligations due to their lack of capacity. Scott Barrett in his book Why Cooperate: The Incentive to Supply Global Public Good (2007) says that in the case of public goods that bind many parties, the existence of free-riders in the regime is very numerous so that effective implementation is needed which can suppress free -the riders.

Barrett's environment is also defined in the same book as a public good. In international regimes, especially for dealing with public goods, methods are needed that are appropriate to the circumstances. There are two forms of implementation that can be done, namely, implementing binding obligations within the regime or providing assistance within the regime (Barret, 2007). Generally, there are not

many sanctions in cases of violations of the international regime, except in the form of threats of sanctions that will be given to violators. Thus, international actors who are members of the international regime can still follow the principles, rules and norms existing in the regime, with or without being bound by the regime.

b. International Cooperation

In implementing the international regime, not a country can completely stand alone, especially in meeting its domestic needs, so cooperation is needed. In international relations, countries as the main actors maintain their respective interests. It is not uncommon for many countries to have different interests and face potential conflicts. In this case, cooperation is an alternative for these countries to avoid conflict through policy adjustments until reaching an agreement that meets the interests of these countries (Sato, 2010). Holsti in his book, International Politics: A Framework for Analysis (1988), considers that cooperation involves principles, norms and mechanisms that facilitate cooperation between countries. Apart from that, international cooperation also includes many parties such as international institutions, agreements, and diplomatic relations as cooperation mechanisms. According to Holsti, there are several things that can be defined in international cooperation such as (Holsti, 1998):

a) Interests

When two or more interests, values, or goals meet and produce something that can be promoted or fulfilled by all parties.

b) Policy Adjustment

A country's hope or expectation that the policies taken by other countries will help that country achieve its interests and values.

c) Agreement

Agreements on specific issues between two or more countries to exploit common interests. The existence of this Agreement can also prevent conflicts from arising due to clashing interests.

d) Set of Rules

A set of transactional rules, both official and unofficial, regarding the implementation of future agreements.

e) Fulfillment Needs

Transactions between countries are carried out to meet the needs of each country. This Needs Fulfillment is bound by the Pacta sun Servanda in international law where international cooperation must be implemented and fulfill the obligations of each country in this cooperation.

RESULT AND DISCUSSION

Urgency for Singapore to Collaborate on CCS with Indonesia

In 2022, carbon dioxide emissions produced by Singapore will reach 70.4 million tonnes, with information as shown in the image below.

Year	GHG emissions Mt CO_2eq/yr	GHG emissions per capita t CO_2eq/cap/yr	GHG emissions per unit of GDP PPP t CO_2eq/kUSD/yr	Population
2022	70.470	11.667	0.116	6.040M
2015	67.030	12.110	0.136	5.535M
2005	51.214	11.404	0.179	4.491M
1990	34.203	11.352	0.301	3.013M

Figure 1. Singapore's total emissions for 1990, 2005, 2015, and 2022, emissions per capita, per GDP PPP, and population data (European Commission, 2023).

The table in Figure 1 states Singapore's total emissions in 1990, 2005 where there was the Kyoto Protocol, 2015 when the Paris Agreement was initiated, and the latest data in 2022. It can be stated that the carbon dioxide emissions produced by Singapore increased significantly, even in 2015–2022 the increase is not that big, considering that industrial activity was stopped during COVID-19. Singapore's CO2 emissions are highly concentrated on two islands, namely Jurong and Bukom. Jurong Island is home to most of Singapore's refineries, petrochemicals and power plants. Bukom Island, which is located not far from Jurong Island, is the location of Shell's largest refinery (Sepura, n.d.). Singapore's industrial sector is highly concentrated in refining and petrochemicals, which are highly integrated to increase efficiency. Singapore has the fifth largest oil refining capacity in the world with 1.5 million bbl/d in 2018 (NS Energy, 2020).

About 75% of Singapore's power plants, 70% of oil refineries, and almost all petrochemical and chemical plants are on Jurong Island (National Environment Agency, 2020). The island is home to some of the largest oil refineries and petrochemical complexes in Southeast Asia. Oil refineries in Jurong and Bukom convert crude oil into petrol, kerosene, diesel and jet fuel that are sold at home and abroad. In 2015, Jurong Island contributed SGD 81 billion or one third of Singapore's total manufacturing production (EDB Singapore, 2020). Due to this

industrial concentration, 54% of Singapore's total CO2 emissions (European Chamber of Commerce, 2022), or 27 million tons per year, come from Jurong Island. This creates unique opportunities for carbon capture and processing.

CCS is the process of capturing CO2 before it enters the atmosphere, transporting it, and storing it (carbon sequestration) for centuries or millennia, usually in underground geological formations (Forster; Sawsan et al., 2018). Alternatively, once captured, CO2 can be used to produce other substances through chemical transformations. In both cases, its spread in the atmosphere can be avoided. CCS is critical to address process emissions from cement, natural gas-based hydrogen, and biofuel production, to produce synthetic fuels, and to achieve negative emissions from bioenergy with carbon capture and storage and direct air capture with storage (Della Moretta & Craig , 2022).

Industries on Jurong Island emit a lot of CO2, so their “waste” gas can be sent to a central location to capture and concentrate the CO2. There are several ways to capture CO2 from exhaust gases, and the method depends on how much CO2 is already present. Carbon dioxide absorbers are treated with special chemicals that can absorb CO2. Then, CO2 is separated from the chemical and compressed into a liquid or very solid form (Zhang & Lau, 2022). Building one central plant to capture CO2 from all the plants is cheaper than having to add capture equipment to each plant. Singapore plans to build a giant factory that can capture millions of tons of CO2 every year. This approach is only possible because of the unique way Singapore's factories are concentrated in one area.

The CO2 storage place is in the form of a porous underground layer called a reservoir. Reservoirs are formed from deposits of eroded material (sediment) and the deposition of chemical elements and organic remains in the water environment. Over a long geological period, these sediments will pile up and become a reservoir. There are three types of reservoirs that have the potential for CO2 storage: (a) salt water layers (aquifers), (b) oil fields, and (c) gas fields, which also require the same factors as oil fields, except that the source rock is gas (Della Moretta & Craig, 2022).

The first step is to identify sources of CO2, such as factories and power plants, and underground storage sites. Suitable storage areas include deep rock formations with salt water (salt aquifers) and depleted oil and gas fields within 1,000 kilometers of Singapore. This storage area has a layer of rock that can trap CO2 and prevent it from escaping (Lau et al., 2021). Oil and gas companies have explored some of these areas, but more research is needed on the aquifer. It is estimated that there is enough space underground to store CO2 emissions for centuries.

Singapore is surrounded by eight basins that have potential as storage areas, most of them in Indonesia. The eight basins include: North Sumatra, Central Sumatra, South Sumatra, North West Java, Turtle, Melayu, West Natuna and East Natuna basins. These basins can store more than 100 billion tons of CO2, with most of it stored in salty aquifers. An interesting bonus is that injecting CO2 into depleted oil and gas fields can help squeeze out more oil or gas. This can make CO2 capture and storage more economical (Lau et al., 2021). Overall, this plan involves identifying the largest CO2 producers and the best storage locations, taking into account factors such as distance and capacity. Then, they can match these sources and storage sites for efficient CO2 capture and storage.

Once captured, CO2 needs to be transported to a storage location. There are two main Co2 delivery options: pipelines and ships. Pipelines are the preferred choice for shorter distances. They carry CO2 in a supercritical state, which is like a solid liquid. Singapore has a network of natural gas pipelines from Indonesia that can be reused for CO2 transportation if gas is no longer needed (Lau et al., 2022). This will be a cost-effective option. For longer distances or if pipelines are not available, ships can be used. Currently, small amounts of CO2 are delivered by the food and beverage industry. However, large cargo ships such as those used for liquefied natural gas (LPG) can also be used for CO2. Singapore's existing facilities for handling LNG could be modified to handle CO2 offloading, and its shipbuilding industry could adapt existing LPG tankers or even build new tankers specifically for CO2 transport (Lau et al., 2022).

By 2030, SG is committed to reducing CO2 emissions by 33 million tonnes through Singapore's Long-term Low-Emissions Development Strategy (LEDS). In the Singapore Net Zero Roadmap published by the Ministry of Sustainability and Environment Singapore, SG has 3 frameworks in its decarbonization strategy, namely 3R (Reduce, Replace, Remove). CCS is part of the Remove framework, where SG is committed to developing innovative solutions to CCS technology. This can address residual emissions from important public services, such as waste incineration and used water treatment (Ministry of Sustainability and the Environment, n.d.).

By collaborating with Indonesia through a legal framework, the programs or development that Singapore wants to encourage will have the potential to run more easily in the future, including in bureaucratic and licensing matters. These factors are Singapore's rationalization in designing a cooperation framework with Indonesia, where the basin location is very close and does not require high operational costs for carbon transfer.

Paris Agreement as an International Regime

On December 12 2015, an international agreement focusing on the issue of climate change was signed at the 21st UN Climate Change Conference or commonly referred to as COP21 in Paris, France (United Nations, 2015a). This international agreement under the UN Framework Convention on Climate Change (UNFCCC), binding around 196 participants from international actors, finally began to be implemented on November 4 2016. Referring to Article 2 in the Paris Agreement, this agreement aims to increase cooperation between countries, especially in the issue of climate change through several methods, including maintaining and limiting the increase in global average temperature to well below 2°C compared to temperatures in pre-industrial times (United Nations, 2015b). Then, increase the ability of countries and other non-state actors to deal with the negative impacts of climate change and encourage climate resilience through reducing greenhouse gases and intensifying decarbonization programs. In addition, this agreement also encourages financial assistance to pursue decarbonization and climate resilience programs.

The implementation of the Paris Agreement is through a mechanism in which member countries periodically, in this case every 5 years, provide their country's contribution or what is called Nationally Determined Contributions (NDC) (Raiser et al, 2020). Some of the things included in the NDC reported by countries include climate mitigation efforts, finance for climate management, technology, capacity development, and others. These contribution reports legally bind a country to fulfill their NDC in the Paris Agreement, although it does not force participating countries to fulfill their contributions. This is in accordance with article 10(2) in the Paris Agreement which states:

"... shall be expert-based and facilitative in nature and function in a manner that is transparent, non-adversarial and non-punitive."

Apart from that, the Paris Agreement emphasizes transparency in its participating countries. The transparency mechanism in the Paris Agreement includes expert review and multilateral communication to respect national sovereignty and nationally determined NDCs. Thus, the Paris Agreement will not intervene in the contributions determined by participating countries (Ruo-Shui, 2022). The Paris Agreement will only receive progress information while the NDC is implemented and completion reports after the NDC is implemented. The committee will also be able to open dialogue to discuss financial support, technical support, and capacity development for participating countries that fail to meet their NDCs.

As in Article 10(2) in the Paris Agreement, it states that the NDC set by each country does not legally bind them in the Paris Agreement and does not force countries to fulfill their NDC contributions. However, if participating countries cannot fulfill their NDCs, there will be a Paris Agreement Implementation and Compliance Committee or PAICC which facilitates participating countries to continue to fulfill their NDCs (UNFCCC, 2019). This can also encourage other participating countries to overcome their failures and pressure participating countries to fulfill their contributions and achieve other, more pressing contributions in the next NDC period (Ruo-Shui, 2022).

The Paris Agreement can put pressure on participating countries through Global Stocktake (GST), which is a forum for Paris Agreement participating countries to evaluate and see the progress of the NDC that has been made (UNFCCC, n.d.b). GST could force participating countries to collectively set higher contributions than previous period NDCs, which could ultimately advance the goals of the Paris Agreement. In the end, with the contribution in the NDC and the encouragement to achieve even higher contributions, pressure on participating countries to achieve the goals of the Paris Agreement as a form of collective action and their commitment to global change.

As explained by Krasner, that in the international regime there is a set of norms, rules, principles and policy-making processes to overcome an issue in international relations, the Paris Agreement can also be said to be a regime that focuses on overcoming climate change. So, even though the Paris Agreement does not completely force participating countries to fulfill their NDCs, this agreement still indirectly forms new norms in international relations and becomes a guideline for encouraging climate change policies. The existence of this climate change regime also encourages countries to collaborate with each other in fulfilling their NDC contributions in the Paris Agreement.

Singapore was one of the many countries that also signed the Paris Agreement at the 21st COP (The Ministry of Foreign Affairs of the Government of Singapore, 2018). After participating in ratifying the Paris Agreement on 21 September 2016, Singapore on 31 March 2020 formed their first NDC with the aim of reducing carbon emissions from Singapore by 2030 by 36% from 2005 levels (National Environment Agency, 2018). Then on 4 November 2022, Singapore reported their second NDC contribution and committed to reducing carbon emissions to 60 MtCO2e by 2030, and achieving zero emissions by 2050 (Singapore Green Plan 2030, n.d.).

To fulfill their NDC contribution in the Paris Agreement, Singapore took several steps, such as reducing Greenhouse Gas (GHG) emissions by switching to using natural gas-powered power plants and implementing a vehicle usage quota in Singapore. In 2021, Singapore succeeded in meeting 95% of their country's electricity needs using natural gas power plants (Powering Lives, n.d.). Apart from that, there are not many energy source options in Singapore due to the lack of land and dense population in the country, so technology development is encouraged to obtain alternative energy sources such as geothermal, solar and nuclear power to be developed in Singapore. The use of alternative energy sources in Singapore, for example using solar power. The Singapore government encourages the development of solar power through investment, research, development and demonstration to reduce costs, increase efficiency and build innovative projects such as floating photovoltaics, offshore, and buildings integrated with photovoltaics. As of 2020, Singapore has achieved their target of using solar power of up to 350 MWp and is targeting up to 2 GWp by 2030 (Energy Market Authority of Singapore, n.d.).

Energy efficiency is also emphasized in industry in Singapore. As a country that accounts for 2.1% of world exports, Singapore also encourages reducing carbon emissions by providing incentives for wise use of energy and encouraging the use of energy-saving technology through The Energy Efficiency Grant, Resource Efficiency Grant for Emissions and Investment Allowance for Emissions Reduction (National Climate Change Secretariat Singapore, n.d.). On the legal side, Singapore also emphasizes the 2018 Carbon Pricing Act which regulates the obligation to report and pay taxes regarding GHG emissions from business facilities (Carbon Pricing Act 2018, 2018).

Singapore is the first Southeast Asian country to implement a carbon tax. The carbon tax in Singapore began to be implemented in 2019 and is applied to facilities that emit up to 25 ktCO2e or more GHG emissions in one year through the Carbon Pricing Act 2018. This amount covers 80% of Singapore's total carbon emissions and encourages many sectors to reduce carbon emissions from their facilities. In February 2022, Singapore announced to progressively increase carbon tax to around S$50 to S$80 per tCO2e by 2030 (UNFCCC, n.d.).

In fulfilling this, Singapore is also maximizing their city planning to make it more efficient and energy efficient. By implementing 80% of buildings by gross floor area to be green by 2030, Singapore can meet their NDC contribution targets despite having a high population density (National Climate Change Secretariat, n.d.). Singapore through their first Adaptation Communication contained in the 5th

National Communication on "Vulnerability and Adaptation Action" (Singapore's Fifth National Communication and Fifth Biennial Update Report, 2022).

In fulfilling their NDC contribution, Singapore has collaborated actively with other international institutions in addressing the issue of climate change at the global level. Apart from that, Singapore has also invited developing countries to participate in capacity development programs under the Singapore Cooperation Program (SCP) which addresses several important issues such as sustainable development, urban planning, water management and transportation. One of the collaborations carried out by Singapore to promote the Paris Agreement in the field of climate change is the Carbon Capture Storage collaboration between Singapore and Indonesia (Ministry of Trade and Industry Singapore, 2024).

Decarbonization Bilateral Cooperation

The cooperation framework that is being explored by Singapore and Indonesia meets several criteria in the theory of cooperation as proposed by Holsti. As discussed in the previous section, Singapore and Indonesia have different interests in decarbonization efforts but share the same corridor through CCS. Singapore is also targeting to be able to build a large factory covering most of Indonesia's sedimentary area for carbon storage. On the other hand, Indonesia is geologically capable of storing a lot of carbon in the area bordering Singapore, but Indonesia still needs knowledge transfer for technology development and RnD on carbon capture and storage methods. To avoid conflicts of interest and ensure that both parties benefit equally, Singapore and Indonesia agreed to create an initial bilateral cooperation agreement, namely the signing of the CCS LoI.

According to a press release report from the Singapore Ministry of Foreign Affairs, with the LoI, Singapore and Indonesia emphasize the importance of CCS as a decarbonization pathway, and the potential of CCS to enable sustainable industrial activities and generate new economic opportunities. A working group consisting of Singaporean and Indonesian government officials will work towards a legally binding bilateral agreement that would allow cross-border transport and storage of carbon dioxide between Singapore and Indonesia. Keith Tan, Deputy Secretary of the Singapore Ministry of Trade and Industry said,

"*Cross-border carbon capture and storage is an emerging solution in Asia, and supports Singapore's transition towards a low-carbon future. Singapore is the first country to sign an LOI with Indonesia after its presidential regulation to allow cross-border CCS was announced. With this LOI, Singapore and Indonesia*

can become the pathfinders to catalyze the deployment of cross-border CCS projects in Southeast Asia" (Ministry of Trade and Industry Singapore, 2024).

The government claims that Indonesia has more than 400 gigatons of storage capacity, including abandoned oil and gas reservoirs and salt aquifers. In addition, it is noted that Indonesia is currently pursuing 15 CCS projects involving carbon capture, storage and utilization measures, with a total investment approaching $8 billion. As additional information, Indonesia issued a presidential regulation last month allowing CCS operators to use up to 30% of their storage capacity to import CO2 (Ministry of Energy and Mineral Resources, 2024). This step is consistent with Indonesia's view of the potential for developing the upstream natural gas sector and CCS as an important component in the global transition towards cleaner energy sources. Meanwhile, in its efforts to achieve zero emissions by 2050, Singapore is leading the way in exploring low-carbon technologies such as hydrogen and CCS as part of its climate change mitigation strategy. As outlined in the Sustainable Jurong Island Plan announced in November 2021, Singapore aims to capture 2 million metric tons per year (mtpa) of carbon dioxide by 2030, increasing to 6 mtpa by 2050 (Paramitha, 2024).

Indonesia's cooperation with Singapore regarding CCS in regulations in Indonesia is outlined in presidential regulation no. 14 of 2004 concerning the implementation of carbon capture and storage activities. In this collaboration, Singapore has limitations in terms of areas or spots to store carbon. Meanwhile, Indonesia has limitations in terms of the technology used to store carbon. Therefore, the two of them collaborated. In this presidential regulation, it is stated that the implementation of CCS in Carbon Storage Permit Areas is carried out by permit holders based on exploration permits and storage operation permits. This collaboration is implemented through various types of contracts such as production sharing contracts with a mechanism for returning operating costs and gross split profit-sharing contracts. In more detail, CCS implementation carried out based on a Cooperation Contract can be monetized in the form of storage fees and/or other forms; or based on the Storage Operation License monetized in the form of storage fees. In addition, in supporting the implementation of CCS, Contractors can be given tax incentives in accordance with the provisions of laws and regulations regarding tax treatment of Upstream Oil and Gas Business Activities as well as non-tax incentives in accordance with the provisions of laws and regulations.

Based on this explanation, it can be understood that this step is an opportunity for both countries to accelerate the targets for achieving their respective countries' NDCs, where for Indonesia the target for reducing Indonesia's GHG emissions with its own capabilities in the Updated NDC (UNDC) of 29% increased to 31.89% in

ENDC, while the target with international support for UNDC was 41%, increasing to 43.20% for ENDC (PPID, 2022). Apart from that, each country benefits from this collaboration, such as compensation for storage services. Singapore Ministry of Trade and Industry Deputy Secretary (Industry) Keith Tan said that cross-border carbon capture and storage is a growing solution in Asia. In addition, CCS also supports Singapore's transition towards a low-carbon future (Natsir, 2024). With the existence of a binding cooperation framework between the two countries, it is expected that Singapore and Indonesia can obtain mutual benefits and can achieve their respective targets towards NZE. However, it needs to be understood that this collaboration is still in the early stage, that means the implementation and impact of this collaboration cannot yet be measured precisely. Therefore, it is important for each party to oversee this collaboration so that it can be carried out according to targets and does not only benefit a few parties.

CONCLUSIONS

Based on the discussion, it can be concluded that there is a commitment from the Singapore government to reduce Co2 emissions, the majority of which come from power plants and factories. This commitment is also an effort to fulfill the NDC Paris Agreement, where Singapore ratified the international environmental regime. One of the initiatives that can be taken to achieve NZE 2050 is for Singapore to collaborate with other countries, which in this article specifically refers to Indonesia.

In signing the LoI cooperation framework with Indonesia, it was discovered that the emissions produced by Singapore were centered on Jurong Island. Singapore has a big picture of creating a giant factory to implement carbon capture and storage. With the technology it currently has, Singapore can store carbon in reservoirs up to 1,000 km from Jurong Island. The majority of the reservoirs in question are basin sediments located in Indonesian territory. Considering Indonesia's large geographical area and its location close to Jurong Island, Singapore is targeting Indonesia's territory to become a carbon storage area, which is in line with Indonesia which also has a vision of developing CCS.

On Indonesia's side, it is believed that the enormous storage potential can significantly support long-term emission reduction targets, supported by Indonesia's need for technology, knowledge transfer and increased CCS RnD from Singapore. This bilateral cooperation has just been initiated and is currently still ongoing, where its implementation needs to be monitored and supervised. Considering that this research is preliminary research, it is important for further

researchers to deepen the implementation aspects of bilateral CCS cooperation between Indonesia and Singapore.

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