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Legal Status and Cross-Border Transport in Carbon Capture and Storage (CCS): an International and Indonesian Law Perspective

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Abstract. *This study analyzes the legal status and cross-border transportation of carbon in Carbon Capture and Storage (CCS) under international and Indonesian law. Indonesia's commitment to net-zero emissions by 2060 has encouraged CCS adoption, regulated by Presidential Regulation No. 14 of 2024, which permits foreign carbon storage through bilateral agreements. While offering economic opportunities, this framework also presents legal and environmental risks, especially regarding the unclear classification of carbon across jurisdictions. The regulation does not define carbon's legal status, leaving a gap that may cause differing interpretations with partner countries. Domestic inconsistencies are also reflected in Minister of Trade Regulation No. 84 of 2019, which permits only the import of specific non-hazardous wastes, from which carbon is excluded, thereby creating potential conflict with CCS policies. Using normative legal research with statutory and comparative approaches, this study reviews Indonesian provisions against international instruments such as the London Protocol, Basel Convention, and OSPAR 1992. Findings show that carbon in CCS technically qualifies as waste, but international law provides exceptions for climate mitigation, which Indonesia has not yet adopted. This legal gap, compounded by inconsistencies between environmental and trade regulations, may hinder the implementation of cross-border CCS. The study contributes novelty by assessing carbon's legal classification and its implications for Indonesia's role as a CCS host country. It recommends enacting explicit national rules, harmonizing domestic provisions with international standards, and ratifying the London Protocol Amendment.*

Keywords: *Carbon; Cross-Border; Transportation.*

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1. Introduction

The Indonesian government is committed to reducing carbon emissions as part of its climate change mitigation efforts (Prasetyo & Windarta, 2022). This commitment is reflected in the implementation of the ratified Paris Agreement, the submission of the enhanced Nationally Determined Contribution (NDC) with an unconditional emission reduction target of 31.89% and a conditional target of 43.20% (Ministry of Environment and Forestry, 2024), as well as the vision for achieving net-zero emissions by 2060 or earlier as stated in the Long-Term Strategy for Low Carbon and Climate Resilience (LTS-LCCR) 2050 (Ministry of Environment and Forestry, 2021).

One of the key strategies being developed is the implementation of Carbon Capture and Storage (CCS)—a technology for capturing and storing large volumes of carbon. CCS serves a dual role: reducing emissions both nationally and internationally (Putri et al., 2024), while also creating economic opportunities. Indonesia aims to become a regional carbon storage hub for other countries, with the potential to earn commission-based revenues and establish infrastructure capable of generating at least 170,000 new jobs annually in construction, engineering, and monitoring sectors (Kompas, 2025).

As a legal framework for the transboundary shipment of carbon into Indonesia, the government has issued Presidential Regulation No. 14 of 2024 on the Implementation of Carbon Capture and Storage Activities (Perpres 14/2024) (Legal Development, 2024). According to this regulation, carbon transportation is governed under the Carbon Transportation Permit, as defined in Article 1, point 7: *"Carbon Transportation Permit is a permit granted by the Government for the transport of carbon to the delivery point at the injection site."* However, this provision has the potential to conflict with the prevailing trade law regime, given that Minister of Trade Regulation No. 84 of 2019 on the Import Provisions of Non-Hazardous and Non-Toxic Waste as Industrial Raw Materials explicitly permits only the import of non-hazardous waste, while carbon is not included in the annexed list of materials eligible for import under this regulation.

From the perspective of international law, the legality of transboundary carbon transportation requires careful analysis—particularly to determine whether carbon qualifies as a type of waste, which is generally prohibited from export, or whether it is exempted under certain conditions, such as its urgency in accelerating climate change mitigation. Instruments such as the London Protocol and the Basel Convention regulate ocean dumping prohibitions and restrictions on the transboundary movement of hazardous waste, making them particularly relevant in the context of CCS governance.

However, in practice, Indonesia's legal framework—including Perpres 14/2024—does not provide sufficient justification for the legality of transporting carbon across jurisdictions. The regulation opens the door to transboundary carbon transport without first establishing the legal classification basis for such activity. This legal vacuum could potentially lead to disputes over the status of carbon transported across borders and its legal implications, particularly in cases where differing interpretations of carbon's legality arise between countries.

Several previous studies have addressed the implementation of CCS in Indonesia. For instance, Fitrianggraeni et al. have examined dispute resolution mechanisms in transboundary carbon transport (Fitrianggraeni et al., 2024), while Setyadi et al. have assessed the CCS regulatory framework from the perspective of public and national interest (Didik Sasono Setyadi, 2024). These studies have contributed significantly to understanding legal challenges related to CCS but have not specifically analyzed the legal status of transboundary carbon transport from both international and national legal perspectives.

The novelty of this research lies in its comprehensive analysis of international and national law in identifying the legal status of carbon and the legal basis for transboundary carbon transport within CCS projects—an area that has not yet been explored in depth within Indonesian legal scholarship.

This study aims to analyze the legal status of carbon and the legality of transboundary carbon transport in CCS projects based on international law and Indonesian national law. The discussion is structured into two main parts: An explanation of the legal status of carbon within the CCS framework from both international and national perspectives; and An analysis of the legality of transboundary carbon transportation and its implications for Indonesia's legal framework.

2. Research Methods

This research is a normative legal study, in which legal analysis is based on the applicable laws and regulations relevant to the legal issues under discussion (Benuf & Azhar, 2020). The focus of the study is directed toward analyzing the legal status of carbon and the legality of cross-border carbon transportation within the CCS framework, based on international law and Indonesian national law, as well as identifying regulatory gaps that require legal reinforcement, as outlined in the research objectives. This study employs a statutory approach, which is implemented by examining legal norms and regulations related to the issues at hand (Peter Mahmud Marzuki, 2007), including the London Protocol, Basel Convention, and Presidential Regulation No. 14 of 2024 on the Implementation of Carbon Capture and Storage Activities. In addition, a comparative approach is applied by comparing Indonesian regulations with those of other countries, with the aim of addressing legal gaps in Indonesia when national regulations have yet

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to provide specific legal guidance on the matter (Dr. Mukti Fajar ND & Yulianto Achmad, 2022). In this context, the comparison focuses on the international and national legal frameworks concerning the legal status of carbon and the legality of cross-border carbon transportation. The primary legal materials used in this study include international conventions, national legislation, and other legal instruments relevant to CCS. Meanwhile, secondary legal materials consist of scholarly journals, legal textbooks, and prior research findings pertinent to the topic. All legal materials are analyzed qualitatively in order to draw conclusions that address the research questions—particularly with regard to the harmonization of international and national law related to the legal status of carbon and the legality of its transboundary transportation.

3. Results and Discussion

3.1. The Carbon in the Carbon Capture and Storage (CCS): Waste or Commodity?

Huaman and Jun explain that: "CCS is a technology that can reduce the amount of carbon released into the atmosphere from fossil fuel use in power generation and various other industries, such as steel, cement, and ammonia. CCS involves three main stages: the collection or capture of carbon produced at large-scale industrial facilities, the transportation of the carbon to a suitable storage site, and the injection of carbon into deep underground rock formations for safe and permanent storage, separated from the atmosphere." (Nataly Echevarria Huaman & Xiu Jun, 2014). CCS is closely linked to the energy industry, in line with the nature of the energy sector as one of the hard-to-abate sectors, making CCS a vital technology for emission control (Steen et al., 2024).

Technically, CO_2 in the CCS tends to be positioned as an industrial by-product that must be managed—specifically, through permanent subsurface storage. However, to determine whether carbon in this context can be classified as waste, it is crucial to first understand how the term "waste" is defined—both from a technical and legal perspective in international law. Given that the CCS involves cross-border transportation and may potentially be classified as waste, international legal approaches are particularly relevant.

In international law, the term "waste" does not have a single universal definition. In the context of ocean dumping, Frederick Forrest Richards notes that although each convention may define ocean dumping or marine waste differently, they share a common thread: the deliberate disposal of certain substances via ships or other human-made structures into the sea (Frederick Forrest Richards, 1991). The intentionality of disposal is a key component of the definition in many conventions. The London Convention (1972), for instance, uses the term "dumping", defined in Article III (1)(a) as: "'Dumping' means: (i) any deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea; (ii) any deliberate disposal at sea of vessels, aircraft,

platforms or other man-made structures at sea." This definition is reiterated in the London Protocol (1996)—prior to its 2009 amendment—where Article 1(4.1) retains the same wording.

Pollution resulting from dumping is considered a composite form, as it involves industrial waste originating from land but transported by ships or aircraft to be disposed of at sea (J. Tampubolon, 2016).

While "dumping" is commonly used in the context of marine waste, the broader term "waste" is more prevalent in general legal frameworks. The Basel Convention (1989), which focuses on waste management from its source through prevention and reduction (Nufus et al., 2024), defines waste in Article 2(1) as: "'Wastes' are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law." This aligns with the EU Waste Framework Directive (Directive 2008/98/EC), which in Article 3(1) defines waste as:

"'Waste' means any substance or object which the holder discards or intends or is required to discard."

Based on these definitions, most legal instruments describe waste as a by-product of activity or production that is deliberately discarded, no longer holds value, and may pose environmental risks. Accordingly, carbon within the CCS meets the criteria for classification as waste. In Indonesian national law, the definition of waste is provided in Article 1 point 20 of Law No. 32 of 2009 on Environmental Protection and Management (*PPLH Law*), which states: "Waste is the residue of a business and/or activity." This provision has subsequently been amended by Government Regulation in Lieu of Law (Perpu) on Job Creation. More specifically, Article 1 point 22 of the same law defines hazardous and toxic waste (*Limbah B3*) as "the residue of a business and/or activity containing hazardous and toxic substances."

Based on this legal construction, Indonesian law neither explicitly includes nor excludes carbon in the waste category, whether as B3 or non-B3 waste. Thus, determining the legal status of carbon in the CCS requires further interpretation, including comparisons with definitions and exceptions under international legal regimes.

Over time, there has been a paradigm shift in how carbon is classified—especially in CCS contexts—excluding it from the definition of waste. This began with the 2006 amendment to the London Protocol (1996), in which parties agreed to add "carbon dioxide streams from carbon dioxide capture processes for sequestration" to Annex 1—one of the few substances permitted for dumping, provided certain technical conditions are met. The amendment states:

"Carbon dioxide streams from carbon dioxide capture processes for sequestration in sub-seabed geological formations may be considered for dumping, provided that:

a. disposal is into a sub-seabed geological formation; and

b. they consist overwhelmingly of carbon dioxide. They may contain incidental associated substances derived from the source material and the capture and sequestration processes used; and

c. no wastes or other matter are added for the purpose of disposing of those wastes or other matter."

This provision demonstrates that captured carbon in CCS, when permanently stored beneath the seabed, is no longer regarded as prohibited waste, but rather as a substance subject to specific disposal regulations, provided that it is not mixed with other waste and is stored in a suitable geological formation. Furthermore, as part of efforts to establish a legal framework that supports the deployment of CCS technology in the European Union, captured carbon dioxide intended for geological storage has been excluded from the waste regulatory regime. This is affirmed in an official document of the European Commission, which states:

"The first is the removal of carbon dioxide captured and stored for the purposes of geological storage, and stored in accordance with the proposed GSD, from the scope of the Waste Framework Directive 2006/12/EC, and of shipments of CO_2/carbon for geological storage from the scope of the Waste Shipment Regulation 1013/2006/EC." (Brockett, 2009)

This exception demonstrates that carbon in the context of CCS—although it may substantively fulfill the criteria of waste—has been excluded under international law due to its classification as part of a climate mitigation system that requires a distinct regulatory framework, as long as the storage is conducted in a controlled, permanent manner and in accordance with safety standards.

A comparative analysis between international law and Indonesian law, as outlined above, shows that while carbon may substantively meet the definition of waste, international law has classified it as an exception for the purpose of climate change mitigation. In Indonesia, however, no similar legal provision currently exists, resulting in a regulatory gap that may lead to differences in interpretation, particularly in the context of cross-border cooperation.

3.2. Legality of Cross-Border Carbon Transport in the CCS

Technically, the CCS is divided into three main phases, namely Capture, Transport, and Storage (CCS Center of Excellence ITB, 2025). In particular, the Transport phase raises important legal considerations regarding cross-border carbon transportation, as this activity involves not only technical aspects but also cross-jurisdictional legal issues. The potential risks of leakage, storage failure, or incidents during transportation may have transnational impacts on the environment, public health, and the national security of the receiving country. Therefore, there is a clear need for an international legal framework that is well-defined and mutually accepted by participating states.

At present, there is no single international convention that specifically regulates the mechanism of cross-border carbon transportation. Therefore, this paper will examine relevant legal instruments, namely:

a. London Protocol

In 2009 an amendment was made to Article 6 of the London Protocol, which added Article 6bis to allow the export of carbon for geological storage purposes under the sea:

(Vivian & Del Savio, 2024) *The export of carbon dioxide streams for the purpose of sequestration in sub-seabed geological formations may occur provided that an agreement or arrangement has been entered into by the countries concerned*."(Vivian & Del Savio, 2024)

Regarding the amendment, Vivian and Del Savio note that:

"In 2009 the LP Parties amended Article 6 banning the export of waste in order to permit the export of carbon dioxide streams for disposal in accordance with Annex 1, provided that an agreement or arrangement had been entered into by the countries concerned."

The amendment has not yet applied globally because it has not been ratified by two-thirds of the country parties. As a result, countries are currently only allowed to permanently store carbon within their national territory, while storage outside national territory/cross-border carbon transport is still prohibited (Roggenkamp & Martha M, 2018). It was only in 2019 that the parties to the London Protocol adopted Resolution LP.5(14). Through this resolution, a country party can activate the amendment provisions before it officially enters into force, by submitting a declaration of provisional application to the Secretariat of the International Maritime Organization (IMO). This declaration of provisional application was submitted by several countries, including Norway, the Netherlands, Denmark, and South Korea (Commission Services Analysis Paper, 2022). Thus, these countries are legally allowed to carry out cross-border carbon transport under Article 6bis of the London Protocol, as long as it is accompanied by a bilateral agreement.

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b. OSPAR 1992

OSPAR 1992 is a convention that protects the marine environment in the Northeast Atlantic region, with 15 (fifteen) countries and the European Commission as parties (OSPAR Commission, 2025). Although it was not initially designed to accommodate CCS activities, as technology evolved, OSPAR adjusted its legal framework through amendments in 2007 (Dixon et al., 2015).

Article 3

1. "The dumping of all wastes or other matter is prohibited, except for those wastes or other matter listed in paragraphs 2 and 3 of this Article.

2. The list referred to in paragraph 1 of this Article is as follows:

f. carbon dioxide streams from carbon dioxide capture

processes for storage, provided:

i. disposal is into a sub-soil geological formation;

ii. the streams consist overwhelmingly of carbon dioxide. They may contain incidental associated substances derived from the source material and the capture, transport and storage processes used;

iii. no wastes or other matter are added for the purpose of disposing of those wastes or other matter;

iv. they are intended to be retained in these formations permanently and will not lead to significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area."

Thus, OSPAR now accommodates sub-seabed carbon storage as part of climate change mitigation efforts. Although this convention applies only to the North-East Atlantic region, the regulatory model developed under OSPAR can serve as an important reference for non-party countries such as Indonesia, particularly in designing CCS policies that align with the principles of marine environmental protection.

c. Basel Convention 1989

The Basel Convention does not explicitly list carbon in Annex I or Annex III as a hazardous waste. Article 2(1) defines waste as:

"Substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law."

The application of this convention depends on each party state's determination of whether carbon is classified as waste. If it is classified as such, then Article 6(1) applies:

"The State of export shall notify, or shall require the generator or exporter to notify, in writing through the channel of the competent authority of the State of import of any proposed transboundary movement of hazardous wastes or other wastes."

This provision requires the exporting country to obtain prior informed consent from the importing country before any transboundary shipment of waste takes place. This includes providing detailed information and clear declarations about the potential impact of the waste on human health and the environment (Muhammad Busyrol Fuad, 2022).

A potential legal risk arising from this provision is the discrepancy in how carbon is defined across different jurisdictions. For instance, if Indonesia does not classify carbon as waste, but a partner country does consider it hazardous waste, then cross-border transportation of carbon would be subject to the Basel Convention. This could complicate the permitting process, delay CCS projects, and even trigger interstate disputes if there is no mutual understanding outlined in bilateral agreements.

Therefore, harmonizing the definition of carbon in bilateral treaties is crucial to avoid legal conflicts and to ensure the smooth implementation of cross-border CCS activities.

Another key issue is the inconsistency in Indonesia's domestic framework. Presidential Regulation No. 14/2024 allows cross-border carbon transport through bilateral agreements, yet Minister of Trade Regulation No. 84/2019 only permits the import of non-hazardous waste, and carbon is not listed as eligible. This disharmony creates legal uncertainty, potentially obstructing licensing, deterring foreign partners, and triggering disputes. Harmonizing these regulations is therefore crucial to secure both legal clarity and practical feasibility of cross-border CCS.

d. Directive 2009/31/EC

Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide (hereinafter referred to as Directive 2009/31/EC) (European Union, 2009) provides both technical and legal standards related to carbon storage activities, including the transportation of carbon dioxide via pipeline networks, the obligation to grant third-party access, the requirement for cross-border approval when storage infrastructure or transport networks extend across national boundaries, and the assignment of long-term liability to the storage operator.

Although formally applicable only to EU member states, Directive 2009/31/EC has also served as a reference for non-EU countries. Norway, for example, adopted the directive through the European Economic Area (EEA) mechanism (Tim Howes, 2010) and incorporated it into national law in 2014 through specific regulations on storage, revisions to the Pollution Control Act, hazardous substances regulations, carbon safety rules, and the Planning and Building Act (Levina, 2024), enabling six sub-seabed storage exploration permits and cross-border cooperation. Iceland began adopting the directive in 2015 for exploration and research purposes, and revised its legal framework in 2021 to allow industrial storage through the Act on Hygiene and Pollution Prevention and the Regulation on the Storage of Carbon Dioxide Underground. Meanwhile, Liechtenstein has not yet authorized carbon storage but is currently assessing the potential for long-term storage technology and infrastructure (EFTA Surveillance Authority, 2023).

In Indonesia, the regulation on carbon transportation—specifically cross-border carbon transport—is stipulated in Article 45 of Presidential Regulation No. 14/2024 as follows:

(1) In order to facilitate cross-border carbon transportation for the implementation of CCS, a bilateral cooperation agreement between countries shall be established.

(2) The cooperation agreement as referred to in paragraph (1) shall serve as a guideline for all parties in issuing recommendations or permits necessary for cross-border carbon transportation, in accordance with the applicable laws and regulations in each respective country.

(3) The cooperation agreement as referred to in paragraphs (1) and (2) shall be carried out in accordance with the provisions of the legislation governing international agreements.

Upon examination, these provisions align with Article 6bis of the 2009 Amendment to the London Protocol, which requires that cross-border carbon transport be conducted on the basis of bilateral agreements. A similar strategy has been adopted by the European Union, which encourages its member states to conclude bilateral agreements as a legal foundation for the operation of cross-border CCS transport. As outlined by Hao Zhang (Zhang, 2021), this approach enables member states to carry out cross-border CCS projects without violating applicable international legal provisions, particularly in light of the fact that the London Protocol amendment has yet to enter into full force.

A concrete example of such cross-border cooperation is the Memorandum of Understanding (MoU) on Cross-Border Transportation of CO_2 with the Purpose of Permanent Geological Storage between Norway and the Netherlands, signed on 15 April 2024 in Brussels (Ministry of Economic Affairs and Climate Policy of the

Netherlands and Ministry of Energy of Norway, 2024). The MoU explicitly refers to Article 6bis of the London Protocol and establishes a shared framework for cross-border carbon transportation intended for permanent geological storage in Norway. Within this document, both countries agree on the division of responsibilities concerning permitting, monitoring, and emissions reporting, in accordance with the London Protocol, EU regulations, and standards under the United Nations Framework Convention on Climate Change (UNFCCC).

Cross-border CCS cooperation has also taken place between Singapore and Malaysia. On 7 January 2025, during the 11th Malaysia–Singapore Leaders' Retreat, both countries signed a Memorandum of Understanding (MoU) on Cooperation in the Field of Cross-Border Carbon Capture and Storage (Ministry of Trade and Industry Singapore, 2025). The MoU explicitly states that Singapore and Malaysia will:

1) Conduct bilateral discussions to develop a legally binding Government-to-Government agreement;

2) Share best practices and technical information on CCS; and

3) Promote industry-led research and development projects relevant to the implementation of cross-border CCS. Additionally, a Joint Committee comprising representatives from both countries has been established to facilitate the MoU's implementation.

These examples of cross-border cooperation—such as between Norway–the Netherlands and Singapore–Malaysia—demonstrate that cross-border carbon transport is becoming an essential component of the global climate mitigation infrastructure.

Nevertheless, the author argues that bilateral agreements alone offer only a temporary solution. Without the ratification of the London Protocol Amendment, Indonesia's cross-border CCS projects will continue to face constraints in terms of partner availability, diplomatic hurdles, and divergent legal interpretations of carbon's status. Therefore, the expedited entry into force of the amendment is key to ensuring legal certainty, international compliance, and the long-term viability of CCS projects as part of the global climate change mitigation agenda.

4. Conclusion

This study concludes that a regulatory gap persists in Indonesian law regarding the legal status of carbon and its cross-border transport. While international regimes have excluded carbon from the waste category to support climate change mitigation, Indonesia has not yet explicitly adopted this approach. Although Article 45 of Presidential Regulation No. 14 of 2024 provides for bilateral agreements, challenges remain due to Indonesia's non-ratification of the London Protocol

Amendment, divergent national classifications, and the absence of detailed technical rules. Accordingly, it is essential for Indonesia to establish a clear legal status for carbon, harmonize domestic regulations with international standards, and expedite the ratification of the London Protocol Amendment to ensure legal certainty, safeguard environmental integrity, and strengthen its role as a regional CCS hub.

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