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REDUCTION OF GHG EMISSIONS FROM SHIPS

OCCS - An independent study - Key findings and policy issues

Submitted by ICS

SUMMARY

Executive summary: This document presents the findings of an independent review of onboard carbon capture and storage (OCCS) commissioned by the International Chamber of Shipping (ICS).

The review concludes that OCCS has the potential to contribute meaningfully to the reduction of GHG emissions from international shipping while the availability, affordability and supporting infrastructure for zero and near-zero GHG fuels continue to develop. A range of OCCS technologies are progressing towards commercial deployment and offer potential emissions reductions across different ship types and trades.

The review highlights that OCCS should not be regarded as a single technological pathway. In addition to chemical absorption systems linked to transport and geological storage of captured CO₂, alternative approaches such as mineralization, thermocatalytic decomposition and other capture technologies are under development. These technologies have different infrastructure requirements and may be better suited to particular shipping sectors. In particular, technologies that produce stable or benign products may be more practical for tramp shipping, where access to dedicated CO₂ reception and storage facilities cannot be assured.

The review further identifies the need for regulatory clarity, including robust monitoring and verification methodologies and consideration of legal uncertainties relating to MARPOL, the Basel Convention, the London Convention and the London Protocol. This document therefore encourages the Committee to support a technology-neutral regulatory framework and engage with relevant international bodies to clarify the pre-eminence of conventions and the appropriate categorization of captured carbon streams and OCCS products, e.g. as cargo, as waste or as hazardous waste.

*Strategic direction,
if applicable:* 3

Output: 3.2

Action to be taken: Paragraph 36

Related documents: None

Introduction

1 The decarbonization of international shipping is entering a critical implementation phase. While the industry supports the rapid development and deployment of zero and near-zero GHG fuels, significant challenges remain relating to fuel availability, scalability, affordability and global infrastructure readiness.

2 In this context, ICS commissioned an independent review of onboard carbon capture and storage (OCCS) to assess the technical maturity, operational implications, regulatory status and commercial considerations associated with its deployment across major ship segments.

3 The review examined capture technologies, onboard storage solutions, disposal pathways, port infrastructure requirements, pilot projects and applicable international and regional regulatory frameworks. It also assessed the suitability of OCCS for different ship types and trade patterns.

4 This document provides a concise summary of the principal findings and highlights policy considerations that may warrant further attention by the Committee.

Summary of findings

5. The review concludes that OCCS has the potential to contribute significantly to the reduction of GHG emissions from international shipping and may serve as an important complementary measure during the transition to zero and near-zero GHG fuels.

6 The review finds that OCCS should not be considered a single technology pathway but rather a group of technologies with differing technical characteristics, operational requirements and infrastructure dependencies. These include chemical absorption systems producing captured CO₂ for transport and permanent storage or utilization, as well as emerging technologies such as mineralization, thermocatalytic decomposition and other carbon capture processes.

7 Among the technologies assessed, chemical absorption systems are generally the most mature and have been demonstrated aboard several ship types. However, their deployment relies upon the availability of suitable reception facilities, transport networks and permanent storage or utilization solutions for captured CO₂.

8 The review notes that these requirements may be more readily accommodated by ships on regular routes with dedicated carbon management infrastructure, e.g. liner routes.

9 By contrast, ships operating in tramp trades may face greater challenges due to unpredictable trading patterns and the limited availability of dedicated reception facilities. For these sectors, technologies that convert captured carbon into stable solids or other benign products may offer operational advantages by reducing reliance on specialized shore-side infrastructure.

10 The review therefore concludes that different OCCS technologies may be better suited to different ship types, trades and operating profiles and that no single technology pathway is likely to meet the needs of the entire shipping industry.

11 The review further finds that successful deployment of OCCS will depend upon the establishment of robust monitoring, reporting and verification arrangements capable of demonstrating genuine and permanent emissions reductions across a range of technology pathways.

12 The review identifies a number of legal and regulatory uncertainties that may affect future deployment. These include questions relating to the legal status of captured CO₂ and other OCCS carbon products and uncertainty over the pre-eminence of the relevant international conventions.

13 The review notes that clarification of these issues will be important to provide regulatory certainty and ensure that future IMO frameworks support innovation while maintaining environmental integrity.

Key policy issues

Recognition of a technology-neutral approach

14 The review highlights that OCCS encompasses a range of technologies at differing stages of maturity, including chemical absorption and mineralization, as well as thermocatalytic decomposition and other emerging carbon capture technologies.

15 While absorption technologies currently represent the most mature OCCS solutions, their deployment is highly dependent upon the availability of suitable reception facilities, transport networks and permanent storage infrastructure. Such requirements may be achievable for ships operating on regular trading patterns and calling at ports with established carbon management infrastructure.

16 However, many sectors of international shipping, particularly tramp shipping, operate on highly variable trading routes and cannot rely upon regular access to specialized CO₂ reception facilities. For these sectors, amounting to about two thirds of the world fleet in terms of cargo capacity, alternative OCCS technologies that convert carbon into stable solid products or other benign materials may ultimately prove more practical and operationally flexible.

17 The report therefore suggests that IMO should ensure a technology-neutral approach across all the working groups considering OCCS. Environmental outcomes, life cycle emissions performance and verification requirements should be focused on, rather than favouring any individual OCCS technology pathway.

18 Such an approach would encourage innovation, avoid unintended market distortions and allow the most appropriate technologies to emerge for different ship types, trades and operating conditions.

19 ICS observes that the degree to which technology neutrality has been upheld by the groups that are contributing to the regulation of OCCS varies significantly. These groups include:

- .1 the MEPC working group that is developing the overall regulatory framework;
- .2 the CCC working group that is developing the safety requirements;
- .3 the LCA working group that is developing the emission factors; and
- .4 the mid- and long-term measures work that may incentivize the uptake of OCCS.

20 This is of concern, as ultimately the extent to which the technologies can be utilized will be limited by the common denominators, which currently appear to be absorption capture technologies and sequestration of CO₂. ICS recommends that the groups harmonize their approaches to align with that taken by the MEPC working group that is developing the overall

regulatory framework. This is a phased approach whereby the requirements for the technologies are developed in a hierarchical sequence with the most mature technologies first.

21 For capture technologies this should initially include absorption and mineralization. For disposal, sequestration and technologies that permanently bind carbon into construction materials should be among the first considered. The terms of reference for all groups should be adjusted to ultimately develop regulatory requirements for all mature technologies that have been deployed to at least pilot level.

Recognition within IMO measures

22 Currently the only prospect for incentivization of OCCS is through the application of the LCA emission factors within the mid- and long-term measures.

23 The existing IMO measures energy efficiency design index (EEDI), energy efficiency existing ship index (EEXI) and carbon intensity indicator (CII), do not provide a mechanism through which carbon captured onboard can be reflected within compliance calculations.

24 ICS hopes that the adoption of the mid-term measures can be concluded this year. However, if OCCS incentives are not included, or there are significant delays to adoption, it is recommended for the Committee to consider interim OCCS incentive measures. For example, enabling captured and permanently disposed carbon to be deducted from the calculation of CII ratings.

25 Until such time as an OCCS regulatory incentive can be provided, industrial scale uptake of OCCS cannot happen. This would represent a lost decarbonization opportunity, as mature, proven OCCS technologies exist today.

Legal and regulatory uncertainty

26 The review identifies several legal and regulatory uncertainties that may affect the deployment of OCCS technologies.

27 In particular, questions remain concerning the pre-eminence between MARPOL and the London Convention and London Protocol with respect to OCCS emissions to sea. There is also uncertainty with respect to the potential restriction of transboundary movement of cargoes of captured carbon, if considered a hazardous waste under the Basel Convention and the Basel Ban Amendment.

28 Therefore, the following legal clarifications would be beneficial:

- .1 whether captured CO₂, mineralized products or other OCCS carbon products should be considered as cargo, as waste, or as hazardous waste for the purposes of international conventions;
- .2 the pre-eminence of MARPOL or London Convention and London Protocol for emissions to sea when those emissions are from the normal operation of the ship (i.e. in this instance from the OCCS plant); and
- .3 the evidential requirements necessary to demonstrate permanent sequestration or equivalent emissions abatement.

29 The report notes that unresolved legal questions may create investment uncertainty and act as a barrier to deployment.

30 The Committee may therefore wish to engage with the governing bodies of the London Convention, London Protocol and the Basel Convention with a view to developing common interpretations and thereby ensuring regulatory clarity.

Monitoring, reporting and verification

31 Robust monitoring, reporting and verification procedures will be required across all OCCS pathways to ensure environmental integrity and comparability of outcomes.

Conclusions

32 The report demonstrates that OCCS is evolving rapidly and encompasses a diverse range of technological solutions.

33 While current attention has focused primarily on chemical absorption and geological sequestration, alternative approaches such as mineralization and thermocatalytic decomposition may offer advantages for certain shipping sectors, particularly where operational flexibility and limited infrastructure dependence are important considerations.

34 The report therefore concludes that IMO should develop a technology-neutral regulatory framework that enables innovation and allows all OCCS technologies capable of delivering demonstrable emissions reductions to compete on an equal basis.

35 The report further concludes that resolution of legal uncertainties concerning the legal status of captured carbon streams and other OCCS products under international conventions will be important to facilitate investment and deployment.

Action requested of the Committee

36 The Committee is invited to:

- .1 consider the information provided in this document;
- .2 note the findings of the ICS sponsored [independent OCCS review \(link to the report\)](#);
- .3 amend the terms of reference of the following groups progressing the OCCS requirements, to ensure a harmonized approach to technology neutrality:
 - .1 the MEPC working group that is developing the overall regulatory framework;
 - .2 the CCC working group that is developing the safety requirements;
 - .3 the LCA working group that is developing the emission factors; and
 - .4 the mid- and long-term measures work that may incentivize the uptake of OCCS;
- .4 note that their approaches should align with that taken by the MEPC working group that is developing the overall regulatory framework, i.e. a phased approach should be adopted, whereby the requirements for the technologies are developed in a hierarchical sequence with the most mature technologies first. For capture technologies this should initially include absorption and

mineralization. For disposal, technologies that permanently sequester, or bind carbon into construction materials should be among the first considered. Ultimately regulatory requirements should be developed for all mature technologies that have been deployed to at least pilot level;

- .5 consider that if there are significant delays to OCCS incentives, the Committee needs to consider interim OCCS incentive measures. For example, enabling captured and permanently disposed carbon to be deducted from the calculation of CII ratings;
 - .6 engage with the governing bodies of the London Convention, London Protocol and the Basel Convention with a view to developing common interpretations and thereby clarifying:
 - .1 whether captured CO₂, mineralized products or other OCCS carbon outputs should be considered as cargo, as waste or as hazardous waste for the purposes of international environmental conventions, and under what circumstances is it appropriate to restrict transboundary movement of these substances; and
 - .2 the pre-eminence of MARPOL or London Convention and London Protocol for emissions to sea when those emissions are from the normal operation of the ship (i.e. in this instance from the OCCS plant); and
 - .7 take action as appropriate.
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