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"ANALYSING THE ENVIRONMENTAL IMPACT OF IMO SULPHUR REGULATION 2020, ANNEX VI, MARPOL"

"ANÁLISIS DEL IMPACTO AMBIENTAL DEL REGLAMENTO SOBRE AZUFRE DE LA OMI DE 2020, ANEXO VI, MARPOL"

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Abstract:

The IMO has set different SOx limits over the years, including different limits for SECA and areas outside SECA. The EU has formulated stricter limits for its member states. The EU port and SECA areas have reduced SOx emissions vastly. Ocean acidification, degradation of the environment, and human health has been improved in the EU ports and SECA areas. However, the improvement at the global level is limited.

SOx emission causes a cooling effect on temperature and decreases the warming effect of GHG emissions. The lowering of SOx can impact global warming. Further, the Black Carbon emission from alternate fuels can lead to increased GHG emissions. The acidic wash water from EGCS contains toxic metals and PAHs which when discharged at sea cause severe damage. The SOx reduction, Black Carbon emission and wash water discharge adversely impact oceans and violates the UNCLOS, UNFCCC, Paris Agreement, CBD, and even the UNDRIP. An IPCC report will help analyse the SOx, Black Carbon emission, and wash water impact, which can be taken up in COP 28.

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The 2022 MEPC Guidelines for Environmental Risk Assessment and reception of wash water, with Port authorities are based on the submissions by nations and environmental organizations to the PPR 9, which have highlighted the environmental problems and challenges in the use of EGCS and the discharge of its wash water. The guidelines are non-binding and may not have the desired impact. Much stricter regulation is required to ensure the protection of the marine environment.

Resumen:

La OMI ha establecido diferentes límites de SOx a lo largo de los años, incluidos diferentes límites para SECA y áreas fuera de SECA. La UE ha formulado límites más estrictos para sus estados miembros. El puerto de la UE y las áreas SECA han reducido enormemente las emisiones de SOx. La acidificación de los océanos, la degradación del medio ambiente y la salud humana han mejorado en los puertos de la UE y las zonas SECA. Sin embargo, la mejora a nivel global es limitada.

La emisión de SOx causa un efecto de enfriamiento en la temperatura y disminuye el efecto de calentamiento de las emisiones de GEI. La reducción de SOx puede afectar el calentamiento global. Además, la emisión de carbono negro de los combustibles alternativos puede provocar un aumento de las emisiones de GEI. El agua de lavado ácida de EGCS contiene metales tóxicos y HAP que, cuando se descargan en el mar, causan daños graves. La reducción de SOx, la emisión de carbono negro y la descarga de agua de lavado impactan negativamente en los océanos y violan la UNCLOS, la CMNUCC, el Acuerdo de París, el CDB e incluso la UNDRIP. Un informe del IPCC ayudará a analizar el SOx, las emisiones de carbono negro y el impacto del agua de lavado, que se puede abordar en la COP 28.

Las Directrices MEPC de 2022, para la evaluación de riesgos ambientales y la recepción de agua de lavado, con las autoridades portuarias se basan en las presentaciones de las naciones y organizaciones ambientales al PPR 9 que han resaltado los problemas y desafíos ambientales en el uso de EGCS y la descarga de su agua de lavado. Las pautas no son vinculantes y es posible que no tengan el impacto deseado. Se requiere una regulación mucho más estricta para garantizar la protección del medio ambiente marino.

Keywords: SOx emission. Marine Environment. Sulphur Limit. SECA. EGCS. Marine fuel

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Palabras clave: Emisión de Sox. Ambiente marino. Límite de azufre. SECA. EGCS. Combustible marino

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1. INTRODUCTION

The pollution from ships remained unregulated until the formation of the International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL) in 1959. Nevertheless, OILPOL merely oversaw the ship-based oil pollution having direct cause and effect on the marine environment. The other types of ship-sourced pollution remained unregulated till the formation of the International Convention for the Prevention of Pollution from Ships 1973/78 (MARPOL). The ship-sourced air pollution however was regulated until the implementation of Annex VI of the MARPOL in 2005.[1] The reasons behind the tardy implementation of regulation for air pollution from ships can be the lack of direct cause and effect linkage with the contamination of the marine environment. The air pollution from ships manufactures a snowballing effect that negatively impacts the air quality, damaging the populations, and causing environmental degradation.[2]

The ignition system in the Ship engine is responsible for a wide variety of pollutants that are responsible for the degradation of human health, ocean, and marine biodiversity.[3] In addition to the Green House Gas (GHG) emission causing sea level rise and climate change, a ship also causes the emission of fine particulate

[1] Attard, D., Fitzmaurice, M., Martinez, N., & Hamza, R. (2016). *The IMLI manual on international maritime law: Volume III: Marine environmental law and maritime security law*. Oxford University Press. And 'International Maritime Organization. (n.d.). *Convention on the International Maritime Organization*. See this link
[2] International Maritime Organisation, *Prevention of Air Pollution from Ships*, See this link
[3] European Commission. (n.d.). *Cleaner Air in 2020: 0.5% sulphur cap for ships enters into force worldwide*. See this Link

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matter having a diameter lower than 2.5 μm (i.e., PM2.5).[4] A ship also emits high quantities of sulphur oxides (SOx), and nitrogen oxides (NOx)[5]. The NOx and SOx emissions result in premature death and morbidity. Mostly, the SOx emission in form of sulphate (SO4) aerosols causes significant damage to human health and contributes to ocean acidification[6].

The Organisation for Economic Co-operation and Development (OECD) has also specified that Sulphur is responsible for a variety of illnesses such as pulmonary diseases and premature death. It highlights that in 2007, within East Asia, South Asia, and Europe, 70% of ship-based sulphur emissions transpire within 400 km of the coastline causing roughly 60,000 early deaths yearly. In 2010, however, certain ambiguities were revealed in the data collected in 2007 and the methods used to analyse the data. Consequently, a new estimate was submitted that depicted 20000-104000 deaths yearly. Thus, the impact of Sulphur emission is of concerning magnitude.[7]

To tackle the emission problem IMO and EU imposed restrictions on permissible Sulphur emissions from ships. The IMO and EU directed that a lower Sulphur limit be set for certain Emission Controlled Areas (ECAs) which was set at 0.1% m/m in 2015. For the Areas Outside ECAs, more recently in January 2020, the permissible Sulphur limit was brought down to 0.5% m/m from the earlier 3.5 m/m limit causing an 86% drop in the permissible Sulphur limit.[8] To comply with the Sulphur limit, the maritime industry has an option to use alternate fuels with low Sulphur limits such as VLSFOs, LNG, and MGOs or to use HSFO with scrubbers installed.

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[4] Chen, C., Saikawa, E., Comer, B., Mao, X., & Rutherford, D. (2019). Ship emission impacts on air quality and human health in the Pearl River Delta (PRD) region, China, in 2015, with projections to 2030. *GeoHealth*, 3(9), 284-306. See this Link

[5]Kattner, L., Mathieu-Üffing, B., Burrows, J. P., Richter, A., Schmolke, S., Seyler, A., & Wittrock, F. (2015). Monitoring compliance with sulfur content regulations of shipping fuel by in situ measurements of ship emissions. *Atmospheric Chemistry and Physics*, 15(17), 10087-10092.
and
Lee, H., Park, D., Choo, S., & Pham, H. T. (2020). Estimation of the non-greenhouse gas emissions inventory from ships in the Port of Incheon. *Sustainability*, 12(19), 8231. See this link

[6] Sofiev, M., Winebrake, J. J., Johansson, L., Carr, E. W., Prank, M., Soares, J., Vira, J., Kouznetsov, R., Jalkanen, J., & Corbett, J. J. (2018). Cleaner fuels for ships provide public health benefits with climate tradeoffs. *Nature Communications*, 9(1). See this link

[7]OECD. (2014). The competitiveness of global port-cities. *OECD Publishing*. See this link

[8]DNV GL. (n.d.). Global sulphur cap 2020, *MARITIME GLOBAL SULPHUR CAP 2020 SAFER, SMARTER, GREENER Know the different choices and challenges for on-time compliance*. SAFETY4SEA | Shipping and maritime news. See this link

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2. VARIATIONS IN GLOBAL SULPHUR LIMIT; ECAS, OUTSIDE ECAS, AND THE EU

2.1. Under MARPOL

The protection of the marine environment from ship-sourced air pollution was ensured by IMO through its constitutional body namely the Marine Environment Protection Committee (MEPC),[9] which in the year 1997 formulated Annex VI to the MARPOL which entered into force in May 2005. Presently 87 nations are parties to the Annex VI of the MARPOL, which is more than 96% of global shipping tonnage.[10] Annex VI created a restriction on the permissible Sulphur emission limit.[11] It permitted a global sulphur emission up to the limit of 4.5% m/m which was revised to 3.5 % m/m effective from January 2012, and subsequently to 0.5 % m/m effective from January 2020 by the MEPC. The Resolution MEPC.176(58), also created the Emission Control Areas (ECAs) and created an even lower limit of 1.5% m/m for the area. These areas have been characterized as SECA, (i.e., Sulphur Emission Control Areas). The SECA limit was thereafter brought down to 1.0% m/m in July 2010 and was again set at a lower limit of 0.1% m/m from January 2015.[12] The geographical area highlighting the SECA is provided in Image 2. The MEPC in its Resolution MEPC.176(58) of 2008, also mandated that before the enforcement of the 0.5% m/m limit, a review on the readiness of the maritime industry needs to be conducted no later than 2018 in case the readiness is not found the implementation will be deferred until January 2025. On October 27, 2016, after the analysis of readiness, the MEPC concluded to go ahead with the enforcement of the revised Annex VI with the 0.50 m/m Sulphur emission limit from the scheduled date, i.e., January 1, 2020. The variation in sulphur limit has been highlighted in Image 1.[13]

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[9] International Maritime Organization. (n.d.). *Structure of IMO*. See this link

[10] Grimmer, R. (2018, March 1). *IMO 2020 rule: Overview & background*. Ship & Bunker. See this link

[11] International Maritime Organisation. (n.d.). *Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships of 2 November 1973, as modified by the Protocol of 17 February 1978 (London, 26 September 1997) (New Annex VI - Regulations for the Prevention of Air Pollution from Ships)*. admiraltylawguide. See this link

[12] International Maritime Organisation. (n.d.). Resolution MEPC.176(58) Adopted on 10 October 2008, Amendments to The Annex of The Protocol of 1997 to Amend the International Convention For The Prevention Of Pollution From Ships, 1973, As Modified By The Protocol Of 1978 Relating Thereto (Revised MARPOL Annex VI) (MEPC 58/23/Add.1). See this link

[13]Grimmer, R. (2018, March 1). *IMO 2020 rule: Overview & background*. Ship & Bunker. See this link

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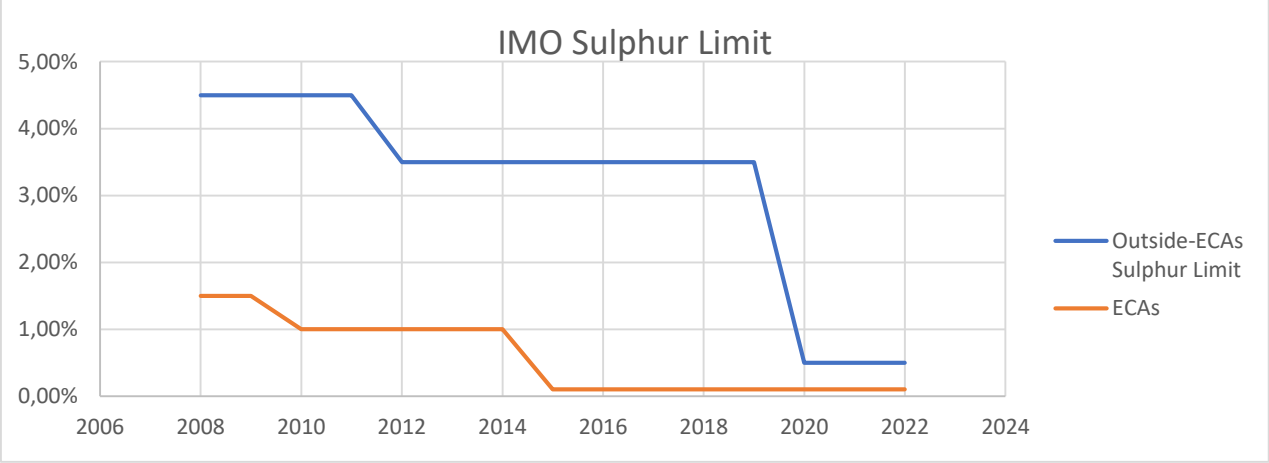
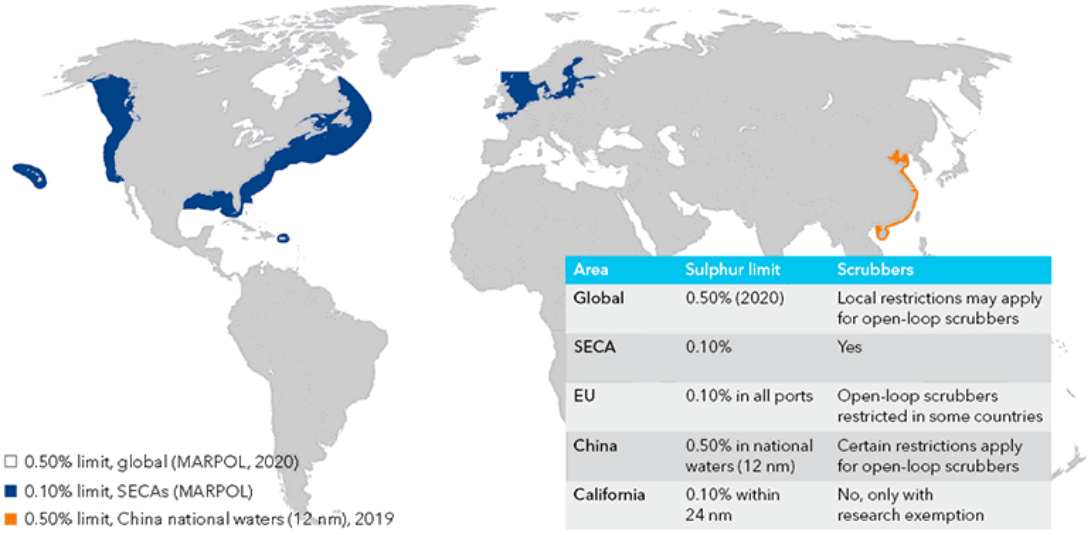


Image 1: Timeline highlightning in the Variations in Sulphur limit ender MARPOL.

(a) 4.50 % m/m from 10 October 2008;
(b) 3.50 % m/m from 18 June 2014;
(c) 0.50 % m/m from 1 January 2020[14]



Area	Sulphur limit	Scrubbers
Global	0.50% (2020)	Local restrictions may apply for open-loop scrubbers
SECA	0.10%	Yes
EU	0.10% in all ports	Open-loop scrubbers restricted in some countries
China	0.50% in national waters (12 nm)	Certain restrictions apply for open-loop scrubbers
California	0.10% within 24 nm	No, only with research exemption

Image 2: Sulphur Emission Control Areas[15]

[14] International Maritime Organisation. (n.d.). Resolution MEPC.176(58) Adopted on 10 October 2008, Amendments to The Annex of The Protocol of 1997 to Amend the International Convention For The Prevention Of Pollution From Ships, 1973, As Modified By The Protocol Of 1978 Relating Thereto (Revised MARPOL Annex VI) (MEPC 58/23/Add.1). See this link

[15] *Sulphur limit in ECAs - increased risk of PSC deficiencies and detentions.* (2019, March 12). DNV. See this link

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2.2. The Sulphur limit and the European Union (EU Sulphur Directives)

The EU on 1st January 2010 launched its Directives 2005/33/EC and 2009/30/EC, by amending the Directive 1999/32/EC and establishing a 0.10% m/m sulphur limit on all ships berthed in EU ports, a 1.50% m/m sulphur limit on passenger ships within the EU, 1.50% m/m sulphur limit within its SECAs and 4.50% m/m sulphur limit from all vessels outside ECAs.[16] The European Council further revised the limit, providing a lower sulphur limit of 3.5% m/m effective from 18 June 2014. The EU revised its sulphur limit for ECAs to the existing 0.10% m/m sulphur emission limit on 1 January 2015. Lastly, from 1st January 2020, the EU revised its Sulphur limit for all areas and ships outside SECA and kept it to 0.50% m/m. The EU has also reaffirmed that the member states shall undertake all necessary steps to prevent the use of High Sulphur Fuels Oil (HSFO) by ships within the territorial seas, exclusive economic zones, and pollution control areas. The regulation also mandates that all the vessels entering the EU Ports shall not emit more than 0.10% m/m sulphur limit (as provided in image 3).[17]

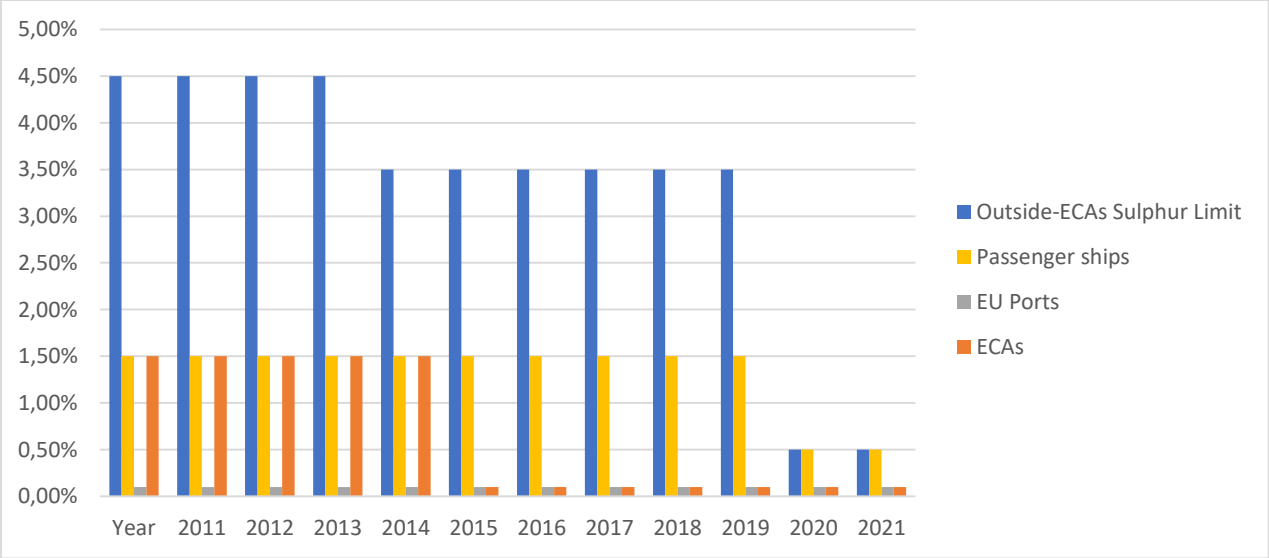

Image 3: Timeline highlighting the Variations in Sulphur limit in the EU

[16] Exhaust Gas Cleaning System Association. (n.d.). *European Union Sulphur Directive.* See this link
And
Bergqvist, R., Turesson, M., & Weddmark, A. (2015). Sulphur emission control areas and transport strategies -the case of Sweden and the forest industry. *European Transport Research Review*, 7(2). See this link

[17] European Union. (2012). *Directive 2012/33/EU of the European Parliament and of the Council of 21 November 2012 amending Council Directive 1999/32/EC as regards the sulphur content of marine fuels . . . . .* (L 327). Official Journal of the European Union. See this link

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- 4.50% m/m before 18 June 2014 in Outside-ECAs
- 3.50% m/m from 18 June 2014 in Outside-ECAs
- 0.50% m/m from 1 January 2020 in Outside-ECAs
- 1.50% m/m from 1 January 2010 from passenger's vessels
- 0.50% m/m from 1st January 2020 from passenger's vessels
- 0.10% from 1st January 2010 in EU Ports
- 1.50% m/m from 1 January 2010 in ECAs
- 0.10% as from 1 January 2015 in ECAs

3. ENVIRONMENTAL ASSESSMENT OF SULPHUR EMISSION LIMIT

The SOx emissions from shipping have been reported to be higher by a factor of 1.6 to 2.7. from road transport and 80 times higher when compared to aviation which is a substantial quantity.[18] The reduction in sulphur limit to 0.5% m/m is considered to be a constructive action toward the protection of the marine environment. It ensures a supply of clean coastal air, a decrease in ecological harm, and a reduction in ocean acidification substantially reducing premature mortality and morbidity caused by SOx emissions from Ships.[19] The reduction in sulphur limit by IMO to 4.5 % in 2005 m/m and 3.5% m/m in 2012 has not made a substantial contribution to the environment. This is evident from the 2018 data, which shows that 250,000 annual death and 6.4 million childhood asthma cases result from sulphur emissions.[20] The new limit seeks to bring down sulphur emissions by 85%.[21] The population living near the coastal and port areas are the most direct beneficiaries of the 0.50% m/m sulphur limit from ships.[22]

[18] Merk, O., OECD, & International Transport Forum. (n.d.). Shipping Emissions in Ports (Discussion Papers 2014/20). See this link
[19] Ji, J. S. (2020). The IMO 2020 sulphur cap: A step forward for planetary health? The Lancet Planetary Health, 4(2), e46-e47.
[20] Merk, O., OECD, & International Transport Forum. (n.d.). Shipping Emissions in Ports (Discussion Papers 2014/20). See this link
[21] CMA CGM. (2019, October 9). *IMO 2020 Low Sulphur Regulation.* See this link
[22] Viana, M., Hammingh, P., Colette, A., Querol, X., Degraeuwe, B., Vlieger, I. D., & Van Aardenne, J. (2014). Impact of maritime transport emissions on coastal air quality in Europe. *Atmospheric Environment*, 90, 96-105. See this link

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3.1. Emission in Ports impacting major cities

To analyse the environmental impact of the low sulphur limit, its effect on the ports needs to be identified as they endure the maximum ship-sourced emission. The ten largest SOx emitting ports are located in cities with a combined population of approximately 40 million directly exposing them to a large quantity of SOx. These ports are responsible for the emission of 22% of the overall SOx emissions from ports.[23] The mega-ports which entertain most traffic by container volume are Los Angeles, Rotterdam, Singapore, Shanghai, Ningbo, Shenzhen, and Guangzhou.[24] Even though the port of Shanghai contributes only 12% of total sulphur emission in the city, due to the application of the 0.50% m/m sulphur limit applicable since 2016.[25] The Hongkong port is reported to be responsible for 36% of sulphur emissions within the city,[26] and the Los Angeles Port contributes 45% of sulphur emissions within the city. The port of Tianjin, and Klang are not far behind as being among the largest SOx emitters. [27] Nevertheless, Ports had taken environment-friendly steps seeking a voluntary change in fuel and nudging shipping lines towards using low sulphur fuel. These steps are majorly taken up by providing compensations to the shipping lines for the additional charges they incur by switching to low sulphur fuel or by imposing lower port dues and charges. Few ports in the US, including the Los Angeles Port, had provided reimbursements to ships using low sulphur fuel within the port.[28] Furthermore, the Singapore port had provided a reduction of 15% in port charges for ships using cleaner fuel.[29] Hongkong is decreasing the SOx emission by implementing the 0.50% m/m sulphur limit from 1st January 2019 (a year early than the rest of the world).[30] The

[23]Merk, O., OECD, & International Transport Forum. (n.d.). Shipping Emissions in Ports (Discussion Papers 2014/20). See this link

[24] Ji, J. S. (2020). The IMO 2020 sulphur cap: A step forward for planetary health? *The Lancet Planetary Health*, 4(2), e46-e47.

[25] Zhang, Q., Zheng, Z., Wan, Z., & Zheng, S. (2020). Does emission control area policy reduce sulfur dioxides concentration in Shanghai? *Transportation Research Part D: Transport and Environment*, 81, 102289. See this link

[26] Mason, T. G., Chan, K. P., Schooling, C. M., Sun, S., Yang, A., Yang, Y., Barratt, B., & Tian, L. (2019). Air quality changes after Hong Kong shipping emission policy: An accountability study. *Chemosphere*, 226, 616-624. See this link

[27] Merk, O., OECD, & International Transport Forum. (n.d.). Shipping Emissions in Ports (Discussion Papers 2014/20). See this link

[28] GARD. (2008, August 1). *Ports of Los Angeles and Long Beach - Voluntary incentive programme for low sulphur fuel.* See this link

[29] Merk, O., OECD, & International Transport Forum. (n.d.). Shipping Emissions in Ports (Discussion Papers 2014/20). See this link

[30] Hongkong e-legislation. (n.d.). *Air Pollution Control (Fuel for Vessels) Regulation* (L.N. 135 of 2018). See this link

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impact of the 2020 sulphur regulations on emissions by major ports is yet to be seen. Nevertheless, the question of whether decreasing the sulphur limit can actually impact the global sulphur presence and thereby improve human health and the environment can be analysed by studying the impact of low sulphur limit in the Sulphur Emission Control Areas.

3.2. Environmental Impact Assessment in SECA limit.

The Ships in SECA regions have been required to maintain a 0.10% m/m sulphur limit since 2015. As highlighted in image 2, parts of North America, namely the United States Caribbean Sea, the North Sea, and the Baltic Sea, fall within SECA categorization.[31] Further, the MEPC, in its 79th session, also plans to include parts of the Mediterranean Sea in the SECA region.[32] Furthermore, several nations have implemented the 0.10% m/m sulphur limit by formulating domestic regulations to that effect. All the EU Ports also follow the 0.10% m/m sulphur limit (shown in image 2). Further, certain parts of the United States, China, and South Korea have implemented the 0.10% m/m sulphur limit.[33]

The 0.10% m/m sulphur limit has caused a major decline in total sulphur emission. The Rotterdam port hosts most maritime traffic in Europe and, due to the implementation 0.10% m/m sulphur limit,[34] contributes little to the global SOx emission.[35] The port of Kyllini in Greece has been reported to emit the lowest emission. The ports located in Sweden, Greece, the UK, US (under SECA) are reported to emit the lowest SOx emission. In total, despite heavy traffic, nations under the European Union are responsible for emitting only 5% of the total Global SOx emission.[36] The Baltic Sea reported a decline in SOx emission from 101 kt (Thousand Tonnes) in 2009 to 93 kt in 2010 due to the implementation of the 1.0% m/m Sulphur emission limit in 2010. The Baltic Sea further reported a major

[31] International Maritime Organization. (n.d.). *Special areas under MARPOL*. See this link
[32] International Maritime Organisation. (2022). CONSIDERATION AND ADOPTION OF AMENDMENTS TO MANDATORY INSTRUMENTS Draft amendments to MARPOL Annex VI concerning Mediterranean Sea Emission Control Area for Sulphur Oxides and Particulate Matter (MEPC 79/3/2). See this link
[33] NETPAS. (n.d.). ECA and ports list. Smart port distance table. See this link
[34] European Commission. (2020, April 2). Rotterdam: The largest freight port in the EU. Erostat. See this link
[35] Merk, Olaf (2014): *Shipping emissions in ports*, International Transport Forum Discussion Paper, No. 2014-20, Organisation for Economic Co-operation and Development (OECD), International Transport Forum, Paris, See this link
[36] Merk, O., OECD, & International Transport Forum. (n.d.). Shipping Emissions in Ports (Discussion Papers 2014/20). See this link

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decline in SOx emission from 73 kt in 2014 to 9 kt in 2015 due to the implementation of a much lower sulphur limit of 0.10% m/m in 2015. Similarly, the North Sea reported a decline of 209 kt in 2010 from 230 kt in 2009 and a decline of 31 kt of SOx in 2015 from 168 kt in 2014. As shown in Image 4, the SOx emission in the North Sea and the Baltic Sea declined initially in 2010 with the implementation of the 1.0% m/m SECA limit and further in 2015 when the SECA limit was fixed at 0.10% m/m.[37]

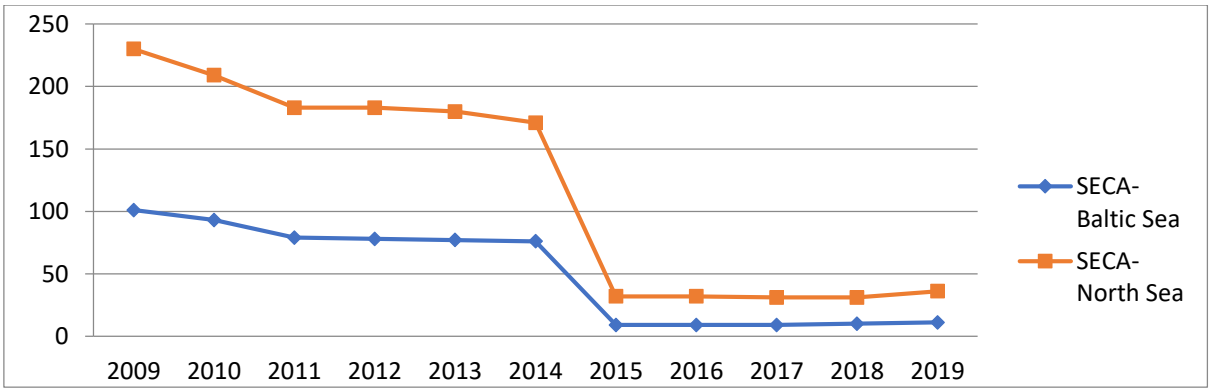

Image 4: Variation in SOx emission in SECA declared in Baltic Sea and the North Sea

3.3. Environmental impact Assessment in Areas Outside SECA

Entire Europe does not fall within the SECA. The territorial and surrounding waters of European Nations not under SECA are governed by EU Sulphur Directives. The North-East Atlantic Ocean, the black sea, and the Mediterranean Sea are also not covered within the SECA. The Non-EU nations in Europe although governed by the directives, must however follow the IMO Sulphur regulation. Consequently, due to little change in the sulphur limit before 2012, a continuous increase in SOx emission has been reported. A slight lowering of SOx emission can be seen in 2012 due to the decline in the global sulphur emission limit to 3.50% m/m outside SECA (as shown in image 5).[38]

[37] Bongrand, G., & Allemand, N. (2020). *Background informal technical document on maritime shipping emissions, reduction techniques and determination of their costs:* TFTEI background informal technical document. TFTEI Techno-Scientific Secretariat. See this link

[38] Fagerli, H., Tsyro, S., Simpson, D., Nyíri, A., Wind, P., Gauss, M., Benedictow, A., Klein, H., Valdebenito, A., Mu, Q., Wærsted, E. G., Gliß, J., Brenna, H., Mortier, A., & Griesfeller, J. (2021). *Transboundary particulate matter, photo-oxidants, acidifying and eutrophying components* (EMEP Report 1/2021). METEOROLOGISK INSTITUTT; Norwegian Meteorological Institute. See this link

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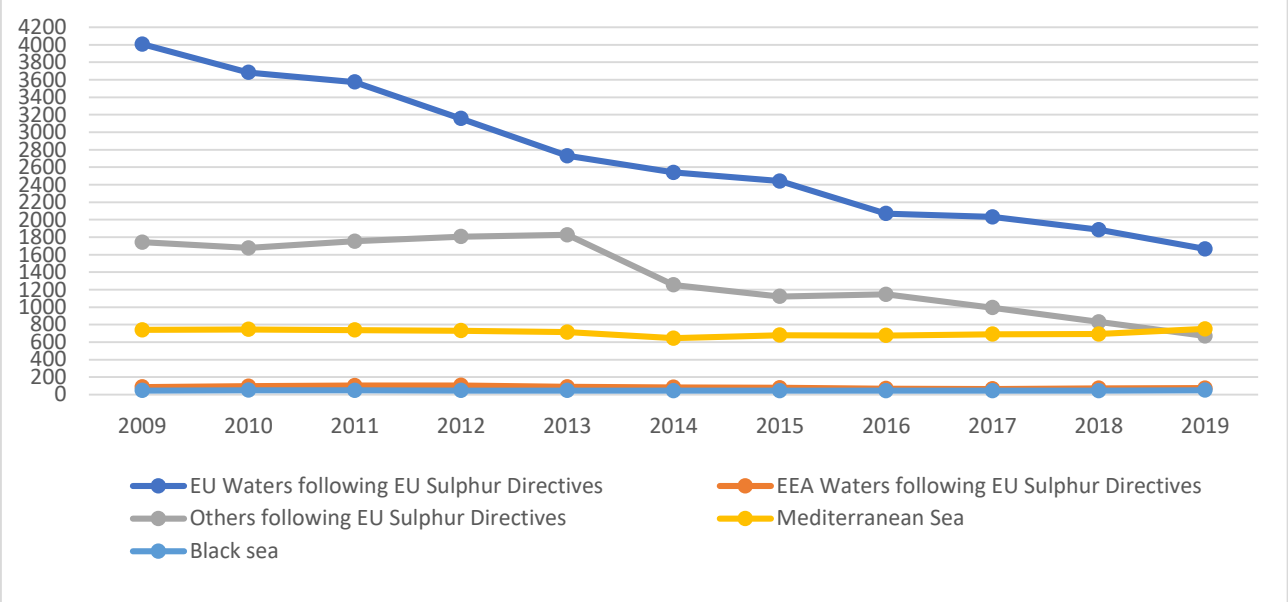

Image: 5 Variations in SOx emission in Europe under Sulphur Directives

Similarly, the Asian Area, North Africa, North East Atlantic Ocean, and other regions show a decline in sulphur limit due to a 3.50% m/m sulphur limit in 2012, as shown in Image 6.

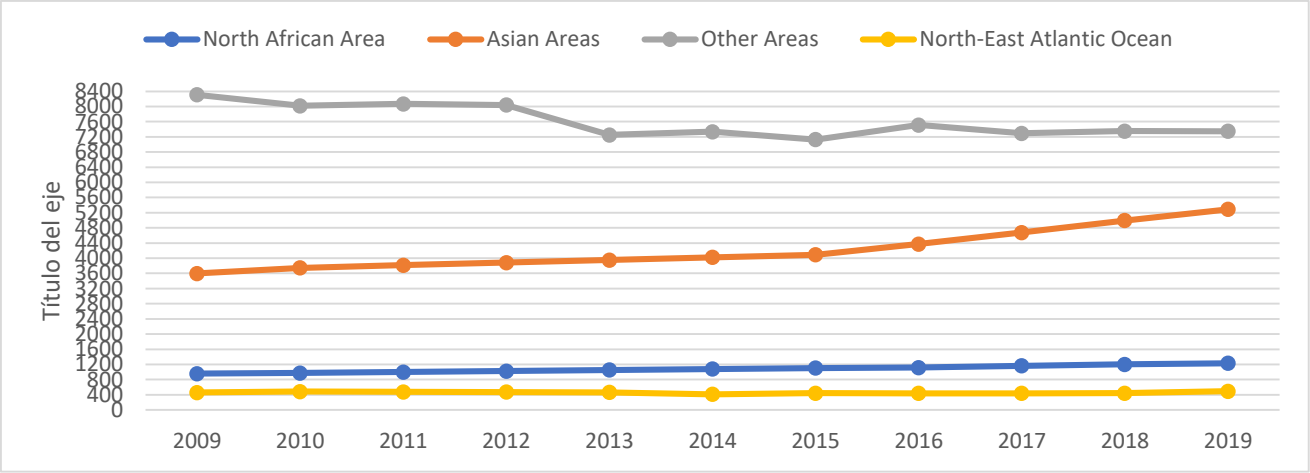

Image 6: Variations in SOx emission Outside Europe

The total SOx emission was also affected by the change in SOx policy in 2010. A slight decrease was seen in the sulphur limit when SOx emission was reported to be 23156 kt in 2010 from 23580 kt in 2009. The SOx in 2011 was reported to be 23532, dropping to 22836 in 2012. The year 2014 reported a very high SOx emission of 31735 kt due to 11823 volcanic emissions, which was 943 in the previous year; nevertheless, the changing sulphur regulations brought a decline in

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the sulphur limit to 21698 kt in 2015.[39] The reported total Sulphur emission provided in the EMEP Report 1/2021, which is used as a reference, shows a slight discrepancy. The totals for 2009, 2011, 2012, 2015, 2016, and 2018 are slightly different from what is mentioned in the report, as shown in Table 1.

Year	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
SECA-Baltic Sea	101	93	79	78	77	76	9	9	9	10	11
SECA-North Sea	230	209	183	183	180	171	32	32	31	31	36
EU Waters following EU Sulphur Directives	4008	3683	3574	3156	2730	2540	2441	2069	2032	1885	1665
EEA Waters following EU Sulphur Directives	87	95	103	104	89	82	78	68	65	71	74
Others following EU Sulphur Directives	1742	1676	1753	1807	1827	1253	1122	1145	994	832	671
North African Area	958	974	1000	1026	1052	1078	1104	1116	1163	1200	1230
Asian Areas	3596	3745	3815	3884	3954	4023	4093	4373	4676	4992	5289
Mediterranean Sea	739	746	738	730	715	645	680	676	691	692	750
Black sea	46	49	48	47	46	45	44	44	45	44	50
North-East Atlantic Ocean	459	483	478	473	463	414	441	440	439	442	494
Other Areas	8308	8019	8069	8039	7252	7335	7130	7511	7293	7354	7347

Table 1: Variations in SOx emission in kt (Thousand Tonnes) (Continues in following page)

[39]Fagerli, H., Tsyro, S., Simpson, D., Nyíri, A., Wind, P., Gauss, M., Benedictow, A., Klein, H., Valdebenito, A., Mu, Q., Wærsted, E. G., Gliß, J., Brenna, H., Mortier, A., & Griesfeller, J. (2021). *Transboundary particulate matter, photo-oxidants, acidifying and eutrophying components* (EMEP Report 1/2021). METEOROLOGISK INSTITUTT; Norwegian Meteorological Institute. See this link

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Natural Marine Emission	2356	2314	2446	2368	2434	2250	2454	2390	2394	2440	2926
Volcanic emission	950	1070	1243	943	943	11823	2070	943	943	943	943
Reported Total[40]	23578	23154	23532	22836	21762	31735	21695	20813	20775	20937	21486
Calculated Total	23580	23156	23529	22838	21762	31735	21698	20816	20775	20936	21486

Table 1 (continuation): Variations in SOx emission in kt (Thousand Tonnes)[41]

3.4. Impact of decrease in SOx on Climate Change

The responsibility for Climate change has been majorly blamed on GHG emissions. The increase in GHG emissions from human activities builds up in the atmosphere warming the earth, thereby causing catastrophic natural calamities around the world.[42] The IMO has been working to bring the GHG emission down for over a decade, starting with the first international mandatory measures adopted on 15 July 2011. More recently, in June 2021, an IMO strategy has been adopted that mandates certain short-term actions to be taken by the shipping industry for decarbonization. The strategy aims to reduce carbon emissions by 40% by 2030 and prevent global warming.[43] The IMO, at the same time, has sought desulphurization as well since SOx emission causes acidification of oceans, acid

[40] Fagerli, H., Tsyro, S., Simpson, D., Nyíri, A., Wind, P., Gauss, M., Benedictow, A., Klein, H., Valdebenito, A., Mu, Q., Wærsted, E. G., Gliß, J., Brenna, H., Mortier, A., & Griesfeller, J. (2021). *Transboundary particulate matter, photo-oxidants, acidifying and eutrophying components* (EMEP Report 1/2021). METEOROLOGISK INSTITUTT; Norwegian Meteorological Institute. See this link

[41]Fagerli, H., Tsyro, S., Simpson, D., Nyíri, A., Wind, P., Gauss, M., Benedictow, A., Klein, H., Valdebenito, A., Mu, Q., Wærsted, E. G., Gliß, J., Brenna, H., Mortier, A., & Griesfeller, J. (2021). *Transboundary particulate matter, photo-oxidants, acidifying and eutrophying components* (EMEP Report 1/2021). METEOROLOGISK INSTITUTT; Norwegian Meteorological Institute. See this link

[42] United States Environmental Protection Agency. (2022, April 27). *Climate change indicators: Greenhouse gases*. See this link

[43] International Maritime Organisation. (2021, July 15). *Cutting GHG emissions from shipping - 10 years of mandatory rules*. See this link

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rain, and damage to marine biodiversity and human health.[44] While calling for desulphurization, IMO may have ignored the cooling impact of SO_2 in the atmosphere. The existence of Atmospheric SO2 through conversion into sulphuric acid aerosols causes a cooling effect as it chunks the arriving solar radiation and reflects the heat from the sun. The recognised Geoengineering technique of reducing the negative effect of global warming is achieved by emitting Sulphur into the environment. The emitted sulphur causes a cooling impact by reflecting the radiation from the sun to space and consequently reducing the surface temperature.[45] The intensive SO2 emission reduction sought by the IMO in 2020 may disturb the composite relationship between SO_2 and CO_2. A major reduction in SO_2 without concurrently reducing CO_2 emissions can contribute to global warming and climate change. As can be analysed from the study, the reduction of sulphur can be achieved in the short term as the gas lasts only for a few days in the environment. However, the warming caused by CO2 emissions lasts for ages.[46] This reduction of sulphur also violates the provision of the United Nations Framework Convention on Climate Change (UNFCCC) of 1992 and the Paris Agreement of 2015 as it aids in the warming of the climate.

4. IMPACT OF ALTERNATE FUEL

The heating due to desulphurization is not the only issue. A study submitted before the IMO has highlighted that the use of the VLSFO blend can increase Black Carbon emissions and can hinder the IMO's efforts to prevent climate change. The (International Organization for Standardization) ISO-approved VLSFO blends formulated to ensure compliance with the 0.50 % m/m sulphur limit comprise aromatic compounds in high magnitudes, ranging between 70% to 95%. When these VLSFO are burned, they can result in an increase in Black Carbon emissions from 10% to 85% when compared to Heavy Fuel Oil and up to 67% to 145% when compared with DMA and DMZ, which are the best quality Distillate Fuels. The review to analyse the readiness for implementing the IMO sulphur regulation, which took place in 2016, also does not focus on the impact of

[44]International Maritime Organization. (n.d.). *IMO 2020 – cutting sulphur oxide emissions.* See this link

[45] Laakso, A., Korhonen, H., Romakkaniemi, S., & Kokkola, H. (2017). Radiative and climate effects of stratospheric sulfur geoengineering using seasonally varying injection areas. *Atmospheric Chemistry and Physics*, 17(11), 6957-6974. See this link

[46] Fuglestvedt, J., Berntsen, T., Eyring, V., Isaksen, I., Lee, D. S., & Sausen, R. (2009). Shipping emissions: From cooling to warming of climate—and reducing impacts on health. *Environmental Science & Technology,* 43(24), 9057-9062. See this link

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desulphurization on Black Carbon emissions. Several governmental and non-governmental International Organisations, including the ISO,[47] all stress that the VLSFO blends must comply with the ISO 8217 specification. Nevertheless, ISO 8217 itself is silent on the permitted black carbon emission. In consideration of the same, the MEPC called on shipowners, charterers, and member states to voluntarily prohibit the use of marine fuel, which can lead to high Black Carbon emissions.[48]

The Life cycle emission of marine fuels is also necessary to be analysed to provide a holistic environmental impact. As shown in image 7, although the lifecycle GHG emission from Ultra Low Sulphur Fuel (ULSFO) and VLSFO is less than heavy fuel oil, nevertheless, the lifecycle emission of SOx from ULSFO is more than the emission caused by the HFO just in its operation. The lifecycle SOx emission from VLSFO is also higher than HFO.[49]

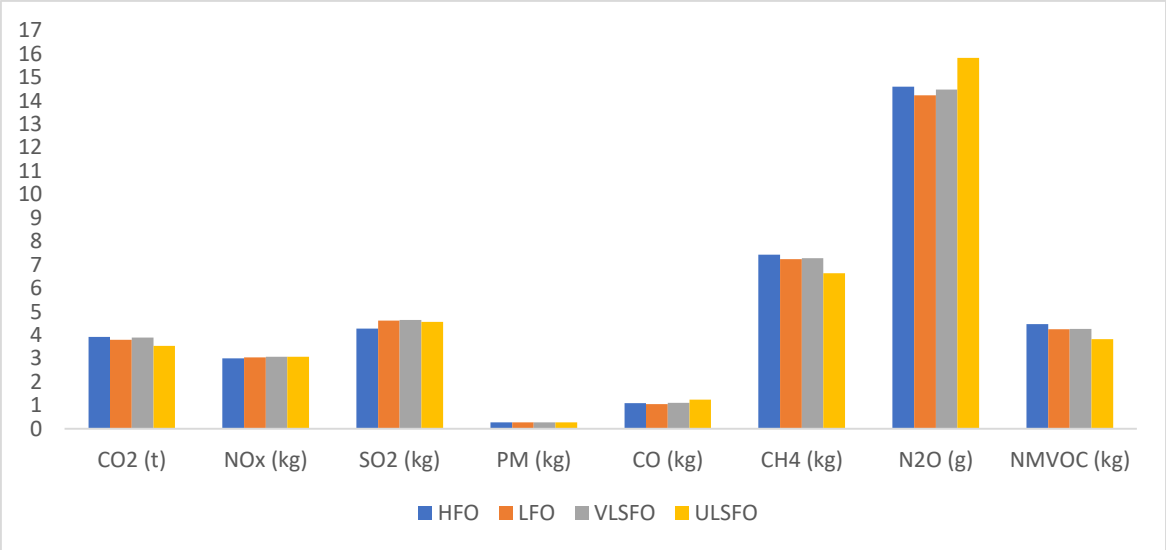

Image 7: Lifecycle emission of different marine fuels

[47] The mentioned international organisations are:The Arctic Council and its Protection of the Arctic Marine Environment (PAME) Working Group, International Council on Combustion Engines (CIMAC), the European Commission, and IBIA

[48] FOEI, WWF, Pacific Environment and CSC. (n.d.). *AIR POLLUTION PREVENTION The need for urgent action to stop the use of blended very low sulphur fuels leading to increases in ship-source Black Carbon globally (MEPC 75/5/5).* International Maritime Organisation. See this link

[49] Bilgili, L. (2021). Life cycle comparison of marine fuels for IMO 2020 sulphur cap. *Science of The Total Environment*, 774, 145719. See this link

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5. IMPACT OF EXHAUST GAS CLEANING SYSTEMS (EGCS)

The IMO permits the use of EGCS aka Scrubber to bring down sulphur limit to the complicit level. The EGCS removes excess sulphur generated from the combustion of HSFOs and allows vessels to operate on the cheaper high sulphur fuel.[50] The combustion of HSFOs in addition to SOx emission also causes high emissions of pollutants such as toxic metals and Polycyclic Aromatic Hydrocarbons (PAHs). The EGCS operates by spraying water on the exhaust gas to remove SOx. Nevertheless, an elevated concentration of acidic and toxic compounds such as zinc, nickel, copper, naphthalene, fluoranthene, phenanthrene, etc. have been detected from the wash water/bleed water (i.e., the water collected after the cleaning is EGCS is completed).[51] The ESCS is of three types, i.e., Open Loop, Closed Loop, and Hybrid EGCS, each having the same function but operating on a different modal. The Open loop EGCS functions by initially spraying seawater to eliminate the excess sulphur as mentioned above and afterward discharging wash water into the sea. The Closed-loop EGCS similarly uses water to filter the exhaust gas. However, the bleed water is subsequently recycled back to the scrubber. Lastly, the Hybrid EGCS is a combination of open loop and closed loop, the ship can switch the operation of the hybrid scrubber to open-loop or closed-loop at will.[52]

5.1. EGCS Potentially Violating UNCLOS and other International Conventions.

The UNCLOS in its Chapter XII provides provision for the Protection and Preservation of Marine Environment.[53] The Sulphur regulations allow the discharge of wash water from EGCS into the sea which although brings down sulphur emissions from ships but causes serious harm to the oceans.[54]

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[50] Wang, Z. (2020). Analysis on the application prospect of EGCS on ocean-going ships [Doctoral dissertation]. See this link

[51] Teuchies, J., Cox, T. J., Van Itterbeeck, K., Meysman, F. J., & Blust, R. (2020). The impact of scrubber discharge on the water quality in estuaries and ports. *Environmental Sciences Europe*, 32(1). See this link

[52] Norton Rose Fulbright. (n.d.). *IMO 2020: Are we ready?* See this link
And
Comer, B. (2020, June 18). *Scrubbers on ships: Time to close the open loop(hole)*. International Council on Clean Transportation. See this link

[53] United Nations. (n.d.). *UNLCOS, PART XII, Protection and Preservation of the Marine Environment*. See this link

[54]International Maritime Organization. (n.d.). *IMO 2020 – cutting sulphur oxide emissions.* See this link

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Consequently, this compliance mechanism of the 2020 sulphur regulation under Annex VI of the MARPOL violates Chapter XII of the UNCLOS. The UNCLOS provides that all states are obligated to ensure the protection and preservation of the marine environment. It demands that constructive action is taken to ensure environmental protection and that all measures are taken to prevent environmental degradation.[55] The States shall also take actions for prevention, reduction, and control of marine pollution from all sources. These actions shall be framed to minimize environmental degradation to the maximum extent possible.[56] This creates an obligation on the member states to ensure that the discharge of wash water although permitted under MARPOL shall not cause degradation of the environment. The States shall take all actions ensuring that they do not directly or indirectly transfer any damage or hazards from one area to another, nor do they by any means transform one pollution into another.[57] The States must also ensure that any technology under its jurisdiction or control shall not cause significant and harmful change and must ensure prevention, reduction, and control of marine pollution.[58] The word "transform" has been inserted to denote the type or characteristic of marine pollution. The EGCS technology is in direct violation of these provisions as it washes the sulphur from the exhaust gas by spraying water, and subsequently discharges this wash water filled with acidic content into the sea, converting air pollution into water pollution.

The wash water discharge for EGCS does not merely violate UNCLOS it is also inconsistent with other international conventions, namely the UNFCCC, the Convention on Biological Diversity (CBD) of 1992, and the Paris Agreement of 2015. The acidic wash water discharge from EGCS reduces the ocean's capacity to reduce CO_2. This is inconsistent with the climate law goals as it compromises the ocean's capability to act as a sink[59] and balance climate change.[60] The UNFCCC imposes fundamental responsibilities on the states to prevent climate change and apply the precautionary approach, to avert or diminish any act negatively impacting

[55] Article 192, General obligation, See this link
[56] United Nations. (n.d.). *UNLCOS, Article 194, Measures to prevent, reduce and control pollution of the marine environment*. See this link
[57], United Nations. (n.d.). *UNLCOS, Article 195, Duty not to transfer damage or hazards or transform one type of pollution into another.* See this link
[58] United Nations. (n.d.). *UNLCOS, Article 196, Use of technologies or introduction of alien or new species*. See this link
[59] "Sink" means any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere.; United Nations. (1992). *Article 1(8), United Nations Framework Convention on Climate Change.* See this link
[60] United Nations. (1992). *Preamble, United Nations Framework Convention on Climate Change.* See this link

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the climate system.[61] The UNFCCC and the Paris Agreement encourage sustainable management, promotion, and cooperation to conserve and enhance sinks and reservoirs of greenhouse gases.[62] The discharge of wash water from EGCS is also inconsistent with the CBD which emphasises the conservation of biological diversity and requires sustainable use.[63] And the wash water causes ocean acidification and spreads toxicity damaging the marine ecosystem. It goes so far as to violate even the United Nations Declaration on the Rights of Indigenous People (UNDRIP) of 2007**,** and the provision of UNCLOS[64] which necessitates conservation and preservation of waters enabling the Indigenous peoples to exercise their rights under the national and international law.[65] The conventions specifically restrict the discharge of any hazardous substance, including wash water from EGCS within the ancestral waters of the Indigenous peoples.

5.2. International Submissions before PPR 9 and the MEPC intervention

The negative environmental impact of wash water from EGCS has become a cause for global concern. The wash water discharge from ECGS is found to be 78% of the total main discharge from the ship, excluding the ballast water. This already high quantity discharge is reported to increase even further which calls for a pressing need for International measures.[66] The concern has led to multiple studies**,** debates, and discussions calling for the implementation of Best Available Technology and Best Environmental Practice (BATBEP). Multiple Nations have submitted their collaborative and independent studies along with suggestions on the *"Evaluation and Harmonization Of Rules And Guidance On The Discharge Of Discharge Water From Exhaust Gas Cleaning Systems (EGCS)"* before the Sub-Committee on

[61] United Nations. (1992). *Article 3, United Nations Framework Convention on Climate Change.* See this link
[62]United Nations. (1992). *Article 4, United Nations Framework Convention on Climate Change.* See this link
And
United Nations. (2015). Article 5, Paris Agreement. See this link
[63] United Nations. (1992). *Preamble and Article 1, Objectives, Convention On Biological Diversity*. See this link
[64] United Nations. (n.d.). *Preamble, Article 140 and Article 160, United Nations Convention on the Law of the Sea.* See this link
[65] United Nations. (2007). *Article 25 and 32, United Nations Declaration on the Rights of Indigenous Peoples.* See this link
[66] OSPAR Commission. (2021). *Information related to the OSPAR Commission's work on discharge from exhaust gas cleaning systems (EGCS) into waters* (PPR 9/INF.2). International Maritime Organisation. See this link

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Pollution Prevention and Response (PPR 7, PPR 9) of IMO for its consideration. In December 2019, the 28 European Nations and European Commission suggested to the PPR 9 that the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) and the Sub-committee must convene more scientific research on the environmental impact of wash water from EGCS by using the state-of-the-art scientific evidence.[67] Further from 2021 to June 2022 multiple other studies with suggestions on the Evaluation and harmonization of rules and Environmental Risk Assessment from EGCS were made before PPR 9.

The question of what EGCS is more scientifically efficient in reducing pollution is still unanswered. This has led to the implementation of different domestic policies and has created inconsistency in the law thereby making it harder to implement the IMO Sulphur limit. As a result, the OSPAR Commission in December 2021 submitted to PPR 9 highlighting the requirement of forming a uniform and unambiguous regulatory measure to efficiently control the pollutants from EGCS wash-water discharges. It emphasised that this requirement of uniformity and unambiguity has become with time more pressing so that the economic impacts on industries and Administrations can be mitigated. The OSPAR Convention and the EU provide an intergovernmental set up to protect the North-East Atlantic, and the Environmental Impacts of Human Activities (EIHA(2) 2020) Committee of the OSPAR has recognized the EGCS as a source of marine environment pollution.[68] The stricter sulphur limit has caused an increase in the number of ships going for the installation of EGCS with Open-Loop EGCS being the most popular as shown in Image 8.[69]

[67] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom and European Commission. (2019). *Evaluation And Harmonization Of Rules And Guidance On The Discharge Of Liquid Effluents From Egcs Into Waters, Including Conditions And Areas,*. International Maritime Organisation. See this link

[68] OSPAR Commission. (2021). *Information related to the OSPAR Commission's work on discharge from exhaust gas cleaning systems (EGCS) into waters* (PPR 9/INF.2). International Maritime Organisation. See this link

[69] Osipova, L., Georgeff, E., & Comer, B. (2021). *Global scrubber washwater discharges under IMO's 2020 fuel sulfur limit*. International Council on Clean Transportation. See this link

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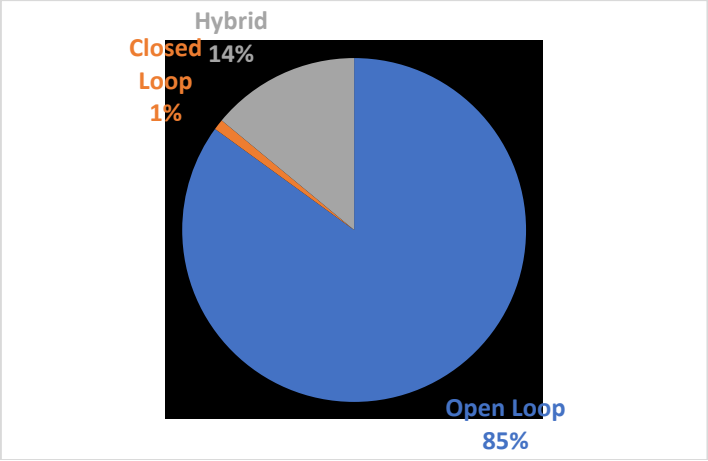

Image 8: Difference in the number of types of ESCG installed on ships.

Although these devices enable ships to burn HSFO and at the same time ensure compliance with the sulphur limit. The acidic wash water discharged from EGSC contains high volumes of pollutants such as PAH, heavy metals, nitrates, and oil residues. Furthermore, the most popular Open-loop EGCS discharges the wash water directly into the sea. This discharge can lead to acidification and has the potential to inflict long-term harm on eutrophication and bioaccumulation, causing structural and functional damage to marine ecosystems.[70]

Belgium, however, has submitted to PPR 9 that the wash water from the closed-loop EGCS has much greater concentrations of toxic metals and PAHs approximately 40 times and 1.3 times higher than the open-loop EGCS as shown in image 9. It contains higher concentrations of Chromium, Copper, Nickel, Zinc, and vanadium as shown in image 10. In terms of acidification, wash water from Closed Loop EGCS causes a decrease of 0.015 units in pH. The discharge of wash water from Closed-Loop or Open-Loop Scrubbers is required to be restricted. If the same is not done, then the reduction of ocean acidification will not be achieved.[71]

[70] OSPAR Commission. (2021). *Information related to the OSPAR Commission's work on discharge from exhaust gas cleaning systems (EGCS) into waters* (PPR 9/INF.2). International Maritime Organisation. See this link

[71] Belgium. (2021). *Evaluation And Harmonization Of Rules And Guidance On The Discharge Of Discharge Water From Exhaust Gas Cleaning Systems (Egcs) Into The Aquatic Environment, Including Conditions And Areas: Study on the impact of scrubber discharge water on the water quality in estuaries and ports* (PPR 9/INF.5). International Maritime Organisation. See this link

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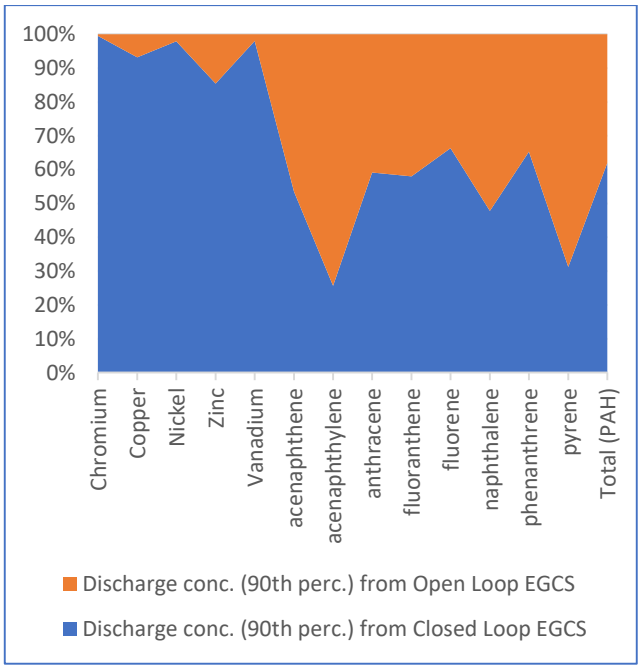

Image 9: Difference in discharge

Water samples were collected in 1-L		
Elements	**Discharge conc. (90th perc.) from Closed Loop EGCS**	**Discharge conc. (90th perc.) from Open Loop EGCS**
Chromium	10,120	45
Copper	1780	130
Nickel	6060	127
Zinc	1524	260
Vanadium	25,000	500
acenaphthene	745	648
acenaphthylene	185	536
Anthracene	446	308
fluoranthene	661	478
Fluorene	2370	1200
naphthalene	6370	6960
phenanthrene	6970	3700
Pyrene	554	1220
Total (PAH)*	22,200	13,620

Table 2: Data of discharge

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Japan in January 2022 moved a step further and submitted the "*Draft Guidelines for Risk and Impact Assessments of the Discharge Water from Exhaust Gas Cleaning Systems"* to PPR 9. In the draft, Japan has suggested that a new head titled *"Chemicals in EGCS Discharge Water"* shall be created under the IMO Global Integrated Shipping Information System (GISIS) wherein detail on the hazardous content of wash water shall be provided upon inspection.[72] New Zealand has also suggested that information regarding EGCS should be provided to IMO GISIS.[73] Japan further suggested that the Member State shall declare "Discharge limitation area (DLA) and Sea Area for calculating PEC (SAP). DLA will be the area wherein the discharge of wash water will be permitted. SAP is the *"Sea area selected for stimulating estimate Predicted Environment Concentration."* The SAPs shall be selected from the highest risk areas within the DLA and should not be too small compared to DLA. Total SAPs should cover over 50 % of the DLA or the ship traffic within total SAPs shall be over 50% of those in the DLA. States shall conduct regular screening for environmental degradation, Bioaccumulation, and Toxicity. The Member State shall also perform the Whole Effluent Toxicity (WET) testing of the EGCS discharged wash water. The Member States who have concluded the risk and impact assessments should notify the results to IMO along with local regulations on discharge from EGCS.[74]

China also made its submission wherein it suggested that the IMO must mandate that the wash water from EGCS should not be discharged at sea nor it should be incinerated on board. The wash water shall be delivered to the port reception facilities. Ships must be required to carry an EGCS Record Book which shall have the record of storage and disposal of EGCS wash water.[75]

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[72] Japan. (2022). *Evaluation And Harmonization Of Rules And Guidance On The Discharge Of Discharge Water From Exhaust Gas Cleaning Systems (Egcs) Into The Aquatic Environment, Including Conditions And Areas Combined draft guidelines for risk and impact assessments based on documents MEPC 76/9/2 and MEPC 76/INF.33* (PPR 9/INF.10). International Maritime Organisation. See this link

[73] New Zealand. (2022). *Valuation And Harmonization Of Rules And Guidance On The Discharge Of Discharge Water From Exhaust Gas Cleaning Systems (Egcs) Into The Aquatic Environment, Including Conditions And Areas Environmental risk assessment of discharges from exhaust gas cleaning systems (EGCS) on ships in Aotearoa (New Zealand)* (PPR 9/10/3). International Maritime Organisation. See this link

[74] Japan. (2022). *Evaluation And Harmonization Of Rules And Guidance On The Discharge Of Discharge Water From Exhaust Gas Cleaning Systems (Egcs) Into The Aquatic Environment, Including Conditions And Areas Combined draft guidelines for risk and impact assessments based on documents MEPC 76/9/2 and MEPC 76/INF.33* (PPR 9/INF.10). International Maritime Organisation. See this link

[75] China. (2022). Evaluation And Harmonization Of Rules And Guidance On The Discharge Of Discharge Water From Exhaust Gas Cleaning Systems (Egcs) Into The Aquatic Environment, Including Conditions And Areas Proposals on standardizing the reception of

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The Environmental protection association namely Friends of the Earth International (FOEI), World Wildlife Fund (WWF), Pacific Environment, and Clean Shipping Coalition (CSC) have also submitted to PPR 9. They have mentioned that the EGCS worsens ocean acidification. The Seawater in the areas where the wash water is discharged from EGCS is more acidic than in the surrounding areas.[76] The EGCS-equipped ships discharge a minimum of ten gigatonnes of wash water from EGCS annually. Roughly 80% of these wash water discharges happen where endangered marine bio-organisms prevail, in the Particularly Sensitive Sea Areas (PSSAs) and within the 200 nautical miles of the coastline.[77] These Environmental protections association have suggested a total ban on EGCS discharges. Nevertheless, as an interim measure risk and impact assessment guidelines can be formulated to bring down severe impacts until a total ban on EGCS wastewater discharge is implemented.[78]

The MEPC in its 78th session from June 6th to 10th, 2022 approved the "*Guidelines for Risk and Impact Assessments of the Discharge Water from Exhaust Gas Cleaning Systems.*" The guidelines have provided a list of priority hazardous substances which includes ecotoxicological, physicochemical, and toxicological substances. The presence of these substances is to be analysed in order to calculate environmental risk assessment (ERA). It calls on the member states to impose restrictions or a complete prohibition on the discharge of wash water from EGCSs in areas where good environmental, chemical and ecological status is not maintained or discharge can severely damage the marine environment and impact the climate system or can violate an International Convention or increases the costs of managing the dredged materials in ports. The guidelines require that while conducting the ERA the degradation of the marine environment, Bioaccumulation and Toxicity shall be analysed. The member state should also conduct the Whole

EGCS residues delivered to port reception facilities (PPR 9/10/2). International Maritime Organisation. See this link

[76] FOEI, WWF, Pacific Environment and CSC. (2022). Evaluation And Harmonization Of Rules And Guidance On The Discharge Of Discharge Water From Exhaust Gas Cleaning Systems (Egcs) Into The Aquatic Environment, Including Conditions And Areas Global EGCS wastewater discharges under IMO's 2020 fuel sulphur limit (PPR 9/INF.22). International Maritime Organisation. See this link

[77] Osipova, L., Georgeff, E., & Comer, B. (2021). *Global scrubber washwater discharges under IMO's 2020 fuel sulfur limit*. International Council on Clean Transportation. See this link

[78] FOEI, WWF, Pacific Environment and CSC. (2022). *Evaluation And Harmonization Of Rules And Guidance On The Discharge Of Discharge Water From Exhaust Gas Cleaning Systems (Egcs) Into The Aquatic Environment, Including Conditions And Areas Urgent matters related to the harmful effects of EGCS wastewater discharges and conflicts with international treaty commitments and duties* (PPR 9/10/4). International Maritime Organisation. See this link

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Effluent Toxicity (WET) testing of the discharged wash water from EGCS. The Member States conducting the risk and impact assessments should notify the results to IMO along with the local regulations on EGCS discharges.[79]

In the same session IMO also approved the "*2022 Guidance regarding the delivery of EGCS residues to port reception facilities."* The guidelines require that the EGCS-equipped ships (both for open loop and closed loop scrubbers) should not discharge wash water at sea and ensure its storage on board. Nevertheless, it does allow for restrictive discharge. The guidelines also instruct the ports to ensure adequate reception facilities.

6. CONCLUSION AND SUGGESTIONS

The Ship-sourced air pollution was only regulated after the application of Annex VI to the MARPOL in 2005 with no emphasis on Sulphur emission at the time. It was only in 2008 that Annex VI was revised, and a global 4.5% m/m Sulphur emission limit was set. The Global limit was subsequently revised in 2012 to 3.50% m/m and 0.50% m/m in 2020. In 2010 the IMO created Sulphur Emission Control Areas (SECA) and established a much lower limit of 1.0% m/m for the same. Which was subsequently revised to 0.10% m/m in 2015. The EU also, in 2010 revised its earlier policy setting a 1.50% m/m limit for SECA, and passenger ships, and a 0.10 limit for all EU Ports. In 2014 EU established a 3.50 m/m Sulphur limit for ships outside SECA and in 2015 revised the limit for ECAs to 0.10 m/m.

The lowering in 2008 and 2012 brought little impact in reducing the global Sulphur emission. In the EU ports and SECA, however, the Sulphur limit was kept at a much lower level which led to a vast reduction in Sulphur emission. Due to the decrease in port emissions, the overall emission within the city also decreased. The North Sea and the Baltic Sea also provided reported very low Sulphur within the area. The study analysing the impact of the 0.50% m/m limit on global Sulphur emission is yet to be seen, nevertheless from the existing data available for SECA areas and EU Ports, the 0.50% m/m limit will surely bring down the Sulphur limit at a greater trajectory. The new Sulphur limit will bring a massive decline in the existing global Sulphur emission.

[79] MEPC. (2022). *2022 Guidelines For Risk And Impact Assessments Of The Discharge Water From Exhaust Gas Cleaning Systems* (MEPC.1/Circ.899). International Maritime Organisation. See this link

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The lowering of Sulphur, however, may not be as beneficial for the environment as predicted. The low sulphur emission does improve public health and decrease the mortality rate. However, the initial limit of 4.50% m/m was set in 2008, which was subsequently lowered to 3.50% in 2012. And the comparison of data collected in the research on mortality and human health initially conducted in 2007 and thereafter in 2018 shows very little improvement. This proves that a slight lowering of sulphur limit was not enough, which justifies the set taken by IMO to establish the much lower 0.50% m/m sulphur limit. The 0.50% m/m sulphur limit will bring a major drop in sulphur and will potentially cause a significant improvement in public health and mortality rate.

Further, it should not be ignored that the low sulphur limit may cause an increase in global temperature creating a new challenge in the struggle against global warming and climate change. As the sulphur causes a cooling impact by reflecting the radiation coming from the sun back to space and the decrease in sulphur can cause a warming effect. The 0.50% m/m sulphur limit can hinder the relationship between SO2 and CO2 in maintaining the balance in temperature. This hindrance can result in violation of UNFCCC and the Paris Agreement which discourages any action causing an increase in temperature. Consequently, it becomes vital that to negate the damaging effects of low SO2 emission the GHG emission is reduced proportionally. In the upcoming COP 28 to be held in 2023, the requirement of this proportional decrease should be addressed, and countries should be required to decrease the GHG emission level keeping in mind the reduction in global desulphurization. The Intergovernmental Penal on Climate Change (IPCC) should conduct a study and provide scientific solutions to fixing the ratio of proportional reduction.

The concern of Black Carbon emission from alternate fuels is another alarming issue. The VLSFO blends are likely to emit black carbon violating the UNFCCC and Paris agreement and at the same time defeating the IMO goals in reducing GHG emissions. Although IMO has asked the member state to voluntarily prohibit the use of marine fuel which causes Black Carbon emissions the banning of such fuel can be better achieved by inserting the requirement in the ISO 8217 or by providing detailed guidelines or guidance highlighting the concerns of Black carbon emission and calling for its ban. The IMO also does have the power to insert the requirement of no black carbon emission from VLFOs by amending the existing sulphur regulation.

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The wash water from EGCS is another major concern that not only violates the UNFCCC, Paris Agreement, CBD, Art 192 to 196 of the UNCLOS, chapter XII but even violates the UNDRIP. The discharge of acidic and toxic wash water is a major concern, and its prohibition shall be required by the MEPC. Only with the prohibition of wash water discharge at sea, the problem caused by Annex VI of MARPOL which violates several international conventions can be neutralised.

The submissions made by organisations and states to the PPR 9 all have a common ground that the wash water discharge has the capability of causing serious harm to the environment and there is a need for unambiguity in the existing policies. Some nations have suggested a ban on open-loop EGCS while some have suggested a comprehensive ban on all kinds of EGCSs. The MEPC in their 2022 guidelines has provided due consideration to the submission and has come out with a mechanism to analyse the environmental risk assessment. Nevertheless, these guidelines although have restricted the discharge of wash water in certain areas, they do not call for a complete ban on such discharge, opening the possibility of continuance breach of the international conventions. Further, these guidelines are non-binding and provide only a guiding effect. A much stricter policy is required to be set in place to ensure avoidance of harm from wash water discharge.

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