

FICCI

FUELING THE MARITIME SECTOR

IMO 2020 & BEYOND

KNOWLEDGE PARTNER

KPMG



राज्य मंत्री
पोत परिवहन (स्वतंत्र प्रभार),
रसायन एवं उर्वरक
भारत सरकार

सत्यमेव जयते

Minister of State
Shipping (Independent Charge),
Chemicals and Fertilizers
Government of India

मनसुख मांडविया
MANSUKH MANDAVIYA



FOREWORD

The Indian shipping sector plays an important role in the country's economy. Almost 90 per cent of the country's trade by volume is conducted via sea. The industry is in a phase of rapid transformation with several initiatives like Sagarmala project, port development, port modernization and development of Inland Waterways & Coastal Shipping.

While the focus is on sustaining the shipping industry's momentum in the growth of the country's trade and commerce, there are some concerns that need to be addressed.The introduction of the International Maritime Organization (IMO) low sulphur regulations for marine fuel oil, which comes into effect from January 1, 2020, poses a challenge. The regulation is likely to impact the shipping sector in terms of operating costs, freight rates, shipping economics, scrubber demand, accelerated ship scrappage and more. The Government of India is committed to comply with the global mandate whilst also guarding the interests of the Indian shipping companies.

New regulations are being developed, and the IMO Sub-Committee on Environment is deliberating on implementation of these regulations. The Government is keen to address the marine pollution by promoting the use of clean alternative fuels and technologies and, at the same time, keep the interests of the Indian shipping industry high on the agenda.In this context, this conference is being held at an opportune time to gain better understanding of various concerns and opportunities pertaining to the clean fuel choices for the maritime industry.

I congratulate **FICCI** and **KPMG** for preparing a white paper on **"Fueling the Maritime Sector: IMO 2020 and Beyond"** which covers various critical aspects of the impact of IMO 2020 mandate.

I am sure, the deliberations and exchange of views and ideas during the conference would help in identifying areas of cooperation between industry and Government to ensure India's compliance with the IMO 2020 regulations.

I wish the Conference all the success.

(Mansukh Mandaviya)

Place: New Delhi
Date: July 18, 2019

FOREWORD



Capt BVJK Sharma
Chairman (Shipping), FICCI National Committee on Infrastructure and
Driector (Ports), CEO office, Adani Ports and SEZ Limited

I am pleased to share with you the FICCI-KPMG Report on "Fueling the Maritime Sector: IMO 2020 & Beyond" to be released at the Conference on Fueling the Maritime Sector: IMO 2020 & Beyond" organized by Federation of Indian Chambers of Commerce and Industry.

The shipping industry faces several constraints on complying with the move by the International Maritime Organization (IMO) to introduce a 0.5 percent sulphur limit from current 3.5 percent on fuel oil from January 2020. The regulation poses the largest and most disruptive change that the shipowners and operators face contemplating over which fuel options they should choose in order to comply with the stringent regulation of running their vessels. The transition period has started and moving to the lower sulphur fuel will have a major cost implication to the players.

With this background, a comprehensive report – "Fueling the Maritime Sector: IMO 2020 and Beyond" has been prepared by FICCI and KPMG. The objective of the report is to highlight the mandates of IMO regulations and analyse the implications of the mandate on the Indian shipping industry. It also recognises the need of investing in emissions-cleaning technology and developing bunkering infrastructure in the country to produce cleaner fuels catering to the demands of the shipping industry.

I hope you will find this report useful. We welcome your suggestions and feedback.

FOREWORD



Sameer Bhatnagar
Partner &
Global Sector Leader – Ports, KPMG in India

I am happy to share with you the KPMG - FICCI Knowledge Paper on "Fueling the Maritime Sector: IMO 2020 & Beyond" to be released by the Federation of Indian Chambers of Commerce and Industry.

IMO's Sulphur cap regulation on ship fuels is expected to have far-reaching impact on an industry that sustains more than 85% of global trade. While this 0.50% Sulphur limit shall not only impact the fuel basket available to shipping companies, it will also drive refiners towards producing environment friendly products for the industry. At the same time, this development will underline the government's role in ensuring compliance to the MARPOL Convention. Europe, Singapore, China, among others have already set ambitious targets for themselves in their commitment towards environment protection.

New varieties of low Sulphur fuels are expected to be priced at a premium vis-à-vis existing heavy fuel oils. An increase in fuel prices shall impact several sectors that are sensitive to shipping costs.

This price differential between heavy fuel oil and low Sulphur variants is likely to push shipping companies towards adoption of abatement technologies like Exhaust Gas Cleaning Systems (or scrubbers) for their existing fleet in the short-term. Over the long-run, the industry shall evaluate several options including equipping new-builds with scrubbers, utilizing low Sulphur fuel variants and using alternate fuels such as LNG, Methanol, and Hydrogen. This will open up new opportunities in marine bunkering as well.

The 'Fueling the Maritime Sector: IMO 2020 & Beyond' conference is an important milestone in the journey to establish an IMO 2020-ready road-map for stakeholders in India. The conference will focus on significant roles that the industry and government can perform to ensure India's compliance with the IMO 2020 regulations.

IMO's planned transition of the shipping industry from desulphurization in 2020 to decarbonization by 2050 necessitates the need to promote alternate fuels as a lucrative option and develop a national level policy framework for successful acceptance of such fuels.

As the 'Knowledge Partner' to the conference, KPMG has prepared this comprehensive Paper covering various critical aspects of the impact of IMO 2020 mandate.

I am confident you will find the Paper informative and thought provoking on this significant disruption awaiting the global shipping industry.



Acknowledgments

FICCI and KPMG like to express their sincere gratitude to the Ministry of Shipping, Government of India for their support, guidance and contribution to the development of this Knowledge Paper. The research and work done on this publication are based on extensive research done by the KPMG team. The KPMG team of experts who prepared the Knowledge Paper are Davinder P.S. Sandhu, Sameer Bhatnagar, Abhishek Mukherjee, Saurabh Sood and Neetika Bansal.

Special mention to the team from FICCI namely Komal Sharma, Tushar Sharma, Nikika Goyal and Amit Singh for providing important insights and industry connects and undertaking the designing and publication of this Knowledge Paper.



List of Abbreviations

BAF	Bunker Adjustment Factor
BPCL	Bharat Petroleum Corporation Limited
CO2	Carbon Dioxide
COA	Contract of Affreightment
ECA	Emission Control Area
EGCS	Exhaust Gas Cleaning System
EMSA	European Maritime Safety Agency
ENOA	Electronic Notification of Arrival
EPAN	Electronic Pre-Arrival Notice
EU	European Union
FO	Fuel Oil
FONAR	Fuel Oil Non-Availability Report
GHG	Green House Gases
GST	Goods and Services Tax
HFHSD	High Flash High Speed Diesel
HFO / HSFO	Heavy Fuel Oil / Heavy Sulphur Fuel Oil
HPCL	Hindustan Petroleum Corporation Limited
IAPP	International Air Pollution Prevention
IEA	International Energy Agency
IMO	International Maritime Organization
IOCL	Indian Oil Corporation Limited
IRS	Indian Register of Shipping
ISO	International Standards Organization
IWT	Inland Water Transport
LDO	Light Diesel Oil
LNG	Liquefied Natural Gas

List of Abbreviations

MDO	Marine Diesel Oil
MEPC	Marine Environment Protection Committee
MGO	Marine Gas Oil
MLIT	Ministry of Land, Infrastructure, Transport and Tourism, Japan
MMT	Million Metric Tonnes
MoPNG	Ministry of Petroleum and Natural Gas
MPA	Maritime and Port Authority of Singapore
MTPA	Million Tonnes Per Annum
NOx	Nitrogen Oxides
ODS	Ozone Depleting Substances
OISD	Oil Industry Safety Directorate
SEEMP	Ship Energy Efficiency Management Plan
SOx	Sulphur Oxides
TEU	Twenty-foot Equivalent Unit
ULSFO	Ultra-Low Sulphur Fuel Oil
VGP	Vessel General Permit
VLCC	Very Large Crude Carriers
VLOC	Very Large Ore Carriers
VLSFO	Very Low Sulphur Fuel Oil
VOC	Volatile Organic Compounds



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IMO 2020:
SHIFTING THE PARADIGM



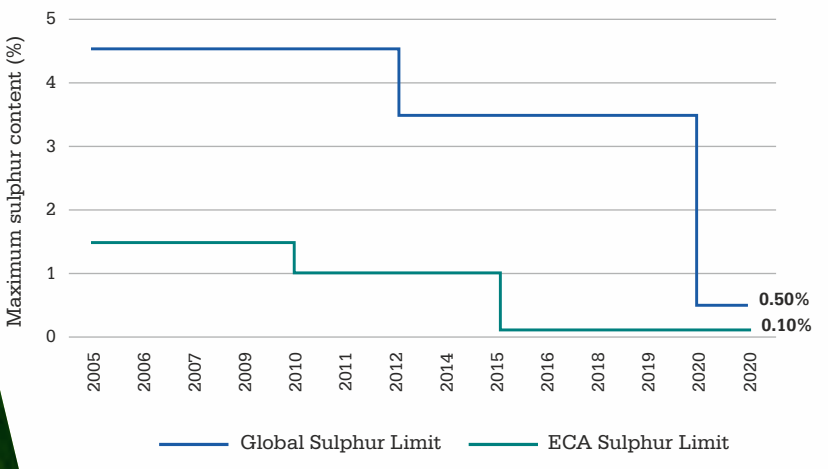
A GLOBAL CHALLENGE

International Maritime Organization's (IMO) mandate for use of marine bunkers having maximum 0.50% Sulphur mass / mass (m/m) shall be enforced on 1 January 2020. This will mark a significant shift from the current scenario where 3.50% Sulphur m/m fuel is the predominant fuel in a global industry that enables nearly 85% of international trade. The guidelines also emphasize IMO's focused efforts targeted at reducing air pollution and global warming as well as for improving health of local population in coastal areas.

For marine bunkers, the shipping industry has conventionally used residual fuel oils, such as Heavy Fuel Oil (HFO), that are derived as a residue from crude distillation in refineries. These residual fuel oils contain Sulphur which, upon combustion, ends up in ship emissions in the form of Sulphur Oxides (SOx). As per IMO estimates, the shipping industry accounts for 2.20% of the Global Green House Gas (GHG) emissions, around 14% of global NOx emissions and 16% of global SOx emissions, mainly through burning of such residual fuels. Ship emissions are expected to contribute nearly 20% of total GHG emissions by 2050.

To reduce air borne emissions (SOx, NOx, Ozone Depleting Substances (ODS), Volatile Organic Compounds (VOC), and shipboard incineration) from ships, the IMO adopted Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL Convention). To meet its environmental obligations, IMO has introduced increasingly stringent stipulations for reduction in Sulphur limit since 2005 with the next landmark action planned for 2020.

Figure 1 : IMO's initiatives to control Sulphur emissions from shipping



Source: International Maritime Organization

Table : FAQs on IMO 2020 mandate

What are the highlights of IMO 2020 mandate?

- For ships operating outside designated Emission Control Areas (ECAs), IMO has set a limit for Sulphur in fuel oil used on board ships of 0.50% m/m (mass by mass) from 1 January 2020.
- Sulphur limit for fuel oil used by ships operating in Emission Control Areas (ECAs), designated by IMO, for the control of Sulphur Oxides (SOX) has been 0.10% m/m since 2015. Additional ECAs are also planned by IMO.

Are all ships required to comply with IMO 2020 Sulphur limit?

- MARPOL regulations apply to ships of all sizes belonging to Flag States that are signatories to the Convention. Ships of 400 gross tonnage and above that undertake voyages to ports or offshore terminals are required to have an International Air Pollution Prevention Certificate, issued by the ship's Flag State.

How can stakeholders comply with IMO 2020?

- Ships can meet the requirement by:
  - Using Low-Sulphur compliant fuel oil with Sulphur content not exceeding 0.50% m/m.
  - Switching to cleaner alternate fuels like gas (LNG etc.) and Methanol
  - Adopting abatement technologies, such as Exhaust Gas Cleaning Systems or "scrubbers", if using fuel having more than 0.50% m/m Sulphur content
- Refining companies & Bunker providers
  - Ensuring sufficient supply of IMO 2020 compliant fuel oils and other alternate fuels at ports and bunkering areas
  - Providing sufficient, and safe infrastructure for storage, mixing, handling and transporting IMO 2020 compliant fuel oils and alternate fuels

Can the implementation of IMO 2020 be moved to a future date?

- No. 1 January 2020 has been set in MARPOL Treaty and accepted by all signatories.

What should shipping companies do for 1 January 2020?

- Shipping companies are required to adhere to IMO 2020 guidelines, including ship implementation and planning guidance as well as local guidance issued by Flag States and Port State Control authorities

Who is responsible for enforcement?

- Monitoring and enforcement is the responsibility of the Governments and national authorities of Member States that are Parties to MARPOL Annex VI. Sanctions are to be determined by Flag States and Port States.

What happens if IMO 2020 compliant fuel is not available at a port?

- In case of non-availability of IMO 2020 compliant fuel oil at a port, ships are required to complete a Fuel Oil Non-Availability Report (FONAR). However, FONAR is not an exemption. Ships are expected to operate on IMO 2020 compliant fuels after taking into consideration fuel oil availability, logistics etc. at destination ports. Penalties on ships using non-compliant fuels are responsibilities of Flag States and Port States

What compliance requirements will applicable after 1 January 2020?

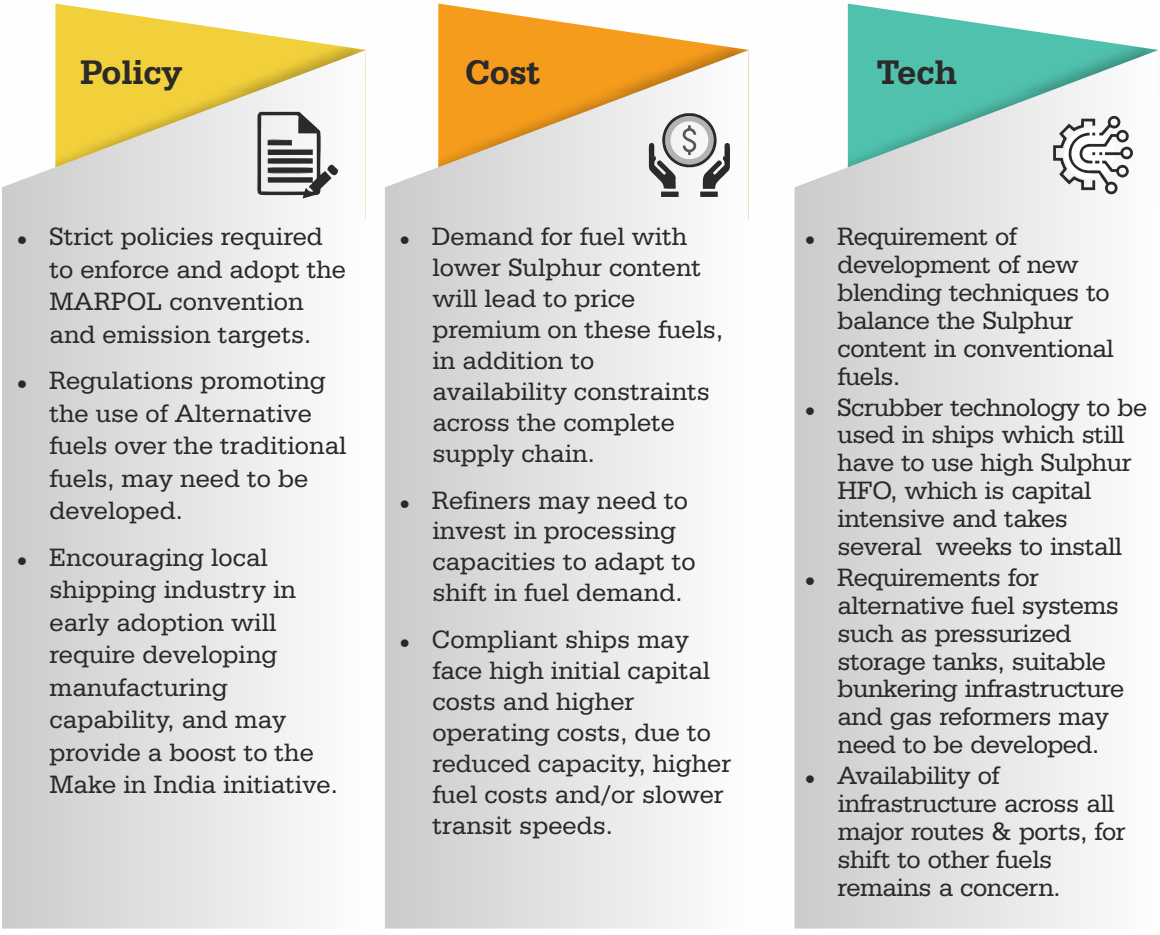
- Ships taking on fuel for use shall need to obtain a Bunker Delivery Note stating the extent of Sulphur in the fuel oil supplied.
- Ships would require issuance of an International Air Pollution Prevention (IAPP) Certificate by their respective Flag States stating that the ship uses IMO 2020 compliant fuel oil.
- Port and coastal States can use Port State Control to verify whether a ship is compliant.

What are the exemptions under IMO 2020?

- Exemptions are provided for situations involving the safety of the ship or saving life at sea, or if a ship or its equipment is damaged.

Source: International Maritime Organization

Figure 2 : Concerns to meet the Emission Targets



OPTIONS FOR COMPLIANCE WITH IMO 2020 EMISSION LIMITS

To comply with the IMO 2020 guidelines, the shipping industry primarily needs to evaluate the following alternatives:

1) **Switch from Heavy Fuel Oil (HFO) to Marine Gas Oil (MGO), Marine Diesel Oil (MDO) and low Sulphur distillate fuel oils** - Shipping companies may opt to use MGO, MDO or procure low Sulphur distillate oils to meet the 0.50% Sulphur limit. However, availability of IMO 2020 compliant fuels to meet demand and their potentially higher prices compared to HFO could pose challenges in the short-term.

2) **Adoption of cleaner alternate fuels:** Use of Liquefied Natural Gas (LNG), Biodiesel, Hydrogen and Methanol are currently being considered as possible alternatives to traditional heavy fuel oils and distillates. The prerequisites for adopting of such alternate fuels will be determined by factors such as sufficient

availability of alternates; availability of desired level of bunkering and allied infrastructure to enable supply of fuel to vessels, installation of technological and design changes on-board marine vessels, and justified fuel pricing post-2020.

3) **Installation of abatement technologies** such as Exhaust Gas Cleaning Systems (commonly known as "scrubbers") will allow vessel owners to continue using HFO while still adhering to the 0.50% Sulphur cap. Many ship owners have already opted for SOx scrubbers in their new-builds and retrofit old vessels due to the expected economic benefit of lower priced HFO, since low Sulphur distillate fuel oils have, historically, been priced considerably higher than conventional HFO.

The new Sulphur specifications are expected to have far-reaching impact for the industry's demand-side and supply-side. The demand for high Sulphur fuels (HFO) is expected to decline and demand for low Sulphur fuels (MGO, MDO, VLSFO, ULSFO etc.) would rise going forward. It is critical for shipping companies, refining companies and other stakeholders to understand the factors that will impact their business operations after 1 January 2020.

IMPLICATIONS FOR THE DEMAND SIDE

Challenges for Shipping companies:

1 **Uncertainty in future policies and operational procedures:** IMO has indicated its intention to regulate GHG emissions, other than SOx, in the coming years. However, the implementation plan is yet to be finalized and regulations are expected to be issued in a phased manner. The commercial standards of these fuels are established by the International Standards Organization (ISO). As of March 2019, complete standards have not been established for low Sulphur fuels that meet IMO 2020 requirements.

Flag states and Port states are responsible for implementation and compliance with the IMO 2020 regulations. This might further add on to the lack of standardization of procedures in global trade.

2 **Sufficient availability of IMO 2020 compliant fuels:** Some of the major bunkering hubs such as Singapore, Fujairah, Rotterdam and other European ports have assured availability of wide variety of IMO 2020 compliant fuels. However, availability of compliant fuels at other smaller bunker ports still remains uncertain as 1January 2020 approaches.

3 **Uncertainty around fuel pricing:** As per studies, global demand and supply

scenario of marine fuels is expected to undergo major disruptions. Significant price differentials between HFO and VLSFO / ULSFO may guide decision makers at shipping companies to opt in favour of Exhaust Gas Cleaning Systems ("scrubbers").

Further, shipping companies may have to pass on a major chunk (if not full) of their cost impact to the end customers, possibly by way of increased Bunker Adjustment Factor (BAF). As per industry estimates, this could result in an increase of USD 150-200 per TEU for the end customer.

4 Unpredictability in planning and operational strategy:

a. To mitigate risks of non-compliance, shippers shall need to arrive at strategic decisions around best suitable compliance options and accordingly plan ahead for investments in new vessels and phasing out old ones; fleet mix for each compliance option; re-negotiation of bunkering and chartering contracts and decision on retrofitting existing vessels with scrubbers

b. At an operational level, advance planning would be required to incorporate changes in voyage itinerary to address shift in bunkering availability for IMO 2020 compliant marine bunkers, planning for buffer fuels, adherence to additional procedures for Port States and Flag States, as well as training staff for new



technologies.

Challenges for other stakeholders - Bunkering and Charter companies

1 Bunker storage could face increasing difficulties due to a wide spectrum of fuel transportation, logsitics, storage and mixing requirements for varioust types of fuels. Additional tank storage space at ports and hub locations may also be needed to store and blend a variety of marine fuels expected to be available post-2020.

2 A changing demand-supply scenario, at least in the short-term, may result in uncertainty in costs for time charterers / long-term Contracts of Affreightment (COAs) and spot pricing. Bunker fuel clauses within Charter Party Agreements represent significant risk for both ship-owners and charterers. Ship owners are dependent on the charterers to procure IMO 2020 compliant fuels and any failure on part of the charterer to comply with these stipulations may result in disputes.

IMPLICATIONS FOR THE SUPPLY SIDE

Challenges for Refining companies:

As per industry estimates, IMO 2020 is expected to create a demand shift from HSFO to MGO/VLSFO. Moreover, as of today, there is no universally accepted standard for a 0.50% Sulphur fuel. The refining industry will have to undergo changes in refining capabilities to address the shipping industry's demands which may drive up pricing of such fuels.

1 **Up-gradation in refinery and storage configuration:** The existing refining capacities may not be sufficient to meet the low Sulphur bunker fuel demand in a post-2020 scenario. Refiners can consider options - building secondary units such as crackers etc. to upgrade residual oils to gas oil standards; reduction of residue production through changes to a sweeter crude slate; desulphurization of residual fuel oil and blending with low Sulphur gas oils - to meet IMO 2020 fuel requirements.

2 **Managing the over-supply of HSFO after 2020:** Reduced demand of HSFO post-2020 is predicted to create a surplus of the heavy fuel oil in 2020 and 2021. While complex refineries may attempt to fully utilize HSFO with their existing capacity or even expand their current system to be able to crack fuel oil; simple refineries

would have insufficient processing capabilities to optimize HSFO surplus.

IMPLICATIONS FOR THE GOVERNMENT

Signatories to the International Convention for the Prevention of Pollution from Ships are obligated to prevent pollution of the marine environment by discharges of polluting effluents from ships. To achieve this envisaged reduction in carbon-footprint, the signatory countries must:

1 Evaluate enacting enabling regulations to promote alternate fuels over the medium- and long-term, along with suitable supply and bunkering infrastructure, along with ensuring IMO 2020 compliant fuels and technologies in the short-term.

2 Encourage relevant stakeholders to undetake reasonable measures to ensure IMO 2020 compliant fuels as well as direct such stakeholders to notify IMO when a vessel presents evidence of non-availability of IMO 2020 compliant fuel. Handling instances of non-compliance would require establishing standard country-wide operating procedures for monitoring and reporting such incidents.

3 Disposal of wash-water from open-loop scrubbers pollut the country's coastal waters. This requires stringent guidelines and a robust monitoring mechanism to control / prohibit ships from dumping polluted effluents from scrubber systems into port limits and territorial waters.

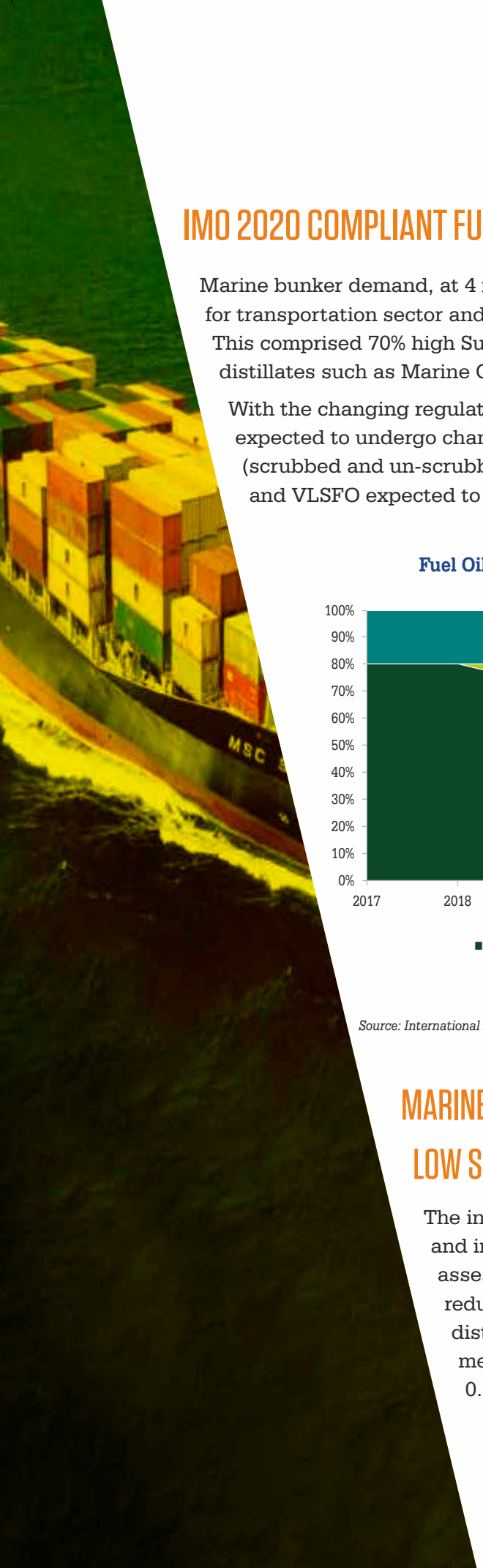
4 At the same time, the government should ease supply side worries regarding availability of IMO 2020 compliant fuel oils and alternate fuels by ensuring the refiners and bunker providers increase production of higher value, low Sulphur fuel oils as demand for such fuel increases.



FICCI

GETTING READY FOR 2020



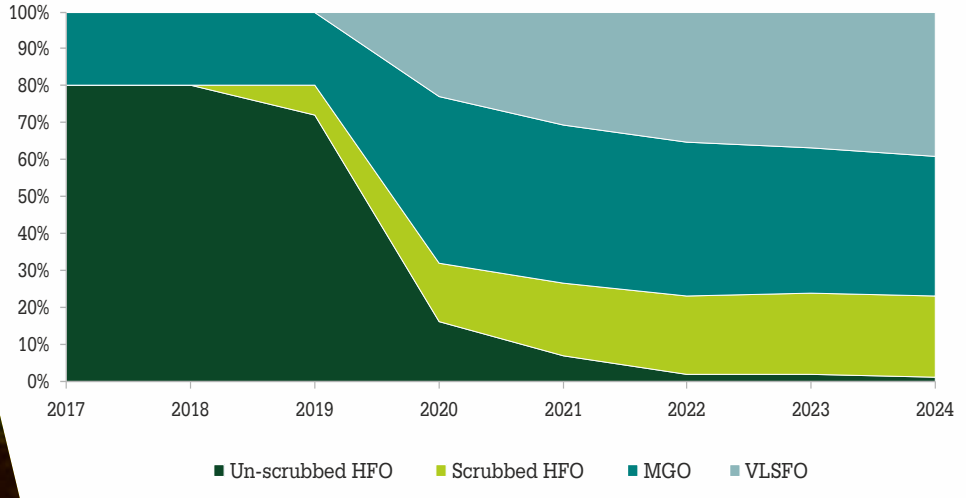


IMO 2020 COMPLIANT FUELS

Marine bunker demand, at 4 mb/d annually, constituted 7.20% of global oil demand for transportation sector and approximately 4.10% of global oil demand in 2017. This comprised 70% high Sulphur Heavy Fuel Oil (HFO / HSFO) and 30% distillates such as Marine Gas Oil (MGO) as per IMO.

With the changing regulatory environment, the marine bunker basket is expected to undergo changes with share of Heavy Sulphur Fuel Oil (HSFO) (scrubbed and un-scrubbed) expected to reduce drastically and share of MGO and VLSFO expected to increase in the post-2020 scenario.

Fuel Oil composition in marine bunker basket (2017-2024)



Source: International Energy Agency, 2019

MARINE GAS OIL (MGO), MARINE DIESEL OIL (MDO) AND LOW SULPHUR DISTILLATE FUEL OILS

The increasing emissions from ships with growing trade and impact of the MARPOL convention necessitated an assessment of various fuel and technology options to reduce SOx emissions. Switching to MGO / low Sulphur distillate fuels is seen as the most straight forward method to comply with the Sulphur threshold limit of 0.50%.

Table : Typical Parameters of Marine Fuels[1]

Fuel Types	ISO Category	Sulphur Content (% m/m)
Heavy Fuel Oil (HFO / HSFO)	Residual	1.0 - 3.50
Marine Diesel Oil (MDO)	Distillate	0.10 - 1.50
Marine Gas Oil (MGO)	Distillate	0.10 - 1.0
0.50% Heavy Fuel Oil (HFO Global Fuel) (or Very Low Sulphur Fuel Oil, VLSFO)	Not standardized	0.10 - 0.50
0.10% Heavy Fuel Oil (HFO ECA Fuel) (or Ultra Low Sulphur Fuel Oil, ULSFO)	Not Standardized	Up to 0.10

Marine Gas Oil (MGO) is one of the highest grade distillates from crude and denotes marine fuels that consist exclusively of distillates. This category has a maximum Sulphur limit of 1.0% but 0.10% Sulphur content MGO is available for marine use[2] . However, there is no reduction in NOx and GHG emissions from burning of MGO thereby creating the need to consider other fuel options to meet IMO 2050 GHG emission norms.

Marine Diesel Oil (MDO) comprises of different blends of distillates. These category of fuels have a maximum Sulphur limit of 1.50% but MDO ranging between 0.10% - 1.50% Sulphur content is available for marine use.

IMO 2020 compliant ULSFO of 0.10% maximum Sulphur content, already exists and is used for vessels that operate in the ECA zones and incur frequent transitions in and out of ECA zones. ULSFO is perceived as a cheaper alternative to MGO and can be procured by ships voyaging to ECAs.

Technology Requirements:

Distillate fuels do not require major modifications to the existing ship engines which makes it easy to switch to MGO / MDO without any significant capital expenditure or down time. However, mixing fuel from different sources or mixing Heavy Fuel Oil with Distillate Fuel Oil is generally to be avoided. Fuel tanks used for HSFO previously will require thorough cleaning before bunkering MGO to avoid contamination and non-compliance problems.

Fuel pricing & availability:

Switching to distillate fuels will translate into higher bunkering costs due to higher MGO prices compared to HFO. During June 2019, MGO prices traded $150 - $250[3] per

[1] *Marine Fuel Oil Advisory 2018, American Bureau of Shipping*
[2] *Marine Fuel Oil Advisory 2018, American Bureau of Shipping*
[3] *S&P Global Platts, June 2019*

ton higher than the HFO prices at major bunkering hubs globally. The operators will have the choice to either absorb the cost of the higher fuels or pass it on to their customers, where possible.

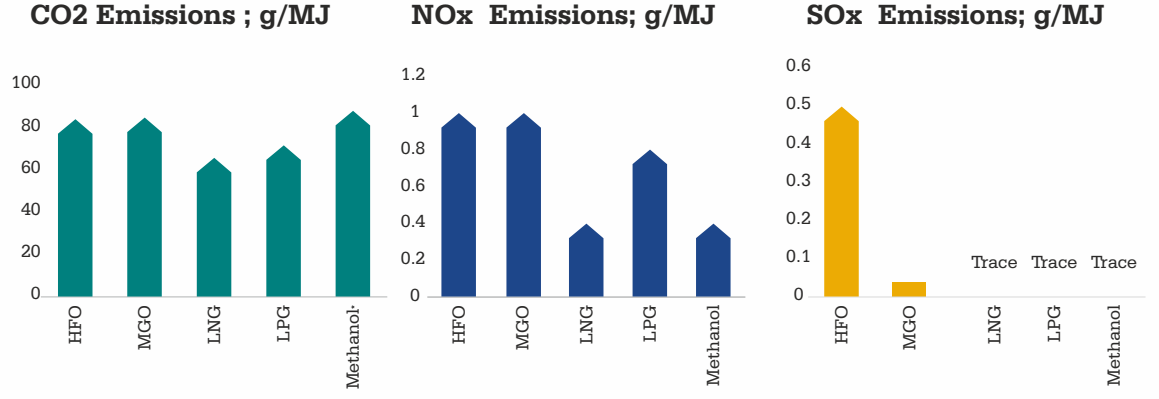
Apart from the prices, other major challenge with adoption of MGO will be the availability of fuel to meet the rising demand from the industry. Although refiners have been adding to their capacity to increase the MGO production, however it would be difficult for simple refineries to produce such quantities of MGO without making changes.

Low Sulphur Compliant fuels

There are a variety of low-Sulphur-compliant fuel blends which are expected to be available for the shipping industry. Refineries may blend HFO with fuel oils having lower than the desired Sulphur content of 0.50% to achieve a compliant fuel oil. The corresponding ISO Working Group is working on identifying methodologies for testing long-term stability and compatibility between different fuel batches. Due to the processes involved in producing ISO standards, a new standard is not expected to be finalized before 2020.

Various publications, analysis of available data and industry interactions suggest that during the initial years of IMO 2020 implementation, shipping industry is more likely to opt for a fuel switch from High Sulphur Fuel Oil (HSFO) to Low Sulphur products vis-à-vis adopting capital intensive solutions such as switching to alternate fuels (LNG, Methanol etc.) that require significant modifications in piping, storage and engine for vessels. This change-over from HFO to IMO 2020 compliant low Sulphur fuels can present operational challenges including need for segregation of fuel oil tanks with integral piping systems.

Emission Comparison between Alternate Fuels



Note: CO_2 emissions from Methanol is due to release of unburned methane (called methane slip)

ALTERNATE FUELS

METHANOL

Methanol is easy to produce but the greenhouse gas (GHG) emissions are about twice as high as from Natural Gas. Even though Methanol has low Sulphur content, it has several limitations from a technical and commercial perspective. SOx emissions from burning of Methanol are negligible and NOx emissions are reduced by almost 60% compared to HFO.

Technology requirements:

Dual fuel engines are available for Methanol. Certain modifications in engine design and tanks are required for Methanol which makes the likeliness to be used on ships designed for its use. Methanol increases the risk of corrosion, which must be met with sufficient upgradation of fuel tanks, etc., and the low energy content per cubic meter (m3) of Methanol means that it takes up cargo space on the ship.

As per industry estimates, installation of Methanol systems on vessels amount to around one-third of the additional cost associated with LNG systems. This is mainly because Methanol, being a liquid fuel, can be stored in standard tanks used on board vessels[4] .



[4] *Assessment of selected Alternative Fuels and Technologies, DNV-GL*

Bunkering infrastructure and Pricing:

Regulations for Methanol and low-flashpoint diesel fuels are under development.

Current level of adoption:

Assuming Methanol-propelled ship would require only minor additional capital investment, Methanol needs to be available in desired quantity, quality and at a competitive price as compared to other compliant fuel for it to be commercially competitive.

Although Methanol storage is expected to be available at most ports owing to its industry use, there are very few bunkering locations globally. Use of Methanol is established for short sea shipping, offshore, ferries and passenger segments. The adoption in ocean going vessels is also gaining pace slowly.

LIQUEFIED NATURAL GAS

Amongst fossil fuels, natural gas is known to be the cleanest source of energy which makes it attractive for usage as alternate fuel in shipping operations. Liquefied Natural Gas (LNG) is practically Sulphur-free which makes use of LNG as marine fuel devoid of virtually any SOx.

As per industry estimates, LNG as bunker fuel is expected to reduce NOx emissions by 85% to 90% and almost nil SOx and particulate matter compared to HFO. CO2 emissions are also expected to reduce by about 20% which will lead to reduction in GHG emissions as well.

Technology requirements: Engines required for LNG include gas-only engines, dual fuel 4-stroke and 2-stoke. Dual fuel engines running on gas can emit small amounts of unburned hydrocarbons, also known as methane slip which is a contributor to GHG emissions. With introduction of modern 2 - stroke engine technology, methane slip during combustion is eliminated and further reductions are expected by use of 4-stroke engines.

LNG bunkering and LNG-fueled new-builds shall form the significant chunk of investments in the path of popularizing this fuel option.

Fuel Pricing:

Prices for LNG has been traditionally lower than crude oil and HFO. Post-2020, a competitive pricing of LNG along with relevant bunkering infrastructure can possibly position the fuel as an attractive alternative to low Sulphur fuel options.

[5] *Clarksons World Fleet Monitor 2019 – Does not include LNG Carriers*

Current level of adoption:

LNG bunkering requires roughly twice the space as compared to HFO for the same amount of energy generation. Also, LNG-fueled ships shall be required to carry more fuel or make more frequent stops for bunkering. Application of LNG in shipping depends on the availability of worldwide network of bunkering infrastructure which is still at a developing stage. As of June 2019, there are around 137[5] LNG ready ships under operations worldwide, with another 86 new builds confirmed ranging from tankers, cruise ships, container ships, car carriers to Very Large Ore Carriers (VLOC). LNG bunkering for ships is currently available only in Europe, Incheon (Korea), Buenos Aires (Argentina), Singapore, US, Fujairah among a few more.

LNG bunker vessels have been delivered for operations in locations such as the Amsterdam, Rotterdam, Antwerp (ARA) region, the North Sea, the Baltic Sea and at the coast of Florida. Bunker vessels for other key locations such as the Western Mediterranean, the Gulf of Mexico, the Middle East, Singapore, China, South Korea and Japan are under development and are likely to increase with growing demand for LNG-fueled deep-sea ships during next few years.

HYDROGEN

For marine usage, Hydrogen (H_2) can be stored as a cryogenic liquid (compressed gas) or chemically bound. It can be produced by electrolysis of renewables, or by reforming natural gas. When Hydrogen is used in combination with marine fuel cells, the emissions could be negligible. Fuel cells are considered the key technology for hydrogen and fuel cells with batteries are being considered a promising option as a future marine fuel.

Currently there is no bunkering and distribution infrastructure available for Hydrogen fuel. However, Liquefied Hydrogen (LH) can be distributed in similar way of LNG. Use of LH-based vessels shall drive demand for distribution and bunkering infrastructure at ports.

Additional Costs:

As per industry estimates, due to challenges such as lower storage temperatures and higher insulation requirement, the storage tanks for liquid Hydrogen are expected to be significantly more expensive than LNG. All other equipment (e.g. piping, ventilation, heat exchangers, and pumps) are expected to have costs similar to LNG-based systems.

Current level of adoption:

[5] *Clarksons World Fleet Monitor 2019 – Does not include LNG Carriers*

Hydrogen is expected to be the potential game changer in the marine fuel industry. Irrespective of the higher costs, hydrogen is expected to gain due recognition with enforcement of stricter emission limits and corresponding higher costs of emissions. Battery or fuel cells powered by hydrogen are technically feasible for smaller vessels with short and fixed voyages and offer the benefit of zero-emission transportation. Battery-powered ferries are already in operation in Norway and Hydrogen-powered ferries are planned to be built in the next two to three years in Norway, Scotland and California.[6]

Figure3 : Fuel options for meeting IMO 2020 requirements



Source: KPMG Analysis, Secondary research

ALTERNATE TECHNOLOGIES

Exhaust Gas Cleaning Systems (Scrubbers):

IMO permits use of Exhaust Gas Cleaning Systems ("EGCS" or "Scrubber") on vessels using HFO as an alternative to utilizing low Sulphur marine fuels while remaining compliant with the new global Sulphur cap of 0.50%. EGCS used for Sulphur emission control are commonly known as SOx scrubbers, and are capable of removing Sulphur emissions by upto 95% and majority of Sulfate particulate matter.

[6] *DNV-GL Guidance paper on Alternate Fuels 2018*

Scrubber technology and Cost implications:

The three types of wet scrubber technologies available are:

A. **Open Loop scrubbers** take in alkaline seawater to clean the exhaust before discharging the wash-water back to the sea following treatment. One major concern with the use of open-loop systems is discharge to ocean thereby increasing the sea pollution levels and ocean acidification.

B. **Closed loop scrubber** systems use freshwater for washing and add caustic soda to raise the alkalinity of the water being used and have the option to retain discharge onboard ship for disposal at shore side. Closed loop scrubbers are known to have higher operational costs due to the use of caustic soda and costs related to discharge disposal at ports.

C. **Hybrid scrubbers** can operate on both open loop and closed loop systems.

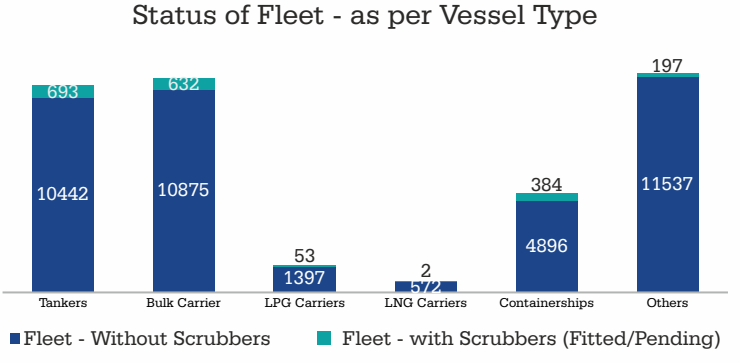
An estimate by Drewry Research pegs the cost of installing open loop scrubber on a new-build VLCC at around $2.5-$3.0 million, and the cost of retrofitting to be $4-$4.5 million[7]. Installation costs of closed loop scrubbers is estimated to be 0.8 million dollars[8] higher than open loop ones.

As per industry estimates, payback period for scrubber systems is estimated at around 0.5 - 3 years depending on the price differential between HFO & MGO/ULSFO, type of scrubber used and other operational factors. Another factor affecting scrubber adoption are high costs incurred in retrofitting existing vessels with scrubber technology, opportunity cost of non-availability of the vessel during scrubber installation, and availability of dry dock facilities. There are also concerns around the reduced space availability on the retrofitted ships and increased use of power to operate such scrubbers.

Scrubber Uptake:

As of June 2019, Clarksons database suggests uptake of scrubber technology is much higher for new order book vessels - an average of 24% of new-builds as against the installation of scrubbers on existing fleet - a meagre average of 4%.

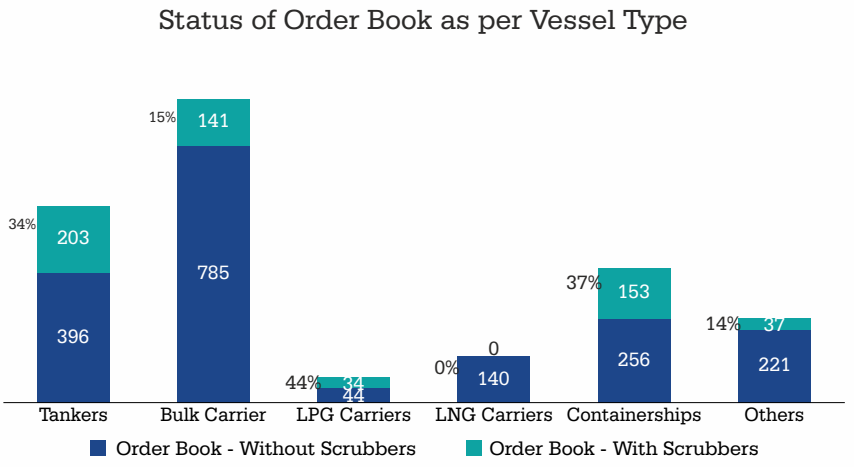
Figure 4 : Total Merchant fleet with % of scrubber installations (June 2019)



Source: Clarksons Research

[7] *Drewry Research – Market Opinion - 2018*
[8] *S&P Global Platts*

Figure 5 : % of Order-book installed with scrubbers (June 2019



Source: Clarksons Research





BUNKERING FOR 2020 & BEYOND



With 1 January 2020 ushering in an assorted fuel mix, the need for bunkering infrastructure is also expected to change. Apart from residual and distillate fuels, alternative fuels are expected to emerge as viable options in the longer run as mitigating steps to combat GHG emissions and meet IMO 2020 and 2050 targets.

Singapore, Rotterdam and Fujairah are the largest ports for bunkering globally and account for almost one third of the total bunker consumption. Bunker prices at key ports are usually lower than the average bunker prices in the region and global average since these ports have been able to leverage their locational advantage and/or other operational efficiencies to maintain lower bunker prices.

GLOBAL BUNKERING - FUTURE SCENARIO

LNG Bunkering

Only a small share of the marine bunker demand is expected to be met by alternate fuels such as LNG over the short-term. IEA estimates global demand for LNG as marine bunker to reach 11.6 MTPA by 2025 and 37 MTPA by 2040. However, in the longer run, LNG has the potential to become preferred alternative fuel in the bunker fuel mix. LNG-fueled vessels are expected to witness growth with the growing focus on LNG bunkering infrastructure and LNG favoring policies. The sector has seen participation of major bunker ports, shippers and respective government.

Major initiatives to promote LNG bunkering across the globe

Europe:

Alternative Fuel Infrastructre Directive 2014 mandates EU member ports to develop LNG infrastructure. Funding for LNG is made available through the CEF (Connecting Europe Facility) principally. Funding is also available through the Horizon 2020 programme; and other regional and national level programmes. Additional financing is also available under the European Fund for Strategic Investments and the EIB (European Investment Bank).

Asia:

South Korea has announced plans worth $2.48 billion to develop LNG bunkering facilities in the country. Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has also announced its support of the country's first LNG bunker vessels to supply Ise Bay and Mikawa Bay near Nagoya port and Tokyo Bay, near Yokohama port. China is also expecting delivery 8,500-cbm LNG bunker vessel in 2019 to operate from its Zhoushan terminal, close to Ningbao in China.

Middle East:

The United Arab Emirates (UAE) is reportedly working on plans to install LNG storage facilities at the Port of Fujairah, which is the world's second-largest fuel oil bunkering hub. Apart from Fujairah, Oman's port of Sohar is also planning to develop LNG bunkering service and develop natural gas discoveries located in the Greater Barik area.

INDIAN BUNKERING SCENARIO

Bunker Fuels demand[9] at Indian ports is about 1% of the global demand. Majority of the demand comes from defence ships, domestic vessels, coastal vessels and a small portion of international ships calling at Indian Ports. On an average, 27,000 ships call at Indian ports and this number is expected to grow by 7%.

As per the statistics from Ministry of Petroleum and Natural Gas (MoPNG), 1.38 MTPA of HFO, HSD and LDO deliveries were made; 0.42 MTPA to international bunkers and 0.96 MTPA to coastal bunkers. Indian bunker segment is majorly distributed between defence, trading, direct sales and exploration & dredging. IOCL is the largest bunker provider with 41.6% market share with Adani, HPCL and BPCL contributing to 18%, 15% and 10% share respectively.

LNG bunkering in India:

Petronet's LNG Terminal at Kochi with a capacity of 5 MTPA, first of its kind in South Asia, is operational and provides LNG bunkering facilities. The Kolkata Port Trust, meanwhile, has set aside about 10 acres of land within the Haldia Dock Complex as part of a wider push to introduce LNG as a fuel for barges. India's oil companies - Indian Oil Corporation and Bharat Petroleum Corporation - are in discussions with the Maharashtra Maritime Board (MMB) to build liquefied natural gas (LNG) bunkering facilities in the state.

Availability of IMO 2020 compliant fuels: India Perspective

Indian refineries with modern and complex configurations are relatively better

[9] *Worldportsource.com, Outlook for Marine Bunkers and Fuel Oil, https://www.researchgate.net/*

positioned to deal with the challenges of producing cleaner products. Indian refiners have high level of coking and hydrocracking capacity relative to installed primary distillation capacity, which would allow them to produce more gasoil and diesel.

Indian Oil Corporation has taken proactive steps to ensure availability of 0.50% Sulphur compliant fuels (RMG 380, RMG 180, and MGO) prior to the deadline of Jan 1, 2020. IOCL has already carried out detailed tests to advance the production of low Sulphur fuel oil compliant with IMO 2020 regulations and aims to start supplying cargoes commercially from September 2019. IOCL aims to supply more than 1 million MT/year of the cleaner fuel from its Haldia refinery on the eastern coast and the Gujarat refinery on the western coast for international and domestic bunkering.

GST regulations for India bunkering:

Post representations from industry and reduced foreign earnings from foreign vessel bunkering, Government of India revised GST rates on marine bunker from 18% to 5% on 06 Oct 2017. However, majority of the ports in Asia and Middle East apply zero tax on bunker fuels, thereby reducing the bunker costs as compared to India. Further reduction of GST rate to a minimal rate for Coastal & Foreign going ships can be considered for boosting bunkering in India.



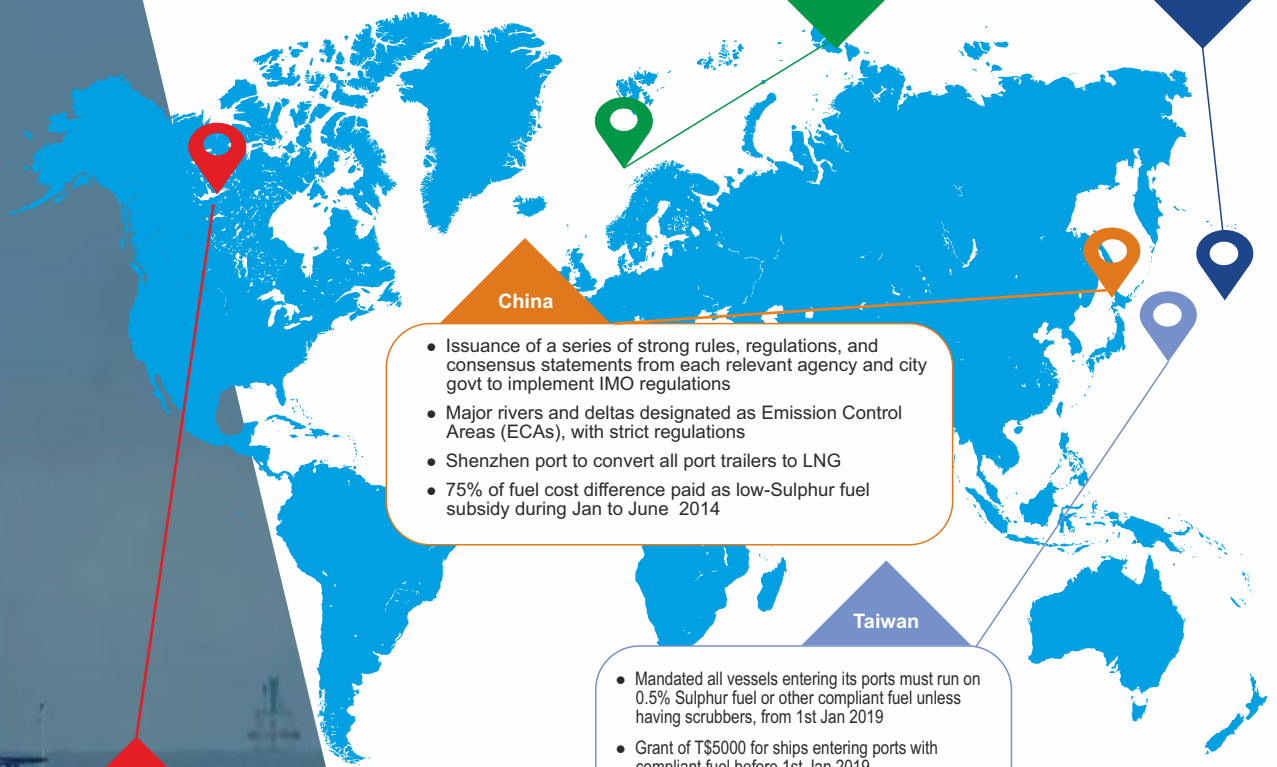


THE WAY FORWARD

GLOBAL ADOPTION OF IMO 2020

IMO 2020 regulations have been ratified by 91 states, of which 31 already have low Sulphur regulations in place and 16 are Emission Control Areas (ECAs). Some key states plan are undertaking measures to fast-track their adherence to IMO 2020:





Europe

- EU typically has a stronger response than the IMO on emission regulations, e.g. limit on Sulphur content set as <0.1% m/m in special control areas
- Promoting the use of land power equipment at ports by incentives
- The Marco Polo program launched to increase overall environmental efficiency of transportation system
- Netherlands gives a 6% Port Fee discount to ships using green fuels

Japan

- Japan promotes the construction of modal shift vessels with policies such as infrastructure maintenance, regulatory maintenance, and subsidy payments.
- The port sector implementing policies to reduce GHG emissions and to transform port logistics system

China

- Issuance of a series of strong rules, regulations, and consensus statements from each relevant agency and city govt to implement IMO regulations
- Major rivers and deltas designated as Emission Control Areas (ECAs), with strict regulations
- Shenzhen port to convert all port trailers to LNG
- 75% of fuel cost difference paid as low-Sulphur fuel subsidy during Jan to June 2014

Taiwan

- Mandated all vessels entering its ports must run on 0.5% Sulphur fuel or other compliant fuel unless having scrubbers, from 1st Jan 2019
- Grant of T$5000 for ships entering ports with compliant fuel before 1st Jan 2019

U.S.A

- Issuance of a series of strong rules, regulations, and consensus statements from each relevant agency and city govt to implement IMO regulations
- Major rivers and deltas designated as Emission Control Areas (ECAs), with strict regulations
- Shenzhen port to convert all port trailers to LNG
- 75% of fuel cost difference paid as low-Sulphur fuel subsidy during Jan to June 2014

Singapore:

Maritime and Port Authority of Singapore (MPA) has committed full compliance to the IMO 2020 regulations by taking steps to ensure compliance starting January 01, 2020:

a. Preparing the Port, as well as the ships carrying the Singapore flag to comply with IMO 2020 guidelines. Ships calling Port of Singapore and intending to changeover to compliant fuel are also encouraged to follow Ship Implementation Plan in advance, taking into consideration traffic density, maneuvering space and engine manufacturer's guidelines for early identification of issues.

b. Ensuring availability of compliant fuels at the Port - MPA receives regular updates on the availability of compliant fuels from its licensed bunker suppliers. The list consisting of bunker suppliers and range of fuels is updated regularly and published to be available for ships planning to bunker at Port of Singapore.

c. Discharge of wash-water from open-loop scrubbers is prohibited in Port of Singapore. However, guidelines and facilities have been developed for discharge from hybrid/closed loop scrubbers under Singapore's Environmental Public Health (Toxic Industrial Waste) Regulations.

d. Ships calling into Singapore and submitting a FONAR would need to declare so in the Electronic Pre-Arrival Notice (EPAN) or the Electronic Notification of Arrival (ENOA).

e. Port of Singapore has also announced that, from the start of 2020, captains and owners of vessels that burn high Sulphur fuel in the Asian country's territorial waters, without using Sulphur-reducing technology such as scrubbers, could face as long as two years in prison, however the same has not yet been enforced. Other penalties include a fine of up to S$10,000 ($7,400).

Europe:

The European Maritime Safety Agency (EMSA) has released information and guidelines for the state authorities, ship owners, masters, fuel suppliers, agents and operators of ships to meet requirements of IMO 2020 regulations.

a. **Guidelines for Ship Operators:** EMSA has published guidelines to ensure operators establish appropriate compliance procedures pertaining to maintaining logbooks, fuel changeover plans, recording of bunkering fuel operations, on board and the ship crew is aware of the same.

b. **Penalties** may be imposed by EU Member States for breaches of the national provisions adopted pursuant to Directive 1999/32/EC as amended.

c. Other initiatives include proposal to IMO for standardization of shipping's current reporting mechanisms to utilize the existing processes used by the IMO's Global Integrated Shipping Information System to collect data on fuel availability and quality, including Sulphur content of the fuel. Denmark has made announcements

to deploy 'sniffer' drones technology in its waters to detect non-compliant operators. These drones fly into a vessel's exhaust gas and analyze the content of the plume.

United States:

In the United States, individual states regulate scrubber wastewater discharges from open loop scrubbers often under the Clean Water Act. While California bans the use of scrubbers entirely through the California Air Resource Board's Ocean Going Vessel regulations, others such as Connecticut and Hawaii have discharge prohibitions. The requirements for discharging scrubber wastewater are defined by 2013 Vessel General Permit (VGP) and violations could result in fines and penalties of up to $25,000/day.

INDIA'S PATH TO MEETING IMO 2020 REGULATIONS

STEPS UNDERTAKEN TOWARDS MEETING IMO 2020

India has already initiated measures to comply with IMO 2020 regulations.

1 In line with the IMO requirements, the Directorate General of Shipping released the IMO Data Collection Circular with guidance on procedures of reporting, methodology, and responsibility for data collection and their transmission with suggested timelines under its role of flag state.

   The circular applicable to Indian vessels registered under the Merchant Shipping Act, 1958 requires shipping companies to:

   - Ship Energy Efficiency Management Plan (SEEMP), review of SEEMP by the Recognized Organization to ensure compliance and issuance of compliance confirmation.
   - Collect and submit fuel oil consumption data on yearly basis, and Recognized Organizations to verify the data and issue Statement of Compliance.
   - Submit data to Indian Register of Shipping (IRS) and IRS to submit yearly data to IMO fuel oil consumption database and submit compliance report.

2 Directorate General of Shipping has also released Draft Engineering Circular to provide preliminary guidance on the responsibilities of Indian shipping companies and bunker suppliers to demonstrate compliance with the provisions of MARPOL Annex VI. The circular requires shipping companies to develop ship specific implementation plan based on a risk assessment taking into consideration guidance developed by IMO. Ships fitted with scrubbers are required to have documents/certifications required by MEPC on board and compliance to wash water disposal requirements set out by MEPC.

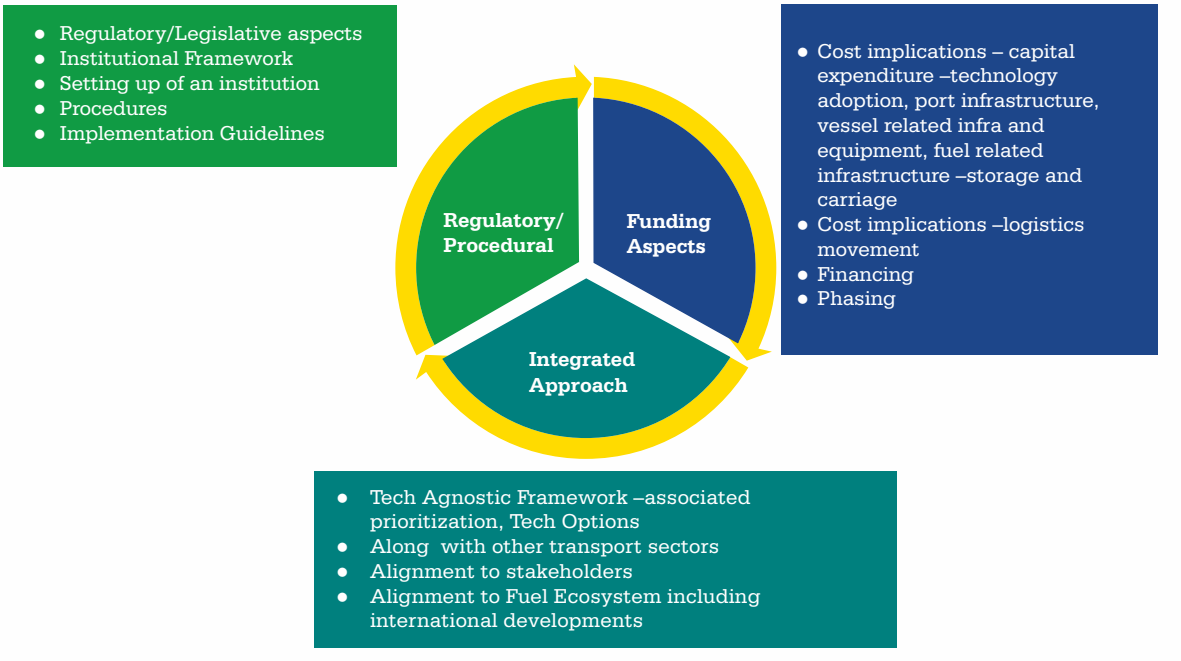
3 To comply with IMO 2020 regulations and to promote alternate fuels in India, the Ministry of Shipping advised Oil Industry Safety Directorate (OISD) to develop

standard on Safety for LNG Bunkering Facilities at Ports, for Large Ships, Coastal Shipping and Inland Water Transport (IWT) Terminals. The standard, after its approval in the 35th Safety Council Meeting held on 17th October, 2018, has been released for implementation by the Industry.

FURTHER SUGGESTIONS

With 1 January 2020 inching closer, India needs to expedite progress on assessing the current level of preparedness, develop national policies and provide implementation guidelines for the shipping industry for smooth transition to compliance with IMO 2020.

Develop a policy on 'Alternate Fuel Options for Marine Vessels' for the nation through an integrated approach involving all stakeholders. The policy makers may consider a long term vision to achieve a sustainable marine industry and use of alternate fuel options like LNG, Methanol etc.



Support development of LNG bunkering facilities: The government can aim at providing regulatory and economic support for development of infrastructure network for LNG and supply barges. States might also consider incentivizing use of LNG for coastal ships over conventional fuels and devise policy to subsidize LNG.

India needs to address the potential environmental concerns pertaining to discharge of wash-water from open-loop scrubbers and disposal of scrubber residue from vessels calling at Indian ports. At the same time, ports need to ensure ample supply of neutralizing agents for closed-loop / hybrid scrubbers.

Formulate standard procedures for de-bunkering of ships having non-compliant grade(s) of bunker fuel. This will require creation of adequate infrastructure at bunker ports as well as availability of IMO 2020 compliant fuel oils at the same bunker ports.

To encourage use of green fuels, the government may consider discounted port charges for vessels using alternate fuels.

Provision of tax rebates to entities involved in production and supply of IMO 2020 compliant low Sulphur fuel oils and alternate fuels to domestic bunker locations can be considered to make India attractive for bunkering operations.

DEVELOPMENT OF READINESS CHECKLIST FOR STAKEHOLDERS TO ENSURE COMPLIANCE WITH IMO 2020

01 COMPLIANCE

Ship maintenance regime to include mitigating fuel compatibility issues, arrangements for carriage ban, emission monitoring, equipment inoperability etc.

02 ON-BOARD READINESS

Fuel switch-over requirement, crew training on switch-over operations and handling non-availability of compliant fuel

03 PROCUREMENT READINESS

Re-negotiation of bunker contracts to procure compliant fuels from certified suppliers along voyage, arrangement for disposal of non-compliant fuel

04 OIL TANKS READINESS

Tank cleaning for storing compliant fuel, lube oil spare tank arrangement for dual fuel carriage, additional containment system for the possible overflow of sludge volume due to tank cleaning requirements

05 SAMPLING READINESS

Identify sampling points and install sampling valve, procedure for onboard and in-use samples and crew familiarization training

06 FUEL OIL SYSTEM READINESS

Segregation modifications for fuel oil tanks system, system lines testing, and crew familiarization training, agreement of fuel availability plan with manufacturers

BEYOND IMO 2020 - MOVING FROM DESULPHURIZATION TO DECARBONIZATION

In 2018, the MEPC adopted an initial strategy to reduce GHG emissions from international shipping and phasing them out, at the earliest possible within this century. By 2050, IMO aims to cut annual GHG emissions by at least 50% compared to 2008 standards.

IMO has already adopted energy-efficiency measures that have legal implications across the global shipping industry and is applicable to all Member states. By 2025, all new ships are expected to be at least 30% more energy efficient than those built in 2014, if IMO guidelines are followed.

The shipping industry is expected to witness significant changes post-2020 with newer variety of fuels like fuel cells gaining prominence to meet the 2050 guidelines.

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