

Shell Marine

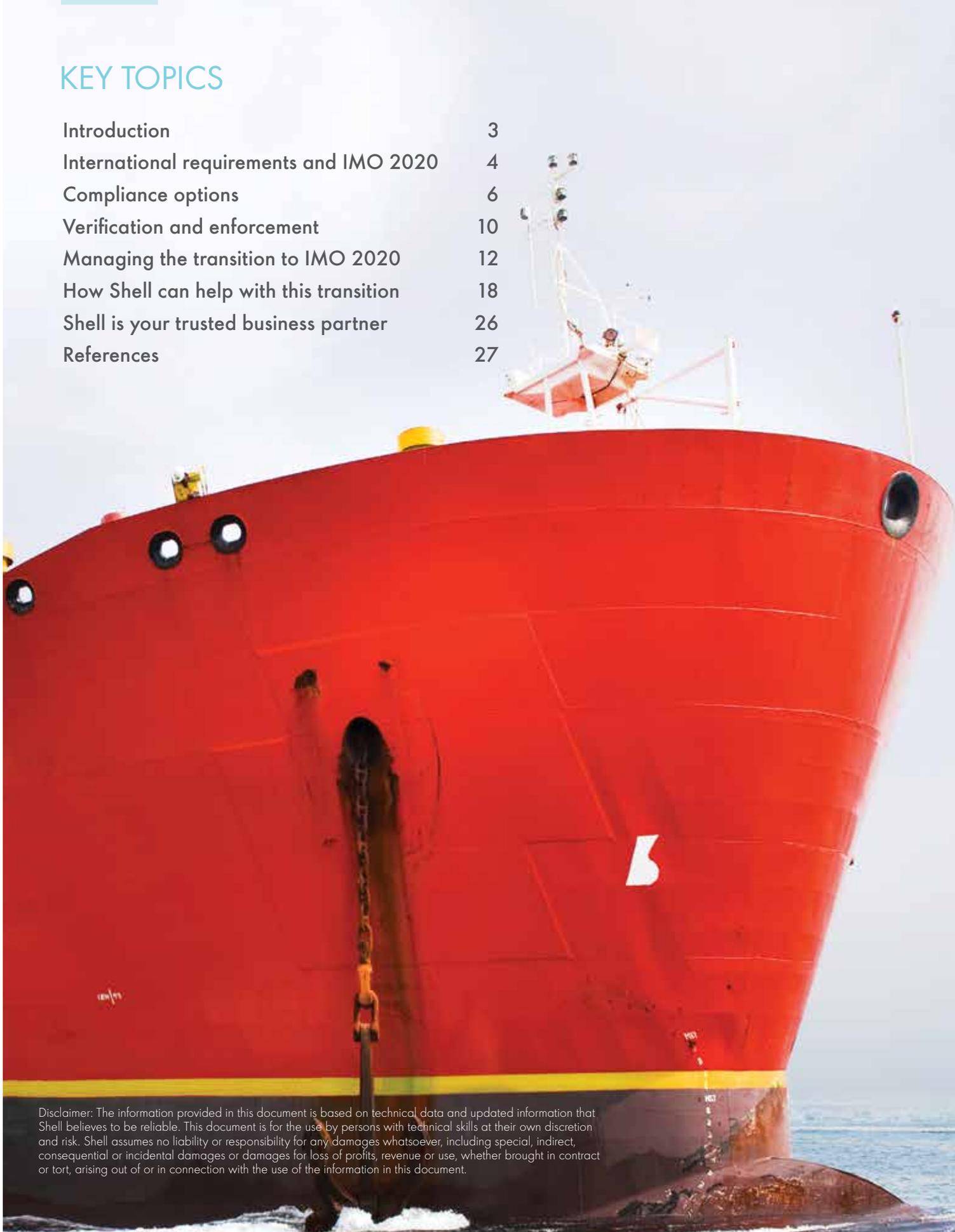


# IMO 2020 READY



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## INTRODUCTION

Shell supports the decision of the International Maritime Organization (IMO) to implement a 0.5% sulphur cap on 1 January 2020. We are preparing to provide our customers with options for complying with the changes in a flexible and timely manner. As the world moves to a lower emissions future, our industry will change. An efficient and effective transition depends on governments, energy companies and shipping firms, etc., working together. It will take a real effort by all to ensure that the industry continues to grow in a sustainable manner. Shell has an excellent portfolio of marine products and more than 100 years of experience in the shipping industry, which positions us well to support customers across the value chain:

- a competitive global fuel supplier with expertise in fuel oil formulation, trading and term supplies
- global presence across a network of key bunkering ports
- long-established commercial relationships in and understanding of the shipping industry
- an innovation leader in supplying liquefied natural gas (LNG) and technology solutions for the transportation sectors
- global understanding of the refining industry and access to a range of fuel sourcing solutions
- proven, integrated marine lubricants capabilities.

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SHELL SUPPORTS THE DECISION OF THE INTERNATIONAL MARITIME ORGANIZATION (IMO) TO IMPLEMENT A 0.5% SULPHUR CAP ON 1 JANUARY 2020. WE ARE PREPARING TO PROVIDE OUR CUSTOMERS WITH OPTIONS FOR COMPLYING WITH THE CHANGES IN A FLEXIBLE AND TIMELY MANNER.

## INTERNATIONAL REQUIREMENTS AND IMO 2020

The IMO has put in place the International Convention for the Prevention of Pollution from Ships (MARPOL), a set of regulations to prevent pollution of the marine environment by ships from operational or accidental causes.

MARPOL has expanded over the years to include new annexes, for example, sulphur oxides (SO<sub>x</sub>) and nitrous oxides (NO<sub>x</sub>). MARPOL Annex VI – Resolution MEPC.176(58), which is applicable from 1 July 2010, outlines the controls specific to operations inside Emission Control Areas (ECA), established to limit the emission of SO<sub>x</sub> and particulate matter (PM) and is primarily achieved by limiting the maximum sulphur content of the fuels used onboard vessels.

Initially, the IMO approved two sulphur ECAs, known as Sulphur Emission Control Areas (SECA),

which are the Baltic Sea and the North Sea. Afterwards, they approved the United States Caribbean Sea ECA that included NO<sub>x</sub> Tier III emission restrictions, in addition to the SO<sub>x</sub> emissions restrictions (see Figure 1 and Table 1). Although further expansion of the SECAs remains a possibility, it is less likely because of the scheduled implementation of the 0.5% sulphur global cap. In addition to the IMO approved ECAs, some countries set different rules for their own territorial waters, ports or domestic shipping, for example, the China Air Pollution Prevention Law (also in Figure 1).

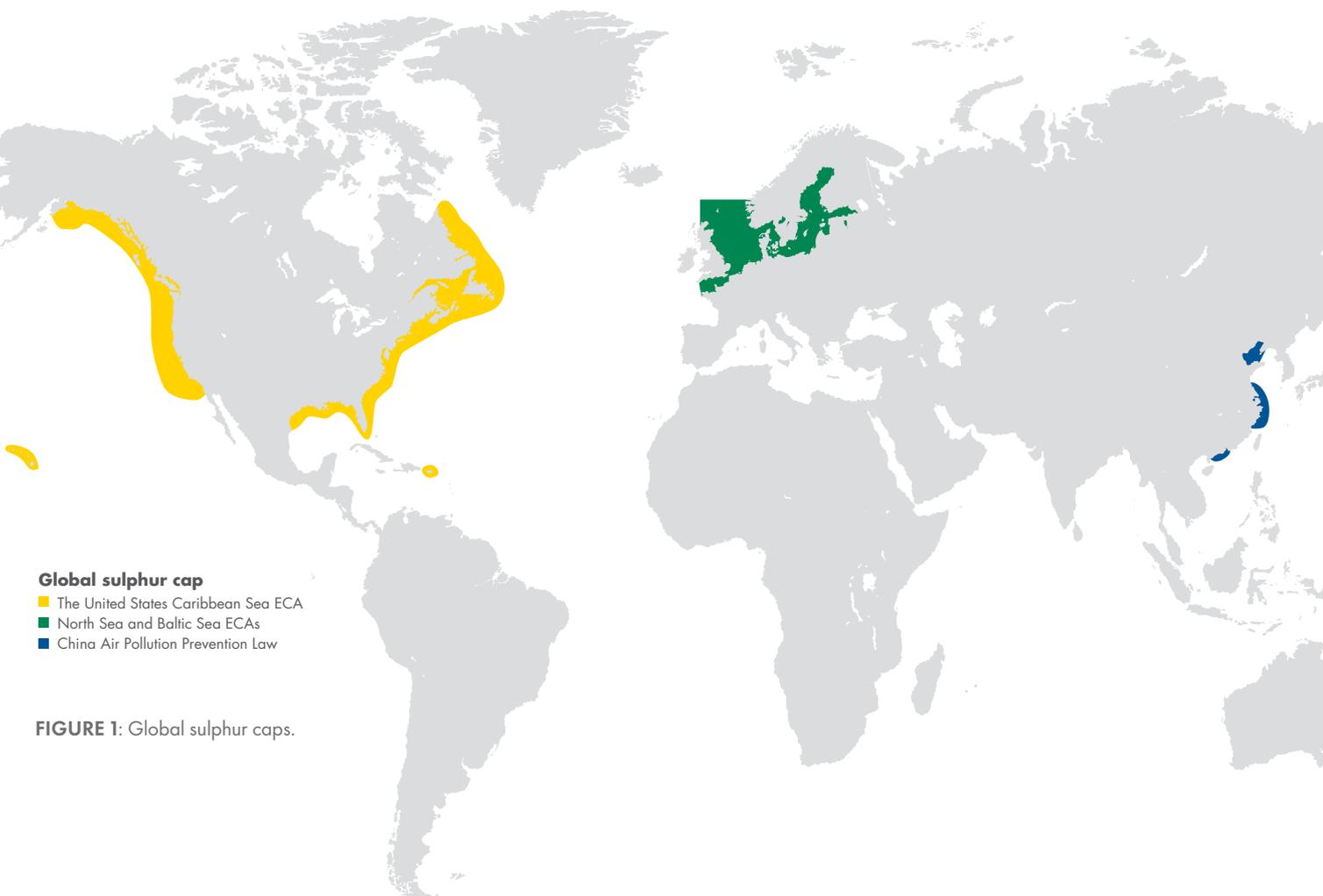


FIGURE 1: Global sulphur caps.

Annex VI special area	Adopted	Entry into force date	Effective date
Baltic Sea (SO <sub>x</sub> )	26 September 1997	19 May 2005	19 May 2006
North Sea (SO <sub>x</sub> )	22 July 2005 (Resolution MEPC.132(53))	22 November 2006	22 May 2007
North America (SO <sub>x</sub> and PM)	26 March 2010 (Resolution MEPC.190(60))	1 August 2011	1 August 2012
US Caribbean Sea (SO <sub>x</sub> and PM)	15 July 2011 (Resolution MEPC.202(62))	1 January 2013	1 January 2014

TABLE 1. IMO-designated SECAs.

From 1 January 2015, ships that operate within the ECAs are required to use low-sulphur fuel that has a sulphur content no greater than 0.10% or an alternative compliance route such as an exhaust gas cleaning system (or scrubber).



To comply with the requirement, vessels would need to use distillate fuel (for example, marine gas oil) or 0.10% heavy fuel oils. To satisfy the 0.10% sulphur cap when operating within ECAs, vessels must switch to lower sulphur fuels as they approach ECAs. The ship should carry a written procedure that details the fuel oil changeover plan and ensures that sufficient time is allotted to flush all non-compliant fuel before entering ECAs. The crew must be trained on fuel management and fuel switching procedures. A fuel oil management plan template is shown in Figure 2.

In addition to the current limit of 3.5% in place for SECAs, the IMO will implement a 0.50% global sulphur cap for marine fuels on

1 January 2020. As stipulated in Regulation 2.9 of IMO MARPOL Annex VI, SO<sub>x</sub> emission controls apply to all fuel oil used in onboard combustion equipment and devices unless approved equivalent methods, such as an exhaust gas cleaning system, are installed under regulation 4.1 of MARPOL Annex VI. The requirements for ECAs remain unchanged.



FIGURE 2. A fuel oil management plan template.

## COMPLIANCE OPTIONS

There are multiple options for complying with **IMO 2020** that enable operators to adhere to the requirements by either selecting the right fuel or deploying sulphur mitigation technologies. The options are as follows:

1. **Marine gas oil** (low sulphur distillate fuel)

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2. **Heavy fuel oil**
  - a) 0.1% ultra low sulphur fuel oil (ULSFO)
  - b) 0.5% very low sulphur fuel oil (VLSFO)

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3. **Exhaust gas cleaning system** (scrubber) with high-sulphur fuel oil (HSFO) >0.5% sulphur

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4. **LNG**

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5. **Alternative fuels**, for example, liquefied petroleum gas, methanol, compressed natural gas, biofuel, solar power and fuel cells.

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Although many options are available, it is anticipated that most vessels will choose to use ULSFO or VLSFO.

### Alternative fuels

Any fuel source that has a sulphur content below the mandated 0.5% sulphur level could be used to ensure compliance with the regulation. Alternative fuels such as these are not readily available on a large scale and are, therefore, unlikely to play a significant role in meeting the challenge of IMO 2020. Further developments and trials are anticipated, particularly as the industry looks towards the next challenge of meeting greenhouse gas targets according to the latest IMO commitments.

### LNG

LNG is a credible, cost-competitive option available to customers today. LNG as a marine fuel, in addition to being virtually sulphur free, also produces less NO<sub>x</sub> and PM, so emits less air pollution. Shell anticipates that demand for LNG as a marine fuel will continue to increase and is confident about the long-term role LNG will play in the global marine industry.



### Exhaust gas cleaning system with HSFO

Fitting a new build or retrofitting a current vessel with a scrubber and using HSFO is a viable option for complying with IMO 2020. Although this involves an initial capital outlay, the price differential between HSFO and VLSFO/ULSFO could make this an attractive option for high-fuel-consumption vessels. There are various scrubber technologies available on the market from multiple suppliers. Scrubbers can be open loop (using seawater), closed loop (using chemicals and possibly able to operate without discharge for limited periods) or hybrid (able to operate in open- or closed-loop mode). Before deciding, vessel owners need to address the cost, the typical operation of the vessel and the normal trading route to determine the best option.

It is estimated that more than **2,000 vessels** have invested in a scrubber or had a firm order in place at the start of 2019 compared with about 400 at the end of 2017 (see Figure 3). Although this number may rise as 2020 approaches, it is limited by the capacity of both dry docks and scrubber manufacturers.

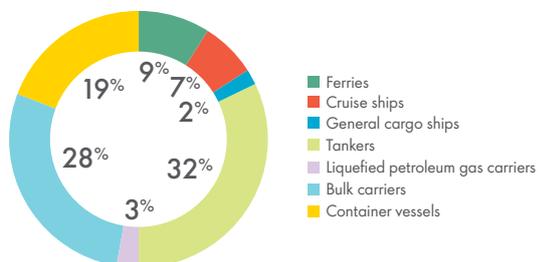


FIGURE 3. Current scrubber base (Source: Clarkson Research Services Ltd).



Some vessel owners are cautious about using scrubbers because of their vessel's suitability, operational concerns, including sludge and chemicals handling, and uncertainty about future fuel prices. In addition, some local authorities are limiting the use of open-loop scrubbers while in port, including the United Arab Emirates, Singapore, China and various European countries. In relevant ports, vessels will need to be able to operate a scrubber in a closed mode or switch to a compliant fuel.

### Compliant fuels

It is expected that most vessels will need to switch to compliant fuels to comply with IMO 2020. These fuels could be of a distillate or residual type, and it is important to understand the differences between the different types of available fuels. Table 2 outlines the typical parameters for marine fuels. The International Organization for Standardization does not define the sulphur content of fuel.

The transition to a global sulphur cap of 0.50% will cause significantly more change to the global

marine industry than the switch to the 0.10% cap in ECAs. Whereas the switch to the 0.1% cap displaced more than 300,000 bbl/d of HSFO, the upcoming switch is likely to affect 10 times this amount and will create some challenges to the refining industry in managing the impact. The refining industry can react in many ways, which have differing timelines and financial implications:

- **crude diet change:** changing from a high-sulphur crude to a low-sulphur crude
- **residue destruction:** investing in hardware to upgrade residue, for example, cokers or moving residue from bunkers to bitumen
- **segregation:** improving the segregation between low-and high-sulphur crude, feedstocks and blendstocks
- **blending:** blending additional distillate or other low-sulphur streams into the fuel oil pool.

Figure 4 shows some of the options for blending 0.5% sulphur fuel and demonstrates the complexities at a typical refinery (source: Shell, representation of a standard refinery process).

Fuel type	ISO category	Typical viscosity (cSt) (at 50°C for residual and 40°C for distillate fuels)		Sulphur content (%)
		Minimum	Maximum	
ULSFO	Residual (RMA-RMK)*	9	67	Max. 0.1
VLSFO	Residual (RMA-RMK)*	Not available yet	Not available yet	Max. 0.5
Heavy fuel oil (HFO)	Residual (RMA-RMK)*	10	700	>1.0
Marine diesel oil (MDO)	Distillate (DMB)	2	11	0.1-1.5
Marine gas oil (MGO)	Distillate (DMA-DMZ)	2	4	0.1-1.0

\*RMA-RMK: RMA, RMB, RMD, RME, RMG and RMK

TABLE 2. The typical parameters for marine fuels

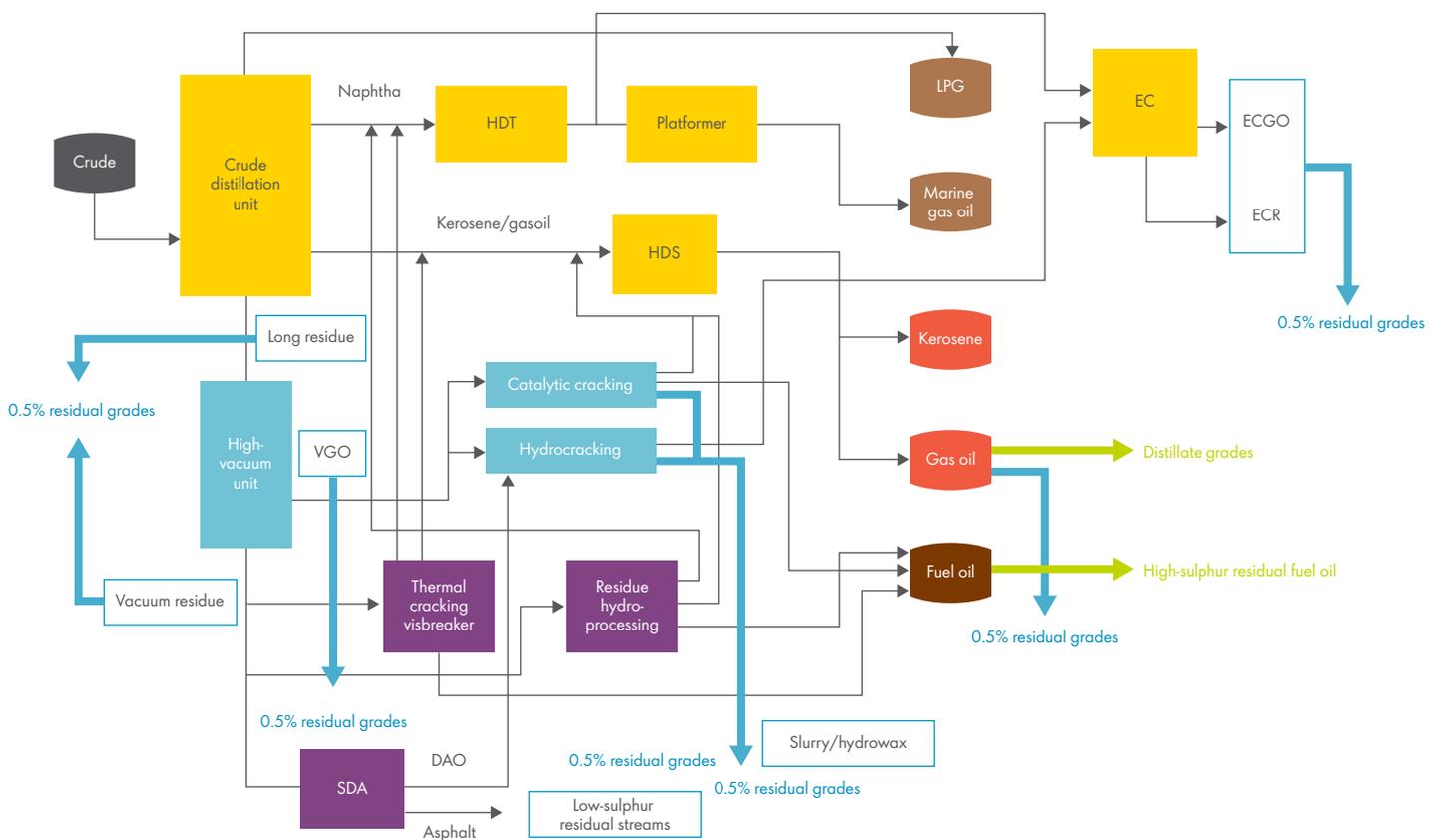


FIGURE 4. The complex process of blending 0.5% sulphur fuel.

## VERIFICATION AND ENFORCEMENT

The IMO is clear that the 1 January 2020 deadline will come into effect, and shipowners and the refining industry are preparing to be ready. However, work is still ongoing to clarify the regulatory framework on, for example, sulphur verification, enforcement and non-availability reporting. The 74th Marine Environment Protection Committee (MEPC 74) meeting in May finalised the 2019 guidelines; however, it will take longer for the member states to confirm how the guidelines will be implemented. Work on scrubber guidelines will continue in 2020.

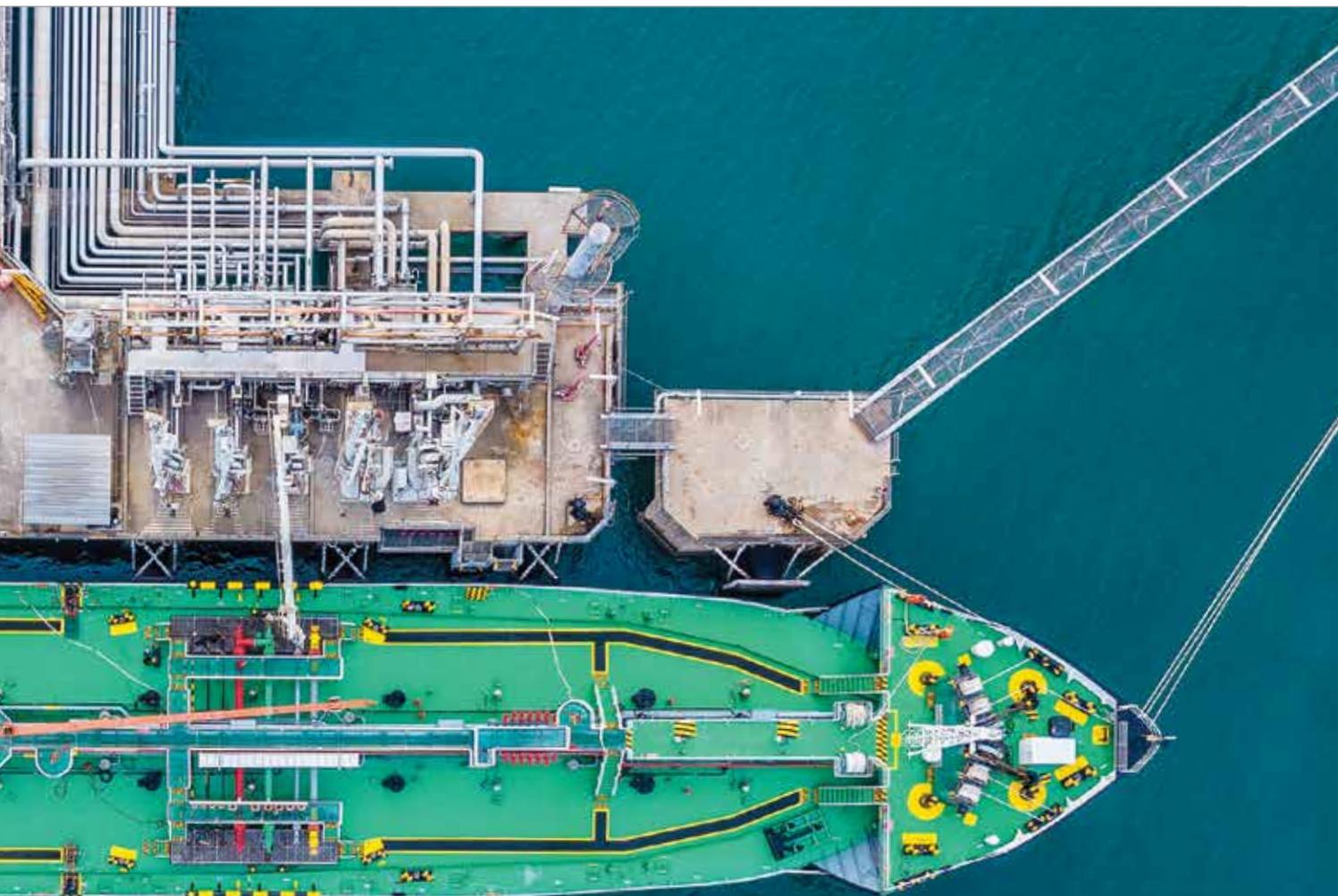
In general, Shell anticipates that compliance will vary by region. There are varying views on the estimated levels of non-compliance within the industry. Several measures are being put in place to help manage compliance; some examples are outlined below.

### CARRIAGE BAN

It has already been agreed that the carriage of fuels for combustion, as opposed to cargo, with a sulphur level of more than 0.5% on vessels that do not have scrubbers installed will be banned from 1 March 2020. However, once compliant fuel is available, a lack of clarity remains on how this will be enforced and what the vessels that are forced to take non-compliant fuel will need to do with their remaining high-sulphur fuel. Ensuring compliance with the carriage ban is complex. There is a need to take samples from onboard fuel tanks but no guidelines on how to take a representative sample safely (not all onboard tanks have sampling ports and their configuration may make it difficult to retrieve a representative sample). However, it should be remembered that, in the case of a commercial dispute over fuel oil quality, it is standard practice to take fuel oil samples from vessels. The Institute of Marine Engineering, Science and Technology submitted a paper on this at MEPC 74 that was tabled for further discussion.

### FUEL OIL ON AVAILABILITY REPORTING (FONAR)

At the recent Pollution Prevention and Response (PPR 6) meeting, the FONAR form was finalised with some explanatory notes. Outstanding questions remain, for example, how to deal with communication between the port state where no compliant-fuel was available and the next port of call, where the vessel will arrive burning high-sulphur fuel.



### MEASUREMENT OF SULPHUR CONTENT IN THE FUEL

Typically, ISO 8217 is the marine fuel standard that is used to sell and/or buy fuel. Within this standard, repeatability and reproducibility standards are defined according to ISO 4259 that enable a 95% confidence limit to be applied. However, the procedure for testing a delivered fuel sample sets a hard target. What this effectively means is that a vessel has no claim on a fuel supplier if the sulphur content of the fuel is within the 95% confidence limit but it may still be fined by the authority. The exception is if the fuel supplier supplied an incorrect bunker delivery note (BDN), whereupon the MARPOL-delivered sample is the means for port states to ensure that fuel suppliers are compliant. Several industry bodies have lobbied that the commercial practice should be aligned with the guidelines to ensure that if a fuel sample is taken onboard, compliance is assured within the reproducibility limits.

### FUEL UNSUITABLE FOR USE (FOR EXAMPLE, LOW FLASHPOINT, ENGINE DAMAGE OR SULPHUR CONTENT NOT ACCORDING TO THE BDN)

Fuel quality remains a major concern for users. Typically, challenges arise when the fuel is already onboard or in use, as it would not have been accepted if the issue had been known. In terms of how this should be handled, there is no change to the current situation: the ship should send a letter of protest to the port and/or flag state and supplier. Port states are encouraged to act when they receive information that fuel suppliers have not met requirements. Resolution of the issue is of a commercial nature between supplier, vessel and charterer. One area that has yet to be clarified is what will happen if the vessel sends a notice of protest that the sulphur content is not according to the BDN and the ship is detained in the next port because of non-compliance. In this case, it is likely to discourage vessels from sending a letter of protest. This was also discussed at MEPC 74.

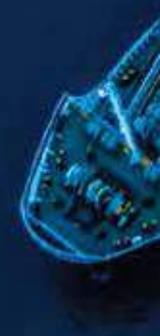
## MANAGING THE TRANSITION TO IMO 2020

In preparation for the transition, the IMO has issued guidance recommending that all vessels prepare a ship implementation plan (SIP) that details how the vessel plans to reach full compliance by 1 January 2020. Although having a SIP cannot assure full compliance, there are some within the industry who believe this at least demonstrates that the vessel has made significant efforts to comply and that, therefore, some leniency will be applied.

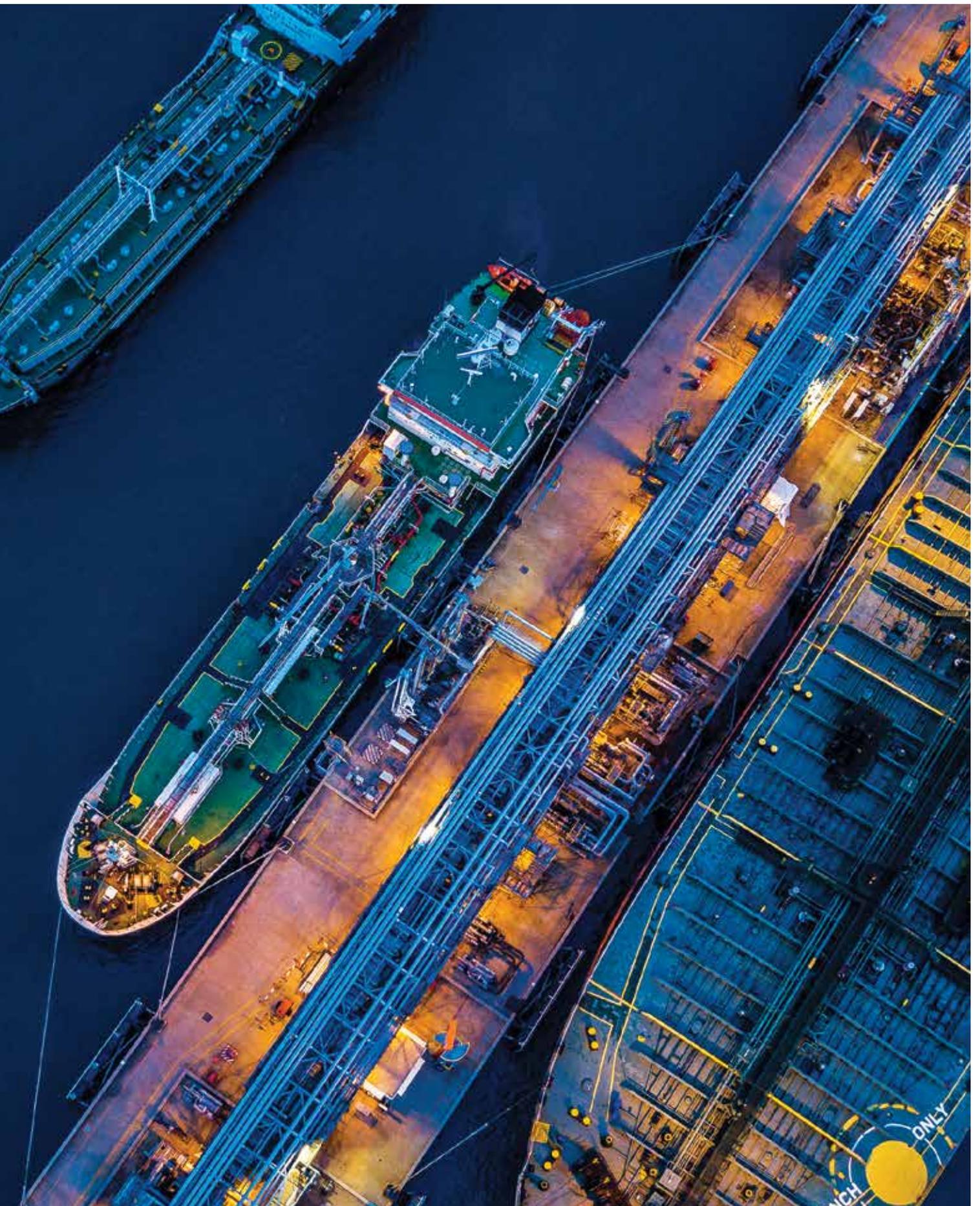
### Exhaust gas cleaning system with HSFO

Vessels that have an exhaust gas cleaning system onboard will continue to use HSFO. Caution should, however, be exercised about the sulphur levels of the purchased fuels to ensure that the scrubber can operate effectively to reduce the emissions to those equivalent of running a compliant fuel. In some locations, it is possible that the average sulphur content of HSFO could rise. For vessels that are planning to install scrubbers after the 1 January 2020 deadline, plans will need to be put in place to ensure that the vessel can successfully run on compliant fuel until the scrubber is installed. Although it may be possible to keep HSFO onboard in readiness for the scrubber, this will only apply if the scrubber is in place before 1 March 2020, after which the carriage ban will mean that the HSFO needs to be removed.

Lubricants in use are likely to remain unchanged. For two-stroke vessels these could be **Shell Alexia 70**, **Shell Alexia 100** or **Shell Alexia 140** (depending on the engine type and typical operating conditions); for four-stroke vessels these could be **Shell Argina S4** or **Shell Argina S5**. It is highly recommended that an increased focus is put on monitoring engine condition using the **Shell LubeMonitor** and **Shell LubeAnalyst** services.



LUBRICANTS IN USE ARE LIKELY TO REMAIN UNCHANGED. IT IS HIGHLY RECOMMENDED THAT AN INCREASED FOCUS IS PUT ON MONITORING ENGINE CONDITION USING THE **SHELL LUBEMONITOR** AND **SHELL LUBEANALYST SERVICES**.



### Compliant fuels

In managing the transition, it is important that vessel owners and operators understand the issues that may occur with the different fuel types on the market. Many concerns have been raised, including about incompatibility, instability, catalytic fines, combustion characteristics, flash point and pour point. It is often mentioned that part of the challenge is that there is no ISO specification to cover these new fuels that will become prevalent in the market. In fact, many of these fuels will meet the ISO 8217 specification, but the real challenge is that typical properties may vary significantly between different fuels, even between those that meet the same specification.

**Incompatibility:** Incompatibility is not a new challenge, as it can and does occur when mixing the HSFO grades that are currently available on the market. The challenge is, however, likely to be more pronounced when moving to ULSFO/VLSFO grades, as wide variability between grades is foreseen. If vessels want to take away the risks of managing different fuels onboard, they can consider the use of MGO fuels as these will typically be compatible whatever the source.

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**Stability:** Stability issues with fuel oil grades is not a new phenomenon and it is possible for HSFO and ULSFO products that are currently available to be unstable. With such a significant part of the market moving to VLSFO, particular attention needs to be paid when mixing fuels, as two fuels may be stable separately but unstable when mixed.

### **Catalytic fines, combustion**

**characteristics and pour point:** These properties are all specified by ISO 8217. Although it is possible that some fuels will have increased levels of catalytic fines, others may have much lower levels. Similarly, it is anticipated that many VLSFOs will have excellent combustion characteristics. The pour points may vary across different grades, so care will need to be taken to handle fuels appropriately. The key point to note is that it is expected that there will be significantly more variance across fuels, so each must be treated according to its own specific properties.

**Flash point:** Concern has been raised that flash points may decrease with the new fuels. The SOLAS convention clearly defines the required flash point and fuels should not be purchased that do not meet this specification.

It is well recognised in the industry that there will be more compatibility issues between the compliant 0.5% sulphur fuels. If switching to VLSFO or a mixture of fuel types, vessel owners and operators need to ensure that they are fully aware of the changes required and equipped to deal with them. This includes the need for careful consideration and necessary procedures to prevent damage to auxiliary machinery, engines, boilers and their components.

There are also potentially more risks such as a power deficiency that could lead to possible loss of propulsion or the inability to generate power at critical times during vessel manoeuvring that place the ship and the environment at risk.

### **Guidance on how to transition effectively and safely:**

- Develop onboard plans for fuel segregation, mixing and compatibility testing.
- Allocate sufficient budget, as there will be higher capital and operating expenses.
- Plan for tank cleaning to remove residual components and sludge.
- Ensure the suitability of fuel types and specifications for the vessel.
- Ensure the right grade of lubricants are used with low-sulphur fuels.
- There will also be an effect on the design of the ships, so it is important for vessel owners to evaluate storage capacity, fuel piping systems and equipment to segregate and handle different types of fuels with varying viscosities, densities and handling temperatures.

The safety implications and consequent actions are summarised in Table 3.

Safety implication	Action by	Action
Fuel stability and flash point	Supplier	Know your blendstock
Fuel compatibility	Ship	Segregation is the best strategy; ISO and CIMAC guidance
Cold flow properties	Ship	Ambient temperatures; heating
Viscosity and density	Ship	Fuel conditioning; combustion

With care in supplier blending and fuel management, these risks can be mitigated, as is done today for blended fuels.

**TABLE 3:** Safety implications and actions.

# MAKING THE SWITCH

Switching from high-sulphur to low-sulphur fuels needs to be managed efficiently to ensure compliance and safe operation. There are several operational challenges that vessel operators need to be aware of and prepared for.

## 1 SHIP TANK DESIGN

As there will be an increased risk of incompatibility with the new fuels, it is important that vessel operators pay special attention to managing these fuels according to their tanks' configuration to try to minimise mixing:

### a) Segregated fuel system

A segregated fuel system with internal piping is ideal for avoiding mixing. Special care and attention should be paid to the different fuels that are used together.

### b) Two settling tanks into one daily service tank

For ships that have two settling tanks that feed into one daily service tank, the contents of the daily service tank must be minimised before it is refilled with the next fuel.

### c) One settling tank into one daily service tank

For ships that have one settling tank that feeds into one daily service tank, the contents of the settling tank must be minimised before it is refilled with the fuel from the settling tank.

## 2 QUALITY OF FUELS

The quality of fuels is likely to vary significantly according to local refinery configurations, as there is a great deal of variability possible within the current ISO specification because there is no specific category for blended fuels. Therefore, to avoid problems with incompatibility, it is imperative that different batches of fuels are kept separate and not mixed without testing.

## 3 NATURE OF BLENDED FUEL OILS

The blend components used for 0.5% sulphur fuels can vary considerably: different amounts of traditional paraffinic and aromatic nature components are used, along with other low-sulphur feedstocks. This poses the risk of incompatibility with conventional residual fuels such as RMG, RMK, DMA or MGO.

## 4 CAREFUL MANAGEMENT OF NEW FUELS

- Because of the differing densities between new fuels and conventional residual fuels, centrifuges will require readjustment or recalibration to ensure that the correct gravity disc is selected.
- To avoid the risk of wax formation, new fuels may require heating for delivery purposes and suitable heating throughout the fuel handling system.
- As with existing fuels, new fuels need to be purified before use; purifiers need to be set up and calibrated accordingly to eliminate any issues that could occur.
- Monitoring of all fuel filters is essential, as additional backflushing of the fuel's auto-filter can be expected. This is particularly important at changeover or when VLSFOs are initially used.



**In general, it is certain that the 0.50% sulphur fuel blends will be different from current fuels while continuing to meet ISO 8217 standards. This will be reflected in, for example, their densities, viscosities, pour points and compatibility with each other.**

It is expected that further guidance on fuel characteristics and handling will be available (for example, from OCIMF/IPIECA) and Shell will have detailed operational guidelines available for customers that purchase Shell fuels. The SIP agreed at MEPC73 also specifies what a vessel should consider when preparing for a switch to 0.50% sulphur fuels, for example, what modifications may be necessary to the engine, fuel systems and storage to be able to use distillates or fuels with different viscosities, lubricities, etc. Procedures should be developed to deal with changeovers between fuel qualities and maintaining segregation, etc. A SIP is not mandatory but may be considered by authorities when assessing compliance.

As well as managing the fuel transition, vessel operators will also need to consider how they transition the lubricants in use, as the use of a lower sulphur fuel is likely to require the use of a lower base number (BN) lubricant. For two-stroke vessels, a move to Shell Alexia 40 is likely to be necessary, although the specific lubricant will depend on the engine type and typical operational conditions; equipment manufacturers' guidelines should be followed. For four-stroke vessels, a lower BN Shell Argina grade or a switch to Shell Gadinia (if running purely on distillate fuel) is likely to be necessary. It is also highly recommended that an increased focus is put on monitoring the condition of the engine using the Shell LubeMonitor and Shell LubeAnalyst services.



## HOW SHELL CAN HELP WITH THIS TRANSITION

### A suite of fuel solutions that are widely available

Shell has developed a suite of fuel solutions for the shipping industry that include MGO, VLSFO and HSFO for ships with onboard scrubbers and LNG (Table 4). Building on its experience with the 0.1% sulphur launch, Shell is preparing for the implementation of the 0.5% sulphur blends by performing extensive onboard fuel trials and collaborating with leading industry players. Shell is also developing key supply locations to serve LNG fuel customers (Figure 5). LNG fuel is readily available, cleaner and more cost competitive than traditional fuels and is one of the next steps in the journey towards zero emissions.

### Extensive range of lubricants available in more than 700 ports and 61 countries around the world

Shell offers an extensive range of lubricants for two- and four-stroke diesel engines. For two-stroke engines, we offer the Shell Alexia cylinder oil range, which contains products ranging from BN25 to BN140 (Table 5). The higher BN products are for those vessels that continue to use HSFO in conjunction with exhaust gas scrubbing and the lower BN products are for use with LNG and 0.1 and 0.5% sulphur fuels.

Shell Alexia 40 has been tried and tested in the latest engine types using representative 0.5% sulphur fuels; three of the four test vessels operated solely off the Chinese coast where there is already a requirement for running on 0.5% sulphur fuels and such fuels are available. The fourth vessel has completed 1,500 hours of field trials in the European ECA on 0.1% ULSFO and exhibited many of the same characteristics as it did on 0.5% sulphur fuel, which demonstrates that the product can be successfully used with 0.1% sulphur fuels.

For four-stroke engines, Shell offers Shell Argina and Shell Gadinia oils (Table 6). These lubricants can deal with the faster viscosity increase and BN depletion experienced by oils in modern medium-speed engines that work at pressures 10–17% higher than their predecessors and oil temperatures approaching 300°C at the top crown. Both Shell Argina and Shell Gadinia are available with a variety of BNs to support customers’ needs. For LNG vessels, Shell offers a range of Shell Mysella products.



## OUR FUEL SOLUTIONS

	HSFO				VLSFO	ULSFO	MGO	
	RME 180	RMG 380	RMK 500	RMK 700	0.5% (2020)	<0.1%	<0.1%	0.5% (2020)
<b>AMERICAS</b>								
Antigua		■					■	■
Baltimore		■					■	■
Freeport		■			■		■	■
Houston		■			■		■	■
Montreal and St Lawrence	■	■				■	■	■
Nassau		■					■	■
New Orleans		■			■		■	■
New York	■	■	■	■		■	■	■
Sarnia	■	■	■				■	■
Vancouver	■	■					■	■
<b>EUROPE</b>								
Antwerp			■	■	■	■		■
Barcelona					■		■	■
Danish Strait					■		■	■
Piraeus		■	■		■		■	■
Rotterdam		■	■	■	■	■	■	■
<b>AFRICA AND THE MIDDLE EAST</b>								
Durban	■				■			■
Fujairah	■	■			■			■
Mauritius	■	■			■		■	■
Richards Bay	■				■			■
<b>ASIA AND THE SOUTH PACIFIC</b>								
Hong Kong		■	■				■	■
Noumea		■						
Singapore		■	■		■		■	■

The table shows general specifications and availability. For specific specifications and availability, please contact the corresponding account managers for information.  
 'Ex-wharf business only

TABLE 4: Shell’s global fuel availability.



FIGURE 5: Shell's global LNG marine bunker network.

## OUR LUBRICANT SOLUTIONS

The new Shell Alexia portfolio	Previously known as	Base number BN	SAE viscosity grade	Product features
Shell Alexia 25	Shell Alexia S3	25	50	0.1% sulphur fuel, ECAs and LNG
Shell Alexia 40	-	40	50	0.1% sulphur and 0.5% sulphur fuel
Shell Alexia 70	Shell Alexia 50	70	50	HSFO <sup>2</sup> + scrubber
Shell Alexia 100	Shell Alexia S6	100	50	HSFO <sup>2</sup> + scrubber
Shell Alexia 140	Shell Alexia 140	140	60	HSFO + scrubber

TABLE 5: Shell Alexia two-stroke engine oils and their applications.

Product	BN	SAE grade	Application
Shell Argina S2	20	30, 40	0.1–0.5% sulphur HFO, dual-fuel application
Shell Argina S3	30	30, 40	Main grade, 0.5–2.0% sulphur HFO or MGO, dual-fuel application
Shell Argina S4	40	40	Main grade, 2.0–3.5% sulphur HFO, dual-fuel application
Shell Argina S5	55	40	Premium product, 2.0–3.5% sulphur HFO
Shell Gadinia S3	12	30, 40	<0.1% sulphur MGO, dual-fuel application
Shell Gadinia AL	15	30, 40	Anti-lacquer performance
Shell Mysella S3 N	5	40	Low-ash stationary gas engine oil
Shell Mysella S5 N	4.5	40	Premium, long-life, low-ash stationary gas engine oil

TABLE 6: Shell Argina and Shell Gadinia oils for four-stroke engines.

<sup>2</sup>0.5% sulphur fuel (if needed for cleanliness)

## SHELL TECHNICAL SERVICES

Shell offers a range of technical solutions to help customers manage the transition to be IMO 2020 compliant as safely, efficiently and cost-effectively as possible.

### **SHELL LUBEMONITOR:** Monitoring services to ensure engine performance during fuel transition



Switching fuel can have a severe impact on your engine's performance. Shell LubeMonitor can help customers to understand engine performance during the transition to a low-sulphur fuel. The Shell LubeMonitor service is designed to monitor two- and four-stroke marine engine performance. It includes access to Shell tools and advice to help customers strike and maintain an acceptable balance between oil costs and maintenance expenses.

### **SHELL LUBEADVISOR:** Expert guidance and transition planning



#### **a) Changeover guidelines – Get the right lubricant for the planned fuel or the fuel in use**

Selecting the correct lubricant to comply with any IMO 2020 regulation is critical. Each Shell lubricant has been carefully developed and tested at sea to give the optimum performance for each fuel solution. Shell has a wide range of lubricants available and will assist customers in making the right choice.



#### **b) Understand fuel quality and compatibility**

There are universally perceived benchmarks that characterise the key attributes of fuel oils and their suitability for use onboard. With the introduction of a wide range of fuels that can differ considerably from those currently in use, Shell has the expertise to help customers understand the different fuel types and their potential impact on vessel operation.



#### **c) Onboard testing of fuel**

Fuel incompatibility and contaminants such as catalytic fines could pose concerns and problems for onboard fuel management and engine operation. Shell Marine offers customers different onboard fuel tests solutions, such as compatibility testing, that can help customers to identify quickly potential fuel stability problems on mixing, and tests for catalytic fines to help prevent irreparable damage to fuel pumps, injectors, piston rings and liners.



#### **d) Step by step vessel transition planning**

Fuel transition planning will have to be managed carefully; everything from lubricant stock management to understanding the lubricant system layout requires thorough planning. Shell can help customers to understand this and will tailor make vessel-specific transition plans for lubricants.

### **SHELL LUBEANALYST:** Oil condition monitoring service



This flexible used-oil laboratory analysis service is designed to save you time and money on maintenance resulting from equipment failure. It is early-warning system that aims to give you peace of mind that your equipment and lubricants are in optimum working order.

WE CAN HELP TO  
KEEP YOUR BUSINESS  
RUNNING SMOOTHLY  
AND GIVE YOU PEACE  
OF MIND.



An aerial photograph of a ship's wake in clear turquoise water. The ship's hull is visible on the right side, cutting through the water and leaving a white wake. The water has a textured, rippled appearance. The text is overlaid on the left side of the image.

**SHELL OFFERS A RANGE OF TECHNICAL SOLUTIONS** TO HELP CUSTOMERS MANAGE THE TRANSITION TO BE IMO 2020 COMPLIANT AS SAFELY, EFFICIENTLY AND COST-EFFECTIVELY AS POSSIBLE.



# MILES – AN INTEGRATED SMART SOLUTION THAT HELPS OPTIMISE BUSINESS PERFORMANCE



The transition to being IMO 2020 compliant highlights many of the challenges in efficiently managing the fuels and lubricants necessary to ensure safe and cost-effective operation of vessels. It is clear that, after 2020, the shipping industry will continue to face changes with ongoing initiatives relating to energy efficiency and the carbon dioxide emission and greenhouse gas targets set by the IMO. Shell Marine will help its customers be ready for the changes with its proprietary marine integrated lubrication and expert solutions (MILES). Shell MILES combines high-quality lubricants, technical support, advanced procurement and inventory management into a strategy that addresses customers’ most pressing operational concerns (Figure 7). By using MILES, we work with customers to help manage the reliability, efficiency and profitability of their business.

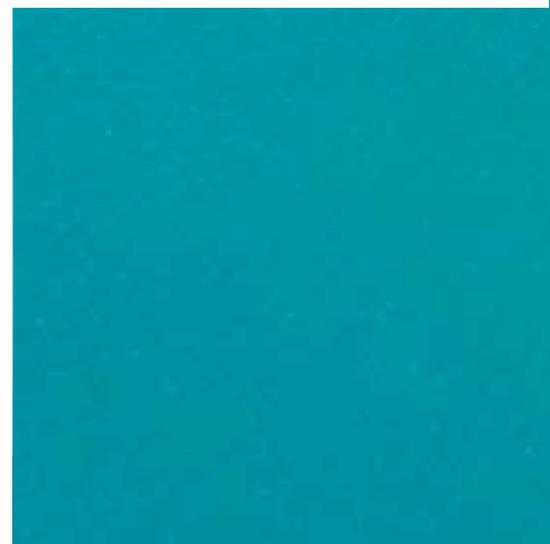
## Enhancing reliability through lubrication solutions

Our extensive range of lubricants has been developed to help optimise performance in new fuel-efficient engines, existing engines with long lifespans, engines operating at full and part loads, and engines working inside and outside ECAs. We also offer auxiliary oils and greases ranging from hydraulic fluids to environmentally acceptable lubricants for onboard equipment. Our range of technical services can help you get the most from our product portfolio, thereby helping you to achieve greater equipment reliability, reduce downtime and identify potential faults.

## Enhancing efficiency by using advanced technology to optimise procurement

Ordering lubricants can be a complex and time-consuming process and poor decision making can create cost overruns. Typically, 30% of lubricants are purchased as multiple small orders, which creates an additional administrative burden. The MILES programme is powered by advanced technology that uses integrated vessel tracking, route prediction and intelligent consumption modelling to support and improve your procurement operations. This web-based service gives customers the potential to free themselves from manual operational tasks while identifying opportunities to drive value. The information generated enables us to recommend lubricant quantities and the best uplift ports for our customers based on real-time consumption and sailing patterns. The service manages end-to-end vessel lubrication and offers customers

- effective replenishment
- alerts when auxiliary oils are needed
- optimised economics through reducing the number of lifts and targeting these for efficient port visits
- availability confirmation in advance of orders.



### Enhancing profitability with smart payment schemes

Through the MILES programme, we offer different payment solutions such as flexi-pay that can help you to optimise your working capital and budgeting. Shell Marine believes that helping shipowners to reduce their operating expenses and their budgets will benefit them over time. We work with shipowners to assess and offer payment schemes to help optimise their working capital outlay with

- monthly payments (cost of lubrication per month)
- mileage payments (cost of lubrication per mile).



THE MILES PROGRAMME IS POWERED BY ADVANCED TECHNOLOGY THAT USES INTEGRATED VESSEL TRACKING, ROUTE PREDICTION AND INTELLIGENT CONSUMPTION MODELLING.

# SHELL IS YOUR **TRUSTED** BUSINESS PARTNER

Our Shell Marine expertise supports your business.

# 100+

years of experience in the marine industry

# 60+

years of field experience working with equipment manufacturers

# 10,000+

vessels we serve: from ocean-going tankers to small fishing boats

## People, expertise and high-quality products

### Manufacturing and energy production

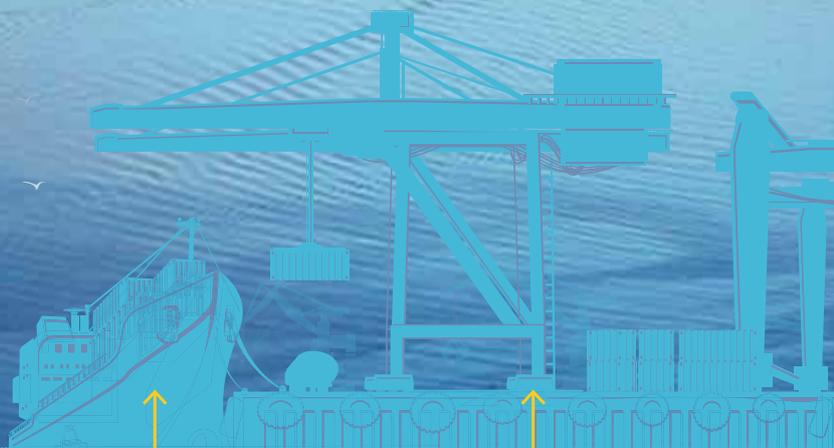
- Refining oil into fuel and lubricants
- Producing petrochemicals
- Liquefying gas by cooling (LNG)
- Converting gas to liquid products (GTL)
- Upgrading bitumen

### Transport and trading

- Shipping and trading
- Regasifying (LNG)
- Supply and distribution

Reduced CO<sub>2</sub> intensity by reducing number of operations through optimized liftings

By providing the right fuelling lubrication solutions we help to manage emission requirements





# 700+

worldwide network of ports and shipyards

# 61

countries around the world where Shell Marine is present

# 24/7

customer service team is available to assist you



Reduced CO<sub>2</sub> intensity by incorporating green raw materials to our sites, zero waste, carbon neutral production as well as transportation and reducing packaging waste.

#### References

Marine Fuel Oil Advisory 2018 (ABS)

IMO feedback on PPR6: [www.imo.org/en/mediacentre/meetingsummaries/ppr/pages/ppr6th-session.aspx](http://www.imo.org/en/mediacentre/meetingsummaries/ppr/pages/ppr6th-session.aspx)

MAN Energy Solutions information on 0.5% sulphur fuels: [https://marine.man-es.com/docs/librariesprovider6/marketing-publications/calines-paper/detailed\\_paper\\_0\\_50S\\_fuel.pdf](https://marine.man-es.com/docs/librariesprovider6/marketing-publications/calines-paper/detailed_paper_0_50S_fuel.pdf)

MAN Energy Solutions two-stroke service letters: <https://marine.man-es.com/two-stroke/service-letters>

American Bureau of Shipping information on IMO 2020: <https://ww2.eagle.org/en/products-and-services/abs-advisory-services/environmental-performance/imo-2020-global-sulphur-cap.html>

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