

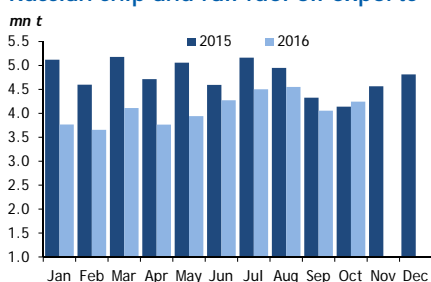
## SPECIAL REPORT: BUNKER FUEL

**Shipping firms are expected to switch to low-sulphur fuel or middle distillates rather than install scrubbing technology**

### Marine fuel 0.1pc vs HSFO



### Russian ship and rail fuel oil exports



## Industry braces for IMO sulphur cap

A decision to cap global marine fuel sulphur emissions will have major implications for the world's refining and bunkering industries.

The International Maritime Organisation (IMO) decided in October to limit the maximum sulphur content in marine fuels to 0.5pc by 2020. This will lead to a global reduction in the sulphur content of marine fuels from 3.5pc now. Some IMO members and some in the shipping industry were pushing for 2025 as the start date, warning that low-sulphur fuels could suffer shortages caused by a sharp upswing in demand for shipping. The decision will have a major impact on the bunkering and refining industries globally.

Shipping companies will have to switch to 0.5pc sulphur fuel oil, hybrid fuel or cleaner marine gasoil (MGO). Alternatively they could install scrubbing technology or switch to LNG in places where the infrastructure exists to support its use as a bunker fuel. Less scrupulous companies may choose to ignore the new regulations, given difficulties surrounding their enforcement. The industry appears to be taking a wait-and-see approach on the best way to comply with the regulations. The long lead times needed for investment in refinery upgrading units may mean that shipowners will be better placed to invest and recoup costs more quickly.

Shipowners can invest in scrubbers to remove sulphur from exhaust fumes as an alternative to switching to low-sulphur marine fuel, although scrubbing units are expensive at \$2mn-5mn. But a shipping company could recoup the cost of investment within two years, according to some estimates, given that high-sulphur bunker fuel currently trades at up to a \$200/t discount to 0.1pc sulphur fuel oil (see graph).

The IMO decision is expected to force many tanker and dry bulk carrier operators to switch to low-sulphur fuel or cleaner middle distillates, but it is uncertain whether sufficient quantities of compliant fuel will be available by 2020. The IEA calculates that the industry will have to switch from using around 2.2mn b/d of fuel oil to MGO in a very short period. A study by consulting firms Ensys and Navigistics conducted for shipping association Bimco puts the figure at 3.6mn b/d, and cites a limited uptake of scrubbers by the end of 2019.

Russia, a major fuel oil exporter, has cut production this year by 27pc to around 1mn b/d, after it added upgrading units. Many European refiners are considered unlikely to invest in new upgrading capacity and are expected to reconfigure existing systems instead. The investment timeframe is several years for new refinery units such as cokers, hydrodesulphurisation units or hydrocrackers, which boost distillate output and reduce sulphur content. This means that projects will already have to be under way if refiners are to benefit from the expected fuel shift in 2020.

Regional disparities in compliant bunker fuel output are expected, opening up arbitrage opportunities. New and planned refinery upgrades in the Middle East are expected to lead to a surplus of compliant fuel oil, while North America, Africa and Asia-Pacific are expected to be in deficit.

### Scrubbing up

Opec in its *World Oil Outlook 2016* expects gradual rather than instant compliance with the new standards, and expects scrubber technology to remove sulphur emissions to be "relatively successful over the long term".

But it adds that the "need to supply large volumes of compliant fuel could lead to a period of substantial market tightness as the industry adapts". Opec forecasts around 7.3mn b/d of global crude distillation unit additions in 2016-21, with a further 1mn b/d of increased capacity achieved through debottlenecking.

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**Studies disagree on whether the global refining industry is capable of producing enough compliant bunker fuel for ships by 2020**

## Marine gasoil vs HSFO



Russian refinery upgrades	mn t/yr			
	2016	2017	2018	2019
Primary processing	0.3	10.0	7.6	23.6
Vacuum distillation	3.6		3.4	
Hydrocracking	6.5	2.0	10.1	
Vacuum residue hydrocracking	2.7		4.8	
Coking	7.7		2.4	2.0
Combined vacuum block and visbreaking				
Diesel hydrotreatment	4.0	11.1	7.6	6.4
Visbreaking	0.8			
Sulphur production	0.0	0.0	0.0	
Gasoline/naphtha hydrotreatment	2.6	1.5		4.6
Catalytic cracking	3.2	5.6	3.1	
Catalytic reforming	0.7	1.3	1.0	1.5
Isomerisation	0.8	1.4	0.5	0.8
Alkylation	0.4	0.3	0.2	0.1
Oxygenate production	0.6	0.0		0.1
Hydrogen production	0.3	0.1	0.3	
Gas fractionation			0.1	
Total	34.2	33.3	41.1	39.0

## Global sulphur cap poses challenge for refineries

The 0.5pc global sulphur cap on bunker fuels poses a major challenge for the world's refiners.

The International Maritime Organisation (IMO) decided in October to implement a cap of 0.5pc on sulphur content in marine fuels by 2020, leading to a reduction in the maximum sulphur content of marine fuels from 3.5pc now. Most tanker and dry bulk carrier operators will have to switch from running high-sulphur fuel oil (HSFO) to 0.5pc sulphur fuel or cleaner middle distillates, principally marine gasoil (MGO). This is expected to hit refiner margins, supply contracts, equipment and possibly even share value.

Studies into the potential impact of the 2020 cap put the potential quantity of high-sulphur fuel that will need to be converted into lower-sulphur product at up to 3.6mn b/d. It is uncertain whether the global refining industry is capable of producing enough compliant bunker fuel for the world's ships by the 2020 deadline. A study led by environmental consultancy CE Delft found that planned new upgrading capacity, much of it in the Middle East, will help ensure that sufficient compliant fuel is produced.

But another study, primarily carried out by US-based Ensys Energy, found that a shortfall in hydrotreaters and sulphur recovery units at refineries will lead to a deficit in compliant bunker fuel by 2020. Desulphurisation requires treatment with hydrogen, producing toxic hydrogen sulphide gas, which has to be recovered in a sulphur unit. Some 35-50pc more hydrogen plants and an additional 60-75pc more sulphur recovery unit capacity is needed on top of what is currently scheduled for construction in 2016-19, the report says.

Significant regional disparities in compliant bunker fuel output are expected, potentially leading to new trade flows. CE Delft expects new refining capacity to give the Middle East a 13mn t/yr surplus of compliant fuel oil, while North America is expected to have a 9mn t/yr deficit. Africa and Asia will be in deficit, while Europe and Latin America are likely to be marginally long.

## Piling on the pressure

Investment in upgrading capacity is unlikely in Europe, where refiners are under pressure from new capacity in other regions, high energy and labour costs, and tightening environmental rules. Refiners are likely to focus on debottlenecking and reconfiguring existing systems. Hungary's Mol and Greece's Hellenic say they have enough upgrading capacity to limit fuel oil output. Portugal's Galp is likely to process low-sulphur crudes. Swedish refiner Preem is investing in a hydrogen production unit, increasing desulphurisation capacity at its 106,000 b/d Gothenburg plant.

Russia, a major fuel oil exporter, cut its production to around 1mn b/d in January-October, down from 1.39mn b/d over the same period in 2015, through the addition of at least 120,000 b/d of vacuum distillation capacity and over 170,000 b/d of coking capacity in 2015-16. Around 620,000 b/d of FSU hydrocracking additions are planned in 2016-20, with 110,000 b/d of coking capacity coming on stream in 2018-20.

Sophisticated refiners with coking and other heavy upgrading equipment may benefit from the new regulations by being able to purchase cheaper, higher-sulphur crudes and still produce profitable, compliant, low-sulphur fuel oil along with valuable middle distillate blendstocks. But simple hydroskimming refiners could face a rise in the relative cost of sweet crudes – necessary to produce compliant bunker fuels – which will undermine refining margins. Some fear the 2020 cap will contribute to refinery closures.

## SPECIAL REPORT: BUNKER FUEL

*Market participants say the adoption of 0.1pc sulphur rules in ECAs shows the industry's ability to adapt to tougher regulations*

## Bunker buyers concerned at impact of sulphur cap

The shipping industry has been slow to commit to meet the requirements of the International Maritime Organisation's (IMO) 0.5pc sulphur cap.

Shipping companies have several options, including switching to cleaner marine gasoil (MGO), using compliant 0.5pc sulphur fuel oil or installing scrubbing technology. Compliance with the sulphur cap is likely to vary globally, with some reckoning that many will flout the limit beyond the deadline.

Scrubbers are fitted in a tanker's funnel to clean exhaust gases. They are costly, at \$2mn-\$5mn, but shipowners could recoup the cost in just a few years according to some estimates, as high-sulphur fuel oil (HSFO) tends to trade at around a \$200/t discount to lower-sulphur distillates. Some shipping companies are looking at leasing options for installing scrubbers, with projections that they could be cash positive within six months.

Scrubbing technology is likely to become more cost-effective if the new rules drive down the cost of high-sulphur fuels. DuPont Clean Technologies estimates that 500-2,000 ships will retrofit scrubbers in the run-up to 2020, while up to 20pc of the global shipping fleet will be fitted with scrubbers by 2025. If scrubbers become a popular option, equipment and installation constraints could lead to long waiting times for having systems fitted. Some industry experts say it makes little sense to convert older vessels because of the costs involved, as they may be scrapped after a few years.

LNG could be adopted as a bunker fuel, although its use could be undermined by a lack of sufficient bunkering infrastructure at ports.

Most vessels are expected to switch to 0.5pc compliant fuel or MGO. The MGO share of the marine fuel market has risen since 2015, thanks to a reduction in sulphur emissions limits in emission control areas (ECAs). The shipping industry uses MGO for 10-15pc of its fuel requirements, *Argus* estimates. No technical modifications are needed to run MGO instead of HSFO, but some operators have encountered problems when switching between MGO and HSFO at sea.

Some market participants say the industry's adoption of 0.1pc sulphur restrictions in ECAs demonstrates its ability to adapt to tougher regulations, albeit on a much smaller scale. But ECA 0.1pc sulphur fuel in Rotterdam currently commands a \$140/t premium to HSFO. Marine gasoil typically commands a \$170-220/t premium to HSFO across European ports.

### Marine fuel 0.1pc sulphur



### A volatile mix

Problems could arise if fuel specifications vary at different ports, creating uncertainty for vessel operators. Variations in the type of fuel blends available could cause damage to engines, which may be unable to handle differing viscosities. And new fuels may be missing essential lubricant properties, causing wear to engines. Lower flash points could increase the possibility of fires, with the fuel able to ignite more readily at lower temperatures.

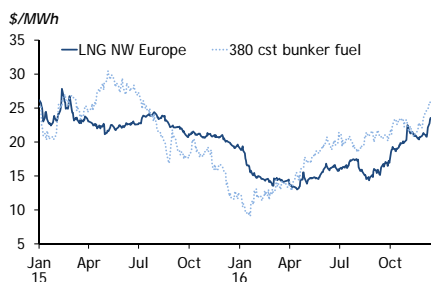
Variations in refining capacity in different regions are likely to lead to supply tightness in some areas, which will lead to imports of low-sulphur fuels and potentially negate the drive to cut emissions.

It remains unclear who will police the use of low-sulphur fuel and at what stage of the consumption process its use will be checked. Trading firms and suppliers are concerned that they will be made responsible for looking at paperwork to check if a ship has exhaust scrubbing capabilities before they can supply the vessel with high-sulphur fuels. They ultimately view such a decision as a refinery and shipping industry problem, as trading firms will adapt quickly and supply low-sulphur fuel as required by the market.

## SPECIAL REPORT: BUNKER FUEL

*The number of LNG-powered vessels is growing and bunkering services are increasing*

## Bunker fuels: LNG and HSFO



## LNG viewed as alternative fuel

LNG is a viable alternative fuel for ships to meet new IMO emissions regulations, and many European terminal operators are developing bunkering services.

The number of LNG-powered vessels operating globally is set to more than double over the next few years, Norwegian classification body DNV GL says. There were 77 vessels running on LNG at the beginning of this year, while 79 are scheduled to be delivered by the end of 2018. The number of LNG-powered vessels has risen from only 25 years ago, as more LNG bunkering infrastructure has come on line. A growing number of ports in Europe are offering LNG bunkering services, increasing interest in running vessels with the fuel, as rules on their movements will be less restrictive. Ports that have recently launched LNG bunkering services include Flushing in the Netherlands and Rostock in Germany.

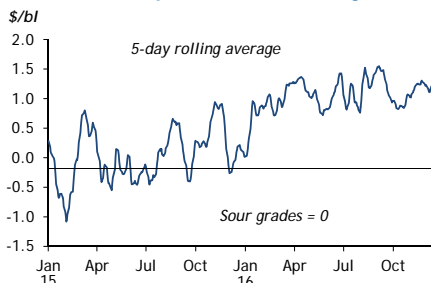
Two new LNG bunkering vessels are due to begin operating in northwest Europe next year, one from Belgium's 7.2mn t/yr Zeebrugge LNG import terminal and another from the Netherlands' 8.7mn t/yr Gate facility. Performing bunkering operations with these vessels, through ship-to-ship transfer, should help lower costs for larger LNG-powered vessels.

The advantages of switching to LNG for bunkering include reducing nitrogen oxide emissions by up to 90pc, and sulphur oxide particulate matter by nearly 100pc. At times, LNG can cost less than competing high-sulphur fuel oil (see graph). But the energy density of LNG is lower, so vessels need bigger tanks to carry the equivalent amount of energy in oil form. This reduces cargo-carrying space and increases a ship's weight. And the conversion of older vessels to run LNG may not pay if a ship has only a few years left to run.

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*The sulphur cap is expected to support middle distillate blend-stocks and marine gasoil, but high-sulphur fuel oil will weaken*

## Sweet crude premium to sour grades



## IMO ruling to boost sweet crudes

The rise in demand for low-sulphur marine fuel will lift demand for low-sulphur crudes, further supporting sweet crude's premium to sour grades.

The 0.5pc sulphur cap on marine fuel by 2020 is likely to strengthen demand for middle distillate blend stocks and marine gasoil, supporting distillates margins. But high-sulphur fuel oil is expected to weaken.

The premium of low-sulphur crude relative to high-sulphur crude is expected to rise, driven by higher demand for sweeter grades that yield more low-sulphur products. A rise in the relative cost of sweet crudes could pressure simple hydroskimming refineries. Some fear that the 2020 cap will contribute to refinery closures, with simple plants considered most at risk.

The premium of sweet crudes relative to sour grades has risen steadily since 2015, supported by the increased output of Iraqi, Iranian, Saudi and Russian sour grades, and sporadic disruptions to light sweet supplies from Nigeria and Libya, as well as declining light sweet crude output from the US (see graph).

Demand for Mideast Gulf and Latin American heavy sour crudes could wane because of the new regulations. But new refineries coming on stream in recent and future years are geared towards running heavier crudes, and could still profitably produce compliant, low-sulphur fuel oil.

The regulations could shift global crude flows. Less complex European refiners will seek to increase sweet crude runs, potentially taking more from west Africa. At least one marine fuel blender in the Rotterdam area has been processing very low sulphur African crude at a refinery in northwest Europe to produce a low-sulphur straight-run fuel oil that meets the current emission control area sulphur cap of 0.1pc.