

April 2026

Bunker Quality Trends

Navigating localised risk in a complex marine fuel landscape.

GLOBAL QUALITY
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BIOFUEL BUYING
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GEOPOLITICAL
IMPACT



Introduction

Written by: Chris Turner, Technical Manager

Beyond Specification: Rethinking Fuel Quality, Risk, and Value

At a macro level, marine fuel quality across the principal grades and hubs remains broadly stable. Most supplies meet specification, and headline averages continue to provide reassurance.

The risk, however, sits at the micro level. It concentrates geographically, from port to port; and operationally, from supplier to supplier. Elevated tolerance patterns, clustered sulphur exceptions, shifts in total sediment potential distribution, and persistently higher catalyst-fine averages appear locally rather than across entire regions. Supply chain inflexibilities—such as multiple product barges combined with tightening blend giveaway—add further complexity, meaning routine variance can carry greater consequences. The picture is therefore not one of structural decline, but of localised spikes.

In environments like this, the fundamentals matter. Buying discipline, operational control, and the management of known risks remain the first line of defence. But the wider message in this report goes further: the industry must move beyond headline price—first to the real price of fuels, and ultimately to its true value.

True value now extends beyond simple compliance and stability. It means buying energy rather than tonnes, understanding calorific value, combustion behaviour, and operational consistency. It also means recognising carbon intensity as a measurable commercial exposure, not a secondary consideration. The fuel decision is no longer just about what meets specification today, but about what delivers energy efficiently and positions a vessel competitively as regulatory and geopolitical pressures tighten.

This report examines where risk is concentrating, how performance is shifting, and what that means for commercial decision-making in an increasingly complex bunker market.

Data Used in This Report:

+62m	+750
MTs of Deliveries	Suppliers
1,114	
Global Locations	

Likelihood of owner analysis testing beyond 95% confidence table limits

Across the reporting window from July 2025 through January 2026, owner 'in-delivery' testing continues to show ULSFO as the grade most likely to trigger a quality notification beyond the 95% confidence limit, at 3.1% of samples.

The key change compared to the previous reporting window is the runner up: VLSFO has moved up to 2.7%, ahead of HSFO at 2.1% and MGO at 1.8% (shown in figure 1).

Against the previous report baseline (January through June 2025), the movement is clear and not uniform. ULSFO edges down from 3.5% to 3.1%, VLSFO rises from 2.1% to 2.7%,

HSFO falls from 2.6% to 2.1%, and MGO drops from 2.4% to 1.8%.

The categorisation of notifications has also shifted. HSFO's improvement is led by fewer critical notifications—down by 0.5%— while MGO sees a reduction across compliance and high-risk bands. ULSFO remains the most variable grade, but with lower overall consequence, as compliance, critical, and high-risk notifications all ease marginally.

VLSFO, however, bucks the trend and is the only grade moving the opposite direction, rising in overall incidence as well as in the compliance and critical-risk categories.

Fuel Grade	Beyond 95% Confidence* %	Compliance %	Critical %	High Risk %	Low Risk %
HSFO	2.1 (-0.5)	0.1 (=)	0.3 (-0.5)	0.4 (-0.1)	1.7 (+0.1)
VLSFO	2.7 (+0.6)	0.8 (+0.1)	1.0 (+0.2)	1.8 (+0.3)	0.9 (+0.3)
ULSFO	3.1 (-0.4)	1.5 (-0.1)	0.3 (-0.1)	1.8 (-0.2)	1.3 (-0.2)
LSMGO**	1.8 (-0.6)	1.0 (-0.3)	0.2 (=)	1.2 (-0.3)	0.6 (-0.3)

Figure 1: Types and frequencies of notification by grade excluding biofuel blends (% change since last reporting period in parentheses).

*Beyond 95% confidence for a parameter listed in table 1 or table 2 of ISO 8217:2010 basis owner test.

**Data includes pour point notifications in Singapore (which is not routinely guaranteed) and fuels that may contain biofuels but are not identified as such.

Global Quality Trends

Written by: Chris Turner, Technical Manager

How likely are we to face a major quality issue within ISO 8217 table parameters?

Practically speaking, genuine table limit failures remain the exception, not the rule. When problems onboard a vessel occur, they are as likely to be driven by housekeeping and post-delivery handling as much as by a clear specification exception.

However, this increases the need to move beyond the specification itself when buying, rather than losing focus on understanding and appreciating some of the challenges experienced including cold flow, compatibility, stability and varied injection and purification controls.



High Sulphur Fuel Oil

Written by: Chris Turner, Technical Manager

HSFO Traded ISO Specifications

HSFO continues to be sold on obsolete ISO editions, despite having fewer headwinds than the other residual grades.

Across HSFO 180, 380, 500 and 700, trading remains concentrated in two contract references, ISO 8217:2017 (53.5%) and ISO 8217:2010 (45.7%). Other editions are effectively traces with ISO 8217:2005 and ISO 8217:2024, both only accounting for 0.4% of trades each.

The latest 2024 specification remains embryonic at a global level, with no meaningful shift in contracting behaviour.

The regional picture (see figure 2) explains why the global position barely shifts. East of Suez is the main laggard with 56.2% of all fuels sold to ISO 8217:2010, whilst West of Suez is dominated by ISO 8217:2017 at 72.5%.

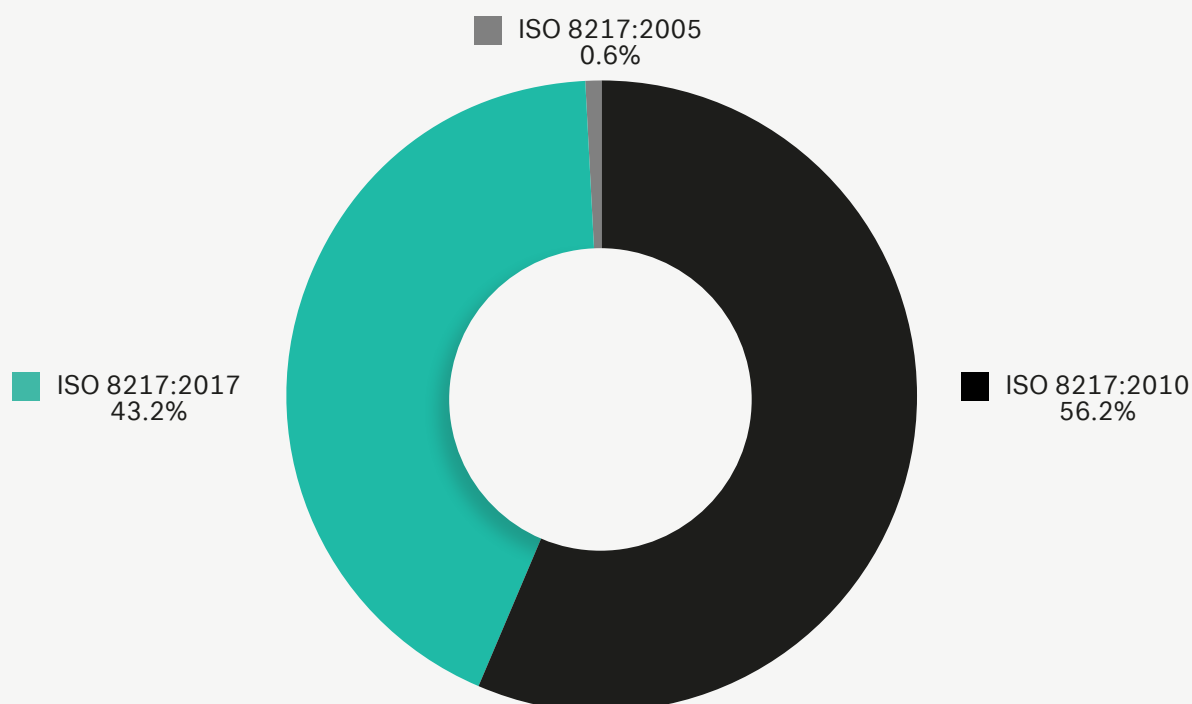


Figure 2: HSFO traded volumes by specification– East of Suez.

These “default” specifications are now clearly geographically influenced but the direction of travel remains slow towards 2024. There are some signs of ISO 8217:2024 appearing, but it remains niche. The clearest pockets are the Americas (2.6% referencing 2024) and West of Suez (1.2%), while the mainstream HSFO contract language is still anchored to 2010 and 2017 (see figure 3).

The Singapore supply chain remains broadly capable of meeting many of the 2024-style expectations for HSFO, but fuels are simply not being sold into it. Indeed, no 2024 sales were referenced in the last 180 days, which suggests buyers are not asking for the uplift in specification.

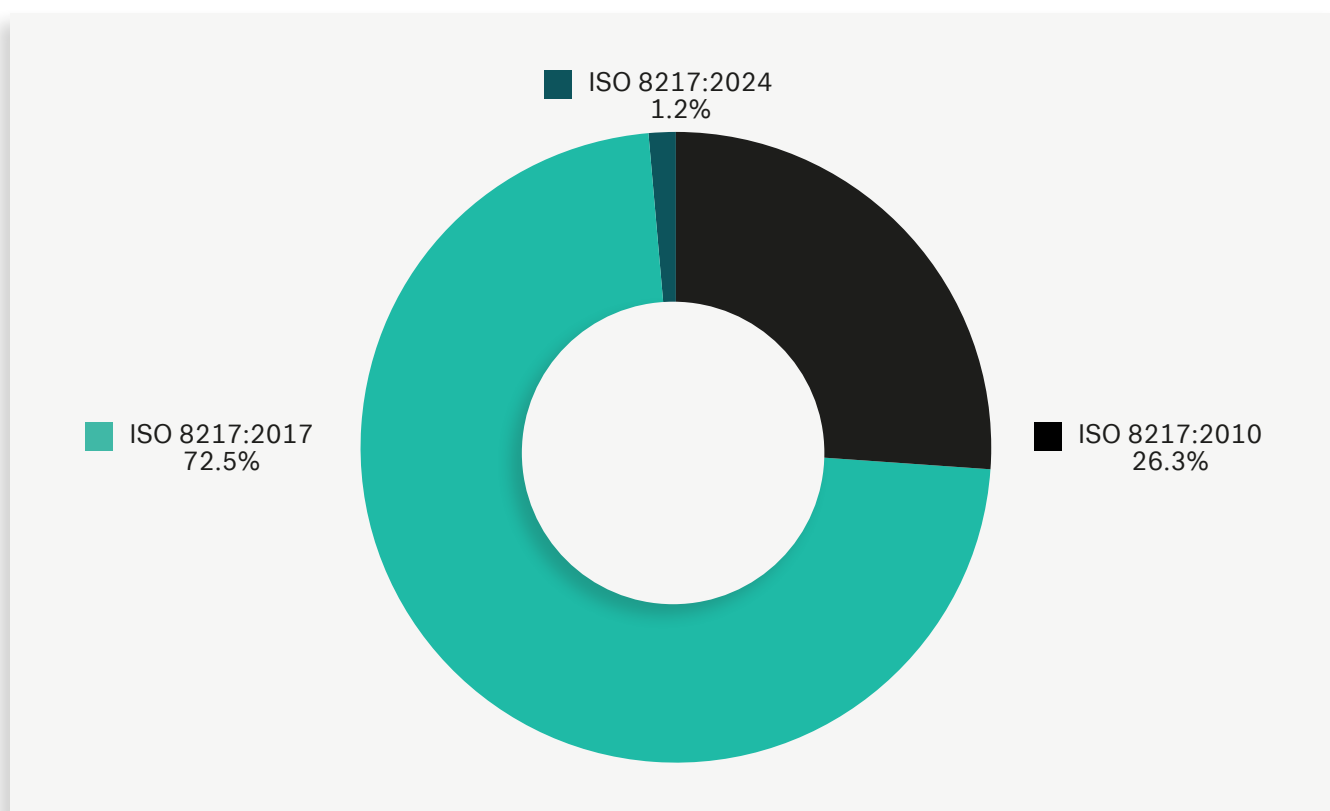


Figure 3: HSFO traded volumes by specification– West of Suez.

This laggard behaviour is nothing more than simply meeting the requirements of the Charter Parties where references to older legacy specifications remain, and unless this changes, the highly logical (and beneficial) movement to the new specification, with enhanced guarantees, will be further delayed.

The reality is that the enhanced guarantees that need to be provided, and the results required additional test parameters on the CoQs, may not be available therefore unless the recap and supplier confirmation explicitly call up ISO 8217:2024 or incorporate the relevant additional requirements into the Charter Party wording.

HSFO Quality

Over the assessed period, only **2.1%** of HSFO supplies tested beyond 95% confidence—an improvement on the previous period's **2.6 %** (see figure 4).

Compared with the previous report, HSFO quality shows a global improvement. The share classed as beyond 95% confidence has fallen to **2.1%**, while the severity mix has improved, with **critical cases at 0.3%** and **high-risk cases at 0.4%**. Outright MARPOL and SOLAS non-compliance outcomes remain minimal at **0.1%**.

Alongside the improving headline, HSFO quality exceptions remain unevenly distributed. This update highlights several concentrated pockets where notification rates are materially higher than the wider market, most notably across parts of the USA, Panama, and several locations in Italy. These should be treated as localised supply chain issues rather than a shift in global HSFO quality.

The practical message for buyers is unchanged: the grade is broadly stable in the main hubs, but stakeholders should remain alert to specific ports where variability persists and ensure that supplier selection, confirmation discipline, and onboard segregation and handling controls are tightened accordingly.

Singapore HSFO performance has improved in the latest period, with quality notifications falling compared to the previous period. The quality signature has also shifted. Inorganic contamination markers such as ash and sodium remain under observation but are no longer the dominant theme.

Late period Singapore data shows ash-related HSFO notifications are rare and concentrated. The overall off spec rate is low, and ash flags sit within a small subset of deliveries rather than being spread across the supplier base. This points to isolated supply chain cases rather than a systemic Singapore HSFO issue.

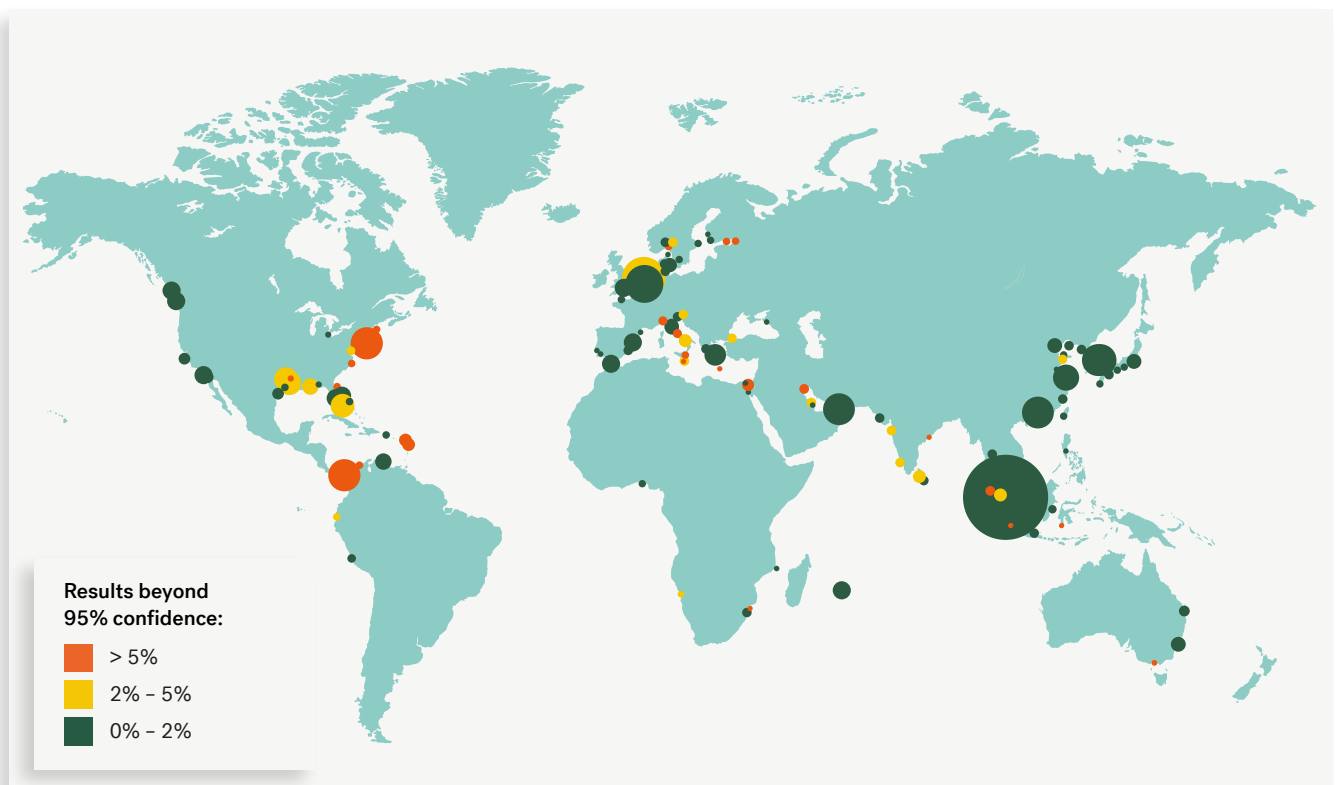


Figure 4: Geographical distribution of HSFO quality infractions from July 2025 to January 2026.

Focus on USA

The USA remains a market where HSFO quality is shaped by local pockets rather than a single, national trend.

Over the assessed period, notifications across the USA (3%) are materially worse than the global HSFO benchmark. The key factor is distribution: most ports are stable, but a small number show localised spikes which come and go over time as commercial pressures ebb and flow.

The earlier part of the assessed period was consistent, with issues centred on blend control and homogeneity rather than a broader contamination theme.

The parameter mix was led by density and viscosity, with water as a secondary contributor. This combination is typically associated with tight gravity blending of heavier RMK grades with LSMGO.

This can result in fuels being non-homogeneous at the point of sampling, which may occur where blend components, tank turnover, or barge operations are not tightly controlled. However, later in the period, this signal eased, with the focus shifting towards the higher-volume hub ports.



US Gulf Coast

Additionally, the US Gulf Coast presents localised pockets. New Orleans stands out in the later part of the assessed period, with 5.3% of HSFO results at borderline or above limit.

The signature, once again, points to blend control and delivery homogeneity, led by density and viscosity, with water as a secondary factor, rather than a contamination theme. In contrast, Houston's issue set is more clearly focused on critical parameters like cat fines and stability pressure, tracked through aluminium and silicon (Al+Si) and total sediment potential (TSP).

The share of samples in Houston (shown in figure 5 below) borderline or exceeding limit for Al+Si rose from 2.1% in March to 28-30% from August-September, before easing back into the low teens through October – January.

TSP shows a more recent story with borderline fuels (0.06% Wt. or higher), running around 11-14% frequency in October-November, before increasing to 28.1% in December and 32.7% in January— a three-fold increase compared to October. This warrants extreme caution when buying HSFO in the Houston region.

Looking more broadly, recent geopolitical developments, including programmed increases in heavy, sour Venezuelan barrels imported into the US Gulf Coast, have raised the possibility of increasing density, ash, vanadium and total acid number levels due to naturally occurring organic acids in the naphthenic crude slates.

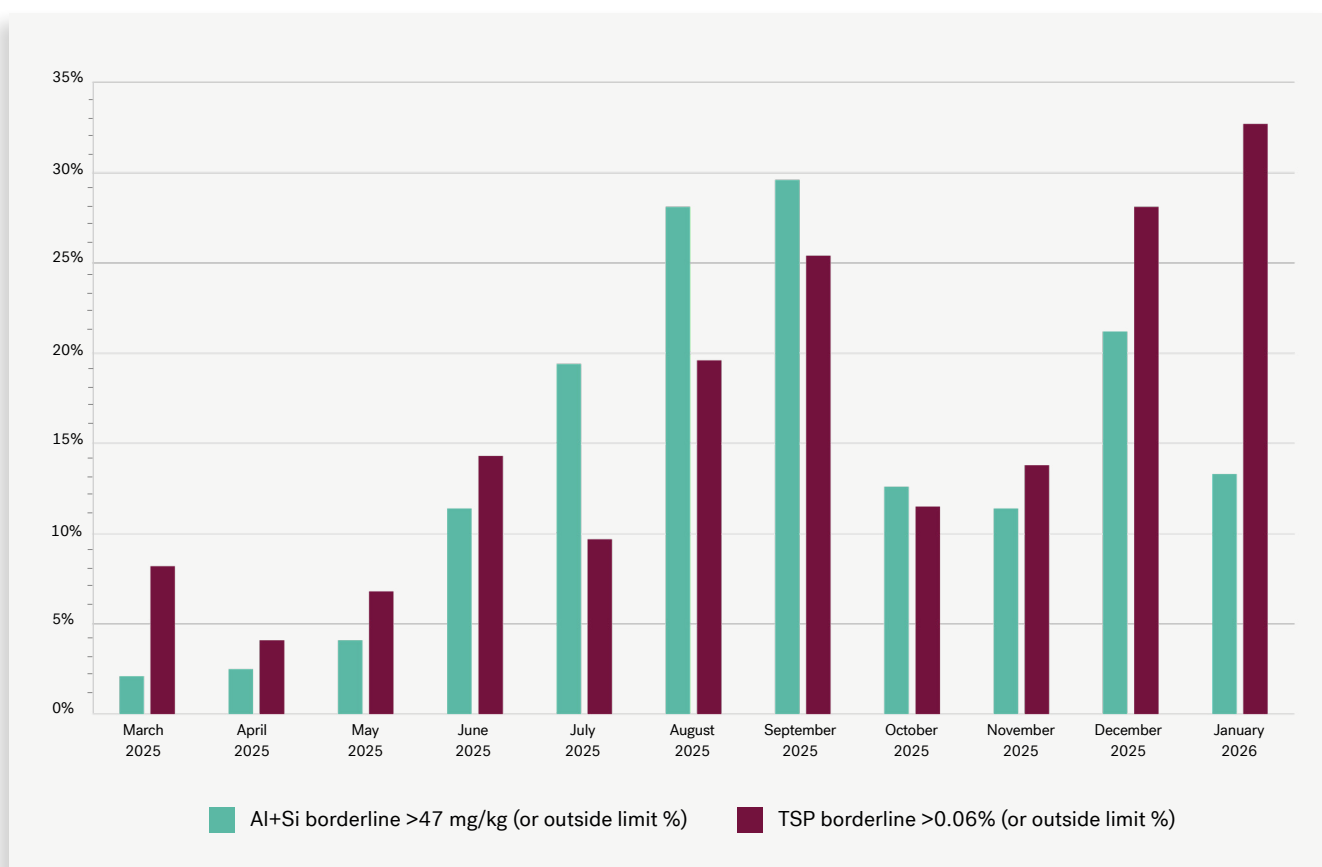


Figure 5: Trends in borderline HSFO quality in Greater Houston, showing Total Sediment Potential (TSP) and aluminium plus silicon (Al+Si).

Panama

Panama remains a location where HSFO performance is driven by local supply chain behaviour rather than a broader market shift.

Over the assessed period, Panama HSFO records a 10% quality exception rate, shaped primarily by the main hub Balboa (9%), but with materially higher exceptions in Cristóbal (30%) and Colón (12%). The exceptions are dominated by viscosity, density and water—consistent with blending with no giveaway rather than critical contamination.

Thankfully, the dataset shows no meaningful signal of critical issues such as TSP or Al+Si, which could otherwise exacerbate the risk of serious onboard challenges given the impact of elevated densities on purification.

Trend-wise, Panama exceptions peaked at **16%** in September before easing to **7%** in January, while Cristóbal remained materially higher and more variable, keeping the port variance highly relevant for any buying discussion.

Focus on Italy

In Italy, the risk is concentrated in one location—Civitavecchia—and it appears tied to a single delivery chain rather than the wider port supply chain.

Civitavecchia has **recorded a high exception rate of 6.9%**, while other Italian ports in the same period remain unaffected.

The parameter profile is led by **TSP**, with smaller contributions from water and density, consistent with a localised stability and handling issue during September and October 2025 rather than a wider deterioration in Italian HSFO supply.



Very Low Sulphur Fuel Oil

Written by: Chris Turner, Technical Manager

VLSFO Traded ISO Specifications

From July 2025 through January 2026, VLSFO maintains the same contracting pattern as HSFO, the split is geographic rather than operational.

East of Suez remains a laggard, anchoring to the older specifications, with ISO 8217:2010 leading at 58.9% versus 40.5% on ISO 8217:2017 (see figure 6).

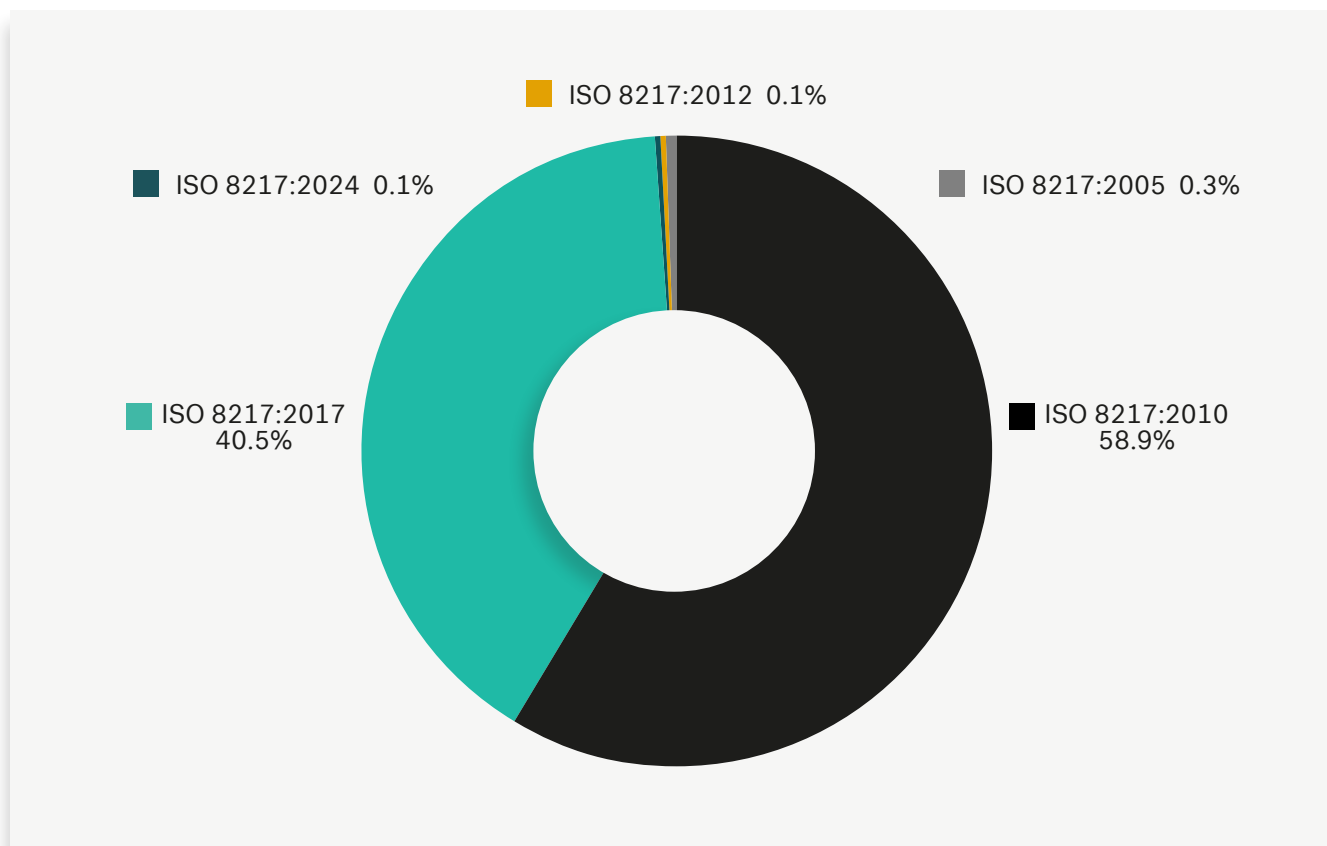


Figure 6: VLSFO traded volumes by specification – East of Suez.

West of Suez, the picture is again the opposite, with contracts moving materially to ISO 8217:2017, which dominates at 74.1% versus 24.3% on ISO 8217:2010. ISO 8217 2024 remains in its infancy however but is visible in traded terms at 1.4% (see figure 7).

Singapore sits in the slowly modernising bucket with 65.4% ISO 8217:2017 and 34.6% ISO 8217:2010, showing that even in the most liquid VLSFO hub a meaningful minority of trades are still concluded on a 15-year-old specification.

Globally, VLSFO is effectively a split market: ISO 8217:2010 at 49.9% and ISO 8217: 2017 at 49.3%.

Availabilities should therefore not be assumed and must be explicitly locked at fixing to avoid later ambiguity or conflicts with Charter Party mandates.

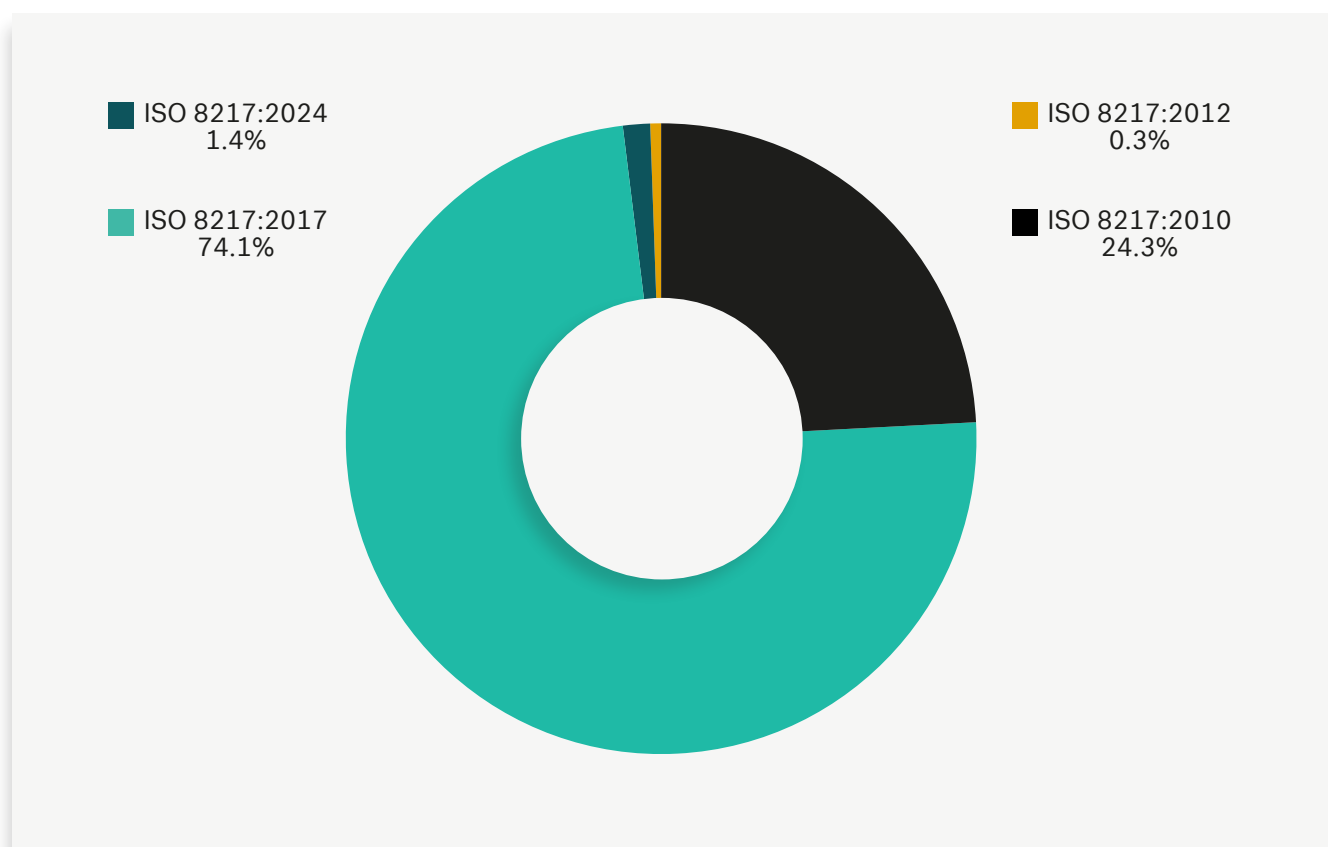


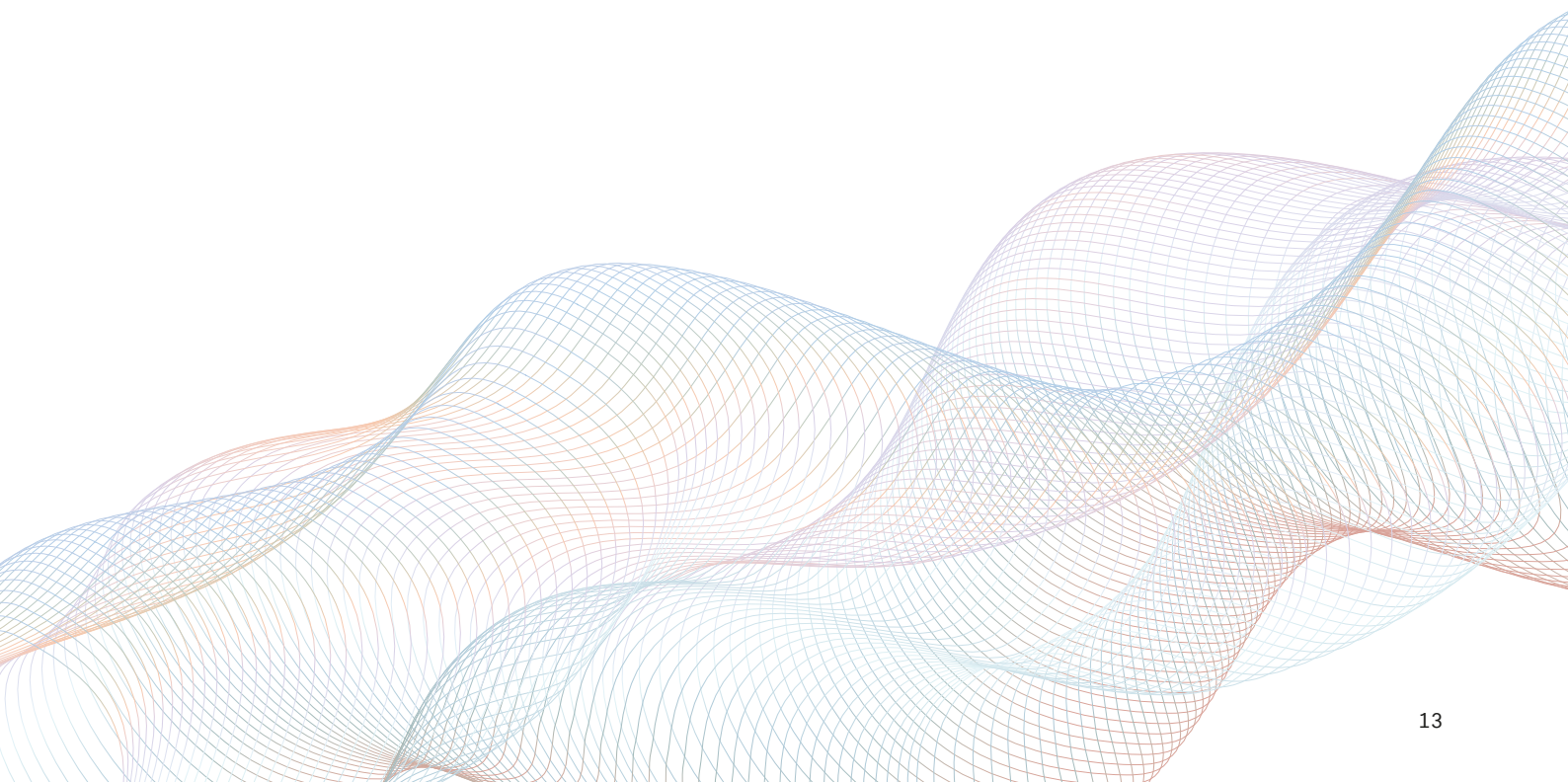
Figure 7: VLSFO traded volumes by specification – West of Suez.

Given that VLSFO blends have historically been targeted primarily around sulphur, viscosity has often been a secondary consideration. The minimum viscosity requirement for ISO 8217:2024 changes that. If demand shifts, suppliers will need to source and guarantee fuel above 120 cSt.

These headwinds ensure that ISO 8217:2017 remains the default in many hubs, and ISO 8217:2024 tends to be contracted only where a buyer is prepared to mandate it, commit volume, or accept a premium for controlled supply.

Region	Samples Returned ≥ 120cSt	VLSFO Availability ≥ 120cSt (%)
Singapore	3,920	76.0%
Belgium & Netherlands (ARA)	1,129	88.9%
Gibraltar & Algeciras	502	86.1%
Fujairah & Khor Fakkan	929	76.0%
US Gulf Coast, Greater Houston & NOLA	290	28.6%

Figure 8: VLSFO viscosity distribution (July 2025 – January 2026) and samples meeting 120cSt or higher.



VLSFO Quality

2.7% of all VLSFO supplies in the dataset were reported as testing beyond 95% confidence limits for ISO 8217 table 2 parameters in the last 180 days—this is 0.6% higher than the previous period.

As with HSFO, the global average still masks the fact that certain locations carry a much higher concentration of exceptions.

Within the exceptions noted, the high-risk parameters that matter operationally—aluminium plus silicon (Al+Si) and total sediment potential (TSP)—remain low in absolute terms. Their share of outcomes has increased versus the previous data, but this is driven by a reduction in other issues in real terms including sodium and density-related reports rather than a step change in cat fines or sediment behaviour.

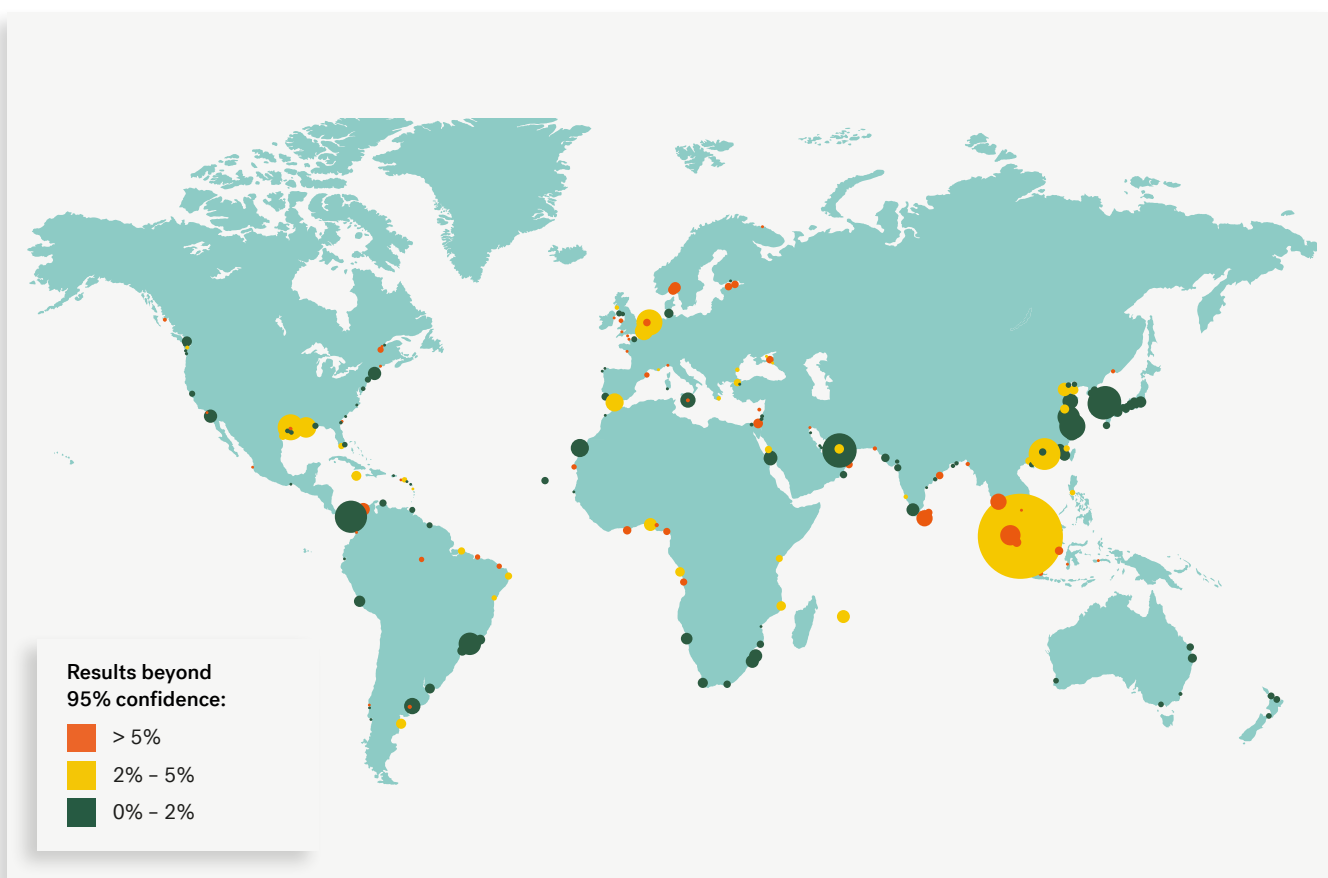


Figure 9: Geographical distribution of VLSFO quality infractions by parameter July 2025 to January 2026.

The overall mix of VLSFO quality issues remains broadly unchanged: sulphur (30%), water (19%), TSP (8%), and cat fines (8%) together now make up 65 % of all exceptions, in-line with previous reports.

Flash point non-compliances are almost non-existent (3%), at below one sample in a thousand, underscoring that the main legislative pinch-points for VLSFO continue to sit under MARPOL rather than SOLAS.

VLSFO Sulphur Compliance

Previous reports highlighted the ARA complex as the principal sulphur compliance pinch-point for VLSFO, and the last 180 day assessment period strengthens that conclusion.

Across twelve Belgium and Netherlands ports with 10 or more owner samples, 15.8% of VLSFO results fall within the 0.51–0.53% sulphur tolerance band, with 3.5% beyond it. This is materially weaker than the previous picture, and it widens the gap to Singapore (see figure 10).

In the same assessment period, Singapore remains controlled with 0.5% of Singapore VLSFO results sitting within the tolerance band and 0.4% sitting beyond it.

In practical terms, a stem lifted in the ARA now carries a **ninefold higher** probability of analysing beyond the global sulphur cap (0.53%) than a stem lifted in Singapore, based purely on the owner result distribution.

Within the ARA region, performance varies significantly, further cementing the conclusion that this is not just an ex-wharf blend story, and handling and segregation practices still matter, particularly where barges switching between HSFO and VLSFO are continuously identified.

Outside Singapore and ARA, the picture is nominally acceptable, with the rest-of-world data identifying 1.6% of all VLSFO samples in the 0.51–0.53% range and 0.9% beyond 0.53%. Pockets of issues, of course, exist so data-driven buying is critical for sulphur compliance.

Region	Tolerance Sulphur 0.51-0.53 incl.%	Sulphur exceeding 0.53%
Singapore	0.5 (–0.9)	0.4 (+0.2)
Belgium & Netherlands (ARA)	15.8 (+6.3)	3.5 (+1.8)
Rest of the World	1.6 (–0.1)	0.9 (+0.2)

Figure 10: Distribution of owner sulphur results for VLSFO by area.

Sulphur Compliance: Mediterranean Basin

Across the Mediterranean, most established VLSFO hubs show steady sulphur compliance. The clear exceptions in the latest period were Barcelona and Port Said, where 10.9% and 7.7% of samples respectively exceeded 0.53% sulphur (see figure 11 below).

On closer examination, Barcelona's issues were driven by a concentrated issue around late Q4 2025 window rather than continuous deterioration across the full period. The issue coincided with VLSFO blends consistently delivered close to the 0.50 % sulphur cap and historic barge models handling both HSFO and VLSFO on the same units.

In that configuration, effective compliance headroom narrowed materially — with small product crossovers, line residues, remaining residues on board, or minor operational variances, pushing sulphur results beyond 0.53 %. More recently, liftings indicate that the acute spike has eased, but dual-grade handling remains present in some barge supply models.

Port	Sulphur Tolerance 0.51-0.53 inclusive (%)	Sulphur exceeding 0.53 (%)
Barcelona	5.0	10.9
Port Said	3.4	7.7
Malta Offshore	4.9	1.4
Gibraltar	1.9	1.1
Algeciras	4.2	0.9
Istanbul	3.3	0.7

Figure 11: Distribution of owner sulphur results for VLSFO across the Mediterranean Basin.

US Gulf Coast

Previous reports highlighted the US Gulf Coast as a focus area for VLSFO, and the latest data keep Greater Houston firmly in that bracket.

Across this area, 3.1% of supplies return one or more ISO 8217 table 2 results beyond the 95% confidence limits. Of material concern, however, is that total sediment potential (TSP) and aluminium plus silicon (Al+Si) remain the most common critical parameters, accounting for close to 60% of the exceptions noted.

TSP has drifted materially over the period, the distribution has moved out of the <0.05% band, and into the 0.06–0.10% band.

Inherently, stable fuels (<0.05%Wt) fell from 75.7% in July 2025 to 58.5% in January 2026, while the 0.06– 0.10% band rises from 19.9% – 38.0%. That shift is visible month-on-month through the period.

Al+Si levels along the US Gulf Coast remain elevated compared to other hubs. This is not a single spike but a consistently higher baseline in Greater Houston, supporting a reassessment of buying choices where alternatives exist, depending on the buyer's risk appetite compared to price.

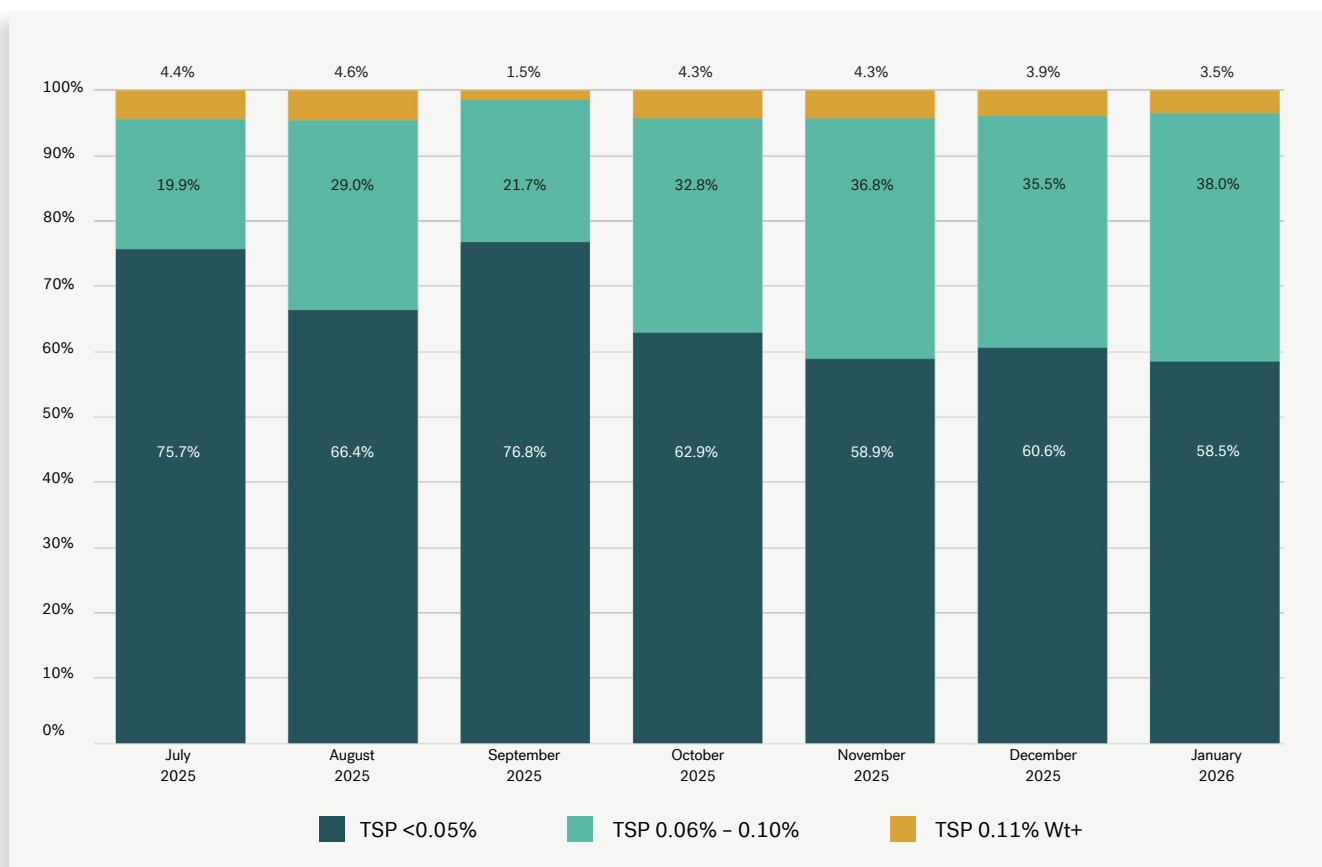


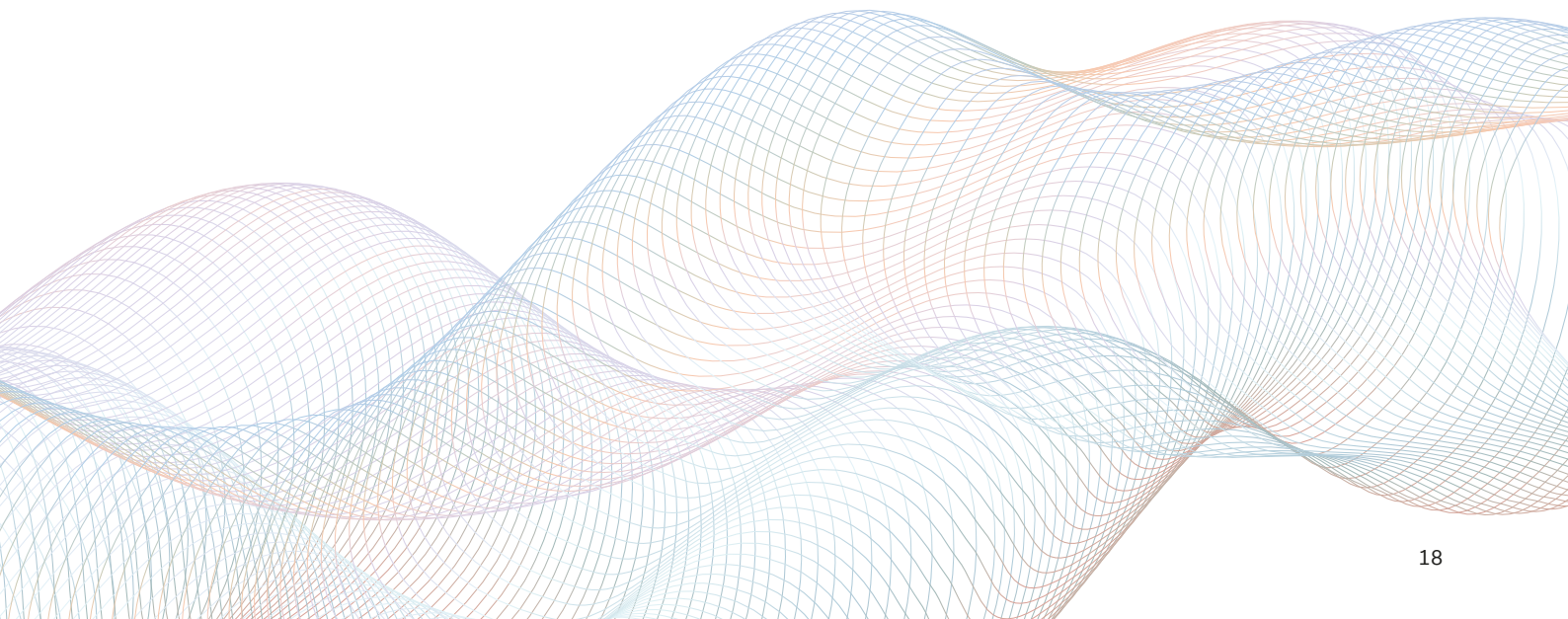
Figure 12: % Distribution of owner total sediment potential (TSP) results for VLSFO across Greater Houston (over the last 180 days).

Al+Si results in Greater Houston also remain elevated versus other hubs. Whilst month-on-month variances occur, and the underlying basis remains elevated. On a weighted average basis, Greater Houston sits at **29.83 mg/kg**, compared with **26.31 mg/kg** in Singapore and materially lower levels across the main European hubs (see figure 13).

Given critical impacts such as vessel breakdowns, port profiles and buying strategies are *as important* as price. Presently, this is an area where it is reasonable to challenge the default supply model and whether it fits the buyer's risk appetite.

Hub/Port	Country	Al+ Si Average (mg/kg)
Greater Houston	USA	29.83
Singapore	Singapore	26.31
Antwerp	Belgium	23.26
Algeciras	Spain	22.84
Rotterdam	Netherlands	20.39
Hong Kong	Hong Kong	19.90
Gibraltar	Gibraltar	18.12
Fujairah	UAE	16.77
Balboa	Panama	14.56

Figure 13: % Average Al+Si results for VLSFO across key bunker hubs.



Panama Canal Residual Fuel Requirements

The Panama Canal Authority requires fuels burned during transit to remain below **70 cSt at 50°C**. Vessels must complete any changeover to compliant fuel, defined as VLSFO or ULSFO with Viscosity <70cSt at 50°C, before entering the canal.

This requirement becomes a commercially significant consideration given the widening price differential between distillate fuels and residual fuels, where such fuels can be safely sourced in the surrounding areas.

For vessels transiting from the US Gulf and Caribbean, materially better options exist to avoid switching to LSMGO for Panama Canal passage.

The blending hubs of New Orleans (61%) and Houston (41%) provide the strongest availability of VLSFO below 70 cSt (see figure 14).

Outside the US Gulf coast, the probability of securing this material drops significantly, with only a limited pool observed in Colón and Cristóbal. On the Pacific side, Balboa is effectively devoid of sub-70 cSt material, leaving Long Beach as the primary West Coast bunker option, where 97% of recent VLSFO tests fall below the 70 cSt threshold.

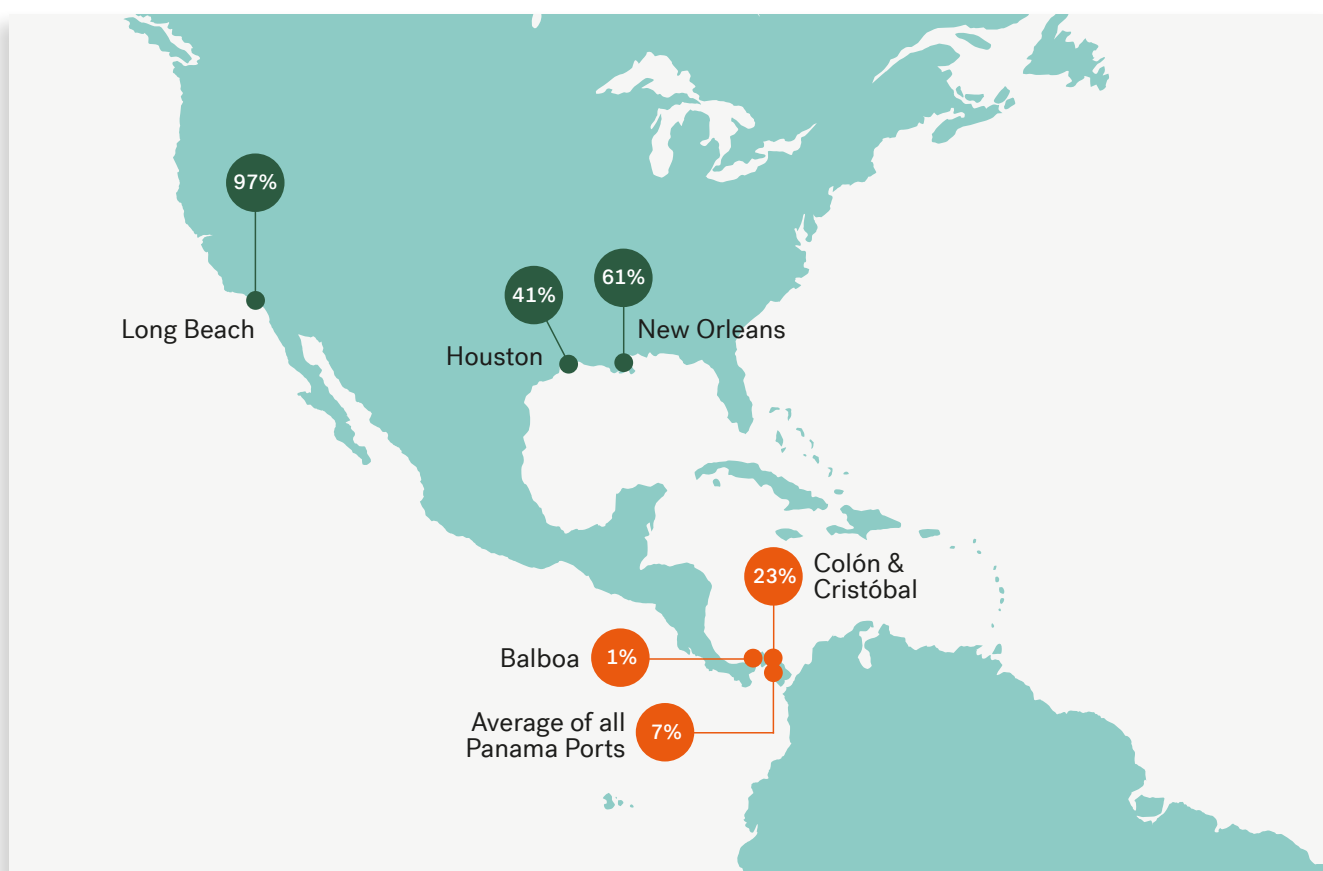


Figure 14: % Availability of sub-70cSt VLSFO around the Panama Canal.

Marine Gas Oil

Written by: Chris Turner, Technical Manager

MGO Traded Specifications

Overall, LSMGO remains a two-spec market. ISO 8217:2010 is still the single biggest reference (58.9%), with ISO 8217:2017 lagging behind at (42.8%), shown in figure 15.

All other specifications are marginal: ISO 8217:2005 (1.6%), ISO 8217:2012 (0.3%), and ISO 8217:2024 (0.6%).

West of Suez: ISO 8217:2017 remains the dominant specification (66.1%), with ISO 8217:2010 retains a meaningful share (31.7%). All other specifications, including ISO 8217:2024, remain at trace levels.

East of Suez: The pattern reverses with ISO 8217:2010 dominating (71.3%) and ISO 8217:2017 representing a minority share (26.1%). Other specifications are negligible, apart from ISO 8217: 2005 (2.3%).

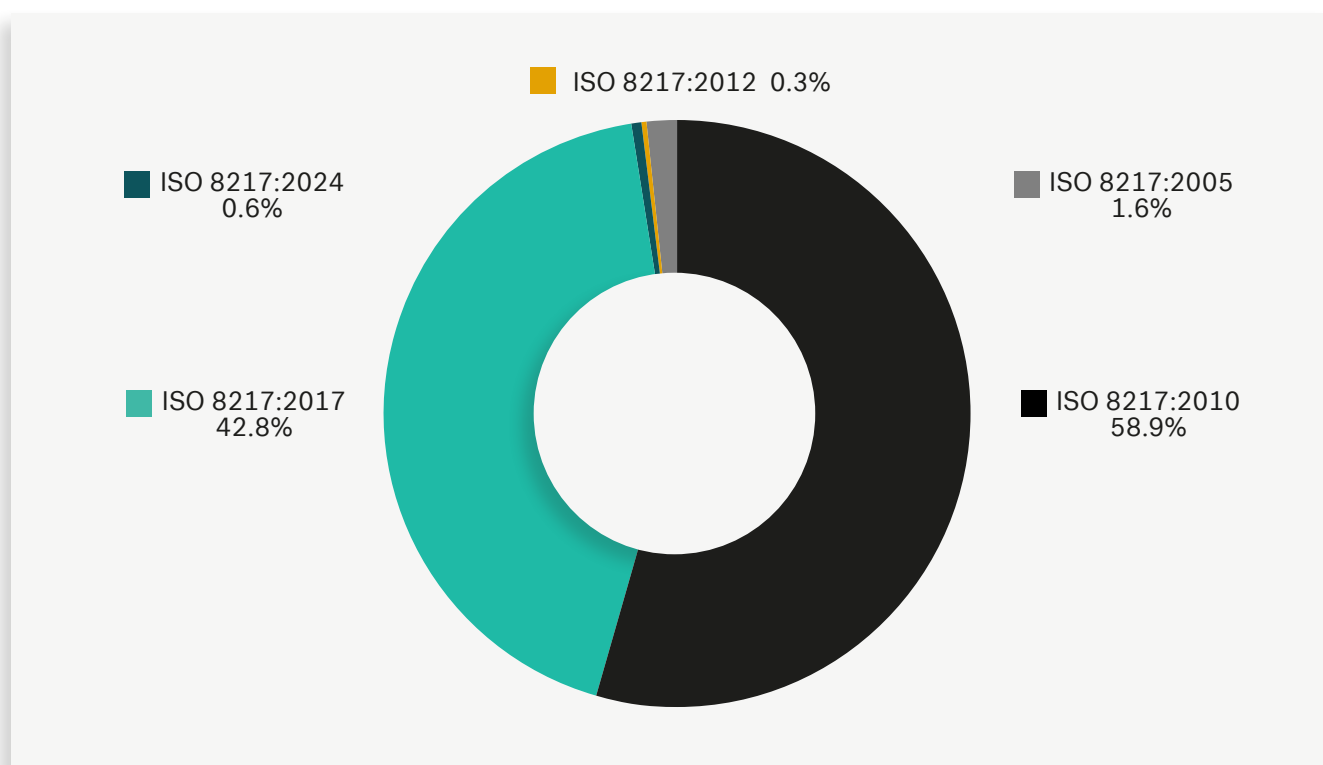


Figure 15: Global LSMGO traded volumes by specification.

Gas Oil Quality

Overall, 1.8% of LSMGO supplies tested beyond the 95% confidence limit for ISO 8217 table 1 characteristics.

Most months remained within a tight 1.1%–1.6% band before a spike to 2.4% in December, easing back to 1.6% in January.

MARPOL Annex VI and SOLAS compliance remain the biggest challenge with 63% of all breaches attributed to flash point (46%), and sulphur (17%). Remaining breaches are dominated by viscosity (17%), pour point (13%) and cetane index (6%).

December's LSMGO spike was due to an ARA viscosity issue rather than a broad deterioration in the high viscosity distillate pool (> 6 Cst), accounting for **roughly 32%** of all specification exceedances that month.

Even within ARA, the picture was mixed. Elevated viscosities were concentrated in a handful of supply chains, consistent with recipe or pool choices rather than a basin-wide quality shift. These were associated with heavier signatures, higher density, and higher cloud point, reflecting the waxier distillate flows that are well known in the region (see figure 16).

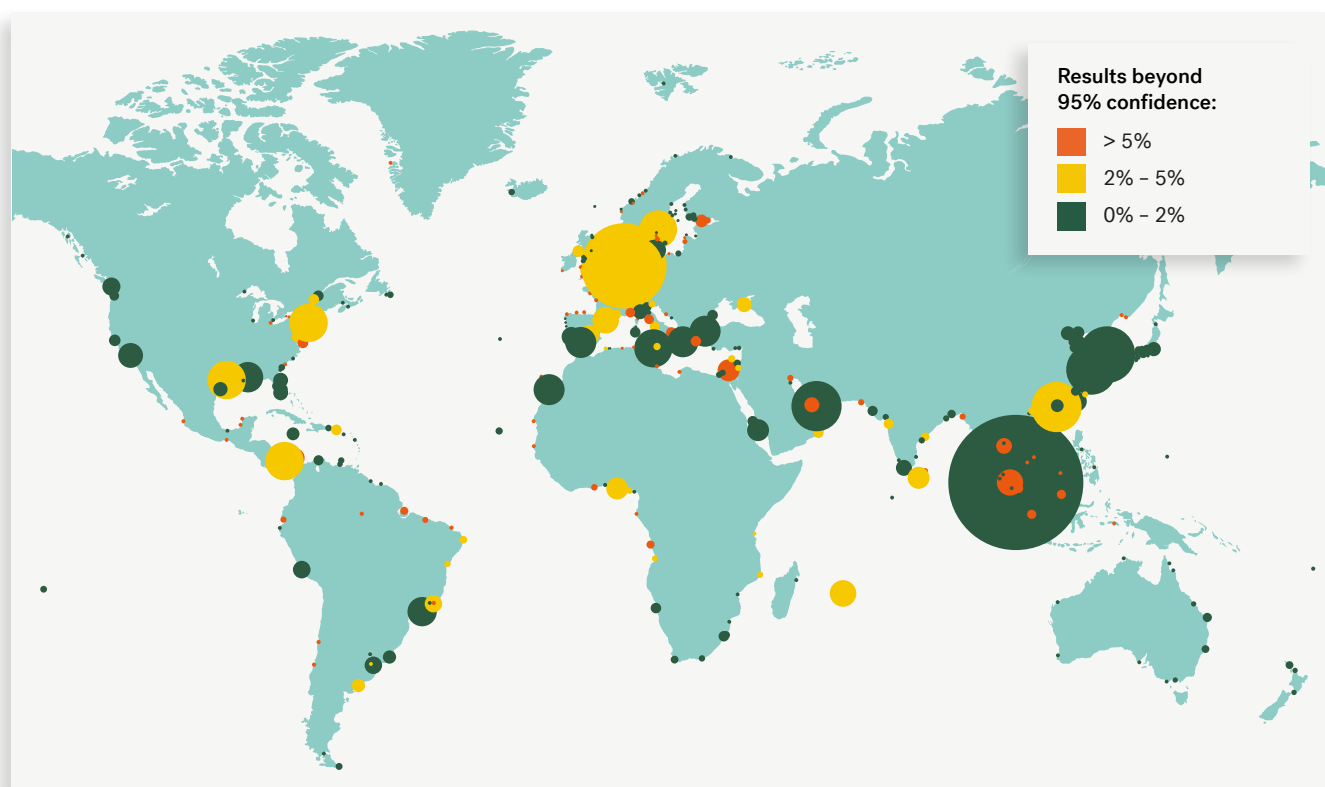


Figure 16: Geographical distribution of LSMGO quality infractions from July 2025 to January 2026.

Flash Point

Flash point is now the key LSMGO compliance risk because it falls under Safety of Life at Sea (SOLAS) regulations as a hard 60°C minimum limit.

When supply chains blend close to this threshold, normal variance can be sufficient to push product below 60°C. Exposure is highest where delivery chains are more fragmented, particularly small truck-supplied parcels, where multi-source product, interfaces, and weaker segregation control can amplify the risk compared with stable barge supply.

Data remains critical to managing this challenge, as conditions can vary significantly from country to country, port to port, and even supplier to supplier depending on supply chains and blending models.

Several areas of concern persist, including the wider challenges in the UAE and Spain, alongside port specific issues such as Aliaga in Turkey.



United Arab Emirates

The extreme failure rates previously seen in Sharjah and Dubai have eased sharply, while Hamriyah now represents the highest risk pocket over the period. Fujairah remains the most reliable terminal, with only isolated instances of non-compliance observed (see figure 17).

The national average therefore continues to mask a tight cluster of risk around the northern terminals. For critical stems, the prudent approach is to favour Fujairah—where operationally possible— or require current certificates of quality and tighter loading controls when lifting from higher-variance ports, given the increasing focus on SOLAS compliance.

Most sub-60°C results are marginal, around 58.5–59.0°C, consistent with fuels blended too close to the limit with distillate pools leaning towards road-diesel-type components. In the UAE, this risk is amplified in truck-supplied parcels, where smaller volumes, more frequent interfaces, and multi-source loading increase supply chain variance and reduce segregation headroom compared with barge supply.

A smaller number of results are materially lower, consistent with cross-contamination from lighter clean products or weak-line flushing discipline. Fujairah remains unaffected, but when lifting elsewhere buyers should insist on current certificates of quality and reconfirm flash point prior to delivery.

UAE Port	Flash Pt % <60°C
Hamriyah	9.1 (6.7)
Sharjah	7.7 (29.9)
Abu Dhabi	5.4 (—)
Jebel Ali	2.0 (9.1)
Khor Fakkan	2.3 (5.3)
Dubai	1.6 (22.6)
Fujairah	0.1 (0.0)

Figure 17: LSMGO flash point testing below 60°C in UAE ports over the last 180 days (previous reporting period results in parentheses).

Spain

Flash point infractions in Spain are almost exclusively generated by small parcels delivered by truck, outside of the key bunker hub of Algeciras.

When evaluating the character of these fuels, flash point sits near the SOLAS compliance minimum of 60°C, with results repeatedly falling marginally on the wrong side of the limit. Notably, cetane index is materially higher than ISO guarantees, averaging around 50°C. This, combined with a lower than average viscosity of 3.2cSt, supports a lighter cut profile over conventional marine gas oil flows.

Taken together, this points to a large influx of kerosene-rich, land-based gas oils with inherently lower flash points being drawn into the marine pool to meet demand. These marginal certificates of quality may appear acceptable at the shore terminal but once exposed to normal supply chain variance—or simply test method precision—the likelihood of testing below 60°C is far greater.

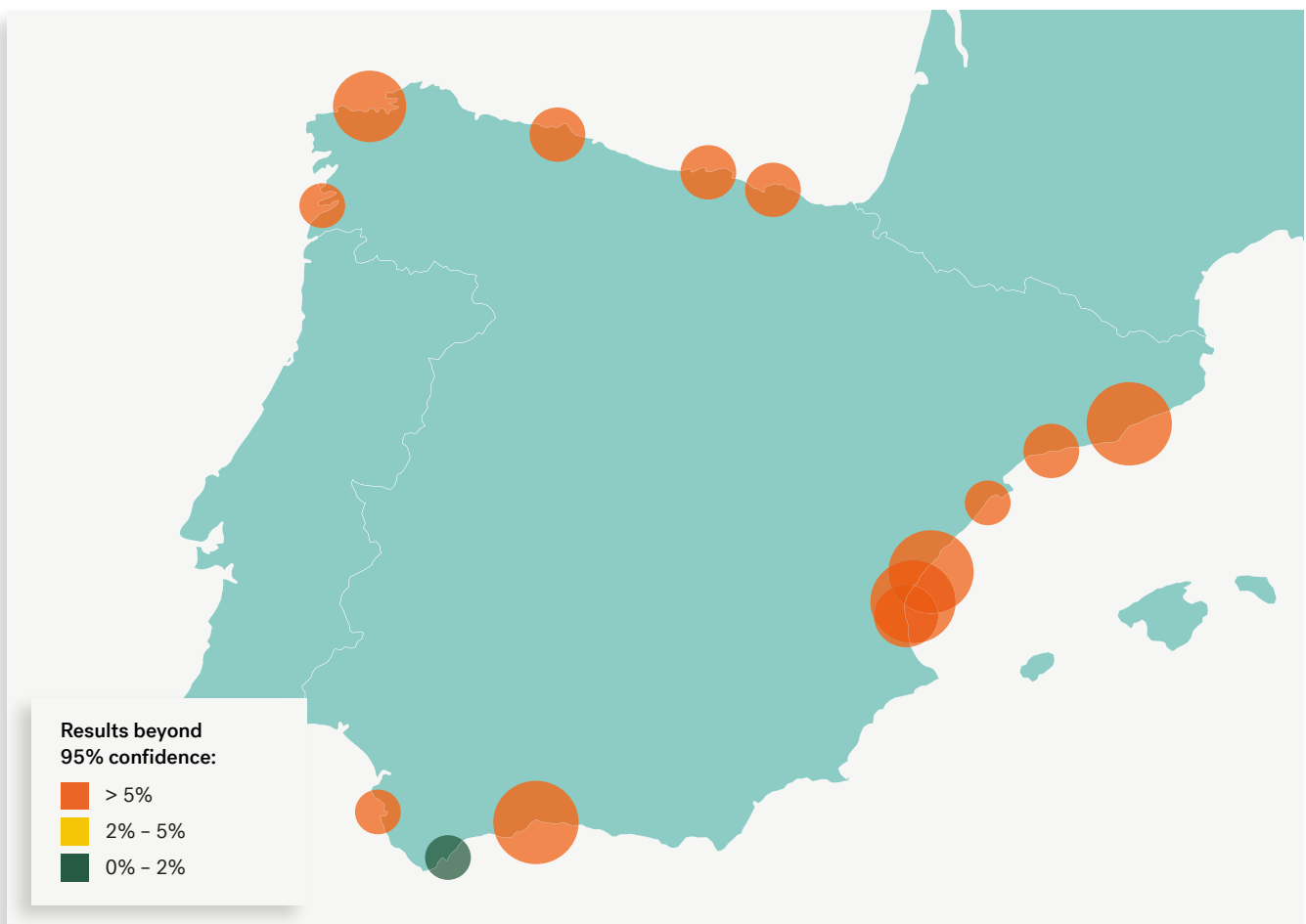


Figure 18: LSMGO flash point testing below 60°C in Spanish ports over the last 180 days.

Ultra Low Sulphur Fuel Oil

Written by: Chris Turner, Technical Manager

ULSFO Traded Specifications

Availability West of Suez is significantly higher given the demands associated with emission control areas (ECAs) with the traded specification mix split of ISO 8217:2017 at 65.2%, ISO 8217:2024 at 21.7%, and ISO 8217:2010 at 13.0% (see figure 19).

In execution, this means ISO 8217:2017 is the baseline for ULSFO, though ISO 8217:2024 has gained more traction in ULSFO than in other fuel grades. This is not a fuel-driven technical effect, it is a contracting one: ULSFO sits outside many of the older charter party and standard clause ecosystems, still anchoring other grades to legacy wording so counter parties have more freedom to adjust terms.

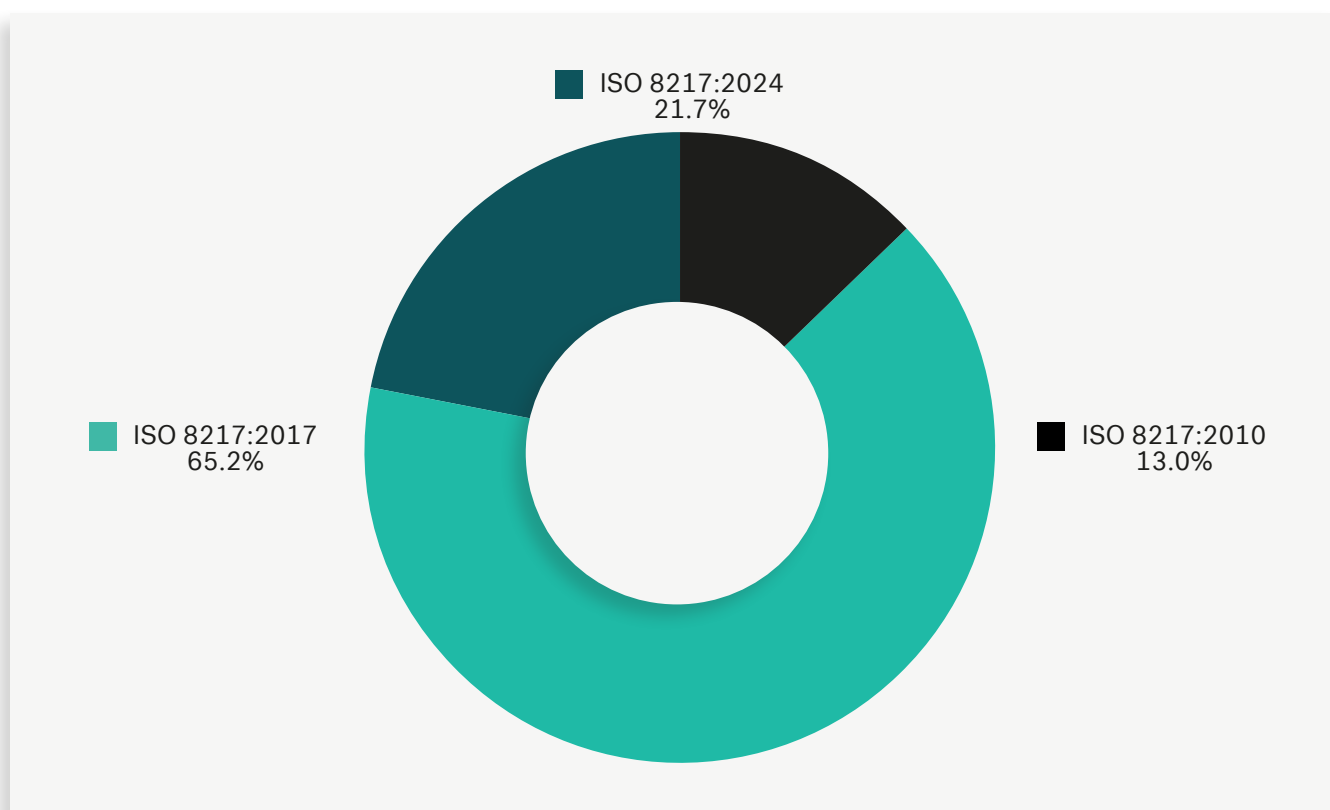


Figure 19: Global ULSFO traded volumes by specification.

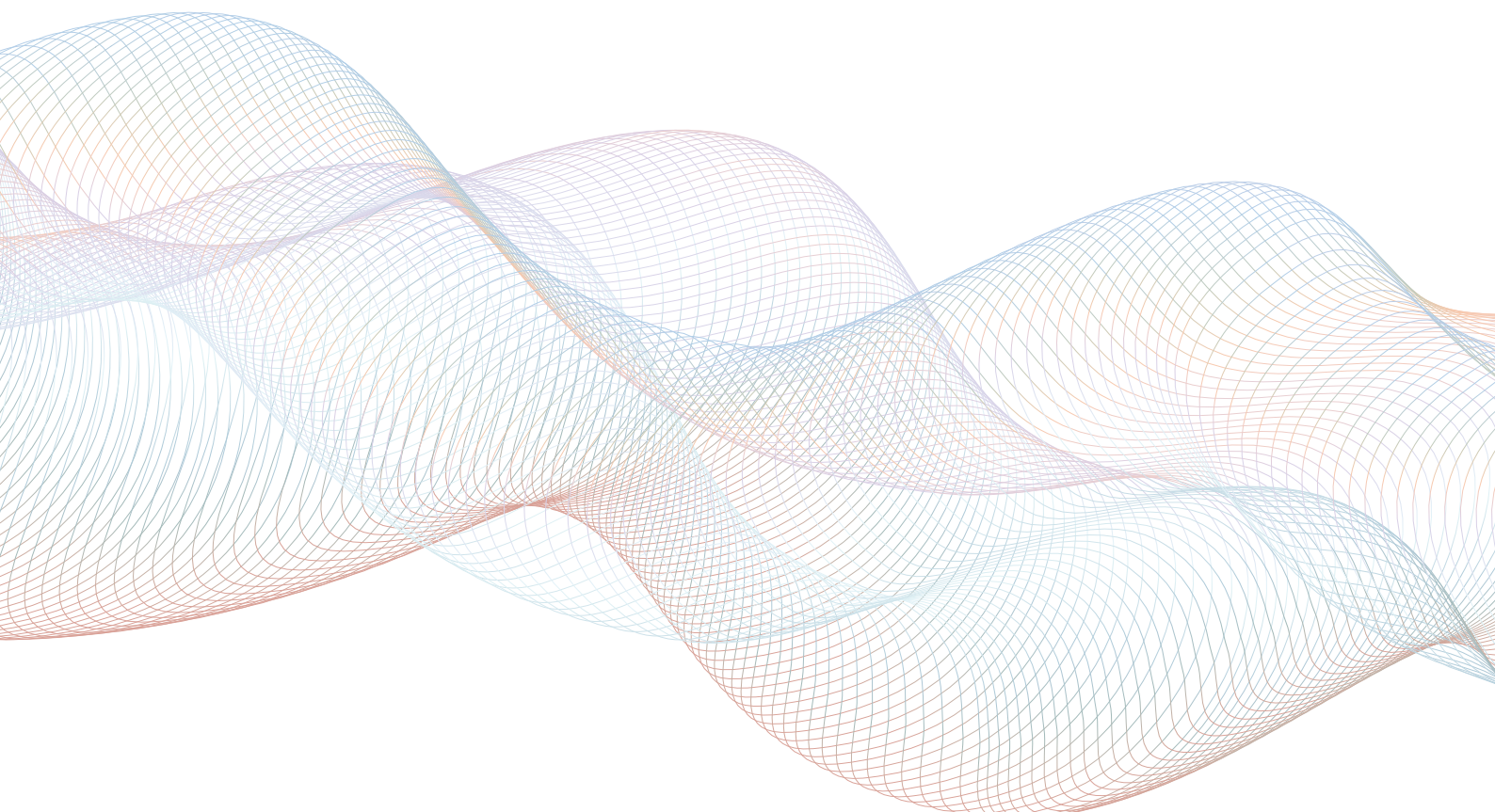
Key developments in the ULSFO market have revolved around the implementation of the Mediterranean ECA, with the market share now hovering around 12%, a figure supported by the ARA mix for the same period.

Supply is still anchored in the major bunkering hubs, notably Algeciras and ARA, where oil majors and large blenders have the tankage and blend flexibility to carry an additional residual grade.

Smaller independent ports have been slower to follow suit, largely because their infrastructure is built around the core fuel grades and historically, ULSFO has not justified the working capital, segregation burden, or operational complexity.

Fuel Grade %	December 2024	June 2025	September 2025	December 2025
VLSFO	60.1	35.6	29.9	30.9
HSFO	26.6	30.1	27.0	24.7
LSMGO	13.0	30.2	30.3	32.0
ULSFO	0.3	4.1	10.9	12.0

Figure 20: Mediterranean ECA fuel supply share by grade %.



ULSFO Quality

ULSFO continues to record the highest rate of owner test results breaching ISO 8217 specification limits, with 3.1% of all samples falling outside the required parameters.

Critical cases (such as TSP) remain low at just 0.3%, although 50% of all breaches relate to sulphur notifications. Given the relatively small datasets, individual spikes in issues can have a magnified statistical effect.

Nevertheless, key ARA hubs, Rotterdam and Antwerp in particular (0.2%), provide considerably more comfort than some of the newer market entrants.

Around 30% of all breaches relate to pour point, reflecting the paraffinic (waxy) natures of many ULSFO blends. This paraffinic nature introduces handling challenges associate with cold flow and compatibility.

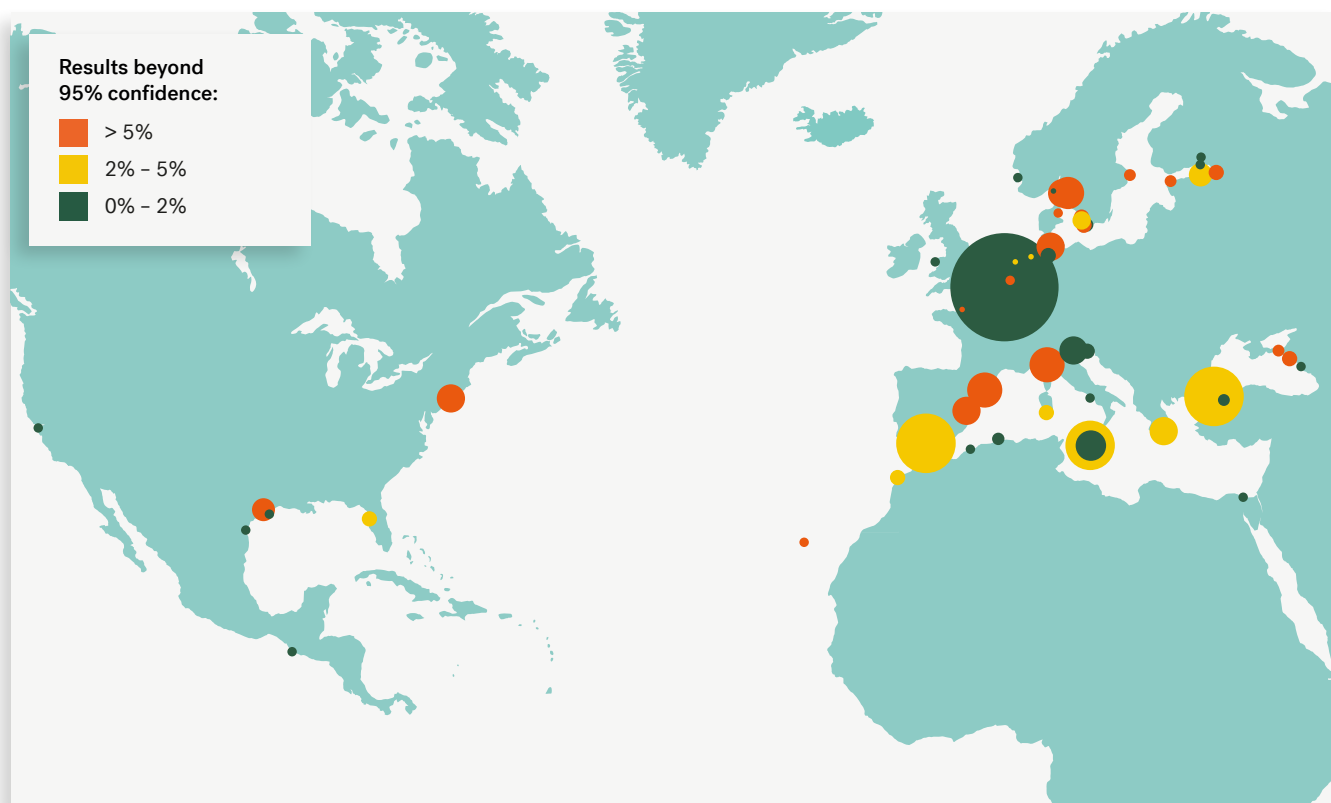


Figure 21: Geographical distribution of ULSFO quality infractions from July 2025 to January 2026.

Cold Flow & Incompatibility

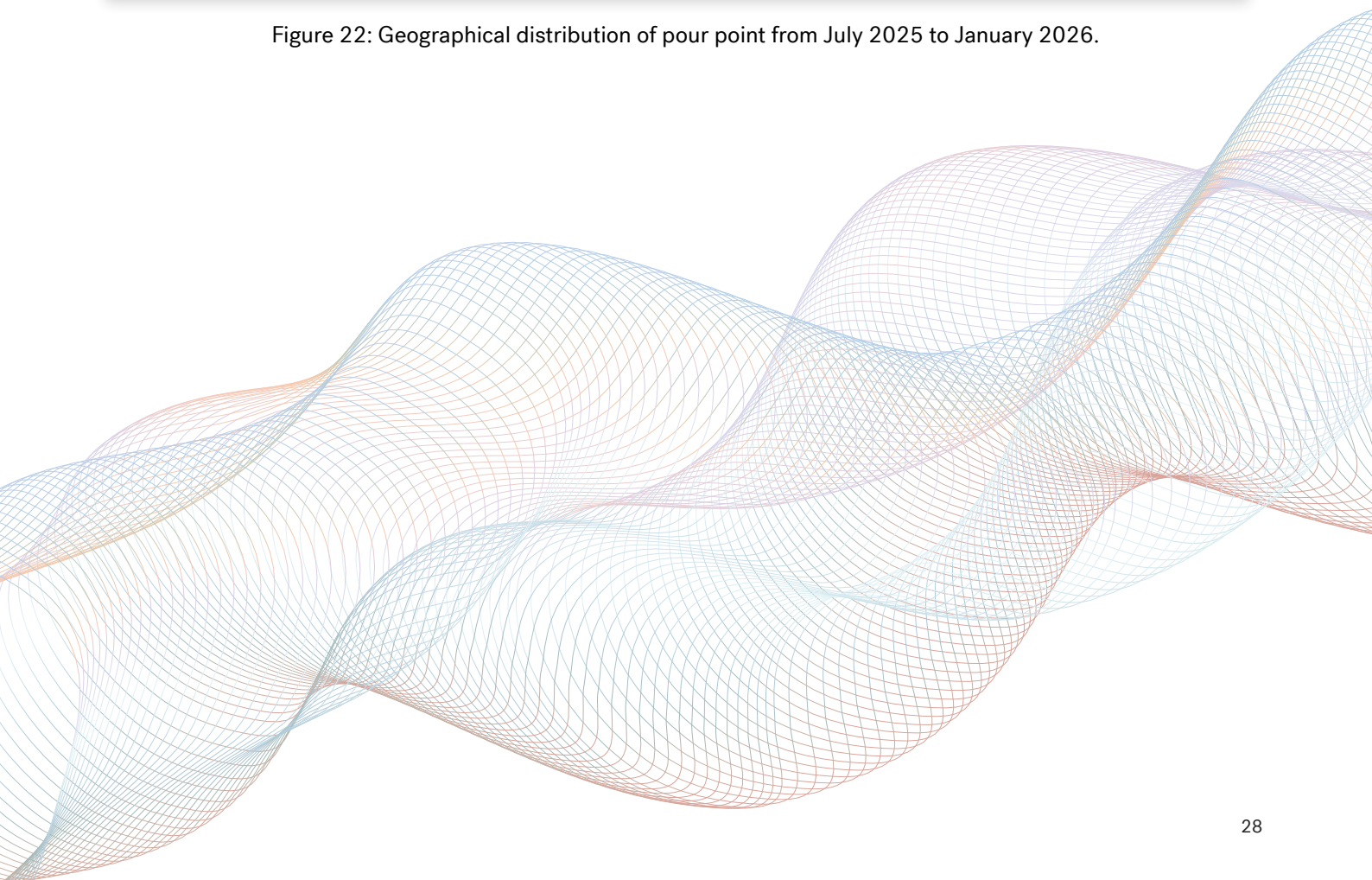
Given the risks associated with elevated pour points, it is highly recommended to maintain fuels at 40°C—10°C above pour point limit— until results of the owner's analysis are known.

Once results are available, storage temperatures may be adjusted to minimise the additional costs associated with fuel heating.

The paraffinic nature of ULSFO increases the risk of incompatibility with other residual fuels by destabilising the asphaltenes in more aromatic products, manifesting themselves as sludge formation onboard. Total sediment potential accounted for under 10% of breaches, pointing to sporadic and isolated instability in certain locations.

Port	% Samples > 33°C	Pour Point (Average)
Genoa	6.6	24.9
Barcelona	6.6	27.2
Skaw	3.8	27.4
Algeciras	1.3	28.3

Figure 22: Geographical distribution of pour point from July 2025 to January 2026.



Biodiesel

Written by: Chris Turner, Technical Manager

Biodiesel Quality

Headline biofuel notifications across all blend percentages and neat fuels sit at 23% when measured against the nearest ISO 8217 grade.

That figure, however, needs context. While the ISO table provides a sensible benchmark, it does not always mirror what is warranted in supply terms for developmental blends. Certain properties—most notably pour point and carbon residue—are not routinely guaranteed for some feedstocks.

For residual FAME blends, minimum viscosity can also sit outside ISO 8217:2024 limits without automatically constituting a contractual breach. In these cases, vessel suitability, handling margin, and the terms explicitly agreed in the nomination and supplier guarantee become more relevant than the ISO reference line alone.

Geographical issues are stark, with a clear SOLAS compliance fracture present in Indonesia for routine B40 blends as compared to other regions.

Fuel Grade	Beyond 95% Confidence (%)	Compliance (%)	Critical (%)	High Risk (%)	Excluding Pour Point & MCR (%)	High Risk (%)	<i>Also</i> Including Indonesia (%)
B100	37.0	0.5	0.5	1.0	1.0	-	-
LSMGO-30	13.3	10.6	0.6	11.2	5.9	-	2.2
ULSFO-30	42.2	1.7	0.0	1.7	22.5	1.7	-
VLSFO-30	22.5	0.8	0.3	1.1	22.2	4.2	-
HSFO-30	39.9	0.5	0.0	0.5	37.2	3.2	-

Figure 23: Types and frequencies of notification by grade for biofuel blends (blank indicates no occurrences, HVO data not available).

B100 & Biofuel Blends

B100

Headline B100 notification rates sit at 37% compared to the nearest ISO 8217 reference grade. However, that figure overstates actionable risk in two ways, pour point and MCR are often not warranted in the supply terms for the relevant feedstocks and blend structures. Excluding pour point, notifications fall to 10%. Excluding micro carbon residue (MCR), the residual notification rate drops to 1.0%, leaving isolated total acid number (TAN) and flash point cases.

B30-LSMGO

A similar picture exists for LSMGO B30, but with one additional factor: Indonesia. Headline figures show 13.3% of samples above the 95% confidence threshold, with flash point driving a 10.6% compliance hit rate.

The critical point, however, is that the SOLAS compliance fracture sits within the Indonesian B40 pool, rather than across the wider B30 sector. Once Indonesia is excluded, the remaining notifications relate primarily to pour point and MCR because of B100 blending behaviour rather than a distillate supply chain failure. Removing those parameters—many of which are not always warranted depending on feedstock and contractual terms—the exceedance rate drops to 2.2%, returning to normal marine fuel noise levels.

B30-VLSFO

The pattern continues with VLSFO, but from a different angle: viscosity. Headline figures show 22.5% of samples outside the 95% confidence threshold versus the nearest ISO 8217 reference grade. However, the signal is overwhelmingly driven by low-viscosity flags, as fuels are routinely assessed against the RF 80 specification and many B30 residual blends are not sold with minimum viscosity guarantees.

Once viscosity is excluded, the one recurring operational theme that merits attention is water, which is concentrated heavily in Singapore. This serves as a useful reminder that B30 is still 70% mineral fuel, and housekeeping, segregation, tank heels, line flushing and storage discipline remain the decisive controls.

ULSFO B30

ULSFO B30 is the outlier in the biodiesel set, with 42.2% of samples sitting beyond the 95% confidence limits. However, the drivers are narrow and predictable, vastly outplaying the issues observed.

Once low-viscosity flags are removed, the picture normalises immediately: compliance falls to 1.7% and critical issues drop to zero, with the remaining notifications tied to pour point behaviour in the bio component rather than any recurring hard quality fault in the mineral backbone.

That said, ULSFO is the only biodiesel blend that routinely introduces an onboard handling interaction—low viscosity combined with high pour point.

If the delivered viscosity is below 20 cSt at 50°C, the practical consequence is that, to optimise purification and achieve a viscosity of 20 cSt, the fuel would require cooling. Any reduction in temperature erodes cold flow margin, drawing the handling temperature closer to the pour point and increasing the risk of wax formation, with knock-on effects for filters, transfer stability, and purifier performance.

B100 Quality

Neat biodiesel (B100) characteristics continue to be shaped by the feedstock used in its manufacture.

Pour point measurements range from -6°C (the DMA winter specification) to above 12°C . End users should therefore clarify, as part of a suitability study with the receiving vessel, the expected pour point of the incoming material, as some fuels will require routine heating or possible additisation to prevent onboard handling issues.

Only a single flash point failure appears in the data within a B30 parcel, suggesting the mineral fuel being the root cause. Viscosity issues are marginal at under 8% and likely reflect blending rather than underlying fuel chemistry.

Headline Price to True Value

Headline bunker price per tonne is a convenient trading reference, but it does not measure the real economic value of a fuel grade.

Marine engines consume energy, rather than tonnes, and fuels with different calorific values deliver different amounts of usable propulsion energy, meaning that two fuels priced identically on a per-tonne basis can generate materially different voyage costs.

To illustrate this effect, a simple fleet-level model has been constructed using global VLSFO energy data. The model converts physical bunker purchases into an energy-equivalent basis and then evaluates how variations in fuel energy content alter the quantity of fuel required to deliver the same work across a fleet.

A second layer is applied to capture the regulatory cost impact arising from exposure to the EU Emissions Trading System. Because EU ETS obligations scale directly with the amount of fuel burned, lower-energy fuels increase both the physical fuel requirement and the associated carbon liability.

This framework therefore shifts the comparison away from headline bunker price and towards **true delivered value**, combining energy content and carbon exposure to demonstrate how relatively small variations in fuel properties can translate into meaningful cost differences at fleet scale.



Modelling

For the purposes of this model, a representative small owner fleet has been assumed, comprising ten MR product tankers operating on a typical international trading pattern.

Each vessel is assumed to bunker eight times per year, lifting approximately 700 tonnes per stem (at \$600/mt), reflecting common operational practice for this vessel segment.

On this basis, the fleet purchases roughly 56,000 tonnes of VLSFO annually, providing a realistic scale at which variations in fuel energy content and regulatory exposure can be examined across a multi-vessel operation rather than a single voyage or isolated stem.

Energy Analysis

VLSFO global data LCV (lower or net calorific value) over the last 180 days has been assessed as follows:

10th Percentile LCV: **41.261_{GJ}**
per tonne

50th Percentile LCV: **41.468_{GJ}**
per tonne*

90th Percentile LCV: **41.799_{GJ}**
per tonne

** For the purposes of this model, the annual fleet energy demand is held constant at the median energy case.*

EU ETS Exposure

20% of fleet fuel consumption is assumed to fall within EU ETS scope:

Emissions factor for VLSFO (CO₂ + CH₄ + N₂O):

3.1631 tCO₂e per tonne

EUA price:

€73 per tCO₂e

Exchange rate:

€1 = \$1.16

(effective EUA price: \$84.68 per tCO₂e)

Impacts

Holding fleet work constant, variation in VLSFO energy content shifts the annual quantity required by roughly +281 mt to -443 mt relative to the median case.

At \$600/mt, this translates into a direct fuel cost swing of approximately +\$169k to \$266k across the energy spread. Applying the EU ETS at 100% of in-scope CO_{2e} for the modelled exposure, carbon costs scale directly with fuel burn through the emissions factor.

Lower-energy fuels require more tonnes to deliver the same work, increasing both fuel spend and EUA costs, while higher-energy fuels have the opposite effect. Across this 10 MR fleet, the resulting annual cost swing between the P10 and P90 energy cases is approximately **\$0.47 million** before any density loss or supplier execution effects are considered.

Case (LCV percentile)	LCV (GJ/mt)	Tonnes required (mt)	Δ tonnes vs P50 (mt)	Fuel cost (USD)	In-scope fuel tonnes (20%)	ETS cost (USD)	Total cost (USD)	Δ total vs P50 (USD)
P10 energy	41.261	56,281	+281	33,768,600	11,256	3,014,985	36,783,585	+183,650
P50 energy	41.468	56,000	0	33,600,000	11,200	2,999,935	36,599,935	Baseline
P90 energy	41.799	55,557	-443	33,334,200	11,111	2,976,179	36,310,379	-289,556

Figure 23: Energy analysis results and impacts.

Biofuel Pricing Beyond Face Value

Written by: Konica Bhatt, Senior Reporter, ENGINE
Nachiket Tekawade, Reporter, ENGINE

The EU emissions bill has gone up this year, and so has biofuel's advantage

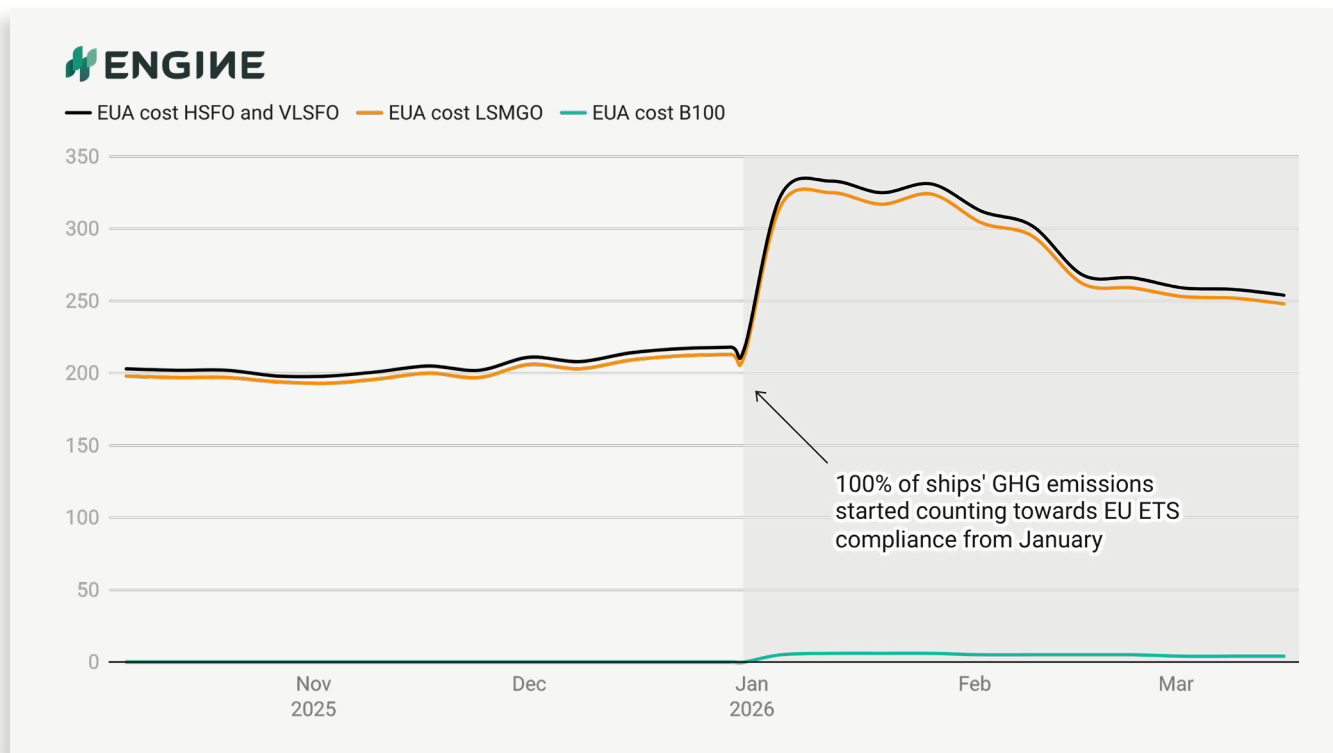


Figure 24: EUA costs for B100 for intra-EU voyages have gone from zero to \$5/mt VLSFO-equivalent this year, but this gain has been eclipsed by the bump in EUA costs for conventional fuels. EUA costs for HSFO, VLSFO, LSMGO, and B100 biofuel all given in \$/mtVLSFOeq.

All bunker prices described in the following text have been adjusted for calorific contents to make them VLSFO-equivalent. They have estimated EU-EU voyage compliance costs included for Rotterdam, and non-EU-EU compliance costs included for Singapore. These account for all EU ETS costs and FuelEU Maritime penalties, and compliance surplus prices from the FuelEU pooling market.

EU ETS fully phased in

The EU Emissions Trading System (EU ETS) has reached its final phase-in this year. Ships sailing between two EU ports must now pay for 100% of their emissions, up from 70% last year. Voyages between EU and non-EU ports are now subject to 50% coverage, up from 35%.

The scope has also widened. Methane and nitrous oxide (NO₂) emissions are now included alongside carbon dioxide (CO₂). This has increased the compliance burden for conventional fuels. Emission factors for HSFO, VLSFO, LSMGO and B100 have all gone up by \$0.049mtCO₂e/mtFuel now that the EU ETS is fully phased in.

To put that in dollars per emission terms, Dec25 EU Allowance (EUA) prices averaged \$94.49/mtCO₂e in the fourth quarter last year. If Dec26 EUAs had also averaged that level in the first quarter of this year, the estimated EUA cost for burning HSFO, VLSFO and LSMGO on intra-EU voyages would have gone up by \$91-93/mt.

That figure illustrates the cost of a fully phased in EU ETS for ships in isolation. But since EUA prices have averaged 2% lower in the first quarter, the estimated additional cost of burning HSFO, VLSFO and LSMGO have gone up by a slightly lower \$85-88/mt.

From our estimates, it has cost a total average of \$287-294/mt in EUAs to burn HSFO, VLSFO and LSMGO in the first quarter, up from \$201-206/mt in the fourth quarter of last year.

Biofuels, by contrast, have fared differently. Burning B100 did not cost anything in EUAs last year, when only CO₂ emissions were in scope and sustainable biofuels had a zero-carbon factor. With methane and NO₂ emissions counting from this year, B100's EUA cost has gone up to average \$5/mt in the first quarter.

Attractive B100 pooling value

While the EU ETS has tightened, FuelEU Maritime has not, but the regulation continues to reinforce biofuel's advantage by adding a layer of value for over compliant fuels.

B100 bunkered in Rotterdam has had potential to generate an average pooling value of \$672/mt on intra-EU voyages this year, according to ENGINE estimates. This is \$16/mt down from the average in the fourth quarter of last year, but the value is still huge and is the main reason why B100 makes sense to burn for shipping companies that can transfer or sell compliance surpluses to under-compliant ships in pools.

These values are indicative rather than fixed, however. Pooling markets remain opaque, and transactions are typically negotiated over-the-counter between shipowners, brokers and, in some cases, suppliers.

Some compliance surplus deals are linked to discounts on FuelEU penalties or compliance borrowing, while others reflect bid-ask spreads that include administrative costs and margins.

Underlying prices flying

More recently, rising Brent and gasoil prices from supply disruptions linked to the Middle East conflict have sent conventional bunker fuel prices flying since the start of March.

Rotterdam's underlying prices for HSFO, VLSFO and LSMGO have averaged \$68-95/mt higher in the first quarter than the last quarter of 2025. The port's advanced B100's price has gone up by \$74/mt.

On a percentage basis, Rotterdam's conventional grades have averaged 15-20% higher in the first quarter, against a much smaller 6% gain for B100.

Regulatory costs can compound for conventional fuels, while compliant fuels can generate value for buyers. The benefit is not limited to bunkering in Rotterdam.

The cost of bunkering VLSFO in Singapore and consuming it on a voyage to an EU port has crossed the \$1,200/mt mark, and the cost of LSMGO has risen to \$1,900/mt.

Total cost of consumption

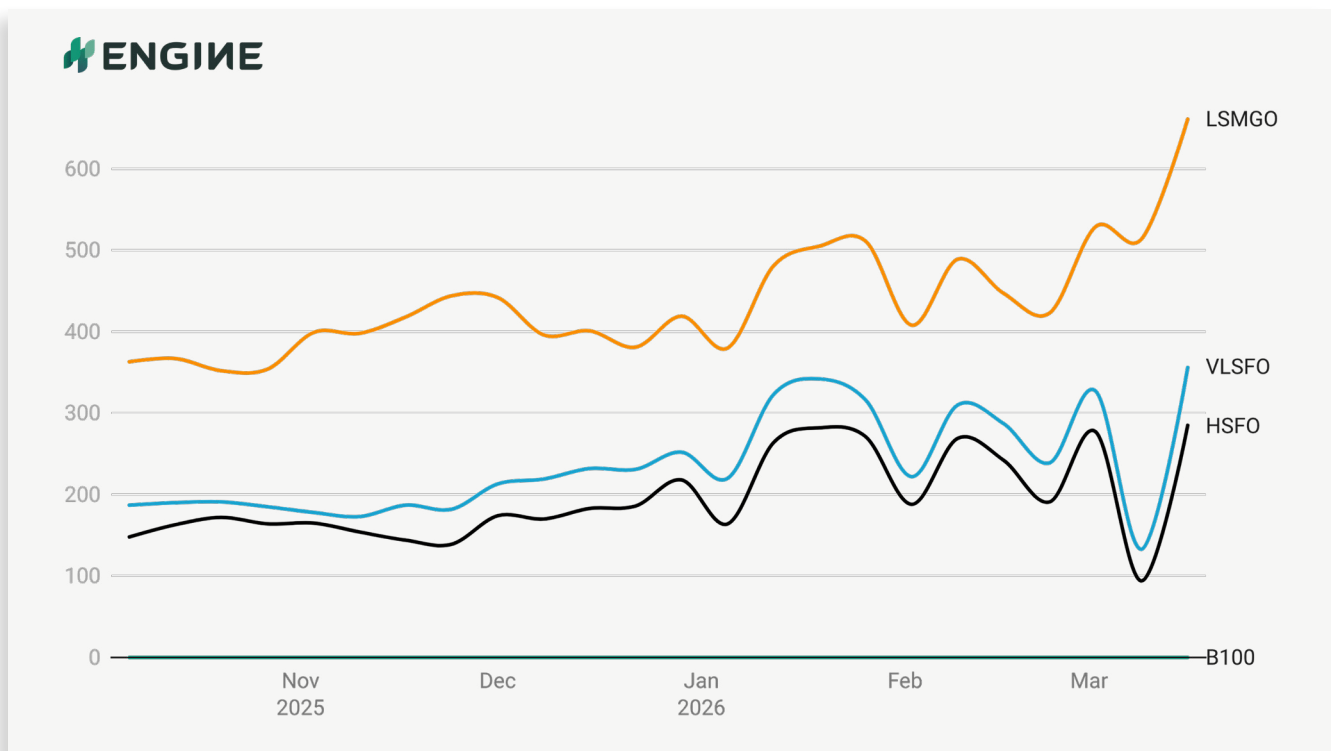


Figure 25: Rotterdam's LSMGO premium over B100 has shot up for intra-EU voyages after Iran blocked cargo vessel traffic through the Strait of Hormuz in March 2026. EUA costs for HSFO, VLSFO, LSMGO, and B100 biofuel all given in \$/mtVLSFO-eq.

When we look at the complete picture, we have sharply rising underlying HSFO, VLSFO and LSMGO prices, greater EUA cost increases for conventional fuels than for biofuels, and a continuous ability for biofuel to generate high FuelEU pooling values.

This all sums up to widen biofuel's discount to the conventional fuels.

Rotterdam B100's total average cost for intra-EU voyages has dropped by \$62/mt against HSFO between the quarters, \$78/mt against VLSFO and \$91/mt against LSMGO.

Singapore's B30-VLSFO has become more attractive against pure VLSFO.

In the week leading up to the war in the Middle East, the two fuel grades were priced at parity for extra-EU voyages. B30-VLSFO is now at a \$40mt discount.

The gasoil price war rally in Singapore has meant that B100 has actually been \$490/mt cheaper to consume than LSMGO on extra-EU voyages, and \$50/mt in general. Most ships would opt for cheaper HSFO or VLSFO on voyages outside of 0.10% sulphur Emission Control Areas (ECAs), but B100's discount to LSMGO illustrates how far LSMGO is out of the money.

For bunker buyers, the economics are tilting. When emission and compliance costs are included, biofuels are increasingly delivering better value than conventional fuels.

PoC vs PoS

If you are buying biofuel for bunkering in the Netherlands, you will be faced with two choices: buy rebated biofuel made from advanced feedstocks; or buy non-rebated biofuel made from feedstocks like used cooking oil.

Rebated biofuels will come with Proof of Compliance (PoC) documents, while non-rebated biofuels are accompanied by Proof of Sustainability (PoS) documents.

You cannot get a PoS with rebated biofuel because Dutch biofuel bunker suppliers have to retire the PoS created from their biofuel sale to Dutch authorities. If they also pass a PoS to customers, it would be double-counting and fraudulent.

The Dutch ERE system

Biofuel is often offered at significant discounts for bunkering in Rotterdam compared with neighbouring ports such as Antwerp.

This is because the Netherlands rewards suppliers for delivering renewable fuels to the transport sector.

When the Netherlands implemented the EU's third Renewable Energy Directive (RED III), it replaced its earlier HBE system with a new market mechanism known as the ERE system from 1 January 2026.

Unlike the previous scheme, where suppliers were encouraged to increase the renewable energy volumes they supplied by generating HBE tickets, the ERE system is more purely focused on reducing greenhouse gas (GHG) intensity and emissions.

In the ERE system, Dutch bunker suppliers can generate tickets by selling fuel with lower GHG intensities to ships. For the first time, the Dutch system has introduced sector-specific credits for bunkering, known as ZREs. ZRE A tickets are the most common for advanced biofuels sold to ships, and they can be traded between bunker suppliers.

The bunker suppliers must hit a 2.9% GHG intensity reduction target for the fuels they sell compared to a fossil fuel reference of 94 gCO₂e/MJ. Suppliers that only sell fossil fuels like HSFO, VLSFO and LSMGO will not meet the 2.9% reduction target and will then have to purchase ZREs from other suppliers that are overcompliant through selling biofuels.

They can also buy tickets for up to 0.9 percentage points of their ERE obligation from non-maritime sectors like road fuels.

The overall GHG intensity reduction target is expected to increase gradually to reach 8.2% by 2030 as the Netherlands strengthens its renewable fuel obligations under RED III.

The Dutch system restricts the types of fuels that can generate ZRE tickets. Eligible fuels include renewable fuels produced from waste and residue streams listed in RED III's Annex IX-A, like palm oil mill effluent methyl ester (POMEME), or renewable fuels of non-biological origin (RFNBOs).

Biofuels made from Annex IX-B feedstocks like used cooking oil methyl ester (UCOME) are treated as fossil fuels in the system and do not generate ZRE tickets. So are fuels derived from food or feed crops.

UCOME is the most common biofuel type to bunker outside of the Netherlands. Several years ago it was also rewarded in the now-defunct Dutch HBE system, but it was later disincentivised in favour of POMEME and other advanced feedstocks to free up volumes for domestic consumption.

Conclusion

Written by: Chris Turner, Technical Manager

In a market increasingly driven by lowest headline price, suppliers, traders, and customers are all under margin pressure.

That pressure feeds a race to the bottom and encourages short-term decisions, even though the cost of getting it wrong is rarely visible until it occurs. When a vessel encounters a problem, the conversation quickly becomes “never again.” By then, however, it is usually too late: the fuel has been long burned, the evidence is incomplete, and the real root cause is often blurred by handling, housekeeping, and operating conditions.

This report seeks to disrupt that cycle. It makes the case for data-driven buying, not as a “nice to have,” but as a practical tool for protecting reliability, efficiency, and liability in an increasingly complex supply chain. The objective is straightforward: move decisions away from anecdotes and post incident reactions, and towards measurable risk signals that can be acted on before the stem is fixed.

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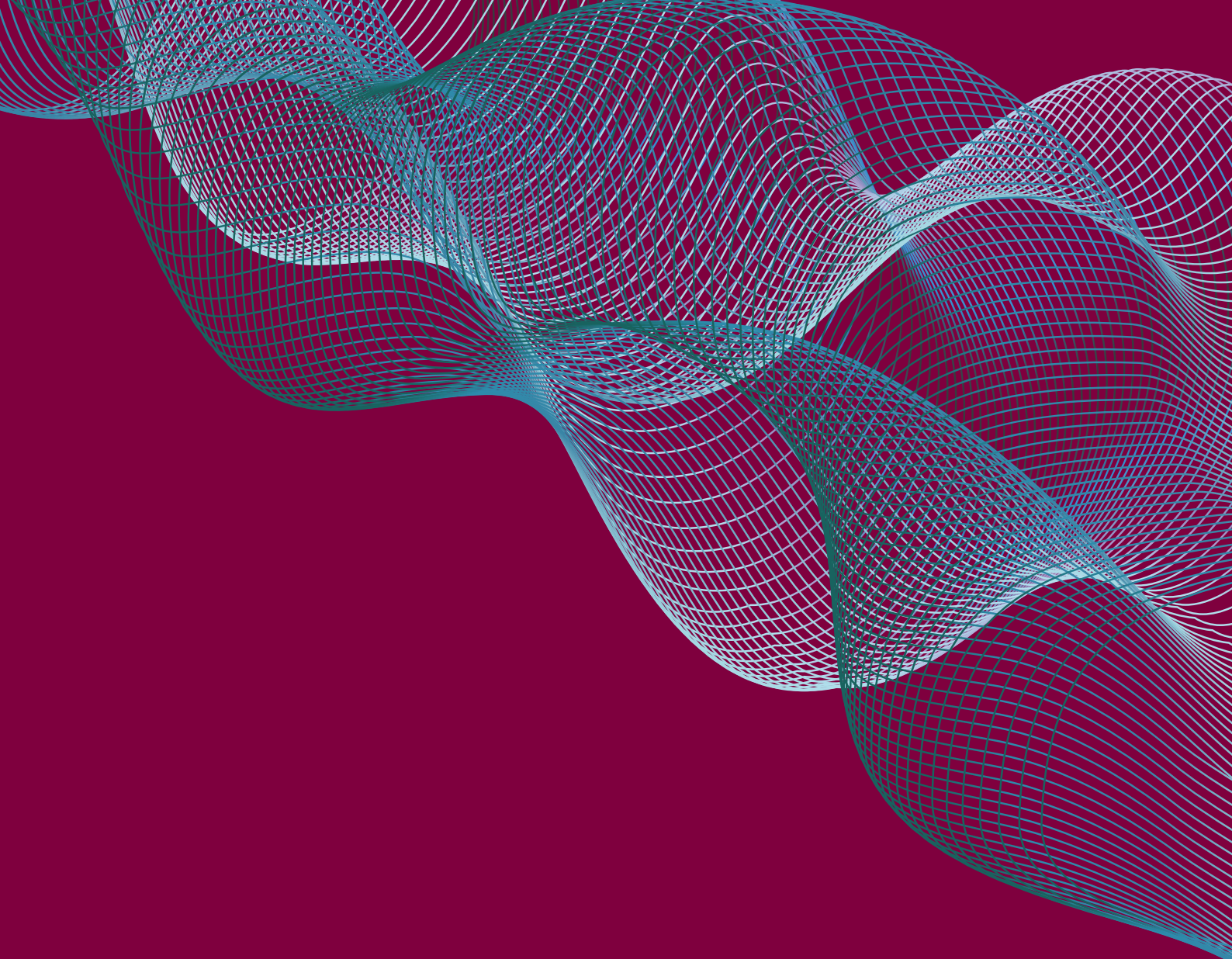
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