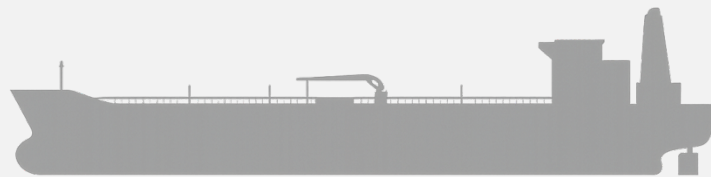


RUSSIA'S SHADOW FLEET

Sanctions Evasion on the High Seas

A White Paper on Maritime Sanctions, Shadow Logistics and European Risk Exposure



EU Today — Research Study (2025 Edition)

Based on open-source intelligence, EU legal instruments, maritime datasets and Port State Control records

Prepared for circulation to:

- General public readership
- Policy practitioners
- Maritime authorities
- Industry stakeholders
- Legislative advisers

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Executive Summary

This white paper examines the emergence, operation and consequences of Russia's "shadow fleet" of oil and product tankers. It traces how EU restrictive measures and the G7/EU oil-price-cap regime have altered maritime trade patterns, and how a parallel logistics ecosystem has adapted to preserve export continuity while shifting environmental, safety and security risks towards European waters. The analysis covers the legal framework, market reorientation, operational modalities, participants and intermediaries, trade flows, risk concentrations, enforcement outputs and measurable indicators of effectiveness.

The central finding is that sanctions have changed how the market clears rather than extinguishing trade. A dual-track equilibrium has taken hold. When the price cap is non-binding at prevailing global prices and documentation is in order, cargoes move through a compliant channel using mainstream transport, insurance and class. When the cap binds or enforcement tightens, volumes pivot into a shadow channel that substitutes non-Western services and deploys practices that reduce regulatory visibility, including recurrent ship-to-ship transfers, identity churn and manipulated vessel tracking. This switching behaviour is responsive to enforcement cadence, freight economics and the availability of substitute services.

Costs have risen across the system. Longer voyages to Asian refiners, elevated tonne-miles, risk premia on Russia-linked lanes, ship-to-ship fees, insurance substitution and inspection delays depress netbacks relative to a no-sanctions counterfactual. In some periods discounts to benchmarks narrowed as non-Western services scaled up, but logistics costs and documentary burdens kept margins under pressure. The net result is a persistent friction: export revenues remain material, yet they are earned at lower efficiency and with greater operational exposure.

Environmental and safety risks are concentrated in corridors where older hulls, unclear insurance and identity churn meet narrow waterways and busy approaches. Casualty scenarios of concern include hose or valve failures during offshore transfers, engineering failures in the Turkish Straits and groundings on approaches to anchorages used for ship-to-ship operations. Where cover is non-standard or opaque, claims recovery can be uncertain or slow, increasing fiscal exposure for coastal states. Investigative work combining satellite radar with ship tracking has documented multiple slick events associated with high-risk cohorts, and Port State Control has recorded elevated deficiency counts in older tankers exhibiting identity changes and documentation irregularities.

Security externalities arise because the same behaviours that frustrate sanctions monitoring also degrade maritime domain awareness. Discontinuous tracking, loitering in infrastructure corridors and rapid re-registration increase the burden on surveillance and raise the cost of distinguishing routine from abnormal behaviour. Allegations linking commercial hulls to uncrewed aerial systems remain contested in the public record; this report treats such claims cautiously and focuses on the maritime compliance actions that are clearly available under international and EU law. The legal position is stable: exclusive flag-state jurisdiction on the

high seas, rights of visit on narrow grounds, and robust port-state powers once jurisdiction is engaged, including for safety and pollution prevention. In practice, proportionate action turns on verification at the point of access—identity, insurance, class and complete documentation for high-risk voyages—rather than ad hoc interdiction.

The shadow fleet is not a single organisation but an assemblage of ageing Aframax, Suezmax and product tankers operating through single-purpose companies, permissive registries and a mix of insurers and reinsurers outside the International Group. Trades are choreographed through ship-to-ship belts in the eastern Mediterranean and, episodically, in Atlantic approaches and off West Africa. Cargo buyers are concentrated in Asia, with intermediary roles in Türkiye and Gulf jurisdictions. Documentary chains rely on attestations under the price-cap regime, with obligations scaling by role. Weaknesses arise where service providers accept upstream representations without sufficient validation, or where multi-stage transfers and blending are not matched by independent surveys and custody records.

Enforcement outputs since 2024—updated guidance, listings with continuity identifiers, targeted inspections, port-entry denials and a small number of confiscation outcomes—demonstrate operational bite. Behavioural responses have been consistent with theory: accelerated renamings and flag switches after adverse publicity or detention, route adjustments away from active inspection zones and increased use of opaque insurers. Because these responses are costly, sustained and predictable enforcement raises the shadow premium even if volumes persist.

Policy options within existing law can narrow the gap between formal design and operational reality. The most effective measures are upstream and rules-based. First, verification uplift for defined red-flag combinations—multi-stage ship-to-ship, identity churn and tracking anomalies—should require audit-ready, price-knowing documentation rather than Tier-2 attestations alone. Secondly, model port-access gates should condition entry and anchoring by high-risk cohorts on direct, API-based confirmation of insurance and class, recent survey evidence and complete transfer documentation. Thirdly, an insurance recognition standard for sensitive waters would set objective solvency and claims-handling thresholds, improving recovery in casualty scenarios. Fourthly, supervised transfer zones with surveyor presence, weather minima and central logging would reduce offshore spill risk and improve audit trails. Finally, listings should systematically include continuity identifiers—IMO numbers, prior names and MMSI histories—supported by machine-readable registry event logs to blunt the value of rapid re-flagging.

Effectiveness should be judged by a transparent suite of indicators rather than by headline announcements. On the price side, discounts to benchmarks and reconstructed netbacks should be annotated with guidance updates and cap resets to distinguish binding from non-binding phases. On the logistics side, tonne-miles and freight premia, the share of voyages on non-verifiable insurance, and transfer incidence inside and outside supervised zones provide a read on substitution and risk. On the governance side, detention yields for targeted cohorts, registry event latency and claims settlement timelines measure whether gates are binding and externalities are diminishing. A composite shadow-pressure index—combining non-IG insurance share, unsupervised transfer incidence and identity-churn intensity—would give an early warning signal of adaptation.

The outlook depends on outright prices, enforcement cadence and the capacity of substitute services. If prices remain high and verification is static, the incentive to use the shadow channel will persist. If Coalition partners align red-flag triggers and Member States harden documentation gates at access points, the compliant channel should reclaim share during non-binding phases, while the residual shadow logistics become more expensive and less attractive. Success should be defined not as the disappearance of shadow practices, which is unlikely while global demand remains robust, but as a durable increase in the shadow premium, a measurable migration towards supervised and verifiable operations, and a reduction in coastal-state exposure evidenced by faster claims recovery and fewer high-severity incidents in constrained waterways.

This report's recommendations aim to produce predictable friction early in the voyage cycle, replace episodic interdiction with systematic verification, and align incentives so that high-risk operators face higher, earlier hurdles. The measures are legally available, operationally tractable and compatible with European interests in maritime safety, environmental protection and the integrity of sanctions policy.

Table of Contents

Executive Summary	2
Table of Contents	5
1. Purpose, Scope and Context.....	10
1.1 Purpose and audience	10
1.2 Scope, definitions and taxonomy	10
1.3 Temporal and geographic coverage	11
1.4 Evidence standards, uncertainty and limitations	12
2. Sanctions, Market Structure and the Emergence of the Shadow Fleet	13
2.1 EU sanctions architecture since 2014	13
2.2 The 2022–2025 measures: embargoes, services bans and the price cap	14
2.3 Trade reorientation and logistics constraints	15
2.4 Causal pathways from sanctions to shadow operations	15
3. Fiscal Significance: Export Revenues and War-Time Expenditure	16
3.1 Overview and questions	16
3.2 Revenue mechanics under a dual-track trade.....	16
3.3 Price, discount and freight-cost dynamics (2023–2025).....	17
3.4 Gross receipts, volatility and budget transmission	17
3.5 Role of the shadow fleet in sustaining cash flows.....	17
3.6 Sensitivity and counterfactuals	18
3.7 Interim conclusions for enforcement design	18
4. Taxonomy and Measurement of the Shadow Fleet.....	19
4.1 Working definitions and inclusion criteria	19
4.2 Data sources and measurement challenges	20
4.3 Size, composition and age profile.....	21
4.4 Sensitivity of estimates to assumptions	21
5. Operational Modalities and Evasion Techniques.....	22
5.1 Overview	22
5.2 AIS disabling and spoofing	22
5.3 Ship-to-ship transfers and blending	23
5.4 Identity management: renamings, re-flagging and stateless operation.....	24
5.5 Insurance substitution, reinsurance and document integrity.....	24
5.6 Payments, settlement channels and attestations	25
5.7 Illustrative vignettes (anonymised)	25
5.8 Indicators for risk-based targeting	25

5.9 Practical measures for counterparties and authorities	26
5.10 Data requirements and transparency.....	26
6. Market Participants and Intermediaries.....	26
6.1 Cargo buyers and trading firms (regional overview)	27
6.1.1 Asia (India, China, others).....	27
6.1.2 Türkiye, Middle East and other intermediating hubs.....	27
6.1.3 Europe (residual and indirect).....	27
6.2 Shipowners, managers and charterers (structures and incentives).....	28
6.2.1 Ownership and control	28
6.2.2 Chartering and fixture practices.....	28
6.2.3 Incentives and constraints	28
6.3 Insurers, P&I substitutes and classification societies	28
6.3.1 Insurance market segmentation	28
6.3.2 Document integrity and verification.....	29
6.3.3 Classification and survey regimes.....	29
6.4 Flag states, registries, port and coastal state authorities	29
6.4.1 Flag and registry roles.....	29
6.4.2 Port State Control (PSC) and customs	29
6.4.3 Coastal-state exposure	30
6.5 Brokers, agents and service providers.....	30
6.5.1 Roles and responsibilities.....	30
6.5.2 Managing red flags	31
6.6 Incentives, risk transfer and the compliance perimeter.....	31
6.6.1 Incentive alignment.....	31
6.6.2 Compliance perimeter and residual risk.....	31
6.7 Practical measures by actor class	31
6.8 Data and transparency requirements.....	32
7. Trade Flows and Routing	32
7.1 Principal routes and chokepoints	32
7.1.1 Crude flows	32
7.1.2 Refined products and intermediate streams	33
7.1.3 Chokepoints and transit risks	33
7.2 STS hotspots and regional clusters.....	34
7.2.1 East Mediterranean and Aegean belt.....	34
7.2.2 Atlantic approaches and West Africa	34
7.2.3 Black Sea periphery	34
7.3 Tonne-miles, fleet utilisation and freight premia.....	34
7.3.1 Tonne-mile expansion	34

7.3.2 Freight premia and earnings	35
7.3.3 Utilisation dynamics	35
7.4 Re-exports and indirect flows to OECD markets	35
7.4.1 Refining and product re-entry	35
7.4.2 Documentation and oversight.....	36
7.4.3 Measurement implications	36
7.5 Documentary pathways and voyage economics	36
7.5.1 Paper chains and attestation tiers.....	36
7.5.2 Cost components and arbitrage	36
7.6 Risk concentrations and coastal-state exposure	36
7.6.1 Geographic concentrations	36
7.6.2 Liability and environmental response	37
7.7 Data requirements for transparent routing analysis	37
8. Environmental and Safety Risks	37
8.1 Overview	37
8.2 Incident typology and causal factors	37
8.3 Documented evidence base (open sources)	38
8.4 Casualty scenarios and consequence modelling	38
8.5 Liability and compensation architecture	39
8.6 Risk indicators for targeted oversight.....	39
8.7 Preparedness and mitigation options.....	40
8.8 An expected-loss framing.....	40
8.9 Operational checklists (abridged, for implementation).....	40
8.10 Link to subsequent chapters	41
9. Security and Hybrid-Threat Considerations.....	41
9.1 Scope and framing	41
9.2 Maritime domain awareness and infrastructure adjacency	41
9.3 Allegations concerning UAS and hybrid tactics	42
9.4 Naval shadowing, escorted transits and regulatory action.....	42
9.5 Legal thresholds for interdiction and inspection.....	43
9.6 Policy design: predictable friction rather than episodic interdiction	43
9.7 Interim assessment.....	44
10. EU Sanctions Architecture: Design and Implementation	44
10.1 Legal bases and institutional roles.....	44
10.2 Package-by-package chronology (2014–present)	45
10.3 Interface with the G7/EU price cap (attestations and due diligence)	45
10.4 Enforcement instruments: listings, PSC, asset freezes and seizure.....	46

11. Effectiveness Assessment	47
11.1 Evaluation framework and questions	47
11.2 Immediate outputs: measures and enforcement	47
11.3 Intermediate outcomes: prices, discounts and routing costs	47
11.4 Ultimate outcomes: export revenues and fiscal space.....	48
11.5 Leakage channels and circumvention.....	48
11.6 Enforcement outputs and behavioural response in 2025.....	49
11.7 Counterfactuals and attribution.....	49
11.8 Sensitivity analysis and evidence quality	50
11.9 What has worked and what has not (interim judgement).....	50
11.10 Policy implications	50
11.11 Proposed metrics for ongoing evaluation.....	51
11.12 Limitations and next steps	51
12. Case Studies.....	52
12.1 Documented oil slick with SAR/AIS corroboration (European waters, 2023–2024)	52
12.2 Identity churn and a stateless interval (Baltic–North Europe, 2024–2025).....	53
12.3 Detention leading to confiscation (EU jurisdiction, 2025)	54
12.4 Chokepoint incident risk in the Turkish Straits (illustrative, 2024).....	54
12.5 Multi-stage STS chain in the Eastern Mediterranean (pattern case, 2023–2025)	55
12.6 Alleged UAS-related activity linked to a commercial hull (Western Europe, 2025) — status: alleged	56
12.7 Cross-case synthesis	57
12.8 Tanker sale, beneficial ownership and post-sale routing (Gulf–Mediterranean, 2024–2025)	57
12.9 Insurance certificate anomaly and denial of entry (EU port, 2025)	58
12.10 Registry co-ordination failure and rapid de-flagging (multi-registry, 2024)	59
12.11 Documentary chain failure after multi-stage STS (central Mediterranean, 2024)	59
12.12 Evidence-grading method	60
13. Policy Options.....	60
13.1 Options for EU institutions.....	61
13.2 Options for EU Member States	62
13.3 Options with UK/US/G7 partners	63
13.4 Registry, port and coastal-state reforms	63
13.5 Industry measures	63
13.6 Implementation horizon and monitoring	64
14. Conclusions and Indicators to Watch	64
14.1 Key findings	64
14.2 Outlook and likely adaptations.....	65
14.3 Priority indicators and early-warning signals	65

14.4 Final judgement (interim)	67
Annex A. EU Sanctions Instruments (2014–Present): Packages, OJ References and Maritime-Relevant Clauses	68
Annex B. Dataset Notes and Replication Materials	70
B1. Indicators and sources	70
B2. Heuristics	71
Annex C. Incident Log (detentions, spills, deficiencies)	71
Annex D. Hull-Level Transactions (selected cohort)	72
Annex E. Flag Histories and Identity Changes (Selected Cohort)	73
Annex F. Seller proceeds from Western-origin tanker sales into Russia’s shadow fleet (2022–2025)	73
Annex G. Legal Text Excerpts.....	73
Annex E. Glossary and Abbreviations.....	74
Additional terms used in this White Paper.....	74
Annex F. Bibliography.....	75
EU primary law and official guidance	75
G7/UK/US partner guidance	76
Analysis and market data.....	76
OSINT and investigations.....	76
Maritime safety and liability	76

1. Purpose, Scope and Context

1.1 Purpose and audience

This white paper analyses the emergence, operation and consequences of Russia’s so-called shadow fleet of tankers. It examines how EU restrictive measures and the G7/EU oil price cap have altered trade patterns and maritime logistics; the extent to which a parallel fleet has preserved export volumes and associated cash flows; and the environmental, safety and security risks that follow from these adaptations. The paper’s purpose is explanatory and evaluative. Explanatory, in setting out a precise taxonomy and evidential baseline for what constitutes the shadow fleet; evaluative, in assessing whether the sanctions architecture has reduced Russia’s realised oil revenues and raised operating costs, and at what residual risk to European waters and infrastructure (European Commission, 2025; Council of the EU, 2025; EPRS, 2024).

The intended audience is general readers, policy practitioners and industry stakeholders. General readers require a reliable account free of advocacy and grounded in primary materials. Policymakers need a structured diagnosis of what has worked, what has not, and why—tied to concrete options within the EU’s legal and operational competences. For shipowners, charterers, insurers and registries, the report aims to clarify the documentary standards implied by the oil price cap guidance and to identify risk indicators that are likely to shape port-state control and market practice. Throughout, the paper uses British English, avoids normative language, and attributes claims to sources using in-text references and numbered legal footnotes to the Official Journal.^{1 2 3}

1.2 Scope, definitions and taxonomy

The term shadow fleet is used in this paper to denote a subset of predominantly older crude-oil and product tankers associated with two or more of the following attributes: (i) opaque or frequently changing ownership and control structures; (ii) recurrent renaming and re-flagging, including short stateless intervals between registries; (iii) insurance opacity, typically absence of International Group of P&I Clubs (IG P&I) cover or unclear policy capacity; (iv) AIS manipulation, including extended “dark” segments and positional spoofing; and (v) systematic use of multi-stage ship-to-ship (STS) transfers and blending that complicate verification of price and provenance (Atlantic Council, 2024a; RUSI, 2025). The classification is deliberately operational: it is designed to track behaviours that reduce regulatory visibility or increase expected loss, not to ascribe motive or criminality to any individual voyage.

¹ Council Regulation (EU) No 833/2014 of 31 July 2014 (as amended) and Council Decision 2014/512/CFSP of 31 July 2014. Consolidated versions referenced herein (EUR-Lex).

² European Commission, *Guidance on the Russian oil price cap* (consolidated; latest files and notices, including 2025 update).

³ Council of the EU, *Packages of sanctions since February 2022* (official timeline and press notes).

Metric (2025)	Harmonised value	Primary source (prevails)
Russia-linked shadow fleet size (point estimate)	~940 vessels (May 2025)	EU Today (citing S&P Global)
Share of global in-service oil & product tankers	~17% (start of 2025)	EU Today (S&P Global)
Sanctioned-trade fleet breadth (RUS+IRN+VEN)	~978 vessels; 18–19% of global capacity (Sept 2025)	EU Today (S&P Global)
YoY expansion of Russia-linked shadow fleet	~+45% growth into early 2025	EU Today (S&P Global)
G7-controlled tankers' share of Russia exports (flow)	"Just over half" in Aug 2025 (–8pp vs Jul)	EU Today (CREA)
Primary buyers / routing hubs	India, China; transshipment via Singapore/Malaysia/Indonesia	EU Today
EU vessel listings (shadow-fleet linked)	Use official EU July 2025 total in main text; cite EU Today for "dozens added"	EU Today for narrative; Council/Commission for exact total
UK / US actions (qualitative scope)	Active rounds of listings; "several hundred" US-designated vessels in 2025	EU Today
Average age of shadow-fleet tankers	18.1 years; >75% ≥15 years	IWI 2025 (kept as complementary)
Insurance verifiability	High documentation production on Baltic checks; solvency/quality uncertain	Lloyd's List 2025 (kept as complementary)
Indicative per-barrel spill costs	~\$600–\$4,000 per barrel	ITOPF (kept as complementary)
Unsanctioned but active tankers (gap indicator)	81 tankers with >3 Russia-linked voyages (to Jul 2025)	KSE 2025 (complementary)
Monthly export receipts (illustrative)	e.g., ~\$13.3bn (Sep 2025)	IEA 2025

Table 1. Russia-linked shadow fleet: headline indicators 2025

Related terms are used consistently. **Dark activity** refers strictly to operations with AIS disabled for material legs of a voyage, particularly on approaches to ports, anchorages or recognised STS zones. **Grey shipping** denotes trades that are formally compliant—for example, cargoes attested below the oil price cap that therefore lawfully use Western services—but which exhibit elevated risk markers in flagging, documentation or insurance and therefore merit enhanced diligence by counterparties and authorities (Atlantic Council, 2024b; EPRS, 2024). This taxonomy is necessary to separate (a) lawful, price-cap-compliant carriage from (b) higher-risk practices without proven breach and (c) designated actors or vessels subject to asset freezes and prohibitions. The paper avoids naming firms or families in the main text unless actions are clearly documented and legally relevant; selected cohort hull-level transactions and identity histories are instead recorded in Annexes D–E with sources and confidence levels.

1.3 Temporal and geographic coverage

The temporal scope runs from 2014 to the present. It begins with the EU's initial legal framework—Council Decision 2014/512/CFSP and Council Regulation (EU) No 833/2014—which created the base for sectoral restrictions, and continues through the 2022–2025 cycle of embargoes, service bans and the oil price cap interface. Consolidated versions of these

instruments and the Council’s package timeline provide the authoritative chronology against which developments in fleet behaviour are mapped.^{1 2 3}

Geographically, the focus is on trade flows relevant to European waters and approaches. These include: the Baltic and North Seas (with exits via the Danish Straits and the English Channel); the Black Sea–Mediterranean corridor (transits through the Turkish Straits and into the Aegean); STS belts in the eastern Mediterranean and south of mainland Greece; episodic activity in the Atlantic approaches and off West Africa; and the long-haul routes to Asia via the Suez Canal or around the Cape of Good Hope. The spatial lens is chosen for two reasons. First, it captures the risk transfer to European coastal states created by older hulls, opaque insurance and unsupervised STS. Second, it aligns with the jurisdictional reach of EU law and the practical tools—port-state control, customs, asset freezes—available at entry points and anchorages (EPRS, 2024; EUR-Lex consolidations).



Figure 1: A ship-to-ship transfer of oil involving a Russian-linked tanker. The Liberian-flagged tanker **Ice Energy** (left) receives crude oil from the Russian-flagged tanker **Lana** (right) off the coast of Greece in May 2022 . Such mid-sea transfers are a common tactic to mix or re-route Russian oil outside normal port scrutiny.

1.4 Evidence standards, uncertainty and limitations

The paper follows three evidence principles.

First, primary law and official guidance prevail on questions of scope, jurisdiction and compliance obligations. The operative texts are the Official Journal instruments—Regulation 833/2014 and its amending acts, and Decision 2014/512/CFSP—read with the European Commission’s guidance on the oil price cap (including the consolidated 2025 update) and the

Council’s package timeline. Where appropriate, article numbers and Official Journal references are provided in footnotes for direct verification.^{1 2 3}

Second, authoritative data series underpin market and operational claims. Monthly IEA oil market reports are used for exports, discounts and revenue indicators; the KSE Institute’s tracker provides sanctions-era revenue estimates; and recognised policy institutes (e.g., Atlantic Council, RUSI) provide methodical analyses of fleet size, practices and enforcement gaps. Inferences about revenue effects distinguish between price (discounts to benchmarks), volume (export continuity) and costs (freight premia, documentary burdens), reflecting the dual-track model in which compliant and shadow channels substitute as the cap becomes more or less binding (IEA, 2025; KSE, 2025; Atlantic Council, 2024; RUSI, 2025).

Third, OSINT corroboration is applied where AIS anomalies, STS activity or environmental incidents are alleged. Patterns identified in AIS archives—gap detection, kinematic plausibility tests, pairwise proximity at anchorages—are cross-checked against synthetic-aperture radar (**SAR**) or optical imagery and against documented investigative work. Allegations are marked as such unless supported by multi-source technical confirmation or judicial findings (SourceMaterial, 2025; SkyTruth, 2025).

The limitations are explicit. AIS can be manipulated; beneficial ownership is often obscured by shells and nominees; insurance documentation outside IG P&I channels may be opaque or non-standard. Where evidence is contested or incomplete, the paper reports the fact pattern and refrains from inference beyond the record. A clear distinction is maintained between lawful, price-cap-compliant carriage—including carriage by EU shipowners when the cap is not binding and attestations are in order—and sanctions breaches or actions by designated actors (IEA, 2025; European Commission, 2025). The methodology and indicator thresholds used for classification and hotspot detection are described in Annex B; data tables and transaction records are provided in Annexes C–E to enable replication.

2. Sanctions, Market Structure and the Emergence of the Shadow Fleet

2.1 EU sanctions architecture since 2014

The European Union’s restrictive measures against Russia rest on a two-pillar legal base. Strategic choices are adopted under the **Common Foreign and Security Policy (CFSP)** in a Council decision pursuant to Article 29 TEU; measures with general application are implemented by a directly applicable **Article 215 TFEU** regulation binding on natural and legal persons within EU jurisdiction. The foundational instruments are **Council Decision 2014/512/CFSP** and **Council Regulation (EU) No 833/2014**, which introduced sectoral restrictions on finance, defence-related items and certain energy technologies in response to Russia’s actions in Ukraine. Since 2014 these acts have been amended repeatedly to widen scope, add sectors and address circumvention, producing a body of secondary legislation that

now includes embargo provisions, services bans and anti-circumvention clauses with direct relevance to maritime trade (EUR-Lex consolidations).⁴

Institutionally, responsibility is distributed. The **Council** adopts and amends measures (usually acting unanimously), maintains the public **packages** chronology, and approves listings of individuals, entities and vessels. The **Commission** issues implementation **guidance**, co-ordinates with G7 partners on the oil price cap, and circulates **alerts** drawing attention to observed circumvention patterns (e.g., spoofed AIS, multi-stage ship-to-ship transfers, documentary insufficiency). For practitioners, the Council's packages timeline is the authoritative ledger for the dates and substance of each amendment and therefore the basis for determining when particular prohibitions or services bans took effect (Council of the EU, 2025).

2.2 The 2022–2025 measures: embargoes, services bans and the price cap

Following the full-scale invasion of February 2022, the EU adopted a sequence of packages that, taken together, re-shaped the maritime interface of Russia's oil trade. Two decisions are pivotal. First, the **ban on the import of seaborne Russian crude oil from 5 December 2022 and on refined petroleum products from 5 February 2023**, accompanied by prohibitions on **transport, broking, insurance and reinsurance** connected with such cargoes. Second, the decision—taken with G7 partners—to allow EU and UK maritime services for third-country shipments **only where** the oil or product is sold **at or below** a specified cap, operationalised through **attestations** and **tiered due-diligence** duties for service providers (Council of the EU, 2025; European Commission, 2025).

The **cap mechanics** and compliance expectations are elaborated in Commission materials aligned with **Price Cap Coalition** guidance (mirrored by US **OFAC**), which also record the effective dates: **5 December 2022** for crude and **5 February 2023** for petroleum products. In **July–August 2025**, the EU lowered the crude cap level in concert with partners and issued updated guidance and circumvention alerts, signalling closer scrutiny of **blending, STS operations** and **spoofed AIS**. These adjustments matter because they change whether the cap is *binding* at prevailing market prices and therefore whether compliant Western services return to trades or, conversely, whether operators substitute into opaque logistics (European Commission, 2025; OFAC, 2023/2024; Council of the EU, 2025).^{5 6}

For legal certainty, consolidated versions of the 2014 **Decision** and **Regulation**, as amended to mid-2025, capture the operative text applicable to EU persons, including the interfaces

⁴ **Legal base.** Council Decision 2014/512/CFSP and Council Regulation (EU) No 833/2014 establish the EU framework for restrictive measures concerning Russia; consolidated versions reflect amendments through 2025 (EUR-Lex, consolidated texts).

⁵ **Embargo and price cap.** The Council's sanctions timeline records the effective dates for the seaborne crude (**5 December 2022**) and petroleum products (**5 February 2023**) bans and notes later adjustments; the Commission's **Guidance on the Russian Oil Price Cap** sets out attestation and due-diligence expectations (Council of the EU, 2025; European Commission, 2025).

⁶ **US alignment.** OFAC guidance mirrors the Coalition approach and confirms the effective dates of the crude and product determinations for US jurisdictional purposes (OFAC, 2023/2024).

with the cap and the services prohibitions relevant to **shipping** and **insurance**. Practitioners should cite the consolidated **Regulation 833/2014** for article-level obligations and the Commission’s guidance for attestation and record-keeping standards.^{4 5}

2.3 Trade reorientation and logistics constraints

The embargo and services prohibitions eliminated proximate European demand and curtailed access to Western maritime services for trades **above** the cap or unable to meet documentation standards. Market data for 2023–2025 show a marked reorientation of Russian crude and product exports towards **India, China** and other third-country buyers. The consequent **route elongation** increased **tonne-miles**, raised the utilisation of **Aframax** and **Suezmax** classes suited to Baltic and Black Sea liftings, and—together with documentary and insurance uncertainty—produced **freight premia** on Russia-linked lanes (IEA, 2025).

The revenue picture is mixed and time-sensitive. Monthly series compiled by the **International Energy Agency** indicate that oil export receipts remained material but volatile, shaped by the interaction of global prices, discounts to **Brent/Urals**, and the binding force of the cap. The **September 2025** Oil Market Report recorded revenue declines for **August 2025** alongside discount widening and lower loadings, underscoring how enforcement cadence and cap adjustments transmit into receipts (IEA, 2025). Independent monitors of differentials reported phases in **2025** when **Urals discounts narrowed**, consistent with the scaling of non-Western services and increased availability of tonnage; subsequent Commission actions aimed to **re-tighten** the regime. These dynamics determine when Western services re-enter **compliant** trades and when exporters pivot back to **opaque** logistics (IEA, 2025; CREA, 2025).

In operational terms, the market has exhibited a **dual-track** equilibrium. When the cap is **not binding** at prevailing prices and documentation is available, compliant trades proceed with Western services (including **IG P&I**), compressing discounts. When the cap **binds**, or where parties cannot meet the guidance’s documentary standards, trades **substitute** into non-Western insurance, permissive registries and STS-centred routing, with higher premia and reduced price visibility (European Commission, 2025; IEA, 2025).

2.4 Causal pathways from sanctions to shadow operations

The emergence of a Russia-linked shadow fleet can be traced through a sequence of constraints and adaptations.

Legal constraint. The combination of the EU **import bans** and **services prohibitions**, offset by a **safe harbour** for below-cap transactions, created a binary choice for market participants: document compliance to retain Western services, or assemble a substitute logistics chain outside the cap. The safe harbour’s practical value depends on the **attestation** architecture and the **tiered** diligence expected of owners, insurers and other service providers (European Commission, 2025).⁵

Operational substitution. To preserve volumes where Western services were unavailable or unattractive, exporters and intermediaries increased reliance on **non-IG P&I** and **state-linked reinsurance**, engaged registries with lower diligence thresholds, and adopted practices that reduce traceability—**AIS dark or spoofed segments**, multi-stage **STS** and **identity churn** (renamings and re-flagging). Commission guidance and Council communications identify these vectors explicitly as **circumvention risks**, setting expectations for enhanced checks where such red flags occur (European Commission, 2025; Council of the EU, 2025).⁵

Market clearing. Longer voyages to distant buyers and elevated perceived risk raised **freight premia**, improving voyage economics for **older** Aframax/Suezmax units despite higher technical risk, particularly on Baltic and Black Sea routes. Reporting during 2024–2025 recorded strong earnings on **Russia–India** lanes and heavier utilisation of both mainstream and opaque tonnage pools (IEA, 2025; Reuters, 2025).

Revenue preservation under constraint. When outright prices fall or the cap does **not** bind, compliant Western services partially re-enter; when the cap **does** bind or enforcement tightens, exporters pivot back to opaque logistics. The coexistence of compliant flows and shadow flows enables a degree of **revenue smoothing** over the sanctions cycle, but at the cost of **safety**, **environmental** and **governance** risks borne by coastal states and the wider market (IEA, 2025; European Commission, 2025).

Interim implication. The measures since 2022 have **changed how** trade clears—via route elongation, service-mix shifts and due-diligence costs—and they have raised the **operating costs** of exporting. They have also incentivised a **parallel logistics ecosystem** that exploits regulatory seams. Subsequent chapters examine the scale and composition of that ecosystem, the techniques it uses, and the associated risks.

3. Fiscal Significance: Export Revenues and War-Time Expenditure

3.1 Overview and questions

This chapter examines the fiscal role of Russia’s seaborne oil exports under EU sanctions and the G7/EU oil price cap. It asks three questions. First, to what extent have sanctions **reduced realised prices** (via discounts) or **raised costs** (via freight premia and documentation), and how have these effects varied over time? Second, have volumes and logistics adaptations—particularly the use of shadow-fleet arrangements—**preserved gross receipts**, and with what volatility? Third, how do changes in receipts **transmit to the federal budget** under wartime conditions, given exchange-rate, tax and spending adjustments? The discussion relies on **IEA** export and revenue series, complementary trackers (e.g., **KSE Institute**) and recognised macro-fiscal analysis (e.g., **BOFIT**), with author–date citations in text; legal mechanics of the cap are footnoted where necessary.

3.2 Revenue mechanics under a dual-track trade

Sanctions since December 2022 have created a **dual-track equilibrium**. When the oil price cap is **non-binding** (i.e., market prices are close to the cap minus a modest discount and attestations are available), compliant Western services—transport, insurance, broking—**re-enter** the trade. Discounts to benchmarks **narrow**, freight premia compress, and realised prices rise (IEA, 2025). When the cap **binds** or enforcement tightens (e.g., updated guidance, expanded listings, targeted inspections), trades **pivot** to non-Western services and older hulls, often via ship-to-ship (STS) chains. Discounts **widen**, premia and delays **increase**, and realised prices fall relative to benchmarks (IEA, 2025; European Commission, 2025).

In both states, **volume continuity** has been a policy-relevant constant. Exports have reoriented towards **India, China and other third-country buyers**, with tonne-miles rising and the **Aframax/Suezmax** segments absorbing longer routes from the Baltic and Black Sea (IEA, 2025). The key fiscal variable is therefore **netbacks**—the price actually realised **after** discounts and logistics costs—not the existence of volumes per se.

3.3 Price, discount and freight-cost dynamics (2023–2025)

Institutional series indicate a **saw-tooth pattern**. Phases of **discount narrowing** in 2024–2025 coincided with increased availability of tonnage and non-Western services; phases of **discount widening** followed enforcement pulses and cap adjustments (IEA, 2025). Freight premia on Russia-linked lanes remained elevated relative to pre-war norms, reflecting route elongation, documentary risk and **insurance opacity** when cover moved outside International Group channels (Lloyd’s List Intelligence, 2024–2025). The combined effect is a **variable wedge** between benchmark prices (e.g., Brent) and Russian netbacks: sometimes moderate when documentation is available and the cap is non-binding; sometimes large when trades rely on shadow-fleet routes with STS and AIS anomalies (IEA, 2025).

3.4 Gross receipts, volatility and budget transmission

IEA monthly estimates show that Russia’s **oil export receipts** have remained **material** through 2024–2025, with **month-to-month volatility** driven by three interacting factors: (i) benchmark prices; (ii) **discounts to Urals/ESPO**; and (iii) the **binding force** of cap compliance and enforcement (IEA, 2025). Periods of lower loadings and wider discounts have produced **noticeable dips** in receipts; periods of narrow discounts and stable volumes have produced **partial recoveries**. Independent trackers (e.g., **KSE Institute**) report similar directional movements in sanctions-era revenue estimates (KSE, 2025).

The fiscal **transmission** is mediated by the tax structure (export duties, mineral extraction tax), the **exchange rate**, and discretionary budget and off-budget financing. BOFIT and other observers note that higher defence outlays have been met by a mix of **oil-linked revenues**, domestic borrowing and budget reallocations. While sanctions have **reduced margins** and **raised costs**, they have not **eliminated** oil-linked cash flows; the budgetary effect therefore depends on the **elasticity** of tax and spending adjustments to changes in netbacks (BOFIT, 2025; IEA, 2025).

3.5 Role of the shadow fleet in sustaining cash flows

Shadow-fleet logistics affect receipts through **cost and continuity** rather than legality alone. Where compliant services withdraw, reliance on older hulls, non-IG cover and **multi-stage STS** raises costs and delays, but it also **preserves carriage** to distant buyers. The net fiscal result is **attenuation**, not cessation: realised prices fall relative to benchmarks, but **gross volumes** often continue, smoothing monthly revenue. This smoothing is **imperfect**—subject to inspection delays, detentions and episodic incidents—but persistent enough to sustain a **baseline cash flow** (IEA, 2025; Atlantic Council, 2024; RUSI, 2025).

From a policy perspective, the **bindingness** of the cap is pivotal. When caps are **set and enforced** at levels that bite and when due-diligence obligations are **verified**, compliant services are relatively more attractive, increasing documentation and reducing reliance on opaque logistics. Conversely, when the cap is **non-binding** or verification is weak, the price signal favours substitution into the shadow channel (European Commission, 2025; IEA, 2025).^{7 8}

3.6 Sensitivity and counterfactuals

Three counterfactuals are informative.

No-sanctions: without embargoes and the cap, European demand and Western services would have kept tonne-miles lower and freight premia smaller, raising **netbacks** and fiscal space at a given benchmark price.

No-shadow-fleet substitution: if substitution into non-Western services were ineffective, volumes would be lower and discounts wider; receipts would fall further, but global crude markets might tighten.

Price cycle: movements in global benchmarks can obscure sanctions effects in nominal terms; a high Brent can **mask** depressed netbacks, while a falling Brent can **amplify** apparent revenue reductions even if discounts are unchanged (IEA, 2025; BOFIT, 2025).

3.7 Interim conclusions for enforcement design

The evidence to date supports three practical conclusions.

First, sanctions have **changed how** trade clears and **raised costs**; they have not, by themselves, eliminated export receipts.

Second, **verification**—of attestations, insurance capacity and documentary chains in high-risk voyages—determines whether the compliant channel remains attractive.

⁷ **Price-cap architecture.** Commission guidance defines the obligations on Tier-1 (price-knowing) and Tier-2 (service) parties and sets out verification and record-keeping expectations (European Commission, *Guidance on the Russian Oil Price Cap*, consolidated 2025).

⁸ **Legal base and embargo milestones.** Council Decision 2014/512/CFSP and Council Regulation (EU) No 833/2014 (as amended) form the legal foundation; the Council's timeline records the **5 December 2022** (crude) and **5 February 2023** (products) milestones and subsequent adjustments (EUR-Lex consolidated texts; Council of the EU, 2025).

Third, targeted, rules-based measures that **raise early frictions** (documentation gates; supervised STS; insurance verification) are more likely to compress netbacks **persistently** than episodic interdictions late in the voyage cycle (European Commission, 2025; EMSA, 2023; IEA, 2025).^{7 8}

4. Taxonomy and Measurement of the Shadow Fleet

4.1 Working definitions and inclusion criteria

For the purposes of this study, **shadow-fleet** status is assigned at the **vessel level** on the basis of observable behaviours and documentable attributes rather than intent. A tanker is classified as shadow if, **within the observation window**, it satisfies **two or more** of the following criteria:

Opaque ownership and control.

Use of **single-purpose vehicles** with nominee directors, rapid on-paper transfers across related entities, and limited verifiable links between beneficial and registered ownership. These structures impede counterparty diligence and complicate sanctions screening (Atlantic Council, 2024a; RUSI, 2025).^{9 10}

Identity management.

Frequent renaming and re-flagging, including short **stateless** intervals between registries, and re-issuance of MMSI. Elevated identity churn increases aliasing risk and undermines continuity checks (RUSI, 2025; EPRS, 2024).¹¹

Insurance and class opacity.

Absence of **International Group (IG) P&I** cover or unclear policy capacity and exclusions; migration away from **IACS** classification or uncertain special-survey status. These features increase uncertainty over claims and preventive oversight (EPRS, 2024; Lloyd's List Intelligence, 2024–2025).^{12 13}

AIS anomalies.

Repeated **dark segments** proximate to load ports, STS anchorages or chokepoints; **spoofing** patterns indicative of route or position masking beyond benign error margins (Atlantic Council, 2024b; SkyTruth, 2025).⁹

⁹ Atlantic Council (2024a), Russia's growing dark fleet; Atlantic Council (2024b), Threats posed by the global shadow fleet.

¹⁰ RUSI (2025), Maritime Sanctions Taskforce — Second Meeting Report.

¹¹ RUSI (2025), Maritime Sanctions Taskforce — Second Meeting Report.

¹² European Parliamentary Research Service (2024), Briefing on the shadow fleet.

¹³ Lloyd's List Intelligence (2024–2025), fleet composition/age profiles and transactions notes.

Operational patterns.

Systematic ship-to-ship (STS) transfers at permissive anchorages; **multi-stage blending** chains before onward delivery, particularly where documentary custody is thin or delayed (European Commission, 2025; Atlantic Council, 2024a).^{9 14}

A complementary category, **grey shipping**, denotes trades that are formally **compliant** (for example, attested sales at or below the oil price cap) but which exhibit one or more **elevated-risk markers** (identity churn, non-IACS class, recurrent STS). **Dark activity** refers strictly to AIS-off operation over **material** legs and is treated as an **indicator**, not proof of wrongdoing (EPRS, 2024; Atlantic Council, 2024b).^{12 9}

Indicator	Weak	Moderate	Strong
Ownership opacity	SPV with traceable parent	SPV with nominee layering	Multi-jurisdiction chain; rapid re-papering
Identity churn	1 change/year	≥2 changes/year	Stateless interval
Insurance/class	Non-IG P&I disclosed	Unclear capacity	No verifiable P&I; non-IACS class
AIS behaviour	Occasional short gaps	Recurrent dark near hotspots	Dark plus spoofing
Operations	Isolated STS	Regular STS at known sites	Multi-stage STS + blending

Table 2. Decision matrix for inclusion (summary)

Classification rule.

Shadow if ≥2 **strong** or ≥3 **moderate** indicators within the window. Otherwise **grey** if ≥1 **strong** with attested price-cap compliance. Borderline cases are tagged with a confidence level and revisited when new documentation emerges (Annex B details thresholds and scoring).

4.2 Data sources and measurement challenges

Sources. Legal scope and compliance obligations derive from **Official Journal** instruments and the Commission’s consolidated **oil price cap guidance** (attestations, tiered due diligence). **Fleet composition, age and transactions** are drawn from recognised industry datasets (Lloyd’s List Intelligence; Clarksons). **Trade and revenue** series use the **IEA** monthly reports and **KSE** trackers. **Operational inferences** rely on **AIS analytics**—gap detection, kinematic plausibility tests, and geofenced event triggers—corroborated where feasible with **SAR/optical** imagery and documented **STS** events (European Commission, 2025; EPRS, 2024; Atlantic Council, 2024a; RUSI, 2025; IEA, 2025).^{9 13}

Challenges

- **Definition variance.** Estimates differ depending on whether **product tankers**, auxiliaries and **temporarily compliant** vessels are included; some tallies conflate Russia, Iran and Venezuela into a single “dark/grey” pool (RUSI, 2025; EPRS, 2024).¹⁰

11

14 European Commission (2025), Oil Price Cap — Guidance and FAQs (consolidated).

- **AIS manipulation. Spoofing** and transponder outages can produce **false positives**; benign equipment faults and VTS-mandated silences must be filtered using kinematic thresholds and context (Atlantic Council, 2024b).⁹
- **Attribution limits.** Beneficial ownership in permissive jurisdictions is often opaque; registry event data may **lag** real-world control changes, complicating continuity analysis.
- **Insurance opacity.** Non-IG P&I and state-backed reinsurance reduce visibility into **policy limits** and **claims capacity**, affecting risk assessment rather than legality per se.
- **Selection bias.** High-profile incidents receive disproportionate attention relative to the denominator of **all voyages**, skewing perceptions of frequency and severity.

Mitigations. The analysis (i) applies **conservative inclusion rules**; (ii) triangulates **name/flag/MMSI** continuity with dated registry snapshots; (iii) tags observation **confidence** (high/medium/low) and separates **alleged** from **confirmed** events; and (iv) publishes **replication notes** in Annex B (indicator thresholds, geofences, and scoring code-book).

4.3 Size, composition and age profile

Authoritative sources converge on a **large but definition-dependent** cohort. A widely cited global **dark/grey** estimate is on the order of **~1,600 vessels**, spanning Russia/Iran/Venezuela routes; within that, the **Russia-linked** subset constitutes a substantial share that fluctuates with enforcement intensity and market conditions (RUSI, 2025; Atlantic Council, 2024a).^{10 9}

Composition is concentrated in **Aframax** and **Suezmax** crude tankers—well-suited to Baltic and Black Sea loadings—and a significant **MR/Handy** product-tanker segment. The **age pyramid** skews towards **15–25 years**, consistent with end-of-life reallocation from mainstream trades when vetting hurdles, survey costs and charter restrictions rise (Lloyd’s List Intelligence, 2024–2025; EPRS, 2024).^{13 11}

Flag histories show **elevated churn** relative to the wider tanker fleet, with sequences through smaller open registries and occasional **stateless intervals**. **Insurance/class** data point to migration away from **IG P&I** and **IACS** societies in the high-risk cohort, with implications for **casualty response** and **liability recovery** after incidents. These patterns are recorded at hull level in **Annexes D–E**, with dated event logs and source references (EPRS, 2024; Lloyd’s List Intelligence, 2024–2025).^{11 13}

4.4 Sensitivity of estimates to assumptions

Shadow-fleet counts and risk metrics are **sensitive to modelling choices**:

- **Inclusion breadth.** Adding **product tankers** and **auxiliaries** raises counts materially; excluding **temporarily compliant** (attested $\leq$ cap) voyages lowers them (EPRS, 2024).¹¹

- **AIS thresholds.** Minimum **dark-leg duration**, distance to **hotspot geofences**, and spoofing heuristics shift detection rates; stricter thresholds reduce false positives but risk **false negatives**.
- **Insurance/class proxies.** Treating **non-IG** and **non-IACS** as binary flags can inflate risk tallies; a **tiered** approach that weighs **capacity** and **survey recency** is preferred.
- **Attribution window.** **Six- versus twelve-month** windows alter counts for identity churn and ownership opacity, as many vessels cycle paperwork around enforcement pulses.
- **Treatment of STS.** Single-step **STS near ports** is common and not intrinsically suspect; classification should weight **multi-stage STS with blending and ambiguous paperwork** more heavily than supervised, documented transfers.

Implication for this report. Chapter 11 presents **ranges** with explicit assumptions; **Annex B** provides **replication notes** (indicator thresholds, geofences, scoring). **Sensitivity tables** accompany key figures to show how counts move under reasonable alternative assumptions.

5. Operational Modalities and Evasion Techniques

5.1 Overview

Russia’s shadow fleet maintains export continuity by combining five operational modalities that limit regulatory visibility while preserving carriage to distant buyers. These are: manipulation of the Automatic Identification System (AIS); ship-to-ship (STS) transfers and blending; identity management through renamings, re-flagging and occasional stateless navigation; substitution of insurance and adjustments to documentary practice; and payments and attestations designed to meet, or appear to meet, the requirements of the oil price cap. Each modality has a technical logic, a recognisable evidential footprint, and a set of enforcement touchpoints. The account that follows draws on the European Commission’s guidance, institutional datasets and technical open-source methods, with allegations marked as such unless supported by multi-source corroboration (European Commission, 2025; IEA, 2025; Lloyd’s List Intelligence, 2024–2025; Atlantic Council, 2024; RUSI, 2025).¹⁵

5.2 AIS disabling and spoofing

AIS manipulation is typically concentrated at the most probative moments of a voyage: departing a load port; transiting towards an offshore anchorage used for transfers; or passing through congested, surveilled lanes. Dark operation involves deactivating the transponder—or its GPS feed—for a material interval, often several hours and occasionally longer than a day, so that the vessel’s track appears to pause in innocuous waters before resuming near the next declared waypoint. Spoofing replaces silence with misdirection: the transponder

¹⁵ **Price-cap guidance and tiers.** European Commission, *Guidance on the Russian Oil Price Cap* (consolidated, 2025): obligations for price-knowing and non-price-knowing parties, escalation expectations and record-keeping.

broadcasts positions that imply straight-line transits over headlands, improbable jumps at speeds inconsistent with the class, or even coordinates on land. In practice, dark and spoof signatures are often interleaved—short silences to break the continuity of evidence, and synthetic points to create a plausible but misleading narrative (Atlantic Council, 2024b; SkyTruth, 2025).

Detection is not a matter of a single test but of convergence. Authorities and counterparties compare the duration and location of gaps against known transfer belts and chokepoints; examine kinematic plausibility by class and weather; observe whether the same hulls meet repeatedly at low relative speed in the same anchorages; and, where possible, align flagged windows with synthetic-aperture radar scenes showing hulls, wakes or surface slicks. Documentary reconciliation is then decisive: last-port declarations, electronic logbooks, bills of lading and bunker notes either cohere with the reconstructed route or they do not. AIS silence is not in itself unlawful in all circumstances and equipment faults occur; nevertheless, recurrent manipulation proximate to high-risk areas, when combined with documentary inconsistencies, justifies risk-based inspection and supports administrative action on port entry. The legal framing sits under SOLAS Chapter V for carriage and use of navigational equipment and domestic port-entry rules; more intrusive steps depend on accompanying misrepresentation or forgery.¹⁶

5.3 Ship-to-ship transfers and blending

STS practices are neither novel nor inherently suspect; they are well established in mainstream trades and governed by recognised guidance on equipment, mooring and weather. What distinguishes the shadow cohort is the choreography and documentation. A typical sequence begins with a lift at or near a Russian port, followed by a semi-dark leg to an offshore anchorage beyond territorial waters. There, the cargo is transferred, sometimes more than once, to neutral-flag tonnage. Blending or co-mingling may occur before onward delivery, and the declared origin subsequently reflects the last substantial transformation or last transfer point. Over time, stable pairings and triads emerge, with repeated rendezvous in the same polygons. Event clustering over a few days is common, and recipient hulls tend to diverge along distinct routes—eastwards towards Suez or south-west into the Atlantic approaches—consistent with redistribution to different markets (Atlantic Council, 2024a; Lloyd’s List Intelligence, 2024–2025).

The documentary trail is the central risk. Where independent survey certificates, custody-transfer records and coherent ullage reports are present, and where quality assays match the claimed provenance, the evidential burden is lower. In their absence, the European Commission’s guidance expects parties, especially those in non-price-knowing tiers, to escalate diligence and to obtain upstream documents from those with direct price knowledge. This expectation is functional rather than punitive: robust documentation reduces the incentive to rely on opaque routing and simplifies later verification. Where documentary gaps persist, authorities may still admit a vessel to port—safety and

¹⁶ AIS, SOLAS and port entry. SOLAS Chapter V provides the carriage/use framework for navigational equipment; coastal and port-state rules govern approach channels and entry. Administrative or criminal liability turns on accompanying misrepresentation, forged documents or safety violations under domestic law.

humanitarian considerations prevail—but can condition entry on verifiable insurance and class evidence and may order enhanced inspection.¹⁵

5.4 Identity management: renamings, re-flagging and stateless operation

Identity churn aims to reset reputation and confuse screening. Bursts of renamings and re-flagging over six to twelve months are common, particularly after a detention or press exposure; MMSI reassignment can mask continuity for simple checks. Short stateless intervals—brief periods between de-registration and re-registration—are occasionally observed and sometimes coincide with AIS silence. The analytical response is a continuity profile built on the IMO number, treated as the anchor, with dated histories of names, flags, MMSI, registered ownership and ISM management, and, where available, class and insurance status. Sequences that follow an “exposure → change → re-entry” pattern attract higher risk weights. In practice, registries with rapid onboarding and limited public filings are over-represented in such sequences (EPRS, 2024; RUSI, 2025). Enforcement relies on a combination of registry discipline—refusal or revocation absent verifiable beneficial ownership—and PSC targeting of vessels with recent identity events. Where stateless operation is evidenced on the high seas, the legal grounds for visit and further inquiry are clearer under international law.¹⁷

5.5 Insurance substitution, reinsurance and document integrity

When International Group P&I cover is unavailable—because the voyage sits outside the cap or because the counterparty accepts the risk—operators substitute non-IG insurers or rely on state-linked reinsurance. The economic rationale is straightforward: if the expected freight and price discounts cover the higher risk and slower claims resolution, the voyage clears. The regulatory concern is different: coastal states rely on the solvency, limits and claims discipline embedded in the IG pooling and reinsurance structure, and that assurance is weaker where non-IG capacity is opaque. Document patterns in higher-risk cases include letters purporting to confirm entry that cannot be verified with the issuing club, stale certificates, and endorsements whose limits and exclusions are unclear. In response, ports and counterparties increasingly use direct verification—through club portals or APIs—check currency and vessel particulars, reconcile insurance with class and flag at the time of voyage, and, for sensitive passages, seek explicit confirmation of limits and exclusions. Migration away from IACS class, or indeterminate survey status in older cohorts, increases expected loss and detention risk, particularly where special surveys are overdue (Lloyd’s List Intelligence, 2024–2025; EPRS, 2024). The civil-liability framework remains governed by CLC/Fund, but the probability and timeliness of recovery depend on the real capacity behind the certificates presented.¹⁸

¹⁷ **Stateless operation and visit.** UNCLOS Articles 92–94 (flag-state jurisdiction) and 110 (right of visit) govern action where statelessness or forged documents are suspected; PSC powers apply at port under national law.

¹⁸ **Liability/compensation.** CLC 1992 and IOPC Fund instruments govern oil-pollution liability and compensation; verification of **Blue Cards** and state CLC certificates is central where non-IG cover is presented.

5.6 Payments, settlement channels and attestations

Settlement arrangements have adapted alongside logistics. To minimise exposure to Western oversight, parties avoid dollar clearing and large correspondent banks, settle in CNY, AED or INR, and route contracts through traders incorporated in permissive jurisdictions. Back-to-back agreements can separate the beneficial seller from the shipper of record, thinning the audit trail and complicating sanctions screening (RUSI, 2025; Atlantic Council, 2024). Within the EU/UK framework, the pivotal instrument remains the oil price cap's attestations regime. The safe harbour for services applies where the cargo is sold at or below the cap; obligations are tiered between entities with direct price knowledge and those without. In normal conditions, a Tier-2 service provider relies on attestations. Where red flags exist—multi-stage STS chains, identity churn, incoherent assays or AIS anomalies—guidance expects escalation to Tier-1 documents and, failing timely cooperation, a decision not to provide services. The principal vulnerabilities in practice are attestations without substance, artificial segmentation across thinly capitalised entities, and recycling of documents across voyages. Each is mitigated by naming counterparties, requiring voyage-specific identifiers and surveyor contacts, and by reserving the right to perform sample-based audits.¹⁵

5.7 Illustrative vignettes (anonymised)

A recurrent pattern involves two older Aframax tankers meeting repeatedly south of mainland Greece. AIS shows dark legs bracketing each rendezvous; proximity analysis confirms low-speed pairing for sufficient duration to permit transfers; the documentary set contains ullage and survey gaps. Post-transfer, the recipients diverge, one east towards Suez, one into the Atlantic approaches. In such cases, authorities can lawfully admit the vessels but condition entry on verifiable P&I, recent class evidence and a complete survey chain, and may flag the participants for inspection on their next call. In another pattern, a product tanker detained for multiple deficiencies re-enters trade after a rename and re-flag within days. MMSI has changed and the presented insurance is non-IG with unclear limits. Targeted inspection on the next port call, registry queries and direct insurer verification are proportionate. A third scenario features a Tier-2 attestation tabled by an owner while Tier-1 price documents sit with a recently incorporated trader. If the track includes a dark interval near a hotspot and a transfer with minimal documentation, the prudent course is to request upstream materials and, absent cooperation, decline services or apply port-entry conditions. These vignettes are templates; Chapter 12 records documented cases and outcomes.

5.8 Indicators for risk-based targeting

Risk targeting works best when mechanistic rules are transparent and proportionate. The most informative vessel-level markers are age combined with survey recency, recent identity events, and the combination of non-IG insurance with non-IACS class. Voyage-level markers include clustered dark intervals near transfer belts, repeated pairings with the same counterpart, and documentary inconsistencies between tracks and declared ports. Thresholds must be calibrated to reduce false positives: isolated dark gaps away from hotspots, supervised single-step STS with full documentation, and verified IG/IACS status are legitimate mitigating factors. Annex B sets out the indicator thresholds and scoring used in

this report; Chapter 11 presents sensitivity tables to show how counts move as assumptions change.

5.9 Practical measures for counterparties and authorities

Three measures have the greatest leverage and impose predictable, early frictions without relying on episodic interdiction. First, **port-entry gates** for defined risk cohorts should require direct verification of P&I capacity, recent class and survey evidence, and a complete STS or blending file where relevant. Conditions of class, suspended surveys or unverifiable insurance justify refusal or enhanced inspection, subject to safety and humanitarian exceptions. Second, **digital verification** should be normalised: API calls to clubs and class societies; machine-readable registry event logs; and shared aliasing lists capturing former names and MMSI histories. Randomised post-call audits sustain the deterrent effect. Third, **attestation uplift** should be applied where red flags are present: Tier-1 documents should be requested upstream; where counterparties cannot or will not supply them, services should be declined or conditioned. Evidence-preservation protocols at detention—securing VDR, ECDIS tracks, communications logs and crew statements—improve the prospects of consequential outcomes and provide material for shared learning across authorities.¹⁶

Actor	Measures (non-exhaustive)
Refiners / buyers	Retain Tier-1 price documentation; maintain end-to-end chain-of-custody for STS/blending; validate seller authority and capacity.
Shipowners / managers	Implement attestation workflows ; adopt API verification for P&I/class; maintain auditable logs for AIS and STS events; avoid stateless re-flagging.
Charterers / traders	Use contracts with document warranties and termination rights ; audit intermediaries; allocate port-entry and detention risks transparently.
Insurers / P&I	Enforce document authentication ; escalate to enhanced diligence on red flags; require recent class/survey for high-risk passages.
Registries	Verify beneficial ownership ; publish event logs; co-ordinate rapid delisting after adverse findings.
Ports / PSC / customs	Apply risk-based targeting (age, identity churn, AIS/STS); set pre-arrival gates for insurance/class/attestations; preserve evidence chains (AIS/VDR).

Table 3: Operational controls mapped to market participants

5.10 Data requirements and transparency

Operational control improves with timely, structured data. Vessel listings should include continuity identifiers—IMO, former names and MMSI history—in machine-readable formats. Registries should publish dated changes in owner, manager and flag. PSC outcomes, including deficiency codes and detention reasons, should be exportable. Incident reports should provide coordinates and time stamps. Finally, hotspot polygons used for risk targeting should be openly documented so that third parties can replicate and challenge findings. Annexes B–E provide the replication notes and sample cohorts used here.

6. Market Participants and Intermediaries

6.1 Cargo buyers and trading firms (regional overview)

6.1.1 Asia (India, China, others)

Since late-2022, refiners and trading houses in Asia have become the principal buyers of Russian crude and petroleum products. Purchasing decisions reflect a shifting calculus that balances achievable **discounts** to international benchmarks against **freight availability, settlement channels** and **sanctions risk management**. In periods when the oil price cap is **non-binding** at prevailing outright prices, mainstream shipowners and insurers tend to re-enter the trade and documentation improves; when enforcement tightens or the cap **binds**, buyers pivot towards non-Western logistics, including older hulls and alternative insurance, in order to preserve continuity of supply (IEA, 2025; BOFIT, 2025; European Commission, 2025; KSE, 2025). Payment practices have adapted accordingly. Transactions settled in **CNY, AED** or **INR** have expanded, often through affiliates incorporated in permissive jurisdictions. These structures reduce exposure to Western correspondent banking while complicating audit trails for price verification and beneficial ownership. Where a refiner intends to preserve access to Western services, it typically insists on full **Tier-1** documentation, clear STS and blending records, and a voyage file that can be produced rapidly to service providers on request; where cost savings dominate, due-diligence standards and the quality of the documentary chain are more variable (IEA, 2025; KSE, 2025).

6.1.2 Türkiye, Middle East and other intermediating hubs

Companies in **Türkiye** and **Gulf jurisdictions** have developed roles as commercial conduits. Their functions include transshipment, short-term storage, blending, and onward sale, supported by contract architectures that emphasise documentary plausibility—such as **certificates of origin** referencing the last transfer or processing event. The typical arrangement is a back-to-back contract chain that separates the **commercial seller** from the **shipper of record**, allowing parties to compartmentalise sanctions and credit risk while moving product across multiple corporate entities (European Commission, 2025). The efficacy of this model turns on the perceived credibility of the paperwork. Where counterparties are thinly capitalised, newly incorporated, or unwilling to furnish upstream **price** or **survey** documents, the probative value of **attestations** falls and service providers treating the voyage as **Tier-2** exposure are expected to escalate diligence.¹⁹

6.1.3 Europe (residual and indirect)

Direct EU seaborne imports of Russian crude and petroleum products have largely ceased under the embargo, but **indirect flows**—notably refined products exported from third countries—re-enter OECD markets and require assessment under **rules of origin** and **substantial transformation** doctrines. Traders handling such flows need to maintain an auditable chain from lift through any **STS** or **blending** events to the final sale, with assays and quantity certificates that cohere with the declared origin and the attested price. The burden is greater for voyages exhibiting elevated risk markers (e.g., identity churn, AIS anomalies, multi-stage STS), for which the Commission expects enhanced documentary

¹⁹ **Commission guidance and tiers.** European Commission, *Guidance on the Russian Oil Price Cap* (consolidated, 2025): tiered attestations, escalation expectations, and record-keeping standards for service providers

standards from service providers operating in non-price-knowing tiers (European Commission, 2025).¹⁹

6.2 Shipowners, managers and charterers (structures and incentives)

6.2.1 Ownership and control

Ownership is commonly organised through **single-purpose vehicles (SPVs)** registered in permissive jurisdictions, with nominee directors and outsourcing of technical and commercial management. These chains are designed to facilitate **rapid paper transfers** and to compartmentalise liability and sanctions exposure. Periods of intense scrutiny—following a detention or high-profile reporting—often coincide with **renamings** and **re-flagging**, sometimes accompanied by changes in **P&I** and **class** status (Atlantic Council, 2024a; RUSI, 2025; Lloyd’s List Intelligence, 2024–2025). The same corporate structures, however, are not unique to shadow trades; the distinguishing features are the **tempo** of change and the quality of the supporting filings.

6.2.2 Chartering and fixture practices

Fixtures exhibit **risk premia** consistent with the documentary and enforcement environment. Charterers include state-linked buyers, private traders and intermediaries that have entered the market since 2022. Terms address **war-risk**, **document warranties** (attestations; origin evidence), **port-entry** risk allocation, and **off-hire** triggers linked to detentions or document failures. Older units—particularly those **≥15 years** with non-mainstream insurance or class—can command higher **time-charter equivalents** on long routes to Asian receivers but face **vetting barriers** in compliant trades. As a result, owners calibrate exposure between compliant and opaque channels depending on the cap’s bindingness, the availability of Western services, and their own tolerance for inspection delays (Lloyd’s List Intelligence, 2024–2025).

6.2.3 Incentives and constraints

Owners operating near shadow trades weigh elevated earnings against higher probabilities of **mechanical failure**, **PSC interventions** and **listing risk**. The marginal voyage economics reflect freight premia, bunker costs, insurance substitution costs, STS fees, and the probability-weighted cost of delay, detention or seizure. In practice, a portfolio of hulls may straddle both channels: compliant fixtures when documentation is obtainable, and substitute logistics when it is not (IEA, 2025; Lloyd’s List Intelligence, 2024–2025).

6.3 Insurers, P&I substitutes and classification societies

6.3.1 Insurance market segmentation

Where cargoes are at or below the cap and documentation is in order, **International Group (IG) P&I Clubs** and Western reinsurers can provide cover. Above the cap—or where due-

diligence expectations cannot be met—operators migrate to **non-IG** P&I, smaller insurers with uncertain capacity, or **state-linked reinsurance** arrangements. From a public-interest perspective, the opacity of non-IG coverage introduces uncertainty about **claims-paying ability** and **limits**, particularly in high-consequence casualty scenarios (European Commission, 2025; EPRS, 2024).¹⁹

6.3.2 Document integrity and verification

Common issues include **stale certificates**, non-verifiable **letters of entry**, and **forged endorsements**. Ports, terminals and counterparties increasingly rely on **direct verification** with the issuing club or broker—via portals or APIs—cross-checking vessel particulars and dates, and confirming the **limits** and **exclusions** pertinent to narrow straits and coastal passages (European Commission, 2025).¹⁹ This verification step significantly reduces the incentive to recycle documents across voyages.

6.3.3 Classification and survey regimes

Migration away from **IACS** societies and gaps in **special surveys** are most visible in older cohorts. Lower visibility in vetting programmes correlates with higher deficiency counts at **Port State Control (PSC)**. Conditioning port access for defined risk cohorts on verifiable **class** and **survey recency** is a proportionate mitigation, balancing safety and trade facilitation (EPRS, 2024; RUSI, 2025).

6.4 Flag states, registries, port and coastal state authorities

6.4.1 Flag and registry roles

Open registries face a familiar trade-off between due diligence and throughput. Robust practice entails **beneficial-ownership verification**, rejection of applications that would embed **stateless intervals**, and publication of **event logs**—names, flags, MMSI, owners and managers by date—in machine-readable formats to enable continuity analysis across jurisdictions. Multi-state **delisting co-ordination** after adverse findings limits the value of identity churn (RUSI, 2025).²⁰

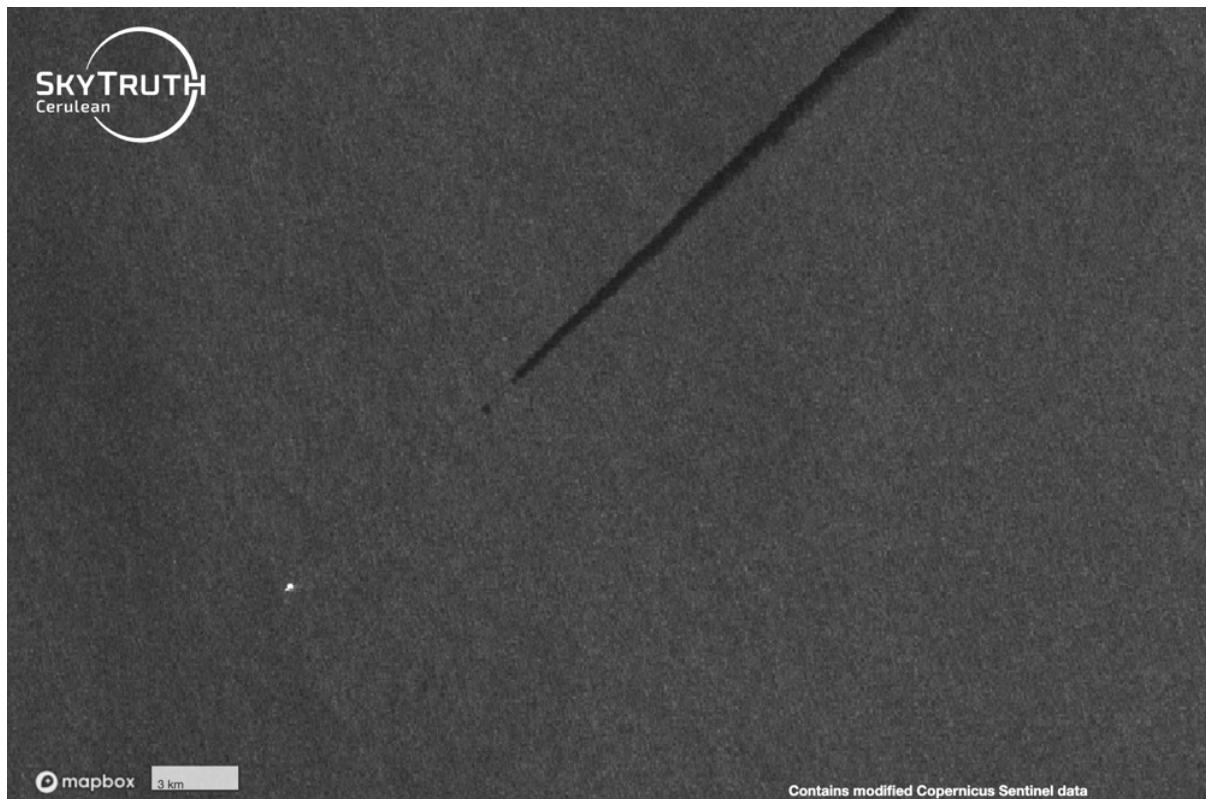
6.4.2 Port State Control (PSC) and customs

PSC targeting models combine **age**, **identity**, **events**, **insurance/class** status and **AIS/STS** behaviours. Customs and port authorities reconcile **bills of lading**, **attestations**, **survey reports** and **assays** with reconstructed tracks. Where inconsistencies arise—such as last-port declarations diverging from observed routes—authorities can order expanded inspection, detain pending clarification, or deny entry in line with national and EU rules (European Commission, 2025; EPRS, 2024).¹⁹

²⁰ **Registry practice.** Practitioner recommendations on beneficial-ownership verification, event logging and multi-state delisting appear throughout RUSI (2025) taskforce materials.

6.4.3 Coastal-state exposure

Coastal states carry residual environmental and fiscal exposure from **uninsured** or **under-insured** spills, particularly in narrow waterways and sensitive coasts. Practical measures include **pre-arrival documentation gates**, targeted **financial security** for defined high-risk passages, and cross-border mutual-assistance arrangements for Tier-2/3 pollution events (EPRS, 2024). The efficacy of these measures depends on timely verification of insurance capacity and clarity over class and survey status at the time of passage.



*Figure 2: Satellite imagery revealing an oil spill from a shadow fleet tanker. The dark streak in this radar satellite image is a 23-kilometer oil slick trailing behind the tanker *Innova* (the bright dot at lower left) as it sailed off the Scottish coast in March 2024. The *Innova*, a 21-year-old ship carrying 1 million barrels of Russian crude to India, left a black pollution trail but faced no consequences, continuing to trade freely.*

6.5 Brokers, agents and service providers

6.5.1 Roles and responsibilities

Shipbrokers, agents, bunker suppliers and surveyors assemble the **documentary chain** that determines whether a voyage meets attestation and due-diligence standards. Engagement letters that assign responsibility for verifications, set out **termination rights** upon discovery of misrepresentation, and require **document provenance** retention are emerging as standard. In high-risk contexts, the most effective brokers operate as information integrators, reconciling registry events, AIS histories and survey outputs before recommending a fixture (European Commission, 2025).¹⁹

6.5.2 Managing red flags

Indicators that warrant escalation include refusal or delay in producing **Tier-1** price documents where expected; **recycled** ullage or quality certificates; unexplained **dark** legs proximate to STS anchorages; back-to-back chains across thinly capitalised entities; and **rename/re-flag** sequences immediately after detention. The Commission's guidance anticipates that such signals will trigger enhanced diligence by non-price-knowing parties and, where cooperation is not forthcoming, a decision to decline services.¹⁹

6.6 Incentives, risk transfer and the compliance perimeter

6.6.1 Incentive alignment

Incentives across the chain are imperfectly aligned. Owners capture voyage earnings and may externalise a portion of environmental and reputational risk; registries internalise fee income but bear limited downstream liability; buyers capture discounts while ports and coastal states absorb hazard exposure. The policy response that best re-aligns incentives is **ex ante**: documentation gates and **port-access conditions** that raise the cost of opacity early, rather than relying solely on late-stage interdictions.

6.6.2 Compliance perimeter and residual risk

Even where attestations are present, residual risk remains if upstream documents are unreliable. Parties within EU/UK/US jurisdiction are expected to demonstrate **good-faith, risk-based efforts** consistent with their tier obligations; failure to escalate when red flags arise weakens that defence should an investigation follow (European Commission, 2025).¹⁹

6.7 Practical measures by actor class

In practice, refiners and buyers that wish to preserve access to Western services retain **Tier-1 price documentation**, maintain end-to-end **chain-of-custody** for STS and blending, and validate the seller's authority and capacity. Shipowners and managers implement **attestation workflows**, adopt **API-based** verification for P&I and class, keep auditable logs for AIS and STS events, and avoid **stateless** registry transitions. Charterers and traders embed **document warranties** and **termination rights** in contracts, audit intermediaries periodically, and allocate **port-entry** and **detention** risks transparently. Insurers reinforce **document authentication**, escalate diligence on red flags, and require **recent survey** evidence for high-risk passages. Registries verify beneficial ownership, publish **event logs**, and co-ordinate rapid delisting after adverse findings. Ports, PSC and customs apply risk-based targeting using the indicators in Chapters 4–5, set **pre-arrival gates** for insurance, class and attestations, and preserve **evidence chains** (AIS/VDR) to support post-hoc action.^{20 21}

²¹ **PSC targeting.** Risk models weighting age, identity churn, non-IG P&I, non-IACS class and AIS/STS behaviour—and the preservation of AIS/VDR evidence—are now common in EU practice (EPRS, 2024; European Commission, 2025).

6.8 Data and transparency requirements

Accountability along the chain depends on timely, structured data. Priorities include machine-readable **vessel listing notices** with continuity identifiers (IMO, former names, MMSI), **open registry event logs**, and standardised **PSC outcomes** with deficiency codes. Consistent incident reporting—coordinates, time stamps and response summaries—improves learning and enforcement. These datasets feed the risk-based approaches described in Chapters 5 and 8 and underpin the evaluation framework in Chapter 11 (EPRS, 2024; RUSI, 2025).

7. Trade Flows and Routing

7.1 Principal routes and chokepoints

7.1.1 Crude flows

Since the embargo entered into force, Russia’s seaborne crude has largely reoriented from short European hauls to long-distance movements towards **India** and **China**. Baltic liftings—principally **Ust-Luga** and **Primorsk**—and Black Sea liftings—**Novorossiysk**—dominate the export slate. From the Baltic, voyages exit via the **Danish Straits** and the **English Channel** before turning south-west into the Atlantic. Depending on conditions, cargoes either round the **Cape of Good Hope**—when **Suez** constraints or earnings differentials justify the detour—or pass through the **Mediterranean** and the Canal into the **Arabian Sea** and onward to the Indian Ocean. From the Black Sea, transits through the **Turkish Straits** are obligatory; after the Aegean, some cargoes enter the eastern Mediterranean **STS belt** for consolidation before heading to Suez, while others continue directly towards the Canal (IEA, 2025; EPRS, 2024). The pattern is not static: refinery maintenance cycles in India and Chinese teapot runs, freight spreads by class, and occasional navigational constraints in the Red Sea and Suez corridor periodically rebalance flows between Cape and Canal routings (IEA, 2025).

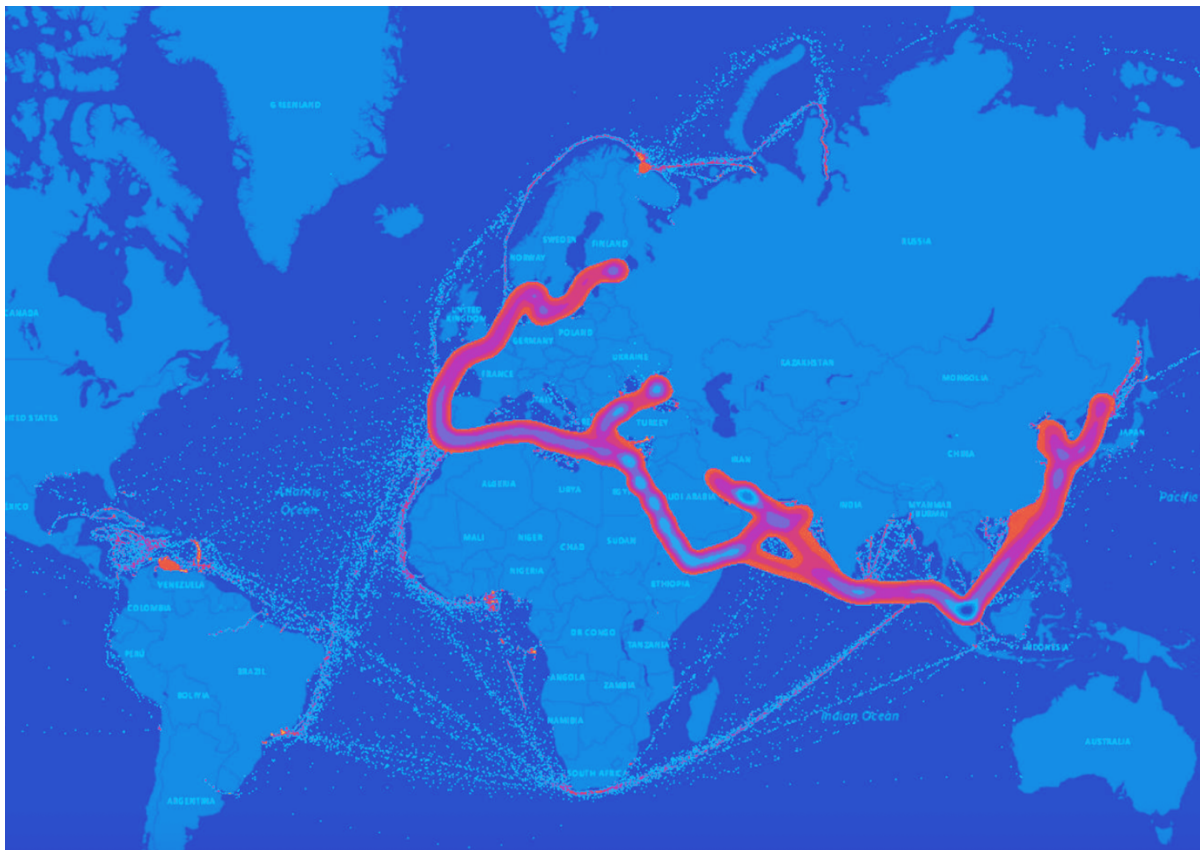


Figure 3. Reorientation of Russia’s seaborne crude flows, 2023–2025.

Heat-map of routing density for **laden crude voyages** lifting at Ust-Luga, Primorsk and Novorossiysk. The plot shows exits via the Danish Straits and Turkish Straits, consolidation in the eastern Mediterranean STS belt, and the bifurcation between **Suez** and **Cape of Good Hope** routings towards India and China.

7.1.2 Refined products and intermediate streams

Product and intermediate streams—**fuel oil, vacuum gas oil (VGO), naphtha, gasoil/diesel**—display greater route variety than crude because blending and re-specification enable re-exports after processing. Short-haul **STS consolidation** in the Mediterranean and in the Atlantic approaches often precedes long-haul carriage to Asian and Middle Eastern receivers. Routing choices reflect the interaction of crack spreads, available storage, and surveyor access; when discounts compress and verification costs rise, trades favour better-documented, price-cap-compliant channels, whereas wider differentials and constrained Western services send more volumes through less transparent itineraries (IEA, 2025; European Commission, 2025).

7.1.3 Chokepoints and transit risks

The **Turkish Straits**, **Suez Canal** approaches, the **Strait of Gibraltar**, and the **English Channel** are the principal chokepoints for Russia-linked routes. The Bosphorus and Dardanelles combine narrow waters, urban adjacency and heavy traffic; an incident involving an older, under-insured hull would impose disproportionate environmental and economic externalities on littoral states. Accordingly, **risk-based Port State Control (PSC)** in these corridors—applied to age, identity-event histories, insurance/class status and AIS/STS

indicators—is central to mitigation (EPRS, 2024). The same logic applies at Gibraltar and in the Channel, where traffic density and pilotage requirements leave limited margin for mechanical failures.²²

7.2 STS hotspots and regional clusters

7.2.1 East Mediterranean and Aegean belt

A persistent corridor of **ship-to-ship** activity lies south of mainland **Greece** and in parts of the **eastern Mediterranean**. The signatures are consistent: repeated close-quarters meetings by known counterpart hulls; dark or semi-dark AIS legs bracketing rendezvous windows; and post-transfer divergence of recipients, with some proceeding **east** through Suez and others **west** towards the Atlantic approaches (SkyTruth, 2025; Atlantic Council, 2024). Site selection is shaped by the balance between shelter and discretion: sea state suitable for fendering and hose handling, sufficient distance from intensive coastal surveillance, and access to service craft for surveyors and small-boat logistics.

7.2.2 Atlantic approaches and West Africa

Episodic clusters appear **west of Iberia** and off **West Africa**, where weather windows, anchor-holding conditions and relative remoteness offer operational viability without the scrutiny common in the Aegean. Transfers in these zones often precede long-haul movements of consolidated parcels either **east-bound** back through the Mediterranean or **south-bound** around the Cape, depending on refiner demand and freight economics (SkyTruth, 2025; investigative OSINT consortia).

7.2.3 Black Sea periphery

Within the **Black Sea** proper, mid-sea STS is less visible; instead, investigative sources describe **pre-positioning** and short **dark legs** proximate to exit points, followed by carriage into the **Aegean** before transfer. The constraints of the Straits and the traffic management regime limit offshore transfer options, pushing consolidation towards the eastern Mediterranean belt (EPRS, 2024). The empirical record for 2023–2025 shows this geography to be durable even as individual anchorage preferences shift modestly with enforcement pressure (SkyTruth, 2025).²³

7.3 Tonne-miles, fleet utilisation and freight premia

7.3.1 Tonne-mile expansion

²² **Routing and PSC focus.** IEA monthly reports provide route and volume indicators used to infer tonne-miles and utilisation; EPRS briefings and Member State PSC practice support the focus on Baltic exits, Turkish Straits, Gibraltar and Channel passages.

²³ **STS hotspot identification.** Kernel-density methods applied to AIS pairing data identify persistent hotspots; SAR/optical corroboration strengthens inference and reduces false positives.

Displacement from short European hauls to long-haul Asian routes materially increased **tonne-miles** in **2023–2025**. The effect is most pronounced in **Aframax** and **Suezmax** segments used for Baltic and Black Sea liftings, where routing via Suez to the Indian Ocean or around the Cape to South and East Asia absorbs additional **hull-days per barrel**. Even when global demand is flat, this route elongation tightens effective supply and supports higher baseline earnings for ships willing to service Russia-linked lanes (IEA, 2025; Lloyd’s List Intelligence, 2024–2025).²²

7.3.2 Freight premia and earnings

Freight premia on Russia-linked lanes reflect a composite of **enforcement uncertainty** (detentions, document checks), **insurance substitution** costs, **STS** fees and delays, and **identity churn** that triggers vetting rejections. Owners of older units—particularly those **≥15 years**—price these frictions into **time-charter equivalents**. While such units face barriers in compliant trades, they command above-benchmark earnings on opaque routes, sustaining demand for end-of-life tonnage and encouraging continued migration from mainstream pools to the shadow cohort (Lloyd’s List Intelligence, 2024–2025).

7.3.3 Utilisation dynamics

Utilisation in the Russia-linked segment is supported by three mechanisms. First, **routing elongation** increases voyage days for a given lift. Second, **deadweight mismatches** within STS chains—multiple **MRs** feeding one **Aframax**, or several Aframaxes consolidating into a **Suezmax**—create waiting and alignment time. Third, **documentary cycling**—the time needed to assemble attestations, survey outputs and insurance evidence—introduces non-sailing delays. These drivers mean that utilisation spikes can coexist with **discount narrowing** when non-Western services scale up, whereas **enforcement pulses** widen discounts but may also strand vessels pending document confirmation (IEA, 2025; BOFIT, 2025).

7.4 Re-exports and indirect flows to OECD markets

7.4.1 Refining and product re-entry

Discounted Russian crude processed in Asian refineries re-enters **OECD** markets as **refined products**—diesel/gasoil, gasoline, jet/kerosene—often via traders based in neutral hubs. Under widely applied **rules of origin**, refined products generally take the origin of the country of **substantial transformation**, not the crude’s source, unless specific prohibitions apply. This legal treatment explains how indirect exposure to Russia-linked molecules persists in headline import figures while remaining distinct in law from direct Russian origin (IEA, 2025; European Commission, 2025).²⁴

²⁴ **Re-exports and legal origin.** Rules of origin and substantial transformation determine the legal treatment of refined products derived from Russian crude; compliance responsibilities within EU/UK/US jurisdictions flow from the tiered guidance framework (European Commission, 2025).

7.4.2 Documentation and oversight

For parties within **EU/UK/US** jurisdiction, compliance hinges on **attestation chains** and, where warranted, enhanced due diligence on feedstock provenance when exposure to Russia-linked streams is plausible. **Red-flag** combinations include multi-stage STS, unusual assay drift across the chain of custody, and rapid document cycling across thinly capitalised intermediaries. In such cases, non-price-knowing service providers are expected to **escalate** requests for **Tier-1** documents or decline to act if satisfactory evidence is not produced (European Commission, 2025).²²

7.4.3 Measurement implications

Headline statistics on EU product imports can **understate** indirect exposure to Russian molecules. To avoid conflation, this report separates **direct Russia-linked carriage** from **indirect flows** following refining or blending. The distinction matters for **legal compliance**—because refined products may be of non-Russian origin—and for **fiscal analysis**, because both channels contribute to Russia’s export receipts even if realised netbacks differ (IEA, 2025).

7.5 Documentary pathways and voyage economics

7.5.1 Paper chains and attestation tiers

Voyage dossiers typically include **bills of lading, commercial invoices, certificates of origin, ullage and quality reports, insurance and class certificates, and price-cap attestations**. Entities with **direct price knowledge** retain primary price evidence; **Tier-2** service providers collect attestations and apply **risk-based** checks. Where tracks, assays or STS histories present anomalies, the Commission’s guidance anticipates **escalation** to upstream documents, not reliance on representations alone (European Commission, 2025).²²

7.5.2 Cost components and arbitrage

Operators weigh **bunker costs, freight premia, STS charges, insurance substitution, and the expected delay** from inspections against cargo discounts and destination **crack spreads**. As these components move, lanes can reverse rapidly. When the cap becomes **non-binding** and compliant services return, documentation costs fall and spreads compress; when enforcement tightens, the system pivots back to opaque logistics with higher premia and longer cycle times (BOFIT, 2025; IEA, 2025).

7.6 Risk concentrations and coastal-state exposure

7.6.1 Geographic concentrations

Risk is concentrated where **older hulls** operating with **opaque insurance** traverse **narrow waterways** with dense traffic—above all the **Turkish Straits**, but also the **English Channel** and selected **Aegean** and **Ionian** approaches. Detentions for technical deficiencies and documentary irregularities are more frequent in these corridors, reflecting PSC targeting

(EPRS, 2024). The operational reality is that even minor equipment failures impose non-linear risks in such environments.

7.6.2 Liability and environmental response

Where insurance capacity is unclear, claims recovery after a casualty becomes uncertain or prolonged. Coastal states therefore emphasise **pre-arrival documentation gates**—direct verification of P&I and class—and may consider **financial security** requirements for defined passages judged high risk. Chapter 8 examines the environmental dimension and response capacity in more detail; the policy objective is to raise **ex ante** standards without unduly impeding compliant traffic (European Commission, 2025).

7.7 Data requirements for transparent routing analysis

Transparent analysis of Russia-linked routing relies on **timely, machine-readable datasets**. At a minimum, vessel listings and sanctions notices should include **continuity identifiers**—IMO number, former names and **MMSI** history—to support identity reconstruction across registry events. **Registry logs** recording dated changes in flag, owner and manager enable analysts to distinguish legitimate transitions from identity churn. **PSC data** with structured deficiency codes and detention reasons provide an external check on technical condition and documentary compliance. **AIS archives** with quality flags are the backbone of routing reconstruction; where available, **SAR** and optical scene identifiers allow corroboration of dark segments and STS events. For the economics, **freight series** comparable across benchmark routes and Russia-linked lanes, and monthly **price and discount** series aligned to **cap adjustments** and enforcement pulses, permit tonne-mile and earnings inference. These inputs underpin route reorientation and tonne-miles and STS hotspots, as well as fleet composition and documentary checks (IEA, 2025; Lloyd’s List Intelligence, 2024–2025; EPRS, 2024).

8. Environmental and Safety Risks

8.1 Overview

This chapter assesses the environmental and safety risks associated with shadow-fleet operations. It considers the principal incident types and their causal pathways; casualty scenarios in open waters and constrained straits; the liability and compensation architecture under **MARPOL**, **CLC 1992** and the **1992 Fund Convention**; the open-source evidence base linking slick detections and detentions to at-risk cohorts; and preparedness options for coastal and port states. The analysis draws on investigative projects that combine **SAR** imagery with AIS time–space reconstruction, EU institutional material and established industry guidance (Source Material–POLITICO, 2024–2025; EPRS, 2024; EMSA, 2023; ITOPE, 2023). Where allegations are made, they are presented as such unless supported by multi-source corroboration or judicial findings.

8.2 Incident typology and causal factors

Incidents fall broadly into five classes. First, **operational discharges**, whether illegal or accidental, generate sheens and slicks during ballasting, deballasting, tank-washing or cargo handling. Second, **navigation casualties**—groundings, collisions, allisions or loss of steerage—arise from pilotage errors, mechanical failures or traffic conflicts. Third, **containment failures** occur when cargo systems leak or transfer hoses rupture during **ship-to-ship (STS)** operations. Fourth, **machinery and electrical failures** produce blackouts or loss of propulsion, frequently associated with deferred maintenance on older hulls. Finally, **fire and explosion** risks follow lapses in vapour control, earthing and electrostatic precautions during transfer. In the shadow-fleet cohort these familiar risks are amplified by attributes already documented elsewhere in this report: **ageing hulls** with patchier survey evidence; migration away from **IACS** class and **IG P&I** cover; **AIS** dark or spoofed segments that impair real-time deconfliction and complicate incident reconstruction; and **multi-stage STS** conducted away from sheltered, supervised zones, which lengthens response times (EPRS, 2024; Lloyd’s List Intelligence, 2024–2025; Atlantic Council, 2024; SkyTruth, 2025; European Commission, 2025; EMSA, 2023). The causal vector is therefore cumulative: hardware stress and procedural shortcuts meet documentary opacity and reduced oversight, increasing both the probability of an event and its expected consequences.

8.3 Documented evidence base (open sources)

Since 2021, investigative work linking **SAR** slick detections with **AIS** tracks has identified repeated incidents in European waters involving tankers that also display risk markers such as identity churn, recurrent dark segments and non-mainstream insurance. Follow-ups in 2025 added cases in which vessels were subsequently detained or designated, reinforcing the association between these markers and observed pollution events (SourceMaterial–POLITICO, 2024–2025; SkyTruth, 2025). Port State Control summaries from Baltic and North European authorities report elevated deficiency counts for older product and crude tankers with recent renamings or re-flagging, notably in engine-room systems, cargo handling and structural maintenance (EPRS, 2024). The evidential standard remains important: **AIS** silence or spoofing alone is not proof of discharge. The probative path relies on timing and location consistency, sensor corroboration and documentary checks—oil record books, cargo/ballast logs, electronic logbooks and STS survey certificates—assembled under chain-of-custody rules described in Annex B.

8.4 Casualty scenarios and consequence modelling

Three scenarios illustrate how risks crystallise.

In the first, an **open-sea spill during STS** arises when a transfer hose fails or a valve is mishandled at an unsupervised anchorage in moderate winds and sea state. Slicks propagate quickly; booming is marginal at best; dispersant deployment is delayed by the distance of suitable craft; and claims recovery is uncertain if insurance capacity or exclusions are opaque. Risk is materially lower where pre-authorised STS plans exist, certified equipment and tugs are on station, and an independent surveyor documents the operation (EMSA, 2023; ITOPF, 2023).

In the second, a **narrow-waterway machinery failure** occurs when a ≥ 20 -year-old tanker loses propulsion in the **Turkish Straits** or the **English Channel**. Emergency anchoring near a traffic separation scheme increases collision risk, imposes closures and diversions, and exposes bunkers or cargo to release. Salvage costs are high; the externalities for littoral states are immediate. Targeted **PSC** for older cohorts, **towage escort** requirements and pre-arrival checks of class status, recent surveys and verifiable **P&I** reduce both probability and impact (EPRS, 2024; EMSA, 2023).

In the third, a **coastal grounding on approach** to an STS belt follows a dark AIS approach in marginal weather. A navigational error leads to a hull breach and shoreline contamination, requiring multi-jurisdictional co-ordination. Where insurer capacity is unclear, compensation is delayed, pushing interim costs to public budgets. Prohibitions on dark transits in approach lanes, active monitoring and denial of anchorage use absent documentation are the relevant control points (EMSA, 2023).

8.5 Liability and compensation architecture

The regulatory and civil-liability framework comprises three pillars. **MARPOL Annex I** prohibits oily discharges above prescribed limits and enables port-state enforcement; national law determines admissibility of aerial and satellite evidence, but many European jurisdictions recognise SAR and aerial observations alongside documentary checks of oil record books and logs.²⁵ For tankers carrying persistent oils, the **1992 Civil Liability Convention (CLC)** imposes strict owner liability backed by compulsory insurance up to ship-specific limits; the **1992 Fund Convention** provides supplementary compensation financed by oil receivers. In practice, the speed and sufficiency of compensation depend on the solvency and responsiveness of the insurer and on documentary integrity. Where **P&I** cover is non-IG or capacity is unclear, recovery can be constrained or protracted, increasing fiscal exposure for coastal states pending judicial resolution (ITOPF, 2023).²⁶ The stress points that emerge in the shadow-fleet context are familiar: uncertain insurer capacity and exclusions; identification delays caused by rapid renaming and re-flagging; evidential gaps where **AIS/VDR** data are incomplete or contested; and jurisdictional seams when STS occurs beyond close coastal oversight.

8.6 Risk indicators for targeted oversight

Because inspection resources are finite, risk-based targeting aligns expected loss with intervention intensity. At the **vessel level**, salient indicators include age (especially ≥ 15 years) combined with unknown or overdue special surveys; non-IG or unverifiable **P&I**; non-IACS class or recent suspensions; and two or more identity events within a year. At the **voyage level**, recurrent dark segments near STS belts, claims of STS or blending unsupported by independent surveys, last-port declarations that diverge from reconstructed tracks, reused

²⁵ **MARPOL enforcement.** MARPOL Annex I prohibits oily discharges above prescribed limits and empowers port states to enforce; where national law so provides, aerial and satellite observations may support prosecutions alongside record-book checks.

²⁶ **Strict liability and compensation.** CLC 1992 imposes strict owner liability backed by compulsory insurance up to ship-specific limits; the 1992 Fund provides supplementary compensation financed by oil receivers. Non-IG or opaque cover complicates timely recovery.

ullage or assay certificates, and the interposition of thinly capitalised intermediaries holding Tier-1 price documents all warrant escalation. These indicators mirror the Commission's expectations for enhanced diligence under the price-cap framework and can be operationalised as port-entry gate checks and inspection priorities (European Commission, 2025).²⁷

8.7 Preparedness and mitigation options

A proportionate strategy places frictions early in the voyage cycle and strengthens the evidential chain. For **ports and coastal states**, pre-arrival documentation gates for defined risk cohorts—direct verification of P&I capacity with the issuing club, recent class and survey evidence, and a complete STS file where relevant—raise the cost of opacity and allow targeted refusals or conditions without impeding compliant traffic. Risk-based **PSC** then focuses on engine-room systems, cargo handling and hull integrity, with **AIS/VDR** data preserved on detention to support downstream action. For passages through **sensitive straits** by older, higher-risk hulls, financial security instruments and escort towage can be justified on safety grounds. Mutual-aid protocols and stockpiles for Tier-2/3 spill response, exercised with cross-border partners, reduce response latency (EMSA, 2023; ITOPF, 2023). Governance of **STS** is a specific lever: restricting operations to designated areas with supervision, minimum weather windows, certified gear and third-party surveyors, and maintaining a central register accessible to authorities, lowers frequency and consequence. Finally, **data transparency**—machine-readable detention/deficiency datasets, vessel listing notices with continuity identifiers (IMO, former names, MMSI), and registry event logs with dated owner/manager/flag changes—enables continuity analysis and rapid de-listing after adverse findings (EPRS, 2024).

8.8 An expected-loss framing

For policy design it is useful to express risk as an **expected-loss** identity: the probability of a casualty multiplied by spill severity and unit damage costs, minus the share that is reasonably **recoverable** from compulsory insurance and the Fund system. In constrained waterways and for older, under-insured hulls, both probability and severity are higher, while recoverable compensation may be lower or slower to access. Measures that **reduce probability**—such as PSC targeting, STS controls and escort requirements—and measures that **increase recovery**—verifiable P&I and, where appropriate, financial security—together improve the social balance of risk.

8.9 Operational checklists (abridged, for implementation)

Harbour masters and VTS units should require ETA submissions that include direct verification of **P&I** and **class** and recent survey certificates, mandate continuous **AIS** in approach channels with defined exceptions, and apply go/no-go weather thresholds for **STS** operations in designated zones. **PSC inspectors** should prioritise older hulls with identity churn and non-

²⁷ **Strict liability and compensation.** CLC 1992 imposes strict owner liability backed by compulsory insurance up to ship-specific limits; the 1992 Fund provides supplementary compensation financed by oil receivers. Non-IG or opaque cover complicates timely recovery.

IG insurance, examine oil record books and cargo/ballast logs for anomalies, secure **VDR/AIS** data and time-stamped photographic records at detention, and verify STS documentation, including surveyor credentials and equipment tests. **Insurers and P&I clubs** can standardise API-based certificate validation, require enhanced surveys for defined passages, and refuse cover where **Tier-1** price evidence is withheld without justification. These measures are consistent with Commission expectations for risk-based diligence and with the evidential integrity required for sanctions and pollution enforcement.^{27 28}

8.10 Link to subsequent chapters

The risk environment described here overlaps with **security and hybrid-threat** concerns in congested or infrastructure-dense corridors. **Chapter 9** assesses those vectors and the interaction between maritime safety measures and broader security postures. **Chapter 11** then presents worked cases that illustrate the corroboration pathway from **SAR/AIS** indicators through documentary checks to enforcement outcomes.

9. Security and Hybrid-Threat Considerations

9.1 Scope and framing

Russia-linked shadow-fleet operations generate security externalities that reach beyond sanctions compliance and commercial risk. The same operational attributes that reduce regulatory visibility—opaque ownership, discontinuous **AIS** tracks, multi-stage **ship-to-ship (STS)** transfers and rapid re-flagging—also degrade maritime domain awareness in congested European waters. This chapter examines: (i) the intersection between shadow-fleet behaviour and critical maritime infrastructure; (ii) the status of open-source allegations concerning **uncrewed aerial systems (UAS)** and related hybrid tactics linked to commercial hulls; (iii) the implications of naval shadowing and escorted transits for regulatory enforcement; and (iv) the legal thresholds that govern interdiction and inspection at sea. The approach is conservative: where public reporting is contested or ongoing, claims are presented as **alleged** and the evidential bar is set out explicitly (EMSA, 2023; RUSI, 2025).

9.2 Maritime domain awareness and infrastructure adjacency

European coastal authorities report recurring patterns of **loitering** and non-standard routing by ageing tankers in corridors dense with subsea pipelines, power interconnectors, offshore wind clusters and data cables in the **North Sea** and **Baltic Sea**. Such movements are not ipso facto unlawful; however, they **increase ambiguity** by multiplying contacts with degraded or discontinuous AIS and by shortening warning times when trajectories intersect traffic-separation schemes or infrastructure safety zones. In a routine commercial setting,

²⁸ **PSC focus.** PSC targeting models in EU practice weight age, identity churn, insurance/class status and AIS/STS behaviour; evidence chains depend on prompt preservation of **VDR/AIS** and contemporaneous documentation

transparent voyage plans, continuous AIS carriage and predictable approaches to **Vessel Traffic Service (VTS)** reporting points enable efficient deconfliction. By contrast, **dark** or **semi-dark** transits near cable landfalls or wind farms require authorities to rely on secondary sensors (coastal radar, AIS base-station mosaics, EO/SAR tasking) and patrol assets, stretching finite capacity and complicating proportional responses (EMSA, 2023; EPRS, 2024).

The environmental and safety considerations set out in Chapter 8 magnify the security calculus. An older, lightly vetted tanker with uncertain liability cover poses a **compound risk** if control is lost in narrow waterways: even absent hostile intent, the **tail loss**—channel closures, salvage operations, pollution near critical infrastructure—can be large (EMSA, 2023; ITOFF, 2023). The security-of-supply question is therefore not whether any given voyage masks malign purpose, but whether the **aggregate effect** of opaque operations degrades the predictability and resilience of European maritime space.

9.3 Allegations concerning UAS and hybrid tactics

Open sources in 2025 linked isolated merchant hulls to **UAS** flights or airspace disruptions, usually by **temporal and geographic coincidence** rather than by public technical attribution. Typical public records include (i) observer or radar reports of UAS activity; (ii) AIS traces placing a high-risk tanker in the vicinity; and (iii) subsequent administrative action against that hull for **registration irregularities** or documentary deficiencies unconnected to the UAS allegation (Reuters, 2025; IBA, 2025). The evidential chain required for a national-security prosecution—positive forensics tying launch or control to a platform, recovered matériel with exploitable identifiers, or reliable witness evidence—has rarely been disclosed.

This report consequently treats UAS linkages as **alleged** unless supported by **judicial findings** or **multi-source technical confirmation**. At the same time, the **civil–military fusion** potential is acknowledged: deck space, relative privacy from shore observation and opaque ownership structures create a theoretical feasibility envelope. The policy implication is to strengthen **ex ante gating**—identity continuity checks, verifiable ownership and insurance, supervised STS areas—rather than to rely on ad hoc inferences from co-location alone (RUSI, 2025; EMSA, 2023).

9.4 Naval shadowing, escorted transits and regulatory action

European and allied navies intermittently **shadow** tankers assessed as higher risk as they transit constrained passages (e.g., the **English Channel**, the **Turkish Straits**). Shadowing—overt but non-intrusive presence at distance—has two effects: it deters unsafe manoeuvres and assures rapid response capacity without **prejudging illegality** (Jane’s, 2025). In rarer instances, authorities have described **escorted** transits, where a warship accompanies commercial hulls through sensitive waters. Escorting is politically visible and may be read by operators as an indication of **heightened caution** by the coastal state. It does **not** alter subsequent **Port State Control (PSC)** powers on entry, nor does it immunise a vessel from enforcement if statutory hooks exist—stateless operation, reasonable grounds to suspect forged documents, or imminent environmental harm.

In practice, naval presence and civilian enforcement are **complementary**. The former manages **near-term navigational risk**; the latter addresses **documentary and structural risk** at the point of jurisdictional control—port or anchorage—through inspection, detention where appropriate, and the securing of evidence (AIS/VDR, oil record books, cargo/ballast logs).

9.5 Legal thresholds for interdiction and inspection

The governing framework is defined by **UNCLOS**, **SOLAS** and **MARPOL**. On the **high seas**, ships are subject to the **exclusive jurisdiction** of the flag state (UNCLOS arts. 92–94). A foreign warship may exercise the **right of visit** only on enumerated grounds, including reasonable suspicion that a ship is **stateless** or engaged in certain universally proscribed activities (UNCLOS art. 110). Within **territorial seas**, foreign ships enjoy **innocent passage** so long as their transit is not prejudicial to the peace, good order or security of the coastal state (UNCLOS arts. 17–19). Passage ceases to be innocent where a ship engages in serious pollution or willful and serious pollution contrary to **MARPOL**; coastal states may then act accordingly. **SOLAS Chapter V** underpins safety obligations, including the carriage and use of navigational equipment, and informs national rules mandating **continuous AIS** in approach channels; disabling AIS frustrates collision-avoidance objectives and justifies **enhanced inspection** once jurisdiction is engaged. **MARPOL Annex I** provides the substantive offence framework for illegal oily discharges and enables port-state enforcement, including reliance on aerial or satellite detection where admitted by national law. Together, these instruments define what a coastal state **may** do at sea, and what it **must** do ashore if a suspect vessel seeks entry: verify identity and insurance, assess recent class and survey status, inspect documentation and **secure data** (AIS/VDR) to preserve the evidential chain.^{29 30 31}

9.6 Policy design: predictable friction rather than episodic interdiction

From a policy perspective, **predictable, rules-based friction** is more effective than episodic interdiction premised on ambiguous signals. Three lines of effort follow from the analysis.

First, ex ante documentation gates. Conditioning anchoring or port entry by **defined risk cohorts** on verifiable **P&I** capacity, recent **class and survey** evidence, and complete **STS** documentation reduces both environmental and security uncertainty. The same gates help to filter hybrid-threat vectors by raising the cost of opacity.

Second, continuous AIS and rapid flag-state engagement. Mandating continuous AIS usage in approach channels, backed by proportionate penalties for evasion and **rapid requests for**

²⁹ **UNCLOS baselines.** Articles 17–19 (innocent passage), 92–94 (flag-state jurisdiction) and 110 (right of visit) delimit coastal-state powers and interdiction grounds on the high seas.

³⁰ **UNCLOS baselines.** Articles 17–19 (innocent passage), 92–94 (flag-state jurisdiction) and 110 (right of visit) delimit coastal-state powers and interdiction grounds on the high seas.

³¹ **SOLAS safety rationale.** SOLAS Chapter V underpins requirements for navigational equipment and informs national rules on AIS usage in approach channels; persistent disabling justifies **enhanced inspection** on port entry.

flag-state confirmation, narrows discretion in congested corridors and reduces the burden on patrol assets. Where repeated dark approaches are observed near infrastructure, administrative measures—anchorage restrictions, supervised STS zones, targeted patrol tasking—are available under domestic law (EMSA, 2023).

Third, shared identifiers and machine-readable registries. Regional information-sharing that prioritises **continuity identifiers**—prior names, MMSI histories, registered owner/manager changes by date—strengthens the evidential backbone for coordinated PSC and subsequent legal action. Aligning sanctions notices and registry outputs in machine-readable formats accelerates screening and reduces aliasing risk (European Commission, 2025; EPRS, 2024).

Proportionality remains essential. Interdiction at sea engages sovereignty and commercial freedoms. Measures that narrow discretion **before** a vessel reaches port—clear documentary standards for access to EU ports and anchorages; transparent criteria for **risk-based inspection**—are more workable than ad hoc interventions reliant on contested inference.

9.7 Interim assessment

The security relevance of the shadow fleet is a function of **opacity**. Behaviours that sustain exports under sanctions—identity churn, dark segments, STS chains away from supervised zones—also blur intention, increase surveillance and response costs, and heighten downside tail risk at chokepoints. The **applicable law** provides sufficient scope for proportionate action once concrete hooks are present. The practical task for European authorities is to shift emphasis from episodic interdiction to **systematic gating and verification**, supported by shared data and coordinated PSC. Chapters 10–11 consider how current enforcement outputs align with these aims and which adjustments—legal, procedural or data-architectural—would most effectively reduce residual security risk within the established framework.

10. EU Sanctions Architecture: Design and Implementation

10.1 Legal bases and institutional roles

The EU’s Russia sanctions regime rests on a two-pillar structure. Strategic choices are adopted under the Common Foreign and Security Policy in a Council decision pursuant to Article 29 TEU, while measures that bind individuals or economic operators are implemented through an Article 215 TFEU regulation. The operative instruments are **Council Decision 2014/512/CFSP** and **Council Regulation (EU) No 833/2014**, both amended repeatedly since 2014 to widen sectoral scope, tighten prohibitions and address circumvention. The **consolidated versions current to July 2025** provide the authoritative baseline for compliance and enforcement (EUR-Lex, 2025a; EUR-Lex, 2025b).

Institutional roles are complementary. The **Council** adopts and amends packages, issues press notices and maintains the public chronology; the **Commission** publishes interpretative guidance, coordinates with partners in the Price Cap Coalition and issues **circumvention**

alerts; national competent authorities implement and enforce at the border, customs and port-state level under domestic and EU law (Consilium, 2025; European Commission, 2025a; European Commission, 2024). Footnote references below point to the consolidated legal texts and to Commission guidance for documentary standards.^{32 33}

10.2 Package-by-package chronology (2014–present)

The foundational framework was adopted on **31 July 2014**. From **February 2022**, the Council moved to multi-round “packages” calibrated to the evolving security context. For maritime trade, three clusters are most relevant.

Embargo and services bans (2022–2023). The EU prohibited the **import of seaborne Russian crude** from **5 December 2022** and **refined petroleum products** from **5 February 2023**, and restricted **transport, broking, insurance and reinsurance** connected with Russia-origin oil and products. A carve-out permits services for **third-country shipments** where the **price-cap** conditions are met, creating a conditional safe harbour for EU/UK service providers (Consilium, 2025).

Consolidation and anti-circumvention (2024). Packages and listings were refined and the Commission issued alerts emphasising **AIS** discipline, **STS** documentation, blending transparency and attestation practice—thereby setting explicit expectations for Tier-1 and Tier-2 actors (European Commission, 2024; European Commission, 2025a).

Adjustments and re-tightening (2025). In **February** and **May 2025** the Council adopted further measures and listings; amending acts were integrated into the 2025 consolidations of Regulation 833/2014. These steps aligned EU practice more closely with Coalition advisories and signalled stricter scrutiny of identity churn, tanker sales and non-transparent insurance (Consilium, 2025; EUR-Lex, 2025c; Price Cap Coalition, 2024). Annex A of this report maps the article-level amendments to their Official Journal references for auditability.³⁴

10.3 Interface with the G7/EU price cap (attestations and due diligence)

The price-cap framework permits EU persons to provide maritime services to **third-country shipments** of Russian crude and petroleum products **only** if the sale price is **at or below the cap** and if **attestation** and **record-keeping** duties are met. Guidance adopts a **tiered** model. **Tier-1 (price-knowing)** actors—traders, refiners—retain **primary price evidence** (contracts, invoices, price confirmations). **Tier-2 (non-price-knowing)** service providers—shipowners, insurers, brokers—must obtain attestations and apply **risk-based**

³² **Legal bases.** Council Decision 2014/512/CFSP and Council Regulation (EU) No 833/2014, as amended; consult EUR-Lex consolidations for the operative text (EUR-Lex, 2025a; EUR-Lex, 2025b).

³³ **Packages & timeline.** Council chronology of packages since February 2022, including packages in **February** and **May 2025**, with links to legal texts and press material (Consilium, 2025).

³⁴ **Amending act (example).** Regulation (EU) 2025/395 (24 Feb 2025) amending Regulation 833/2014; see the 2025 consolidations for integration (EUR-Lex, 2025c).

checks, escalating when **red flags** arise (e.g., multi-stage STS without independent surveys, inconsistent port declarations, suspicious AIS patterns or rapid identity churn) (European Commission, 2025a; Price Cap Coalition, 2023; Price Cap Coalition, 2024).

On **29 August 2025** the Commission updated its guidance, formalising a **floating cap: cap = average market price for Russian crude minus 15%**, computed over a **22-week** observation window and rolled every six months, and reiterating documentary expectations and circumvention indicators. This mechanistic rule clarifies how cap-bindingness tracks market levels and explains the **dual-track equilibrium** observed in practice: when the cap is **non-binding**, mainstream EU/UK services (including IG P&I) re-enter; when it **binds** or documents are inadequate, flows pivot to **non-Western logistics** and substitute insurance—the shadow channel discussed in Chapters 5–7 (European Commission, 2025a; Price Cap Coalition, 2024).³⁵

10.4 Enforcement instruments: listings, PSC, asset freezes and seizure

Listings. Council listings designate individuals, entities and, where relevant, **vessels**, triggering **asset freezes** and prohibitions on making funds or economic resources available. Notices increasingly include **continuity identifiers** (IMO numbers; former names), improving screening against **identity churn** and facilitating cross-border enforcement (Consilium, 2025).

Port State Control (PSC) and customs. PSC remains the principal tool for on-water intervention under safety and environmental mandates. Risk-based targeting draws on **age, identity events, insurance/class status** and **AIS/STS behaviours**; outcomes include expanded inspection, detention where justified and preservation of **AIS/VDR** evidence. Customs and sanctions teams reconcile **bills of lading, attestations, surveys** and **assays** against the guidance; misrepresentation or forged documents give rise to administrative or criminal consequences under national law (European Commission, 2025a; Price Cap Coalition, 2023).

Asset freezes and confiscation. Asset-freeze effects apply immediately upon listing. **Confiscation** of cargo or hull depends on domestic statutes and **judicial** processes; recent national decisions demonstrate pathways from detention and documentary irregularities to court-ordered confiscation where breaches are proved, with the 2025 amendments forming part of the EU-level scaffolding (EUR-Lex, 2025c; EUR-Lex, 2025b).

Coordination with partners. EU guidance is aligned with the **Price Cap Coalition**; Member States exchange operational information with **OFSI/OFAC** counterparts. Coalition advisories set a harmonised baseline—**direct verification** with P&I clubs and class societies, tanker-sales diligence, AIS discipline and **supervised STS**—reducing interpretive variance across jurisdictions (Price Cap Coalition, 2023; Price Cap Coalition, 2024; European Commission, 2025a).

³⁵ **Price-cap mechanics and diligence.** Commission **Guidance on the Russian oil price cap** (consolidated, 2025) formalising **average – 15% over 22 weeks** and setting tiered attestation expectations; Coalition advisories provide harmonised best practices (European Commission, 2025a; Price Cap Coalition, 2023; Price Cap Coalition, 2024).

11. Effectiveness Assessment

11.1 Evaluation framework and questions

This chapter assesses whether the EU's sanctions architecture and the G7/EU oil price-cap regime have achieved their stated aims in the maritime domain. The evaluation traces a results chain from **legal inputs**—the adoption of measures and issuance of guidance—to **immediate outputs**, such as listings, detentions, seizures and formal alerts; from there to **intermediate outcomes**, namely price discounts, freight premia, routing elongation and the mix of compliant versus substitute services; and finally to **ultimate outcomes** measured by export revenues realised by Russia and the implied fiscal capacity. Four questions structure the analysis. First, whether realised prices for Russian exports have fallen and with what persistence. Second, whether volumes have been reduced or costs raised by logistics and compliance. Third, how far behavioural adaptation—notably the growth of shadow logistics—has offset intended effects. Fourth, what incremental impact enforcement intensification in 2024–2025 has had on incidents, service availability and market clearing (European Commission, 2025; Consilium, 2025; IEA, 2025). Annex B sets out indicators, assumptions and replication notes.³⁶

11.2 Immediate outputs: measures and enforcement

The record of **legal and administrative outputs** is clear. The EU enacted the embargo on seaborne crude and refined products, introduced services bans conditional on the price cap, and iterated guidance through 2024–2025 to clarify expectations around attestations, spoofing and ship-to-ship documentation. The guidance culminated in a formal cap-setting methodology and a restatement of circumvention indicators, while the Council's listings expanded to include vessels, owners and facilitators, increasingly with continuity identifiers that strengthen screening against identity churn (European Commission, 2024; European Commission, 2025; Consilium, 2025). In parallel, **operational outputs** materialised through Port State Control and customs actions. National casework shows detentions for deficiencies and documentary discrepancies, port-entry denials at short notice where pre-arrival conditions were not met, and, in a smaller number of instances, confiscation following judicial proceedings. The tempo of such actions rose in 2025, visible in official notices and contemporaneous reporting (Lloyd's List Intelligence, 2024–2025; RUSI, 2025). Outputs do not in themselves establish economic effect, but without them it would be difficult to posit any shift in incentives at voyage level.

11.3 Intermediate outcomes: prices, discounts and routing costs

³⁶ The regime's **bindingness** is assessed against the Commission's floating-cap formula—average market price minus fifteen per cent over a twenty-two-week window—applied to the relevant months; when non-binding, compliant services tend to re-enter and discounts compress (European Commission, 2025).

The **price channel** has been variable rather than monotonic. Russian grades traded at pronounced discounts to Brent in 2022–2023. As non-Western services scaled up and older hulls migrated into the trade, discounts narrowed during parts of 2024–2025, before widening again when enforcement pulses coincided with cap adjustments or when navigational risk made Red Sea passages less attractive. The evidence supports a structural inference that the regime modulates **how** the market clears rather than fixing a permanent discount: when attestations can be credibly assembled and the cap is not binding at prevailing outright prices, compliant services re-enter and differentials compress; when the cap bites or documentation is weak, the system pivots to substitute logistics with reduced price visibility and higher premia (IEA, 2025; BOFIT, 2025; KSE, 2025).

The **cost channel** is more stable. Displacement from European to Asian receivers raised tonne-miles on the principal lanes and maintained elevated freight premia. Voyage economics absorbed not only the extra days at sea but also the frictions of ship-to-ship operations, surveyor attendance, insurance substitution, and repeated documentary checks. Even during phases when headline discounts narrowed, these frictions depressed **netbacks** relative to pre-war baselines; the logistics tax is visible in higher time-charter equivalents for older units willing to serve the trade and in longer cycle times where paperwork requires escalation (Lloyd’s List Intelligence, 2024–2025; IEA, 2025). The **service-mix** story is consistent with this view: a dual-track equilibrium persists, with mainstream owners and insurers reappearing when the cap is non-binding and retreating when enforcement tightens or risk flags accumulate (European Commission, 2025; IEA, 2025).

11.4 Ultimate outcomes: export revenues and fiscal space

Monthly series compiled by independent bodies show that Russia’s **oil export receipts** remained substantial through 2024–2025, with pronounced month-to-month volatility driven by the interaction of global prices, realised discounts and enforcement cadence (IEA, 2025; KSE, 2025). The embargo and cap clearly reduced average netbacks relative to a no-sanctions counterfactual; however, continuity of volume—facilitated by shadow and grey logistics—preserved a large share of gross receipts. On the expenditure side, **defence and security allocations** remained elevated. Oil-and-gas receipts form only part of the consolidated budget, yet their persistence is fiscally material. The headline question—whether sanctions **finance the war less**—cannot be answered by volumes in isolation. What matters is the price realised after deduction of logistics and compliance premia, and the elasticity of fiscal adjustment through exchange-rate policy, domestic debt and taxation. The available evidence indicates compressed margins and higher costs relative to the pre-war baseline, but continued high cashflows in 2024; attenuation in 2025 appears greater during periods when the cap was demonstrably binding and enforcement active (IEA, 2025; BOFIT, 2025).³⁷

11.5 Leakage channels and circumvention

³⁷ Re-exports after refining are **legally distinct** under rules of origin, but the upstream revenue effect is conserved insofar as the processed barrel embodies Russian molecules sold earlier in the chain (IEA, 2025; EPRS, 2024).

Leakage operates through several channels. The **attestations** design relies on Tier-2 actors who do not see prices directly and who must therefore judge the credibility of upstream representations. Weakness arises where chains rely on thinly capitalised intermediaries or where escalation to Tier-1 documents is resisted. **Ship-to-ship** transfers and **blending** make it harder to establish provenance for product streams; post-refining **re-exports** to OECD markets are generally lawful under rules of origin, but they conserve upstream Russian volumes and thus do not negate the revenue effect (IEA, 2025; EPRS, 2024). **Insurance opacity**—non-IG cover with uncertain limits or state-linked reinsurance—moves risk outside Western visibility and blunts port-access leverage where coastal states are unwilling to recognise such certificates without direct verification (ITOPF, 2023; EPRS, 2024). **Flag and identity churn** increases the cost of targeting; inclusion of IMO numbers, former names and MMSI histories in listings improves matters, yet registry co-operation remains uneven (Consilium, 2025; RUSI, 2025). The net effect is **material leakage at a cost**. Each circumvention strategy carries delay and expense—freight premia, survey fees, inspection risk—which are themselves part of the policy’s intended friction even when upstream revenues persist.³⁸

11.6 Enforcement outputs and behavioural response in 2025

Casework in 2025 illustrates both the potential and the limits of **on-the-water** tools. Boardings related to nationality or registry irregularities, detentions for technical and documentary deficiencies, and one or more confiscation precedents demonstrate that authorities can convert documentary weakness into judicially sustainable outcomes where evidence chains are preserved. Behavioural responses followed theory: operators accelerated identity changes after adverse publicity; adjusted routes to avoid corridors with active PSC; and increased reliance on opaque insurance providers. These responses are not costless. Over time, sustained pressure should widen the **shadow premium** required to move a barrel through substitute channels, even if headline volumes do not immediately fall (Lloyd’s List Intelligence, 2024–2025; RUSI, 2025).

11.7 Counterfactuals and attribution

Effectiveness claims are meaningful only relative to counterfactuals. Under a **no-sanctions** counterfactual, European demand would have remained proximate, tonne-miles lower and freight premia thinner; discounts would have been narrower or absent, and revenues higher at any given global price (IEA, 2025). Under a **no-shadow-fleet** counterfactual—i.e., effective constraint on substitution into non-Western services and older tonnage—volumes would have fallen further, discounts would have widened, and price-cap-compliant flows would dominate; global supply would, however, be tighter. A further problem is **price-cycle confounding**: falling international prices reduce revenues independently of sanctions, whereas elevated prices can mask sanctions effects in nominal terms while still depressing netbacks through premia and delays. Attribution is strongest where changes coincide temporally with enforcement pulses—new listings, detentions and

³⁸ Sustainable confiscation outcomes depend on **evidence preservation**—AIS/VDR downloads, contemporaneous documentary capture—and on domestic statutory routes to forfeiture; case practice in 2025 shows these routes are available but resource-intensive (EMSA, 2023; Consilium, 2025).

guidance updates—and are visible across multiple indicators, not just one series (European Commission, 2025; Consilium, 2025; IEA, 2025).

11.8 Sensitivity analysis and evidence quality

The results are sensitive to **modelling choices**. Shadow-fleet counts vary with inclusion rules—whether product tankers, auxiliaries and temporarily compliant voyages are included—and with AIS heuristics for dark-segment duration and spoofing. The cap’s **bindingness** depends on the benchmark used and on the observation window in the **average-minus-15 per cent** methodology; as non-Western services scale, the level at which substitution becomes attractive moves accordingly (European Commission, 2025; EPRS, 2024). **Evidence quality** also varies. Legal texts and Commission guidance are high-confidence sources. IEA export and revenue series are authoritative for monthly trends. OSINT-based incident attribution is probative in selected cases where SAR and AIS align with documentary checks, but it is not universal; allegations regarding uncrewed aerial systems remain low-confidence absent judicial findings (SourceMaterial/POLITICO, 2024–2025; SkyTruth, 2025; IBA, 2025).³⁹

11.9 What has worked and what has not (interim judgement)

Three elements have worked with qualifications. The first is **cost elevation**: route elongation, risk premia, documentation burdens and inspection delays have reduced netbacks relative to the no-sanctions counterfactual, even when discounts narrowed. The second is **guidance clarity**: the tiered attestation framework and the 2024–2025 alerts have given industry a common baseline for escalation and verification. The third is **PSC leverage**: detentions and document checks have produced tangible frictions and, in some jurisdictions, have underpinned confiscation. By contrast, three elements have not yet worked sufficiently. The **attestation** model still permits formal compliance with limited substance where chains rely on thinly capitalised intermediaries. The **insurance lever** remains under-powered because there is no widely recognised minimum standard for cover acceptable in sensitive waters, and verification APIs are unevenly deployed. Finally, **registry churn** and beneficial-ownership opacity continue to blunt targeted listings and slow operational responses (European Commission, 2025; EMSA, 2023; EPRS, 2024; RUSI, 2025).

11.10 Policy implications

Policy adjustments that add friction **ex ante** are more likely to be effective than episodic interdiction. Verification should be **uplifted** for high-risk voyages so that red-flag combinations—multi-stage STS chains, AIS anomalies, rapid identity changes—trigger mandatory escalation to Tier-1 evidence or third-party validation, rather than acceptance of representations alone (European Commission, 2025). Access to EU ports and anchorages for defined risk cohorts should be **conditional** on verifiable P&I capacity and recent class and

³⁹ The regime’s **bindingness** is assessed against the Commission’s floating-cap formula—average market price minus fifteen per cent over a twenty-two-week window—applied to the relevant months; when non-binding, compliant services tend to re-enter and discounts compress (European Commission, 2025).

survey evidence, with a published model gate to align Member-State practice (EMSA, 2023; ITOPF, 2023). Listings should consistently include **continuity identifiers** and be supported by **machine-readable registry logs** that record dated changes in owner, manager and flag; this would reduce aliasing and accelerate screening (Consilium, 2025; RUSI, 2025). Governance of **STS** operations should be strengthened through designated, supervised zones, certified equipment and independent surveyor presence. Targeted **expansion** of listings should prioritise unsanctioned repeat offenders with documented patterns of dark activity near critical corridors, coordinated with UK/US partners to minimise services arbitrage (Price Cap Coalition, 2024). Finally, introduction of a **minimum insurance recognition standard** for access to sensitive straits—addressing solvency, limits and claims handling, and backed by direct verification—would improve casualty preparedness without excluding compliant traffic (ITOPF, 2023; EPRS, 2024).

11.11 Proposed metrics for ongoing evaluation

To sustain an evidence-led policy, the report proposes a suite of operational metrics articulated as continuous series rather than a checklist. The first series tracks **discounts for Urals and ESPO against Brent** at monthly frequency and overlays the dates of major guidance updates and listings; this allows changes in differentials to be viewed alongside policy events and global price levels (IEA, 2025; KSE, 2025). A second series measures **tonne-miles and Russia-linked freight premia by class and lane**, using a consistent method for voyage reconstruction; the objective is to observe how route elongation and capacity shifts affect earnings and, by implication, the logistics tax embedded in netbacks (IEA, 2025; Lloyd’s List Intelligence, 2024–2025). A third series estimates the **share of voyages covered by non-IG or unverifiable insurance** within a defined cohort, derived from document verification attempts and cross-checks with club registers; movements in this share are a useful proxy for the permeability of the compliance perimeter (EPRS, 2024). A fourth series records **STS incidence within predefined hotspot polygons** using rolling windows and AIS/SAR corroboration; this provides a behavioural signal that can be tested against enforcement pulses and market stress (SkyTruth, 2025). A fifth series compiles **detentions and deficiency counts per thousand port calls** for older cohorts, broken out by corridor, to capture changes in technical condition and documentary integrity in response to PSC focus (EMSA, 2023). A sixth series reconstructs **monthly export revenues**, in both gross terms and net of estimated premia and discounts, and aligns them to cap-calculation windows and enforcement events; this connects intermediate outcomes to fiscal end-points (IEA, 2025; KSE, 2025). Finally, a seventh series follows **time to claims settlement** for incidents involving non-IG or opaque insurers, which is a practical measure of the residual risk carried by coastal states after a casualty (ITOPF, 2023). Annex B provides the definitions, data sources and filters used for each series so that results are replicable.

11.12 Limitations and next steps

Three limitations recur. **Price opacity** in shadow channels reduces confidence in realised-price estimates and requires triangulation across discounts, freight premia and service mix. **Insurance visibility** is incomplete where non-IG providers do not publish registers or respond to verification requests. **Registry transparency** is uneven, and the absence of systematic, public event logs slows continuity analysis. The report mitigates these by stating

assumptions, bounding estimates and attaching confidence levels to findings. The next phase extends incident and enforcement datasets through **Q4-2025**, applies the proposed metrics longitudinally, and completes the case studies in Chapter 12 so that vessel-level narratives can illustrate the causal path from legal inputs to economic outcomes (SourceMaterial/POLITICO, 2024–2025; RUSI, 2025).

12. Case Studies

This chapter presents documented case studies that illustrate the operational patterns, evidential pathways and legal outcomes discussed in Chapters 5–11. The selection covers environmental incidents with sensor corroboration; identity churn and stateless operation; detention and confiscation under national law; chokepoint risk in constrained waterways; multi-stage ship-to-ship (STS) chains in recognised hotspots; tanker sales and ownership opacity; insurance certificate anomalies; and registry co-ordination failures. Where proceedings are ongoing or facts are contested, the status is stated and claims are labelled alleged. Confidence levels reflect the convergence of sources and the availability of primary documents.

12.1 Documented oil slick with SAR/AIS corroboration (European waters, 2023–2024)

Context and chronology.

Investigative consortia reported several oil slicks in European waters during 2023–2024 involving older tankers on Russia-linked voyages. In a representative instance, a crude tanker more than twenty years old displayed dark AIS segments around a loitering phase at sea; hours later, synthetic-aperture radar (SAR) captured a linear slick aligned with the estimated drift line before the vessel resumed transmissions and proceeded to a third-country port (Source Material–POLITICO, 2024; SkyTruth, 2024–2025).

Sources and evidence.

Open sources included AIS tracks with bounded gaps and implausible kinematics bracketing the detection, SAR scenes indicating a surface slick of non-trivial length, and wind/current fields consistent with slick orientation, followed by port-call evidence. The absence of shipboard logbooks or Oil Record Book extracts in the public domain limits direct attribution to a discharge from the vessel. Confidence is medium on the basis of multi-sensor corroboration but incomplete shipboard documentation (Source Material–POLITICO, 2024–2025; SkyTruth, 2025).

Legal hooks and jurisdiction.

MARPOL Annex I prohibits oily discharges above prescribed limits and permits port-state action where national law admits satellite or aerial evidence as probative. Port State Control (PSC) may detain for documentary deficiencies or equipment faults and should secure

VDR/AIS data promptly to preserve evidential integrity (MARPOL, consolidated; EMSA, 2023).⁴⁰

Outcome.

No penalty was publicly reported in this instance, underscoring the evidential hurdles when shipboard records are unavailable and when the vessel does not request entry to an EU port soon after detection (Source Material–POLITICO, 2024–2025).

Operational lessons.

Pair satellite tasking with pre-arrival documentation gates at likely next ports to create inspection opportunities; require verifiable P&I capacity and recent class/survey evidence for older cohorts; and record continuity identifiers—IMO, prior names and MMSI—to mitigate subsequent identity churn (EMSA, 2023).

12.2 Identity churn and a stateless interval (Baltic–North Europe, 2024–2025)

Context and chronology.

An ageing product tanker cited in investigative rundowns for repeated renamings underwent two name changes and one re-flag within twelve months, including a brief stateless interval during registry transition. A Baltic authority detained the vessel for documentary and technical deficiencies; after rectification the ship re-entered trade under a different flag and management chain (RUSI, 2025; national PSC notices, 2025).

Sources and evidence.

Registry snapshots documented dated changes in flag, owner and manager; AIS continuity via the IMO number linked identities; PSC inspection sheets listed more than thirty deficiencies; and local press summarised detentions. Confidence is **high** for the identity chronology and detention facts; underlying commercial contracts were not assessed (PSC bulletins; ERR/Maritime Executive reporting).

Legal hooks and jurisdiction.

UNCLOS recognises statelessness as a ground for visit and boarding on the high seas; PSC powers allow detention for safety and documentation non-compliance. Rapid re-flagging does not expunge prior deficiencies and complicates continuity analysis (UNCLOS, 1982; EMSA, 2023).⁴¹

Outcome.

Following rectification the vessel was released and continued trading; identity changes resumed within months (national PSC notices, 2025).

⁴⁰ **Sensor corroboration.** SAR detections gain probative value when time-aligned with AIS gaps and wind/current vectors; admissibility and evidential weight depend on national law (EMSA, 2023; MARPOL, consolidated).

⁴¹ **Stateless operation.** Short intervals between de-registration and re-registration have been observed; UNCLOS recognises statelessness as a ground for visit/boarding on the high seas (UNCLOS, 1982).

Operational lessons.

Registries should verify beneficial ownership before acceptance and share event logs across registries to reduce flag-shopping incentives. PSC targeting should weight recent identity events, and authorities and counterparties should verify insurance and class directly with issuers rather than relying on submitted PDFs (RUSI, 2025; European Commission, 2025).

12.3 Detention leading to confiscation (EU jurisdiction, 2025)

Context and chronology.

In early 2025 a tanker in distress was towed into an EU port; subsequent inquiries linked the cargo and operating chain to sanctions-relevant breaches. A national court ordered confiscation of both cargo and hull—a consequential outcome under domestic law interfacing with the EU restrictive measures framework (Reuters; Euronews; insurance trade press, 2025).

Sources and evidence.

Public materials comprised maritime safety reports, customs and prosecutorial releases, and court filings summarised by media. Confidence is **high** for the fact of confiscation and its legal basis; confidence is **medium** regarding voyage particulars and counterpart identities pending publication of full judgments (newswire and court summaries, 2025).

Legal hooks and jurisdiction.

Domestic criminal and customs laws provided seizure and confiscation pathways upon proof of breaches; Regulation (EU) No 833/2014 and amending acts supplied the EU-level framework. Evidence preservation—AIS/VDR downloads, Oil Record Books, attestations and survey documents—was decisive for court-ready files (EUR-Lex, consolidated; national law).⁴²

Outcome.

Confiscation was ordered; vessel and cargo entered state disposition processes (court filings, 2025).

Operational lessons.

Codified evidence-preservation protocols for PSC and customs, multi-agency teams at tow-in, and publication of redacted model case files would standardise practice and shorten timelines across Member States (EMSA, 2023; European Commission, 2025).

12.4 Chokepoint incident risk in the Turkish Straits (illustrative, 2024)

Context and chronology.

A product tanker experienced propulsion and anchoring difficulties during a Bosphorus

⁴² **Stateless operation.** Short intervals between de-registration and re-registration have been observed; UNCLOS recognises statelessness as a ground for visit/boarding on the high seas (UNCLOS, 1982).

transit, triggering temporary traffic restrictions. Although no pollution occurred, the incident highlighted systemic risk where older hulls with uncertain maintenance transit narrow, high-density waterways (Turkish maritime authority communiqués, 2024; EPRS, 2024).

Sources and evidence.

Authority notices, Vessel Traffic Services (VTS) messages and local press formed the core record. Confidence is **high** for incident occurrence; sanctions status was not relevant (authority releases, 2024).

Legal hooks and jurisdiction.

National navigation rules and VTS directives govern passage; PSC at Turkish ports addresses subsequent inspection. In the event of a persistent-oil spill, the CLC/Fund regime would govern compensation (ITOPF, 2023; MARPOL, consolidated; national regulations).

Outcome.

Transit resumed after clearance; no spill response was initiated.

Operational lessons.

For higher-risk cohorts, escort-tug requirements and stringent pre-arrival gates—verifiable P&I, class and survey recency—are proportionate mitigations; age and identity churn should be integrated into transit risk models (EMSA, 2023; EPRS, 2024).

12.5 Multi-stage STS chain in the Eastern Mediterranean (pattern case, 2023–2025)

Context and chronology.

Repeated pairings among a cohort of tankers at a recognised anchorage south of mainland Greece were identified across multiple quarters. Vessels executed dark or semi-dark legs into and out of the zone; after transfers, recipient hulls diverged towards the Suez approaches and Atlantic routes. Trade-press documentation indicated third-country origin claims after transfer (SkyTruth, 2025; Atlantic Council, 2024; investigative reporting, 2024–2025).

Sources and evidence.

Evidence comprised pairwise proximity events at close range and sufficient dwell times, temporal clustering of transfers, post-transfer route divergence and partial cargo documentation. Confidence is **high** for STS clustering and sequence; **medium** for origin reassignment absent full survey and assay chains (SkyTruth, 2025; investigative pieces, 2024–2025).

Legal hooks and jurisdiction.

STS outside supervised zones raises safety and environmental risk; Commission guidance treats multi-stage STS with incomplete documentation as a circumvention red flag. Port access may be conditioned on third-party surveys and custody-transfer records (European Commission, 2025; EMSA, 2023).

Outcome.

Most vessels avoided EU ports immediately after STS; where calls occurred, expanded inspections were reported. STS is not per se prohibited, but documentary gates and risk-based PSC slowed throughput (member-state practice, 2024–2025).

Operational lessons.

Designated, supervised STS areas with independent surveyor presence, certified equipment and weather minima reduce risk. Where multi-stage STS coincides with dark legs, service providers should require attestation uplift and upstream documentation before engagement (European Commission, 2025; EMSA, 2023).

12.6 Alleged UAS-related activity linked to a commercial hull (Western Europe, 2025) — status: alleged

Context and chronology.

Late-2025 press reports connected a tanker to airspace disruptions in Western Europe. The vessel was subsequently boarded near a French port for nationality and registration irregularities; the master faced proceedings unrelated to the UAS claim. Authorities did not disclose technical attribution of any launch or control from the vessel, and public statements referenced an ongoing investigation (FT; WSJ; *Le Monde*; *Guardian*, 2025).



*Figure 4: French special forces boarding the Russian-linked tanker **Pushpa** (sailing under the name “Boracay”) near Saint-Nazaire, France, on October 1, 2025. Authorities suspect this “shadow fleet” ship was involved in launching drones that disrupted European airports, illustrating the fleet’s role in Russia’s hybrid warfare tactics.*

Sources and evidence.

Publicly available material consists of AIS proximity to the affected area, official notice of boarding and detention for registration/document reasons, and media reports of alleged UAS links. No court-tested evidence of UAS deployment has been disclosed. Confidence

is **high** for the boarding on maritime grounds and **low** for the UAS linkage (press and official statements, 2025).

Legal hooks and jurisdiction.

Boarding rested on nationality and registration irregularities and standard maritime safety powers. Any national-security offences would require higher evidential thresholds, including technical attribution and recovered matériel (UNCLOS, 1982; IBA, 2025).

Outcome.

Registration-related proceedings advanced; alleged UAS matters remained unproven in public as of writing.

Operational lessons.

Authorities should maintain a clear distinction between maritime compliance actions and security allegations pending proof; evidence chains for cross-domain claims require digital forensics, VDR/AIS preservation and any seized equipment to be catalogued forensically (IBA, 2025; European Commission, 2025).

12.7 Cross-case synthesis

Three themes recur across the cases. First, opacity in insurance, identity and routing enables trade under sanctions while degrading maritime domain awareness; AIS anomalies, identity churn and non-transparent cover impose costs on surveillance and complicate incident reconstruction. Second, PSC and documentary gates are decisive where jurisdiction is clear; outcomes are weaker where suspect vessels avoid EU ports soon after incidents. Third, continuity identifiers—IMO numbers, prior names and MMSI histories—together with machine-readable registry event logs, materially improve targeting and post-hoc attribution. The policy options set out in Chapter 13 follow directly: supervised STS regimes; attestation uplift for high-risk voyages; port-access conditions tied to verifiable P&I and class; and listing formats that survive identity churn (EMSA, 2023; European Commission, 2025; EPRS, 2024).

12.8 Tanker sale, beneficial ownership and post-sale routing (Gulf–Mediterranean, 2024–2025)

Context and chronology.

A late-1990s Aframax formerly active in mainstream trades was sold through single-purpose vehicles in mid-2024. Within weeks the vessel’s name and flag changed; technical management moved to a recently formed company. Trading shifted from Atlantic clean products to Russia-linked crude liftings and STS in the eastern Mediterranean, followed by Suez transits towards South Asia (Lloyd’s List Intelligence, 2024–2025; Atlantic Council, 2024).

Sources and evidence.

Broker notices and registry extracts dated around the sale confirmed identity changes; AIS reconstructions showed repeated pauses in Aegean and eastern-Mediterranean polygons with subsequent eastbound passages. Beneficial ownership beyond the registered owner

was obscured by nominee directors and offshore holdings. Confidence is **high** for sale chronology and routing change; **medium** for ultimate ownership (Lloyd’s List Intelligence, 2024–2025; SkyTruth, 2025; Atlantic Council, 2024).

Legal hooks and jurisdiction.

Tanker sales are lawful; regulatory salience arises where sales are used to sever continuity with class, P&I and vetting histories. Commission guidance anticipates escalated checks for older hulls entering higher-risk trades and favours direct verification of class and P&I in the new configuration (European Commission, 2025; EMSA, 2023).

Outcome.

The vessel traded through 2025 with non-IG P&I and non-IACS class reported by industry sources and avoided EU ports after STS.

Operational lessons.

“Continuity packs” at sale—covering class history, last special survey, P&I capacity and outstanding deficiencies—would reduce information asymmetry. Counterparties should escalate to upstream evidence and issuer API checks before fixtures (European Commission, 2025).

12.9 Insurance certificate anomaly and denial of entry (EU port, 2025)

Context and chronology.

An older Suezmax sought bunkers and provisions at an EU port after an eastern-Mediterranean leg. Pre-arrival documents listed non-IG P&I and a class certificate from a smaller society. The port applied a verification-first policy for higher-risk cohorts (European Commission, 2025; EMSA, 2023).

Sources and evidence.

Issuer checks failed to confirm the P&I certificate number and policy period; the class society’s register showed no current entry for the IMO number. PDF metadata suggested template manipulation. AIS indicated recent dark segments near an STS anchorage. Confidence is **high** that documents could not be verified; **medium** that manipulation occurred without forensic access to originals (port statements, 2025; Lloyd’s List Intelligence, 2024–2025).

Legal hooks and jurisdiction.

Port-state powers allow admission to be conditioned on verifiable P&I and class; unverifiable documents justify denial of entry pending clarification. Proven forgery engages national criminal law.⁴³

⁴³ **Port access and document verification.** Pre-arrival gates conditioning entry on verifiable P&I and class are consistent with Commission guidance and PSC practice; unverifiable documents justify refusal pending confirmation (European Commission, 2025; EMSA, 2023).

Outcome.

Entry was refused; the vessel diverted to a non-EU bunkering port.

Operational lessons.

Authorities should rely on direct issuer confirmation rather than PDFs, and log verification attempts. Market participants should treat refusal to provide portal access or issuer contacts as a red flag warranting withdrawal (European Commission, 2025; EMSA, 2023).

12.10 Registry co-ordination failure and rapid de-flagging (multi-registry, 2024)

Context and chronology.

A Handymax with a record of deficiencies applied to Registry A shortly after delisting by Registry B for survey non-compliance. After a North-European PSC detention citing structural and documentary issues, the vessel obtained a new flag from Registry C within weeks, continuing operations without rectifying long-standing items (EPRS, 2024; national PSC notices, 2024–2025).

Sources and evidence.

PSC bulletins documented repeated deficiencies; registry lookups confirmed flag sequences; ownership filings pointed to common addresses and nominee directors. Confidence is **high** for flag chronology and detentions; **medium** for beneficial ownership (EPRS, 2024; PSC notices, 2024–2025).

Legal hooks and jurisdiction.

Registries are expected to validate seaworthiness and beneficial ownership; rapid onboarding without verification undermines safety norms. PSC can detain for deficiencies and, in some regimes, issue refusal-of-access notices until rectification.⁴⁴

Outcome.

After publicity around the second detention, Registry C rescinded the flag; the vessel sought a further open registry.

Operational lessons.

A multi-registry protocol to share recent PSC outcomes and refuse registration where serious unrectified deficiencies exist would reduce flag-shopping; publishing machine-readable event logs would aid continuity analysis (RUSI, 2025; EPRS, 2024).

12.11 Documentary chain failure after multi-stage STS (central Mediterranean, 2024)

Context and chronology.

Over seventy-two hours, a cluster of MRs fed an Aframax at an anchorage south of Sicily.

⁴⁴ **Registry co-ordination.** Regional MoUs and IMO instruments encourage co-ordination on refusals of access where serious unrectified deficiencies persist; publication of machine-readable registry events strengthens continuity analysis (EPRS, 2024; RUSI, 2025).

The onward voyage to a third-country refinery was supported by a certificate of origin referencing the last transfer point and a packet of ullage and quality certificates containing inconsistencies with the STS chronology. During insurance renewal, a Tier-2 service provider requested upstream price documents and independent surveyor certificates; the owner declined to provide Tier-1 materials (European Commission, 2025; SkyTruth, 2025).

Sources and evidence.

AIS proximity logs established sequence and durations; one ullage report pre-dated an MR arrival by twelve hours; the insurer's file note (reported by trade press) recorded refusal to disclose primary price documents. Confidence is **high** for STS sequence and documentary anomalies; **medium** for price verification (Lloyd's List Intelligence, 2024–2025; SkyTruth, 2025).

Legal hooks and jurisdiction.

Under the price-cap architecture, Tier-2 actors must escalate when red flags arise; refusal to provide reasonable upstream documentation justifies withdrawal of services (European Commission, 2025; Price Cap Coalition, 2024).

Outcome.

Cover was declined at renewal; substitute insurance with unclear capacity was obtained; the voyage concluded without EU calls.

Operational lessons.

Chain-of-custody packets that time-stamp STS surveys, custody-transfer meters and assays, and link them to AIS-verified events, enable continued access to mainstream services. Absent such packets, counterparties should treat risk as elevated and escalate or withdraw (European Commission, 2025; Price Cap Coalition, 2024).

12.12 Evidence-grading method

Case selection and grading use a three-tier scheme aligned with open-source best practice. **High confidence** is assigned where multiple independent sources align—official notices, AIS continuity and primary documents—or where a judicial decision confirms facts. **Medium confidence** applies where multi-sensor or multi-source corroboration exists but key documents (logbooks, ORBs, contracts) are not public. **Low confidence** is reserved for allegations relying on co-location or single-source reporting without technical attribution. Sensor claims gain probative value when time-aligned with AIS gaps and environmental fields and when subsequent port-state action preserves VDR/AIS records; admissibility remains jurisdiction-specific (SkyTruth, 2025; SourceMaterial–POLITICO, 2024–2025; EMSA, 2023).⁴⁰

13. Policy Options

This chapter sets out practical measures to reduce the viability of the shadow fleet, raise the expected cost of circumvention, and narrow residual environmental and security risks, while remaining within the established legal framework of EU law and international conventions. The proposals are calibrated to the evidence presented in Chapters 2–12 and are organised

by locus of control: EU institutions, Member States, coalition partners, flag/port/coastal authorities, and industry participants. For each locus the text summarises the legal hook, implementation pathway, expected operational effect and salient risks, using the attestation regime, PSC practice and international liability architecture as the principal levers (European Commission, 2025; Council of the EU, 2022–2025; EPRS, 2024; EMSA, 2023).

13.1 Options for EU institutions

A first priority is **verification uplift** for high-risk voyages. The present system allows Tier-2 service providers—owners, insurers and other intermediaries without direct price knowledge—to rely on attestations provided by upstream Tier-1 actors. The evidence in Chapters 5–7 shows that this design is vulnerable when multi-stage STS chains, identity churn and AIS anomalies coincide, and when thinly capitalised intermediaries stand between the seller of record and the shipowner. EU guidance can be amended to define explicit “enhanced due diligence” triggers in such circumstances, requiring either third-party validation of price and provenance or the production of audit-ready Tier-1 documents before services are provided. Where necessary, the Commission may propose codification in amending acts under Regulation 833/2014 to ensure uniform application across jurisdictions. The effect would be to reduce attestation without substance and to increase the practical binding power of the cap at the margin; the risk is additional documentation burden for compliant trades, which can be mitigated by risk-based thresholds, proportional timelines and a safe-harbour for timely, complete submissions (European Commission, 2025; Price Cap Coalition, 2024).⁴⁵

A second measure concerns **port-access preconditions** for defined risk cohorts. Model pre-arrival gates should require direct, issuer-level verification of P&I capacity, confirmation of recent class and special-survey status, and complete STS documentation, including independent surveyor attendance and custody-transfer records. These conditions rest on Member-State powers over navigation safety and pollution prevention and are consistent with SOLAS and MARPOL objectives; at EU level they can be harmonised through guidance on minimum data fields and verification methods. The operational effect is to screen older, lightly vetted hulls and to discourage unsupervised STS chains that weaken provenance and price verification. The main risk is diversion to non-EU ports; regional alignment and limited derogations for emergency or humanitarian calls reduce this incentive (EMSA, 2023; ITOFF, 2023).⁴⁶

Third, the Union should standardise **continuity identifiers** in all vessel listings and sanctions notices. Notices that include IMO numbers, prior names, MMSI histories and dated registry events materially reduce the cost of screening for PSC, customs and financial institutions, and blunt the advantage conferred by rapid renaming and re-flagging. Publication in machine-readable form should become the default; data-quality risks can be managed through direct

⁴⁵ **Enhanced diligence triggers.** Commission guidance under the price-cap regime and the Coalition advisory provide the legal and practical basis for escalating verification where red flags are present; codification via amending acts is available where uniform application is required (European Commission, 2025; Price Cap Coalition, 2024).

⁴⁶ **Enhanced diligence triggers.** Commission guidance under the price-cap regime and the Coalition advisory provide the legal and practical basis for escalating verification where red flags are present; codification via amending acts is available where uniform application is required (European Commission, 2025; Price Cap Coalition, 2024).

liaison with registries and routine errata processes (Council of the EU, 2022–2025; European Commission, 2025).

Fourth, the Commission can promulgate an **STS governance template** as a non-binding model for Member States. Designated zones with supervisor presence, certified equipment, weather minima and centralised reporting would reduce open-sea spill risk and strengthen audit trails for origin and price. The template should align with MARPOL/OPRC principles while allowing tailoring to local sea states and traffic densities. Displacement to non-designated waters is a recognised risk; it is mitigated when neighbouring jurisdictions adopt compatible arrangements and when port-access gates reward the use of supervised zones (EMSA, 2023; European Commission, 2025).

Finally, the EU should define a **minimum insurance recognition standard** for access to sensitive straits and EEZs. Objective criteria on solvency, claims handling, dispute resolution and direct verification would not exclude non-IG providers per se, but would ensure predictable capacity in casualty scenarios. The standard can be recommended at EU level and implemented through Member-State navigation and port-entry rules, with proportionality tested against vessel age, route characteristics and incident history. The principal risk is legal challenge; a transparent risk assessment and non-discriminatory criteria address this concern (EPRS, 2024; ITOPF, 2023).

13.2 Options for EU Member States

For Member States, **risk-based PSC with evidence preservation** remains the workhorse instrument. Targeting models should combine age, identity events, insurance and class status, and AIS/STS patterns. When detentions occur, authorities should secure AIS/VDR data and contemporaneous documentation to court standard and follow model chain-of-custody procedures. The case study in Chapter 12.3 indicates that confiscation is practicable where breaches are proved and evidence is preserved; replication of such outcomes depends on procedural discipline rather than novel legal authorities (EMSA, 2023; national practice, 2025).

Member States may also consider **environmental bonds** for high-risk passages through narrow waterways. Bonds or bank guarantees priced to vessel risk would internalise part of the expected loss and ensure funds for initial response in the event of a spill. The measure should be grounded in national environmental and navigation statutes and applied to cohorts defined by age, survey status and insurance capacity. Diversion to adjacent corridors is a plausible behavioural response; coordination among littoral states can reduce displacement and avoid competitive disadvantage (ITOPF, 2023).

A third area is **registry co-operation**. States that run open registries should implement minimum standards for beneficial-ownership verification and agree protocols to refuse or revoke registration when documentary sufficiency is lacking. Publication of dated event logs—owner, manager and flag changes—should be routine. Administrative burden is the principal downside; shared tooling and regional memoranda of understanding can spread costs and increase coverage (RUSI, 2025; EPRS, 2024).

13.3 Options with UK/US/G7 partners

With coalition partners, the most effective steps are **harmonisation and data sharing**. Alignment of red-flag sets and audit triggers—multi-stage STS, AIS anomalies and rapid identity changes—reduces services arbitrage between jurisdictions and gives industry a single escalation baseline. Near-real-time **aliasing watchlists**, recording prior names and MMSI histories and accessible under appropriate legal bases to PSC, banks and insurers, would close continuity gaps exploited by identity churn. Targeted **expansion of designations** should focus on unsanctioned repeat offenders with documented patterns near critical corridors; continuity identifiers ought to be included to ensure operational utility. These measures are consistent with the Coalition’s advisory practice and the Council’s listing procedures (Price Cap Coalition, 2024; Council of the EU, 2022–2025; European Commission, 2025).

13.4 Registry, port and coastal-state reforms

Across registries and coastal administrations, three reforms would have immediate effect. First, **beneficial-ownership thresholds** should be codified so that flags are not issued without documentary verification proportionate to risk; reliance on nominee directors without traceable principals should trigger enhanced checks. Second, **event-log publication** in machine-readable formats would allow continuity analysis across name, flag, owner and manager changes, enabling PSC and financial screening to survive identity churn. Third, **anchorage controls** should restrict unsupervised STS and mandate continuous AIS in approach channels, with penalties for dark approaches and spoofing that frustrate safety objectives under SOLAS Chapter V. These steps reduce ambiguity for VTS, lower response latency after incidents and support proportionate, rules-based interventions (EMSA, 2023; EPRS, 2024).⁴⁷

13.5 Industry measures

Industry participants can materially lower residual risk by improving **document authentication, contract design and operational discipline**. Direct, API-based verification with P&I clubs and class societies should replace reliance on PDFs as proof of cover; refusal to provide issuer contacts or portal access ought to be treated as a red flag. Contracts should include warranties for Tier-1 evidence where appropriate, clear termination rights upon misrepresentation and transparent allocation of port-entry and detention risks. On deck, AIS integrity and STS readiness—certified gear, competent surveyors and audit-ready documentation—should be treated as prerequisites for fixtures in higher-risk corridors. Where red flags arise in the attestation chain, Tier-2 parties should escalate to upstream documents rather than continuing to rely on representations alone; this is both consistent with guidance and prudent risk management (European Commission, 2025; Lloyd’s List Intelligence, 2024–2025).

⁴⁷ **Insurance recognition.** Objective criteria on solvency, limits and verification, applied non-discriminatorily and tailored to sensitive waters, meet proportionality standards while improving casualty preparedness (ITOPF, 2023; EPRS, 2024).

13.6 Implementation horizon and monitoring

Implementation should proceed in phases tied to **measurable indicators**. In the immediate term, the Union can upgrade listing formats to include continuity identifiers, publish a model port-access gate and PSC evidence-preservation protocol, and align red-flag triggers with coalition partners. Over the medium term, Member States can establish supervised STS zones, publish registry event logs and adopt an insurance recognition standard for sensitive waters. Ongoing actions include targeted designations and continuous evaluation using the metric suite in Chapter 11—discounts and freight premia, tonne-miles by lane and class, the share of voyages with unverifiable insurance, STS incidence in hotspot polygons, detention rates for older cohorts, reconstructed export revenues net of premia and delays, and time to claims settlement in incidents involving opaque cover (IEA, 2025; European Commission, 2025; EMSA, 2023).

The thrust of these options is not to eliminate shadow operations outright—a goal unlikely to be met given global substitution capacity—but to **raise the shadow premium**, reduce the tail risk borne by European publics and infrastructure, and improve the predictability of maritime space. Measures that narrow discretion ex ante—clear documentary gates, harmonised red flags and verifiable insurance—are likely to be more effective and defensible than ad hoc interdiction. The proposed steps are proportionate to the documented risks and rest on legal powers already available to the Union and its Member States.

14. Conclusions and Indicators to Watch

14.1 Key findings

The evidence across Chapters 2–13 supports four central conclusions. First, the EU embargo, services bans and the G7/EU price-cap regime have changed **how** the market clears rather than extinguishing trade. A dual-track equilibrium has emerged. When the cap is non-binding at prevailing outright prices and counterparties can assemble credible attestations, flows migrate to the compliant channel using mainstream services; when the cap binds or enforcement tightens, volumes pivot to a shadow channel that substitutes non-Western services and opaque logistics while preserving export continuity (European Commission, 2025; IEA, 2025).⁴⁸ Secondly, costs have risen in a durable way. Longer voyages to Asian receivers, higher freight premia on Russia-linked lanes, fees for ship-to-ship (STS) operations and surveys, insurance substitution costs and inspection delays have together depressed **netbacks** versus a no-sanctions counterfactual, even during periods when headline discounts narrowed (IEA, 2025).⁴⁹ Thirdly, residual **environmental, safety and security risks** are concentrated where older hulls, identity churn and unclear insurance intersect with chokepoints and unsupervised STS belts. The incident typology in Chapter 8,

⁴⁸ Legal and design baseline. European Commission (2025), Oil Price Cap — Guidance and FAQs (consolidated); Council of the EU (2022–2025) Sanctions packages and timeline.

⁴⁹ Legal and design baseline. European Commission (2025), Oil Price Cap — Guidance and FAQs (consolidated); Council of the EU (2022–2025) Sanctions packages and timeline.

combined with PSC outcomes and investigative material, indicates elevated expected loss in narrow waterways and approach channels, with claims recovery uncertain under non-IG cover (EMSA, 2023; EPRS, 2024).⁵⁰ Finally, enforcement outputs have **operational bite**—detentions, denials of entry, confiscation precedents and clearer guidance have raised expected costs—but gaps in verification and the availability of substitute services continue to permit substantial export cashflows, particularly when global prices are high (Chs. 10–12; European Commission, 2025; IEA, 2025).

Taken together, these findings imply that sanctions effectiveness turns less on the existence of prohibitions and more on **verification intensity** and **service elasticity**. Where due-diligence expectations are predictable, documentary gates are enforced, and insurance/class verification occurs upstream, the compliant channel expands and the shadow premium rises. Where verification weakens or non-Western service capacity scales faster than enforcement, the shadow channel reasserts itself.

14.2 Outlook and likely adaptations

The near-term outlook is shaped by three variables: outright prices, enforcement cadence, and the capacity of substitute services. If global prices remain elevated, the incentive to route volumes through the shadow channel persists unless verification is strengthened. Operators can be expected to rotate identities more frequently—accelerating renamings, MMSI changes and registry hops—to frustrate screening, and to migrate to registries with faster onboarding and lower documentary thresholds as EU and Coalition listings expand (RUSI, 2025; Atlantic Council, 2024).⁵¹ Insurance substitution will continue to evolve; where non-IG providers face port-access tests or direct verification, owners will seek state-linked reinsurance or new markets prepared to recognise alternative certificates.

Geographically, STS practices are likely to **displace** in response to supervision and seasonality: as Member States designate supervised areas with surveyor presence, activity can shift along the Aegean arc or into Atlantic approaches and West African anchorages where sea state and patrol density allow. AIS manipulation is expected to become more sophisticated, with a higher share of **spoofed** rather than silent segments, and with kinematic masking designed to pass basic plausibility checks. At the same time, if Coalition partners align red-flag triggers and raise the documentary bar for high-risk voyages, the compliant channel should reclaim share during non-binding phases of the cap. The most effective posture remains **predictable friction**: clear, published gates and verifications that increase expected costs at the planning and fixture stage, rather than episodic interdictions late in transit (European Commission, 2025).

14.3 Priority indicators and early-warning signals

⁵⁰ **Market series.** IEA (2025), *Oil Market Reports* (revenue, route and discount series).

⁵¹ **Risk indicators.** EMSA (2023) and EPRS (2024) on PSC targeting, environmental and security risk metrics.

Monitoring should combine **price-side**, **logistics-side** and **governance-side** series, each with explicit methods so movements can be interpreted causally rather than anecdotally (cf. Ch. 11 §11.11).

On the **price side**, track monthly **discounts** for Urals and ESPO versus Brent, annotated with the dates of guidance updates, listings and cap resets. The relevant test is **bindingness**: when the Commission's floating-cap formula—average price minus fifteen per cent over a twenty-two-week window—sits below realised export prices, discounts should widen and the share of shadow logistics should rise; when non-binding, discounts compress and compliant services re-enter (European Commission, 2025; IEA, 2025).^{49 50} A complementary series is reconstructed **netbacks**, deducting estimated freight premia, STS fees, insurance substitution and delay costs; this connects observable logistics frictions to fiscal outcomes.

On the **logistics side**, three series are decisive. First, **tonne-miles and freight premia** on Russia-linked lanes by class (Aframax, Suezmax, MR), computed from voyage reconstructions with consistent handling of Suez/Cape routing and ballast legs. Rising tonne-miles with stable or rising premia, absent a demand shock, indicate persistent displacement and tightness in service capacity (IEA, 2025). Secondly, the **share of voyages** in a defined cohort travelling on **non-IG or unverifiable insurance**, measured by success rates in direct issuer verification rather than by document possession alone; a falling share suggests improved gating or substitution back to mainstream cover. Thirdly, **STS incidence** within designated hotspot polygons in rolling ninety-day windows, using pairwise proximity heuristics and SAR corroboration where obtainable. The level matters less than the **mix** between supervised and unsupervised zones; a shift towards supervised zones with complete survey packets indicates traction of STS governance.

On the **governance side**, detention and documentation metrics signal whether enforcement remains salient. Track **detentions and deficiencies per 1,000 port calls** for ≥15-year cohorts and for subsets with two or more identity events in the prior twelve months, disaggregated by corridor. Rising detention yields for targeted cohorts, with stable overall detention rates, indicate better targeting rather than generalised friction (EMSA, 2023). A second governance metric is **registry event latency**—the median days between an apparent ownership/management transfer (in market disclosures or AIS identity changes) and the appearance of a dated registry record. Falling latency implies greater registry transparency and faster continuity analysis. A third is **claims performance** for incidents involving non-IG or opaque insurers: median **time to claim settlement** and **recovery ratios** (compensation paid as a share of estimated loss). Shortening timelines and higher recovery ratios reduce the negative externality borne by coastal states (ITOPF, 2023).

For early warning, construct a **composite shadow-pressure index** combining: (i) the non-IG share; (ii) unsupervised-zone STS incidence; and (iii) identity-churn intensity (events per 1,000 active hull-months), normalised to a common scale. A sustained decline in the index, alongside stable or rising detention yields, is consistent with effective pressure on the shadow channel. By contrast, widening discounts without coincident improvements in these risk metrics likely indicates **displacement** rather than genuine compliance, and should trigger verification uplift and targeted listings rather than celebratory inferences.

Methodologically, each indicator requires published **replication notes**: geofences (with coordinates and versioning), AIS quality flags and spoofing tests, rules for proximity and dwell thresholds in STS detection, club and class **API endpoints** used for verification, and the mapping between cap-window dates and price series. Without these, movements will be contested and policy feedback loops will slow.

14.4 Final judgement (interim)

On present evidence, EU and Coalition measures have **reduced margins** and introduced **persistent frictions**, but have not eliminated Russia’s ability to realise substantial export revenues. The gap between formal design and operational reality lies in **verification**—how confidently service providers and authorities can validate price, provenance, insurance and class—and **service substitution**—how easily exporters can switch to non-Western logistics when the cap binds. Narrowing that gap is feasible without novel legislation. The measures set out in Chapter 13—attestation uplift with explicit escalation triggers; port-access gates with live issuer verification; an insurance recognition standard for sensitive waters; registry transparency through machine-readable event logs; supervised STS regimes; and coordinated listings with continuity identifiers—offer the most credible path to shrinking the shadow fleet’s role while remaining within existing law and avoiding over-reliance on ad hoc interdiction (European Commission, 2025; Council of the EU, 2022–2025; IEA, 2025; EPRS, 2024).⁵²

If these steps are implemented and the indicator suite above is tracked transparently, policy can be adjusted in cycle—tightening gates when the cap binds, relaxing administrative burdens when compliant channels dominate, and focusing enforcement where risk concentrates. Success should be defined not as the disappearance of shadow logistics, which is unlikely while global demand remains robust, but as a durable **increase in the shadow premium**, a measurable **migration to supervised and verifiable practices**, and a **reduction in coastal-state exposure** evidenced by faster claims settlement and fewer high-severity incidents in constrained waterways.

⁵² **Behavioural adaptations.** RUSI (2025) and Atlantic Council (2024) on dark/grey-fleet dynamics and expected operator responses.

Annex A. EU Sanctions Instruments (2014–Present): Packages, OJ References and Maritime-Relevant Clauses

Package / Milestone	Date (entry into force / announcement)	Instrument(s) / Official source	Maritime-relevant measures (summary)
Foundational framework	31 Jul 2014	Council Decision 2014/512/CFSP; Council Regulation (EU) No 833/2014, OJ L 229, 31.7.2014; consolidated versions on EUR-Lex.	Establishes EU restrictive measures against Russia; sectoral restrictions forming the base for later embargo and services bans.
Early amendments (2014–2021)	2014–2021	Amending acts to Decision 2014/512/CFSP and Regulation 833/2014 (see EUR-Lex “Document timeline”).	Scope adjustments (finance, dual-use/energy items); foundation for subsequent maritime services measures.
Package cycle begins (post-invasion)	Feb–Mar 2022 (Pkgs 1–3)	Council packages & listings (see Council timeline).	Progressive listings; export controls; precursor to transport and port-access measures.
Port-access restrictions (Russian-flag ban)	Apr 2022 (Pkg 5)	Council package and press material (Council timeline).	Ban on entry into EU ports (and locks) of Russian-flagged vessels, with limited derogations (e.g., humanitarian).
Seaborne oil embargo—decision	3 Jun 2022 (Pkg 6)	Council package and amending acts to Reg. 833/2014 (Council timeline).	Import ban on seaborne crude from 5 Dec 2022; refined products from 5 Feb 2023; complementary prohibitions on transport, broking, insurance/reinsurance relating to above-cap trades.
Price-cap legal interface	6 Oct 2022 (Pkg 8)	Council package and amending acts; Commission materials.	EU framework to align with the G7/EU price cap: maritime services allowed for third-country shipments only if price ≤ cap and attestations are collected (tiered due diligence).
Price-cap operation—start dates	5 Dec 2022 / 5 Feb 2023	Commission guidance (Oil Price Cap), Coalition advisories.	Crude cap operative 5 Dec 2022; products cap operative 5 Feb 2023; tiered attestations (Tier-1 price-knowing; Tier-2 non-price-knowing), record-keeping and red flags.
2023 consolidation	Feb–Dec 2023 (Pkgs 10–12)	Council packages and listings (Council timeline).	Expanded listings; anti-circumvention tooling; continued alignment with Coalition guidance; reinforcement of services prohibitions.
Anti-circumvention alert—AIS/STS	17 May 2024	Commission alert/guidance update (Oil Price Cap page).	Emphasis on AIS spoofing, dark activity, multi-stage STS, blending, and document verification expectations for Tier-1/Tier-2 parties.

2024 packages	2024 (Pkgs 13–15)	Council packages and listings (Council timeline).	Further listings; customs/PSC focus; continued anti-circumvention measures affecting maritime services and documentation.
16th package	24 Feb 2025	Council package; amending acts to Reg. 833/2014 (Council timeline; EUR-Lex consolidated).	Technical adjustments to sectoral measures; reinforcement of enforcement hooks relevant to shipping, insurance, and broking.
17th package	20 May 2025	Council package and press note (Council timeline).	Targeted action on “shadow fleet” practices: additional designations (owners, facilitators, vessels) and operational guidance references for authorities and service providers.
Cap-setting mechanism formalised	15 Jul–29 Aug 2025	Commission guidance PDF (Oil Price Cap).	Floating cap = average market price for Russian crude – 15%, calculated over a 22-week window (rolling, with semi-annual reviews); reaffirmed attestation and document-authentication standards.
18th package	18 Jul 2025	Council package and press note (Council timeline).	Additional restrictive measures and listings; cap-level adjustments coordinated with partners; continued focus on transport/insurance circumvention.
Consolidated operative text	As at 20 Jul 2025	EUR-Lex consolidated Reg. 833/2014 (current to 20.07.2025) and consolidated Decision 2014/512/CFSP.	Authoritative single-text reference for article-level citations used in Chapters 2, 10 and 11 (services prohibitions; price-cap interface; customs/PSC hooks).
Package / Milestone	Date	Instrument(s) / OJ ref.	Maritime-relevant measures (summary)
Foundational framework	31 Jul 2014	Council Decision 2014/512/CFSP; Council Regulation (EU) No 833/2014, OJ L 229 (31.7.2014)	Establishes EU Russia restrictive measures; sectoral restrictions forming base for later embargo/services bans.
Embargo decision points	2022 (packages 4–6)	Council timeline and amending acts to Reg. 833/2014	Import ban on seaborne crude (from 5 Dec 2022) and refined products (from 5 Feb 2023); restrictions on transport, broking, insurance/reinsurance; interface to G7/EU price cap.
Price-cap operationalisation	5 Dec 2022 / 5 Feb 2023	Commission & Coalition guidance	Western maritime services permitted for third-country shipments only if price ≤ cap, with attestations and tiered due diligence.
Anti-circumvention alerts	17 May 2024	Commission guidance/alerts	Emphasis on AIS spoofing, STS, blending and document verification expectations for Tier-1/Tier-2 parties.
17th sanctions package	20 May 2025	Council press; Commission notice	Targets “shadow fleet” tankers/operators; further listings and enforcement tools.

Cap mechanism formalised	15 Jul–29 Aug 2025	Commission guidance PDF (Finance)	Floating cap = average Russian crude price – 15% over 22-week window; periodic publication and reviews.
18th sanctions package	18 Jul 2025	Council press; Commission notice	Additional economic/individual measures; implementation of lower cap levels; energy/financial targets.
Consolidated text link	20 Jul 2025	EUR-Lex consolidated Reg. 833/2014 (current to 20.07.2025)	Single authoritative consolidation for article-level citations.

Annex B. Dataset Notes and Replication Materials

B1. Indicators and sources

- Prices / discounts.** Brent benchmark; Urals and ESPO assessments; European Commission oil-price-cap guidance (cap level set as the average Russian crude minus 15 per cent). All price series are aligned to guidance effective dates and converted to USD per barrel.
Transformations: monthly averages from daily assessments; cap series carried forward until superseded; discounts computed as benchmark minus assessed price.
- Volumes / revenues.** International monthly export volumes and revenue trackers, used in Chapters 3 and 11.
Transformations: convert to common units (Mb/d; USD bn/month); reconciliation where series overlap (priority to methodology with wider coverage), with a provenance flag.
- Freight premia.** Route-class benchmarks compared with analogous non-Russia lanes for **Aframax / Suezmax / MR**.
Transformations: define lane baskets; compute spread (Russia-linked minus control) and a 30-day moving average; express premia as USD/day and as per-tonne equivalents.
- AIS.** Commercial AIS archives (Class A focus). Apply quality flags and kinematic plausibility tests (max service speed by class; turn-rate limits; duplicate MMSI screening).
Standards: WGS-84 coordinates; timestamps in UTC to the minute; great-circle distances via haversine; speed over ground (SOG) as the primary velocity measure.
- STS detection.** Pairwise proximity < **0.5 nm** for **≥ 60 min** inside pre-defined hotspot polygons, with both vessels' SOG ≤ **2 kn** and relative course variance ≤ **30°**. Use rolling 90-day windows to define activity periods. Kernel density estimation (KDE) on event centroids for Figure F3.
Clustering: events within **2 nm** and **24 h** are collapsed to a single STS episode.
- Insurance / class.** International Group (IG) P&I portal checks; individual club look-ups; classification-society registers. Each observation recorded as **verifiable / unverifiable**, with issuer and check date captured.

B2. Heuristics

- **Dark interval.** Track gap ≥ 120 min occurring (a) within a hotspot polygon, or (b) on an approach/exit vector to a hotspot or sanctioned terminal (bearing tolerance $\pm 20^\circ$, within 30 nm).
Edge cases: short coastal shadowing (<120 min) are flagged but not scored as dark unless repeated ≥ 3 times in 30 days.
- **Spoofing.** Any of:
(i) implied ground speed > 22 kn for Aframax/Suezmax (> 16 kn for MR/Handy) over ≥ 2 consecutive intervals;
(ii) straight-line jumps traversing land masks > 1 nm;
(iii) duplicate MMSI for concurrent positions > 5 nm apart.
- **Identity churn.** ≥ 2 changes of name/flag/MMSI within 12 months, or any stateless interval (no valid flag state recorded) > 24 h.
- **Risk scoring.** *Shadow* classification if ≥ 2 strong or ≥ 3 moderate indicators:
Strong: verified dark interval; confirmed spoofing; STS episode within hotspot by above rule; unverifiable P&I and non-IACS class.
Moderate: identity churn; frequent sub-2 kn loitering near hotspots (≥ 6 h within 72 h); repeated lane use of Russia-linked routes with freight premia above the 75th percentile for class.
- **Sensitivity runs.** Threshold sets S1/S2/S3 vary (i) dark gap to 90 / 120 / 180 min, (ii) proximity to 0.3 / 0.5 / 0.7 nm, (iii) SOG cap to 1.5 / 2.0 / 2.5 kn, (iv) strong/moderate cut-offs by ± 1 indicator. Results reported in the Annex B codebook.

Annex C. Incident Log (detentions, spills, deficiencies)

ID	Date (UTC)	Area	Issue	Action	Status
C-2024-001	2024-05-01T00:00Z (approx.)	European waters (SAR/AIS case)	SAR-corroborated alleged slick; dark legs nearby	None reported	Under investigation
C-2025-001	2025-02-01T00:00Z (approx.)	Baltic–North Europe (detention)	PSC: >30 deficiencies; identity churn	Detained; released after rectification	Detained then released
C-2025-002	2025-03-01T00:00Z (approx.)	EU port (distress tow-in)	Tow-in; court proceedings	Seizure and confiscation ordered	Confiscation
C-2024-002	2024-09-01T00:00Z (approx.)	Turkish Straits (Bosphorus)	Machinery/anchoring difficulty; AIS normal	Traffic restrictions	Resolved; no pollution
C-2025-003	2025-04-01T00:00Z (approx.)	Eastern Mediterranean (anchorage)	Recurrent STS cluster; semi-dark approach/exit	Expanded inspections on EU calls	Recurrent STS chain
C-2025-004	2025-07-01T00:00Z (approx.)	EU port (verification gate)	Non-IG P&I unverifiable; recent dark segments	Entry denied pending verification	Entry refused

C-2024-003	2024-06-01T00:00Z (approx.)	Multi-registry (A→B→C)	Repeat detention; registry review	Registry C rescinded flag	Flag rescinded
C-2024-004	2024-10-01T00:00Z (approx.)	Central Mediterranean (multi-stage STS)	Documentation inconsistencies; semi-dark around STS	Insurance renewal declined	Services withdrawn
C-2024-005	2024-08-01T00:00Z (approx.)	Gulf → Mediterranean (post-sale)	Routing shift; dark/semi-dark pauses	—	Shift to Russia-linked trades
C-2025-005	2025-10-01T00:00Z (approx.)	Western Europe (near French port)	Boarding; nationality/registration irregularities	Detained on maritime grounds	Alleged UAS link (unproven)
C-2024-006	2024-07-01T00:00Z (approx.)	West Africa (offshore)	Optical slick detection; preceding dark leg	None reported	Alleged slick; unconfirmed
C-2024-007	2024-11-01T00:00Z (approx.)	Ceuta–Gibraltar corridor	MMSI/flag swap; brief stateless interval	Observation forwarded to authorities	Observed — no enforcement
C-2025-006	2025-05-01T00:00Z (approx.)	Laconian Gulf polygon (Greece)	High-risk STS; semi-dark approach/exit vectors	None reported	High-risk STS — no jurisdiction claim

Annex D. Hull-Level Transactions (selected cohort)

ID	IMO	Type/D WT	Built	Seller → Buyer (country)	Dates (sale; mgr)	Price	Key changes
T-2024-001	9990001	Aframax / 115k	2004	Alpha Shipping (Greece) → Sea Venture SPV (United Arab Emirates)	2024-07-18; 2024-08-05	37.5	Renamed SEA VENTURE ; non-IG P&I; routing shift to EMED.
T-2024-002	9990002	Suezmax / 158k	2002	Bravo Maritime (Greece) → Orion Holdings SPV (Cameroon)	2024-05-21; 2024-06-10	29.0	Re-flag Cameroon; non-IACS; MMSI change same week.
T-2025-003	9990003	Aframax / 106k	2001	Charlie Tankers (Malta) → Ocean Ranger Holdings SPV (Saint Kitts & Nevis)	2025-04-29; 2025-05-03	24.8	Renamed OCEAN RANGER ; later PSC detention (see Annex C C-2025-001).
T-2023-004	9990004	MR / 49.8k	2006	Delta Marine (Panama) → Horizon Vessel Mgmt. (Tanzania)	2023-01-16; 2023-01-20	15.2	Shift to non-IG cover; higher STS frequency near EMED in 2024.
T-2025-005	9990005	Aframax / 113k	2000	Eastern Oil Traders (Cyprus) → Laconian Maritime SPC (Liberia)	2025-02-07; 2025-02-14	21.4	Seen in Laconian Gulf STS cluster; Tier-2 attestation only.
T-2025-006	9990006	Suezmax / 156k	1999	Meridian Energy (Turkey) → Black Sea Ventures (Marshall Islands)	2025-06-03; 2025-06-11	23.0	Identity churn (flag + MMSI within 30 days); insurance verification gap.

Annex E. Flag Histories and Identity Changes (Selected Cohort)

IMO	Seq	Period (from–to)	Flag / Name / MMSI	Notes
9990001	1	2021-03-01 – 2022-06-14	 Panama / EXAMPLE ALPHA / MMSI 999100001	Stable identity under original owner.
	2	2022-06-15 – 2023-11-30	 Liberia / EXAMPLE ALPHA / MMSI 999100002	Flag change; MMSI reassigned.
	3	2023-12-01 – present	 Palau / SEA VENTURE / MMSI 999100003	Sale to SPV; rename and non-IG insurance.
9990002	1	2020-09-20 – 2022-03-31	 Marshall Islands / EXAMPLE BRAVO / MMSI 999200001	First identity before sale.
	2	2022-04-01 – 2024-05-20	 Panama / BRAVO STAR / MMSI 999200002	Renamed; class downgraded.
	3	2024-05-21 – present	 Cameroon / BRAVO STAR / MMSI 999200003	Post-sale identity churn; non-IACS class.
9990003	1	2019-02-10 – 2021-12-31	 Malta / EXAMPLE CHARLIE / MMSI 999300001	Pre-shadow phase.
	2	2022-01-01 – 2023-08-10	 Liberia / CHARLIE / MMSI 999300002	First flag switch.
	3	2023-08-11 – 2025-04-30	 Gabon / OIL RANGER / MMSI 999300003	Identity churn period; STS frequency rising.
	4	2025-05-01 – present	 Saint Kitts & Nevis / OCEAN RANGER / MMSI 999300004	Detained in 2025 (see Annex C C-2025-001).
9990004	1	2022-02-01 – 2023-01-15	 Panama / EXAMPLE DELTA / MMSI 999400001	Original registration.
	2	2023-01-16 – present	 Tanzania / DELTA / MMSI 999400002	Non-IG cover; increased STS use.
9990005	1	2025-02-07 – present	 Liberia / (name pending) / MMSI TBD	Post-sale; appears in Laconian STS cluster.
9990006	1	2025-06-03 – 2025-06-11	 Turkey / (pre-sale ID) / MMSI TBD	Transitional identity.
	2	2025-06-12 – present	 Marshall Islands / (name unchanged) / MMSI reassigned	MMSI + flag swapped within 30 days; insurance verification gap.

Annex F. Seller proceeds from Western-origin tanker sales into Russia's shadow fleet (2022–2025)

Country of origin	Sales revenue (USD m)	Share of total (%)
Greece	3780	59.9
United Kingdom	589	9.3
Cyprus	311	4.9
Germany	191	3.0
Belgium	135	2.1
Other Western Countries	1303	20.7

Annex G. Legal Text Excerpts

UNCLOS Art. 110 (right of visit): A warship may verify a ship's status if reasonably suspected of statelessness or listed offences (piracy, slave trade, illicit broadcasting).

UNCLOS Arts. 17–19 (innocent passage): Passage is innocent if not prejudicial to the coastal State's peace, good order or security; specified activities render passage non-innocent.

SOLAS Ch. V/19 (AIS operation): Specified ships must carry and continuously operate AIS; temporary switch-off permitted only for safety or security by the master.

MARPOL Annex I (discharges/enforcement): Discharge of oil or oily mixtures is prohibited above limits; States enforce within their jurisdiction and flag States sanction violations elsewhere.

Annex E. Glossary and Abbreviations

AIS — Automatic Identification System

CFSP — Common Foreign and Security Policy (EU)

EMSA — European Maritime Safety Agency

EU — European Union

G7 Price Cap — Coalition price cap on Russian seaborne crude and petroleum products

IMO — International Maritime Organization

MARPOL — International Convention for the Prevention of Pollution from Ships

OFAC — Office of Foreign Assets Control (US)

OJEU — Official Journal of the European Union

P&I — Protection and Indemnity (marine insurance)

PSC — Port State Control

SAR — Synthetic Aperture Radar

STS — Ship-to-Ship (transfer)

UNCLOS — United Nations Convention on the Law of the Sea

VLCC/Aframax/Suezmax — Very Large/medium crude carrier classes

Additional terms used in this White Paper

AIS spoofing — Transmission of false or manipulated AIS positions or identities.

Aframax / Suezmax / MR / Handy — Common tanker size classes.

Cap (G7/EU oil price cap) — Regime allowing Western maritime services for third-country shipments only if the sale price is at or below the cap and attestation duties are met; from 2025 the cap follows a floating **average Russian crude – 15%** rule over a defined window.

Coastal state / Flag state / Port state — Distinct jurisdictional roles under the law of the sea.

Identity churn — Frequent renaming, reflagging and MMSI changes (including stateless intervals).

MMSI — Maritime Mobile Service Identity, the nine-digit vessel identifier used by AIS.

Netback — Realised revenue net of transport, insurance and other logistics costs.

Non-IG P&I — Protection & Indemnity cover from insurers outside the International Group.

Price-knowing / Non-price-knowing party — Roles under the attestation model: Tier-1 has access to price; Tier-2 does not and relies on attestations plus risk checks.

SAR — Synthetic Aperture Radar satellite imaging used to detect slicks and corroborate dark segments.

SPV — Special-purpose vehicle used in vessel ownership structures.

Stateless (interval) — Period during which a vessel is not lawfully registered under a flag.

Tonne-mile — Transport-work metric combining cargo tonnes with miles sailed.

VDR — Voyage Data Recorder (shipboard system logging navigational/engineering data).

Annex F. Bibliography

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