

WINDSHIP INSIGHTS · 10 NOVEMBER 2026

Sail Cargo Ships

Market potential, economic viability and emission effects

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AGENDA

Four questions guided the study – they also structure today's presentation

1

MARKET

Which goods, customers and business models fit Sail Cargo Ships?

2

ECONOMICS

Can Sail Cargo Ships compete with conventional ships – and under which conditions?

3

EMISSIONS

How large is the emission reduction potential on real trade routes?

4

STAKEHOLDERS

How does the market assess the concept – and what is needed to scale?

Then: an update on the regulatory framework 2026, the conditions for commercial operation, recommendations and a summary – followed by questions and discussion.

CONTEXT

Sail Cargo Ships are the decarbonisation pathway with the deepest cuts – but the lowest fit with today's mass market

	Drop-in & transitional fuels LNG, biofuels	Scalable zero-emission fuels e-methanol, e-ammonia, e-fuels	Efficiency & wind-assist rotor / wing sails, slow steaming	Primary wind propulsion Sail Cargo Ships
CO_2 reduction potential	●●○○	●●●●	●●○○	●●●●
Fit with today's fleet & mass market	●●●○	●●○○	●●●●	●○○○
Independence from new energy infrastructure	●●●○	●○○○	●●●●	●●●●
Availability today	●●●●	●○○○	●●●●	●●○○
Key points	• Available now, fits existing fleet • Limited, uncertain CO_2 benefit • A bridge, not an end state	• Near climate-neutral if renewable • Costly, scarce, no bunkering yet • Chicken-and-egg with fleets	• Quick to retrofit today's fleet • ~5–20% fuel saving only • Complements all pathways	• −70 to −95% CO_2 in operation • Independent of new fuels • Needs own logistics & niches

Qualitative assessment (4 dots = most favourable) based on the study's market analysis. Source: MOVE4WARD, 2026.

STUDY APPROACH

The study looked at Sail Cargo Ships from four angles – market, economics, emissions and stakeholders

Desk research, a cost and revenue model, an emissions calculation and interviews with 15 organisations were combined into one integrated assessment.

DEFINITION USED

Sail Cargo Ship

Wind is the **primary** propulsion (≈70–95% of propulsive power); an auxiliary engine covers calms, port manoeuvres and safety reserves.

Not in scope: conventional ships with wind-assisted propulsion (rotor sails, wing sails, kites) saving ~5–20% fuel.

WORK PACKAGE 1

Market analysis

German seaborne trade (Destatis 2024, NST-2007), IWSA vessel list, cargo and customer segmentation

WORK PACKAGE 2

Economic viability

Cost and revenue model, two reference ships (5,000 / 10,000 dwt) vs. conventional general cargo ships, sensitivities

WORK PACKAGE 3

Emissions

Tank-to-wake CO_2, NO_x, SO_x on four reference routes to Germany, three wind-share scenarios

WORK PACKAGE 4

Stakeholders

Interviews with 15 organisations along the value chain, four case studies, 20 published shipper statements

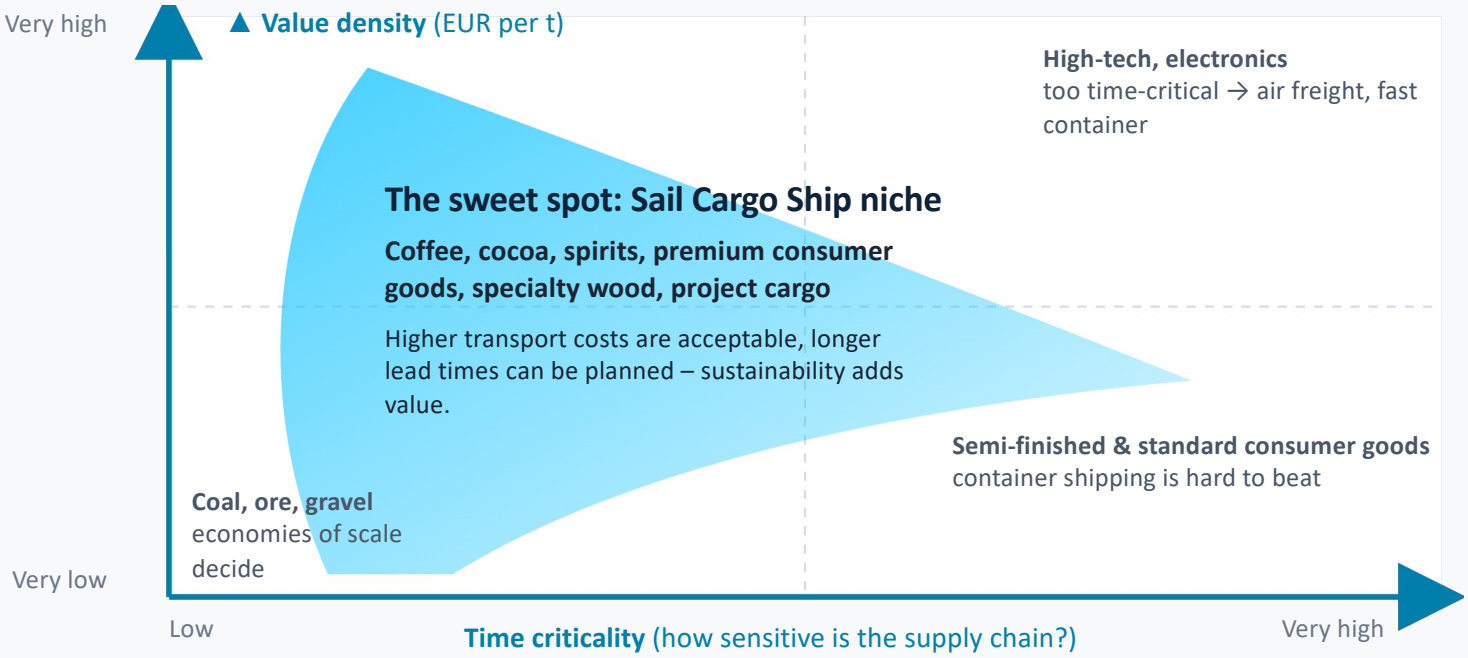
Source: MOVE4WARD potential study “Sail Cargo Ships”, 2026.

Volume is not the game: Sail Cargo Ships target goods with medium-to-high value and low time criticality

274 Mt
seaborne cargo throughput in German ports, 2024

31.8%
share of German foreign trade carried by sea (2019: 27.0%)

35%
handled in Hamburg alone – volume flows reward scale



Source: Destatis (tables 46331-0001, 51000-0001), 2024; MOVE4WARD classification (value density × time sensitivity).

MARKET ANALYSIS

Conventional shipping wins on cost and speed – Sail Cargo Ships win where emissions and brand value count

Dimension	Conventional shipping	Sail Cargo Ships	Edge
Unit costs	Very low – economies of scale	Higher – limited capacity	Conv.
Speed & predictability	High, reliable schedules	Lower, wind-dependent	Conv.
Scalability & networks	Global liner networks, hubs	Few ships, no networks yet	Conv.
System compatibility	Existing fleets, ports, IT	Adapted logistics & planning	Conv.
Emission profile	Reduced, rarely zero	Near-zero in operation (−70 to −95%)	Sail
Energy & fuel dependence	High – incl. new fuels	Very low – wind is free	Sail
Price stability	Exposed to fuel & CO_2 prices	More stable cost base	Sail
Marketing value	Evolution within the system	High – transport as part of the brand	Sail

CONVENTIONAL WINS ON

cost, speed, reliability and network reach – the logic of the mass market

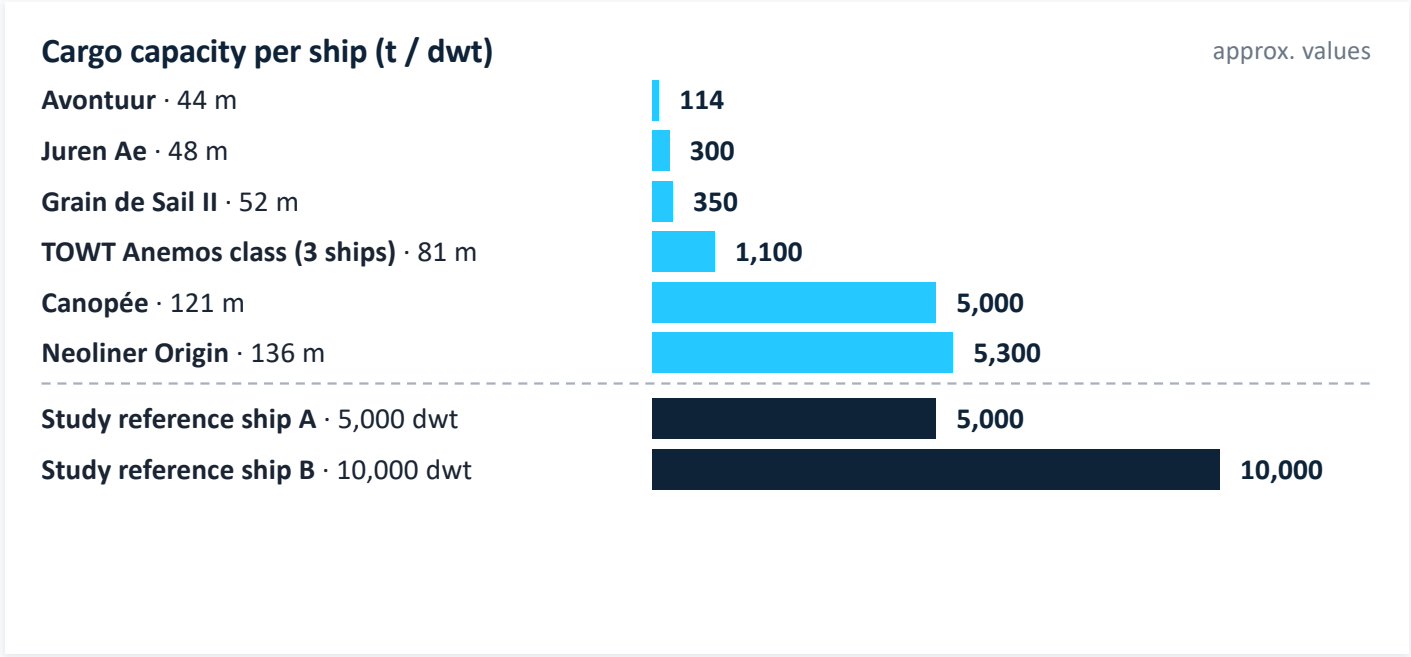
SAIL WINS ON

emissions, energy independence, price stability and brand value – the logic of premium niches

Source: MOVE4WARD study, comparison of Sail Cargo Ships and conventional shipping, 2026.

MARKET ANALYSIS

Primary-wind cargo ships are moving from pilots to first liner services – but the fleet is still small



107 ships

with wind propulsion worldwide (IWSA, Q1 2026) – mostly conventional ships with wind-assist

50–500 t

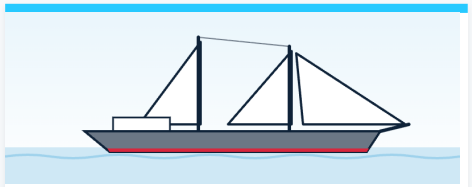
typical shipment per customer – ships sail with mixed cargo

One size class up

The study's reference ships are larger than almost all units in service today

Sources: IWSA Vessel List Q1 2026; operator information (TOWT annual review 2025, Neoline); MOVE4WARD study. Capacities approximate (Neoliner Origin: deadweight figures vary by source).

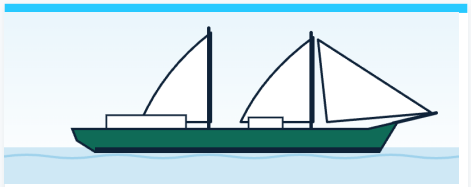
Ship profiles: today’s pioneers range from a 350 t schooner to a 136 m RoRo liner



Grain de Sail II

Grain de Sail (FR)

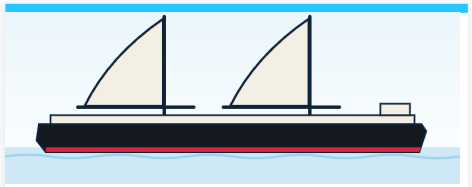
Type	52 m aluminium schooner
Cargo	350 t, climate-controlled holds
Sails	~1,500 m²
Route	St-Malo – New York – Caribbean
In service	since 2024; < EUR 10 m



Anemos · Artemis · Atlantis

TOWT (FR)

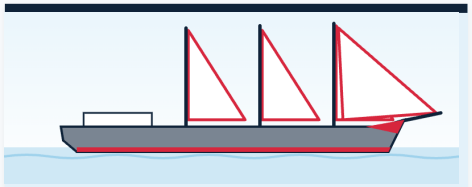
Type	81 m sail cargo ship
Cargo	~1,100 t, palletised
Sails	2,226 m²
Route	Liner Europe – Americas
In service	since 2024; 6 ships by 2027



Neoliner Origin

Neoline (FR)

Type	136 m RoRo
Cargo	1,200 lane m / 265 TEU
Sails	~3,000 m², 66 m masts
Route	St-Nazaire – Baltimore
In service	Oct 2025; 80–90% fuel saving*



Grain de Sail III

planned

Type	~110 m container sail ship
Cargo	~200 TEU
Crossing	Atlantic in ~13 days
Target	2027
Why	container capability

*Operator figures, approximate. Sources: Grain de Sail; Baird Maritime; TOWT; Neoline / Shippax; Maritime Executive; Splash247.

MARKET ANALYSIS

Five customer groups – brand-driven and high-value agricultural shippers show the strongest fit

Brand-driven consumer goods

Sustainability is part of the brand; transport as storytelling

Willingness to pay

High

Fit: **Very high**

High-value agricultural products

Direct / Fair Trade, traceability; coffee, cocoa, wine, spirits

Willingness to pay

Regular use

Fit: **Very high**

Niche & community-driven shippers

D2C brands, cooperatives, crowdfunding; small loads

Willingness to pay

Very high per unit

Fit: **Very high**

Companies with Scope 3 targets

Large brands under reporting pressure; “signature shipments”

Willingness to pay

Premium for pilots

Fit: **Medium–high**

Project cargo & industry

ESG tenders, flexible delivery windows, e.g. wind turbine parts

Willingness to pay

Limited

Fit: **Medium**

Source: MOVE4WARD study, market analysis (customer segmentation), 2026.

MARKET ANALYSIS

Value is created along the whole chain – Sail Cargo Ships need closer cooperation than conventional sea freight

Producers
growers, cooperatives

→

Shippers & exporters
traders, brand owners

→

Forwarders
consolidation, booking

→

Port of loading
handling, storage

→

Sail Cargo Ship operator
vessel, crew, routing

→

Port of discharge
handling, customs

→

Importers & retail
roasters, brands, shops

→

End customers
demand, willingness to pay

Enablers | Investors & financiers | Shipyards & shipowners | Class, certification & insurance | Policy & regulators | Associations & networks | Research & education

Demand side pulls

Brands and importers create the value: storytelling, scope 3 reductions, willingness to pay.

Operators orchestrate

Aggregate many small lots, consolidate cargo, provide verified emission data.

Enablers de-risk

Ports adapt handling, finance prices technology risk, policy rewards real reductions.

Source: MOVE4WARD study, stakeholder mapping, 2026.

Success requires a different business model – shipment-based, corridor-focused and orchestrated along the value chain

Small, fragmented volumes and wind-dependent schedules do not fit the classic liner model – five requirements follow from the market analysis.

1

Shipment-based

Mixed cargo of many shippers instead of full-ship volume contracts

2

Green corridors

Few routes with recurring flows and long-term route partnerships

3

Demand aggregation

Buyer alliances (ZEMBA-type) and anchor customers secure utilisation

4

From pilot to contract

Project contracts first, then multi-year agreements for planning certainty

5

Value beyond transport

Verified emission data for Scope 3, storytelling, book & claim

Implication: the operator's role shifts from **carrier** to **orchestrator** of a network of shippers, forwarders, ports and brands.

Source: MOVE4WARD study, requirements for business and operating models, 2026.

ECONOMIC VIABILITY

Higher CAPEX and fewer round trips are structural disadvantages – daily OPEX is on par, regulatory costs are lower

Reference case assumptions	Sail 5,000 dwt	Sail 10,000 dwt	Conv. 5,000 dwt	Conv. 10,000 dwt
Capital investment (EUR m)	20	40	14	25
OPEX per day (EUR)	6,500	10,500	7,000	11,000
Regulatory costs per day (EUR)	1,300	2,000	3,000	5,000
Round trip incl. port time (days)	28	26	20	20
Round trips per year	13	14	20	20
Capacity utilisation	70%	80%	90%	90%
Freight rate (EUR/t)	110	80	65	60
Green premium	2%	5%	–	–

+43–60%
higher CAPEX for the Sail Cargo Ship

–30%
fewer round trips per year (wind-dependent speed)

+33–70%
higher freight rate needed to compensate

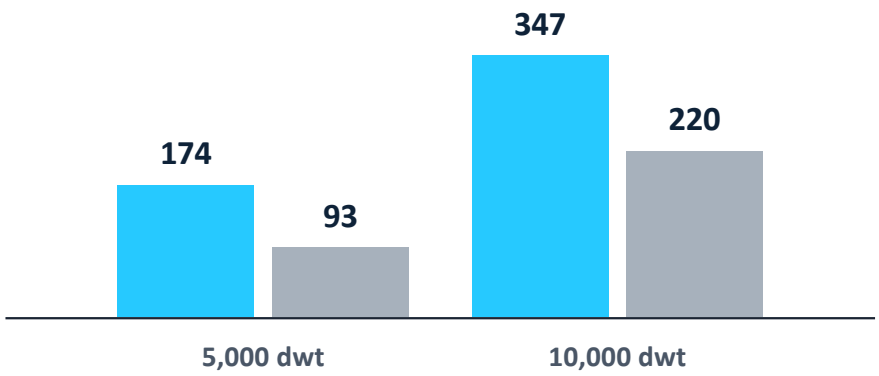
Note: Scenario-based modelling assumptions (industry benchmarks, project information, expert interviews) – not a forecast of market prices. Source: MOVE4WARD study, 2026.

ECONOMIC VIABILITY

Sail Cargo Ships earn more per voyage, but fewer voyages and higher CAPEX leave them behind conventional ships over the year

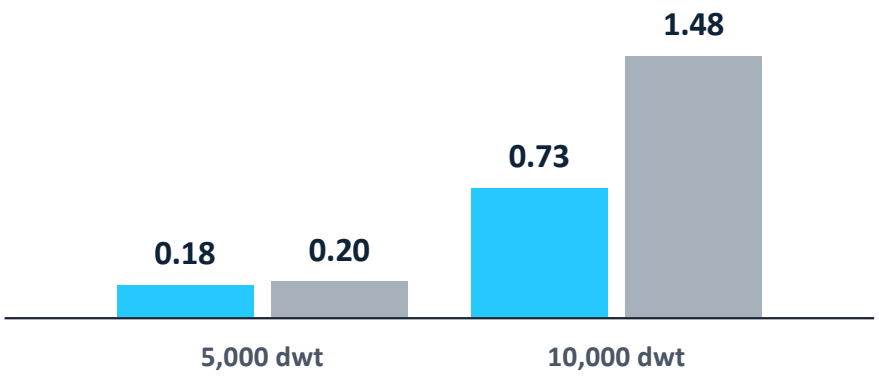
Operating profit per voyage

EUR thousand



Annual result after CAPEX

EUR million



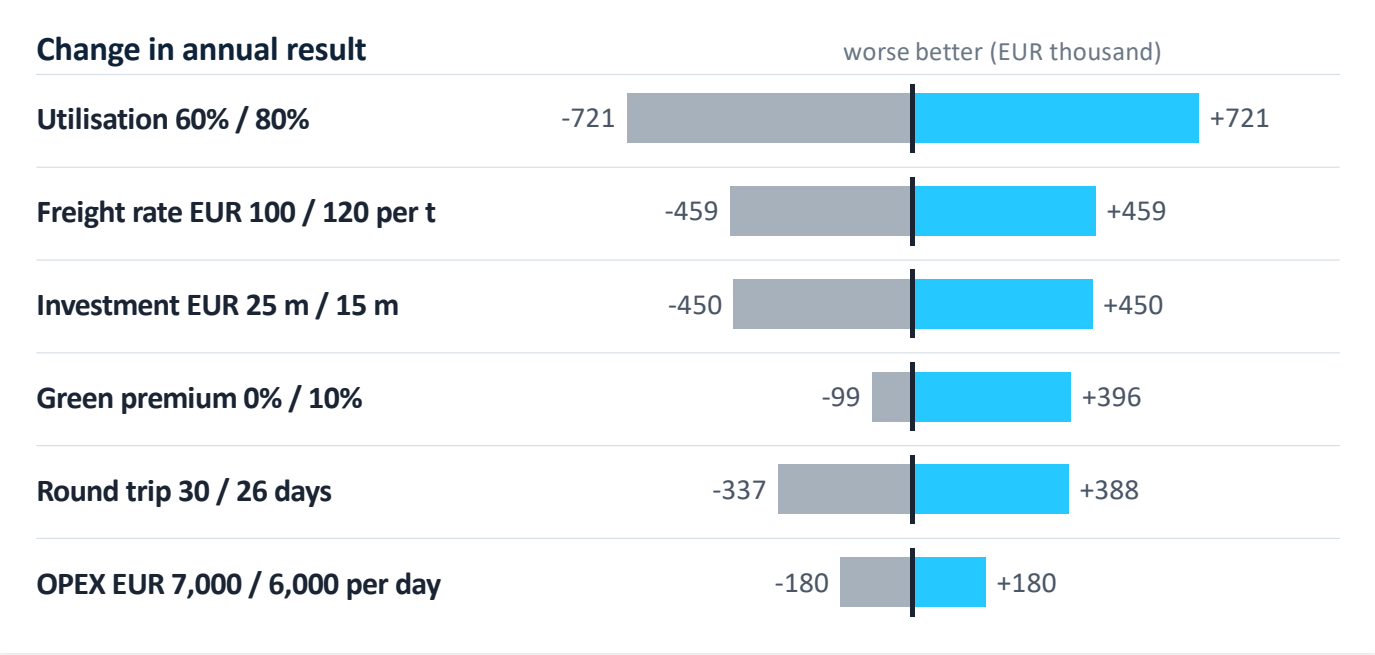
Sail Cargo Ship Conventional general cargo ship

Per voyage the sail ship wins – per year the conventional ship wins.

Annual result after downtime/opportunity costs, CO_2 pricing, depreciation (25 years) and financing (5% sail, 4% conventional). Conventional ships modelled with 20 round trips p.a.
Source: MOVE4WARD study, 2026.

ECONOMIC VIABILITY

Utilisation and freight rate decide – the green premium is a bonus, not the business case



BREAK-EVEN FREIGHT RATE

~EUR 106/t

at 70% utilisation – about EUR 83/t at 90% utilisation

Base case: +EUR 181 k

5,000 dwt Sail Cargo Ship; an OPEX increase of only EUR 500/day almost eliminates the result.

Green premium

2% → 10% adds ~EUR 0.4 m p.a. – helpful, but the freight rate matters more.

Single-parameter variation of the study's reference case (5,000 dwt, 3,500 t per voyage, EUR 110/t, EUR 6,500/day, 28-day round trip). Source: MOVE4WARD calculation, 2026.

ILLUSTRATION

For premium coffee, the sail freight premium is a matter of cents per pack – while transport emissions fall by ~85%

EXAMPLE VOYAGE

Green coffee from Colombia to Germany

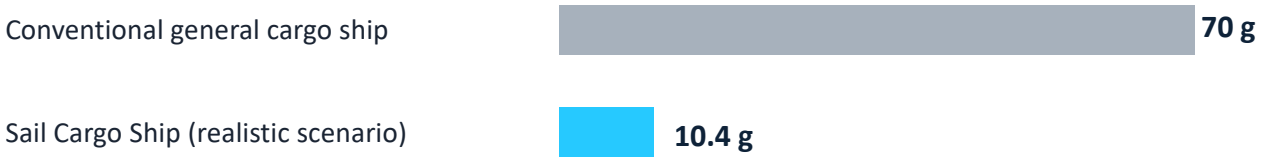
Distance	**~9,000 km**
Cargo per voyage	**4,000 t (5,000 dwt, 80%)**
Freight rate sail	**EUR 110/t**
Freight rate conventional	**EUR 65/t**

+4.5 ct
sea freight premium per kg of green coffee

+3 ct
per 500 g pack of roasted coffee

–59 g
CO_2 per 500 g pack on the sea leg

Sea-leg CO_2 per 500 g pack of roasted coffee



So what: for premium products the freight premium is negligible at shelf level – the real hurdles are consolidating small lots, transit time and quality assurance, not the price per pack.

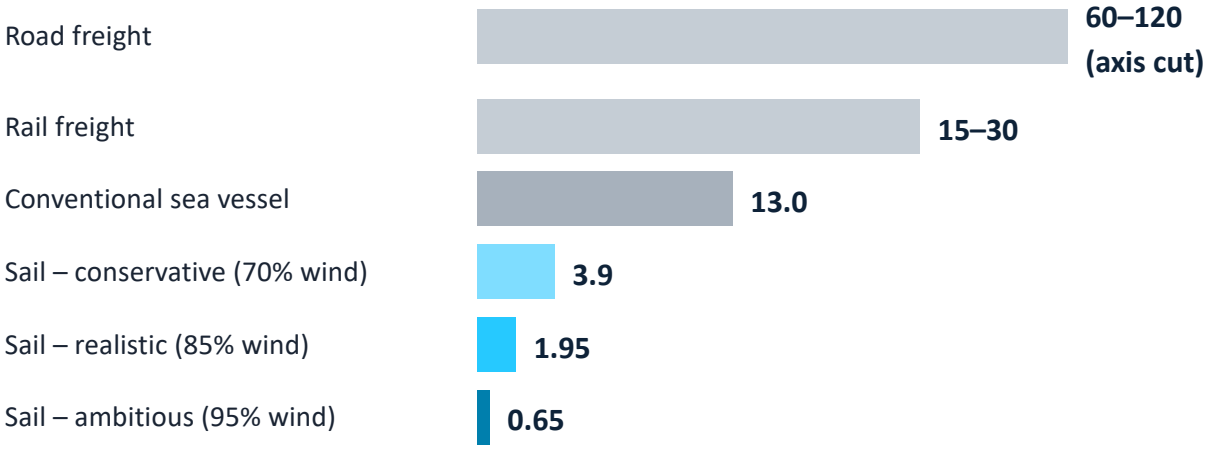
Illustrative calculation, sea leg only (excl. pre-/on-carriage, handling, consolidation). 1 kg roasted ≈ 1.19 kg green coffee; reference ship 13 g CO_2/tkm. Source: MOVE4WARD calculation based on study assumptions.

EMISSIONS

Emissions fall by ~85% in the realistic scenario – far below rail and road per tonne-kilometre

CO_2 intensity by mode of transport

g CO_2 per tonne-kilometre, tank-to-wake



–70%
Conservative · 3.9 g/tkm
70% wind share · 70% utilisation

–85%
Realistic · 1.95 g/tkm
85% wind share · 80% utilisation

–95%
Ambitious · 0.65 g/tkm
95% wind share · 90% utilisation

NO_x and SO_x fall in the same proportion.

Tank-to-wake; reference vessel 13 g CO_2/tkm (NO_x 0.25, SO_x 0.05 g/tkm). Sources: MOVE4WARD study; UBA TREMOD; EEA.

EMISSIONS

On the four reference routes, one voyage saves 256–796 t CO_2 – the longer the route, the larger the benefit



CO_2 saved per voyage (t)

1 Colombia · coffee, cocoa
5,000 dwt — **398**
10,000 dwt — **796**

3 Dominican Rep. · rum, cocoa, coffee
5,000 dwt — **354**
10,000 dwt — **707**

2 Ghana · cocoa, cashews
5,000 dwt — **287**
10,000 dwt — **575**

4 Halifax (CA) · consumer & industrial goods
5,000 dwt — **256**
10,000 dwt — **513**

Realistic scenario (85% wind share, 80% utilisation), tank-to-wake. Map: Natural Earth; route lines schematic. Source: MOVE4WARD study, 2026.

STAKEHOLDER PERSPECTIVE

Stakeholders see a credible niche option – willingness to pay and scale remain the open questions

Niche, not mass market

Limited capacity, longer and less predictable transit times – potential in premium goods, not in container or bulk trades.

Willingness to pay is decisive

Almost all interviewees expect permanently higher transport costs – but few name a premium they would accept.

Wind-assist seen as more scalable

Rotor or wing sails keep economies of scale (owner view: ~15–20% fuel savings on favourable routes).

Pilots yes – scaling is the bottleneck

High openness to pilots; the challenge is turning them into reliable, regularly available services.

CASE STUDY VOICES

Tchibo

7–8k TEU green coffee p.a.; ZEMBA founding member; internal CO_2 pricing – open to sail if a scheduled service exists.

Cooko.co

Premium cocoa: long transits risk quality; needs container capability and stable conditions.

Sport-Thieme

~200 TEU p.a.; biggest climate lever is the product, not transport; EmpCo limits green claims.

F. Laeisz

As tonnage provider, fuel costs sit with the charterer – a split incentive for wind technology.

Interviews with 15 organisations, March–July 2026, plus analysis of 20 published shipper statements. Source: MOVE4WARD study, 2026.

STAKEHOLDER PERSPECTIVE

Interviews in detail: interest is genuine, but economics, operations and regulation still set tight limits

Market potential

- Seen as a niche for high-value goods with low time sensitivity – not for container or bulk mass markets
- Companies close to end consumers are more open – if customers recognise the benefit and pay for it

Economics

- Almost all expect permanently higher transport costs; few name an acceptable premium
- Investments only pay off with secured, multi-year cargo flows – integrated logistics contracts make entry hard

Operations

- Predictable arrival times are critical; weather routing and hybrid propulsion reduce uncertainty
- Rigs can complicate container handling; product quality (temperature, humidity) must be safeguarded

Regulation

- Broad scaling only with stronger incentives: CO_2 pricing, funding, verified accounting
- Open IMO decisions delay investment; EU green-claims rules limit marketing

EARLY ADOPTERS · 20 COMPANIES

Coffee

Café William, Origin Coffee, Yallah Coffee, Shipped by Sail, Belco, Expocacer, Café d'Oriant, WAY Gent

Wine & spirits

Xisto Wines, Ethic Drinks, Longueteau, Drappier, Boisson Delame, Hennessy

Cocoa & food

Chocolarder, Cémoi, New Dawn Traders, Molienda Real

Industry

Manitou Group, Michelin

Mostly brands that make sail transport part of their product story

Source: MOVE4WARD stakeholder interviews (15 organisations, March–July 2026) and secondary research of published company statements.

FRAMEWORK UPDATE 2026

Regulation is tightening – but thresholds and open IMO decisions limit today's advantage for smaller Sail Cargo Ships

EU ETS (maritime)

100% surrender from 2026 – but only 50% of emissions on voyages to/from non-EU ports and only ships ≥5,000 GT; many 5,000 dwt ships fall below (extension under discussion).

FuelEU Maritime

GHG-intensity limits from −2% (2025) to −6% (2030) and −80% (2050); wind reward factor and pooling let operators monetise surplus.

IMO Net-Zero Framework

Adoption adjourned in Oct 2025; decision expected at an extraordinary MEPC session in Dec 2026 – global carbon price still open.

EU Empowering Consumers Directive

Stricter rules on green claims: savings must be verifiable – accounting to ISO 14083 / GLEC becomes part of the product.

Implication: for larger ships, carbon pricing already monetises part of the advantage – for small ships, demand depends on **voluntary Scope 3 budgets** and **credible emission data**.

Sources: European Commission / EMSA (EU ETS maritime); Regulation (EU) 2023/1805 (FuelEU Maritime); IMO MEPC; Directive (EU) 2024/825. Status: November 2026.

SYNTHESIS

Four conditions must hold for commercial operation – today they are met only in niche markets

Condition	What has to be true	Status today	Assessment
Premium freight rate	≥ ~EUR 106/t at 70% utilisation, ideally plus green premium	Met in premium niches; willingness to pay rarely quantified	Partly met
High, stable utilisation	≥ 80% with recurring cargo flows	Requires demand aggregation and anchor customers	Open
Rising carbon costs for conventional ships	Carbon pricing that reaches the relevant routes and ship sizes	ETS fully phased in; IMO price signal pending	Improving
Lower CAPEX for next generations	EUR −5 m investment ≈ EUR +0.45 m result p.a.	Series building and standardisation have started	Improving

SYNTHESIS

SWOT: a strong environmental case meets structural economic and operational limits

Strengths

- Very low CO_2 emissions – wind as main energy source
- Low dependence on fossil fuels and fuel prices
- Strong sustainability and marketing value for premium goods
- Supports Scope 3 targets and ESG strategies
- Technically proven with modern ship concepts

Weaknesses

- Limited capacity compared with conventional ships
- Longer, weather-dependent transit times
- Higher transport costs than mass transport
- Limited integration into container logistics and ports
- Little operational experience, few ships available

Opportunities

- Rising regulatory pressure (EU ETS, FuelEU, IMO)
- Scope 3 and CSRD reporting raise demand
- Green premiums, long-term partnerships, buyer alliances
- Pilot projects build trust and experience
- Funding programmes; rising energy prices

Threats

- Weak or delayed regulation reduces willingness to pay
- Faster progress of other pathways (e-fuels, wind-assist)
- Lack of critical volumes hinders viability and scale
- Financing risk and uncertain returns
- Scale advantages of large container ships remain

Source: MOVE4WARD study, SWOT analysis (market, economics, emissions, stakeholders), 2026.

RECOMMENDATIONS

Each stakeholder group can help move Sail Cargo Ships from pilots to regular services

Moving from pilots to scheduled services requires coordinated steps – no single actor can carry the market ramp-up alone.

Operators

- Focus on niche segments and a few wind-favourable corridors
- Secure long-term partnerships with shippers
- Use weather routing to improve schedule reliability
- Provide verified emission data for Scope 3

Shippers & cargo owners

- Start with pilot shipments of selected product lines
- Integrate savings into ESG / Scope 3 reporting
- Pool demand in buyer alliances
- Conclude multi-year agreements once proven

Policy & institutions

- Reward real emission reductions, technology-neutral
- Fund demonstration and scale-up projects
- Adapt port and cargo-handling infrastructure
- Standardise emission accounting and certification

Source: MOVE4WARD study, stakeholder-specific recommendations, 2026.

SUMMARY

Summary: Sail Cargo Ships cut emissions by ~85% – but today they pay off only in premium niches

Market	Volume is not the game: German seaborne trade (274 Mt) is dominated by bulk and energy. The sweet spot is **medium value density and low time sensitivity** – coffee, cocoa, spirits, premium consumer goods, project cargo – in shipments of 50–500 t.
Economics	CAPEX is 40–60% higher and ships complete only 13–14 instead of 18–20 round trips p.a. Break-even requires **~EUR 106/t** (5,000 dwt, 70% utilisation) vs. EUR 60–65/t in conventional general cargo. Green premiums help, but are not the driver.
Emissions	CO_2 intensity falls from 13 to ~2 g/tkm – **about –85%** in the realistic scenario (tank-to-wake); 256–796 t CO_2 saved per voyage on the reference routes.
Market voice	High interest, low commitment: **willingness to pay is decisive but rarely quantified**; wind-assisted propulsion is seen as more scalable than primary wind ships.
Outlook	A **complement, not a replacement**. Scaling depends on carbon pricing, demand aggregation and the step from pilots to reliable scheduled services.

OUTLOOK

Great potential – but (not yet) a solution for the mass market. What it takes to move beyond the niche:

Bundled demand

Buyer alliances, anchor customers and green corridors that secure utilisation

Next-generation ships

Series building, lower CAPEX, container capability and reliable schedules

Regulatory pull

Carbon pricing that reaches all routes and sizes, plus verified emission accounting

Questions and discussion

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THANK YOU FOR YOUR ATTENTION

Let’s talk about Sail Cargo Ships

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MOVE4WARD

BACKUP

Reference cases in detail

EUR	Sail 5,000 dwt	Sail 10,000 dwt	Conv. 5,000 dwt	Conv. 10,000 dwt
Cargo volume per voyage (t)	3,500	8,000	4,500	9,000
Total revenue per voyage	392,700	672,000	292,500	540,000
Total costs per voyage (OPEX + regulatory)	218,400	325,000	200,000	320,000
Operating profit per voyage	174,300	347,000	92,500	220,000
Round trips per year	12.9	13.8	20	20
Annual operating profit	2,241,000	4,804,615	1,850,000	4,400,000
Downtime and opportunity costs	−60,000	−75,000	−30,000	−50,000
CO_2 pricing	−200,000	−400,000	−500,000	−875,000
Depreciation and financing (CAPEX-related)	−1,800,000	−3,600,000	−1,120,000	−2,000,000
Annual result after CAPEX	181,000	729,615	200,000	1,475,000

Source: MOVE4WARD study, reference cases A and B, 2026.

BACKUP

Methodology and sources

Method notes

- Costs and revenues are scenario-based modelling assumptions, not price forecasts
- Emissions: tank-to-wake, functional unit g/tkm; wind share applied as fuel saving (upper bound)
- Reference routes: Colombia, Ghana, Dominican Republic, Halifax – Germany
- Interviews adapted to each stakeholder group; confidential data not disclosed

Key sources

- Destatis (2025): Seeverkehr – Güterumschlag 2024, tables 46331-0001, 51000-0001/-0012
- International Windship Association (2026): Wind Propulsion Vessel List, Q1 2026
- Lloyd's Register (2024): Applying wind-assisted propulsion to ships
- UBA (2025): TREMOD 2024; EEA (2023): EMEP/EEA Guidebook – Navigation; GLEC Framework / ISO 14083
- European Commission / EMSA: EU ETS maritime; Regulation (EU) 2023/1805 (FuelEU Maritime); Directive (EU) 2024/825
- IMO MEPC: Net-Zero Framework (approved MEPC 83, adoption adjourned Oct 2025)
- Operator information: TOWT annual performance review 2025; Neoline (Neoliner Origin)
- Stakeholder interviews with 15 organisations, March–July 2026