

Maritime Summary Note n°272 – June 2025

« Wind propulsion : where are we now ? »

Today, the maritime merchant shipping industry disposes of access to a vast spectrum of wind propulsion systems, delivering an immense diversity in terms of technical architectures, physical scales, and innovative design solutions (encompassing tilting, retractable, and foldable installations, alongside containerized solutions). This wide array of engineering options unlocks highly customized, tailor-made choices perfectly adapted to the specific characteristics and operational requirements of diverse vessels, whether for newbuild programs (construction neuve) or shipboard retrofits, the latter representing a significantly larger market volume.

MRE wind-assisted solutions currently equip all fleet segments, scaling from giant crude tankers (Socatra), iron ore VLOC carriers (Vale), and chemical tankers (Chemical Challenger), down to Ro-Ro vessels (Neoline, Louis Dreyfus Armateurs, Jifmar), passenger ferries (Scandlines), and multi-purpose ships (TOWT, Grain de Sill), without omitting luxury cruise vessels (Orient Express, Ponant). Henceforth, the symbolic threshold of 100 commercial merchant vessels in active service and on the order books equipped with one of the multiple systems competing on the marketplace has been crossed. Wind propulsion, operating as a cross-disciplinary fruit of aerospace engineering, naval architecture, yacht yachting industries, and digital automation, is officially crossing the threshold into the era of its mass industrialization.

The Macroeconomics of the Wind-Assisted Propulsion Market

When executing the strategic decision to harvest wind energy onboard a vessel, two distinct technical pathways face the shipowner: either retrofitting an existing fleet asset or engineering a brand-new vessel from scratch. In a retrofit framework, the achieved energy efficiency hovers in the range of a 5% to 20% reduction in fuel consumption. Conversely, in a newbuild program specifically optimized to deploy wind as the primary means of propulsion, fuel and greenhouse gas reductions can surpass 50%. The core operational variables determining these trade-offs are notably the physical dimensions and the service speed of the ship.

Pursuant to the latest BRS (Barry Rogliano Salles) annual shipping market report published in 2025, the deployment of wind-assisted propulsion systems has experienced a continuous growth curve since 2019. The international shipbroker structurally categorizes these technologies under the banner of WAPS (Wind-Assisted Propulsion Systems), which command 99% of the currently installed global marketplace, isolating three main typologies:

Sails and Wings : Disposing of diverse structural profiles, thin-section profiles using soft fabrics or rigid paneled sails, or thick-section profiles deploying symmetrical/asymmetrical architectures or multi-element configurations. These can be engineered as inflatable, soft, semi-rigid, or rigid systems.

Rotors / Flettner Rotors : Composed of a vertical metallic cylinder set into active rotation by an internal electric motor. This mechanical rotation enables the cylinder to generate aerodynamic thrust via the Magnus effect. Modern rotors can be retrofitted with tilting systems (*systèmes de bascule*) to dynamically reduce the ship's air draft in port or beneath bridges.

Suction Wings / Suction Profiles: Structured as a vertical, cylindrical metallic wing equipped with an internal boundary-layer suction slot grid and a mechanical flap designed to optimize the system's aerodynamic lift.

These three dominant technologies are rigidly installed as deck-mounted cargo assets (*en pontée*), conversely to **kites**, which operate as fully aerial systems. Kites remain currently confined to an experimental development phase and equip zero commercial merchant vessels on a permanent operational basis. French pioneer Beyond The Sea's kites are undergoing intensive sea trials onboard

two active merchant ships, with a third deployment pending: a product tanker (*Forbin* chartered by *Geogas*), a heavy salvage tug (*Jason* operated by *Les Abeilles*), and a chemical tanker (*UltrNAV*).

Industrial Mapping of WAPS Equipment Manufacturers

Regarding the utilization of conventional sails and wings (aggregating all technologies excluding rotors and suction profiles), BRS identifies 10 active vessels equipped, clustered predominantly on Ro-Ro cargo ships and dry bulk carriers. The equipment manufacturers (OEMs) are overwhelmingly European-based utilities, led by British firms BAR Technologies (*WindWings*) and Smart Green Shipping (*FastRig*), the Swedish consortium Oceanbird (a high-profile joint venture binding *Alfa Laval* and *Wallenius*), and Italian developers *Noas* and *Concrane*.

Within the French industrial landscape, Michelin's Wisamo wing was tested onboard the Ro-Ro *MN Pélican* (operated by *Compagnie Maritime Nantaise*) and is slated for installation on the French Maritime Affairs' next-generation patrol vessel, while Ayro's Oceanwings successfully equipped the heavy-lift spaceship component carrier *Canopée* (Zéphyr & Borée / Jifmar) in 2022 to transport Ariane 6 rocket stages across the Atlantic. On the Asian range, a major Japanese presence is anchored by ocean carrier MOL (Mitsui O.S.K. Lines), which deploys its proprietary telescopic wing technology, *Wind Challenger*, onboard three brand-new delivery vessels.

For suction profiles, 15 commercial vessels are currently active in service worldwide, with two primary European equipment manufacturers carving up the marketplace. The Dutch company Econowind dominates the volume range with 12 equipped vessels, notably including the container vessel *Marfret Niolon* (operated by *Marfret*), while the Spanish pioneer Bound4Blue claims 3 equipped vessels, led by the chart-topping vehicle carrier *Ville de Bordeaux* (leased by Louis Dreyfus Armateurs).

Finally, Flettner rotor technology has captured a slight market advantage over alternative WAPS solutions by virtue of its historical longevity and prior commercial rollout. 22 merchant vessels are equipped with rotors as of 2025 (spanning general cargo ships, dry bulkers, product tankers, ro-ros, and ro-pax ferries). The undisputed global market leader is the Finnish utility Norsepower with 14 equipped vessels, notably powering the product tanker *Alcyon* operated by France's Socatra. The secondary OEM is the British firm Anemoi Marine Technologies with 3 vessels, alongside Germany's *Eco Flettner* (1 vessel). Lastly, the Asian range records the entry of three emerging Chinese equipment manufacturers: *Dealfeng* (2 vessels), *Yard* (1 vessel), and *Chinese* (1 vessel).

Wind as the Primary Means of Propulsion: The French Trailblazers

In the domain of primary wind propulsion, French companies—capitalizing on a rich historical heritage tied to ocean racing and high-performance yachting—powerfully distinguish themselves. Several shipping lines are already operating active vessels, including TOWT (TransOceanic Wind Transport), Grain de Sail, and Ponant, while others manage heavy order books and ongoing construction pipelines, namely Neoline, Vela, Windcoop, and Hisséo. While the initial wave of blueprints strictly targeted transoceanic trade lanes to extract the maximum wind energy through predictive meteorological routing, greenfield initiatives such as Le Caboteur des Îles are henceforth exploring short-sea cabotage architectures.

The specialized roll-on/roll-off cargo vessel Neoliner Origin, operated by Neoline, entered active commercial service in the summer of 2025. Propelled predominantly by wind energy, paired with an auxiliary diesel-electric power plant, it connects Saint-Nazaire (mainland France) to Saint Pierre and Miquelon on a monthly scheduled liner rotation, before expanding its leg down the US East Coast to call at Baltimore and Halifax (Canada). Deployed at a commercial transit speed of 11 knots, the primary operational objective secures an extreme 80% reduction in fuel consumption compared to a conventional merchant ship.

Concurrently, Grain de Sail—originally a coffee-roaster and chocolate manufacturer—launched its transatlantic commercial shipping line in 2020 with its pioneer cargo sailboat, Grain de Sail I. This was followed in 2024 by the larger-capacity Grain de Sail II (scaling up payload export from 50 to 350 tonnes). Moving along this expansion path, the company projects to commission Grain de Sail III by the 2027 timeline, engineering a cargo vessel commanding a 2,800-tonne payload capacity, propelled by 4,000 square meters of SolidSail canvas distributed across a three-masted rig, tailored to bridge the Atlantic in a brief thirteen-day transit.

Meanwhile, the company Vela is advancing the construction of a 100% wind-powered cargo trimaran, engineered to execute transatlantic crossings in fifteen days, scheduling twelve annual roundtrips per vessel, with full commercial commissioning targeted for mid-2026. This pioneer vessel will be

supplemented by a sister fleet of four supplementary trimarans to be delivered between 2027 and 2028, unlocking a high-frequency weekly departure matrix.

The technical gréements remain structurally close to traditional sails, yet incorporate ultra-reinforced advanced materials and a highly pushed automation system. The first steel-cutting ceremony (la découpe de la première tôle) is scheduled for January 2026. To optimize the trimaran's design, the shipbuilder's Australian engineering teams corporate-partnered with MerConcept—the elite ocean racing stable established in Concarneau by legendary skipper François Gabart, who actively participated in the creation of Vela. A massive proportion of the catamaran's hardware and equipment assets will be designed and built in France, where the regional ocean racing supply chain is adapting rapidly to feed this greenfield industrial adventure.

Concurrently, the French carrier TOWT already operates two active wind-powered vessels and masterminds the construction of six supplementary sister ships by 2027 at the Piriou shipyards, deploying them along transatlantic liner routes out of Le Havre. Notably, twelve passengers can legally step on board to share the voyage, an alternative transport option identically delivered by the Neoliner Origin.

Within the passenger and cruise sector, the eco-positioning is structuring around the luxury Orient Express shipping line—a subsidiary of the Accor Group—which is building two cruise liners equipped with the SolidSail rigid wing system engineered by Chantiers de l'Atlantique. This segment concurrently features the entry of Selar and the historical expertise of Ponant, which is actively developing its breakthrough carbon-neutral Swap2zero project. On short-sea coastal transit ranges, smaller-scale boutique vessels operated by Sailcoop or Iliens secure eco-transport services to offshore islands. On the international stage, primary wind propulsion initiatives are spearheaded by the OceanBird consortium and Veer Corporation's concept ship Mamba, a 160-TEU wind-powered cellular container ship.

High-Tech Innovations and Predictive Meteorological Routing

The wind propulsion sector relies on a highly resilient, innovative ecosystem of Tier 1 equipment manufacturers, while greenfield start-ups continuously emerge. The latest newcomer in France, the Brittany-based start-up Cormoran, engineered a breakthrough concept utilizing rigid solar wings to concurrently propel commercial vessels and generate shipboard electricity.

Capable of producing over 15 kW under direct sunlight, these automated solar wings are fully mobile: they can automatically pivot based on real-time wind shear, or fold down to a horizontal position when the vessel is berthed in port, anchored at a roadstead, exposed to extreme gale-force winds, or undergoing heavy maintenance operations.

In parallel with wind hardware technologies, predictive meteorological routing (le routage météorologique)—a direct technological heritage derived from elite offshore racing—operates as an indispensable tool to optimize global maritime routes. Paired with real-time digital modeling tracking the vessel's hydro-kinetic performance under sail, these algorithmic systems assist the Master in dynamically selecting the optimal track to maximize wind capture, while strictly factoring in commercial operational constraints (such as strict transit time matrices).

On board, advanced automated control and surveillance monitoring dashboards optimize the vessel's global energy management. High-tech companies such as D-ICE Engineering, Syroco, Marine Weather Intelligence, MaxSea, and Zelin powerfully contribute to accelerating these predictive performance metrics. According to routing experts, deploying these digital solutions can slash fuel consumption and associated GHG emissions by up to 15%, comprehensively regardless of whether the vessel utilizes wind-assisted propulsion or operates a conventional engine.

Scaling Up and Industrializing the Manufacturing Supply Chain

As wind-assisted and primary wind propulsions establish themselves among the most critical, immediately available options to drive maritime decarbonization and unlock massive bunker savings, mass industrialization of equipment manufacturing becomes a mandatory prerequisite to satisfy surging market demand. Concurrently, transitioning to serial equipment manufacturing operates as a sine qua non condition to democratize these systems, whose initial prototype series remain capital-intensive to procure. In France, three pioneer dedicated factories have entered full operational service to manufacture and assemble the massive structural elements composing these next-generation sails:

- The SolidSail Mast Factory in Lanester: engineered to build the monumental 75-meter-high carbon masts for the SolidSail system developed by Chantiers de l'Atlantique.

- The OceanWings Factory in Caen: dedicated to the serially manufacturing of automated 33-meter-high by 11-meter-wide vertical wings.
- The CWS (Computed Wing Sails) Factory in Montoir-de-Bretagne (Saint-Nazaire): optimized for the heavy structural assembly of the Airfin 350, a high-performance rigid wing standing 40 meters high with a 10-meter wingspan.

The contemporary mandates of industrial re-shoring (réindustrialisation) and economic sovereignty heavily reinforce the strategic necessity to support the immense opportunity represented by this emerging sector, where Europe and France are positioned as undisputed global leaders.

Moving along this path, a landmark "Wind Propulsion Pact" (Pacte vélique) was officially signed in March 2024 by the French Government and industrial stakeholders to secure the regulatory and financial conditions required to scale up the French wind shipping sector. While these commitments remain highly structural, they are increasingly deemed insufficient to comprehensively sustain the sector amid tightening national budgetary constraints.

Ethic-driven Shipowning Models and Citizen-backed Governance

Technological innovation can identically manifest through greenfield corporate structures, blending environmental ethics with purpose-built cargo vessels that strictly prioritize wind energy capture. This model relies on the deep commitment of civil society, materialized by the engineering of a Collective Interest Cooperative Society, funded in substantial part by individual citizens who step in as shared member-shareholders (*sociétaires*) of the shipping line, a model epitomized by the French carrier Windcoop.

The total capital successfully collected from citizen investors reached €6.8 million, backing a cumulative newbuild shipyard contract estimated at €28.5 million. The project masterminds the commercial deployment by the mid-2027 timeline of a 91-meter-long wind-powered cellular container ship, flying the French International Register flag, and commanding a payload capacity of 210 TEUs. The vessel will be constructed by the Turkish shipyard RMK Marine in Tuzla, and equipped with three automated asymmetric rigid wings spanning 1,050 square meters designed and manufactured by CWS.

Operationally, *Windcoop* will pioneer the very first direct regular liner service interconnecting mainland France and Madagascar, calling at three Madagascan gateways that currently suffer from the volatile and slow rhythms of secondary feeder transshipments. The vessel will also offer six double passenger cabins on board. The targeted operational objective secures a 60% CO2 emissions reduction at a commercial transit speed of 9 knots.

Global Environmental Regulations and the OMI Decarbonization Roadmap

To force this transition, the International Maritime Organization (IMO — *OMI*) has locked in an aggressive statutory framework specifically designed to slash greenhouse gas (GHG) emissions from international shipping. In 2023, this global strategy was extensively revised by the Marine Environment Protection Committee during its MEPC 80 session, enforcing significantly more stringent checkpoint targets: including an absolute GHG reduction of at least 20% by 2030, and 70% by 2040, to seamlessly lock in full net-zero carbon neutrality by the 2050 timeline.

To systematically drive down fleet emissions, the IMO implemented a binding matrix of technical and operational efficiency indicators:

The Energy Efficiency Design Index (EEDI): a mandatory mechanism regulating the energy efficiency parameters of greenfield newbuild vessels.

The Energy Efficiency Existing Ship Index (EEXI): a technical benchmark regulating the carbon footprint of the legacy active global merchant fleet.

The Carbon Intensity Indicator (CII): a rolling operational ranking scoring vessels¹ from A to E based on their actual real-time carbon intensity per transport work.

Surgically moving along this path, in 2021, official IMO guidelines formally integrated wind-assisted propulsion benefits directly into the mathematical calculations of the EEDI. While wind solutions were historically treated exclusively as a secondary energy efficiency technology, wind energy has henceforth been permanently embedded within the statutory guidelines regulating the comprehensive Life-Cycle Assessment (LCA) of alternative marine fuels.

¹ Read The Maritime Summary Note 251 May 2023.

Furthermore, during the latest high-level MEPC sessions hosted at the IMO, 147 sovereign States formally committed to a binding path toward net-zero emissions by 2050, anchoring this trajectory onto a dual regulatory mechanism:

The Global Fuel Standard (GFS): a universal fuel standard heavily modeled on the European Union's *FuelEU Maritime* regulation, based on locking in progressive, mandatory reductions in the greenhouse gas intensity of marine energy, thereby legally forcing the systematic incorporation of alternative low-carbon fuels and renewable wind propulsions.

A Global Carbon Levy: a binding market-based carbon pricing mechanism engineered to permanently bridge the competitive price gap separating expensive zero-emission energies from cheap legacy fossil fuels, while generating massive international revenues whose precise volumetric scales and sovereign regional allocation frameworks remain under active multilateral diplomacy.

This mandates international vessels exceeding 5,000 gross register tonnage (GRT / *TJB*). The draft agreement, whose explicit guidelines must still clarify numerous technical parameters, was formally adopted in October 2025 by the IMO Assembly. Subsequently, during the MEPC 84 session in the spring of 2026, the formal enforcement guidelines were officially approved. Full entry into legal force is scheduled for 2027, exactly 16 months post-adoption. The path forward remains long and arduous.

At the European tier, statutory lines of action target achieving absolute carbon neutrality by 2050, falling within the scope of the European Green Deal. The "Fit for 55" Legislative Package (, enacted to secure this target, locks in legally binding measures mandatory for all Member States, explicitly encompassing the extension of the EU Emissions Trading System (EU ETS — *UE-SEQE*) to maritime transport since January 1, 2024.

This carbon pricing architecture strictly targets commercial vessels exceeding 5,000 gross tonnage (GT), comprehensively regardless of their flag State, calling at EU port gateways. Ocean carriers are statutorily mandated to surrender a calculated proportion of their verified greenhouse gas (GHG) allowances: scaling from 40% of their verified emissions in 2024, to 70% in 2025, and hitting 100% in 2026.

The public revenues extracted from the EU ETS directly fund the European Innovation Fund, which has already financially backed over 300 industrial projects (channeled through competitive calls for projects²) linked to maritime transport decarbonization, while concurrently aiming to reinforce the global competitiveness of the European industry. This targeted financial allocation is engineered to benefit energy-intensive industries, renewable energy technologies, energy storage solutions, carbon capture, utilization and storage (CCUS), carbon-neutral mobility solutions, and green building engineering.

The Innovation Fund allocates capital grants through competitive calls for proposals, tailored for:

Large-scale projects: commanding capital expenditures (CAPEX) exceeding €100 million.

Medium-scale projects: scaling between €20 million and €100 million.

Small-scale projects: ranging between €2.5 million and €20 million.

The fund's strategic focus centers on the initial piloting phase of the project, its physical demonstration, and its industrial upscaling, but explicitly excludes its commercial market deployment. Pioneering companies such as Bound4blue and Ponant successfully secured capital grants from this fund. Concurrently, the European FuelEU Maritime Regulation aims to structurally incentivize the onboard utilization of renewable, low-carbon marine fuels and clean energy technologies.

This rigid regulatory framework is engineered to eliminate reliance on heavy fuel oil (HFO). By the 2050 timeline, vessels will be legally required to slash the greenhouse gas intensity of onboard energy by 80% compared to the 2020 baseline average reference valuation (91.16 gCO₂/MJ). These reduction targets encompass not only CO₂ emissions, but also methane (CH₄) and nitrous oxide (N₂O) greenhouse gases across the complete fuel lifecycle, evaluated on a comprehensive "Well-to-Wake" (WtW) basis.

. Within this accounting framework, wind-assisted propulsion systems benefit from a dedicated reward factor (*facteur de récompense*).

Historically, however, zero favorable provisions were initially envisioned within the drafting phase. Furthermore, this reward factor is currently judged as highly insufficient to adequately reflect the genuine, real-world energy efficiency achieved by wind-propelled vessels. Indeed, the fuel savings and associated emission mitigation potential derived from harnessing wind energy is estimated to span between 5% and 20% for the existing legacy fleet, and can skyrocket up to 50% for greenfield newbuilds. Nevertheless, formulating and validating offshore wind performance metrics operates as a highly complex, contextual, and multidimensional process (vessel structural characteristics, operational

² In France, during the 2024 calendar year, nine industrial projects were selected as laureates, successfully capturing a cumulative subsidy envelope of approximately €520 million.

typologies, technological variations, and environmental weather conditions). The shipping sector currently suffers from a chronic deficit in standardized validation norms across the industry. Heightened collaborative research remains mandatory to lock in robust, unassailable testing protocols that account for the operational complexity of wind-propelled merchant crafts, enabling data-driven, informed commercial decision-making.

The contemporary reward factor fails to fully mirror these potential benefits, a distortion liable to severely slow down the commercial market adoption and technological engineering of wind propulsion. The statutory incentives currently structured by Brussels disproportionately favor alternative e-fuels rather than zero-emission technologies, concentrating predominantly on liquid or gaseous substitute fuels while neglecting innovative aerodynamic hardware.

While the EU is theoretically bound by a principle of technological neutrality, the EU Taxonomy Regulation completely omits 100% wind-propelled vessels from its strict registry of sustainable investments, preventing pioneering operators from accessing specialized green financing facilities and preferential commercial bank loans.

On a positive note, the European Net Zero Industry Act (NZIA), whose overarching mandate targets manufacturing 40% of the EU's clean tech requirements domestically by 2030, formally inscribes wind propulsion as an innovative and ecological solution for maritime transport. Despite these severe regulatory hurdles, the industrial value chain continues to advance rapidly. Top-tier classification societies—including *Lloyd's Register*, the *American Bureau of Shipping (ABS)*, *Bureau Veritas (BV)*, and *DNV*—have officially published next-generation class rules for wind-assisted propulsion systems, underwriting the structural maturity of this technology.

Concurrently, the European Maritime Safety Agency (EMSA) released a comprehensive technical report confirming that zero safety or stability challenges exist on a wind-assisted vessel that cannot be fully engineered or resolved. Furthermore, the latest EMTER (*European Maritime Transport Environmental Report*) heavily stresses the absolute necessity to rely on wind propulsion to hit the mandatory European decarbonization milestones locked for the 2030–2050 timeline. As time progresses, bunker-saving mandates will become increasingly stringent, highlighting the paramount relevance of utilizing free renewable energies, slashing hardware CAPEX, and selecting optimized, automated wind propulsion architectures.

Specialized Formations, Maritime Training, and French Employment Horizons

Within the funding framework of the France 2030 investment plan and the national “*Compétences et Métiers d'Avenir*” call for expressions of interest, the benchmark CAPVENT diagnostic study estimates that the French wind propulsion sector aggregated over 1,100 direct industrial jobs in 2022, clustered predominantly across coastal regional economies.

The study projects a powerful expansion trajectory: by 2050, the sector could generate between 13,000 and 23,500 highly specialized jobs within the French civil shipbuilding industry (a monumental metric when compared to the 50,000 workers currently composing the nation's entire ship construction workforce), unlocking an annual corporate turnover of €7.7 billion. This audit concurrently highlights an acute, chronic deficit in operational seafaring profiles trained for wind-assisted navigation, triggering an urgent imperative to deploy a completely renewed architecture of academic formations.

To date, France counts approximately 428 educational courses associated with wind and sail techniques. However, these legacy programs fail to deliver the high-level skills upscaling required to satisfy the specific industrial mandates of the commercial wind shipping sector, forcing pioneering shipowners to internalize vocational training pipelines for their proprietary crews.

To bridge this educational gap, the French National Maritime Academy officially launched a specialized 40-hour wind propulsion curriculum in May 2025. This advanced formation targets certifying merchant marine officers in mastering the diverse wind technologies deployed on modern cargo vessels—encompassing automated bridge operations, real-time trim tuning, heavy maintenance workflows, and managing the greenfield operational risks tied to deploying extra-large rigid rigs and giant sails—coupled with advanced maritime meteorological routing to optimize wind energy yields.

Concurrently, the engineering school Centrale Nantes has deployed a high-level academic certificate titled “*Managing Design Engineering for Wind-Propelled Vessels*,” specifically tailored for R&D engineers, industrial design offices, and naval architects. At the vocational tier, out of France's twelve professional maritime high, four have officially integrated a specialized Wind/Sail Option directly within their maritime business and navigation Baccalauréat degree, located in the coastal hubs of Le Guilvinec, Nantes, La Rochelle, and Ciboure.

The core pedagogical goal targets acculturating next-generation seafarers with the absolute fundamentals of commercial sailing ship operations and maritime cargo management, explicitly encompassing the aerodynamic forces weighing on rigid wing masts, specialized subarctic and tropical

marine meteorology, and automated rig repair workflows. This curriculum is systematically supplemented by physical vessel audits, guest lectures driven by pioneering wind shipping lines, and mandatory sea-time cadet training internships. This specialized wind option operates as a magnificent engine of attractiveness and enrollment growth for regional maritime academies.

Ultimately, the wind is, and will forever remain, a completely free, universally available, and instantly exploitable source of energy sovereignty and operational resilience for a decarbonized global maritime supply chain. Within an international economic and political landscape defined by increasingly volatile, multi-conflictual horizons, wind propulsion delivers absolute, unassailable certainties for the future of world shipping.

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