Project insights

Fuel demand aggregation

Mærsk Mc-Kinney Møller Center
for Zero Carbon Shipping

01 Introduction

Low-emissions fuels are essential for meeting maritime decarbonization targets and regulatory requirements. Yet, production infrastructure is underdeveloped for many of these fuels, but specifically for e-fuels, limiting fuel availability and creating price uncertainty. Accelerated investment in low-emissions fuel production and distribution is critical to closing this gap.

Producers need bankable offtake agreements to secure funding and financing for fuel production plants. These agreements would enable the supply of low-emissions fuels at the volumes that are required to transform the sector. However, the maritime sector is unaccustomed to such long-term offtake agreements and is a highly fragmented industry, with diverse vessel types, ownership structures, and operating models, which complicate coordinated action and investment. This mismatch creates a stalemate: no investment from offtakers* due to uncertain supply, and no supply because producers lack secured offtake.

Stakeholders must adopt innovative approaches to break this stalemate and enable investment that supports the broader deployment of low-emissions fuels in the mid- to long-term. These approaches could include new contracting models, cross sector partnerships, and policy frameworks that de-risk early investments. The new models and partnerships must at all times operate in full compliance with competition law.

The Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping (MMMCZCS) has explored fuel demand aggregation to understand whether consolidating demand across multiple offtakers can help overcome these challenges faced by fuel producers and maritime end-users. The work is based on previous studies[1] and more than 40 interviews with MMMCZCS partners and other relevant stakeholders across the maritime value chain.

We conceptualized and designed a Fuel Demand Aggregator (FDA), a dedicated independent entity or structure that can facilitate coordination and aggregation of demand across the maritime value chain. The FDA serves as a central interface between fuel producers and maritime stakeholders, helping to unlock early commercial-scale production by providing clearer market signals, reducing investment risk, and enabling long-term offtake agreements. In compliance with competition law, the FDA ensures that competitively sensitive information is not disclosed among participants and limits coordination to what is necessary to aggregate bankable volumes for upstream investment.

This report presents the main findings on the concept of fuel demand aggregation and the concrete FDA structure, outlining the processes and mechanisms designed to enable it. A review of the potential issues around competition law is also highlighted. The report provides an overview of next steps and collaboration avenues for private and public actors in the low-emissions fuels space.

* Offtakers are, in this context, organizations or industries that purchase the low-emissions fuels (e.g., vessel operators), or from other industries (e.g., the fertilizer industry) where the molecules are used in products.

[1] Barriers to Scaling Zero-Emission Fuel Supply in Shipping | World Economic Forum, World Economic Forum, 2023

02
Fuel demand aggregation in the maritime sector

The maritime sector needs reliable access to low-emissions fuels to meet international decarbonization ambitions. Today, the sector's access is limited and complex because the market for low-emissions fuels is immature and lacks liquidity. At the same time, regulations and first-mover strategies are pushing for a faster shift away from fossil fuels.

Current maritime access to low-emissions fuels faces volume-related challenges: small, geographically dispersed volumes that are likely to grow slowly without support. This fragmentation makes it difficult for producers to commit to investment and for the sector to scale up. Funding and financing support are critical to accelerate adoption, a need confirmed through our work on green corridors.[2]

Through our research, we identified fuel demand aggregation as a potential pathway to make low-emissions fuels more accessible for the maritime sector and to reduce obstacles across the value chain.

Aggregation as a pathway to maritime decarbonization

Aggregating fuel demand means pooling fragmented volumes from multiple offtakers until a producer's minimum volume threshold ("anchor volume") is reached. This unlocks viable and cost-effective fuel production and enables the maritime sector to transition collectively during the early years of low liquidity in the low-emissions fuels market.

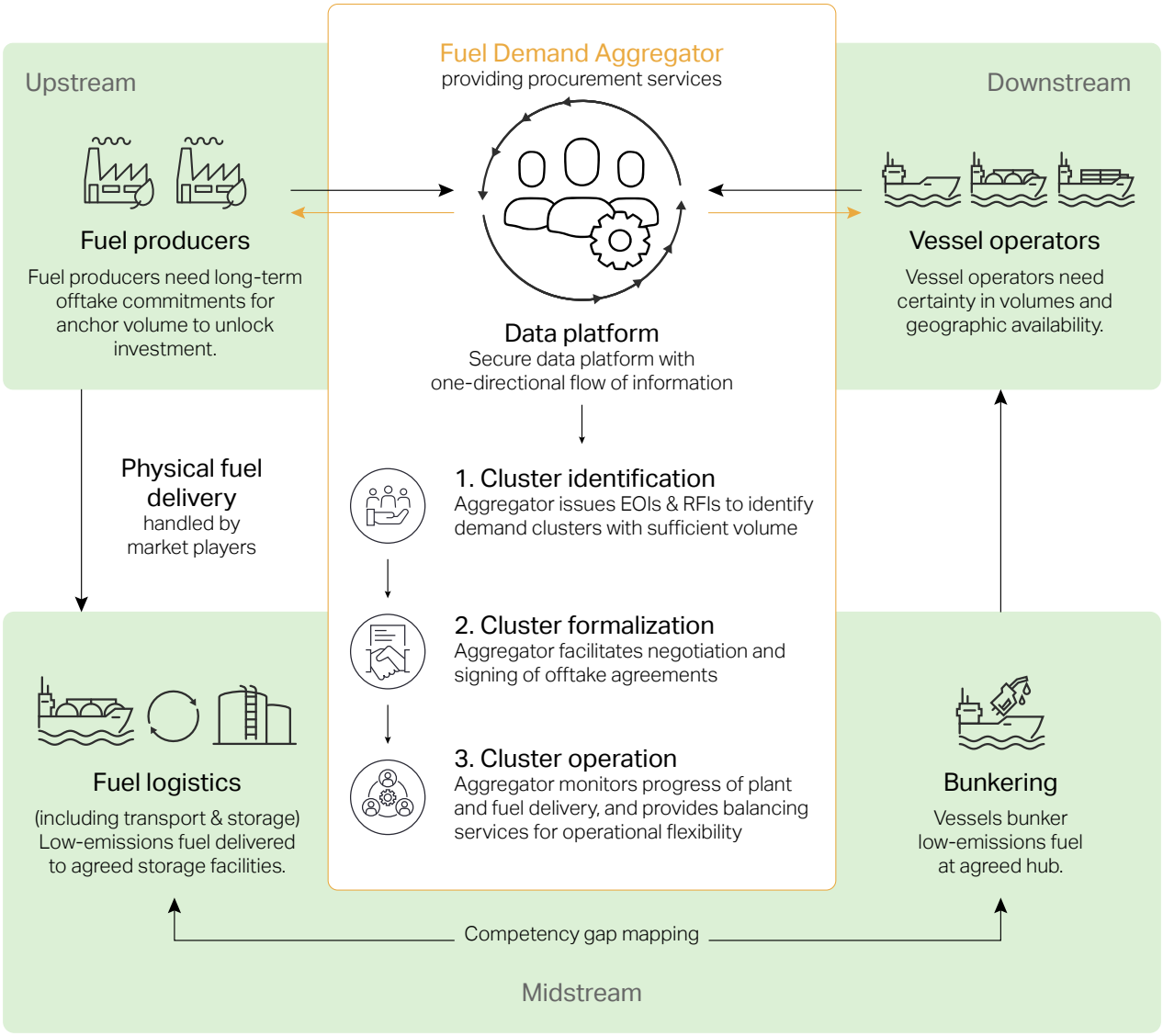
Challenges addressed by aggregation across the value chain

Fuel demand aggregation helps address multiple roadblocks faced by up-, mid-, and downstream segments as the sector transitions, such as:

- ✓ **Upstream:** Facilitates sufficient and reliable offtake commitments, enabling Final Investment Decision (FID) and access to financing for fuel producers.
- ✓ **Midstream:** Provides clear volume signals and bespoke solutions, incentivizing infrastructure investment in fuel transportation, storage, and bunkering for the volumes contracted.
- ✓ **Downstream:** Allows vessel owners and operators to gradually increase commitments to low-emissions fuels while maintaining operational flexibility.

[2] Green corridors cost model, Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping, 2025

Figure 1: The FDA coordinates between fuel producers (upstream) and the vessel operators (downstream). Logistics and bunkering (midstream) will also be handled in the FDA as part of the cluster formalization. Details of the FDA operational design are described further in the document.



What aggregation does – and doesn't solve

While aggregating fuel demand helps address quantity challenges for the upstream players in the emerging low-emissions fuel market, it does **not** solve individual ability to pay. Participation still requires a viable business case.

Additionally, because procurement involves commercial agreements, any attempts to aggregate fuel demand must comply with applicable competition laws in the relevant jurisdictions and markets.

Aggregation frameworks with different commitments

Fuel demand can be aggregated from groups of offtakers ("Clusters") in different ways, with varying levels of obligation for the aggregator and participants. Our work, as illustrated in Figure 2, distinguishes between four conceptual aggregating frameworks, ranked from lowest to highest obligation:

A. Informal network
The lowest obligation level for the aggregator, with no direct responsibilities for participants

B. Sourcing facilitator
Participant engagement and sourcing obligations are expected from the aggregator for a fee, and participants are responsible for contracts and bankability requirements.

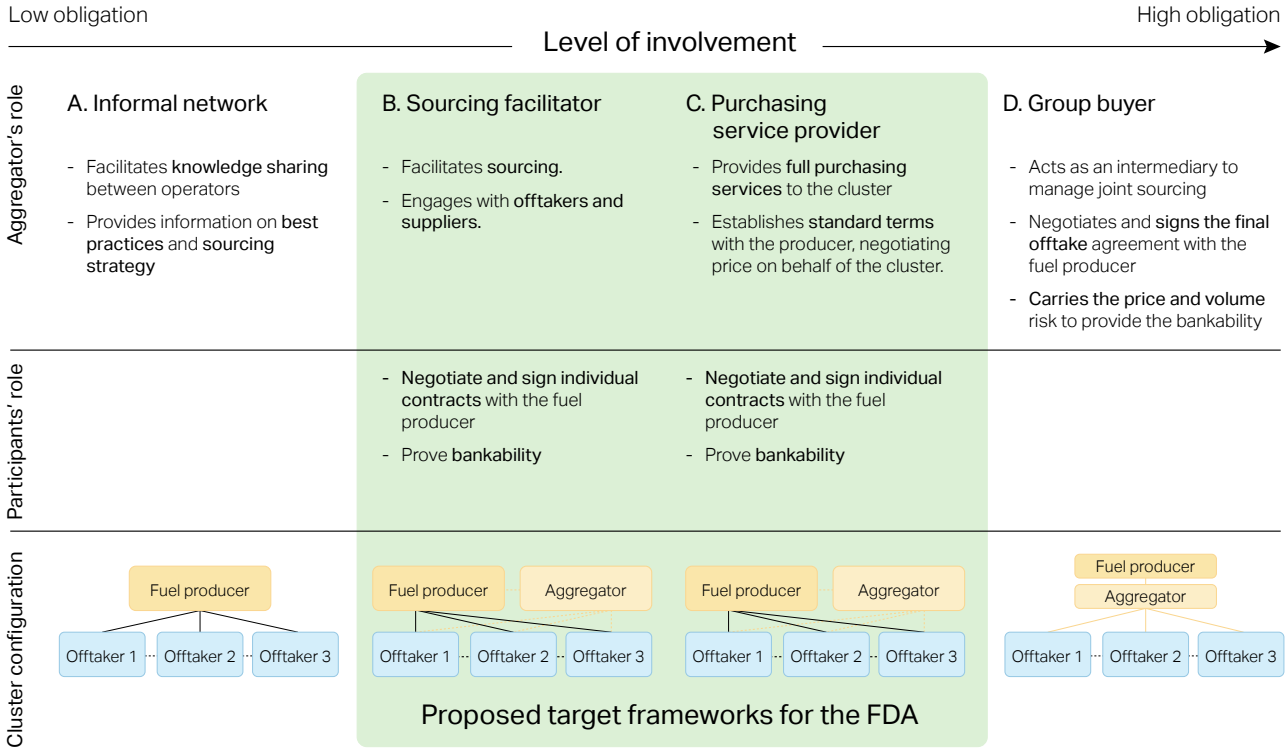
C. Purchasing service provider
Similar to framework B for the participants, as the aggregator assumes responsibility for full purchasing services.

D. Group buyer
Full responsibility lies on the aggregator as it acts as an independent intermediary for sourcing, negotiating agreements, and bankability risks.

Participation in these frameworks does not restrict or disincentivize participants from purchasing fuel individually outside the aggregated demand agreements. All participants retain full commercial independence in their procurement decisions.

Based on our engagements with the industry, the frameworks presented here are potential or existing frameworks currently considered in the market. Fuel demand aggregation offers a practical pathway to overcome fragmented demand and accelerate access to low-emissions fuels across the maritime value chain. To turn this concept into action, the next step is defining how an aggregator can operate effectively - its role, structure, and safeguards.

Figure 2: Four different FDA frameworks with varying roles and relationships between the producer, the aggregator, and the clusters. The green box contains our proposed target frameworks in the FDA design concept.



03
The FDA operational design

Building on the concept of fuel demand aggregation, we explored how an aggregator could effectively operate to accelerate the maritime industry's access to low-emissions fuels. With a fragmented and illiquid low-emissions fuels market, designing the aggregator requires a neutral entity to cluster fuel demand and coordinate procurement without becoming a contractual counterparty. The aggregator design must also comply with competition law and address bankability challenges.

How the FDA works

The FDA entity is designed to be run by a neutral third party and enabled by a secure data platform. Its design follows a three-phase approach, each with clear processes, tools, and decision gates between each phase to ensure flexibility and accountability.

We created a detailed operational plan describing how the FDA can function in practice.

→ Access the FDA Operational Design Manual here.

The FDA design features

Based on industry and ecosystem engagement, our aggregator design focuses on the role between Framework B (Sourcing Facilitator) and Framework C (Purchasing Service Provider).
Key features of this design include:

- ✓ A fuel agnostic FDA design.
- ✓ Driven by participant requirements, the FDA facilitates temporary demand clusters based on compatible demand and supply.
- ✓ It is open to all users with credible need, subject to vetting and due diligence.
- ✓ All contracts remain bilateral agreements between suppliers and purchasers, and the FDA only acts as a facilitator and service provider.
- ✓ The FDA is a transitionary solution, relevant until the market becomes liquid and low-emissions fuels can be purchased as and when required.

Clustering the volume in three phases

Phase 1 Cluster identification

Aggregator role: Identify and mature temporary demand clusters based on molecule specifications, timeline, and location as a neutral, credible third party on behalf of the market. This phase is facilitated by sequential Expression of Interest (EOI) and Request for Information (RFI) issued based on a predetermined and published timeline and underpinned by ongoing due diligence.

Mechanisms: Demand clustering mechanism, competency gap mapping, due diligence service

Phase 2 Cluster formalization

Aggregator role: Facilitate the negotiation and signing of standardized offtake agreements, which include handling communications, coordinating decisions, and resolving outstanding issues (e.g., price discovery and tendering for missing competences) with transparent mechanisms.

Mechanisms: Facilitation service (including appointment of offtake coordinator), competency gap filling, price discovery mechanism, contracts and bankability

Phase 3 Cluster operation

Aggregator role: Support during asset construction or retrofit phase through a dedicated monitoring service and technical sparring. Once the cluster is operational, a dedicated balancing mechanism enables parties to exchange supplied and consumed volumes, providing balancing services and preserving operational flexibility.

Mechanisms: Monitoring service, balancing mechanism

Navigating competition law compliance

Setting up the FDA involves commercially sensitive processes and requires strict compliance with competition laws. Without safeguards, there is a risk of breaching regulations that govern market behavior.

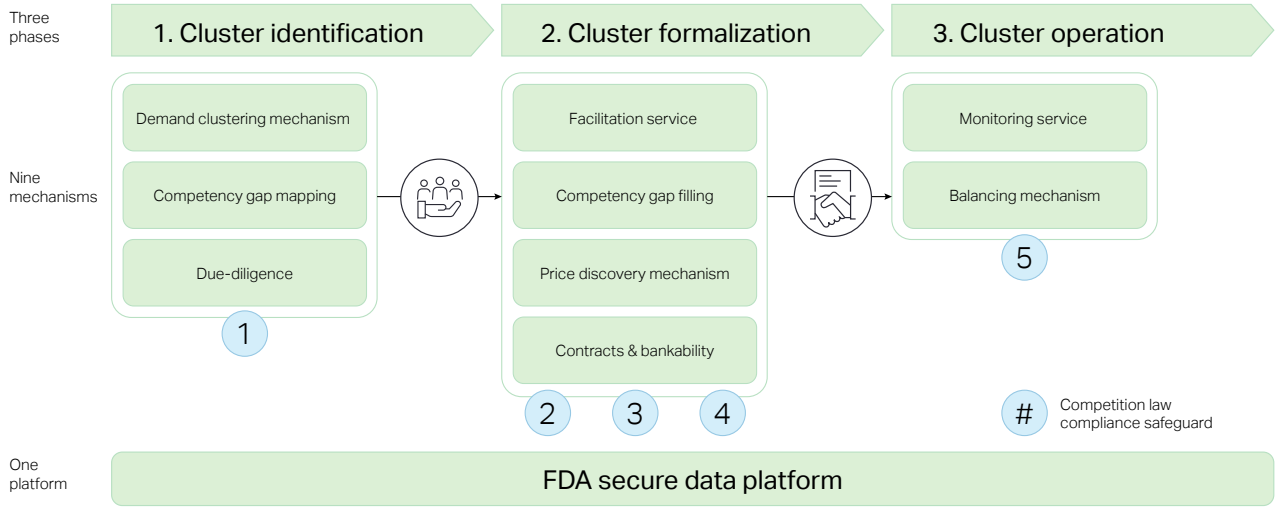
The FDA entity design we developed at the MMMCZCS has been reviewed by external competition law counsel. Their assessment concluded that the FDA is not likely to raise competition law concerns, provided that specific safeguards are maintained. The assessment characterizes the FDA as a joint-purchasing arrangement from a Danish and EU competition law perspective, with participants pooling their clean fuel purchasing activities. Competition law generally looks favorably on joint-purchasing arrangements, with the outcome depending on combined market share and other factors.

To ensure competition law compliance, the FDA must operate on fair, reasonable, non-discriminatory, and objective terms, ensuring transparent and equal access to its platform. Within the MMMCZCS design, five important elements support compliant aggregation of fuel demand, facilitated by a neutral and independent aggregator through a secure data platform.

Five competition laws compliance safeguards

1. **Information protection:** No competitively sensitive information is shared between participants.
2. **Transparent procurement:** The aggregated logistics services are procured through an open, transparent, and competitive process to prevent market distortion.
3. **Neutral facilitation:** The aggregator conducts purchasing facilitation on behalf of participants in a neutral manner, while participants retain full commercial independence and can purchase fuel outside the FDA.
4. **Pricing confidentiality:** Because the data is exchanged through a secure data platform, the aggregator prevents participants from discussing their pricing expectations or other competitive parameters with each other.
5. **Independent price setting:** The balancing mechanism sets prices for volume exchanges. These prices are determined individually by participants to prevent collective price fixing.

Figure 3: Compliance safeguards within the nine mechanisms across the three phases in the FDA design by MMMCZCS: focus on a joint-purchasing setup is key to make the FDA compliant with competition law.



Bankability: opportunities and challenges

The FDA aims to unlock maritime access to low-emissions fuels in an illiquid market and incentivize upstream investment. There is a significant pipeline of low-emissions fuels projects under development, with many at the pre-FID stage – technically advanced but awaiting a positive investment decision

Securing bankable offtake agreements remains a critical challenge for these projects. And our previous work shows that the bankability of offtake contracts is the key factor determining FID outcomes. While regulations such as FuelEU Maritime and the IMO Net-Zero Framework create incentives for low-emissions fuels, many shipping companies operate with asset-light models. This limits their ability to commit to large or long-term contracts, reducing bankability and slowing investment.[3]

This is a key challenge for fuel demand aggregation that would require either private or public funding, or cross-sector collaboration and aggregation (see '*Avenues for further work and collaboration*').

What determines the bankability of an offtake contract?

1. Credit standing of the offtaker
2. Tenor of the contract
3. Volume certainty
4. Price certainty
5. Limited termination clauses

Bankability in a capital-light FDA

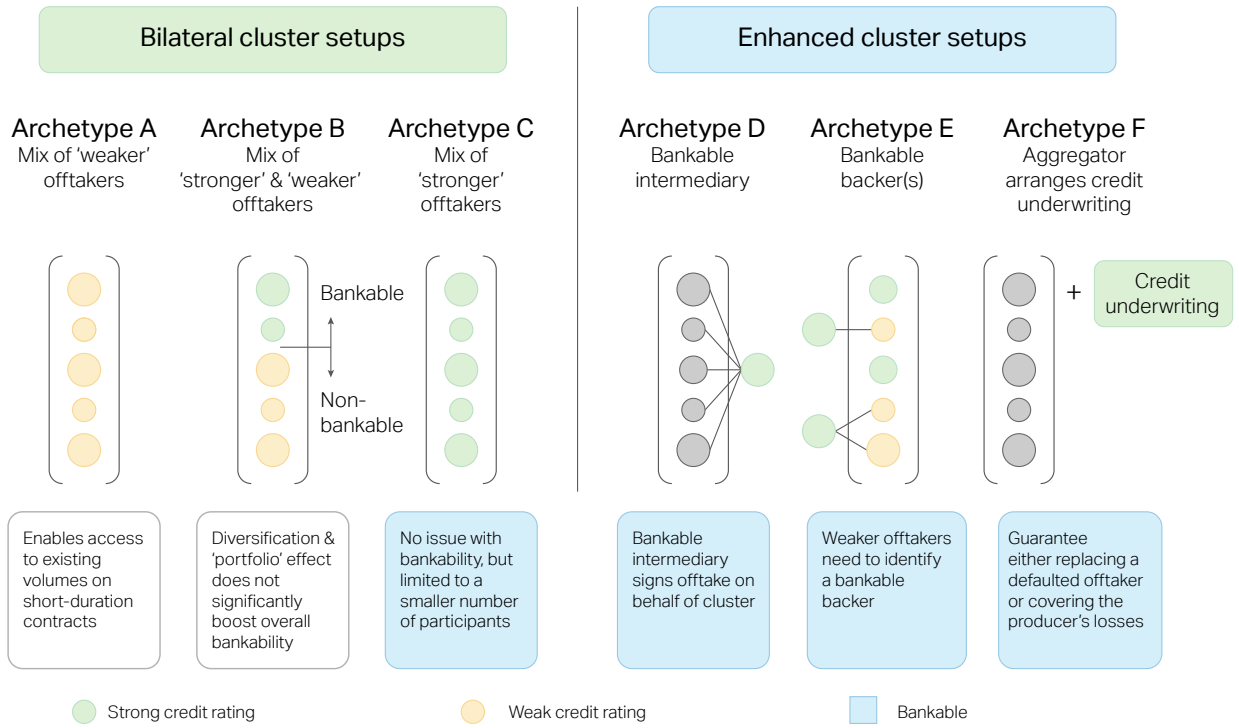
The FDA entity has been designed as a capital-light model, where contracts remain bilateral and the FDA is not a counterparty. As a result, the bankability requirements sit directly with offtakers. Our engagement with financial institutions indicates that aggregating multiple offtakers, where some of them are not sufficiently creditworthy, only offers the overall cluster the bankability for the volumes guaranteed to the extent of the most creditworthy players — the credit rating is only as strong as its weakest participant.

Consequently, capital-light aggregation facilitated through bilateral participation:

- Addresses challenges around access to existing volumes and some newbuild volumes for maritime clusters with sufficient bankability (limited number).
- But it does not guarantee to unlock investment in new facilities and their volumes, or solve for maritime clusters with insufficient bankability, which represents most of the maritime industry.

This issue can be mitigated through an enhanced cluster setup either by a bankable intermediary or credit underwriting

Figure 4: The individual credit rating of the cluster members will influence overall bankability.

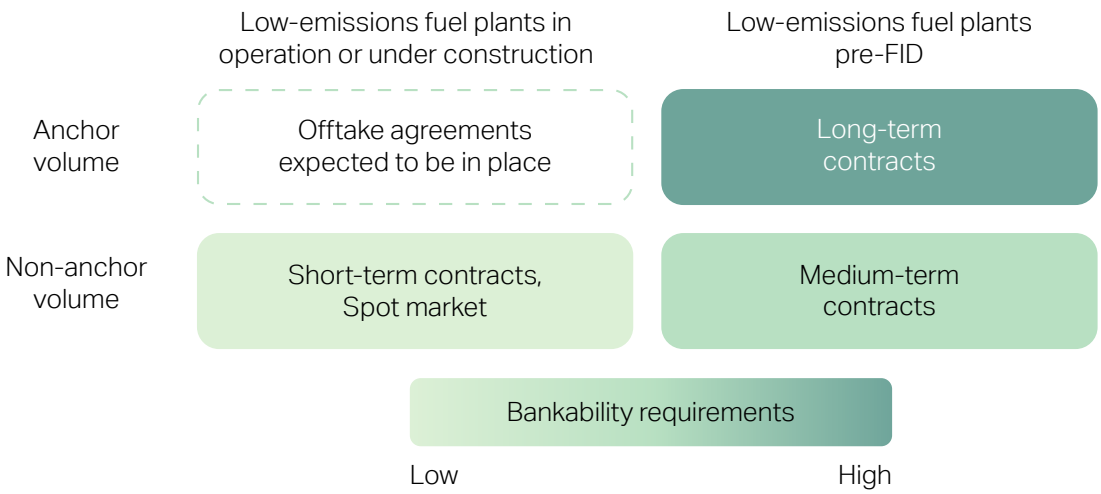


[3] Unlocking offtake: insights from the maritime value chain for securing low-emissions hydrogen-based fuel supply, Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping, 2025.

04
Avenues for further work and collaboration

The FDA design presented earlier addresses volume challenges by pooling demand and ensures compliance with competition laws. However, it does not resolve bankability and creditworthiness issues when the clusters lack sufficient credit rating to secure producer investment. To fully unlock the potential of fuel demand aggregation — especially for newbuild volumes and anchor commitments, and given the asset-light nature of maritime players — additional entities could play a role in fuel demand aggregation to enhance bankability: the private sector, public sector, and cross-industry support.

Figure 5: The barriers for bankability and creditworthiness are higher for fuel production plants in the pre-FID stage than post-FID. The same applies for anchor and non-anchor volumes. Anchor volume refers to the fuel producer's minimum volume threshold required to unlock viable, cost-effective fuel production. Non-anchor volume is the remaining capacity beyond this threshold.



Private sector

Without its own balance sheet, a capital-light aggregator contributes little to the bankability required to underpin offtake of projects, especially newbuild production facilities with higher bankability requirements or clusters where the offtakers lack sufficient creditworthiness.

Our engagement with the industry and financing institutions suggests that introducing additional private entities into FDA credit-light clusters could enhance bankability. These private entities could include bunker suppliers or commodity houses that see a future business case in acting as third-party aggregator. Such entities could provide:

- Balance sheet support to underpin the offtake contracts.
- Credit enhancement or underwriting to enhance the cluster's overall credit rating.

Public sector

The FDA provides a conceptually robust framework for shipowners or operators to pool their demand in line with Danish and EU competition law principles. The FDA also addresses some of the key barriers to signing long-term offtake agreements in the transportation sector. By doing so, FDA-facilitated clusters can create opportunities for public support at national or regional level, development banks, or climate funds.

Such public funding could provide the balance sheet backstops needed to mature FDA clusters. Combining the FDA structure with balance sheet support or similar instruments supported by regulation, the FDA approach can, in principle:

- Enable a broader range of shipowners and operators to commit to fuel offtake, which would enable investment in renewable and low-carbon fuel production facilities.

- Improve the effectiveness of public subsidies in supporting fuel production by subsidizing only a share of the cost required to bring offtake contracts to bankability.

Cross-industry collaboration

We designed the FDA concept for the maritime sector as the sole offtaker. Nevertheless, the concept could be broadened to cover other offtakers from the transportation sector, such as aviation, and can be further extended to sectors beyond transportation (e.g., plastic, cement, or fertilizer). Pooling demand from non-maritime players who can commit to offtake anchor volumes and have the balance sheet to obtain necessary credit rating offers practical ways to strengthen bankability.

Fuel demand aggregation: a strategic lever for maritime decarbonization

Fuel demand aggregation presents a potential pathway to overcome one of the maritime sector's most pressing challenges: securing reliable and affordable access to low-carbon fuels. By pooling demand across multiple actors through an independent entity or structure, aggregation not only creates the scale necessary to attract upstream and midstream investment but can, in under some circumstances, and with the required financial support, also help de-risk supply chains and reduce investment risk.

We developed a conceptually **viable, capital-light aggregation model** that addresses key concerns such as competition law compliance and operational fragmentation, while aligning with the practical realities of the maritime value chain. This FDA model is designed to be inclusive, scalable, and adaptable across different categories of offtake volumes.

However, funding and financing support remain critical for maritime players, particularly small and medium-sized shipping companies, who lack the financial strength and balance sheet resilience to participate meaningfully in fuel transition initiatives. Limited capital restricts their ability to commit to long-term offtake agreements and absorb price volatility, making them less attractive partners for fuel suppliers and infrastructure developers.

There are opportunities for further research and collaboration to enable this transformation, spanning regulatory innovation, blended finance, and strategic partnerships. MMMCZCS will continue to provide analytical insights and share knowledge to support these efforts, bringing its expertise, network, and convening power to help maritime stakeholders — especially small and medium-sized shipowners and operators — navigate the transition toward a low-emissions future.

Get a comprehensive overview of fuel demand aggregation

→ Watch the webinar on-demand

The project team

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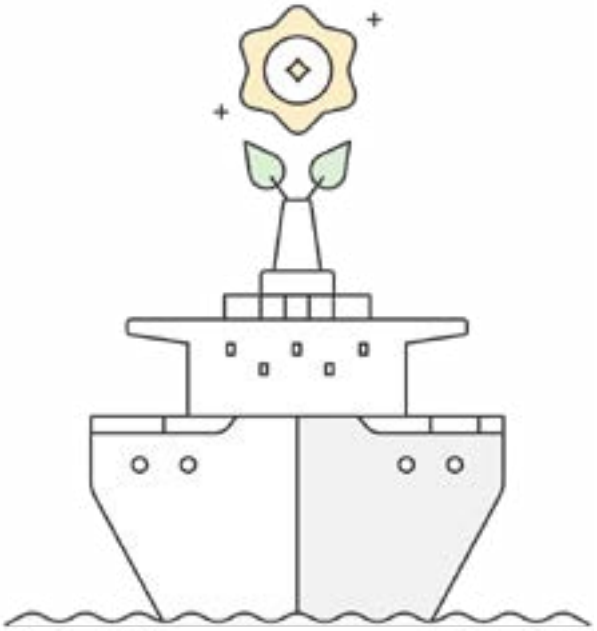

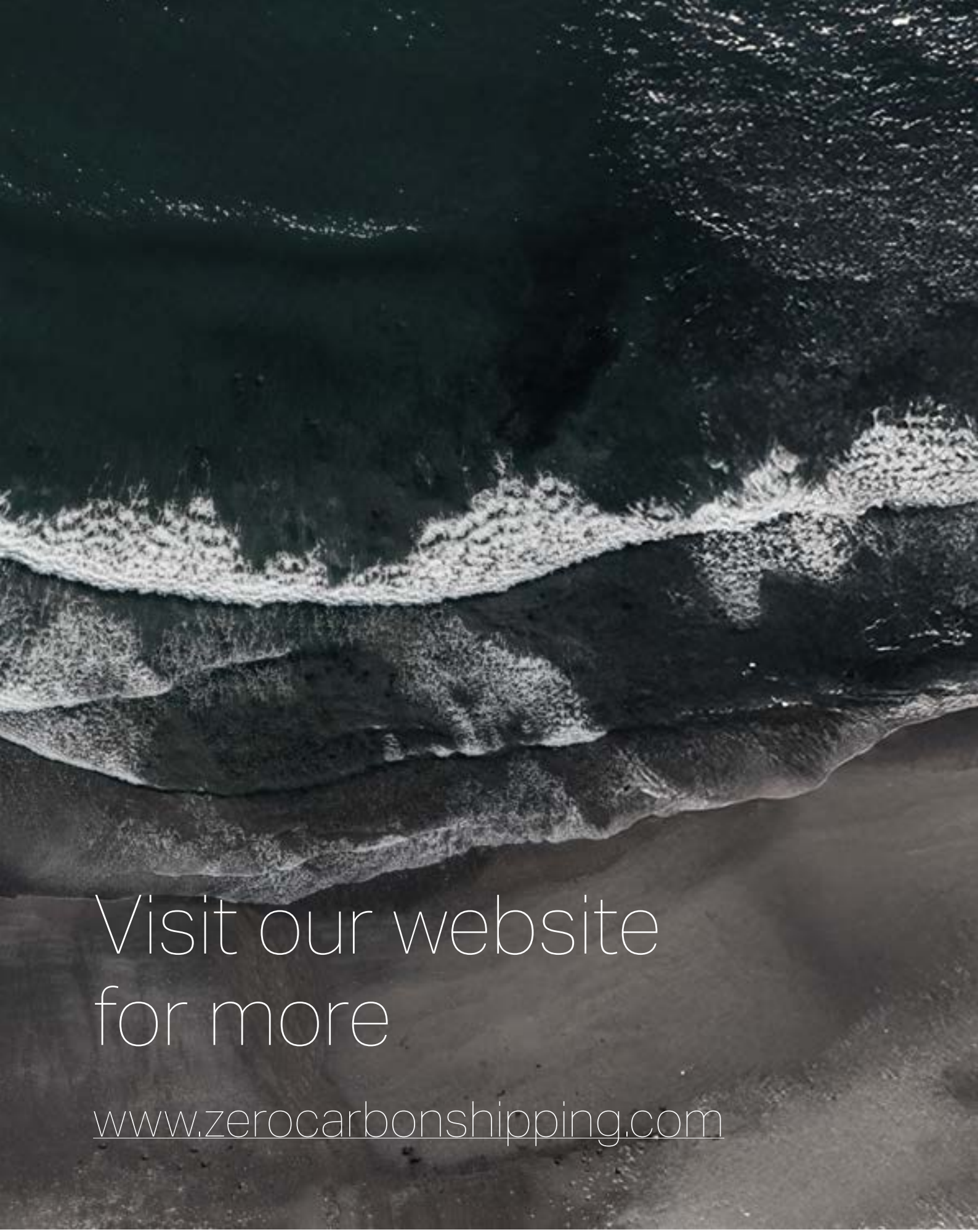

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