Fuel Demand Aggregator

Operational Design & Processes
November 2025

Mærsk Mc-Kinney Møller Center
for Zero Carbon Shipping

Disclaimer

Introduction

There is a need to rapidly accelerate investments in full-scale clean fuel production to support the fuel transition. Currently, there is not expected to be a liquid market for clean fuels by 2030, and most ship operators are too small to enable supply projects on their own. Aggregating demand across ship operators is seen as a promising solution to help resolve pain points across both producers and offtake by ensuring the scale needed to finance and de-risk clean fuel supply.

Demand aggregation seeks to bridge the gaps that currently exist between fuel producers and maritime users, enabling economies of scale by ensuring larger volumes and more attractive terms for producers while providing access to supply for ship operators that are too small on their own to unlock production, or only need a small amount of fuel to comply with regulations. Through aggregation of demand, the FDA seeks to accelerate alternative fuel production and uptake by the maritime sector in the short- to medium-term.

The **Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping** (MMMCZCS) is therefore investigating the potential role a Fuel Demand Aggregator (FDA) entity could play in accelerating this process, providing a structure to bring together stakeholders across the clean fuel value chain to enable the first commercial-scale production facilities to be built and the first vessels to begin sailing on sustainable fuels.

This document provides an overview of the entity's design, underpinned by the four foundational principles of the FDA, namely:

A. **Non-profit:** The FDA will be non-profit, charging fees only to cover its costs. Here, a **capital-light** facilitation entity is preferred, avoiding the need to source and tie-up large amounts of investment capital.
B. **Independent**: The FDA will be open to all users with a credible need for its services, subject to the necessary due diligence outlined in this document.
C. **Temporary:** The FDA will be a transitionary mechanism, necessary only until a commercial clean-fuel market is established, and is therefore expected to be terminated within X years, or once a credible liquid market emerges.
D. **Fuel agnostic:** The FDA will run clean fuel demand aggregation rounds based on the specific fuel molecules chosen based on the submissions of vessel owners / operators and fuel producers respectively[1] and will not individually prioritize any molecule over another. To ensure a level playing field, the same core processes, mechanisms and tools will be deployed across all demand aggregation rounds, with the possibility for minor adjustments based on fuel properities and technical specifications.

The MMMCZCS has explored the potential design and use cases for the FDA within these foundational principles, through engagement with a wide range of maritime stakeholders from across the value chain. The proposed design is based around / follows a three-phased approach, combining a series of clear and well-defined processes with built-in flexibility to respond to the users' specific capabilities and clear decision gates between each phase.

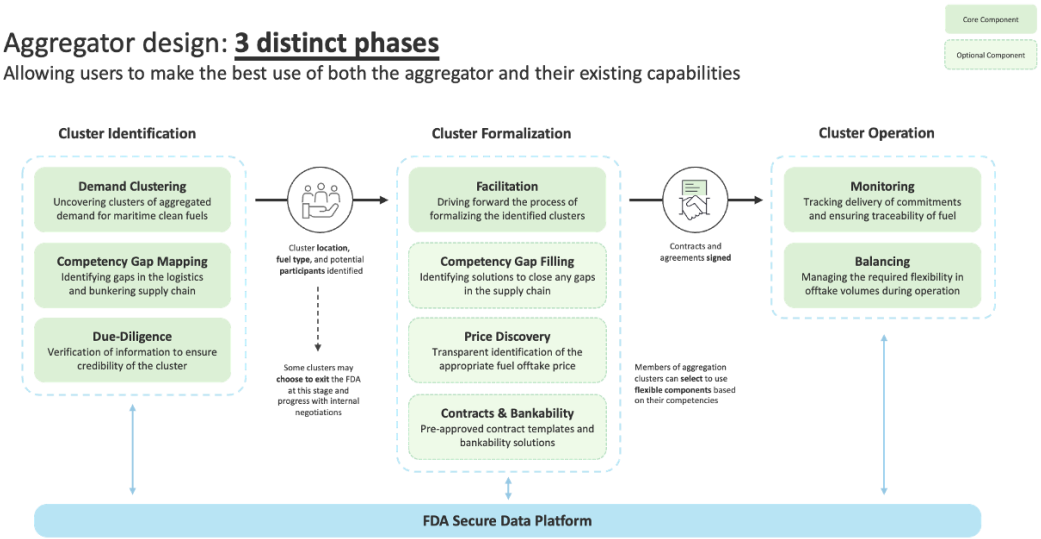


Figure 1 FDA Three-Phase Approach

[1] This will be based on a pre-populated list of clean fuels in line with the MMMCZCS fuel mix.

The three phases of the FDA, which are described in more detail in subsequent sections, are:

1. **Cluster Identification,** where user-submitted information is used to identify potential clusters of credible aggregated maritime fuel demand and any gaps in the supply chain competencies of the emerging cluster are mapped.
2. **Cluster Formalization,** where the identified clusters are guided through the process to formalize the offtake into a series of signed contracts and agreements concerning the supply, transport and bunkering of fuel.
3. **Cluster Operation,** where assistance is provided to the formalized clusters to manage the execution of the contracts, both before and after fuel begins to flow.

This document provides a brief overview of the current thinking on the design developed, with a focus on the FDA operational design and its implications for the end-users; this is delivered through individual deep dives on the three Phases and their individual components.

Phase 1: Cluster Identification

The Cluster Identification Phase constitutes the first phase in the work of the FDA. The aim here is to leverage the independent and confidential nature of the FDA, in order to identify and mature credible demand clusters.

In order to do so, Phase 1 leverages three key and interdependent tools, namely the Demand Cluster Mechanism, Competency Gap Mapping and Due Diligence Service, underpinned by a strong data platform with one-directional flow of information to the FDA entity. Upon successful completion of the Cluster Identification, a stage-gate is then introduced for all relevant counterparties to sanction continuation into the next Phase, namely Cluster Formalization, or alternatively opt out of the process.

Demand Clustering Mechanism

What: The Demand Clustering Mechanism is a core feature of the FDA and constitutes one of the primary services offered in the Cluster Identification Phase. The mechanism offers a neutral, credible third-party actor acting on behalf of the market, which aims to sequentially:

A. collect, process and assess information in a targeted manner on entities' offtake and production interests and capabilities in key locations and across key pre-defined criteria,
B. perform an assessment on the potential overlap between supply and demand, including what and where it occurs,
C. mature the potential identified clusters, including production and delivery terms, and bring them to back to the interested participants to negotiate and further execute upon.

Why: The FDA combines its independence and strong technical, regulatory and commercial understanding of both the fuel production and maritime ecosystems to solve the following issues on behalf of the market:

- overcome and gradually correct for information asymmetry, enabling higher confidence and visibility in decision making around the sourcing of clean fuels for the maritime sector,
- undertake initial market development given the high uncertainties, lack of liquidity in the market, and significant resource requirement otherwise faced by market participants,
- navigate commercial sensitivity in compliance with antitrust and competition law,
- if successful, unlock sufficient aggregation of production and offtake volume to allow for the participants to enter into credible and cost-effective offtake agreements.

The FDA is a transitionary mechanism driving market discovery and development and is therefore expected to step out of the market altogether once sufficient liquidity exists in the market. Here, sufficient liquidity is expressed as 1) natural emergence of clusters in the market without the need for demand clustering, and/ or 2) the ability for a critical mass of individual vessel owners/operators to procure fuel to the necessary level and terms on their own account.

How: The Demand Clustering Mechanism is run by the FDA entity through the formal launch of individual FDA Cluster Identification Rounds, with a goal of identified aggregation clusters for maritime clean fuels.

Each cluster consists of two or more vessel operators, owners, or owner-operators, seeking to acquire fuel for use in their own fleets, and one or more fuel producers, seeking to deliver fuel for maritime use. Additionally, the cluster may at a later stage involve one or more logistics, storage and/or bunkering companies who will provide supply chain services, including transport, storage and bunkering of the fuel on behalf of the cluster participants.

Each FDA Cluster Identification Round will be managed and operated in the same way during the Cluster Identification Phase, in line with the specifications, data requirements and timelines specified below.

A. Frequency and Schedule for the launch of FDA Cluster Identification Rounds

FDA Cluster Rounds are activated and launched formally and exclusively by the FDA entity with a fixed frequency and timing within each calendar year; these are to be communicated to the market with sufficient notice so that interested parties can 1) assess interest and 2) prepare documentation in line with the process and requirements described below. The preliminary timeline for FDA Cluster Rounds in $Year_X$ basis can be seen below:

- 1st of January: Announcement of Final Launch Schedule (exact date) for FDA Cluster Identification Rounds in $Year_X$
- 1st of April: Launch of first FDA Cluster Identification Round in $Year_X$
- 1st of June: Notification of any changes to the Schedule of FDA Cluster Identification Rounds in $Year_X$, and Announcement of Preliminary Launch Schedule in $Year_{X+1}$
- 1st of September: Launch of second FDA Cluster Identification Round in $Year_X$

B. Purpose and Design of individual FDA Cluster Identification Rounds

FDA Cluster Identification Rounds have been designed to follow a pre-determined process and timeline, enabling both interested parties and Cluster participants to have visibility on the timeline and anticipated checkpoints and decision gates for each submission. Through a multi-stage approach, each FDA Cluster Identification Round entails an increasing level of commitment and specification, to ensure credible procurement frameworks are developed through targeted and sequenced maturation of the demand and supply specifications within each Cluster.

The main Stages in each FDA Cluster Identification Round, including their respective objectives and tools can be seen below:

Stage Name	Stage Objective(s)	Stage Tools
#1 Regional Cluster Identification	A. Identify wider demand clusters based initially on fuel molecule, preferred carbon intensity range and / or emission reduction range, as well as preferred timeline for first volumes desired bunkering region submitted by vessel owners / operators into the FDA platform, B. subsequently, match these up the submissions of fuel producers that are interested and capable to produce volumes matching the specifications provided above though their current or planned / future production.	1.1 FDA Expression of Interest (EoI) to Market 1.2 FDA Synthesis of findings based on EoI results
#2 Delivery and Logistics Specification	Assuming sufficient initial common interest, the FDA proceeds here to further mature the Regional Cluster though additional scoping of: A. firstly, concrete bunkering location preferences, or location / method limitations **from vessel owners/ operators,** B. subsequently, concrete definition of **producers' ability and terms for** fuel delivery in line with the specifications in Stage 1 and Stage 2A, including their planned approach to producing / sourcing the fuel.	2.1 FDA Request for Information (RfI) to Market 2.2 FDA Synthesis of findings based on RfI results

C. Timeline and Data Requirements for individual FDA Cluster Identification Rounds

The table below sets out the concrete data inputs to be submitted by individual parties in Stage **#1 Regional Cluster Formation** and Stage **#2 Delivery & Logistics Specification**, in line with the process described in Section 2B above.

#1 Regional Cluster Formation	Vessel Owner / Operator		Fuel Producer	
Instrument: Expression of Interest (EoI) Window for Market Response: 30 days Window for FDA Synthesis: 45 days	Fuel Molecule Carbon Intensity – Range Emission Reduction – Range Desired Volume – Range Bunkering Region Start of Offtake	[list] [gCO_2/MJ] [gCO_2/MJ] [t/yr] [list] [year]	Fuel Molecule Carbon Intensity - Range Emission Reduction – Range Min. Aggregation Volume Max. Production Volume Start of Production	[list] [gCO_2/MJ] [gCO_2/MJ] [t/yr] [t/yr] [year]

#2 Delivery & Logistics Specification	Vessel Owner / Operator	Fuel Producer
Instrument: Request for Information (RfI) Window for Market Response: 30 days Window for FDA Synthesis: 45 days	Preferred Delivery Terms, including extended list of ports and limitations on method or frequency. Logistics Interest or Ability, including related transportation, storage or bunkering capabilities in the designated region discussed in the Cluster.	Specification of Delivery Terms and Range of options, incl. ExWorks, FOB and other options given Cluster specifications. Minimum contract duration.

Here, it is important to distinguish between the following three types of input requested, namely

Pre-defined List Input: The aim here is for all input submitted on the potential boundary conditions of the Cluster to be submitted by all parties on the maritime and fuel production side in a uniform manner. This maximizes the chances for the FDA to be able to identify the highest possible critical mass and undertake maturation with a clear scope. Here, the level of detail increases as maturation progresses providing sufficient time for correct delimitation.

Range Input: The aim here is for vessel owners/ operators and fuel producers to indicate preferences and minimum-maximum ranges. This enables the FDA to run a number of scenarios to identify combinations of critical mass, as well as initial volume equilibria between possible supply and demand volumes.

Absolute Input: In some cases, the FDA allows for parties to provide absolute input on parameters, thereby enabling the FDA to integrate key deal-breakers for the different parties into the assessment and maturation of individual Clusters.

Competency Gap Mapping

What: The Competency Gap Mapping involves assessing whether and to what extent a Cluster identified during the Cluster Identification Phase both has and is willing to deploy the supply chain competences and services necessary for the physical delivery of fuel, based on members' responses to the EoI and RfIs in the Demand Clustering Mechanism. The aim of the Competency Gap Mapping is to 1) document the complete set of possible solutions identified through the Demand Clustering Mechanism and 2) subsequently present these to the Cluster members, in order to provide an exhaustive understanding of the options, and thereby enable the cluster to determine how to proceed on the most informed basis when entering the formalization stage.

The service links to the Competency Gap Filling Service in the Cluster Finalization Phase, where the FDA can run additional procurement processes for missing services on behalf of the Cluster, should the Cluster identify this as the most suitable and advantageous solution.

Why: The novel environment for clean fuels, as well as its physical integration into maritime operations necessitates new and revised methods for collaboration across the value chain in five key areas of competence, namely 1) Fuel Production, 2) Fuel Transportation, 3) Fuel Storage, 4) Fuel Bunkering, and 5) Fuel Offtake. The current market for clean fuel production and maritime uptake is characterized by a wide array of actors with varying and overlapping competences, including;

- **Fuel supply:** from dedicated clean fuel producers with no current or anticipated role in logistics to energy majors with significant activity in transportation, storage and/or trading,
- **Fuel logistics:** from traditional storage and bunkering players to emerging players with specialized services and focus for clean fuels, including dedicated assets for clean fuel storage and/or bunkering,
- **Fuel demand:** from smaller owner/operators in single segments to larger owner/operators involved amongst others in the transportation of clean fuels, and/or able and willing to charter the necessary vessels for fuel transportation from producers.

All clusters will be unique, and a complete fuel supply chain will need to be put in place for successful operation of a Cluster. As such the most suitable setup for each of the supply chain elements needs to be explored and agreed individually for each Cluster (hereafter referred to as Cluster Competency Matrix), making the best use possible use of existing competences within the cluster, and rapidly identifying where there are gaps that need filling in order to ensure a concrete and timely realization of Clusters.

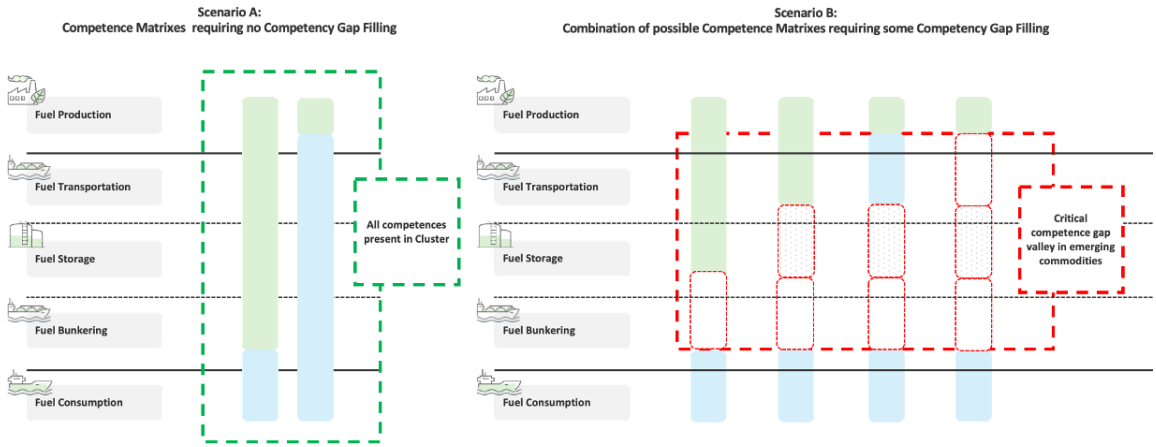


Figure 2 FDA Competency Gap Filling

How: Competency Gap Mapping follows the Demand Clustering Mechanism, and builds on the responses from the interested cluster participants, mapping out the competencies of the participants, in line with the 5 key competency areas identified in the Table below.

This assessment will be based on the responses of vessel owner/operators and fuel producers in connection with the Expression of Interest (EoI) in **#1 Regional Cluster Formation**, as well as the recorded ability of fuel producers to deliver based on the specifications set by the vessel owner / operators, received in connection with the Request for Information (RfI) in **#2 Delivery & Logistics Specification.**

Subsequently, the FDA performs an assessment on the overlap between the submissions, with focus on 1) confirming or amending the scope of the Cluster specifications, and 2) documenting the Cluster Competency Matrix based on the responses, in line with the data points and scenarios presented below:

Key specifications aligned for Cluster to be identified	**Key competences present for Cluster to realize (Cluster Competency Matrix)**
Fuel Molecule 1) Carbon Intensity 2) Emission Reduction 3) Desired Volume 4) Duration of Contract 5) Start of Offtake 6) Bunkering Region and Method, incl. preferred Delivery Terms, including extended list of ports and limitations on method or frequency.	1) Fuel Production 2) Fuel Transportation 3) Fuel Storage 4) Fuel Bunkering 5) Fuel Offtake

In cases, where all submissions between the two sides present sufficient overlap in all key specifications and competences (shown above), the FDA

- makes no recommendations for re-alignment of the specifications, e.g. adjustment of radius for bunkering location, and
- documents the Cluster Competency Matrix for all key competencies.

In cases, where only some combinations of submissions present sufficient overlap in all key specifications and competences, therefore requiring minor re-alignments in the specifications of the cluster, the FDA

- documents the Cluster Competency Matrix for all options with sufficient overlap in specifications, marking any missing competences in relation to 2) Fuel Transportation, 3) Fuel Storage, 4) Fuel Bunkering.
- documents the Cluster Competency Matrix for all options with partial overlap in specification, marking the areas needing re-alignment in specification to achieve a successful Cluster, marking any missing competences in relation to 1) Fuel Production 2) Fuel Transportation, 3) Fuel Storage, 4) Fuel Bunkering, and 5) Fuel Offtake.

In cases, where no combinations of submissions between the two sides present sufficient overlap in all key specifications and competences, the FDA, an unsuccessful Cluster Identification round is declared.

In cases of missing competences in 2) Fuel Transportation, 3) Fuel Storage, 4) Fuel Bunkering, cluster members can exercise the option to cover one or more of the missing competences during the Competency Gap Filling (part of Cluster Formalization) by making a separate bid on the logistics services (pending confirmation with competition and anti-trust) as part of the that stage of the process.

In all of the scenarios presented above, and at the end of the Competence Gap Mapping, the FDA produces and shares with the identified Cluster participants the details of the potential Cluster identified and matured by the FDA during this Round, potential constellations and options forward (incl. options with and without logistics). At this point, Cluster participants can opt to either:

- move forward and organise bilateral negotiations and maturation without the participation of the FDA, or alternatively
- authorise the FDA to continue maturation of the Cluster through entering the Cluster Formalization Phase.

A notice period of X days applies for the Cluster participants to decide on the preferred outcome and notify the FDA entity.

In case of an unsuccessful initial Cluster Identification, the FDA reports back to Cluster members and the market on the outcome of the FDA Cluster Identification Round – in line with the communication plan and specifications agreed or each Cluster[2], and the FDA Cluster Identification Round is formally closed.

Due Diligence

What: Due diligence involves validation of the data that is being provided to the FDA to ensure that the information used to identify and scope the demand clusters is as accurate and reliable as possible. Additionally, there will be a need for a thorough assessment of potential users of the FDA's service, to verify their identity and assess potential risks of illegal activities such as money laundering, fraud, or sanctions.

Why: Due diligence is a core feature of the FDA as it builds the necessary trust and credibility in the clusters as they are formed. While much of the information that will need to be provided to the FDA will be future looking, there is a clear need to ensure that this information is as accurate and reliable as possible. This will be key to maximizing the success rate of turning the identified potential aggregation clusters into concrete fuel delivery contracts.

How: The due diligence to be conducted as part of the FDA is split into multiple phases, with the vast majority conducted in advance of and during the Cluster Identification Phase in the following manner:

A. Due Diligence prior to participation in FDA Cluster Identification Round

When a new entity expresses a desire to participate in an aggregation round organized by the FDA, it will first be subject to checks to ensure that it is an appropriate participant, similar to a standard Know You Customer (KYC) check, including:

- Customer Identification – full name, registered address
- Identify and verify the ultimate beneficial owners (UBOs) to ensure transparency
- Check against government sanction lists, politically exposed person (PEP) lists, and known terrorism lists
- Submission of a business credit report from an approved agency
- Submission of a safety audit report

Furthermore, to be eligible to use the FDA's services, the nature and purpose of the entity's business activities need to align with the intended purpose of the aggregator, which is to accelerate the uptake of low-carbon fuels by the maritime sector. It is not intended for the aggregator to facilitate the purchasing of fuel for the purposes of speculation. Two groups of participants can be distinguished, with the entity required to fit at least one of these categories:

# Group 1	Those involved in the actual fuel offtake contracts, who are using the FDA to either supply fuel or purchase fuel for their own use, including:	1A Vessel operators, owners, or owner/operators, 1B Fuel Producers.
# Group 2	Those interested in registering their interest in potentially providing logistics and/or bunkering services to future clusters, including:	2A Fuel Transportation, 2B Fuel Storage, 2C Fuel Bunkering.

Once registered, an entity will be required to notify the FDA entity of any changes to their business that may affect their suitability to participate in the FDA. The FDA will also periodically reassess participants who are registered to use the system.

B. Due Diligence upon submission of an Expression of Interest (EoI)

As part of the EoI process, in addition to the specific numerical information required to perform supply / demand matching as part of the Cluster Identification process (see relevant section), interested parties will also be required to submit additional information, which does not form part of the identification process for the clusters, but will instead be required to confirm the credibility of the submitted information.

[2] A first version of the Communication Plan proposed can be found in Appendix 1

Participants **# Group 1**		
# Fuel Demand	On the fuel demand side (vessel owner-operators), this will include an overview of the companies' readiness to use the fuel they are procuring, based on how the fuel is intended to be used.	Fuel for owned vessels: overview of status and timeline of new-build or retrofitting of relevant vessels. Fuel for chartered vessels: overview of plan for securing access to relevant vessels, status of discussions with relevant shipbrokers or ship owners.
# Fuel Supply	On the fuel supply side (fuel producers), this will include an overview of the companies' readiness to produce the fuel they are selling, including an overview of the projects / facilities they intend to use to supply the fuel they are offering, based on the status of the projects.	Pre-FID projects: capacity, technology, timeline to start of production, project development status (incl. FEED, permitting, procurement). Existing projects: capacity, technology, availability.
	Additionally, fuel producers will be asked to submit evidence of their track record of their ability to deliver the chosen fuel.	

C. Due Diligence upon submission of a response to a Request for Information

As part of the RfI process, during which the details of the cluster are refined and specified in more detail, additional information will be requested from those entities identified for inclusion in the specific clusters. As the clusters become more specific, more concrete information will need to be provided, including:

Participants **# Group 1**	
#Fuel Demand	- Financial checks to ensure that the entity has the financial strength to take on the commitment for the fuel offtake agreements they are seeking, based on the volume & duration of the cluster that is under formation, and reference prices for the specific type of fuel under consideration (as the final price of the fuel will not yet have been discussed). - Operational readiness check, to ensure that the entity has the operational experience in place to handle the chosen fuel, or a plan in place for how it will ensure such readiness by the time the fuel starts to flow.
#Fuel Supply	- Details of the specific plant(s) that the entity intends to use to supply the specified fuel, including their location, capacity and infrastructure/logistics setup. - Detailed status of the project, including current milestones and plan and timeline for achieving future milestones for pre-FID projects, or current operational status, capacity and availability for existing projects. - Details of feedstocks and how the agreed carbon intensity will be achieved and certified for the project, or proof of existing certification if project is already online.

D. Additional Due Diligence linked to the Cluster's Competency Gap Mapping and Competency Gap Filling

During the Cluster Formalization Phase, additional due diligence may be required targeting stakeholders in Group 2, in scenarios where the following conditions are met:

- the Competency Gap Mapping performed during the Cluster Identification Phase points to one or more gaps in the competence areas of 2) Fuel Transportation 3) Fuel Transportation, and/or 4) Fuel Storage across the solutions documented and presented to the Cluster,

- Cluster members choose to proceed into Cluster Finalization with the FDA,
- Cluster members opt for the optional service of Competency Gap Filling, and the FDA is authorized to issue a new procurement process, possibly a Request for Proposal (RfP) to help bridge the logistics gaps identified in the Cluster.

Here, In addition to the standard entity checks that are conducted in line with #A above, these will also include:

Participants **# Group 2**	
#Fuel Logistics	- Experience and track record with handling the cluster's molecule, - Status of equipment required, and details of the timeline for delivery of any new-build infrastructure.

Phase 2: Cluster Formalization

The Cluster Formalization Phase constitutes the second phase in the work of the FDA. This Phase is optional, and hinges on 1) a successful Cluster Identification during the previous Phase, and 2) the authorization of the FDA by the Cluster members to further mature the Cluster from initial Expression of Interest (EoIs) and Request for Information (RfIs) into concrete commitments and obligations, underpinned by the necessary contracts and agreements.

To do so, the FDA offers one core Service, namely the Facilitation Service, as well as three optional Services and Mechanisms (Competency Gap Filling, Price Discovery, Contracts & Bankability). In spite the optional nature of the latter elements, the successful completion of the Cluster Formalization Phase is followed by the final FDA Stage - Cluster Operation, which is unlocked upon the completion of all necessary contracts, agreements and documentation.

Facilitation Service

What: The Facilitation Service is a core feature of the FDA in the Cluster Formalization Phase and enables the FDA to structure and where relevant enable all relevant procurement discussions. Here, the FDA handles communication, sequences necessary decisions between multiple counterparties and provides transparent mechanisms to solve outstanding issues, in order to ensure that

- all relevant outstanding issues for Cluster Finalization are resolved, in order to finalize relevant contracts and agreements, and
- all the necessary conditions are put in place and documented for the Cluster Operation Phase, governing both the period for all relevant asset construction and procurement activities prior to the Offtake Start Date, as well as all live operations post the Offtake Start Date (fuel flow date).

Why: Fuel demand aggregation involves a simultaneous maturation of the two sides of a deal, namely fuel producers and vessel owners/operators, combined with significant uncertainty and a novel environment. The Facilitation Service offers a neutral, credible and knowledgeable third party to assist with structuring and support, where relevant, the maturation of the procurement frameworks and the necessary agreements. This ensures compliance with antitrust and competition law, as well as helps to solve for the best overall market outcome, whilst acting on behalf of parties with varying interests and volumes committed in an illiquid market. In doing so, the FDA provides market participants with experience and guidance in this space and in the long run enables the market to be able to make such arrangements as fuels become increasingly available.

How: Upon successful completion of the Cluster Identification Phase, A) all Cluster members or B) a critical majority of Cluster members with sufficiently high total volume[3] need to unanimously agree and authorize the FDA to proceed into the Cluster Formalization Phase. Here, the FDA is granted a fixed period to act on behalf of the Cluster, during which Cluster Members are expected to not otherwise redirect their committed volume and price without prior notice and coordination with the FDA.

A. Detailed Scope of Facilitation Service

In this period, the FDA necessitates that a series of elements are discussed and completed. The table below provides an overview of these elements, their purpose as well as possible avenue for solution. All items, but #4 can be performed via individual bilateral or multilateral negotiations between parties, with a requirement for the outcome to be reported back to FDA on a confidential basis, or alternatively dedicated and optional Services and Mechanisms have been developed by the FDA and are the members' disposal.

#1 Competency Gap Filling	Close the gap on missing Competences identified in the Cluster Identification Phase	- Cluster members to perform independently of FDA OR - Use Competence Gap Filling Service
#2 Price Discovery	Determine the Price for the fuel produced and/or delivered to the Cluster and bunkered	- Cluster members to perform independently of FDA OR - Use Price Discovery Mechanism
#3 Finalization of Cluster specifications	Necessary updates and further detailing of all key cluster specifications, including 1) Carbon Intensity 2) Emission Reduction 3) Desired Volume	- Cluster members to perform independently of FDA as outcome of #1 and #2 OR

[3] Derived as the sum of all individual members' total volume bid, which must be equal to or above the cluster's minimum production volume.

	4) Duration of Contract 5) Start of Offtake 6) Bunkering Location, Method and initial Schedule	- FDA Integration of outcomes of Competence Gap Filling Service and Price Discovery Mechanism
#4 Appointment of Offtake Coordinator	Selection and appointment of an offtake coordinator for the cluster via a competitive selection process	Mandatory FDA process outlined below
#5 Contracts (and Bankability)	Translation of all decisions and specifications under #1, #2, #3, and #4 into bilateral contracts	- Cluster members to perform independently of FDA OR - Contracts and Bankability Service

B. Appointment of Offtake Coordinator

What & Why: As part of the facilitation service, the FDA will also select and appoint an offtake coordinator for the cluster via a competitive selection process. The role of the offtake coordinator is to oversee and manage reception of the fuel deliveries from the agreed supplier(s), ensure the availability of adequate storage facilities and oversee the allocation of the fuel to these facilities, and manage the scheduling of fuel bunkering by the vessel operators within the cluster and ensure the volumes lifted are aligned with the agreed position.

Selection of the various logistics solutions for the cluster is not the responsibility of the offtake coordinator (this is done by the cluster participants, potentially with the facilitation of the FDA, see "Competency Gap Filling" below). The offtake coordinator will work with the chosen logistics providers to oversee and manage the operational needs for fuel handling to ensure smooth operation of the cluster.

How: The offtake coordinator will either be appointed from among the existing participants of the cluster (including the various companies that may be chosen to deliver logistics services) or selected from external applicants. Where a fuel producer or vessel operator is selected as the offtake coordinator, this entity will be required to give equal treatment to all other entities within the cluster (i.e. no preferential treatment shall be given to their own operations) and will be required to establish appropriate information barriers to prevent cluster-specific information from other participant being used for purposes other than the coordination of cluster activities.

Remuneration for the role of offtake coordinator will be based on a simple cost-plus basis, whereby all legitimate costs for coordination activities are passed through to the cluster participants and a flat fee is paid for delivery of the service. Selection of the offtake coordinator will therefore use a screening process based on the required competencies, followed by a competitive process based on the level of fee required by each applicant.

Competency Gap Filling

What: Competency Gap Filling is an optional service in the FDA and builds on the Competency Gap Mapping conducted in the Cluster Identification Phase. The Service focuses on the five key competences for clusters to realize – in this Phase with a particular focus on sourcing the competences and services missing in relation to fuel logistics, as identified in the Competency Gap Mapping and further matured in case of any further adjustments to the Cluster scope and specifications, in line with the table below:

Key specifications aligned for Cluster to be identified	**Key competences present for Cluster to realize (Cluster Competency Matrix)**
1) Fuel Molecule 2) Carbon Intensity 3) Emission Reduction 4) Desired Volume 5) Duration of Contract 6) Start of Offtake 7) Bunkering Region and Method, incl. preferred Delivery Terms and Schedule	1) Fuel Production **2) Fuel Transportation** **3) Fuel Storage** **4) Fuel Bunkering** 5) Fuel Offtake

Why: The allocation of the competences and obligations needs to be explored and agreed individually for each Cluster (hereafter referred to as Cluster Competency Matrix), in order to enable best use of competences in the cluster, and the timely realization of Clusters. This is critical and has to be embedded into the contractual scheme of the Cluster, in order to unlock all necessary investments and planning for the construction and/ or retrofitting assets in line with the Cluster's timeline, and ensure highest confidence for both sides that fuel will be delivered in line with the agreed time, location and volume agreements.

How: Building on the assessment and discussions in the Cluster Identification Phase, the FDA advances the maturation and selection of the final procurement solution for the Cluster, including facilitating the necessary Request for Information (RfI) and/or Request for Proposal (RfP), in order to award logistics and/or bunkering services tendered on behalf of the Cluster.

In order to do so, the FDA builds on 1) the time-bound authorization from cluster members to the FDA to act on behalf of the Cluster, and on 2) the time-bound suspension of members' ability to redirect their FDA committed volume and price without prior notice to the FDA. As a consequence, the FDA can run the procurement frameworks discussed above, and upon successful selection of one by the Cluster, the winning party or parties become members of the final Cluster and are integrated into the contractual schemes governing the Cluster, including vis-a-vis the Offtake Coordinator. This is subject to successful completion of all Due Diligence activities and checks, in line with the relevant section in this document.

Taking into account that some vessel owner/operators might have preferences or pre-existing agreements for one or more of the logistics services to be provided to them by their own partners / service providers, it is possible for the Cluster to choose to run a procurement process on one, more or all of the Fuel Logistics competences in scope for the FDA, namely 2) Fuel Transportation, 3) Fuel Storage, and 4) Fuel Bunkering.

Price Discovery Mechanism

What: The price discovery mechanism is an optional mechanism and provides a clear, transparent mechanism by which the various potential participants in the cluster can be down-selected to find the final set of participants and identify an acceptable price for the fuel, but without the individual participants needing to reveal their information to each other. This is particularly relevant where there are either more demand from vessel operators in the cluster than the fuel providers can deliver, or where multiple fuel producers are able to deliver the fuel for the cluster, requiring choices to be made as to the final group of participants in the cluster.

Why: In order to achieve the objectives of the FDA, in particularly the risk around first-mover disadvantage and a lack of price transparency and benchmarks, it is desirable for there to be a single fuel price for all participants in the cluster. In many situations, successful formalization of the demand cluster will therefore require the FDA to assist with price discovery, as with potential competitors present within the cluster, direct discussion and negotiation of a common fuel price may not be possible within the boundaries of competition law. The FDA acts as a neutral 3rd party entity, able to receive and work with the necessary data to run a clearly defined price discovery process for the benefit of the wider cluster.

How: Price discovery is intended to take place relatively late in the cluster formalization process, once the necessary details of the potential cluster participants have been obtained and the competency gap mapping and filling has been completed. This is crucial as the key metric to be used in price discovery will be the 'all-in' price of the fuel P_{fuel}, consisting of three elements: P_{prod}, covering production of fuel at the production facility, $Pl_{og,}$ covering the logistics of moving the fuel to designated aggregation hub and any associated storage, and P_{bunk} covering the provision of bunkering services to get the fuel aboard the end-users vessels.

$$P_{fuel} = P_{prod} + P_{log} + P_{bunk}$$

Price discovery is based around a sealed-bid auction process, where the various actors submit their pricing information only to the FDA, who acts as the neutral party running the auction. No information needs to be exchanged between the various auction participants, avoiding the need for any exchange of commercially sensitive information between potential competitors. The FDA manages the mechanism to ensure transparency over the process while preserving confidentiality of the information provided.

Participants in the auction are classed as either:

1. Fuel producers: entities that are producing fuel and making it available for purchase through the FDA
2. Fuel offtakers: entities that are pooling their demand for fuel through the FDA
3. Intermediary supply chain companies, providing logistics and/or bunkering

All participants will submit their bids through the FDA's secure data platform. The content and scope of these bids depends on the type of entity:

1. Fuel producers submit their minimum price per unit of fuel, covering either just the fuel production scope P_{prod}, or alternatively a combined price that also covers one or more of the intermediary logistics steps P_{log} and/or P_{bunk}. While the individual prices for the separate scopes don't need to be individual set out, the scope of the bid needs to be clearly stated as to what it includes, in line with the information previous provided as part of the competency gap filling.
2. Fuel offtakers submit their maximum willingness to pay, this can either the 'all-in' fuel price P_{fuel}, or a reduced price on the basis that the fuel offtaker will arrange for their own logistics and/or bunkering (corresponding to P_{log} and/or P_{bunk}). Again, while the individual

prices for the separate scopes don't need to be individual set out, the scope of the bid needs to be clearly stated as to what it includes, in line with the information previous provided as part of the competency gap mapping and filling.

3. Intermediary supply chain companies submit their prices for delivering either logistics and/bunkering services (P_{log} and/or P_{bunk}), in line with the requirements identified as part of the competency gap mapping during cluster identification and competency gap filling during the cluster operation phase.

Once all the bids have been received, the FDA can then rank the demand and supply bids to build the supply and demand stack. Where gaps are present in the fuel producers supply chain that need to be filled by intermediary supply chain companies, the lowest bid for that specific element (i.e. either P_{log} and/or P_{bunk}) is added to that producer's minimum production price to allow all bids to be compared on an equal basis, incorporating the lowest cost logistics solution that fills their gaps.

After this adjustment has been applied, fuel production bids are ranked from lowest to highest, while fuel offtake bids are ranked from highest to lowest. The FDA then selects the lowest combined production and logistics bid that meets the aggregated demand. In connection with this,

- An offtake bid that is lower than this minimum production price (incl. logistics) results in that offtaker being removed from the final cluster, as their maximum price expectation is lower than then minimum available.
- The clearing price for the auction is set equal to the lowest offtake bid still in the cluster where the total demand can be met by the combined lowest bids from fuel producers and logistics companies.
- Fuel is allocated to offtakers at the clearing price, ensuring all offtakers pay the same price per unit of fuel.

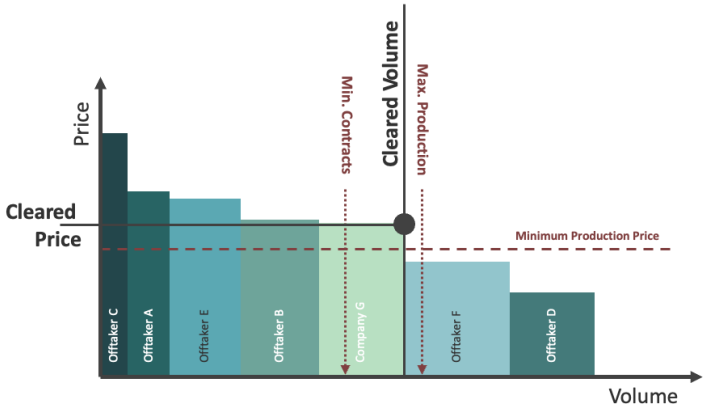


Figure 3 FDA Price Discovery - Sealed Bid Auction

Post-Auction Process: The FDA notifies all participants of the auction results, including the clearing price and their respective allocations. Contracts can then be signed between fuel producers, logistics companies, and offtakers based on the auction results.

Contracts and Bankability

What: [Contracts] The Contracts and Bankability Service refers firstly to a set of pre-developed contract and agreement templates, which are optional and can be made available to cluster members during the Cluster Finalization Phase. Given the significant complexity and novelty associated with clean fuels, the templates provided in this service aim to simplify and standardize the initial 60-70% of the necessary contracts and agreements, allowing individual members to exercise an option to finalize any additional negotiation of Terms and Conditions bilaterally and in accordance with their own internal procedures.

What: [Bankability] The Contracts and Bankability Service builds on the FDA's prior engagement with the Finance Sector, including Credit Committees on the lending side, aiming to review the critical components necessary to render offtake agreements secured via the FDA bankable. The findings of these will be integrated in the pre-developed contract and agreement templates, and be made available to all cluster members, and are expected to thereby raise confidence in the bankability of the offtake contracts signed.

Why: The non-profit, independent nature of the FDA, as well as its capital light structure prevent the FDA from taking on credit and/or other risks on behalf of the Cluster, including purchasing the fuel on behalf of the maritime industry. The Contracts and Bankability Service provides an initial structure that aims to simultaneously solve for the maritime and fuel production side by enabling

- vessel owner/operators to procure smaller volumes of fuel via the FDA, without engaging in extensive negotiations due to the complex and nature discussion of new fuels
- fuel producers to secure offtake agreements that are seen as sufficiently robust by the lenders, in order to unlock the financing necessary to construct.

How: All offtake agreements signed in connection with the FDA will be bilateral contracts between fuel producers and vessel owners / operators in the Cluster, and the FDA is not expected to be a counterparty in these contracts. All relevant contracts and agreement templates provided by the FDA will

- be drafted ahead of the FDA Entity launch in collaboration with relevant expertise, including legal experts, as well as in consultation with relevant bodies, such as BIMCO,
- include the necessary structure, terms and clauses identified by Financing Institutions and Credit Committees as necessary to render the contracts bankable.

The Contracts and Bankability Service is an optional feature of the FDA. Upon entering the Cluster Formalization Phase, all cluster members will be asked to submit their preference in terms of 1) using the FDA pre-approved contracts and agreement templates, or 2) opting out and fully using their own contracts. In the latter scenario, cluster members are permitted to re-assess and request access and use of FDA contract and agreement templates during the entire duration of the Cluster Formalization Phase. It is not permitted, unless an exemption is granted, to switch from the FDA contract and agreement templates to different templates unless notice is given to the FDA.

Lastly, and depending on the preferences of the fuel producer(s) and their lenders, it is possible for some of the cluster members to rely on the FDA contract and agreement templates, and for some to rely on their own.

Phase 3: Cluster Operation

The Cluster Operation Phase constitutes the third and final phase in the work of the FDA. This Phase becomes operational upon the completion of all contracts and agreements during the Cluster Finalization Phase, and entails two parts, namely:

1) **the Pre-Offtake Start Date Period,** covering all relevant asset construction and procurement, and
2) **the Post-Offtake Start Date Period,** taking effect on the Fuel Flow Date.

The Cluster Operation Phase is governed throughout both parts by the relevant contracts and agreements signed and reported back to the FDA. The FDA entity maintains a facilitating responsibility here through its two core components, namely the Monitoring Service and the Balancing Mechanism.

Monitoring Service

What: The Monitoring Service is a core feature in the design of the FDA and involves ongoing, confidential monitoring of technical progress across fuel production, transportation to bunkering, as well as maritime operations, in order to track progress and identify any material changes impacting the likelihood, timeline or specifications of the Cluster materializing.

Why: The service builds on the same principles as the Due Diligence conducted under the Cluster Identification Phase, and Cluster Operation for onboarding of new members, and leverages the FDA's technical expertise, in order to navigate the significant novelty and complexity in new fuel production and offtake on behalf of the Cluster. Through ongoing monitoring and an obligation to raise and address material changes, the service strengthens the credibility of the undertaking and minimizes the uncertainty faced by individual actors.

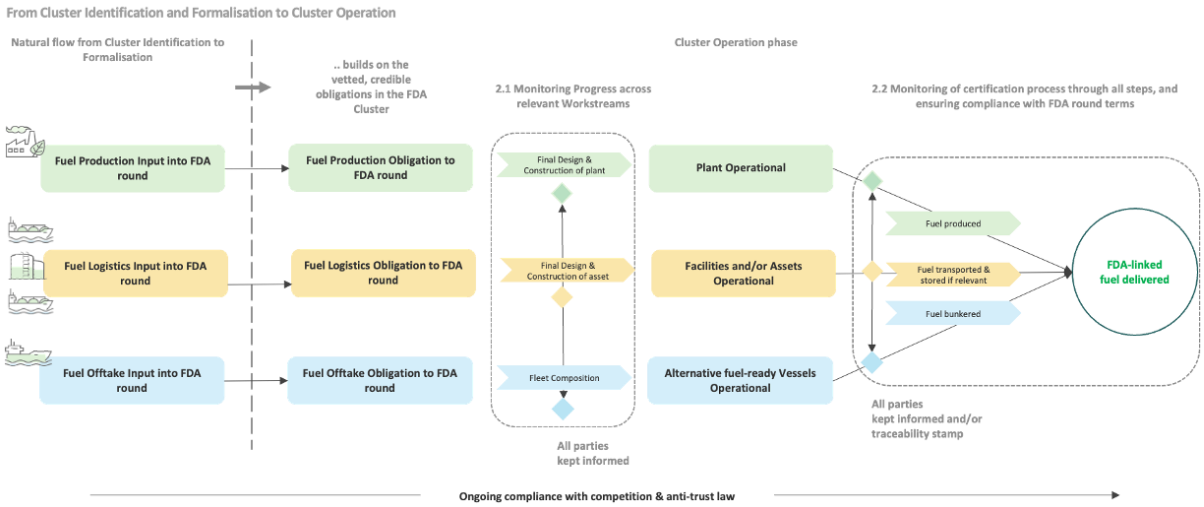


Figure 4 FDA Monitoring Service

How: The Monitoring Service is automatically provided to all Cluster members, unless otherwise specified unanimously and becomes active upon completion of the Cluster Formalization process and the relevant contracts and agreements being put in place. Monitoring takes place between individual Cluster members and the FDA in confidence – unless unanimously agreed for the FDA to report back on all Workstreams, namely 1) Fuel Production, 2) Fuel Logistics and/or Bunkering, and 3) Fuel Demand. Through its monitoring service, the FDA will track and monitor the progress and timelines of the actions agreed by cluster participants that are necessary to ensure the delivery and offtake of the agreed volumes of fuel, and will share the findings of its Monitoring with all Cluster members in case of

- material changes and delays in asset construction / procurement in the Pre-Offtake Start Date Period, which can impact Fuel flow date
- material changes during the Post-Offtake Start Date Period Cluster Operation, which can jeopardize the credibility of operations and the fuel produced and bunkered via the FDA,

in order to ensure that all parties are notified and an appropriate solution can be identified at the earliest and least critical point in time. The Monitoring Service remains active in the entire Cluster Operation Phase and operates in the following manner:

C. Monitoring Service during the Pre-Offtake Start Date Period

In line with the specifications agreed in the contracts, the FDA monitors that progress is taking place in accordance with the milestones and timelines necessary for each Workstream to procure the assets necessary for the successful and timely operation of the Cluster. Depending on the Competency allocation within the Cluster, this involves the following key parameters being monitored:

# Fuel Production	In case of newbuilt fuel plants, Monitoring entails agreed updates on the progress within project development, construction, certification of facilities, as well as any material changes to the timeline, volume or specification of the fuel produced. In case of existing fuel plants retrofitted to produce fuel for the Cluster, Monitoring will involve similar updates on the availability of the plant and the progress of any work being done to prepare the plan for use within the cluster.
# Fuel Logistics and/ or Bunkering	In case of newbuilt transportation, storage and/or bunkering assets Monitoring entails agreed updates on the progress of asset construction and expected delivery date, as well as on ongoing compliance with requirements put forward by the relevant local authorities and/or port(s) selected for the Cluster Operation. In case of existing assets retrofitted, Monitoring entails agreed updates on the progress of the asset being retrofitted, including timeline and technical documentation for its ability to deliver the necessary service for the Cluster fuel. In case of agreed intent for the assets to be chartered, Monitoring entails agreed updates on the progress and plan for the asset to be procured – not least in terms of current market developments and relevant fleet and storage utilization in the specified period.
# Fuel Demand, hereunder Vessel Owner / Operator	In case of newbuilt vessels, Monitoring entails agreed updates on the progress in terms of delivery date, and any material changes in ship design impacting ability of the vessel to take the fuel. In case of existing vessels retrofitted, Monitoring will involve similar updates on the progress of the work, including delivery date and technical documentation for its ability to run on the Cluster fuel. In case of agreed intent for the assets to be chartered, Monitoring entails agreed updates on the progress and plan for the asset to be procured – not least in terms of current market developments.

D. Monitoring Service during the Post-Offtake Start Date Period

Depending on the location of each Cluster and the status of relevant regulatory work on global, regional and/or local level, the FDA will ensure that the Cluster-specific fuel produced, transported, stored and bunkered is in compliance with the technical specifications agreed in the contracts and that furthermore this compliance can be documented through an accepted method – Proof of Sustainability.

Balancing Mechanism

What: The FDA has been designed to include a Volume Balancing Mechanism for both operators and producers by enabling the exchange of contracted volumes during the duration of the contract via a neutral third party. Volume exchanges can happen on behalf and between cluster members where necessary /based on deployment schedules and lifting capability, through a neutral third party, thereby 1) maintaining the total volume in the offtake agreement, 2) securing the necessary operational flexibility and 3) enabling anti-trust and competition law compliance.

Why: During the Cluster Formalization Phase, the Balancing Mechanism de-risks / reduces the early need for high specificity and commitment from vessel owners/operators, whilst aggregating sufficient volume to unlock FID and maritime offtake contracts for fuel producers. Similarly, in the Cluster Operation, the mechanism integrates 1) operational flexibility for operators and 2) business development flexibility for producers, without compromising the total volume contracted and robustness of the offtake contract. Lastly, the mechanism increases the overall bankability of the offtake agreement and mitigates against default and/ or difficulties and limitations.

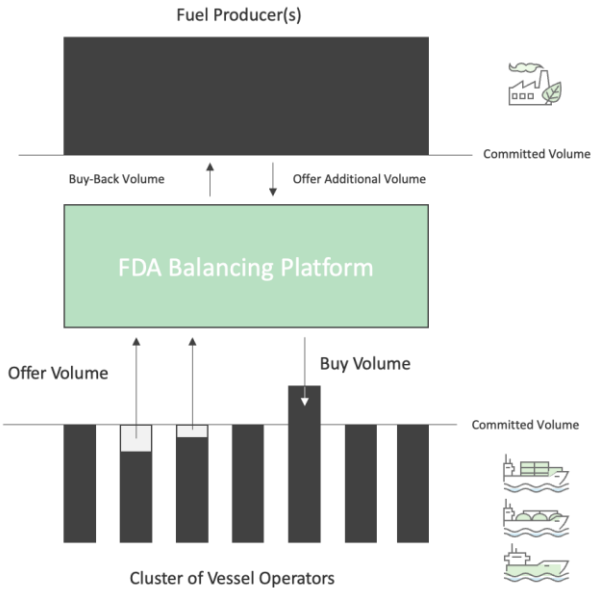


Figure 5 FDA Balancing Mechanism

How: The Balancing Mechanism is a core of the FDA and is automatically included in contracts for fuel secured via the FDA, unless all parties unanimously choose to opt out during the Cluster Formalization process.

The mechanism first becomes exercisable in the Cluster Operation Phase in one or more of the below scenarios:

A. During the Pre-Offtake Start Date Period Cluster Finalization Phase and depending on the progress of asset construction, parties can finalize their position up to 1 year prior to the Offtake Start Date (t_{-1}).
    a. fuel producers can offer additional volume to the Cluster in the period t_{-x} to t_{-1},
    b. fuel producers can buy-back volume from the Cluster in the period t_{-x} to t_{-1},
    c. vessel operators can buy additional volume intra the Cluster in the period t_{-x} to t_{-1}
    d. vessel operators can sell previously contracted intra the Cluster in the period t_{-x} to t_{-1},
    e. vessel operators can buy additional volume from the fuel producer in the period t_{-x} to t_{-1},
    f. vessel operators can sell previously contracted to the fuel producer in the period t_{-x} to t_{-1}.

It is important to note that finalization of positions can only happen in case of a mutually beneficial agreement between both fuel production and fuel offtake. If such an agreement cannot be made, all parties remain bound to the volume outlined in their contractual obligation, as well as associated price and terms, incl. take or pay clauses.

B. During the Post-Offtake Start Date Period Cluster Operation Phase and depending on market and other developments,
    a. fuel producers can offer additional volume to the Cluster with a notice of x days,
    b. fuel producers can offer to buy-back volume from the Cluster with a notice of x days,
    c. vessel operators can offer some or all their previously contracted volume for sale within the Cluster with a notice of x days.
    d. vessel operators buy additional volume that other operators are making available for sale within the Cluster with a notice of x days,

The Balancing Mechanism does not guarantee that volume can successfully be exchanged. Any party issuing a Volume Balancing request within the designated framework has to make an open bid/ or tender for the volume in question, with price subsequently determined through a transparent process of individual bids and offers within a designated time-window. Where the offtake agreement includes a take-or-pay arrangement, the original offtaker remains liable for their volumes unless they have been able to successfully find an alternative taken for the volumes.

Appendix: FDA Data Platform

What: The FDA requires a secure data platform to function effectively, with the platform serving as the primary means for the cluster to receive input from users and provide responses back to those users. The platform will allow FDA participants to submit the data they need to provide to participate in the cluster identification and formalization processes directly to the FDA. The platform would be owned and operated by the FDA entity and hosted on equipment accessible only to FDA staff.

Why: A key aspect of the FDA is its ability to allow clusters of maritime clean fuel demand to be identified without the individual participants in those clusters exchanging commercially sensitive information with each other. The one-way flow of information from users to the FDA, and not between users, is a core feature that allows the FDA to operate in compliance with applicable legislation. The data platform underpins this design feature, providing a secure data entry and storage mechanism.

How: The FDA data platform will consist of a software platform, hosted by the FDA and accessible only to its employees. This system will consist of 2 key elements:

1. A series of data entry forms, that can be used by participants to submit data to the FDA, which the FDA will then use internally to conduct its cluster identification and due diligence processes.
2. An electronic communication tool (e.g. email), that can be used by the FDA to communicate the results of the aggregation rounds (as well as any intermediary outcomes), consisting only of aggregated or derived results that do not reveal the content or owner of any of the original data submissions.

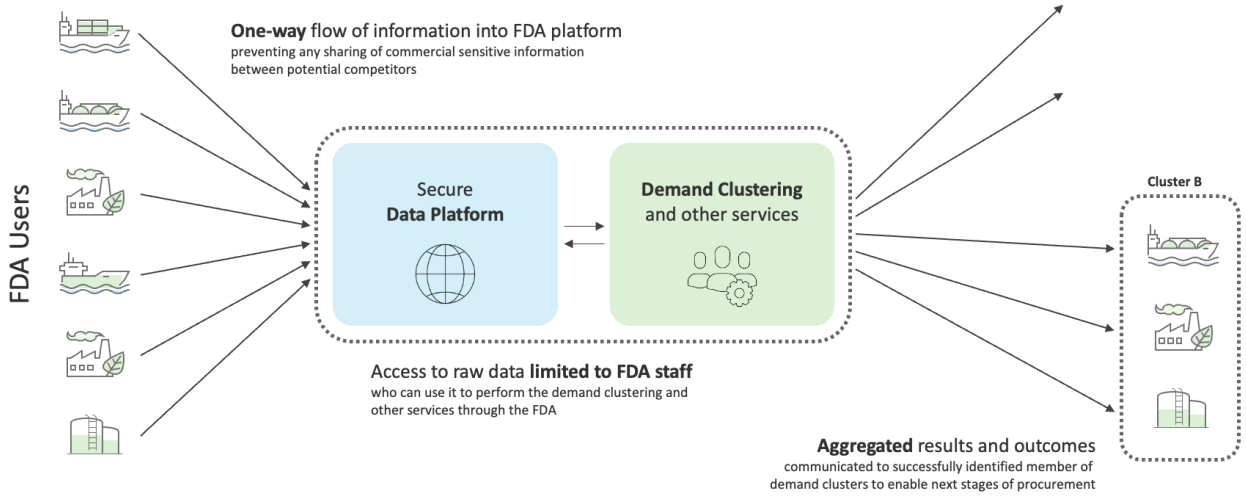
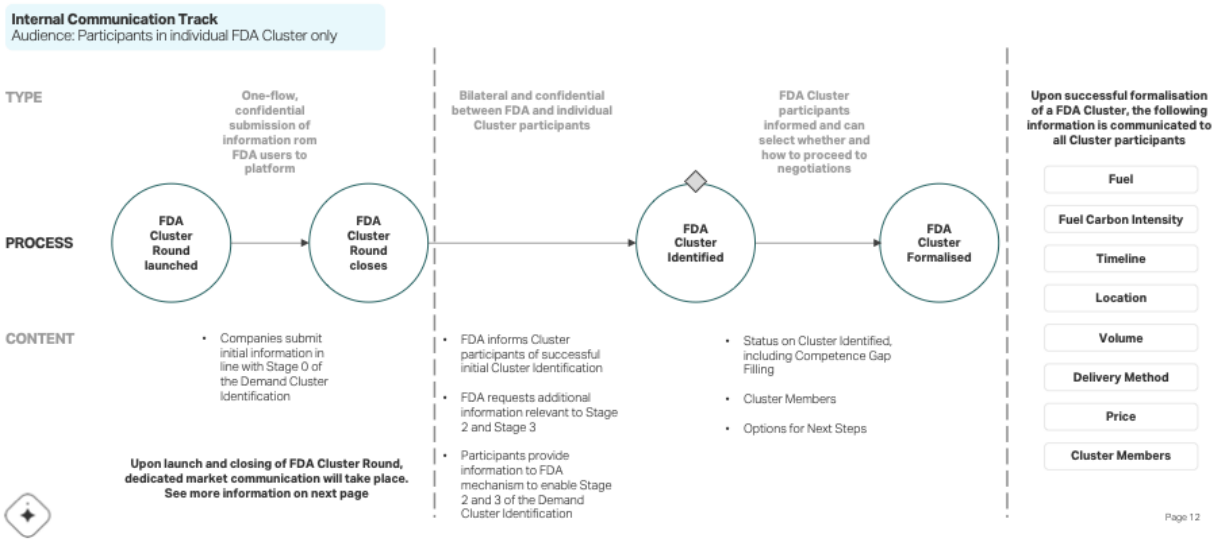


Figure 6 FDA Data Platform

Appendix: Communication Plan

Communication of Identified Cluster: ensuring visibility & market making

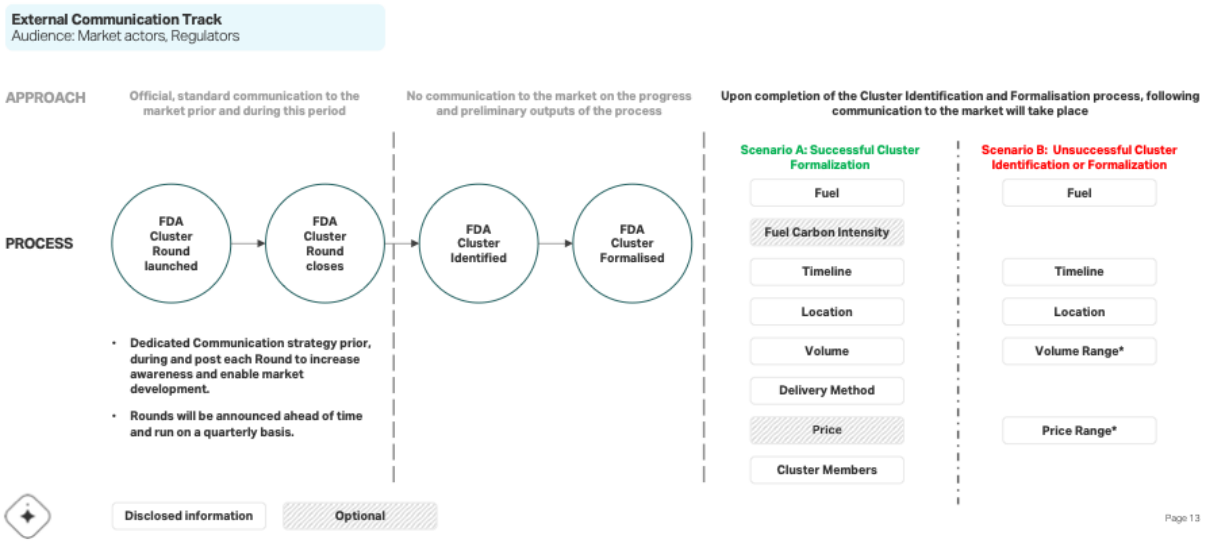
Each aggregation round will entail multi-level communication



Internal

Communication of Identified Cluster: ensuring visibility & market making

Each aggregation round will entail multi-level communication



Internal