Update on Singapore's efforts for a multi-fuel bunkering future

12 Nov 2025

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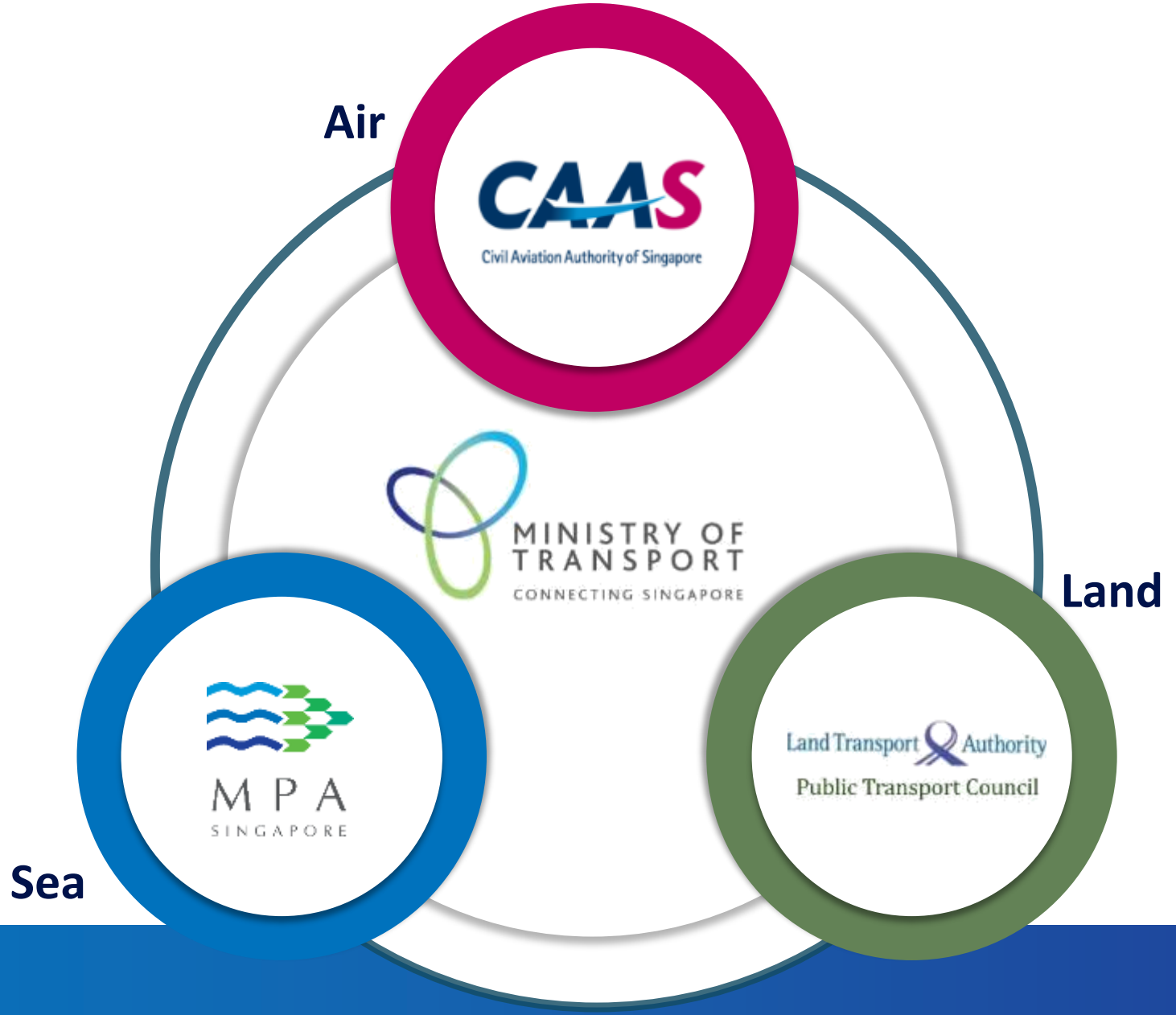
MPA - A Statutory Board under the Ministry of Transport



3 Key Mission Objectives

Premier global hub port

- Port Authority
- Port Regulator
- Port Planner

International Maritime Centre

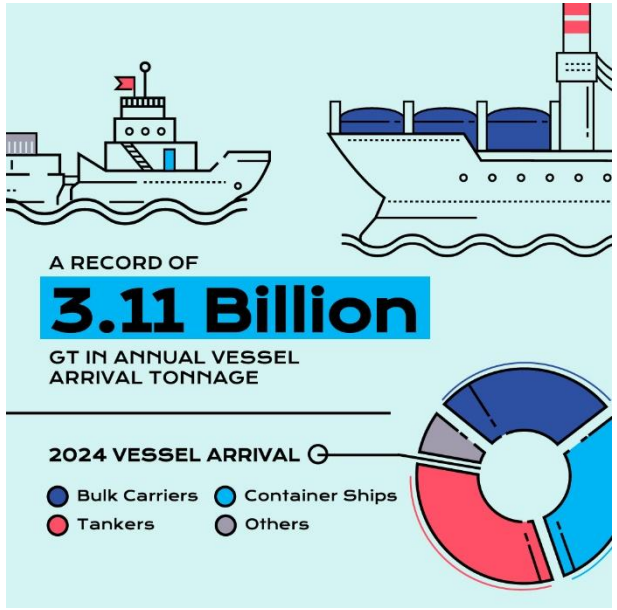
- IMC Promoter
- IMC Developer

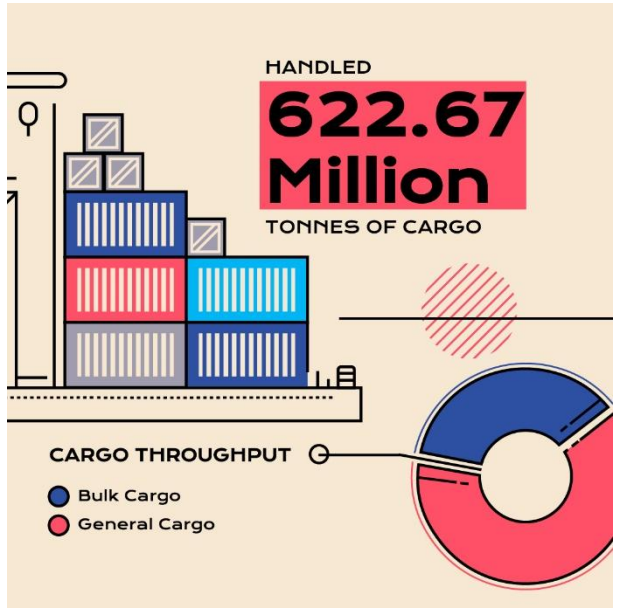
Advance & safeguard Singapore's maritime interests

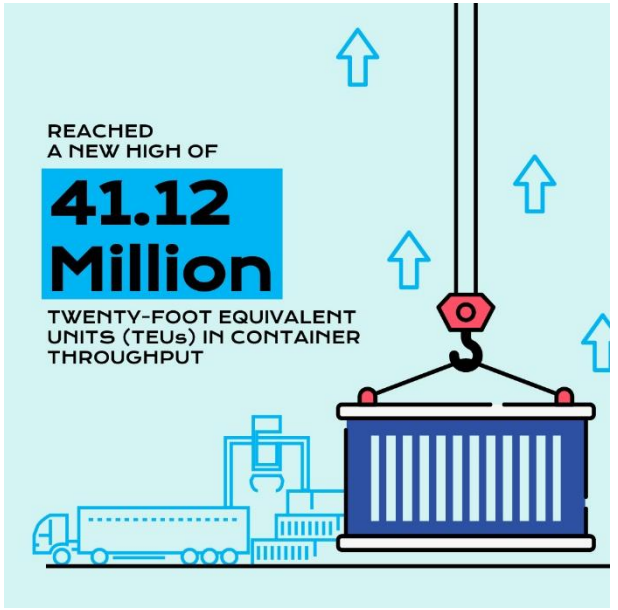
- National Maritime Representative at IMO and other regional/international fora

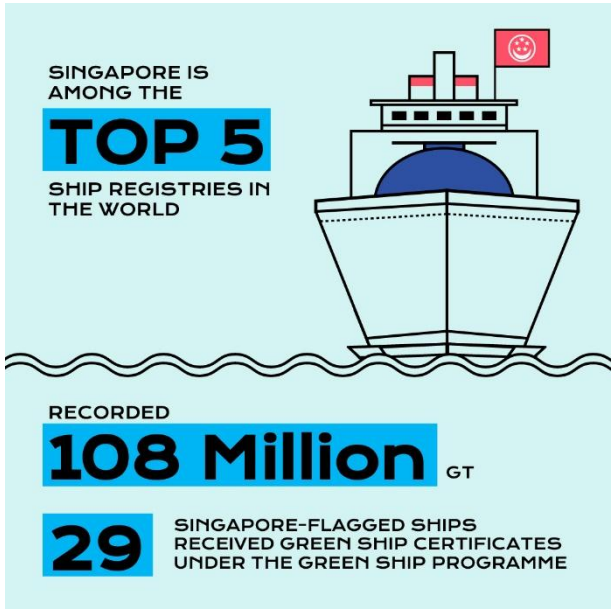
MARITIME SINGAPORE

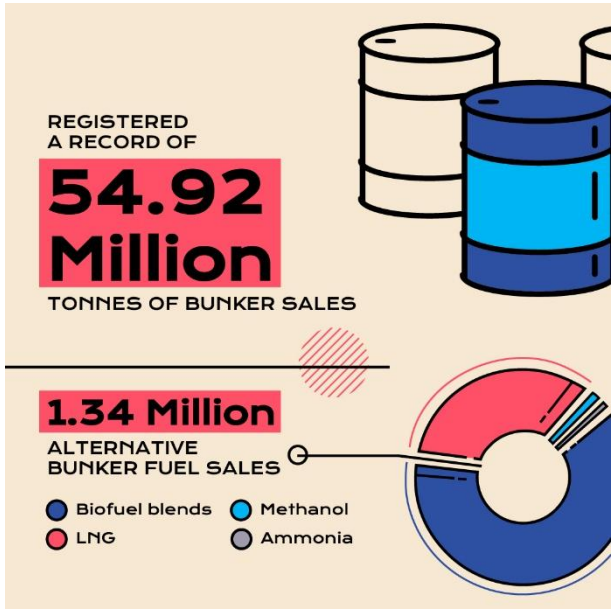
Overview | 2024

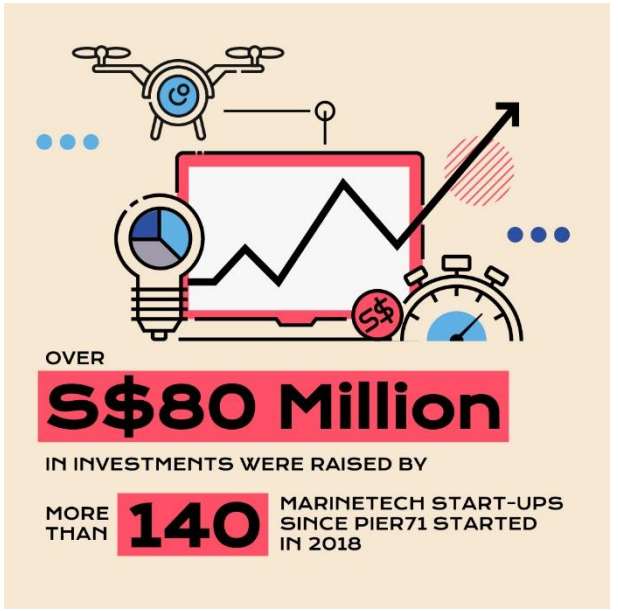




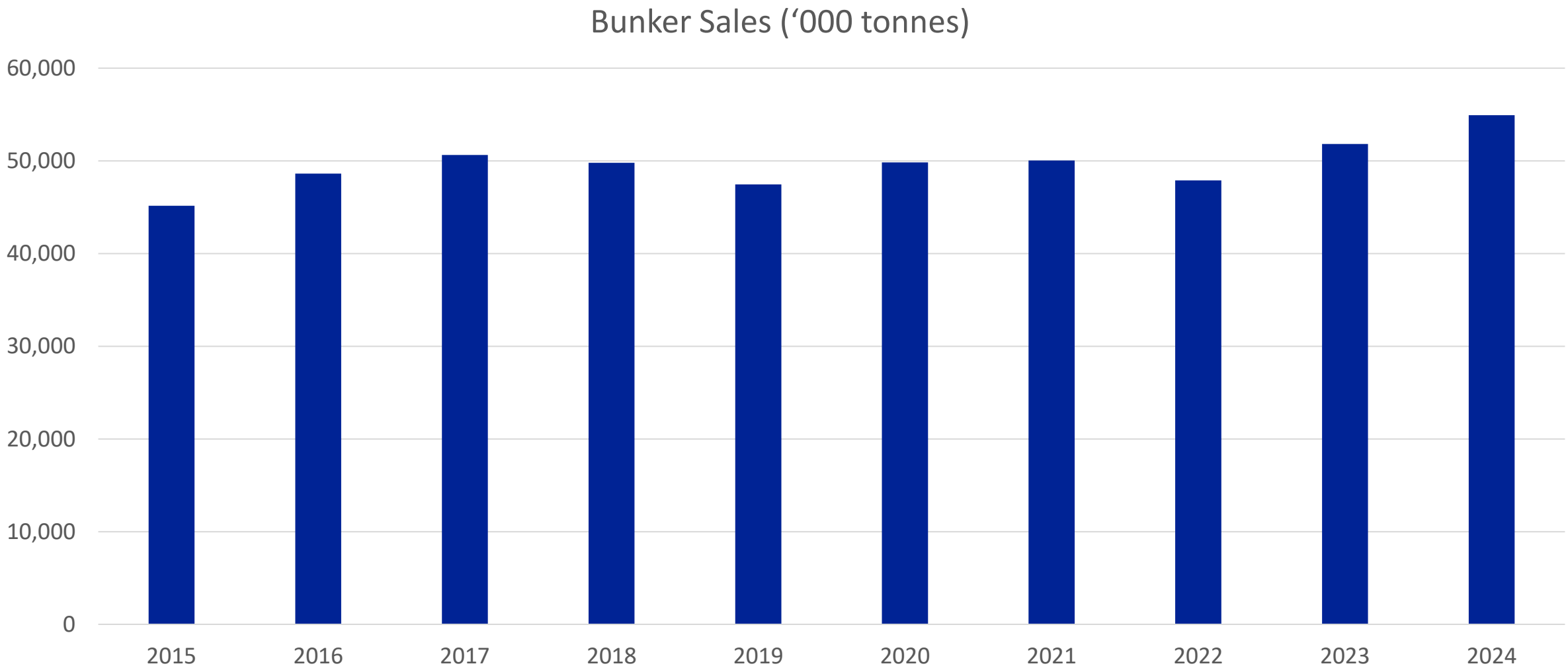






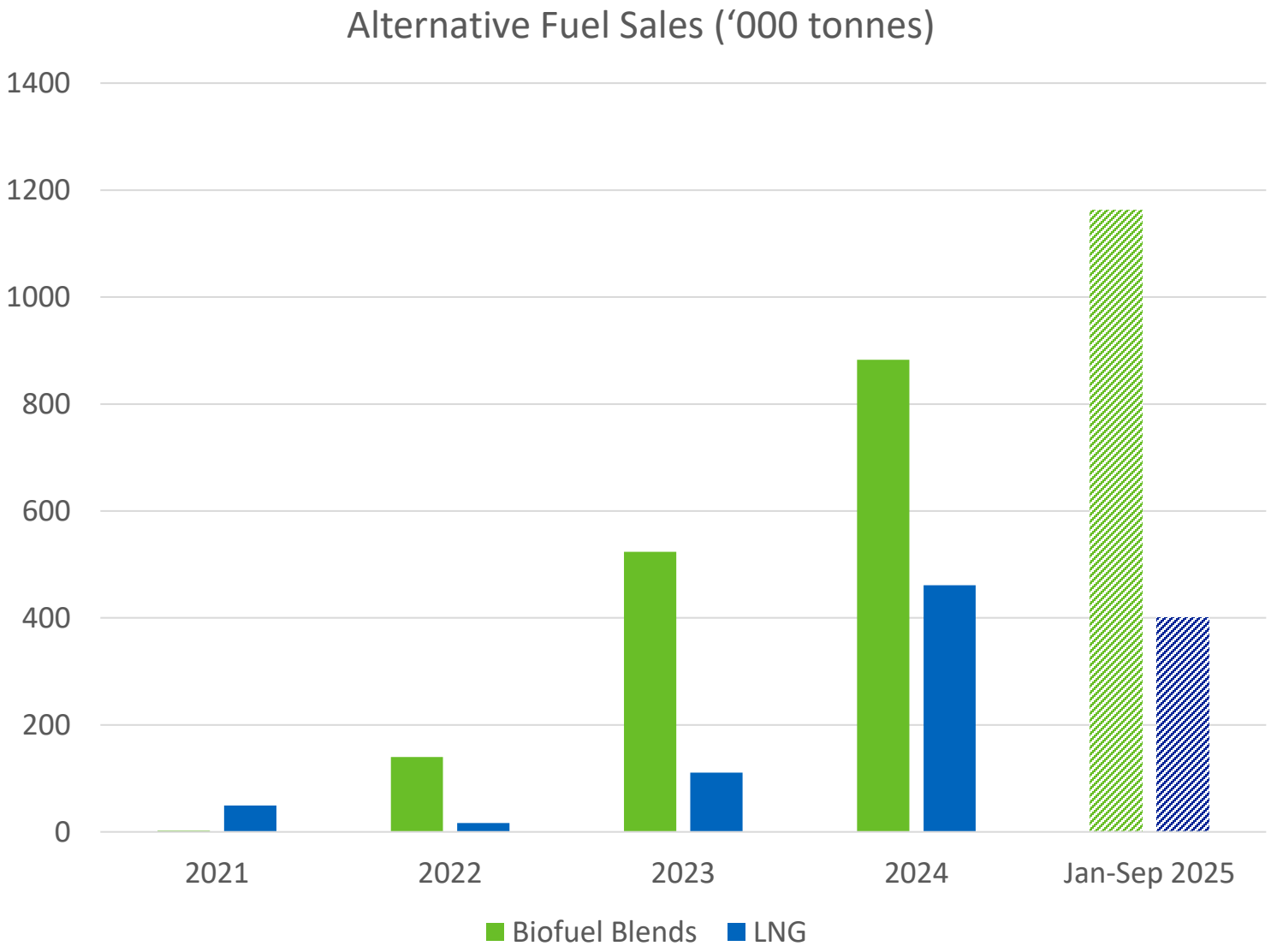


Top Bunkering Hub - Record Bunker Sales in 2024



Bunker sales hit a record of 54.92 million tonnes in 2024.

Growth of alternative fuels



- While more than 97% of sales in 2024 were conventional fuels, alternative fuels sales surpassed 1 million tonnes for the first time, reaching 1.34 million tonnes.
- YTD 2025 Biofuels: **+126% Y-on-Y** as of September
- YTD 2025 LNG: **+20% Y-on-Y** as of September
- Alternative fuels sales expected to grow, as industry aligns to IMO's goal to reduce GHG emissions, with ultimate goal of reaching net-zero emissions by or around 2050.

Singapore's approach to bunkering

- Licensing framework for bunker suppliers and bunker craft operators
- Standards for port limit bunker tankers
- Standards for bunkering, use mass flow meter in bunkering, quality management of bunkering supply chain
  - Updated regularly
- Mandatory use of mass flow meters

- Routine bunker tanker inspections on all licensed bunker tankers

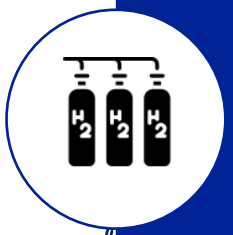
Future global bunker fuel is dependent on several key factors

IMO Regulations post 2025

The adoption of a global IMO measure such as the IMO net zero framework, and trajectory of targets alongside associated rewards/penalties within could influence the adoption of various fuels. Implementation by all member States would be key to maintaining a level playing field and catalysing alternative fuel adoption.

Global/Industry Climate Pledges

Agreements to reduce emissions would put decarbonisation pressures on shipowners e.g. adoption of Global Methane Pledge.



Alternative fuel prices

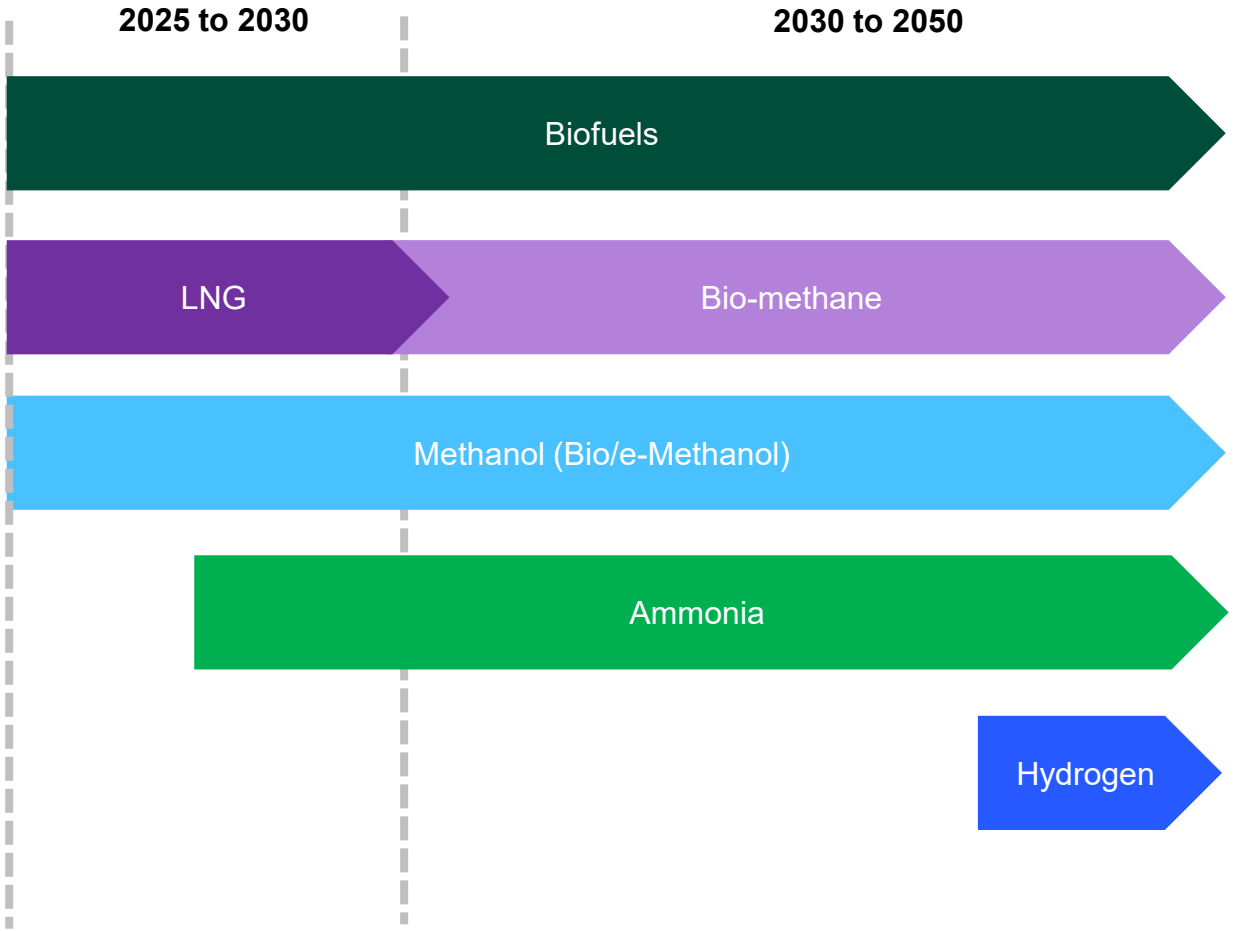
Price sensitive shipping lines will naturally go for the lowest cost options for their fleet. Most vessels in the orderbooks are dual-fuelled, which could slow down demand in the near-term if alternative fuel prices remain significantly higher than conventional fuels. Cross sector demand aggregation could bring fuel prices down.

Supply factors

Alternative fuel supply chains and technology remain nascent. As alternative fuels have lower energy density than conventional fuels, ships will need to refuel in larger volumes or more often. Supply chains across major ports will be needed but are still being developed. Competition across industry sectors for the same fuels could also affect supply. Technical standards to facilitate quality and safety are still being developed

Multi-fuel future with adoption of a variety of alternative fuels

Projected timeline for readiness as mainstream fuel



Biofuels. Widely and reliably used as marine fuel today. Generally compatible with existing engine technology. Likely part of a long-term fuel mix in the industry

LNG/bio-methane. Gaining traction in near-term, with increasing orders and delivery of LNG-fuelled ships.

Methanol. Gaining traction in the near-term, with increasing orders and delivery of methanol-fuelled ships.

Ammonia. Could gain traction in the mid to long term, pending the commercialisation of ammonia engines, development of safety standards, regulations, bunkering infrastructure and training.

Hydrogen. May come online in the long term as direct maritime fuel. Maritime-specific hydrogen technologies, supply chain, regulations and safety standards are relatively nascent. In the interim, hydrogen is expected to play the role of primary feedstock in the production of alternative fuels.

Alternative fuels come with different characteristics

	Methanol	Ammonia	LNG	VLSFO (residual)
Storage	Liquid at ambient temperature	21 °C under 8.8 bar, **-33°C under atmospheric pressure**	-163 °C (Pressurized or unpressurized)	Liquid at ambient temperature
Energy Density MJ/Kg	22.7	**18.6**	50 – 55	41.6
Flammability (% air volume)	6.7 – 36	**15 – 28**	4 – 15	1 – 5
Flash Point (°C)	11	**132**	-188	>60

- Ports need to consider safety (toxicity, flammability), environmental considerations, provision of shore and bunkering infrastructure, etc.

Biofuel bunkering

Range of blends provided

- Mostly blends with LSFO, but also some MFO, MGO, MDO
- Predominantly B24, but have also seen deliveries of B30 and B100 (FAME & HVO).
- Biomass is mostly UCOME from Asia.
- Singapore has conducted multiple pilot trials of up to B100 (alternative feedstocks) biofuel blends.

Issues thus far

- No issues thus far with regard to use of Mass Flow Meters

Scaling Up Biofuels Safely

Facilitating the carriage of higher blends biofuel (B30)

- To support the uptake of high blend biofuels, Singapore has adopted the early implementation of the draft Interim Guidance on the Carriage of Blends of Biofuels and MARPOL Annex I Cargoes by Conventional Bunker Ships for Singapore Registered Ship.
- MPA licensed Annex I bunker tankers operating in the Port of Singapore are now allowed to carry and deliver biofuel blends of not more than 30% by volume of biofuel or synthetic fuel (≤B30) from **7 March 2025 onwards**.

Biofuel Standards (TR140:2025)

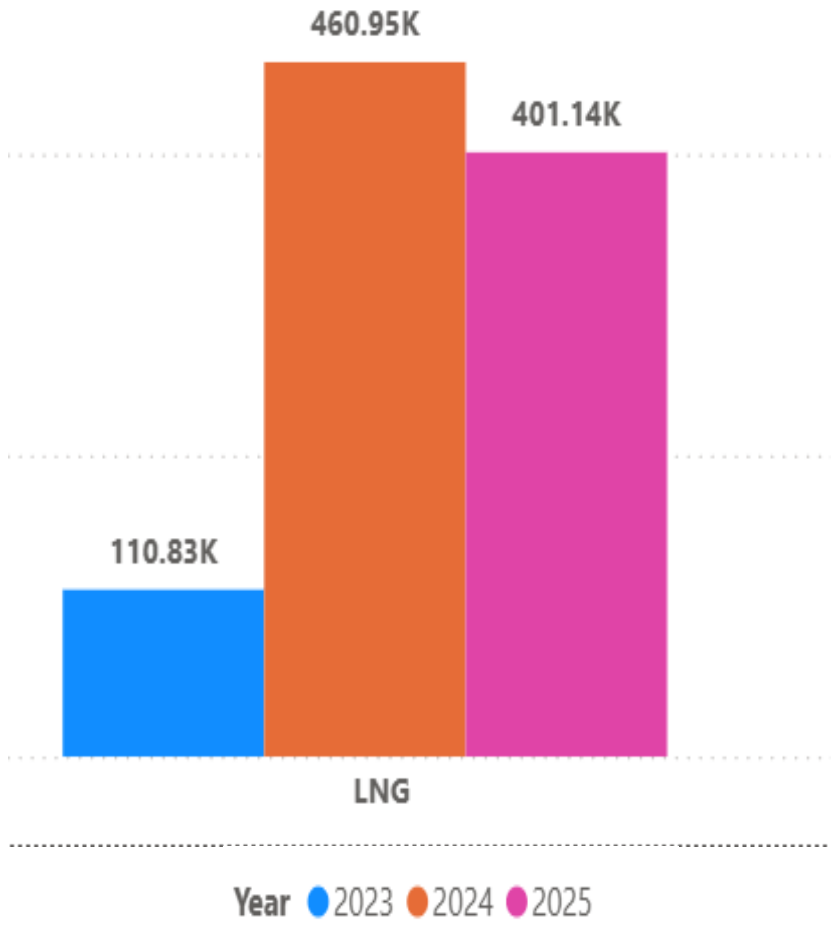
- MPA, through the Singapore Standards Council, had developed a provisional standard on specifications of marine biofuel (WA 2:2022).
- This standard has been enhanced to TR 140:2025 to supplement the existing international standards ISO8217:2024, providing guidance to users on the usage of biofuel up to B100 and ensuring the quality of biofuel delivered in Singapore. This standard will be part of a broader biofuel framework set out by MPA.
- Published on 9 May 2025. Available at Singapore Standards website

Steady Progress for LNG

With 3 licensed LNG suppliers today, Singapore's LNG bunker volumes reached 400K tonnes in Jan-Sep 2025 vs 460K tonnes for whole of 2024.

LNG bunkering carried out ship-to-ship at anchorage and also SIMOPS at container terminals.

LNG bunkering & simultaneous operations of cruise ship Silver Nova was carried out at Singapore Cruise Centre in Feb 2025.



Steady Progress for LNG

Expression of Interest (EOI)

MPA continues to monitor the growing demand for LNG, and seeks to enhance and develop future LNG bunkering capabilities.

In December 2024, MPA launched an EOI to better understand

(i) the potential for scaling up sea-based LNG reloading,

(ii) industry's interest to supply LNG alternatives such as e-/bio-methane

(iii) new concepts and use of floating platform to increase bunkering safety, efficiency and incident response.

The EOI closed on 28 February 2025 and has received 14 proposals.

Standards

Technical Reference (TR) 56 for LNG bunkering was launched in 2017, and provides a framework to enable safe and efficient LNG bunkering operations

TR 56 is currently undergoing updates and revision, to be upgraded to a Singapore Standard.

MPA Partnering with Industry for a Robust Methanol Bunkering Framework

1 Laura Maersk (Trial)

- World's First ship to containership methanol bunkering
- Laid foundations for subsequent methanol bunkering operations

3 Stena Prosperous/Eco Maestro

(Stena Prosperous x Kara)
- Demonstrated large-scale methanol bunkering capabilities with more than 1300MT methanol bunkered

(Eco Maestro x Kara)
- First simultaneous methanol bunkering operations (SIMOPS)

5 Singapore Maritime Week (SMW)

Announced the opening of methanol licence application

7 Application closure

Closing of the licence application and starting of the evaluation

July 2023 — **Dec 2023** — **May 2024** — **March 2025** — **April 2025** — **28 May 2025** — **Evaluation of Proposals & Licence Issuance**


Expression of Interest for the Supply of Methanol as a Marine Bunker Fuel in the Port of Singapore

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Published 14 Dec 2023

Share:

The Maritime and Port Authority of Singapore (MPA) issued an Expression of Interest (EOI) on 14 December 2023 to invite interested parties to submit proposals for the supply of methanol as a marine bunker fuel in the Port of Singapore.

2 MPA's Expression of Interest (EOI)

Over 50 Proposals received

4 Publication of Standards

- TR129 on Methanol Bunkering Standards for Methanol Port Limit Bunker Tankers

6 Industry briefing & Engagement

Over 50+ participants across 33 companies attended the engagement session

Methanol Bunkering

Singapore has successfully conducted 3 methanol bunkering operational pilots with close to 2,000 tonnes of methanol bunkered.

- **Laura Maersk (Jul 2023):** World's first ship-to-containership methanol bunkering that laid foundations for subsequent methanol bunkering operations.
- **Stena Prosperous (May 2024):** Demonstrated large-scale methanol bunkering capabilities where more than 1300 tonnes of methanol were bunkered and tested processes with experiences gained from the first methanol bunkering operation.
- **ECO Maestro (May 2024):** First simultaneous methanol bunkering and cargo operations (SIMOPS) and demonstrated the viability and enhanced operational efficiency of SIMOPS for container vessels.

Methanol Firefighting Awareness

Awareness of properties of methanol is important

Progress on methanol bunkering framework

Expression of Interest (EOI)

In Dec 2023, MPA issued an EOI to invite interested parties to submit proposals for the development of end-to-end methanol bunkering solutions in Singapore from 2025.

Standards

Working Group on standard development for methanol bunkering.
Technical Reference TR 129 on Methanol Bunkering launched in March 2025.
Standards for Methanol Port Limit Bunker Tankers also released in March 2025.

Bunker vessels

Bunker vessels ready to supply methanol already in Singapore port.

Licence

Licence application opened on 26 March 2025 and closed on 28 May 2025. Applications from 13 companies received.

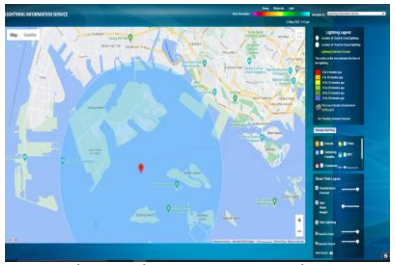
MPA currently evaluating proposals.

Work remains on mitigation measures

Lightning Detection

- Portable lightning detector
- Lightning alert service

Lightning detector



Lightning web service

Thermal Imaging

- Portable Thermal camera

Thermal camera

Gas detector

- Portable gas/methanol detector

Lower Explosive Limit Detector

Methanol detector tubes

Photo-ionization detectors

Smart hose system

- Quick Connect Disconnect coupling
- Dry breakaway coupling

QCDC

Dry breakaway coupling

PPE

- Chemical suit

Chemical Suit

Portable methanol gas detector

Ammonia Bunkering – The Next Frontier

- In 2024, MPA facilitated the world's first use of ammonia as a marine fuel in the Port of Singapore. The successful conduct of the ammonia fuel trials on board Fortescue Green Pioneer marks a significant milestone in Singapore's multi-fuel bunkering capability development to support decarbonisation for international shipping.

Progress on ammonia bunkering

Bunkering proposals

In December 2022, **EOI issued** to invite interested parties to submit proposals for the **development end-to-end low or zero-carbon ammonia power generation & bunkering solutions**.

In 2023, six consortia were shortlisted to participate in a restricted Request for Proposal

Consortium led by Keppel Ltd has been appointed to conduct the next phase of the project to provide a low- or zero-carbon ammonia solution on Jurong Island for power generation and bunkering.

Sumitomo Corporation, Keppel Ltd's bunkering partner, will also conduct a Front-End Engineering Design (FEED) study to advance the bunkering proposal.

Standards

The Ammonia Bunkering Technical Reference (TR) is currently being developed a work group. It will be used during trials to (1) validate the TR, and (2) provide feedback for subsequent revisions. The TR will be used as a (3) requirement for future licensees to comply with. The ammonia TR will cover 4 parts:

Part 1 General introduction
Part 2 Custody transfer requirements
Part 3 Procedures and safety distances
Part 4 Competency requirements

Challenges that need to be addressed

- **Risk associated with ammonia**

I. Ammonia is a widely traded commodity (cargo) but the future receiving vessel crew do not have much experience handling ammonia as a fuel
II. The lack of exposure and knowledge on ammonia increases the risk associated with handling of the product
III. Toxic. Clear hazards zone should be demarcated, and PPE enforced when required to enter the area
IV. Corrosive to certain metals. Need to ensure these metals to are not used in the ammonia fuel delivery system. Stringent procurement and quality assurance procedures to be in place, especially as commonly purchased ship parts might include metals such as copper, copper alloys and zinc.

- **Vessel, equipment and crew**

I. Treatment systems to manage substances such as ammonia, NO_x and N_2O must be in place
II. N_2 generator and system must be in place to ensure smooth and safe operation
III. Ammonia after-treatment equipment is critical for vessel to carry out purging activities safely
IV. QCDC, dry breakaway couplings and emergency shut down (ESD) for safe ammonia transfer ops
V. Careful study of vessel air flow and ventilation important for leak scenarios. Optimise location for detectors and sensors.
VI. HAZMAT suits must be complemented with communication devices (e.g. walkie-talkies) that crew can operate easily while using the suit
VII. Consider having provision for manual sampling with portable detectors in rooms / enclosures with ammonia inventory (e.g. TCS, FPR) from the outside
VIII. Crew training – fire and safety drills specifically due to toxicity, emergency preparedness, evacuation drills. STCW training requirements to be reviewed for ammonia when used as fuel and bunkering.
IX. Safe refuge/haven – positive pressure in accommodation as safe zone

H_2 – Monitoring of Salient Developments for H_2 as fuel in the marine industry

- Singapore's National Hydrogen Strategy launched at the Singapore International Energy Week (SIEW) 2022
- With the low energy density in hydrogen, hydrogen gas needs to be (1) **liquefied**, (2) **compressed**, or (3) **converted into a hydrogen carrier** for transport and storage

1. In **Liquefied** Hydrogen, LH_2, MPA is part of the Maritime Technologies Forum (MTF) which released high-level **safety guidelines and considerations** for LH_2 bunkering systems and procedures in 2024.
2. In **Compressed** Hydrogen, CH_2, while there are preliminary discussions to facilitate CH_2 in marine applications, the use-cases are **limited** and not at commercial scale to justify development of a regulatory framework, e.g. commercial licence.
3. In use of **Hydrogen Carrier**, developments follow the track of ammonia developments.

Singapore Launches Next Stage of Selection of Low- or Zero-Carbon Ammonia Power Generation and Bunkering Project Developer

MPA SINGAPORE
ENERGY MARKET AUTHORITY
Our Clean Energy Future

Published 23 Oct 2023

*(**Above**) Joint Media Release: MPA x EMA EOI on Power Generation and Bunkering Solutions*
*(**Left**) https://www.mti.gov.sg/Industries/Hydrogen*

Digital Bunkering

- Digital Bunkering aims to improve documentation efficiency, data accuracy, and information visibility across the supply chain.

- With effect from 1 April 2025, bunker suppliers are required to provide digital bunkering services and issue electronic bunker delivery notes (e-BDNs) as a default. MPA has also implemented an eBDN record verification facility, allowing stakeholders to verify the eBDNs.

- MPA has worked with EnterpriseSG and various industry partners to launch the specification for digital bunkering supply chain documentation (SS709:2024). This Standard provides requirements for the main types of digital documents utilised and exchanged within bunkering supply chains, aligning with established business practices and bunkering standards.
- MPA continues to be the driver for global adoption of Digital Bunkering, including the use of eBDN

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Thank You