FLEET MANAGEMENT LIMITED
A Caravel Group Company

Learning from Ammonia consortiums

Prepared by : Prakash Chandra

BOTH BLUE AND GREEN AMMONIA HAS HUGE POTENTIAL

In recent years, international shipping has been recognized as a major contributor to global trade, accounting for 90% of trade volume while also emitting **approximately 3% of global greenhouse gas** (GHG) emissions. The International Maritime Organization (IMO) has set an **ambitious target of reducing GHG emissions from shipping by 50% by 2050, compared to 2008 levels.**

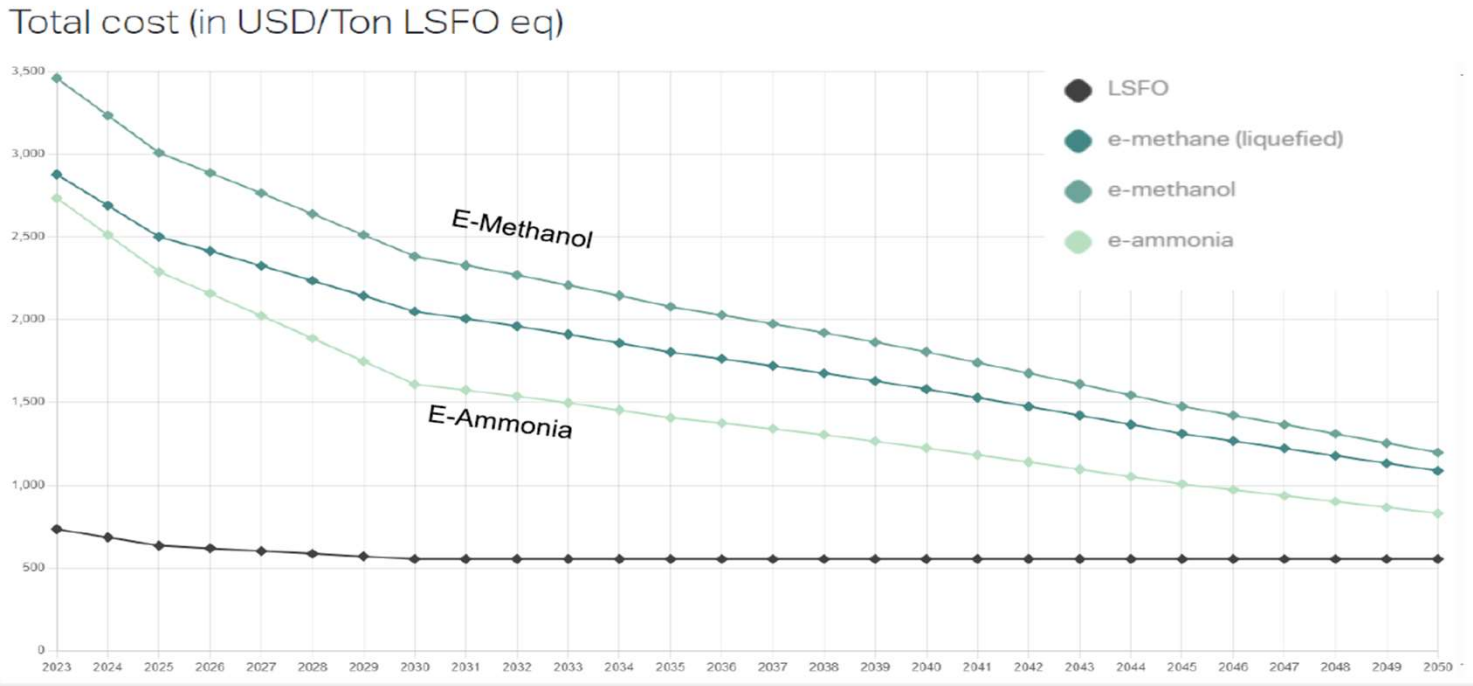
To achieve this goal, the maritime industry is increasingly looking at **green and blue ammonia as viable alternative marine fuels.**

Ammonia stands out as a **promising alternative fuel** for the maritime industry, offering a pathway to significant **reductions in greenhouse gas emissions** while leveraging existing infrastructure and technology. Its **potential to be produced sustainably** further cements its importance in the transition to a low-carbon future for shipping.

While ammonia presents a viable alternative fuel option for decarbonizing maritime trade, **its toxicity** cannot **be overlooked**. Addressing **safety concerns** through **robust handling protocols**, **infrastructure design, regulatory compliance and public awareness** is essential for its **successful adoption.** By prioritizing safety measures, the maritime industry can harness the benefits of ammonia while mitigating its risks.

E-AMMONIA IS EXPECTED TO BE LEAST COSTLY TO PRODUCE

E-ammonia is made from green Hydrogen and N2, which is available in the atmosphere and cheaper to obtain than the biogenic CO2 needed for carbon based e-Fuels.



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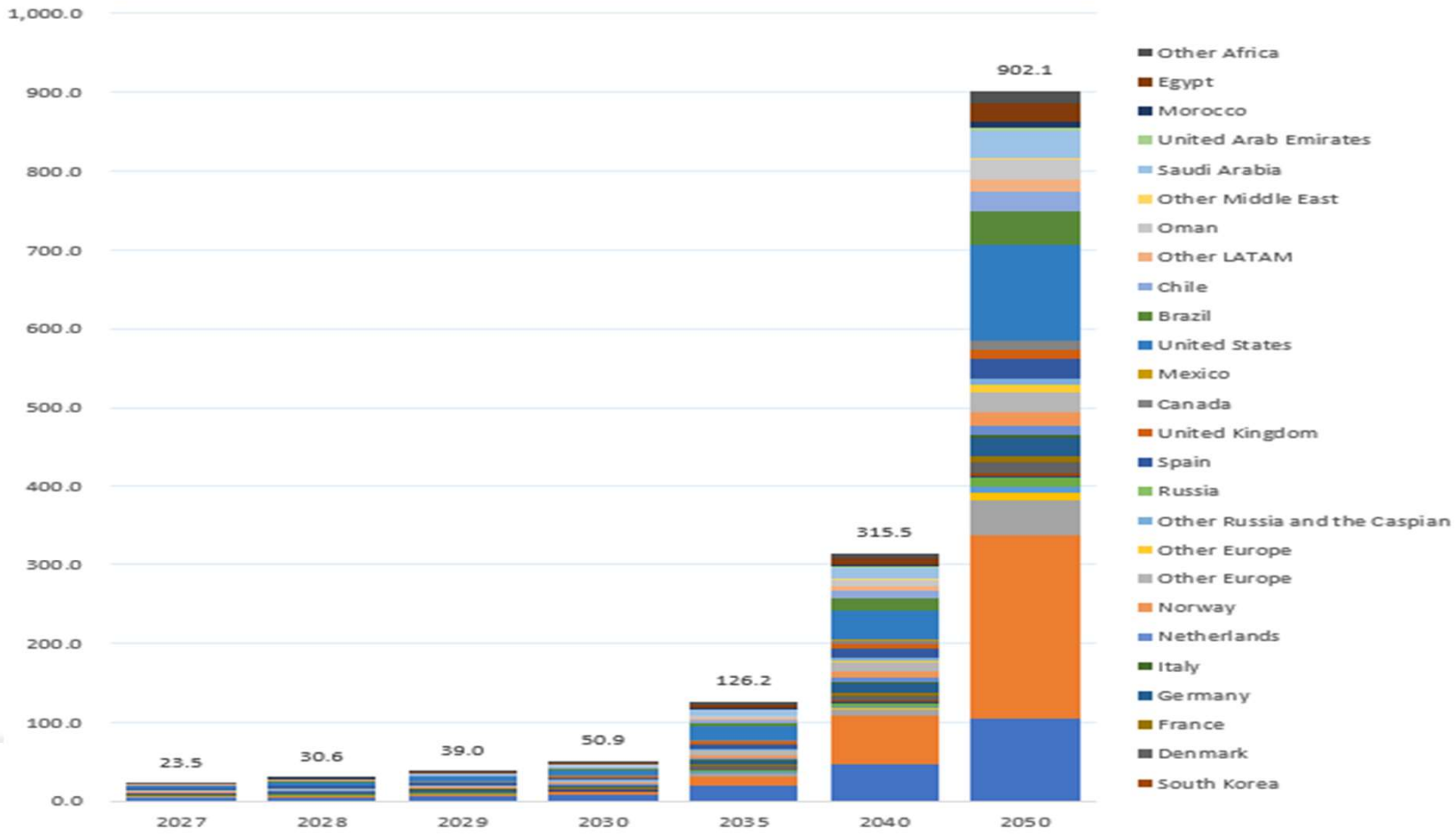
Est. Ammonia Production country wise(Green, mil ton/year)



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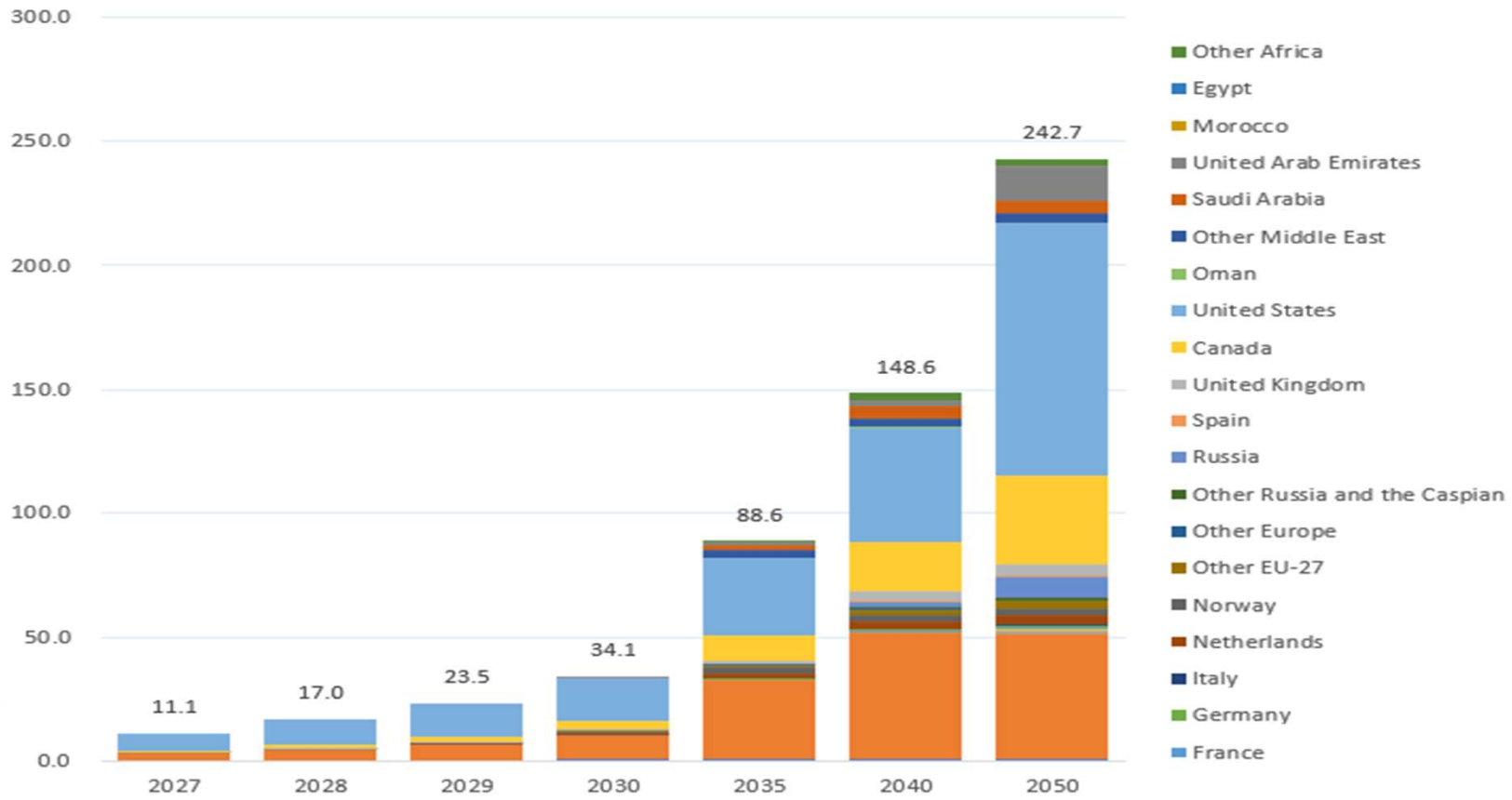
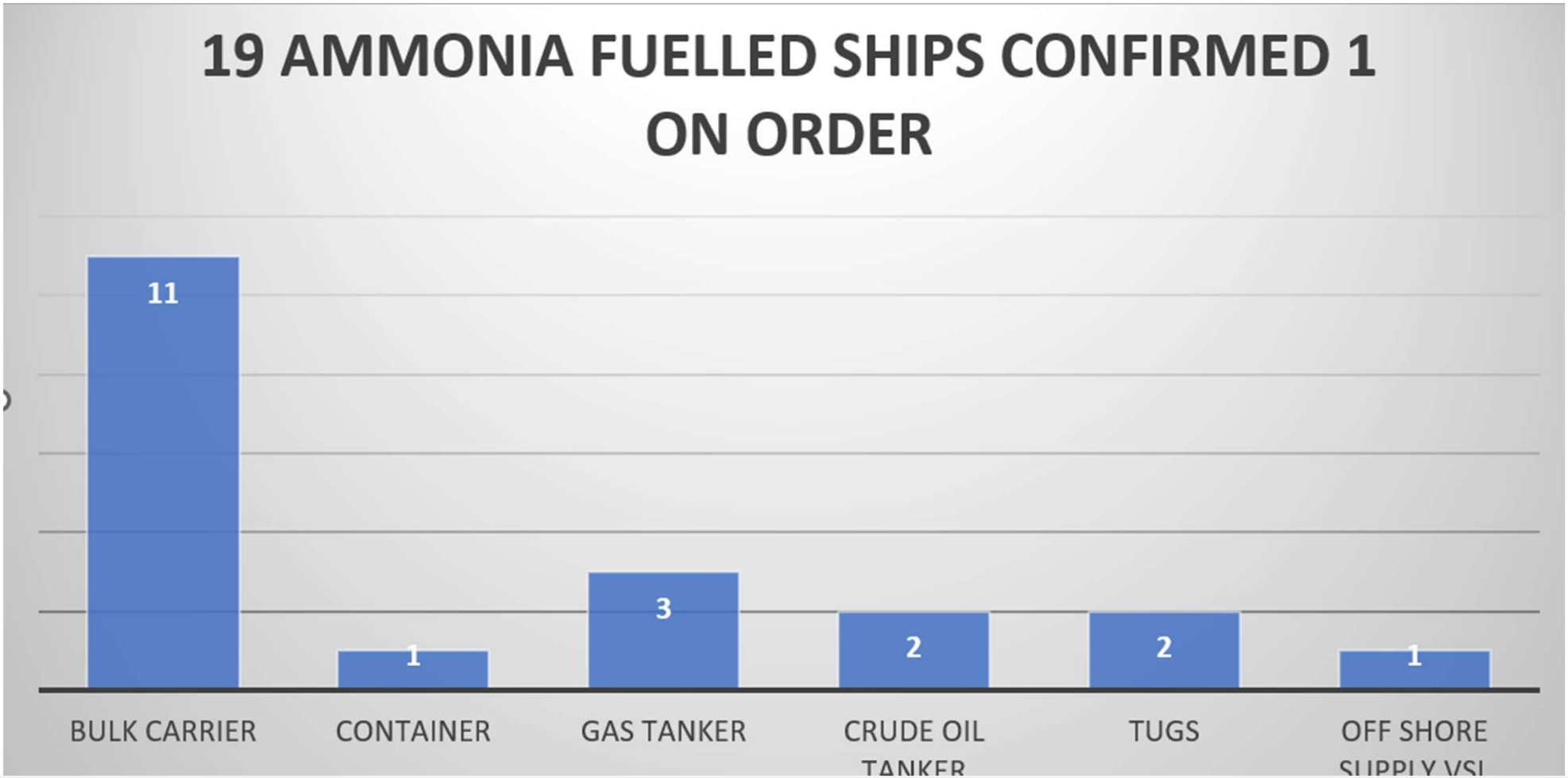
Est. Ammonia Production country wise(Blue, mil ton/year)




19 AMMONIA FUELLED SHIPS CONFIRMED 1 ON ORDER
11
1
3
2
2
1
BULK CARRIER
CONTAINER
GAS TANKER
CRUDE OIL TANKER
TUGS
OFF SHORE SUPPLY VSL

SABRE – SINGAPORE AMMONIA BUNKERING FEASIBILITY STUDY

On 8 Mar 2021 , SABRE partners entered into an MOU to conduct a year long feasibility study to assess the **technical, commercial and regulatory viability** in establishing an end-to-end supply chain to enable **Ammonia Ship-to-Ship bunkering in Singapore.**

Singapore was selected as a location of study based on :
Singapore **being largest bunkering port in world**
Commitment from **major container liner** to make ammonia fuelled vessels necessary to make **demand for ammonia as fuel**
Participation of **major ammonia producer**
Availability of **space for making ammonia storage tanks** backed by major tank owners
Availability of **Major shipbuilder**
Proactive Government interested to develop ammonia as zero carbon fuel

SABRE – SINGAPORE AMMONIA BUNKERING FEASIBILITY STUDY

With the preliminary target to commence Ammonia bunker operation **within 2020s**, the **scope of Study included** :
-Identifying **potential sources of Ammonia**,
-**Engaging local authorities** to understand the current standing
-Plan for **regulatory establishment**
-The **infrastructure** that needs to be put in place
-As well as the **availability of technology** to enable Ammonia bunkering in Singapore.

The Study assumed the development of Ammonia bunkering in **two(2)stages**, i.e. **Pilotstage before** scaling upto **Commercial stage** based on a set of Ammonia bunker demand projections.

Present status in 2024 is that SABRE consortium member has been **selected by Energy Market Authority (EMA) and MPA** as one of the consortia for **power generation and building one of the first ammonia bunkering vessel** and develop **training programs** for **handling ammonia fueled vessel.**

Training program is being developed at **Maritime Energy Training Facility** together with MPA, Singapore

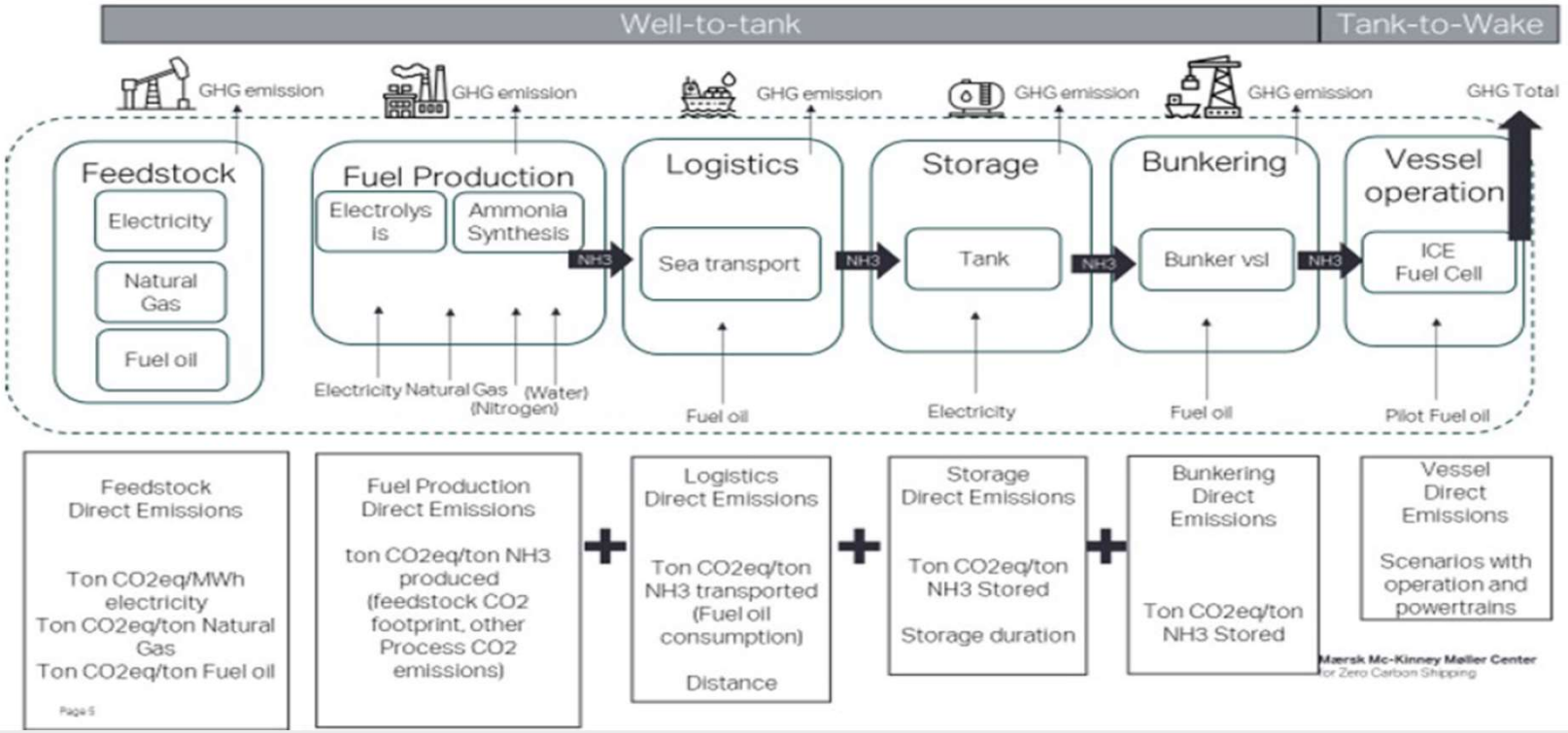
SABRE – SINGAPORE AMMONIA BUNKERING FEASIBILITY STUDY

SABRE CONSORTIUM IS CONSISTING OF FOLLOWING MEMBERS :

AP MOLLER MAERSK AS
MAERSK MC-KINNEY MOLLER CENTER FOR ZERO CARBON SHIPPING
SUMITOMO CORPORATION
FLEET MANAGEMENT LIMITED
AMERICAN BUREAU OF SHIPPING
KEPPEL OFFSHORE AND MARINE
MPA SINGAPORE
K LINE
SEA SPAN(Short Period)
Yara Corporation ASA
(Short period)
SUPPORTED BY MAN
B&W

SABRE – SINGAPORE AMMONIA BUNKERING FEASIBILITY STUDY

LCA of NH_3 supply chain



Source : mmmczc

SABRE – SINGAPORE AMMONIA BUNKERING FEASIBILITY STUDY

Preliminary Supply Chain Structure

		(1) Pilot Period		(2) Ramping Up Period		
		2025	2026	2027	2028	2029
Feeder	Annual Volume (mT-NH_3)	92,000	103,500	103,500	103,500	103,500
	# of vessels	4	4	4	4	4
14000TEU	Annual Volume (mT-NH_3)	-	-	215,000	531,000	590,000
	# of vessels	-	-	6	11	11
Total	Annual Volume (mT-NH_3)	92,000	103,500	318,500	634,600	693,500
	# of vessels	4	4	10	15	15

Period	Production	Supply Chain Plan
(A) Pilot Period (Cost Minimize Plan) 2025~2026	Malaysia	Loading → NH_3 Bunkering Vessel (Serve as Carrier, Storage and Bunkering) → StS → Feeder
(B) Pilot Period (Stable Supply Plan) 2025~2026	Malaysia Australia Middle East	Loading → NH_3 Carrier → StS → NH_3 Bunkering Vessel (Serve as Storage and Bunkering) → StS → Feeder

SABRE - STATUS

PROJECT STUDY STARTED IN MARCH 2021 AND SINCE THEN EVERY MONTH THE CONSORTIUM IS MEETING ON 2ND TUESDAY OF EVERY MONTH.

The project study is now in 2nd phase where design of 24K CUBM and 33K CUB M ammonia bunkering is now being finalized.

- COMPLETED **HAZID** FOR AMMONIA BUNKERING VESSEL
- COMPLETED **AIP** FOR AMMONIA BUNKERING VESSEL
- COMPLETED PRELIMINARY **DESIGN CONCEPT** OF AMMONIA BUNKERING VESSEL
- THERE WILL BE TWO VESSEL MADE
- ONE VESSEL WILL BE OF -- CUBIC CAPACITY PROPELLED BY AMMONIA MAIN ENGINE.
- SECOND VESSEL WILL OF -- CUBIC CAPACITY PROPELLED BY DFAE 4 STROKE AMMONIA ENGINE WITH TWO AZIMUTH THRUSTERS AFT AND TWO BOW THRUSTER IN FORWARD
- STUDY FOR **AMMONIA DISPEERSION** IS COMPLETED AND FINAL TEST SCENARIO WILL BE ENACTED AT RAFFLES RESERVED ANCHORAGE AND PASIR PANJANG CONTAINER TERMINAL
- STUDY IN PROGRESS FOR AMMONIA BUNKERING PROCEDURES AND **TRAINING** FOR CREW WITH CONSORTIUM MEMBERS
- ASSISTED FOR AIP AND DESIGN FOR 15,000 TEU CONTAINER VESSEL FOR SEA SPAN

SABRE – STATUS- LEARNING

LEARNING AND **DIFFRENCE OVER**

ALREADY EXISTING CONTROL

FOR

LNG AND METHANOL BUNKERING

NEED FOR STUDY OF AMMONIA DISPERSION

Ship-to-ship bunkering

Ship-to-ship bunkering with cargo handling (SIMOPS)

Truck-to-ship bunkering

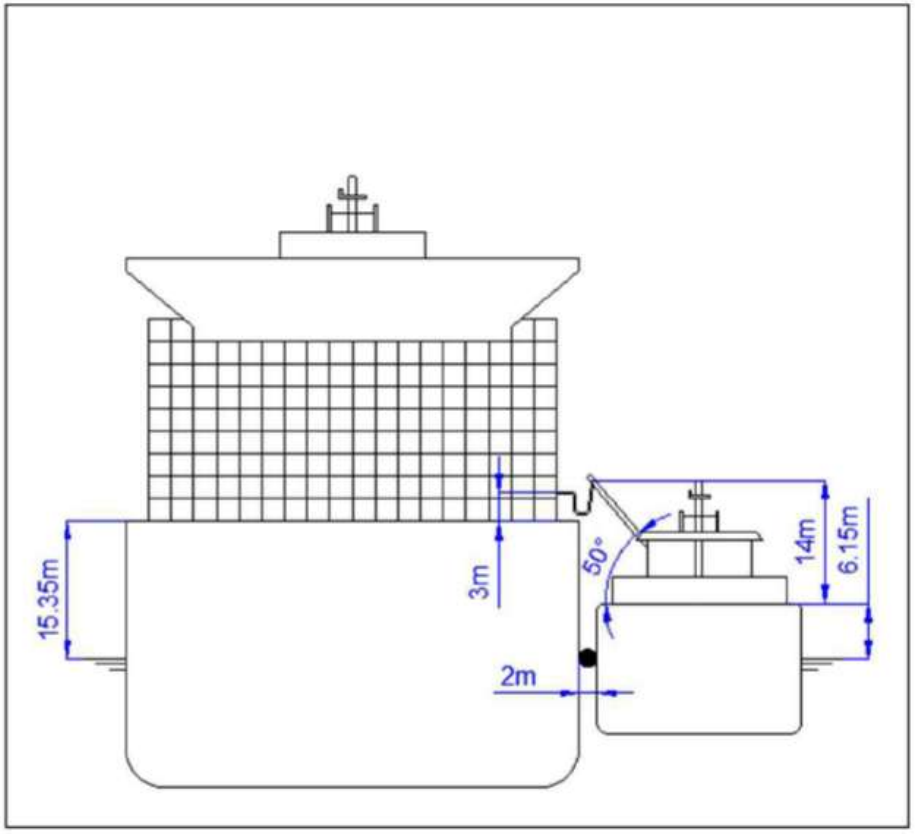
No.	Bunkering Mode	Supply Vessel/Facility	Receiving Vessel	CFD simulation of Ammonia Dispersion		
				Wind Direction	Dispersion Time	Concentration

1	Ship to ship	NH3 carrier	Container ship	• Dispersion of liquid ammonia
				  • Wind blows from bunker vessel to receiving vessel
				  • Wind blows from receiving vessel to bunker vessel
				• Dispersion of ammonia vapor
				  • Wind blows from bunker vessel to receiving vessel
				  • Wind blows from receiving vessel to bunker vessel
					• 30s
					• 60s
					• 2 min
					• 5 min
						• 30ppm (AEGL 1)
						• 160ppm (AEGL 2)
						• 1100ppm (AEGL 3)

2	Ship to ship	NH3 carrier	LPG carrier			
3	Ship to ship	NH3 carrier	Bulk carrier			
4	SIMOPS	NH3 carrier	Container ship			
5	Truck to ship	Truck (ISO tank)	Tugboat			
6	FSU to ship	FSU	Container ship			

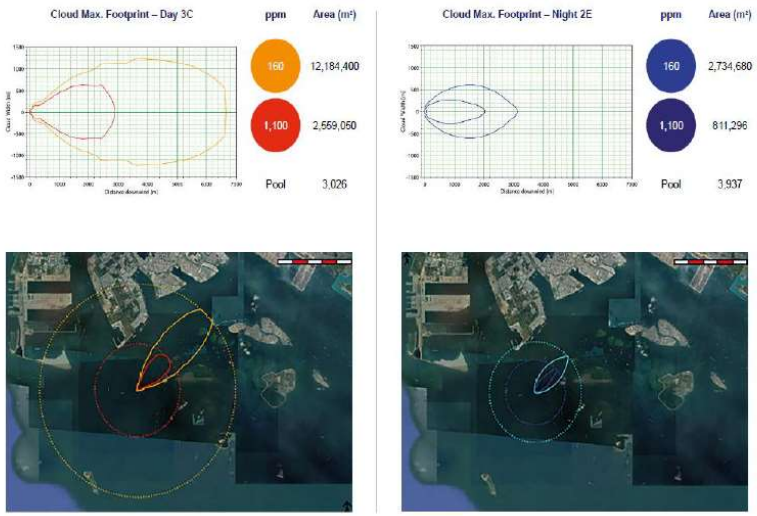
NEED FOR STUDY OF AMMONIA DISPERSION

Category	Parameter	Value
Ammonia release	Release location	Ammonia bunker hose connection at the receiving vessel
	Isolation time	1 min for fully automated blocking system
	Total release volume	26.29 m^3
	Release elevation	Around 18.35 m above water line
	Orifice size	203 mm
	Jet direction	Vertical up
	Liquid fraction	0.999805 (Simulated by PHAST software)
Weather condition	Temperature	30°C (Singapore ambient temp.)
	Relative humidity	85%
	Solar radiation	1 kW/m^2
	Wind speed	3 m/s

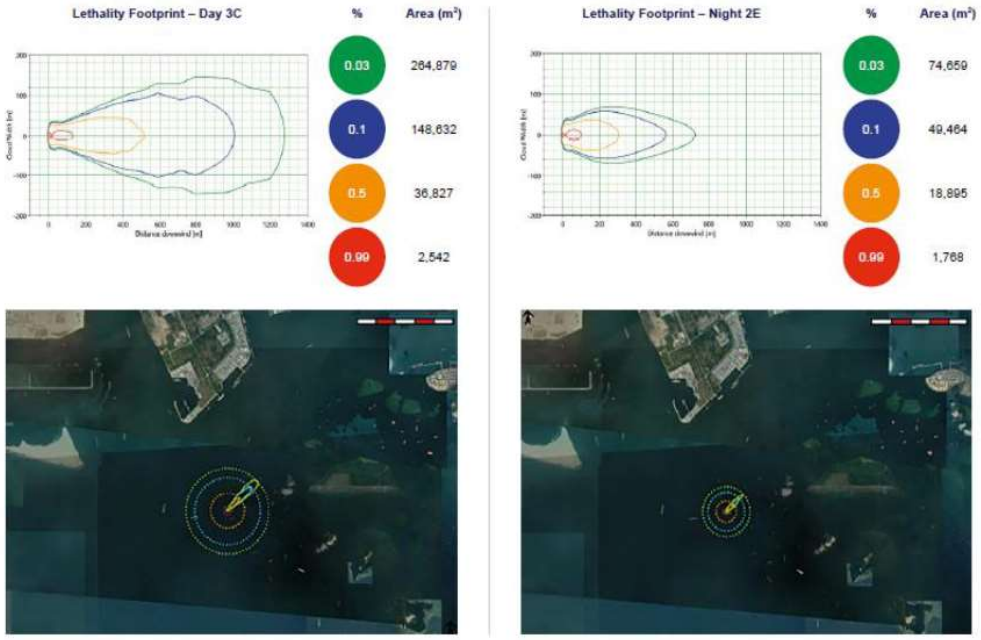


NEED FOR STUDY OF AMMONIA DISPESERSION

Parameters	Atmospheric Stability	Wind Speed	Humidity	Ambient Temperature	Surface Temperature	Solar Radiation
Day	Class C	3 m/s	70%	33°C	38°C	1 kW/m²
Night	Class E	2 m/s	90%	24°C	26.5°C	0



Maximum cloud footprints for ship-to-ship bunkering



Lethality footprints for ship-to-ship bunkering

SABRE – STATUS – LEARNING –STORAGE TANK

- Overview of Storage Locations
  - Storage facilities in Singapore are mostly located on islands lying south of Singapore, which includes:
    - ✓ Bukom Island;
    - ✓ Sebarok Island; and
    - ✓ Jurong Island ("JI").
  - JI is a petrochemical hub, with presence of various Oil & Gas Companies (e.g. ExxonMobil, Shell, Chevron, SRC, PCS) and utilities companies.
  - Most storage capacities are located in JI, with the Universal Terminal being Singapore's biggest independent oil storage terminal at 2.33 mil. cbm.
- Key Storage Terminals in JI

- **Key Storage Operators in JI**
  - Royal Vopak

Countries	NH_3 Storage Facilities
Middle East	84,000 cbm (3 tanks)
Malaysia	78,000 cbm (2 tanks)
China	50,000 cbm (1 tank)
Singapore (Banyan)	10,000 cbm (1 tank)

  - Oiltanking

Countries	NH_3 Storage Facilities
China	53,000 cbm (1 tanks)
US (Construction)	70,000 cbm (2 tanks)

  - Universal Terminal Jurong Port
    - ✓ Shareholders include Jurong Port Pte Ltd ("**JPPL**"), MAIF Investments, PetroChina.
    - ✓ No known existing NH_3 storage but has strong interest to develop and provide NH_3 storage.
    - ✓ Such interest is evident from JPPL's participation in Castor Initiatives in in Dec 2021.
    - ✓ JPPL has expressed interest in supporting SABRE.
  - Horizon Terminals Limited
    - ✓ No known existing NH_3 storage.
  - Stolthaven Terminals
    - ✓ No existing NH_3 storage but is currently executing an pressurized NH_3 storage project in Far East.
    - ✓ Has been supporting SABRE

-CRYOGENIC TANKS
-WHAT CAPACITY
-JETTY ARRANGENET
-DISPERSION STUDY
-SAFETY ZONES
-SHIP TO SHORE AND SHIP

SABRE – STATUS - LEARNING

NEED FOR **STORAGE TANK** TO KEEP **AMMONIA LIQUID FULLY REFRIGERATED**

NEED FOR A **RELIQUIFACTION PLANT**

NEED FOR **MULTIPLE NUMBER OF BUNKER MANIFOLD** TO RECEIVE **SAME AMOUNT** OF FOSSIL FUEL BUNKER IN **SAME TIME**

NEED FOR **A PURGING SYSTEM BEFORE AND AFTER BUNKERING** OF BUNKER MANIFOLD AND CARGO HOSE

NEED FOR **LARGER BUNKER SAVE ALL TRAY**

NEED FOR A **PURGE TANK**

NEED FOR A LARGE **AMMONIA BILGE TANK**

NEED FOR A **WATER SPRAY SPRINKLER** SYSTEM **AND WATER HYPERMIST** SYSTEM AT MANIFOLD

SABRE – STATUS - LEARNING

NEED FOR A **GAS DETECTION SYSTEM, CCTV, WATER CURTAIN, AND DEPENDING ON DESIGN MECANICAL VENTILATION SYSTEM AND MEANS OF ESCAPE AT MANIFOLD**

NEED FOR **BUNKERING HOSES** WITH **CRYOGENIC JACKET SYSTEM**

NEED FOR A FUEL GAS SUPPLY SYSTEM WITH **ZERO VENT OF PROCESS GAS** TO ATMOSPHERE **(AMMONIA RELEASE MITIGATION SYSTEM)**

NEED FOR DIVISION OF VESSEL IN **HAZARDOUS AND TOXIC AREAS**

NEED FOR A SPECIAL **VENTILATION ARRANGEMENT** BASIS TANK LAY OUT

NEED FOR SPECIAL MEASURES TO **FIGHT THE FIRE AND RELEASE OF GAS**

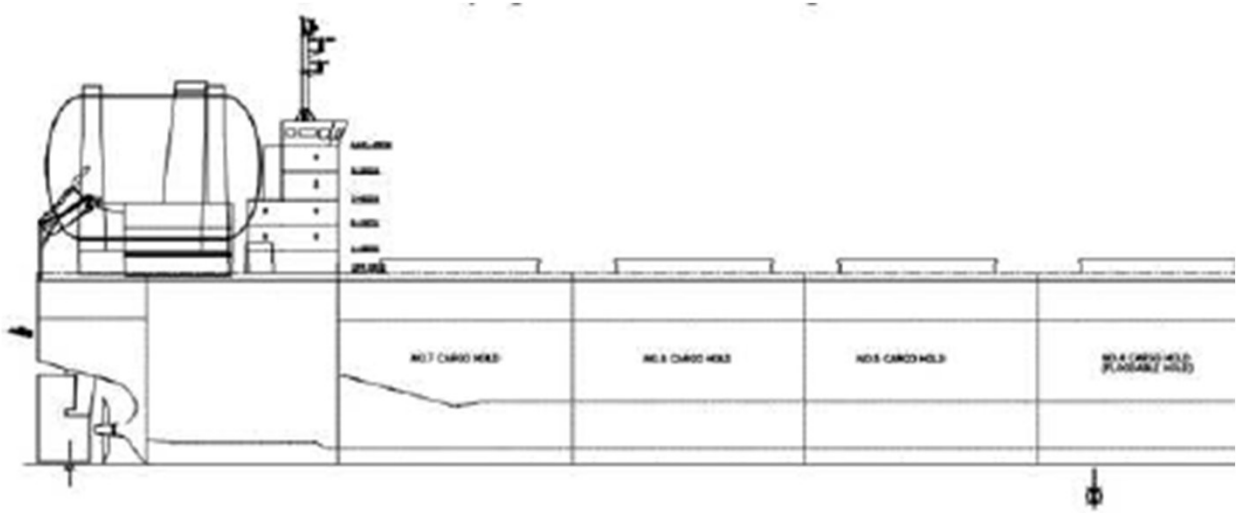
NEED FOR **SPECIAL PPE AND GAS TIGHT SUITS**

GRANTS

#	Grant/Study	Stakeholders	Amount	Requirements	Status
1	**Grant** Maritime Decarbonization Centre ("**MDC**")	❖ **MPA** ❖ BW Group, ❖ Sembcorp Marine ❖ EPS ❖ ONE ❖ Foundation Det Norske Veritas ❖ BHP	❖ S$120mil	❖ Establishment of MDC ❖ Fund maritime-decarbonization-related R&D projects; and ❖ May require collaborating with IHLs and RIs.	❖ TBC
2	**Grant** Low-Carbon Energy Research ("**LCER**") Funding Initiatives	❖ NCCS ❖ A*STAR ❖ EDB ❖ **EMA** ❖ NRF	❖ Total: S$4[illegible] ❖ Per project: up to S$[illegible]mil. ❖ Project duration: up to 36 months	❖ Support development in low-carbon technologies in domains of: ➢ H_2 supply, storage, and downstream uses; and ➢ CCUS ❖ Require strong collaboration across academia and industry.	❖ Submission closed.
3	**Study** H_2 Imports and Downstream Applications for Singapore	❖ NCCS ❖ EDB ❖ **EMA** ❖ MPA ❖ CAAS	❖ NA	❖ The findings will be used to guide private sector consortiums on the deployment of low-carbon solutions, the development of the H_2 supply chain and pilot new technologies in sectors including maritime, aviation, mobility, industry and power.	❖ EMA shared that grants may be made available. If available, likely in 2022.
4	**Grant** Industry Alignment Fund Pre-Positioning Programmes (IAF-PP)	❖ Agency for Science, Technology and Research (A-STAR)	❖ Continuous ❖ Per project: up to S$10mil. ❖ Project duration: up to 36 months	❖ Intended to develop industry-ready capabilities and integrated and multidisciplinary programmes with early industry involvement. ❖ Projects are expected to lead to industry projects and investment in 3 to 5 years' time.	❖ Team is seeking EMA's assistance to link up with A-STAR. ❖ Alternative grant: IAF-Industry Collaboration Projects (IAF-ICP).

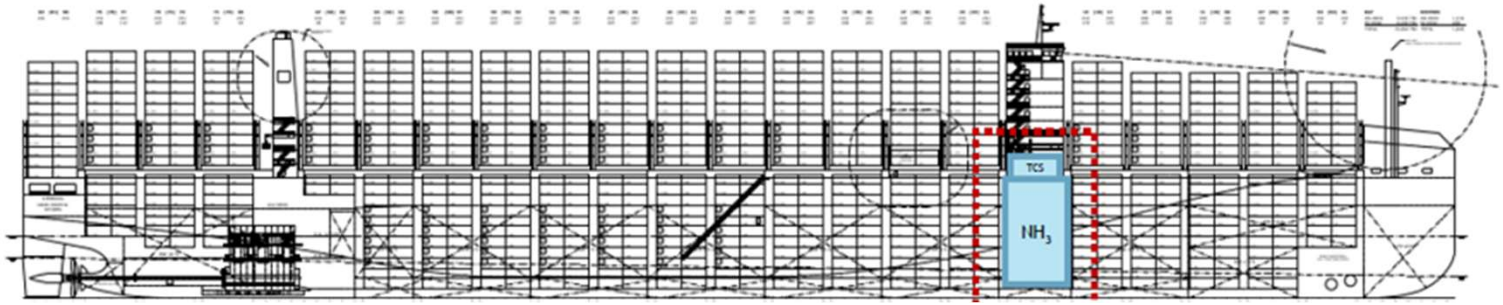
Other Potential Grants			
1	**Maritime Innovation and Technology (MINT) Fund** ❖ Funding support for manpower, equipment and operating expenditures for purposes of the project.	4	**Maritime Cluster Fund (MCF)** ❖ Supports eligible expenses incurred in setting up of new maritime operations or expansion into new lines of maritime businesses in Singapore.
2	**Maritime Transformation Programme** ❖ Covers Sustainable Maritime Environment & Energy.	5	**Maritime Green Future Fund** ❖ Total S$40mil funding available
3	**Singapore Maritime Institute (SMI) fund**		

AMMONIA BUNKER TANK



Ammonia Storage

Location	• Under Accommodation Block
Tank Size	• 11,500m³
Tank Type	• IMO Type B
Tank Width	• Maintain B/5 Prescriptive Requirement
Tank Connection	• Directly above Tank
BOG Management	• 1xreliquification + connection to boiler



Source : mmmczc

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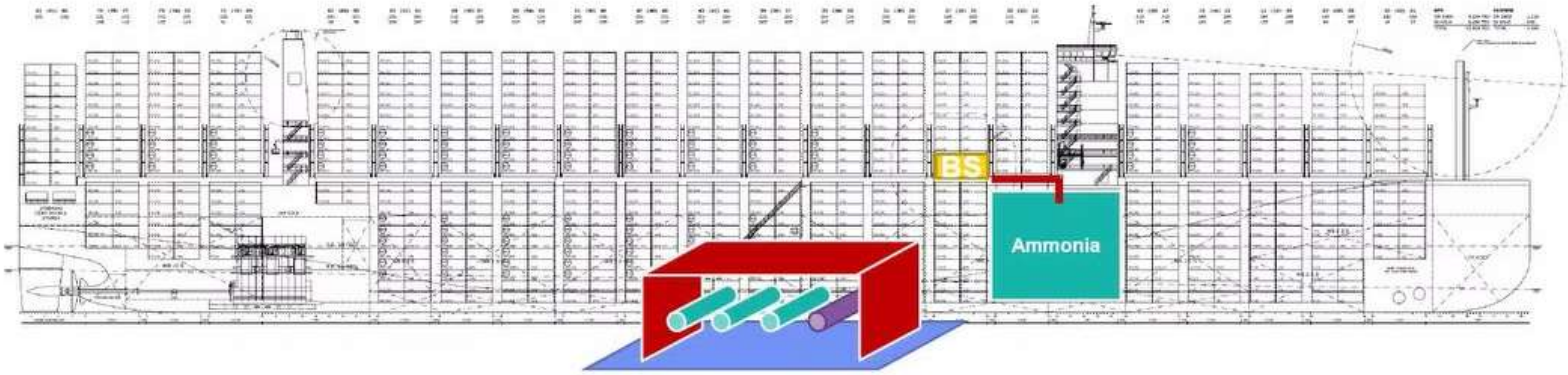
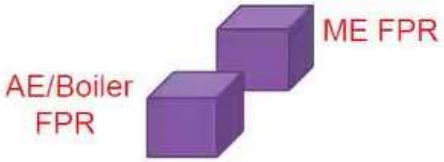
Bunker Station

- Location
  - 1 bay aft of accommodation – lose 1 row in hold due to width of station
- Enclosure
  - Semi enclosed: The bunker station should be enclosed with open side towards the bunker barge. This will increase control of the direction of the leak, make it easier to apply efficient water curtain.
  - Flange connection fully enclosed: Forced ventilation periodically shut off to allow detection of minor leaks.
  - The bunker station is to be protected from dropped objects.
- Connections and capacity.
  - Max 8" hose connections. 3 pcs 8" supply connections and 1 vapor return (6") to be applied.
  - Double barrier to be applied to the bunker lines, on deck as well. It is to be confirmed if the ammonia supply line could be used.
  - Bunker capacity: 2000m^3 / hr (TBC after safety review)
- Ammonia drain system
  - A drain tank and system to be designed to contain scrubbing water and spills from drip trays. Water used to limit spreading of gas due to major leaks and incidents is not expected to be contained.

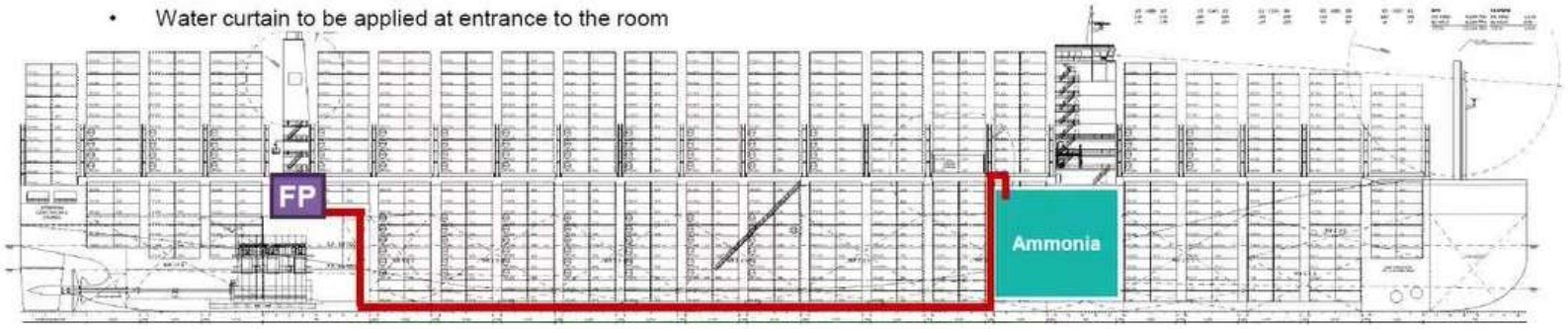


Fuel Preparation Room

- Arrangement:
  - The room is to be split in 2 rooms:
    1) Main Engine FPR
    2) Auxiliary engine and boiler FPR



  - The lay out must enable easy and fast escape, and the room must be equipped with two entrance points
  - External structure of the FPR to be designed to withstand dropped object.
  - Double walled pipe.
  - A service tank TBC: simplify piping arrangement / increase hazards within FPR room
- Ventilation:
  - The outlet of the exhaust from the room must be led to a safe location where it can be allowed that a 100% ammonia concentration is vented in a worst-case scenario.
- Water screen protection
  - Water screen spray system to be applied, covering all sides of the fuel preparation room if this a separate structure on open deck. This is applied on gas carriers. To be discussed if only applicable around openings where gas can escape.
  - Water curtain to be applied at entrance to the room



Source : mmmczc

AMMONIA FUEL SUPPLY SYSTEM

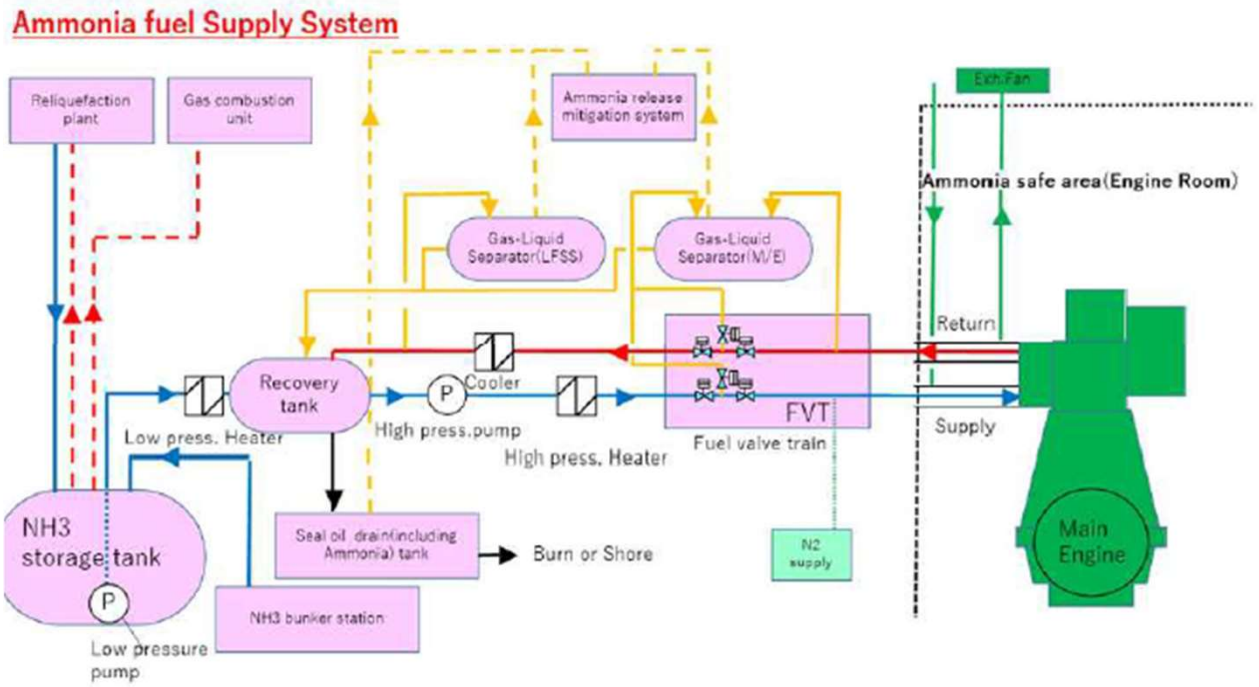


Fig. 10 Ammonia fuel supply system

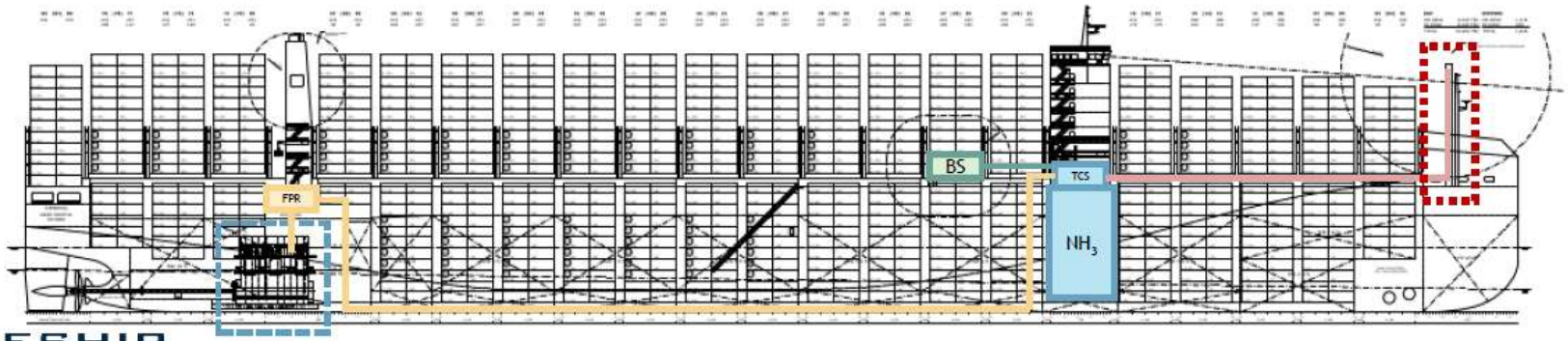
Venting

Location

- The vent mast is located 25 m from the accommodation air intakes
- Two independent vent lines are provided, one routed port side and one routed starboard side
- Vent lines are routed under the hatch covers to protect from dropped objects
- The vent mast will also be provided with fixed ammonia gas detection

Venting only for emergency scenarios

Vapour returned to bunker vessel during bunkering



FORESHIP

Source : mmmczc

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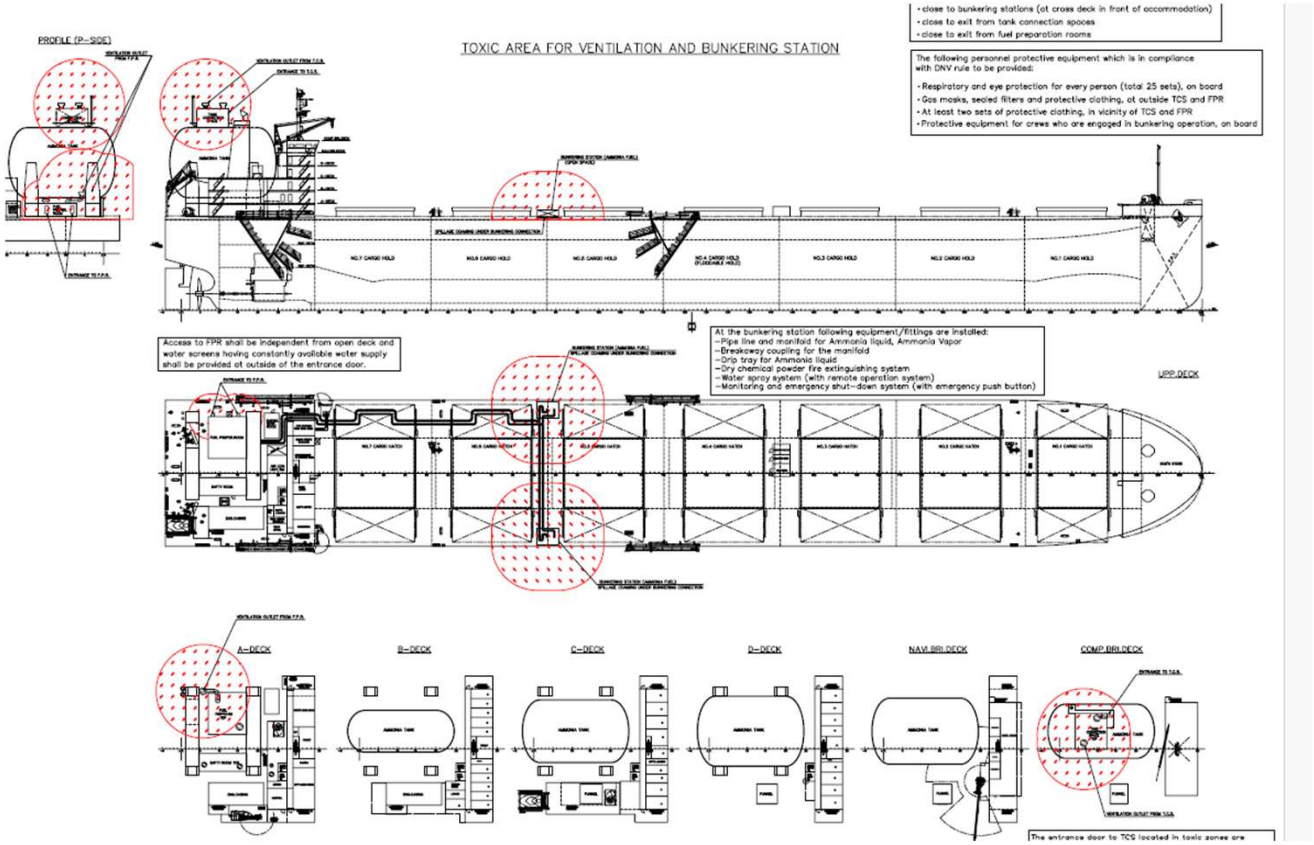
SABRE – STATUS - TOXIC AREA

TOXIC AREA (FOR AMMONIA FUELLED SYSTEM)

TYPE OF AREA	SYMBOL	LOCATION
TOXIC AREA		– VENT MAST – DOUBLE PIPING OUTLET – VENTILATION OUTLETS FROM T.C.S. AND F.P.R. – DRIP TRAYS ON OPEN DECK – SPILLAGE COAMING UNDER BUNKERING CONNECTIONS – THE ENTRANCE TO T.C.S. AND F.P.R.(WITHOUT AIR LOCK)

SABRE – LEARNING – TOXIC AREA



SABRE - STATUS

May 13, 2022
Fleet Management Limited
Keppel Offshore & Marine
Maersk Mc-Kinney Moller Center for Zero Carbon Shipping
Sumitomo Corporation
American Bureau of Shipping
Kawasaki Kisen Kaisha, Ltd.

Acceleration of Study on establishing ammonia supply chain for bunkering in Singapore and Receipt of Approval in Principle for Ammonia bunkering vessel

The Consortium, consisting of A.P. Moller - Maersk A/S, Fleet Management Limited, Keppel Offshore & Marine, Maersk Mc-Kinney Moller Center for Zero Carbon Shipping, Sumitomo Corporation and American Bureau of Shipping ("ABS") (collectively the "Consortium"), is pleased to announce the addition of Kawasaki Kisen Kaisha, Ltd.("K"LINE) and Maritime and Port Authority of Singapore ("MPA") to the Consortium, and the receipt of Approval in Principle ("AiP") from ABS for the design of an ammonia bunkering vessel.

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SABRE – PROPOSED AMMONIA BUNKERING VESSEL

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RADIUS – REALIZING AMMONIA – BUNKERING DEPLOYMENT IN THE US

STUDY FOR AMMONIA AS MARINE FUEL IN THE US EAST COAST

SUMITOMO CORPORATION AP MOLLER MAERSK AS
MAERSK MC-KINNEY MOLLER CENTER FOR ZERO CARBON SHIPPING
FLEET MANAGEMENT LTD
AMERICAN BUREAU OF SHIPPING
GEORGIA PORT AUTHORITY
SAVAGE SERVICES LLC
TOTE SERVICES LLC

THE PROJECT STARTED IN MAY 2023 AND STUDY IS BEING MADE FOR AMMONIA PRODUCTION, AMMONIA BUNKERING VESSEL AND PREPARE PORT OF SAVANNAH FOR SAFE AMMONIA HANDLING PROCESSES

HAZID COMPLETED FOR **AMMONIA BUNKERING ATB** C TOGETHER WITH **VARD** AND CONSORTIUM MEMBER IN MAY 2024
A **RISK ASSEMENT** TOGETHER **WITH LOCAL PORT AND AUTHOROTIES** WAS CARRIED OUT FOR AMMONIA BUNKERING OPERATION FOR PORT OF SAVANNAH, JACKSONVILLE AND BRUNSWICK WAS CARRIED OUT WITH FOCUS **ON LOCAL HABITAT**

RADIUS – REALIZING AMMONIA – BUNKERING DEPLOYMENT IN THE US

Us First Approval in Principle for Ammonia Bunkering Vessel

- Targeting Commercial Operations by 2030 to Decarbonize the Maritime Industry -

American Bureau of Shipping (ABS), Fleet Management Limited, Sumitomo Corporation and TOTE Services (collectively the "Parties") announced today the United States' First Approval in Principle ("AiP") for the initial design of ammonia bunkering articulated tug-barge (*1) / AB-ATB) from ABS. The award ceremony was held in Houston at Gastech 2024, the world's largest energy conference. The approval was achieved in cooperation with the RADIUS consortium, consisting of ABS, A.P. Moller – Maersk A/S, Fleet Management Limited, Georgia Ports Authority, Maersk Mc-Kinney Moller Center for Zero Carbon Shipping (MMMCZCS), Sumitomo Corporation, and TOTE Services (collectively the "Consortium"). The barge design and engineering were completed by VARD Marine US, Inc. (VARD). This design approval is an important step on the maritime industry's decarbonisation journey where ammonia-fuelled vessels are seen as one of multiple fuel pathways.

RADIUS – AMMONIA BUNKERING ARTICULATED TUG BARGE 24,000 CUB M

Fleet Management Limited
A Caravel Group Company

USWAVE (US Westcoast Ammonia-bunkering VEntures)

MOU Signed on 08th April 2024 for the development of Ammonia bunkering on US coast between following parties :

CALAMCO
SUMITOMO CORPORATION
FLEET MANAGEMENT LIMITED
AMERICAN BUREAU OF SHIPPING
TOTE SERVICES LLC

Aim is to conduct a joint feasibility study on the commercial and technical viability of ammonia bunkering for container vessels and car carriers calling at Port of Oakland, Port of Benicia and other ports in U.S. West Coast including but not limited to Los Angeles and Long Beach.

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Map of US West Coast

MAN 2 STROKE AMMONIA ENGINE DEVELOPMENT on going with studies

- 1 CYLINDER TWO STROKE ENGINE TEST RUN STRATED IN JUNE 2023 AND WILL COMPLETE TEST END OF JUNE 2024
- THE RESULTS HAS BEEN VERY PROMISING
- SMALL PILOT FLAME NEEDED TO START AMMONIA COMBUSTION
- TARGET OF 5% PILOT OIL AT 100% LOAD HAS BEEN ACHIEVED
- N2O EMISSIONS ARE EXTREMELY LOW AND HANDLED BY ENGINE TUNING ALONE
- NOX EMISSIONS APPROX 40% LOWER THAN CONVENTIONAL FUEL OIL
- AMMONIA SLIP IS MINIMISED BY DESIGN AND PERFORMANCE MODIFICATION
- 4 CYLINER ENGINE TEST WILL START FROM END OF JUNE 2024 AT COPENHAGEN
- A FULL SCALE ENGINE TEST WILL START AT MITSUI JAPAN FROM JULY 2024
- APPROVAL PROCESS FOR EMISSION FREE LOW FLASH FUEL SYSTEM IS AT FINAL STAGE
- FIRST ENGINE DELIVERY IS EXPECTED IN END OF 2024
- FIRST SEAEXPERIENCE OF PILOT PROJECT IN FIRST QUARTER OF 2026

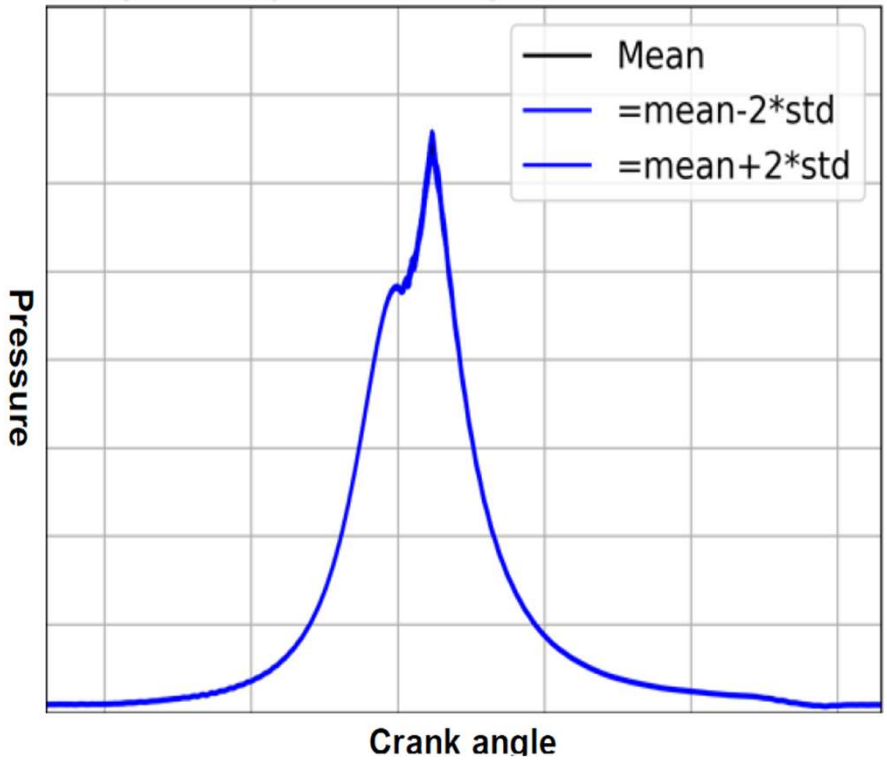
COMBUSTION STABILITY

CYLINDER PRESSURE IS FOLLOWING DIESEL CYLCLE

COMBUSTION HAS GOOD STABILITY BEHAVIOUR AND ACTS LIKE OTHER FUELS BASED ON HYDROCARBON

ROBUST COMPRESSION AND EXPANSION CURVE

STATISTCAL ANALYSIS INDICATE A VERY GOOD COMBUSTION STABILITY ON A CYCLE-TO-CYCLE PRESSURE



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