ONE MILE AHEAD

WIND HUNTER

Creating our Future
with Wind & Hydrogen

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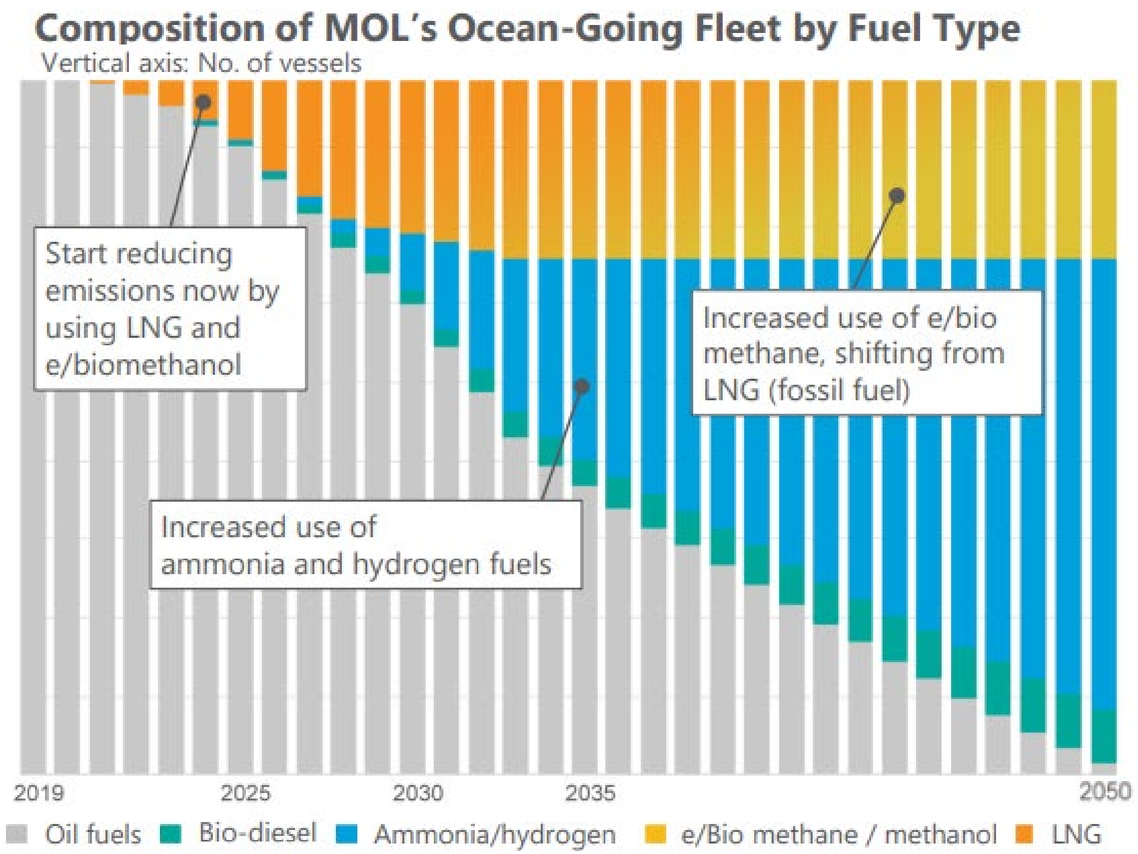
1. MOL Group Environmental Vision 2.2

- We will phase out the useage of heavy oil, which is highly carbon-intensive, and shift to low-carbon and decarbonized fuels.
- Based on the premise that the optimal fuel differs depending on the type of vessel and shipping route, we have begun considering adopting a variety of fuels.
- In addition to preparing alternative fuel-powered vessels, we will take measures to procure clean-energy fuels.

Introduction of alternative fuels
Milestones

- **2030 Ratio of zero-emission fuel used: 5%**
- **2030 No. of LNG/methanol-fueled ocean-going vessels: 90**
- **2035 No. of net zero emissions ocean-going vessels: 130**



1. MOL Group Environmental Vision 2.2

LNG

We are proactively using LNG, a low-emission fuel that is available for immediate utilization as a way of contributing to the carbon budget. As of April 2023, we operate 16 LNG-fueled ocean-going vessels, including car carriers and large bulk carriers (including those under construction).

LNG-fueled "BLUE" series car carrier
(Eight vessels are slated to be completed by 2025)

In terms of coastal ships, 2 LNG-fueled ferries have commenced operation.
We plan to enter two more LNG-fueled ferries into service in the future.

Japan's first LNG-fueled ferry "Sunflower Kurenai"

Reducing methane slip

We are making multiple efforts to further reduce a trace amount of unburned methane emitted from LNG-fueled engines (methane slip).

- Joint projects with Japanese companies to develop technology to reduce methane slip by improving catalysts and engines
- We are a member of The Methane Abatement in Maritime Innovation Initiative, a group which promotes the development of methane slip reduction technology through collaboration among global companies

Methanol

We own one of the world's largest fleets of methanol-fueled transport vessels (5 vessels). We plan to use our know-how to expand methanol fuel to other types of vessels.

Completed methanol transport vessel which uses primarily methanol fuel

Biodiesel

We promote the use of biodiesel as a "drop-in fuel" which can be used with conventional petroleum-fueled equipment.

MOL completed the first biodiesel bunker operation for a vehicle carrier in Singapore.

1. MOL Group Environmental Vision 2.2

Ammonia

We are developing multiple types of vessels. One of them is scheduled to be completed and put into operation around 2026 as the first net zero emissions ocean-going vessel.

We obtained Approval in Principle (AiP) for an ocean-going liquefied gas carrier fueled by ammonia.

We obtained Approval in Principle (AiP) for an ammonia-fueled large bulk carrier.

Hydrogen

We are building a coastal passenger ship propelled by hydrogen and biofuels.

The ship will start operation in the Kanmon area of Japan in FY2024.

Rendering of an electric-propelled hybrid vessel that uses hydrogen and biofuels.

Planned to be owned and utilized by MOTENA-Sea (Largest shareholder : MOL Techno-Trade, Ltd., our subsidiary)

Battery

The pure battery coastal tanker "Asahi," powered by large-capacity lithium-ion batteries, is scheduled to enter operation in spring 2022.

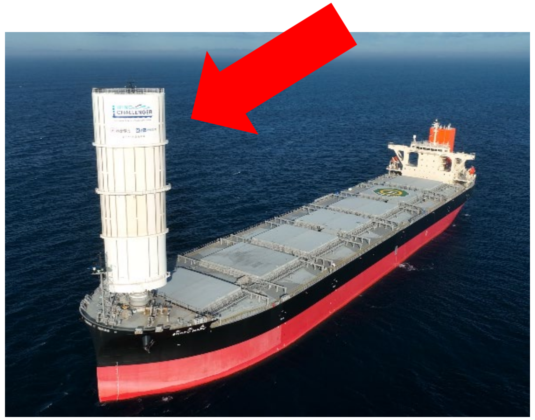
The second ship "Akari" put in service in April 2023, and the delivery of hybrid EV bulk carrier "Asuka" is scheduled in May of the same year.

e5 Project

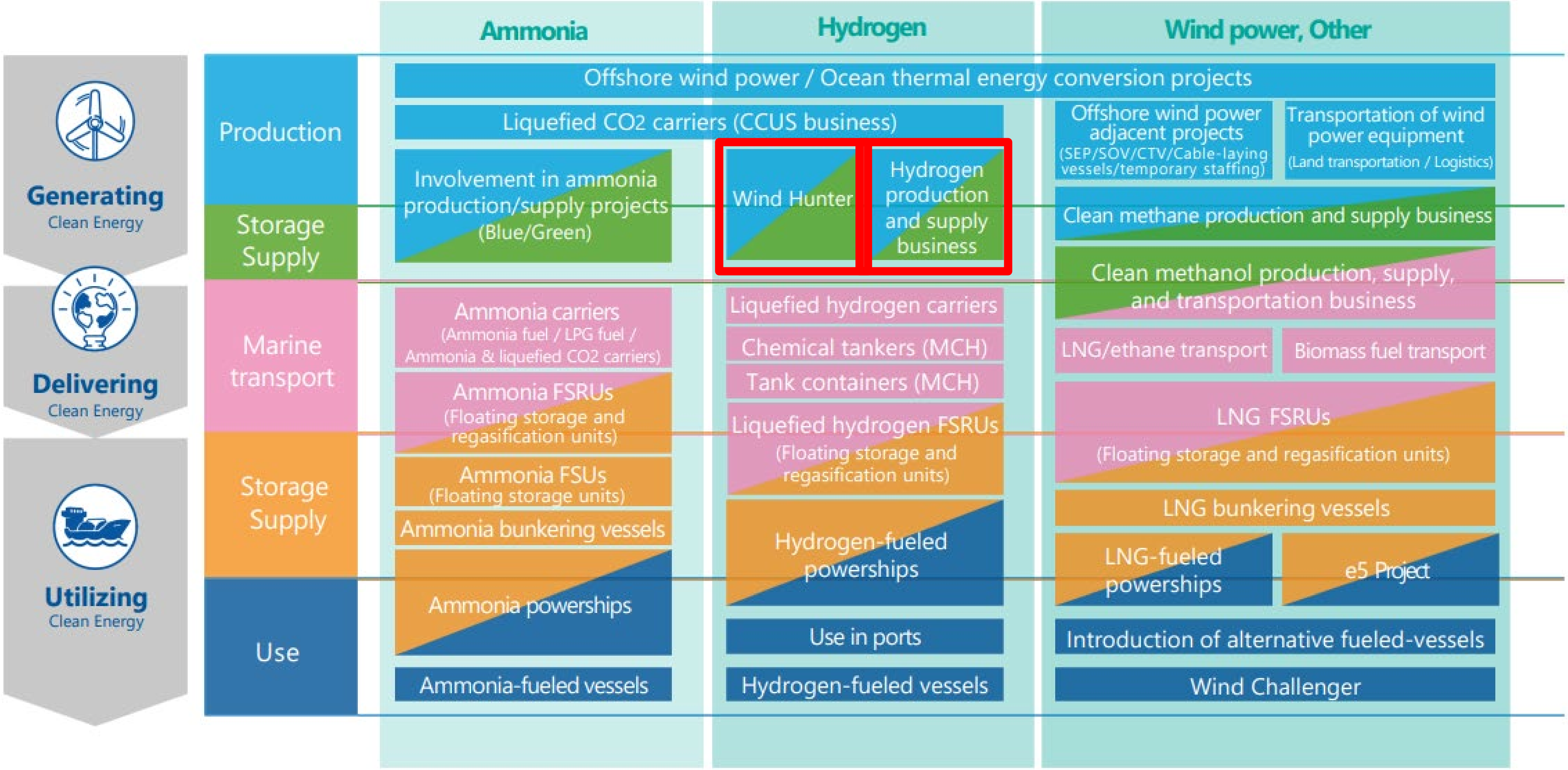
By bringing together technical capabilities and networks related to electric vessels, e5 will establish a standard for sustainable marine transport.

2. Wind Challenger Project

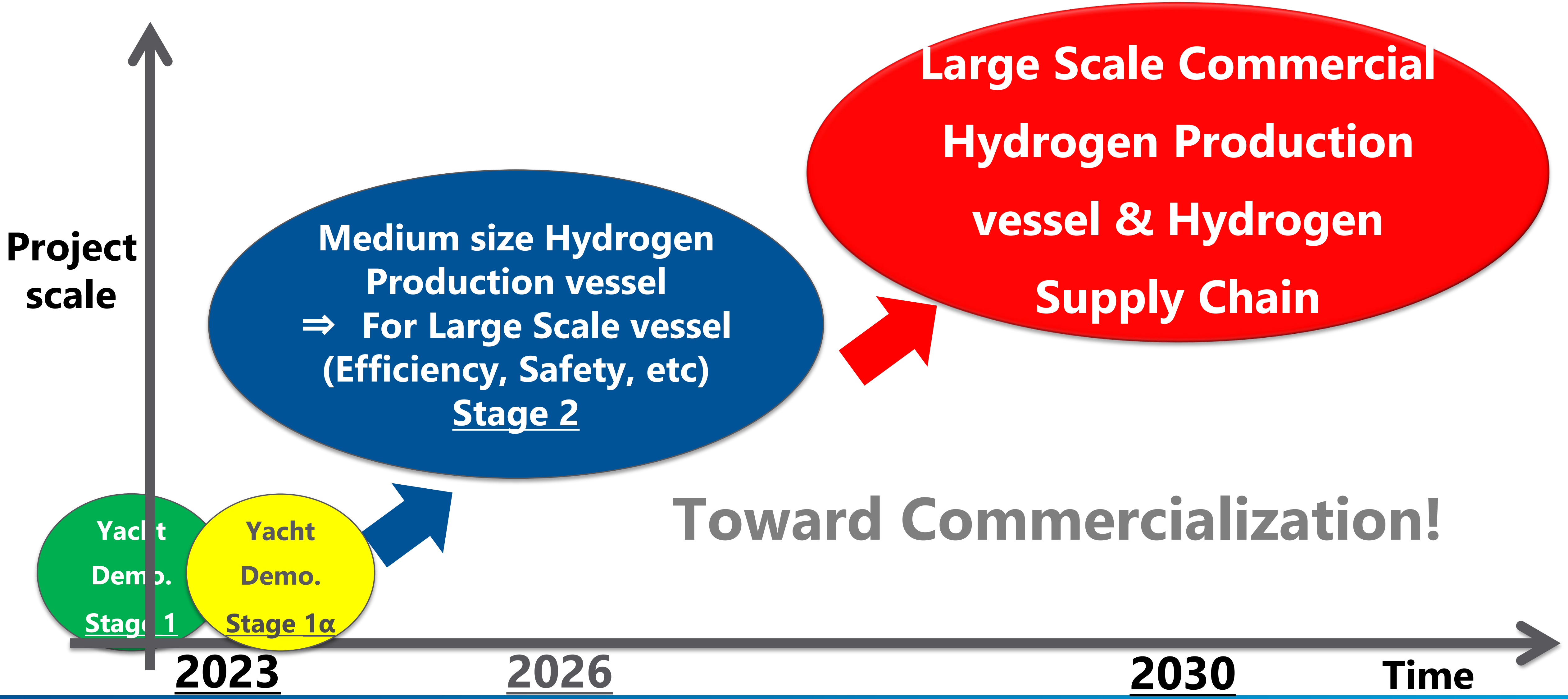
2. Wind Challenger Project ～ Sea Trial



3. Wind Hunter Project Mapping



3. Wind Hunter Road Map



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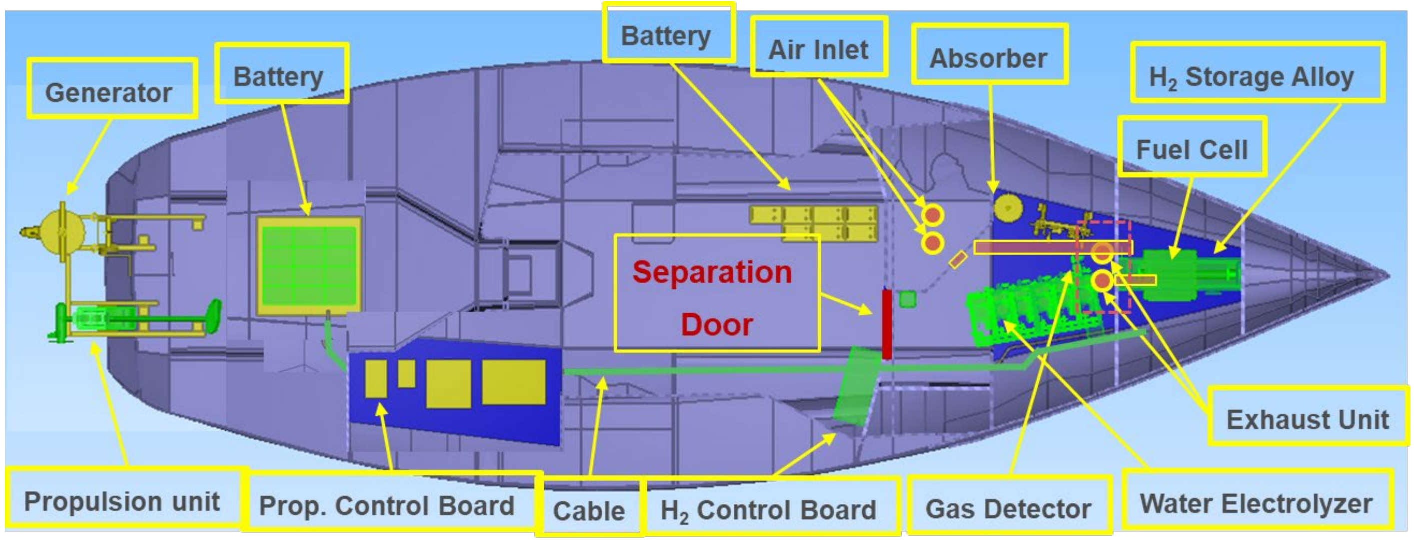
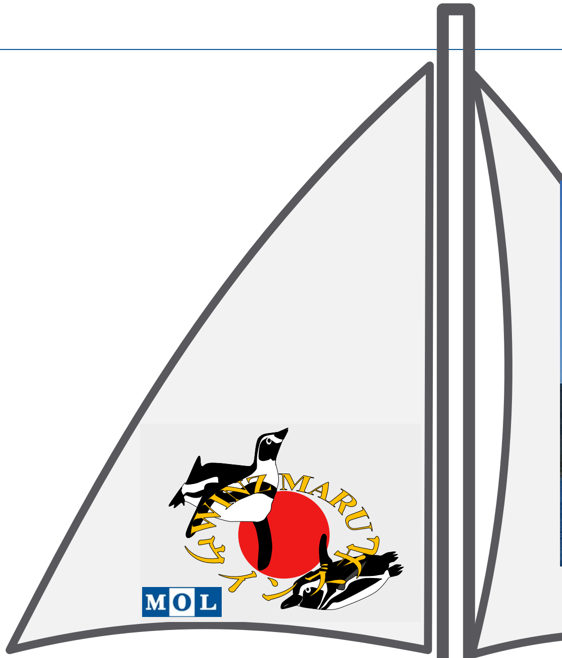
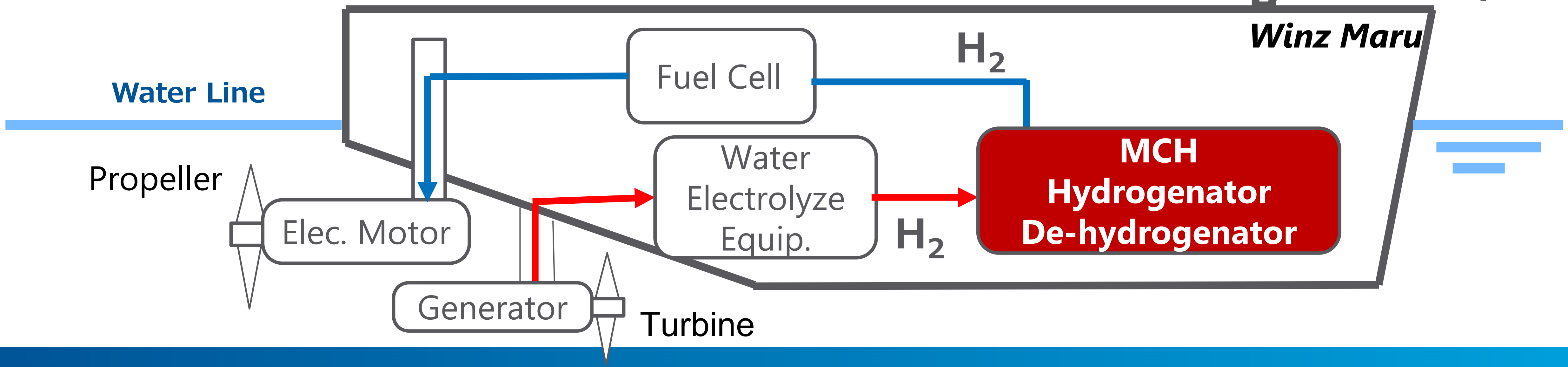
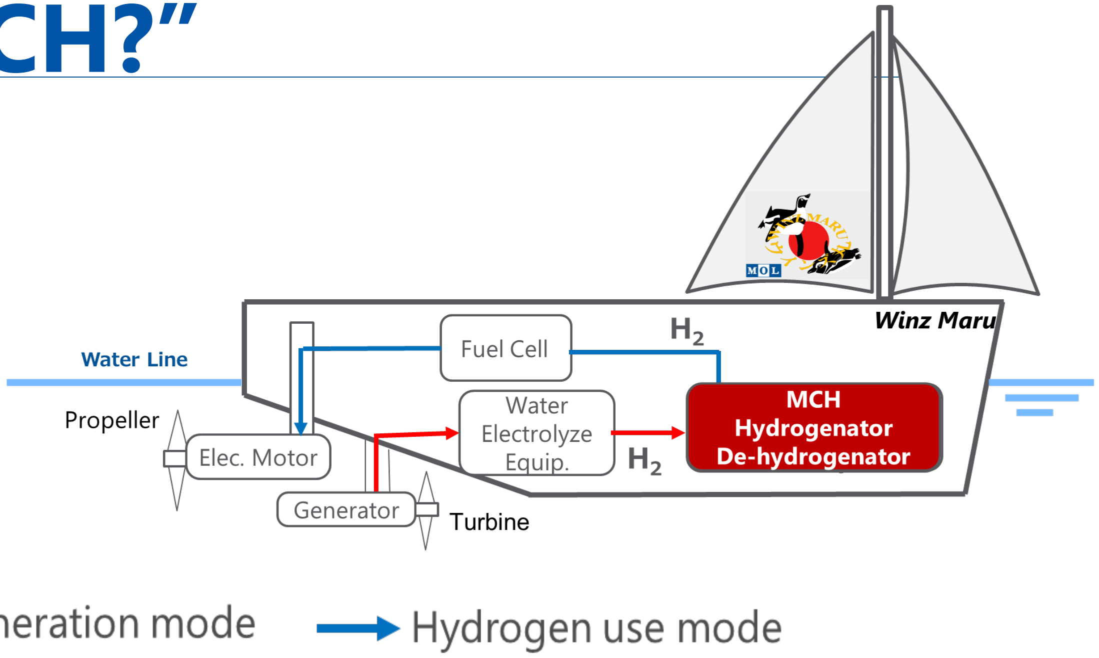
3. Wind Hunter Stage 1α

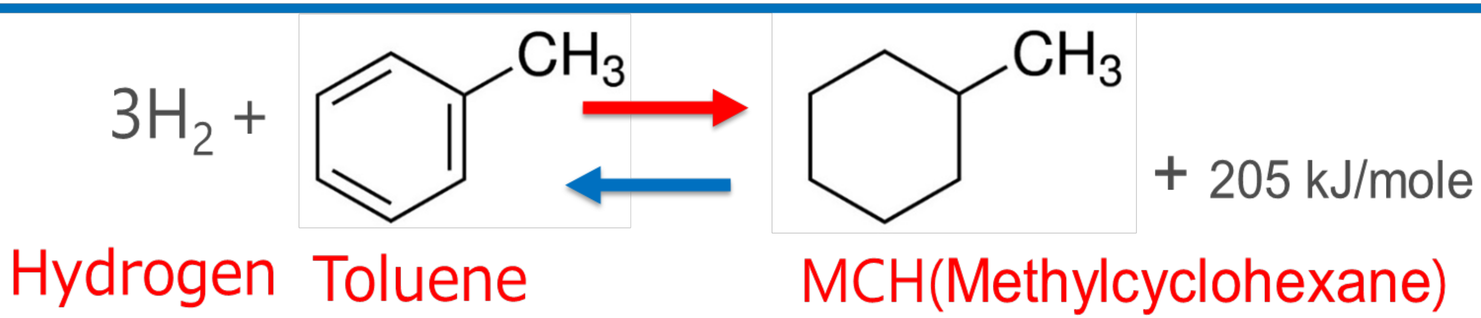






3. Wind Hunter "What is MCH?"





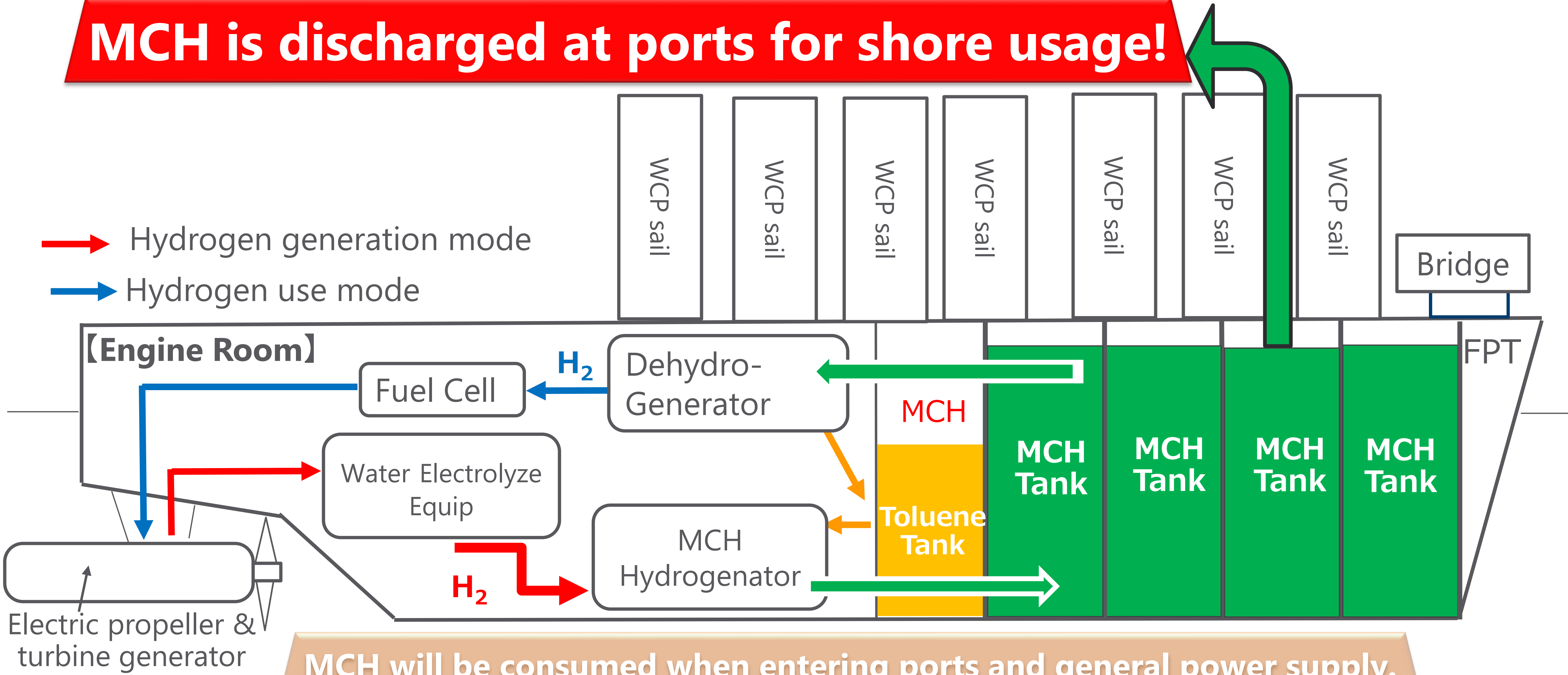
Organic Hydride method

3. Wind Hunter: Hydrogen Carrier

	wt%	kg-H_2/m^3	Gas Vol. ratio	Technical Features
Pressured H_2 (70MBar)	100	39.6	1	High pressure is needed. Hydrogen brittleness consideration is required.
Liquid H_2	100	70.8	1/800 @-253℃	High contamination system is need.
NH_3	17.8	121	1/1350 @-33℃	Toxic, Burning makes N2O. High energy needed to create via Habour-bosh.
MCH	6.2	47.3	1/500 @Ambient Temp.	Gasoline infrastructure can be utilized. Ambient temp and ambient pressure. TOLUENE: Toxic
H_2 Storage Alloy	1-3	93-97	Solid @Ambient Temp.	Heavy and less H2 per weight.

3. Wind Hunter Target

MCH is discharged at ports for shore usage!



MCH will be consumed when entering ports and general power supply.

3. Wind Hunter Stage 2 & 3 Feasibility Study

Symbol	Unit	No Wind	Marginal Wind	Strong Wind	Term & Remarks
L	m				
B	m				th
D	m				
d	m				
Disp	tf				83. Buttock Flow Hull Form
DW	tf				Weight (LW:10,000tf)
W	m2				urface Area
S	m2				ea Total (H80mxB22mx6sets)
Cx					Coeffecient of Sail
Vw	m/s				ent Wind Speed (Cross Wind)
T	tf				Thrust of Sails: T=R
R	tf				Resistance: R=Rh+Rtp
Rh	tf				esistance
Rtp	tf				e Resisance or PropellerThrust
Vs	kt				peed
Fn					e Number : Vs/(gL)^0.5
Ct					esistance Coeffecient
Dia	m				ter of Turbine/Propeller
A	m2				Area of 2 Turbine/Propeller
Ptp	kW				Output on Turbine or Propeller
Pgm	kW				Output on Generator or Motor
H2	m3/d				gen Generation or Consumption
MCH	m3/d				Geneneration or Consumption
ENDU	day				or Filling or Consuming MCH at Tank
MCHT	m3				Storerage Tank Capacity
TOLT	m3				ne Storage Tank Capacity
Remarks		Thrust by Propeller	Thrust by Sail	Thrust by Sail-Turbine	

Under Evaluation

Thank you very much
for your attention!

Mitsui O.S.K. Lines

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N1B3A-06(Japan Pavilion)