Capital Link Decarbonization in Shipping Forum

Carriage of Next-generation Energy, “Hydrogen” – Development of Liquefied Hydrogen Carrier -

July , 2022

Tatsuya Motoi

Kawasaki Heavy Industries, Ltd.

Kawasaki
Powering your potential

カワる、サキへ。
Changing forward

Product of Kawasaki Heavy Industries

Energy System &
Plant Engineering

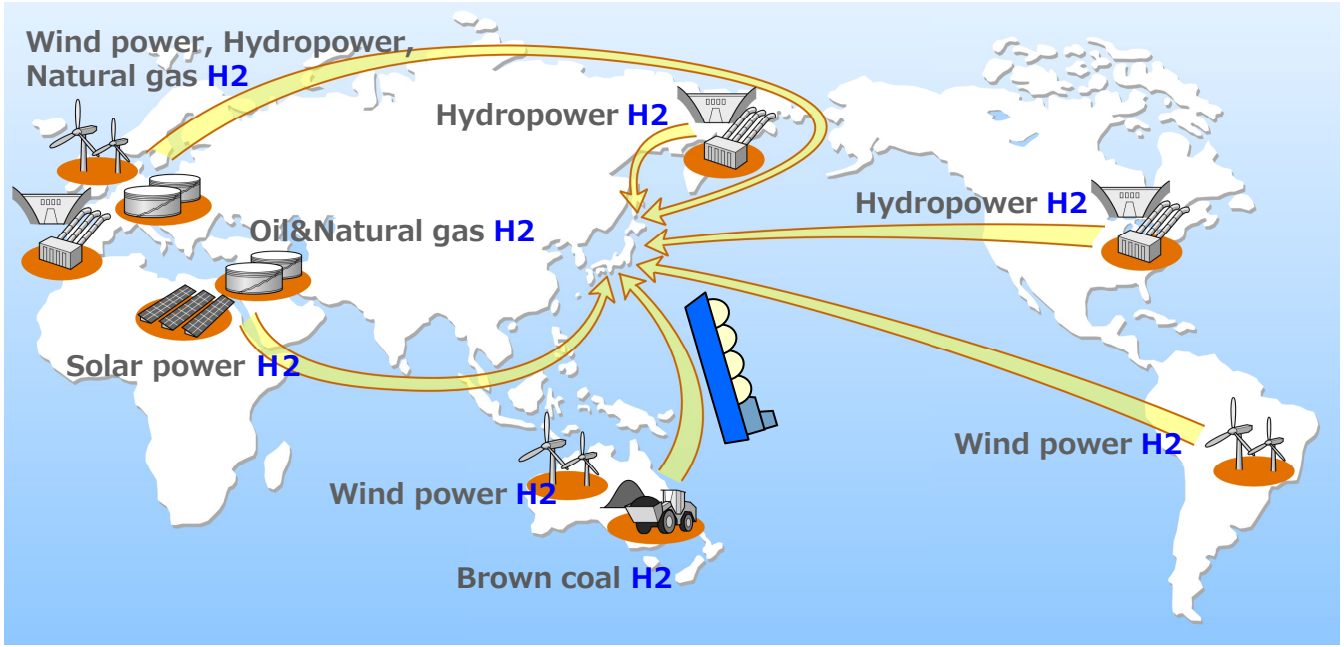
Motorcycle & Engine

Precision Machinery & Robot

Contents

Hydrogen energy supply chain

- Hydrogen can be produced from various sources and procured from many countries.
  → Contribute to energy security
- Large amount, long-distance, Long-term transportation and storage of energy and sector integration are possible with hydrogen → Contribute to resilience



Concept of CO_2-free hydrogen energy supply chain

Stable energy supply while suppressing CO_2 emissions

Producing country
(Australia, ･･･)

Utilizing country
(Japan)

Production of hydrogen at low costs from unused resources and/or abundant renewable energy

Fossil fuel: Natural gas Coal･･･

CCS (CO_2 capture /storage)

Affordable renewable energy

H_2 Production

Liquefied hydrogen carrier

Liquefied hydrogen containers

Liquefied hydrogen storage tanks

LH_2 transport / storage

Process uses
Semiconductor, Oil refinement, etc.

Transport equipment

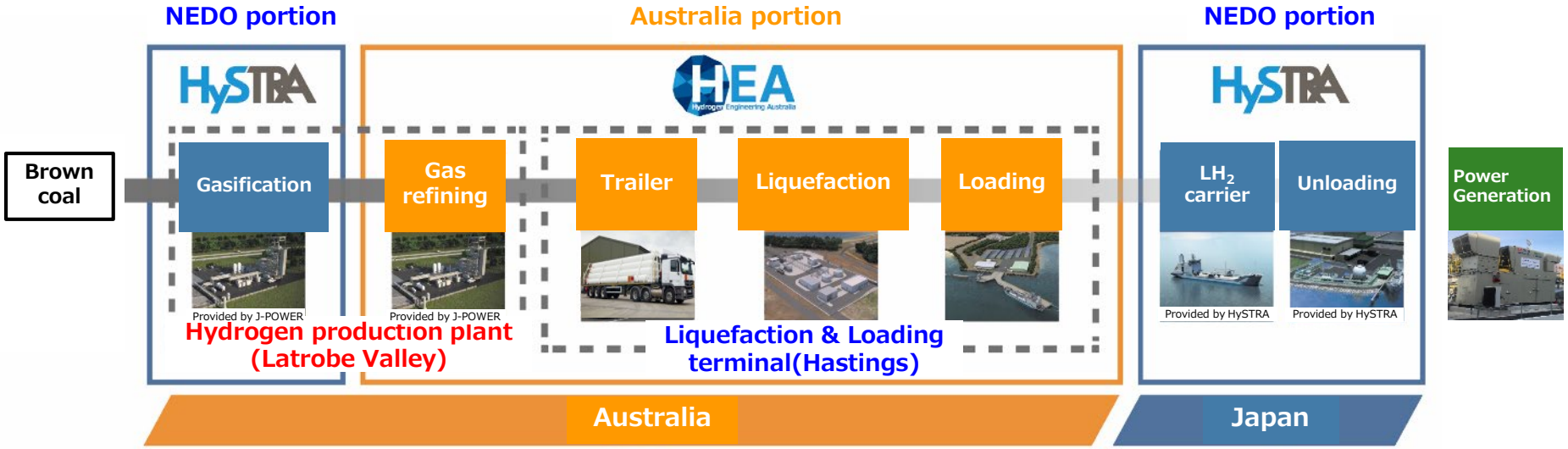
Distributed Power plants

Electrical power plants

H_2 utilization

Pilot project structure

Kawasaki is working with a number of partners on a pilot project supported by the governments of Japan, Australia and Victoria.



CO2-free Hydrogen Energy Supply-chain Technology Research Association

Iwatani, Kawasaki, Shell Japan, J-Power, Marubeni, ENEOS, K LINE

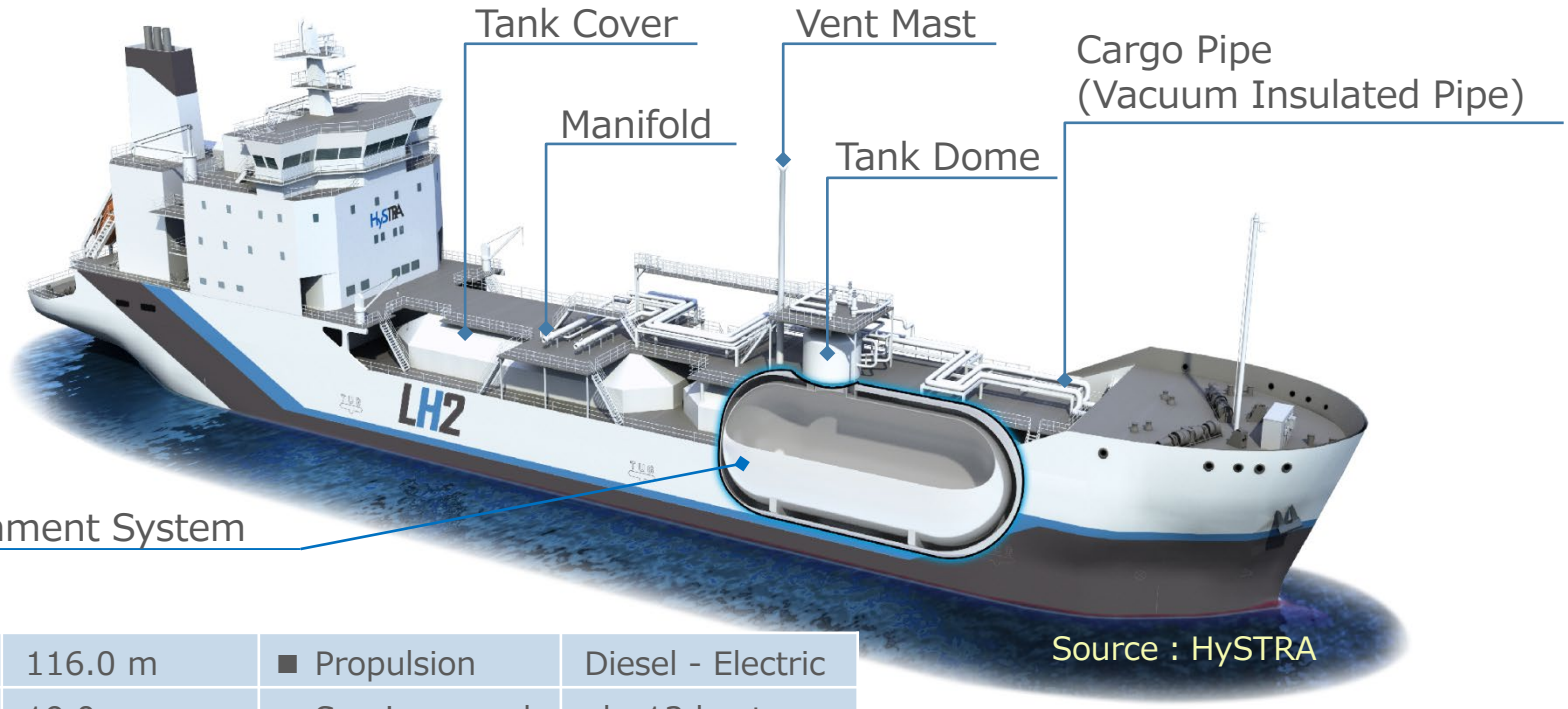
Hydrogen Engineering Australia

Kawasaki, J-Power, J-Power Latrobe Valley, Iwatani, Marubeni, Sumitomo, AGL

*NEDO : New Energy and Industrial Technology Development Organization

LH_2 Carrier “Suiso Frontier”

Supported and subsidized by NEDO

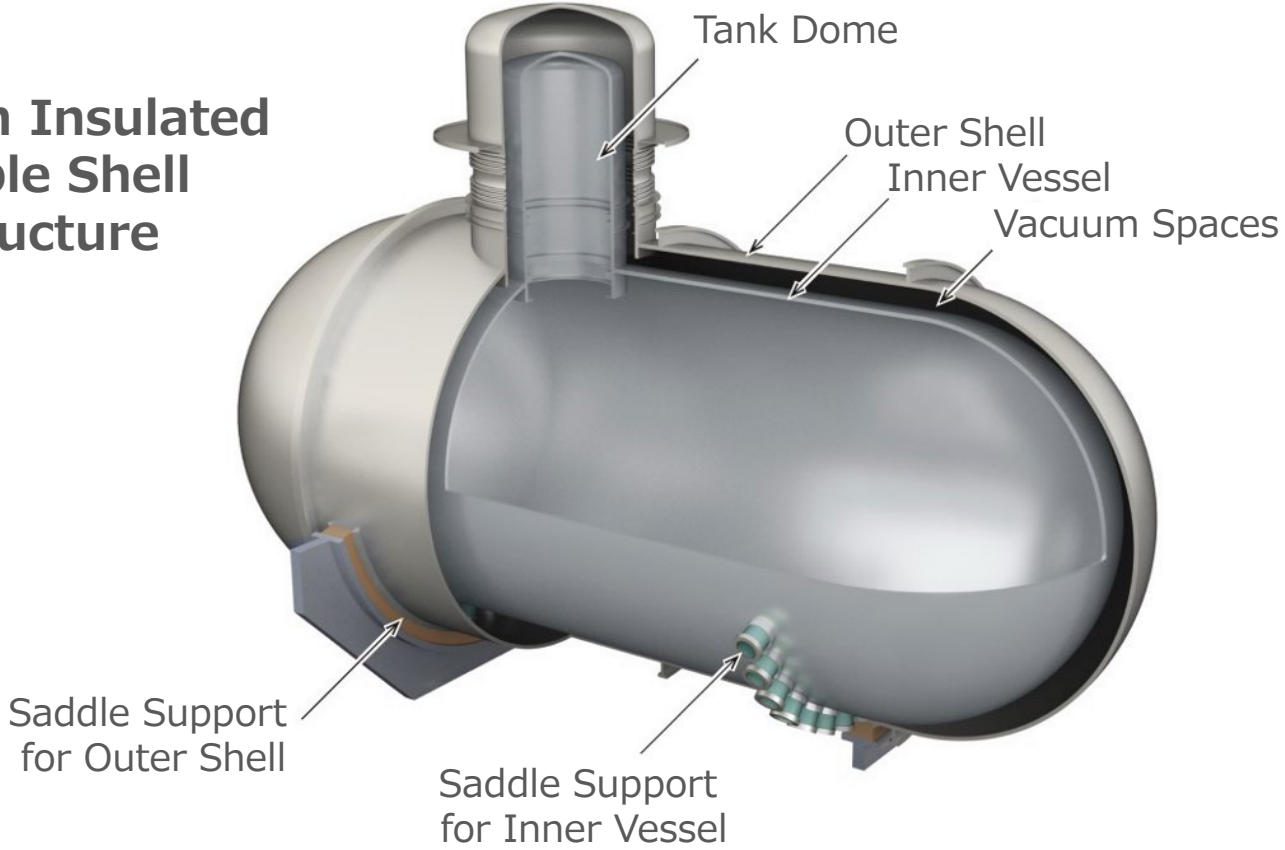


■ Length o.a.	116.0 m	■ Propulsion	Diesel - Electric
■ Breadth	19.0 m	■ Service speed	ab. 13 knots
■ Class/Flag	NK/Japan	■ Complement	25 persons

Cargo Containment System

Supported and subsidized by NEDO

Vacuum Insulated Double Shell Structure



Demonstration I

Supported and subsidized by NEDO

■ Loading and unloading tests were carried out with LH_2 at the onshore terminal “Hy touch Kobe”.

Source of photo : HySTRA

Full load trial voyage in Japan
(September to October, 2021)

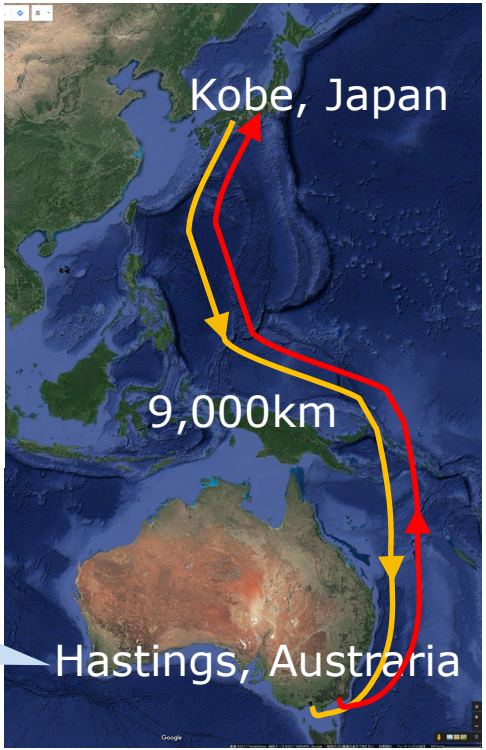
Demonstration II

Supported and subsidized by NEDO

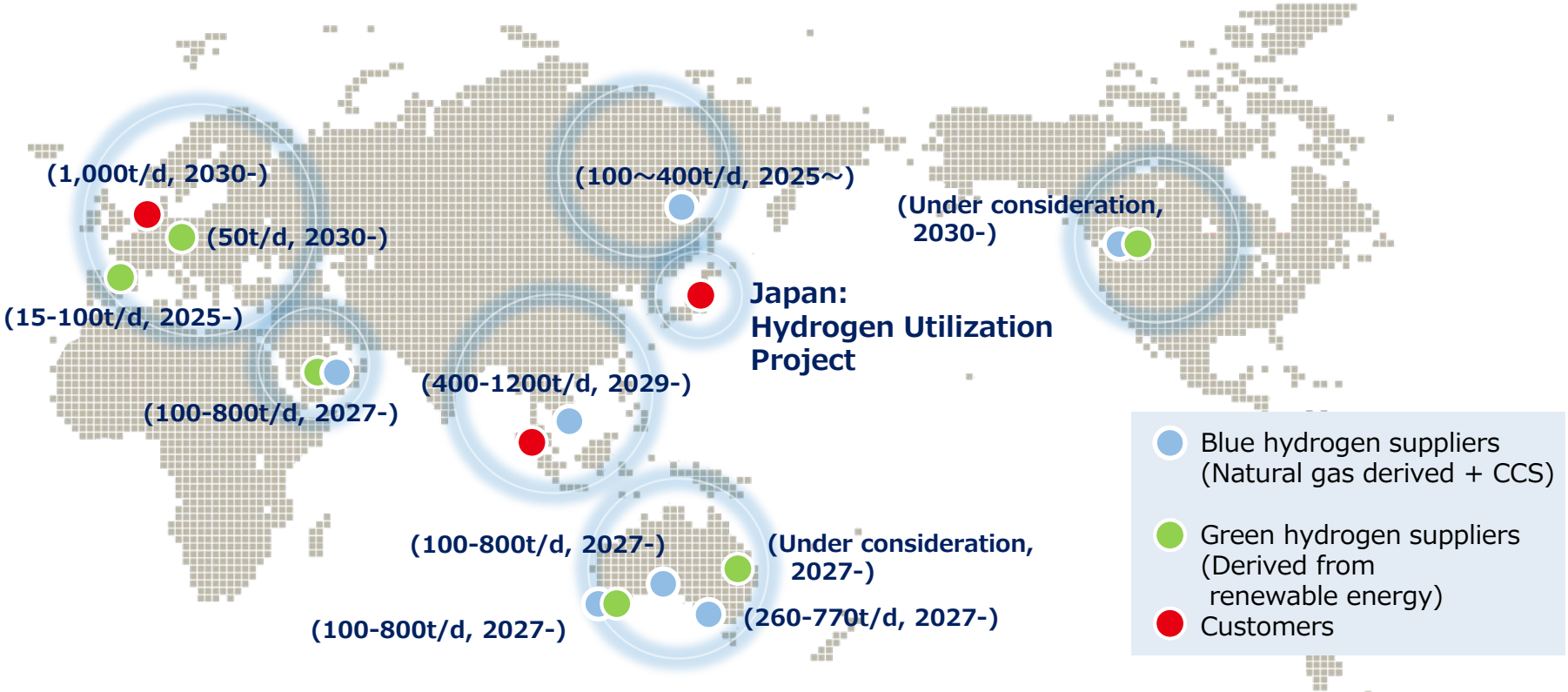
■ Verification of long-haul transportation technology

Demonstration voyages were carried out between Japan and Australia.

Source of photo : HySTRA



Cost Studies on Hydrogen Businesses from The World



*(Production scale, Production start date)

Steps in Scale Up of Hydrogen Use and Transportation

Production

Hydrogen production and liquefaction

Transportation

Liquefied hydrogen carrier

Storage

Liquefied hydrogen tank

Utilization

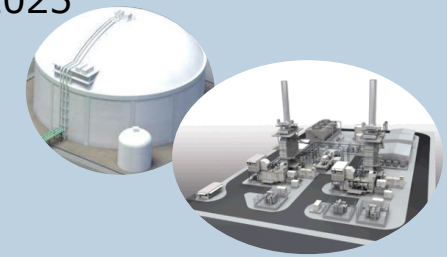
Hydrogen power generation and mobility

Technical Demonstration

Scale up

2020

Commercial Demonstration



2025

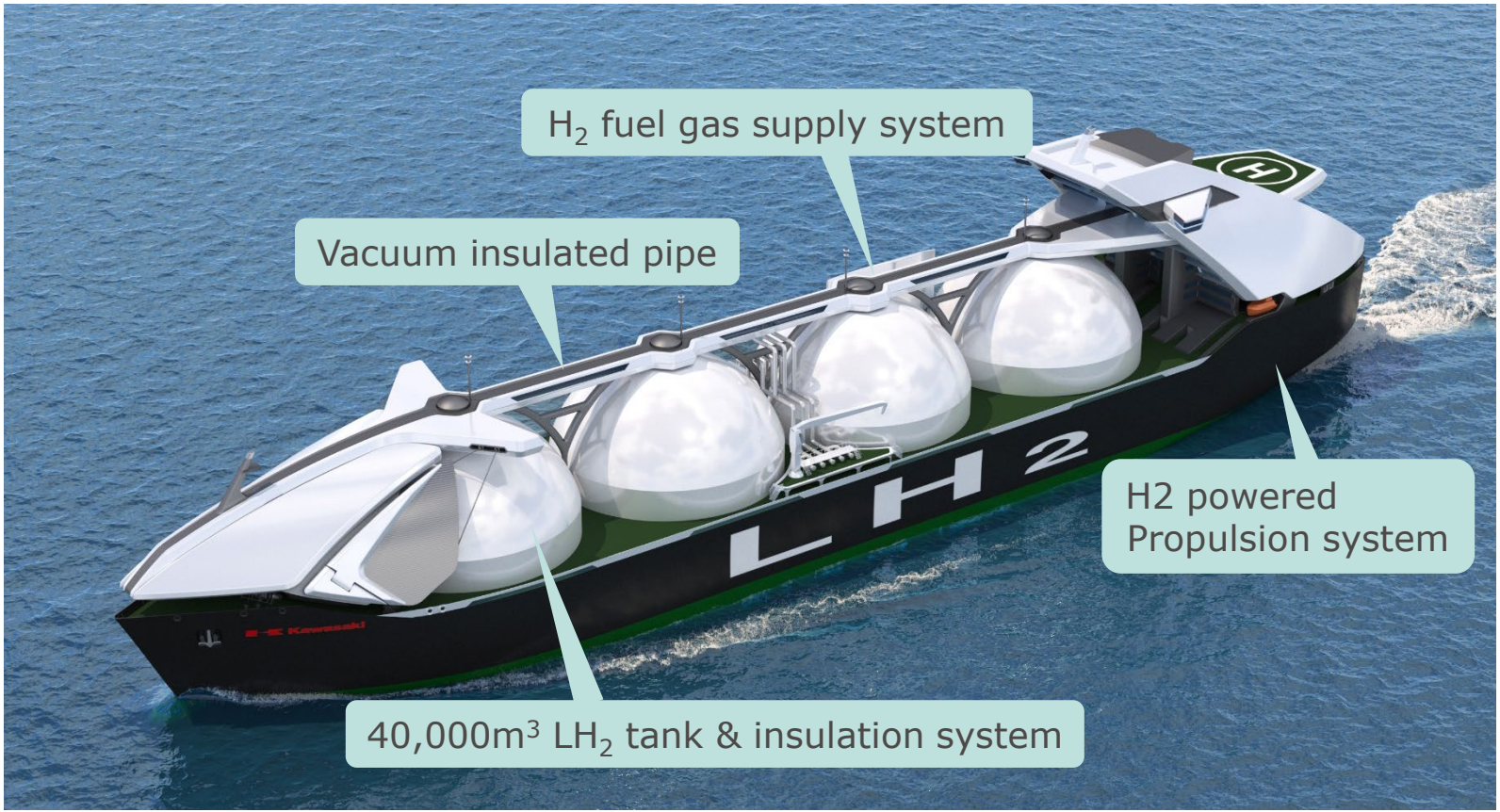
Commercialization

Transportation Volume
225,000t/y

2030

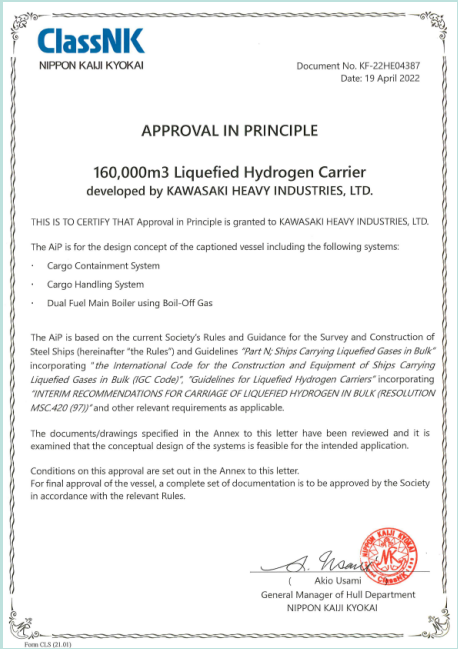
Supported by JP. Gov.
Green Innovation Fund

160,000m³ Large scale LH_2 carrier



AiP obtained from ClassNK

ClassNK issued Approval in Principle (AiP) for 160,000m³ LH_2 Carrier on 19th April, 2022.



ClassNK
NIPPON KAIJI KYOKAI

Document No. KF-22HE04387
Date: 19 April 2022

APPROVAL IN PRINCIPLE

160,000m3 Liquefied Hydrogen Carrier
developed by KAWASAKI HEAVY INDUSTRIES, LTD.

THIS IS TO CERTIFY THAT Approval in Principle is granted to KAWASAKI HEAVY INDUSTRIES, LTD.

The AiP is for the design concept of the captioned vessel including the following systems:

- Cargo Containment System
- Cargo Handling System
- Dual Fuel Main Boiler using Boil-Off Gas

The AiP is based on the current Society's Rules and Guidance for the Survey and Construction of Steel Ships (hereinafter "the Rules") and Guidelines *"Part N: Ships Carrying Liquefied Gases in Bulk"* incorporating *"the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)", "Guidelines for Liquefied Hydrogen Carriers"* incorporating *"INTERIM RECOMMENDATIONS FOR CARRIAGE OF LIQUEFIED HYDROGEN IN BULK (RESOLUTION MSC.420 (97))"* and other relevant requirements as applicable.

The documents/drawings specified in the Annex to this letter have been reviewed and it is examined that the conceptual design of the systems is feasible for the intended application.

Conditions on this approval are set out in the Annex to this letter.
For final approval of the vessel, a complete set of documentation is to be approved by the Society in accordance with the relevant Rules.

(Akio Usami
General Manager of Hull Department
NIPPON KAIJI KYOKAI

Form CLS (21.01)

AiP Certificate

Hydrogen Supply Chain for Decarbonization

1 Stable Supply

- Hydrogen from fossil fuel linked with CCS will realize vast and affordable energy supply → **Contribute energy security**

2 Enviromental

- No CO2 emissions when used → **“Carbon Neutrality”**

3 Economy

- Decarbonization brings Industrial growth → **Creating Job opportunity**
- Hydrogen production started from fossil fuel shifted to the renewables in the future → **Sustainability**

4 Clean Hydrogen Implementation in Japan

- Start from 420,000 ton/year in 2030, 200 billions ton /year in 2050

New Values

A Safe and Secure
Remotely-Connected Society

Trustworthy Solutions for the Future

Cross Over

Energy and Environmental Solutions

"Near-Future" Mobility

Frontier