



# HySTRA

CO<sub>2</sub>-free Hydrogen Energy Supply-chain  
Technology Research Association

Vol. 03\_e

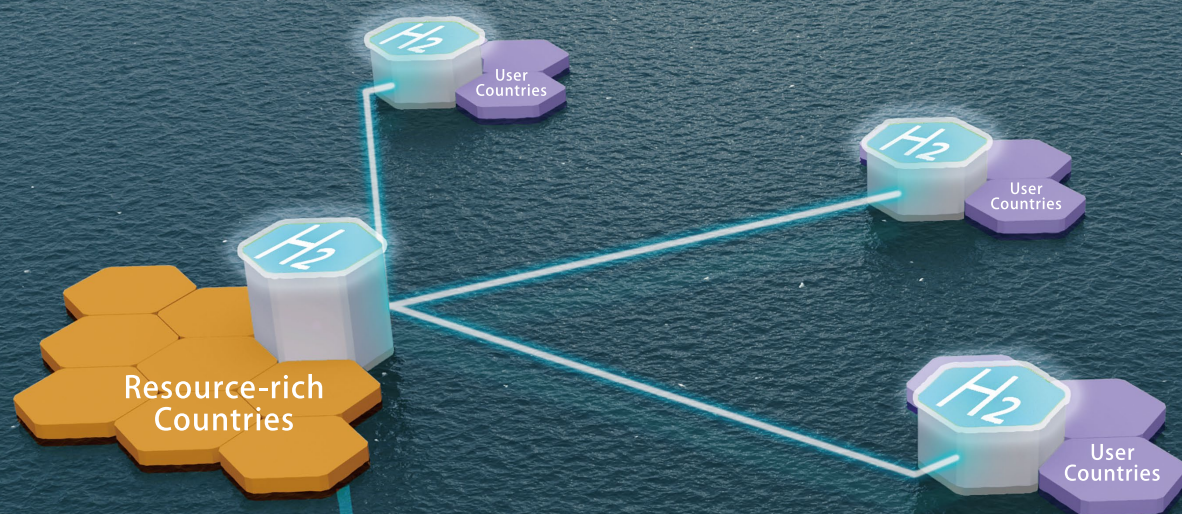
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<https://www.hystra.or.jp/en/>



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## The Vision of HySTRA

A Hydrogen Society, where hydrogen is widely used in the same way as petroleum and natural gas are currently used

To realize this, firstly hydrogen will be produced from unused brown coal in resource-rich countries. Carbon dioxide (CO<sub>2</sub>), a by-product of this process, will be captured and sequestered underground.

The CO<sub>2</sub> free hydrogen produced will be liquefied and transported in large quantities to user countries.

In order to realize such a hydrogen energy supply chain, the world's first technology demonstration pilot project will be implemented in 2020.

This will lead to the dawn of a Hydrogen Society.



## CO<sub>2</sub>-free Hydrogen Energy Supply-chain Technology Research Association

The association working towards creating a CO<sub>2</sub> free hydrogen energy supply chain comprised of hydrogen production effectively utilizing brown coal, transportation, storage and utilisation of hydrogen, and establishing and demonstrating the technologies to commercialise the supply chain around 2030.

※ The organization implementing the Demonstration Project for Establishment of Mass Hydrogen Marine Transportation Supply Chain Derived from Unused Brown Coal by NEDO (the New Energy and Industrial Technology Development Organization)

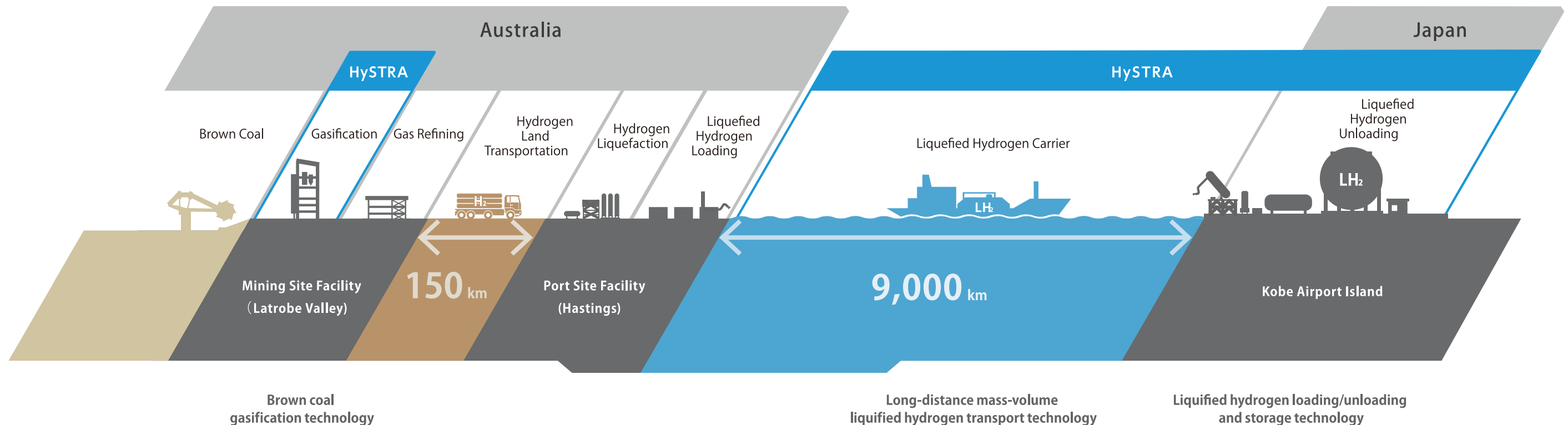
# Hydrogen Energy Supply Chain Pilot Project between Australia and Japan

Since 2020, a pilot project has been conducted to demonstrate brown coal gasification and hydrogen refining at Latrobe Valley in Australia, hydrogen liquefaction and its storage at Hastings Port, marine transport of liquefied hydrogen from Australia to Japan and its unloading in Japan.

With the assistance of NEDO, in the hydrogen energy supply chain pilot project HySTRA is undertaking development of :

- brown coal gasification technology
- technology of long distance transportation of mass liquefied hydrogen
- liquefied hydrogen loading and unloading technologies

※ Demonstration Project for Establishment of Mass Hydrogen Marine Transportation Supply Chain Derived from Unused Brown Coal by NEDO (the New Energy and Industrial Technology Development Organization)





# Brown Coal

An abundant unused resource lying under the earth's surface, this is low rank coal, brown coal.

Approximately half of the world's total coal resources is brown coal.

However, it is relatively heavy and bulky, but low calorie due to its extremely high moisture content.

As it runs the risk of igniting spontaneously upon contact with air, it is not suitable for transportation and storage in its raw form. Thus, it is limited to on-site applications.

Can we mass-produce affordable and clean hydrogen from this unused resource?

Our journey starts here.

## Reserves

Loy Yang Complex in Latrobe Valley.

It is about 6,000 ha, including the power generation facility.

The brown coal reserves in Australia have the potential to meet Japan's electricity demand for several hundred years.



Brown Coal





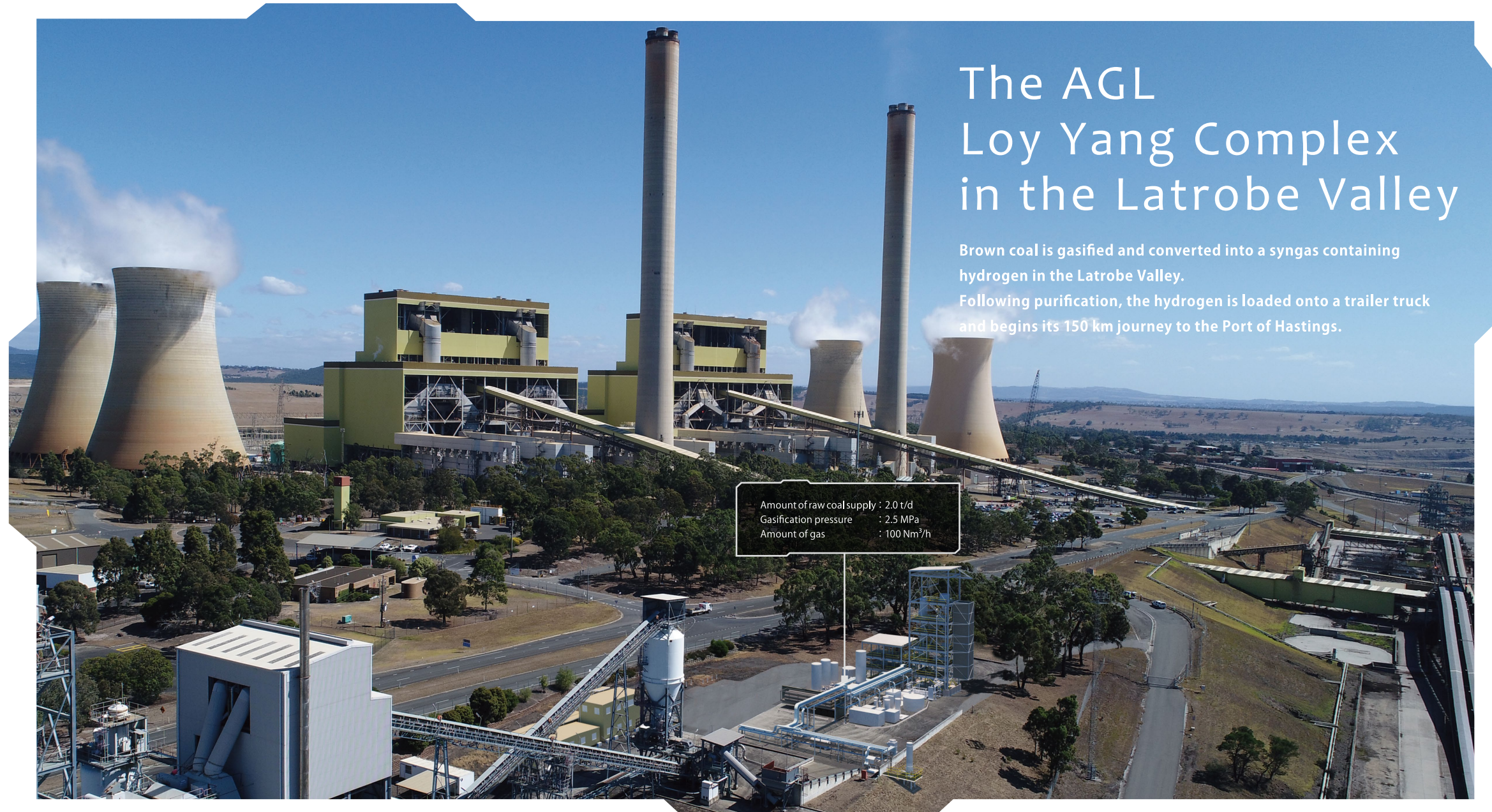
# Gasification Facility

Brown coal has a high moisture content and unstable qualities. The gasification process therefore needs to resolve various technological hurdles in order to realize mass production in the future.



# Gas Refining Facility

During the process of extracting hydrogen from syngas, it is possible to separate and capture carbon dioxide. This will reduce greenhouse gas emissions, despite the energy being derived from fossil fuels.



Gasification

Gas Refining





Australia

Victoria

Hastings

# The Port of Hastings

Hydrogen is liquefied here and loaded onto a liquefied hydrogen marine carrier.  
It then sets off on its long journey to Japan.

Liquefied Hydrogen Loading Facility

Hydrogen Liquefaction Facility

## Liquefaction / Loading Facility

-253°C, 1/800

By cooling hydrogen down to a cryogenic level of -253°C, it is converted from gas into liquid and reduces in volume by 1/800. Such reduction in volume allows for more efficient transportation and distribution of more hydrogen.

Hydrogen  
Land  
Transportation

Hydrogen  
Liquefaction

Liquefied  
Hydrogen  
Loading

LH<sub>2</sub>

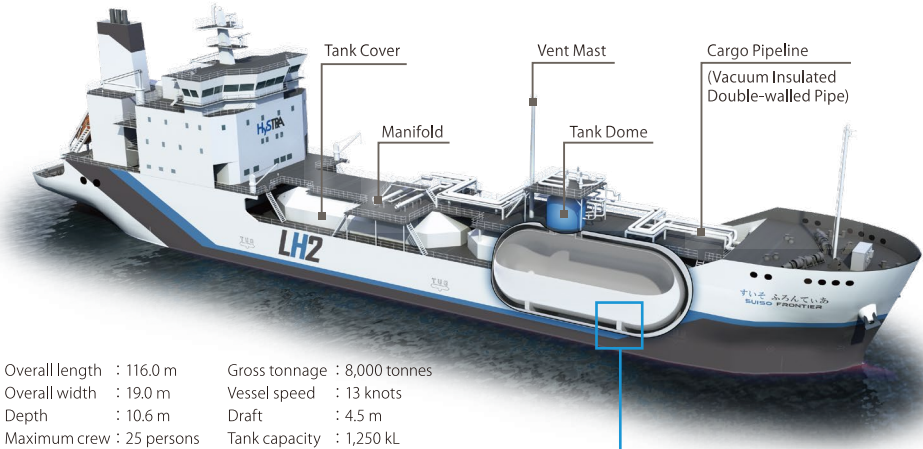


# Liquefied Hydrogen Carrier

## SUIO FRONTIER

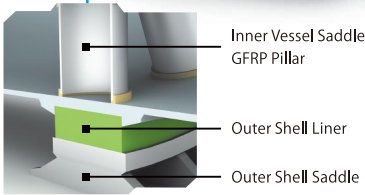
Technology to maintain a temperature of  $-253^{\circ}\text{C}$  whilst traversing the Earth

Using existing technologies for construction of LNG marine carriers and for land transportation and storage of liquefied hydrogen, a new cargo containment system with cryogenic temperature and accumulated pressure to specifically transport liquefied hydrogen on a marine carrier has been developed. Our aim is to establish technology for safe and efficient transportation of mass volumes of hydrogen.



### Liquefied hydrogen tanks for marine transportation

A vacuum insulated double-walled structure provides ultimate insulation properties.  
Using glass fiber reinforced plastic (GFRP) for the support structure enables heat transfer to be reduced.



KEEP IT  $-253^{\circ}\text{C}$





# The Port of Kobe

The pilot project site is located on a 10,000 m<sup>2</sup> area of land in the northeast section of Kobe Airport Island in the Port of Kobe, where the liquefied hydrogen storage tank and unloading facilities are built.



Liquefied Hydrogen Storage Tank  
2,500 kL  
19m diameter  
Spherical Vacuum Double Shell

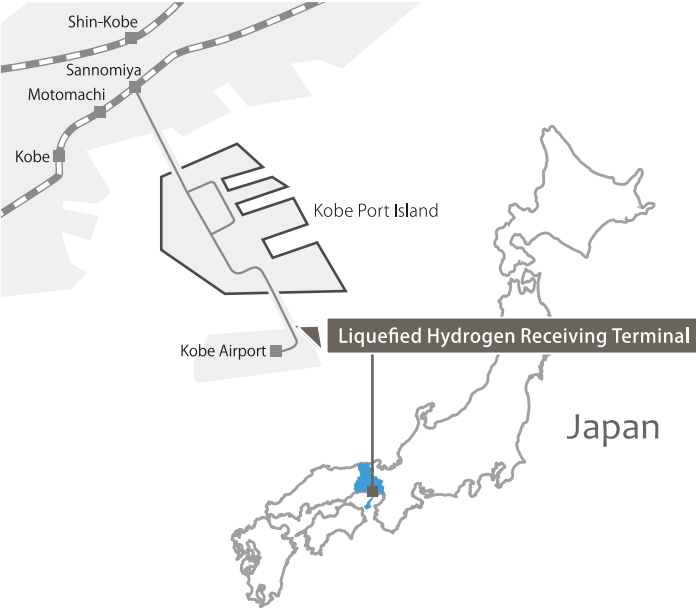
Loading Arm System, LAS  
6 inch diameter  
Double-walled Vacuum Insulation  
Emergency Release System

## Storage and Unloading Facilities Hy touch Kobe

### Liquefied Hydrogen Receiving Terminal in Japan

The liquefied hydrogen marine carrier arrives after a journey of around 9,000 km. A loading arm system unloads the hydrogen from the carrier into an on-land liquefied hydrogen storage tank, whilst maintaining a temperature of -253°C. This is the first new energy terminal in Japan.

Iwatani	Kawasaki	Shell
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Liquefied Hydrogen Unloading





# Hydrogen Energy Supply Chain Pilot Project between Australia and Japan

# Accomplished!

In February 2020, hydrogen produced from unused brown coal and liquefied in Australia was transported by ship and unloaded in Kobe and the supply chain demonstration was successfully completed.



Gasification & Hydrogen Production Plant  
(J-POWER)



Hy touch Kobe  
(Iwatani Corporation & Kawasaki Heavy Industries)

SUIISO FRONTIER  
(Shell Japan & Kawasaki Heavy Industries)

**HySTRA**  
History

2016

HySTRA established

**Iwatani**

**Kawasaki**



**J-POWER**

2018

October

Marubeni Corporation  
joins project

**Marubeni**

2019

August

ENEOS Corporation  
(formerly JXTG Nippon Oil &  
Energy) joins project



December

Kawasaki Kisen Kaisha, Ltd.  
joins project

**K LINE**

December

"SUIISO FRONTIER" liquified  
hydrogen carrier launched



2020

Storage tank installed

June

Operations at Hy touch Kobe  
commenced



August

Hy touch Kobe tank filled  
with liquified hydrogen



2021

February

Target hydrogen  
purity of 99.999%  
achieved  
(Australia)

August

Brown coal biomass  
mixing and  
gasification process  
commenced  
(Australia)



October

Fully loaded SUIISO  
FRONTIER domestic test  
voyage completed

December

SUIISO FRONTIER acquired  
Class

December

SUIISO FRONTIER departs  
Japan for Australia



2022

February

SUIISO FRONTIER returns to  
Japan

April

Hydrogen supply chain  
completion ceremony





Established  
**2016**

### Gasification

J-POWER has been working on producing gaseous hydrogen by applying coal gasification expertise they have cultivated in their power generation project.

#### Brown Coal Gasification

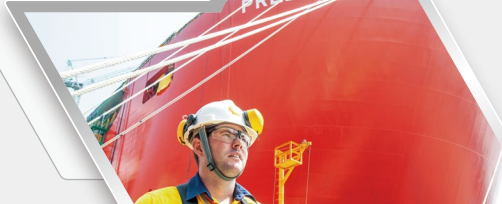


**J-POWER**

### Shipping

Shell, using the knowledge and experience as the pioneer of the LNG (Liquefied Natural Gas) industry, is working on safe transportation for liquefied hydrogen.

#### Marine Transportation



**SHELL**

**HySTRA**

**Kawasaki**



#### Construction/Ship Building

Kawasaki takes their experience and expertise in cryogenic technologies of building LNG carriers, LNG storage tanks, and liquefied hydrogen tanks for rocket fuel, and challenges on building liquefied hydrogen carriers and inland facilities.

### Building

**Iwatani**



#### Terminal Operation

Iwatani Corporation, using the know how obtained as Japan's sole supplier of liquefied hydrogen, are working on Loading/unloading and storage of liquefied hydrogen.

### Operation

**4**  
Companies

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