Tsubame BHB

Empowering Local Industries with Sustainable & Distributed Ammonia Production

Revolutionizing Clean Ammonia Production for a Sustainable Future!

Tsubame BHB, with its unique technology, is committed to serving the industrial and agricultural sectors by improving the security and efficiency of ammonia supply while driving decarbonisation.

3 KEY WORDS to describe Tsubame BHB

University born Start-up

A Japanese Start-up from Institute of Science Tokyo, established April 2017

Electride Catalyst

The core of Innovative ammonia synthesis “Electride Catalyst”

Flexible & Distributed

Revolutionise Ammonia supply chain with Flexible & Distributed production system

Tsubame BHB supports the following United Nations Sustainability Development Goals (SDGs)

OUR PATH TO DATE: Leveraging our 12 key patents*1, we are accelerating business development, with the first 2 commercial plants coming online

2012
Catalyst Technology Developed

Electride catalyst technology was released on *Nature Chemistry*

Oct 2019
Established Pilot Plant

Pilot plant for verification of Catalyst was established at the premise of our major stockholder Ajinomoto in Kawasaki City

July 2022
Received First Commercial Plant Order

Received the first 500t/y scale commercial order. Operation will start in 2025.

Aug 2024
Received 2nd Commercial Plant Order

Received the second and fully commercial order for industrial use. Operation will start in 2026.

April 2017
Company Founded
Paid-in capital US＄3M *3

Tsubame BHB was founded on April 5, 2017, with the goal of innovating ammonia production.

Mar 2019
Fund raised US＄8M

Oct 2020
Fund raised US＄3M

June 2021
Fund raised US＄2.8M

July 2022
Fund raised US＄28M

Feb 2024
Fund raised US＄9M

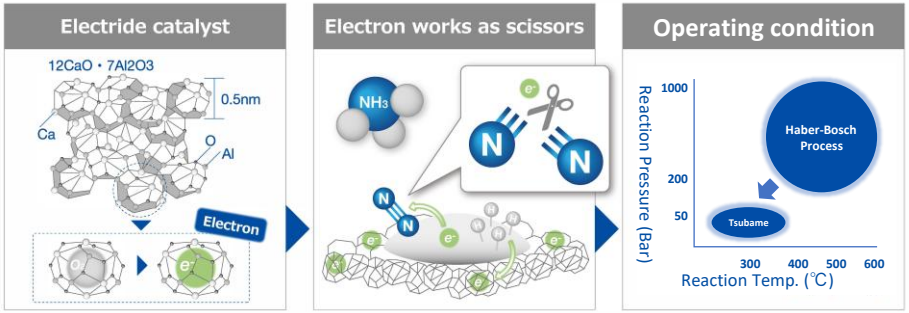
Welcomed our first foreign shareholder **Heraeus**.

*1: Of which 8 are registered, as of Nov 2024, *2 Number in ◆ represents the patents filed to date, including registered and pending, *3 Converted at JPY 145/USD

CORE OF OUR TECHNOLOGY: Tsubame's patented electride catalyst technology allows ammonia production at much smaller capacity.

- Tsubame's **electride catalyst** operates by leveraging the strong electron-donating properties of the electride material, which is composed of cations (positively charged ions) and localized electrons in cavities within the material.
- These localized electrons act as scissors, facilitating the dissociation of nitrogen (N_2) molecules.
- Drastically lowering the activation energy required for the reaction, enabling ammonia synthesis at lower temperatures and pressures than the conventional Haber-Bosch process.

Tsubame's process operates at around 300-400°C and 30-50 bars. With the less pressure resistance the process requires, plant can be designed from a much smaller scale than Haber-Bosch process.



Prevailing operating condition

	Haber-Bosch	Tsubame
Pressure	200-1,000 bar	30-50 bar
Temperature	400-600 ℃	300-400 ℃
Scale	100,000 t/y~	500 t/y~

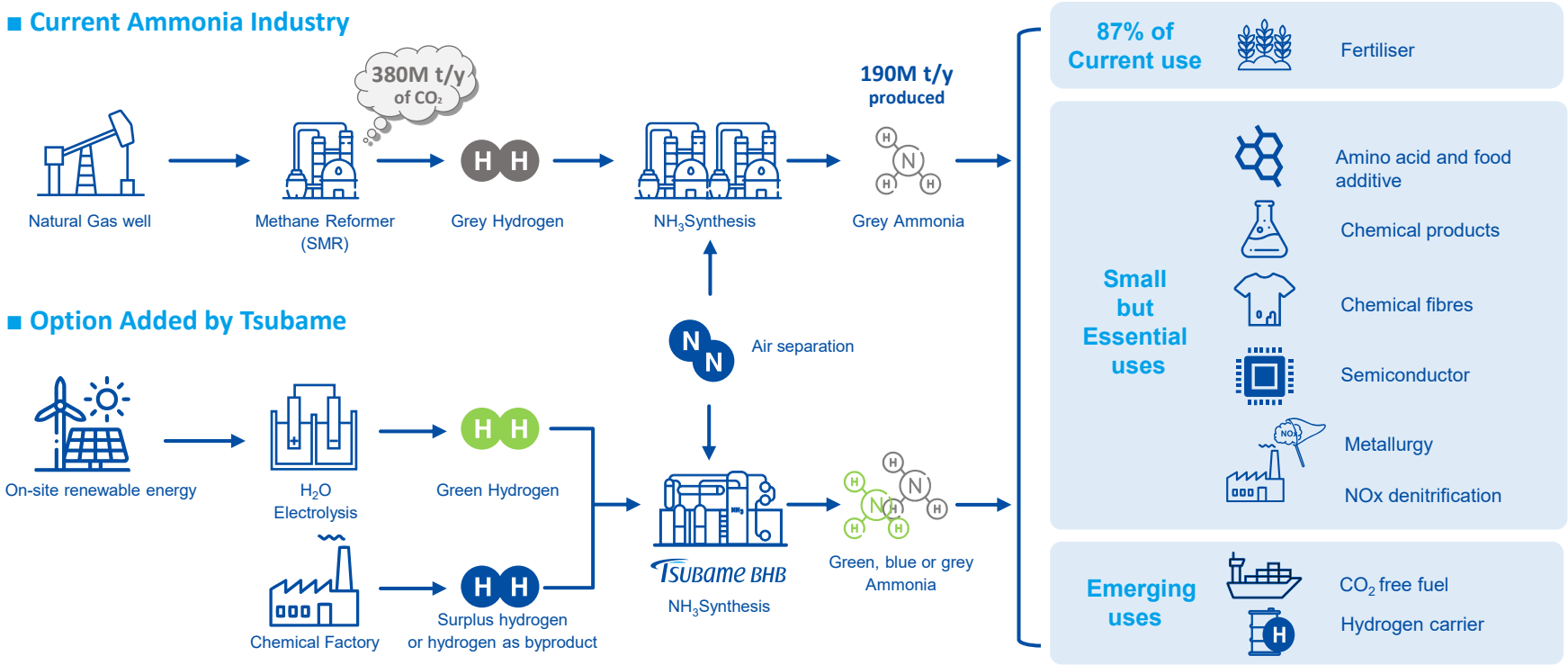
OUR OFFERINGS: Now with the unique small-scales in modular design, medium-scale to be available in 2026

- Tsubame BHB currently market the small-scale ammonia production systems from 500t/y up to 5,000t/y.
- Medium capacities system is going to be launched 2026

Small scales	Footprint	Delivery scope
500 t/y	16m x 21m	• Ammonia production module or basic design • License • Catalyst
3,000 t/y	20m x 30m	
5,000 t/y	25m x 40 m	

Medium scales	Footprint	Delivery scope
10,000 - 100,000 t/y	To be determined at design stage	• Basic design and procurement • License • Catalyst

WHY AMMONIA MATTERS: essential for various industries yet responsible for 380 million ton or 1.8% of global GHG emissions



Benefit we deliver to our customers

Stand-alone production at demand site

Transportation cost saving

Supply security

Easy installation

Easy O&M

Utilization of surplus energy & hydrogen

CO2 reduction

Distribution means Flexibility and Optimization

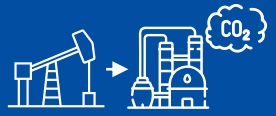
SOLUTION for the DECARBONISATION CHALLENGE:
Tsubame's process drives green transformation of Ammonia production

Ammonia's Role in Global Food Security

Ammonia is essential for nitrogen fertilizers that support global agriculture, crucial to feeding the projected 9.7 billion people by 2050. However, this rising demand contributes heavily to global CO_2 emissions.

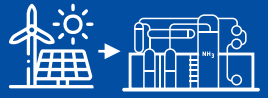
Essential material for many industries

Ammonia is essential material for key industries including chemical and electronics. Industry is under decarbonisation pressure for this hard-to-abate material.



Current Solution is carbon intensive

The Haber-Bosch process, almost universally used for ammonia production worldwide has been optimised over its century-long history for large-scale, centralised production using fossil-derived hydrogen as a feedstock, making radical decarbonisation efforts difficult.



Tsubame Solution for decarbonisation

Small scale and flexible Tsubame process allow for installation to suit the scale and location of renewable energy projects, removing the barrier of decarbonization.

Ammonia, currently produced almost exclusively by the **centralised Haber-Bosch process**, is essential for agriculture and industry yet comes with the environmental cost of **1.8% of global CO2 emissions**.

Tsubame process drive decarbonisation, freeing ammonia production from scale and location constraints and works hand-in-hand with small and decentralised renewable energy projects.

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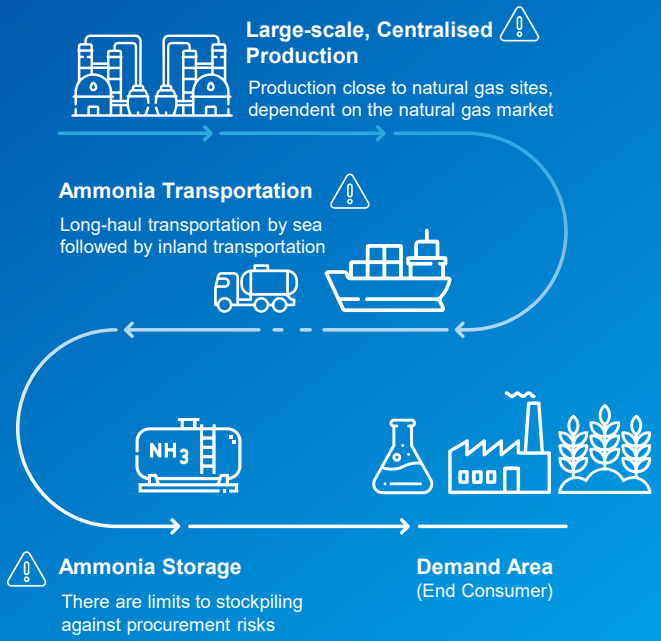
SOUTION for SUPPLY CHAIN SECURITY:
Tsubame's process enables on-site ammonia production, reduces supply risk

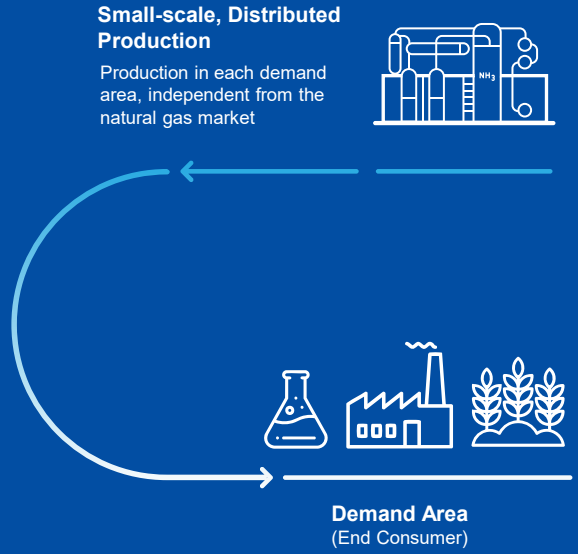
Current Supply Chain

The current geopolitical situation is creating the instability and price volatility of ammonia procurement



Tsubame BHB's Supply Chain

Tsubame delivers stand-alone solution to ammonia procurement, de-risking the end-user from instability and price volatility



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HOW WE WORK WITH CLIENTS:
Depending on the customer needs, Tsubame provide from minimum E&P for ammonia synthesis to BOOT scope

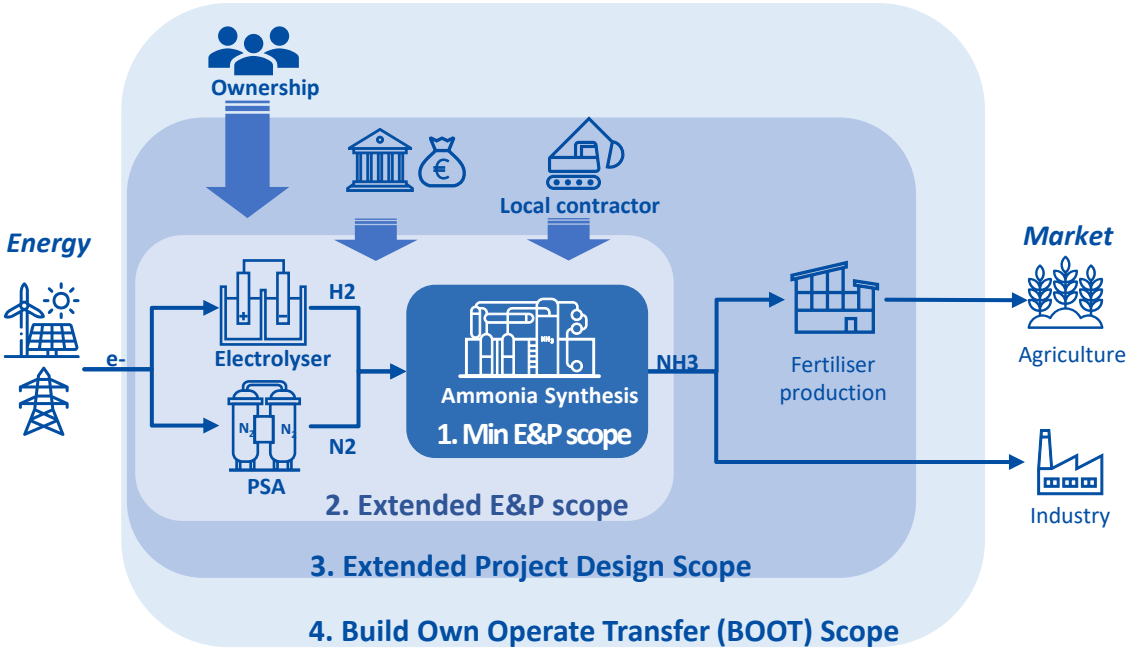
1: Minimum E&P Scope
- Delivery of prefabricated ammonia synthesis module or Basic engineering for larger scale
- Provide operation Training

2: Extended E&P Scope
- Including H2 and N2 generation units

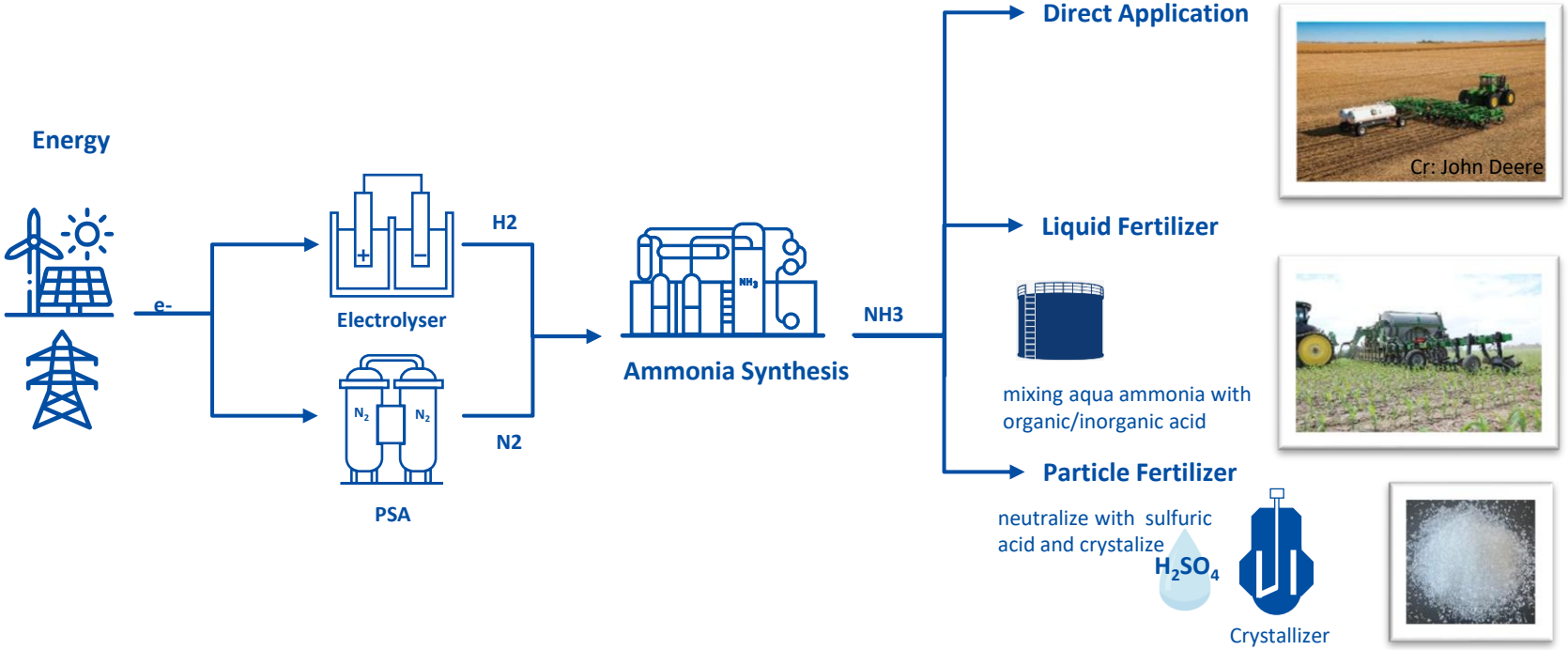
3: Extended Project Design Scope
- Including project design and arrangement for fund application, local general contractor, aiming both economically & technically viable project as a whole

4: BOOT Scope
- Tsubame Build, Own and Operate for an agreed period and Transfer to the client at the end of the period

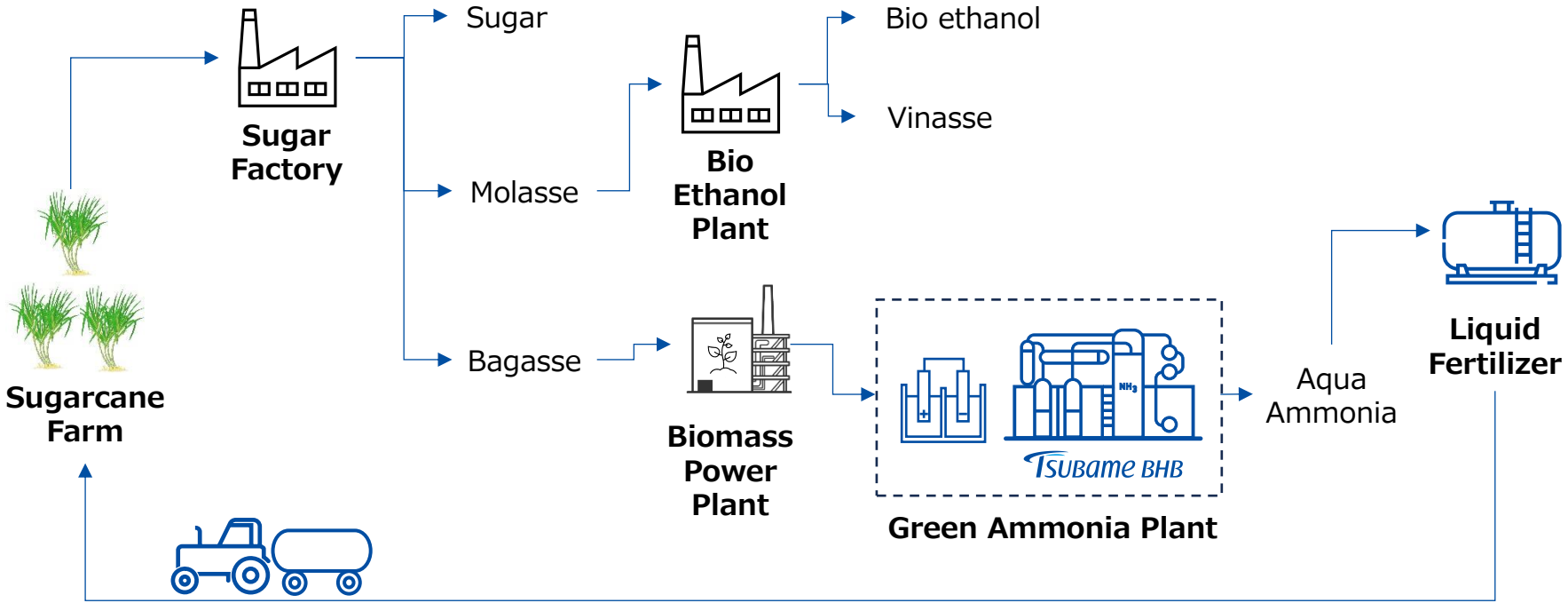
Tsubame's scopes for projects with small-scale plant



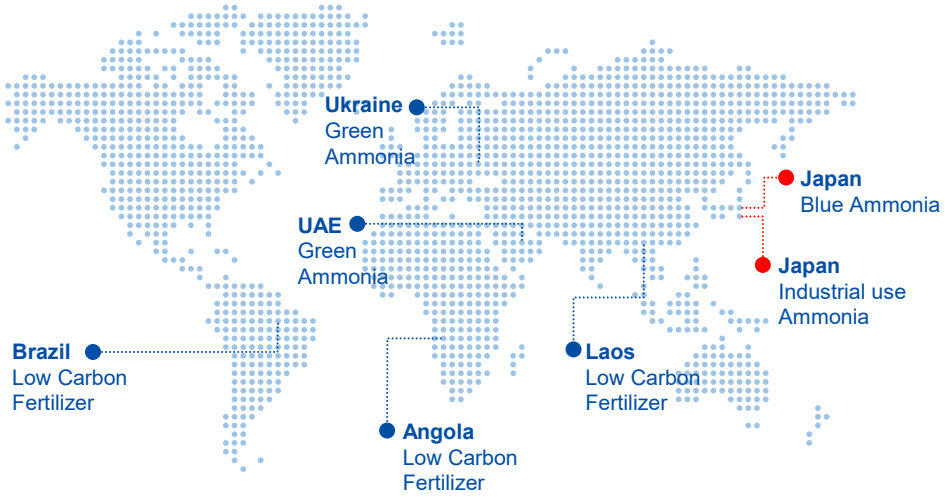
Low Carbon Fertilizer Production Model



Low Carbon Fertilizer Production Model at Sugar industry



Two commercial plant orders in Japan.
Several projects under discussion with global client.



Blue Ammonia Plant

Country: Japan
Capacity: 500t/y
Client: INPEX
Project: Kashiwazaki Clean Hydrogen/Ammonia
Operation: 2025 August

Ammonia Plant

Country: Japan
Capacity: 500t/y
Client: Confidential
Application: Industrial
Feed: 2024 January-2024 June
Award: 2024 August
Operation: 2026 August

Ammonia for Low Carbon Fertilizer

Country: Brazil
Capacity: 5,000t/y
Client: Sugar and bioethanol factory
Application: Low Carbon Fertilizer
Feasibility Study: 2024 April

Management

Koji Nakamura : Representative Director and CEO

- Joined Toyota Tsusho Corporation in 2007 (involved in establishing new businesses, cultivating new customers, seconded to Thailand and overseas transactions)
- Joined Universal Materials Incubator in 2017
- Joined Tsubame BHB in April 2019. Present position since June 2023.
- Applied Chemistry at Nagoya Institute of Technology, Waseda University. (MBA).

Toshiharu Yokoyama : Executive Fellow, CTO

- Joined Mitsubishi Kasei Corporation (now Mitsubishi Chemical Corporation) in 1971 (Central Research Laboratory in 1971.)
- Project manager of the Funding Program and a specially-appointed professor at Tokyo Tech.
- Joined Tsubame BHB in 2019 as Executive Officer and CTO. Present position since June 2023.
- Doctor of Engineering.

Munenobu Ito : Executive Officer (R&D)

- Joined Ajinomoto Co., Inc in 2009. (involved in catalyst engineer as a joint researcher at the Element Strategy Center of Tokyo Institute of Technology.)
- Joined Tsubame BHB as secondee in 2017. Present position since June 2023.

Sachio Kaneki : Executive Officer (Marketing)

- Joined Mitsubishi Corporation in 1980 (mainly involved for chemical business and oversea business, as General Manager Polyester Raw Materials Department at the head office, SVP Chemical group in Europe, Middle East, Africa and CIS, Deputy Regional CEO for Europe and Africa and CEO Johannesburg Branch.
- Joined Tsubame BHB in 2021. Present position since July 2023.

Gen Tatara: Executive Officer (Finance)

- Joined Nippon Oil Corporation (now ENEOS Corporation) in 2004 (involved in in domestic business, seconded to Vietnam, finance and accounting for oversea projects (North Sea, Malaysia and Canada) for oil/gas exploration and production including debt finance, asset acquisition and crossover M&A)
- Joined Tsubame BHB in 2021 and Present position since July 2024.

Background and origin of our staff

More than 60 staff members

- Process Engineer for a major engineering firm
- Catalyst Engineer for a major chemical company
- Postdoc at Tokyo Institute of Technology
- Major trading company
- Energy industry
- Consultant
- Venture capital
- Mega venture
- Loaned from shareholders as employee (Ajinomoto, NYK Line, Sankyu, etc.)

Empowering Innovation with Strategic Partners

AJINOMOTO
MITSUBISHI CHEMICAL
NYK LINE NIPPON YUSEN KAISHA
idemitsu
INPEX
Heraeus
UMI Universal Materials Incubator Co.,Ltd.
MUFG
DJK
三井住友信託銀行 SUMITOMO MITSUI TRUST BANK
SANKYU
YOKOGAWA
i-nest capital
MIRAI SOUZOU
DBJ
Energy Environment Investment
西日本プラント工業株式会社 Nishinippon Plant Engineering and Construction Co.,Ltd.
FUYO LEASE GROUP