

**The 43<sup>rd</sup> JCCP International Symposium**

# **Social Implementation of Carbon Neutral Fuels towards Energy Transition**

**29<sup>th</sup> January 2025**  
**Toyo Engineering Corporation**





## Agenda

1. TOYO's Approach for Carbon Neutrality
2. TOYO's Activities in Green Ammonia Business
3. g-Methanol<sup>®</sup> Production Technology
4. Summary



1 TOYO's Approach for Carbon Neutrality

# TOYO ENGINEERING CORPORATION

- Established: May 1, 1961
- President & CEO: Eiji Hosoi
- Listed: The Prime section of Tokyo Stock Exchange
- Offices: Head Office (Chiba) & Tokyo Head Office
- Capital Stock: US\$ 0.14 Billion





# Toyo's Business Field



## Process Plant

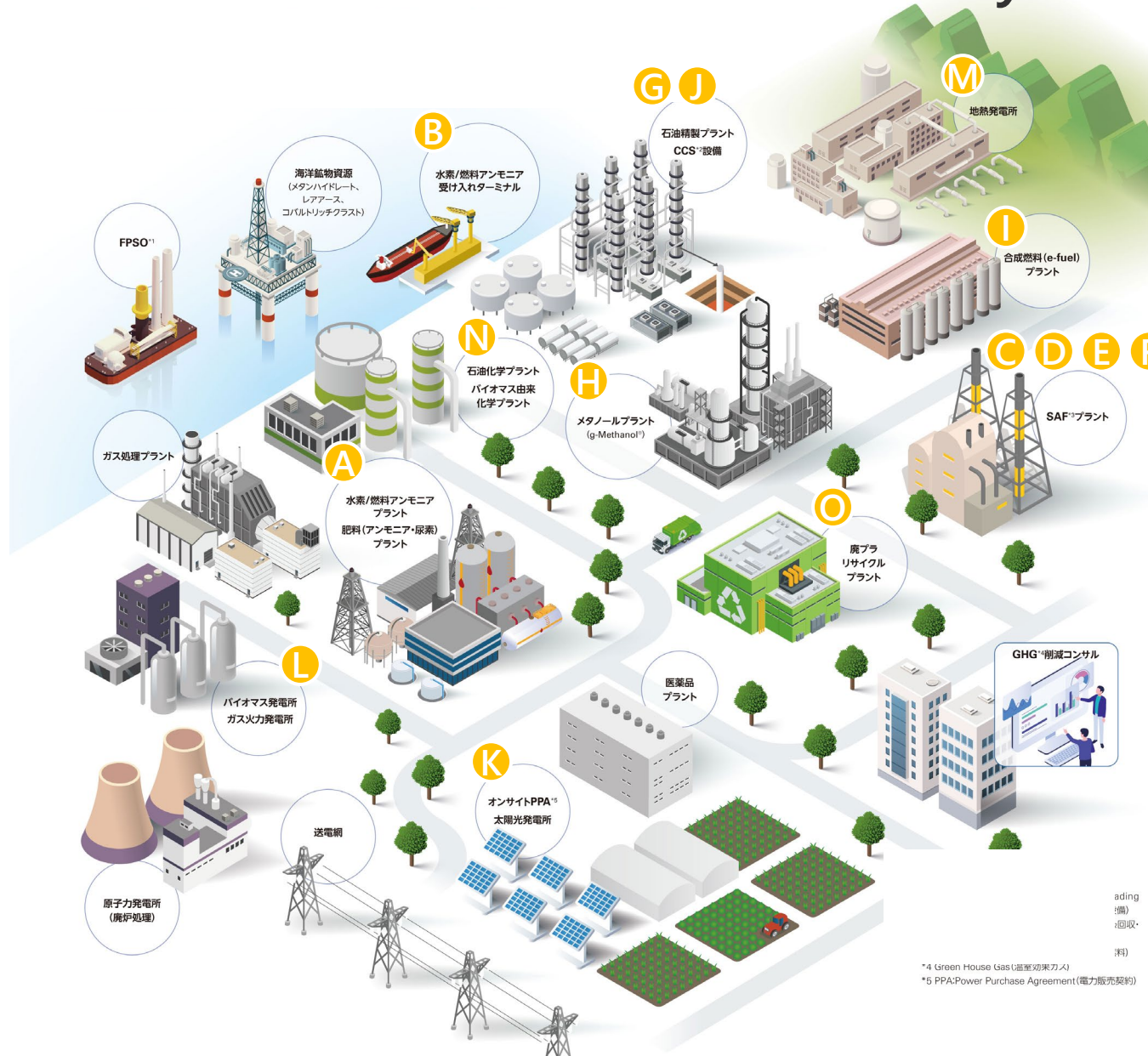
- Oil & Gas Production
- Refinery
- Aromatics
- Ethylene, Petrochemicals, Polymers
- Fertilizers, Chemicals, Ammonia, Methanol
- FPSO, Offshore Platform



## Non-Process Plant

- Renewable Energy(Photovoltaic, Biomass)
- Geothermal
- Thermal Power
- Pharmaceutical Fine Chemicals
- Agriculture, Food

# TOYO's Activities for Carbon Neutrality



## Clean NH3 / H2

- (A) Blue / Green NH3
- (B) NH3 Cracking

## SAF

- (C) Gasification/FT
- (D) Alcohol to Jet
- (E) Power to Liquid
- (F) Bioethanol

## CCUS

- (G) CO2-EOR / CCS
- (H) g-Methanol®
- (I) e-Fuel
- (J) Methanation (e-Methane)

## Renewable Energy

- (K) Solar Power
- (L) Biomass Power
- (M) Geothermal

## Energy Saving / Recycling

- (N) SUPERHIDIC® / HERO
- (O) Recycled PET

\*4 Green House Gas (温室効果ガス)  
\*5 PPA: Power Purchase Agreement (電力販売契約)



# Forecast of Alternative Marine Fuel Adoption

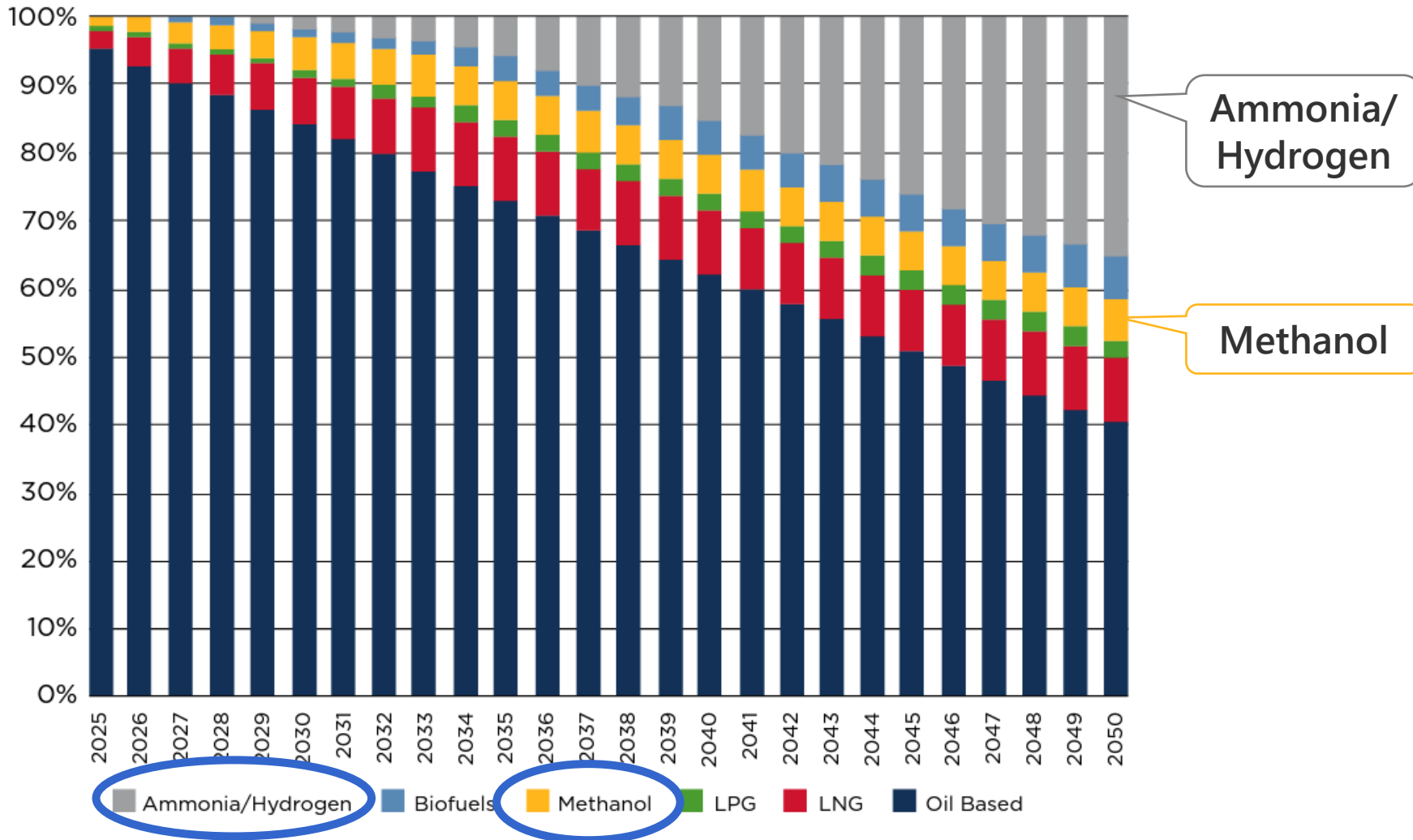


Figure 24: Projected marine fuel use to 2050.

Source: Pathways to Sustainable Shipping, ABS

[https://sustainableworldports.org/wp-content/uploads/ABS\\_2020\\_Pathways-to-sustainable-shipping-report.pdf](https://sustainableworldports.org/wp-content/uploads/ABS_2020_Pathways-to-sustainable-shipping-report.pdf)

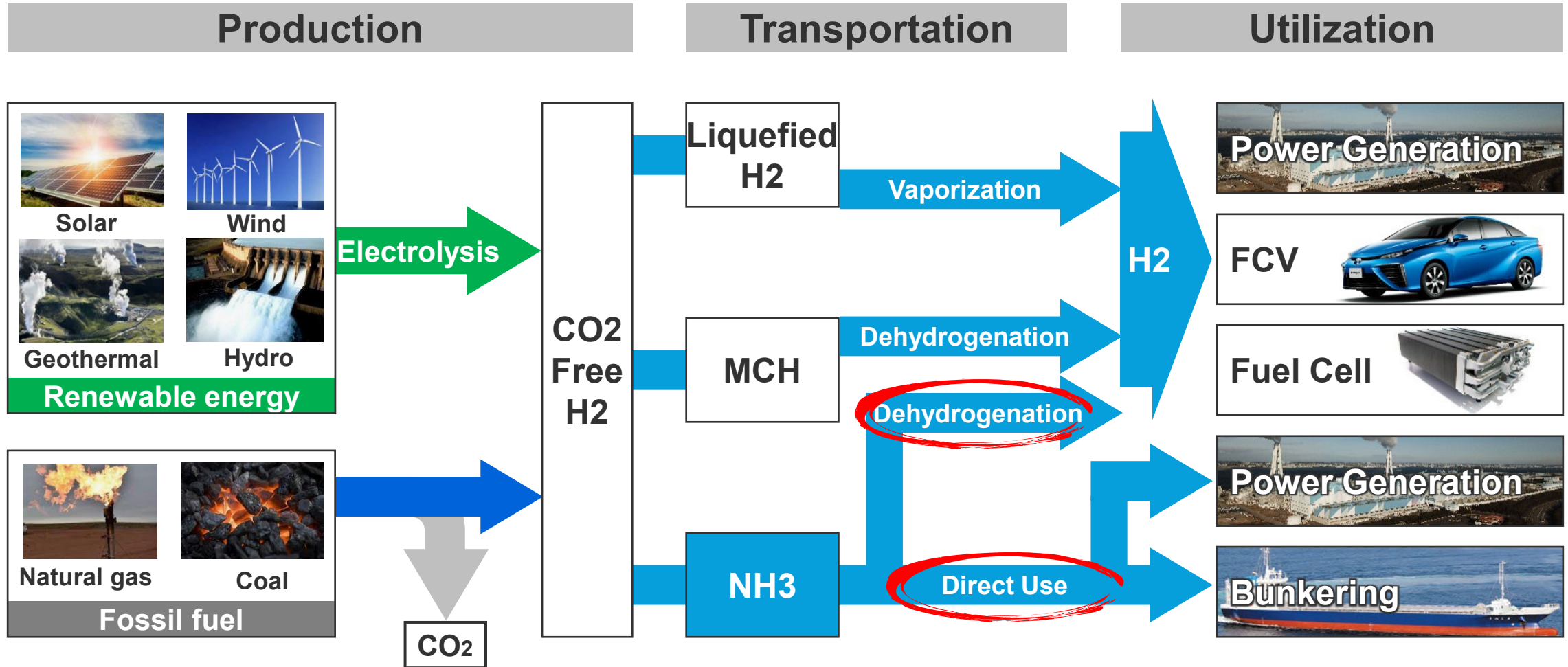


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# CO2 Free Fuel

NH3 is promising both as a direct fuel and as a H2 carrier





# Ammonia Alliance Japan (AAJ)

## JGC and TOYO entered Business Alliance for Ammonia Project



### Strengths

- Extensive experience in the countries where the ammonia plants are being planned
- More than 20,000 projects in over 80 countries

### Strengths

- Extensive experience with KBR licensed ammonia plant
- 87 Ammonia projects

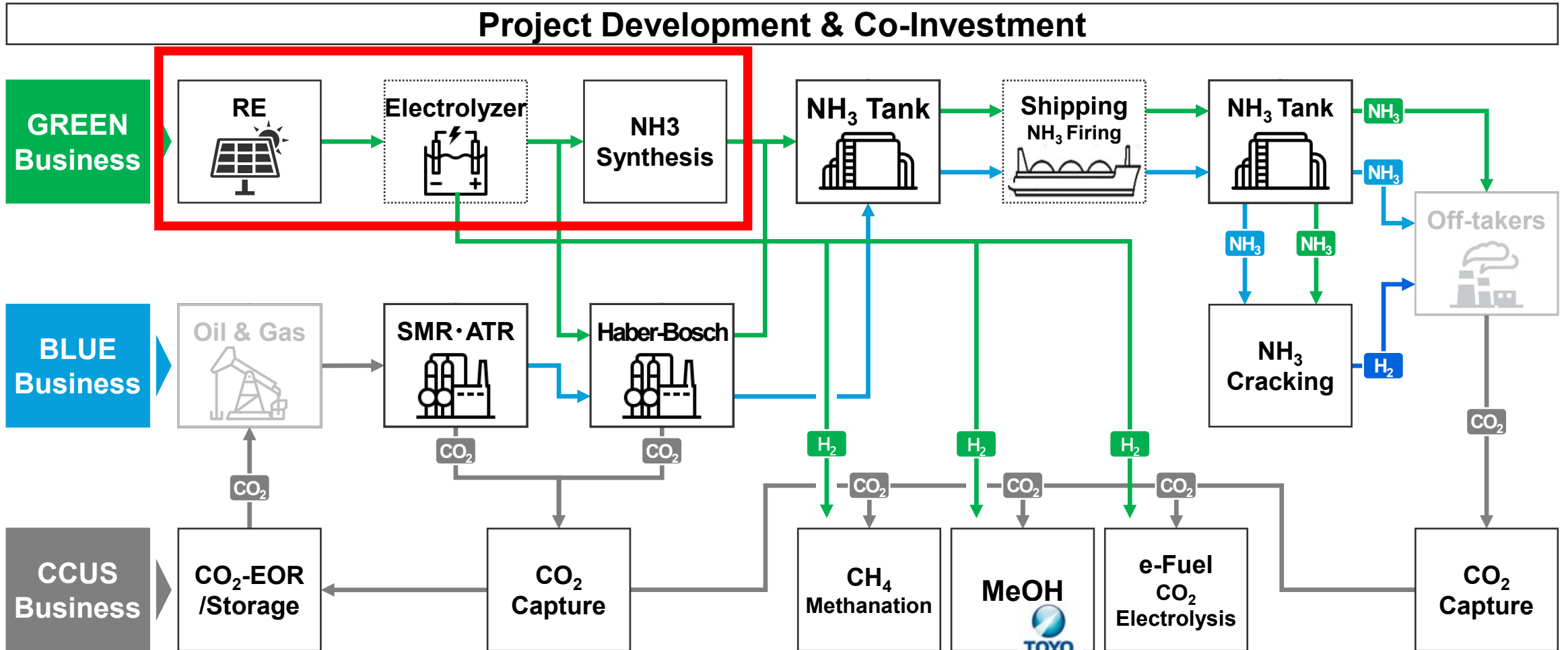
### Ammonia Alliance Japan can

- provide **one stop high value solution** from planning phase to EPC in a timely manner with KBR licensed ammonia process
- offer **the competitive proposal** based on the extensive experience of both parties

# TOYO's Approach & Values to CO<sub>2</sub> Free Ammonia Business

TOYO contributes to building a comprehensive value chain in both technology and business

TOYO's Coverage
  Complemented by Partnering





# GAIA / Green Ammonia Initiative from Aceh

- ◆ Aug.2024 Selected for the Global South Future-Oriented Co-Creation Project
- ◆ Aug.2024 Signed Joint Development Agreement (JDA)
- ◆ Nov.2024 Signed Shareholder's Agreement(SHA)

 Indonesia & Japan Govt. support 



JDA Announcement in AZEC



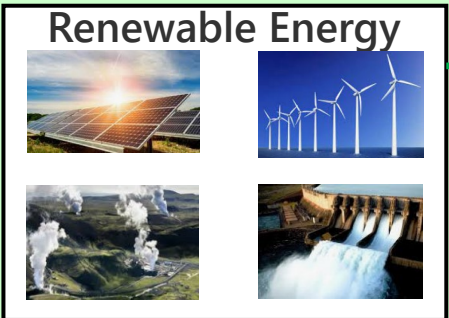
SHA Announcement in COP29 Japanese Pavilion

COP29 webpage (METI)  
[Empowering Action to Zero in Asia | COP29 JAPAN PAVILION - Ministry of the Environment](#)



# Feature of GAIA (Green Ammonia Initiative from Aceh)

## Green Ammonia Production Scheme



Grid  
 PLN  
 Green certs.

Remote location  
 Onsite

Electrolyzer → H<sub>2</sub>

Ammonia Synthesis

### GREEN AMMONIA

NH<sub>3</sub>

Fuel NH<sub>3</sub>

### EXISTING PLANT (PIM-2)



Natural Gas

Reforming/Rectification → H<sub>2</sub>

Urea Plant

### GRAY AMMONIA

NH<sub>3</sub>

Chemical NH<sub>3</sub>

### GRAY UREA

Urea

Urea



More than 50 years of Ammonia Operation Know-how & Expertise

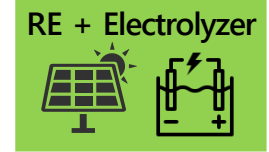
More than 60% of PI's Existing Ammonia Plant EPC Track Record



#### QUICK

Utilize PI's existing facilities

- Add electrolyzers on NH<sub>3</sub> plants
- Get RE electricity from the grid



#### ECONOMIC

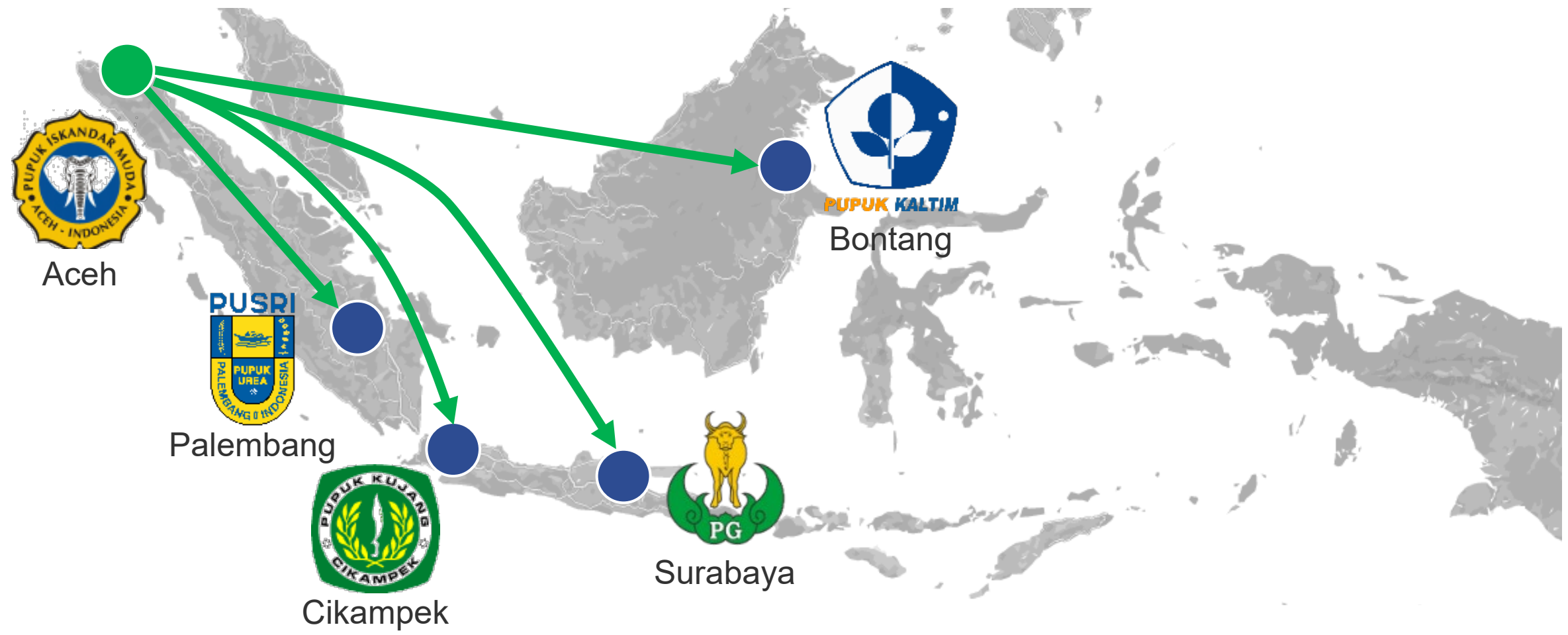
Minimize CAPEX and OPEX

- Utilize unused NH<sub>3</sub> capacities
- Level out NH<sub>3</sub> annual production





# Future Expansion Opportunity



Expand the success of PJ GAIA to other existing plants in Indonesia



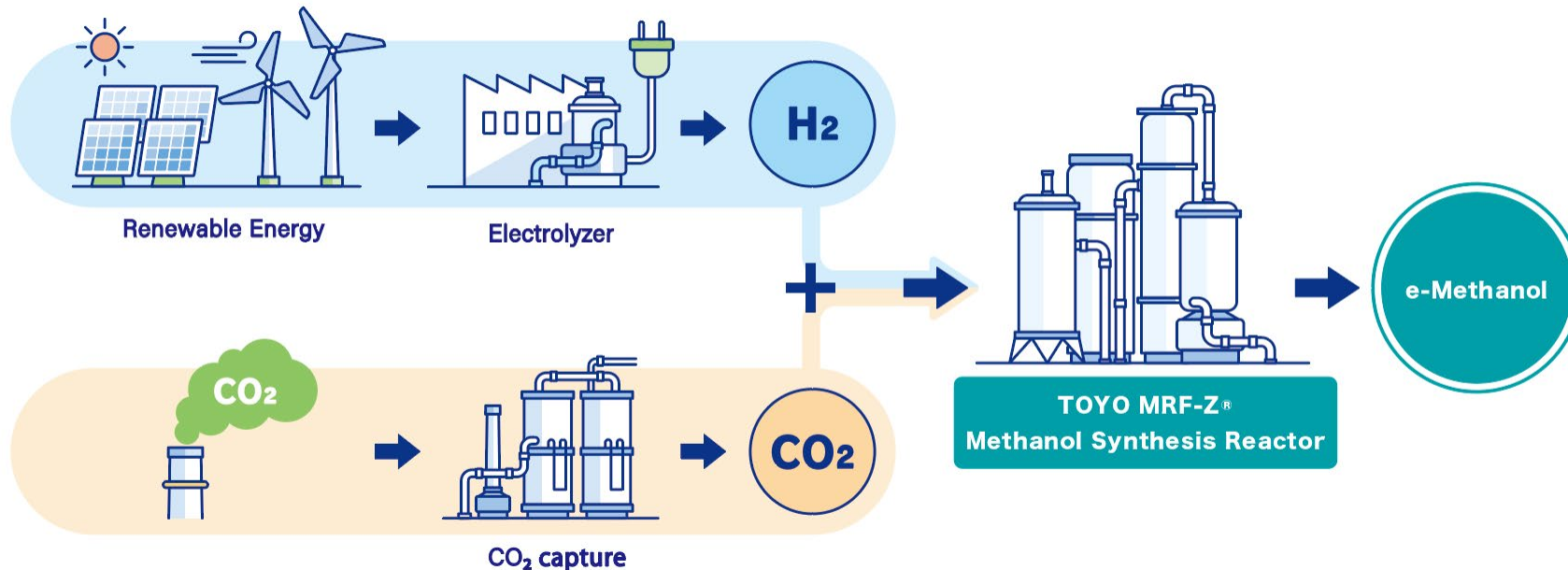
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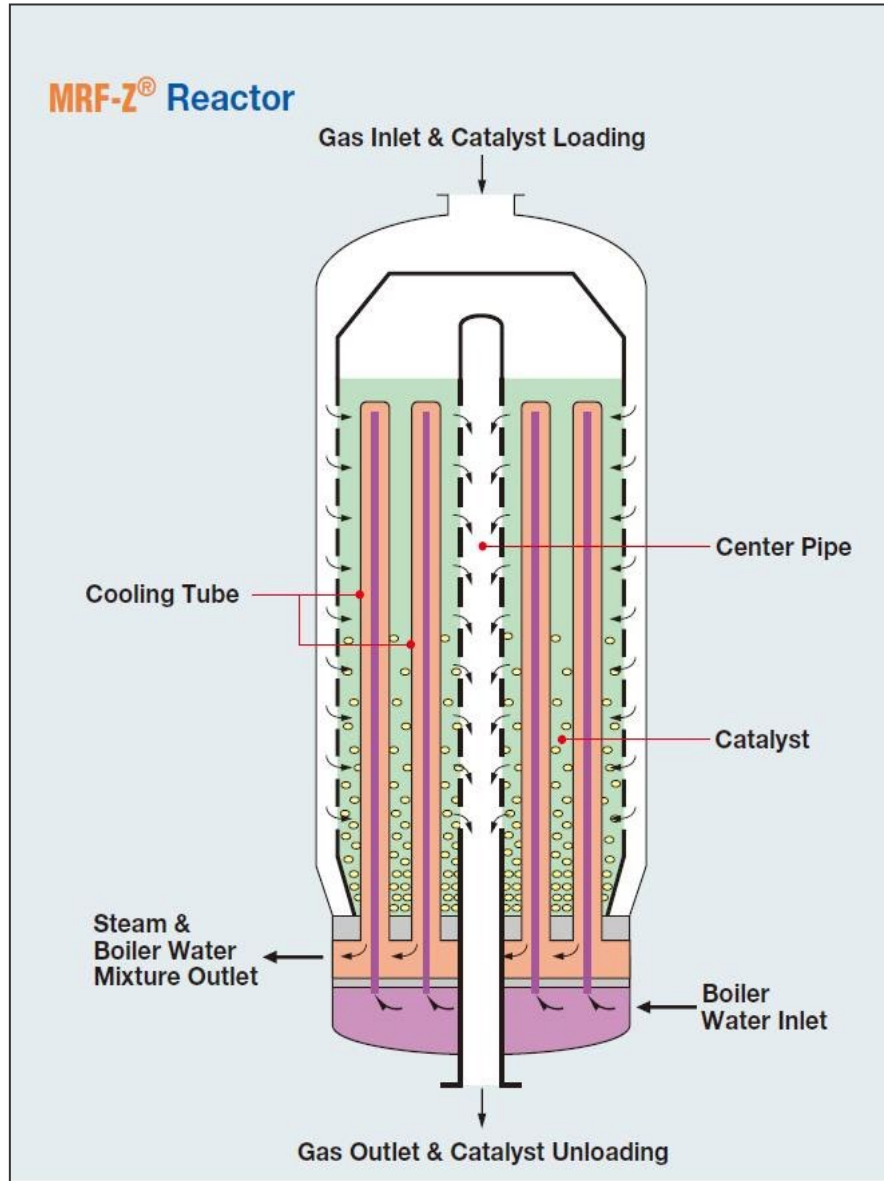


# g-Methanol® Low-Carbon Footprint Methanol

- ◆ Contributing to Net CO2 Zero Emission by 2050.
- ◆ Building CO2 value chain.
- ◆ Converting CO2 to olefins via g-Methanol® not fossil resource.
- ◆ Reducing greenhouse gas emissions by using synthesized Methanol as transportation fuels.
- ◆ Storing renewable energy as liquid fuel (e-fuel)



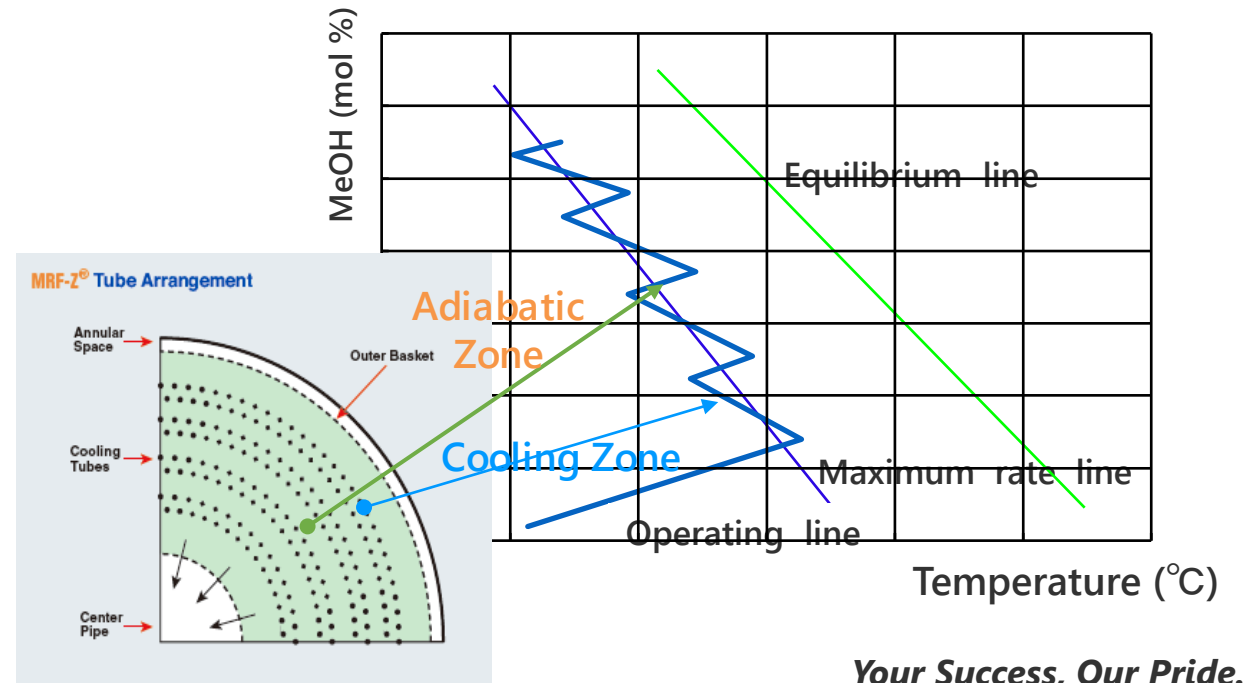
# g-Methanol<sup>®</sup> : Features of MRF-Z<sup>®</sup> Reactor



- Radial Flow → Small  $\Delta P$ , Energy Saving
- Steam Raising → Energy Saving
- Max Rate Operation → min. Cat Volume
- Cat in Shell-side → Easy Load/Unload
- Gas Cross Flow → Higher Heat Transfer

## Mechanical Consideration

- Bayonet Tubes for Heat Stress Relief
- Even Gas Distribution with Orifice Plate

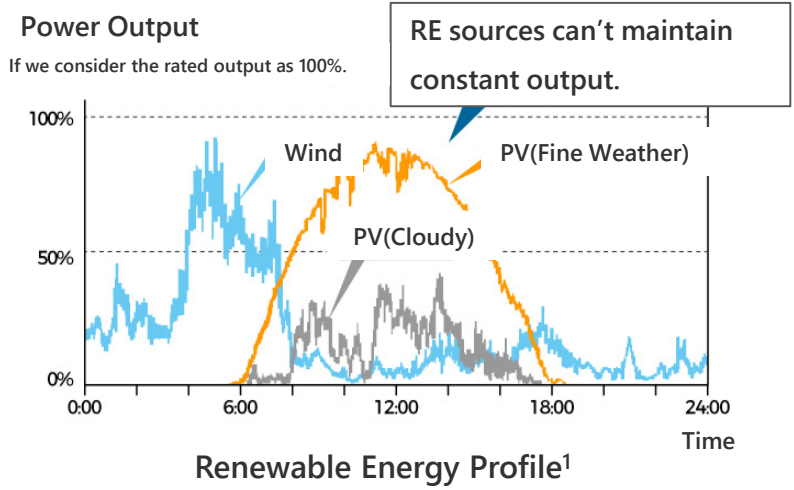




# Responding to Fluctuation of Renewable Energy

Additional facilities are required against unstable power sources.

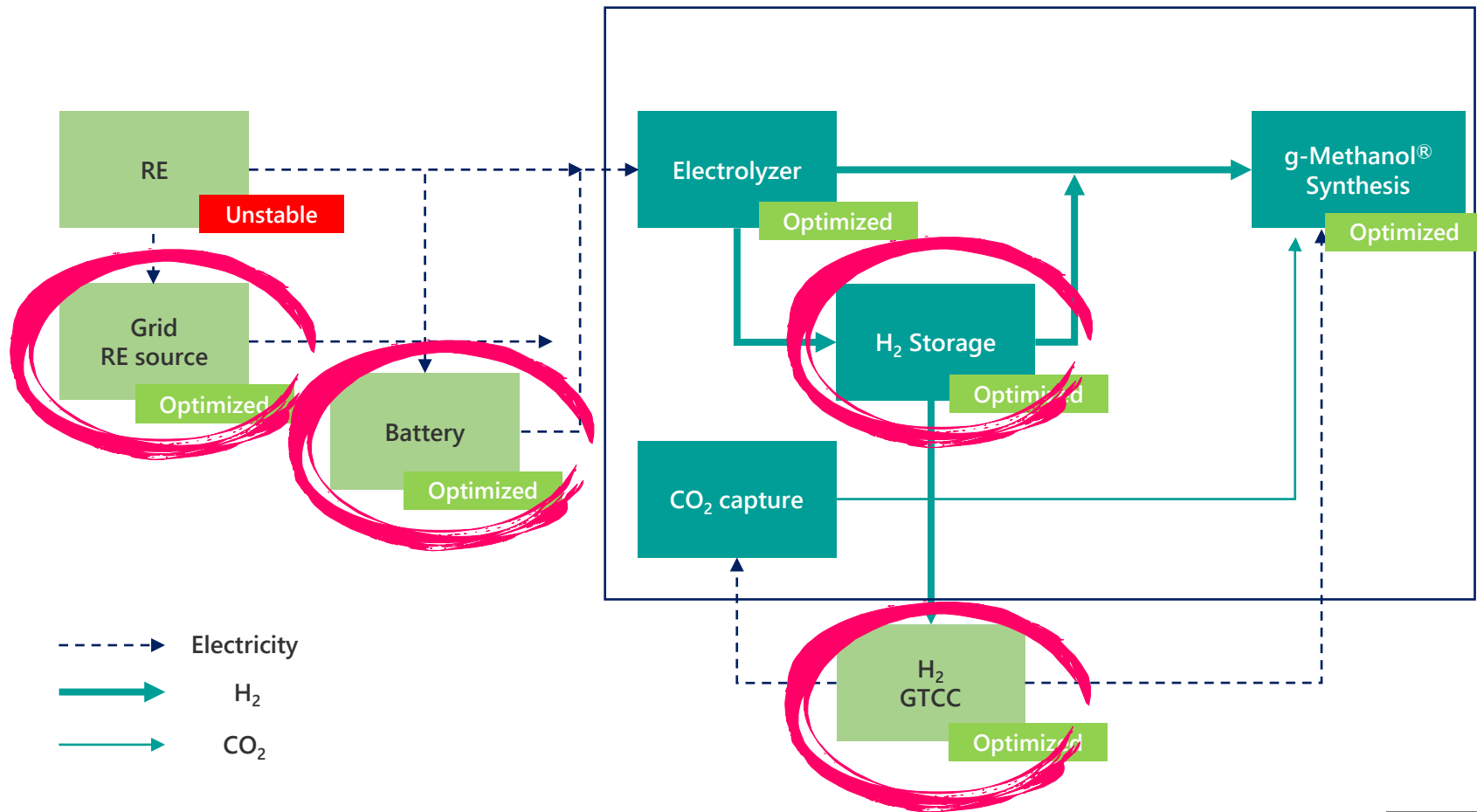
## Challenges



- Renewable Energy is basically fluctuated.
- Traditionally chemical plant prefer stable condition.

Additional Facilities  
needed to fill the gap.

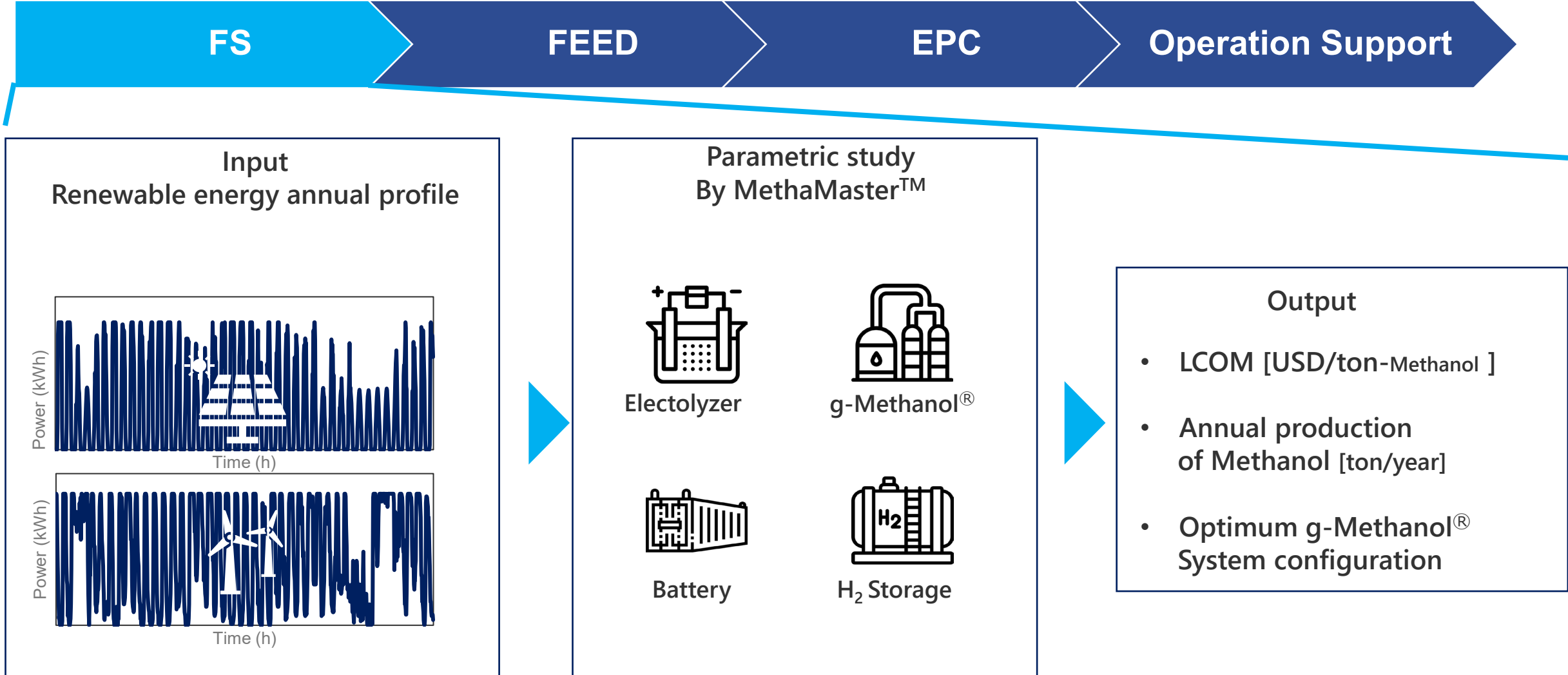
## System configuration sample



Source) 1. Kyushu Electric Power Corporation HP (Translation by TOYO)

# MethaMaster<sup>TM</sup>

System configuration can be studied.



MethaMaster<sup>TM</sup> was applied to the 1<sup>st</sup> FS project for Australia in 2023



## Demonstration Plant in India

- Client : NTPC Ltd.
- Location : Vindhyachal Super Thermal Power Station, Madhya Pradesh, India
- Project start : November 2021
- Project completion : 4Q 2024
- Project scope : Supply of Methanol Synthesis Technology and Reactor
- Plant outline : 10 TPD Methanol Plant from CO<sub>2</sub>
- Licenser : TOYO's own license



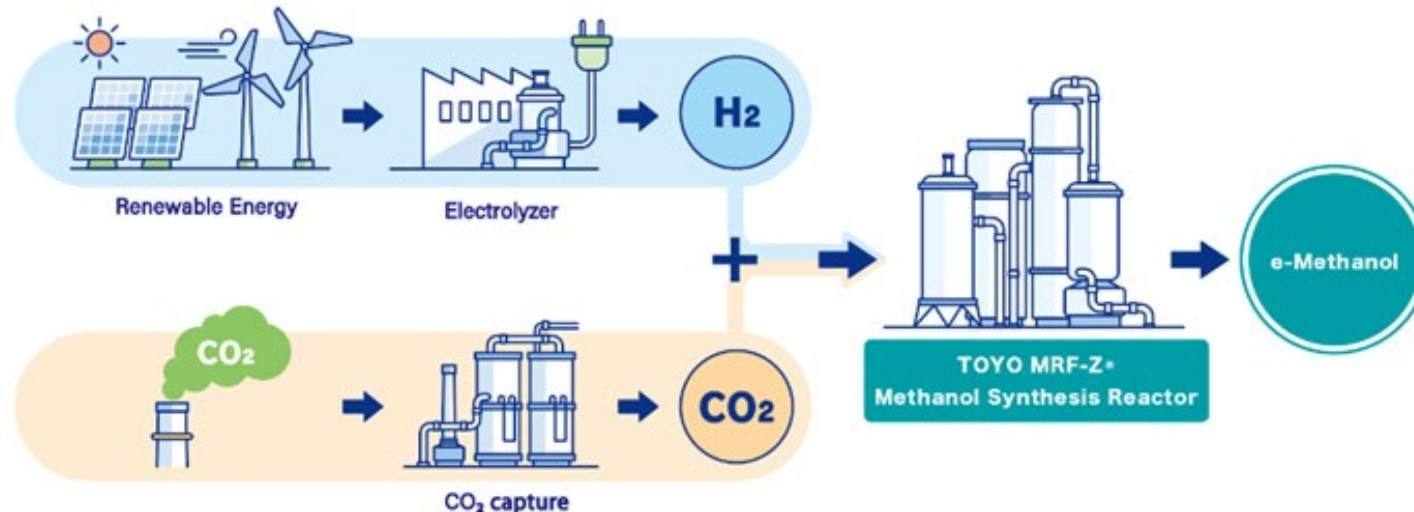
# TOYO, ENEOS and NTPC joint survey under "Global South Future-Oriented Co-Creation Business Expense Subsidy"

Published on 19<sup>th</sup> July 2024:

TOYO and ENEOS have been selected to study the **feasibility of constructing a value chain for the production of e-Methanol** under "Global South Future-Oriented Co-Creation Business Expense Subsidy" arranged by Ministry of Economy, Trade, and Industry's ("METI").

The Survey will be conducted using TOYO's proprietary technology, **g-Methanol®**, which utilizes **green hydrogen and biogenic CO<sub>2</sub>** produced by NTPC Limited ("NTPC") in Southern India.

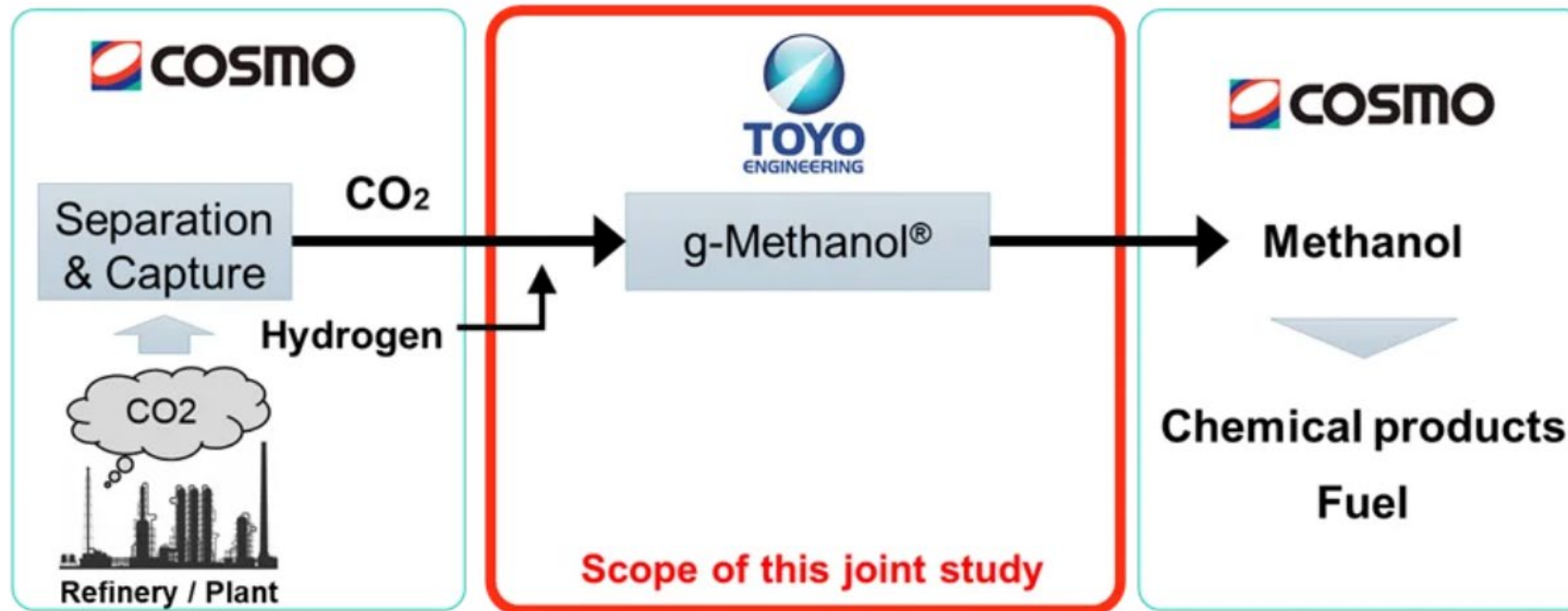
The e-Methanol will be exported to Japan to be supplied as bunker fuel and also used as a raw material for low-carbon synthetic fuels, with **ENEOS Corporation being the prospective off-taker** in Japan for the e-methanol produced by this project.



## g-Methanol® / Initiate a Joint Study on g-Methanol with Cosmo Energy

- TOYO and Cosmo Energy concluded a basic agreement regarding a joint study aimed at direct synthesis of CO<sub>2</sub> into methanol using a catalyst.
- Through this joint study, the two companies will examine factors such as the CO<sub>2</sub> reduction effect and investment profitability, with the aim of producing sustainable products derived from CO<sub>2</sub> emitted from refineries and other Cosmo Energy Group facilities.

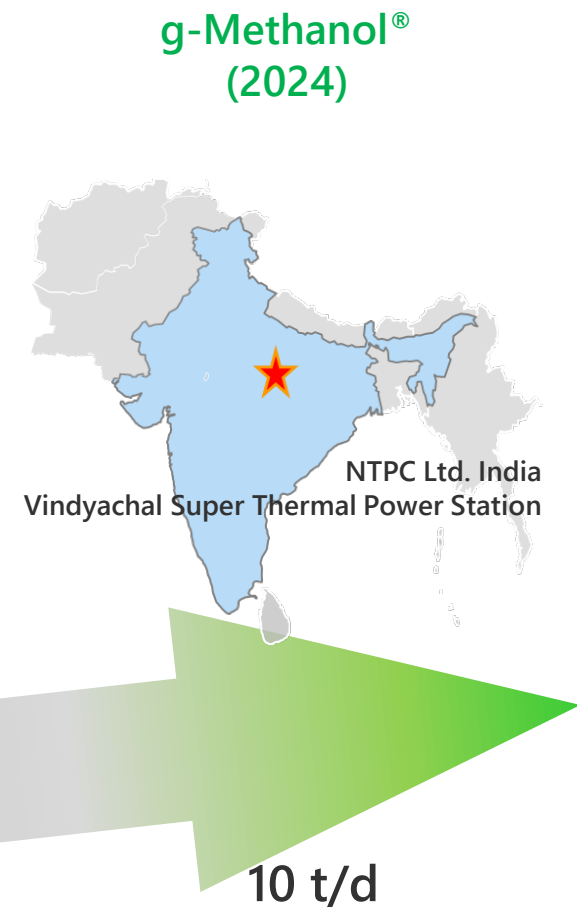
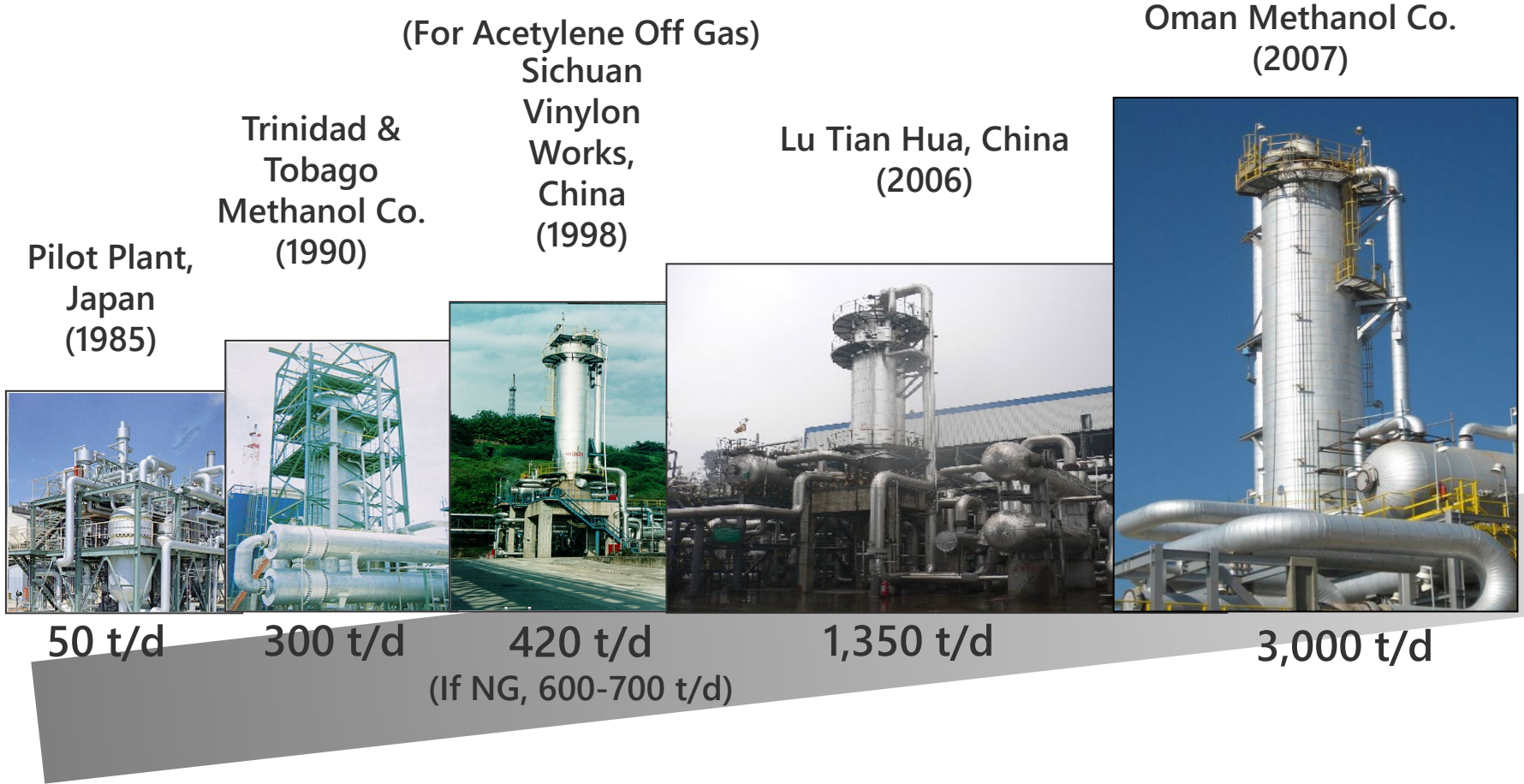
### Joint study conceptual diagram





# Step Development of our Methanol Technology

Now Available  
5,000 t/d Design

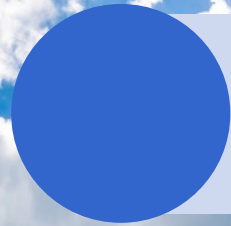
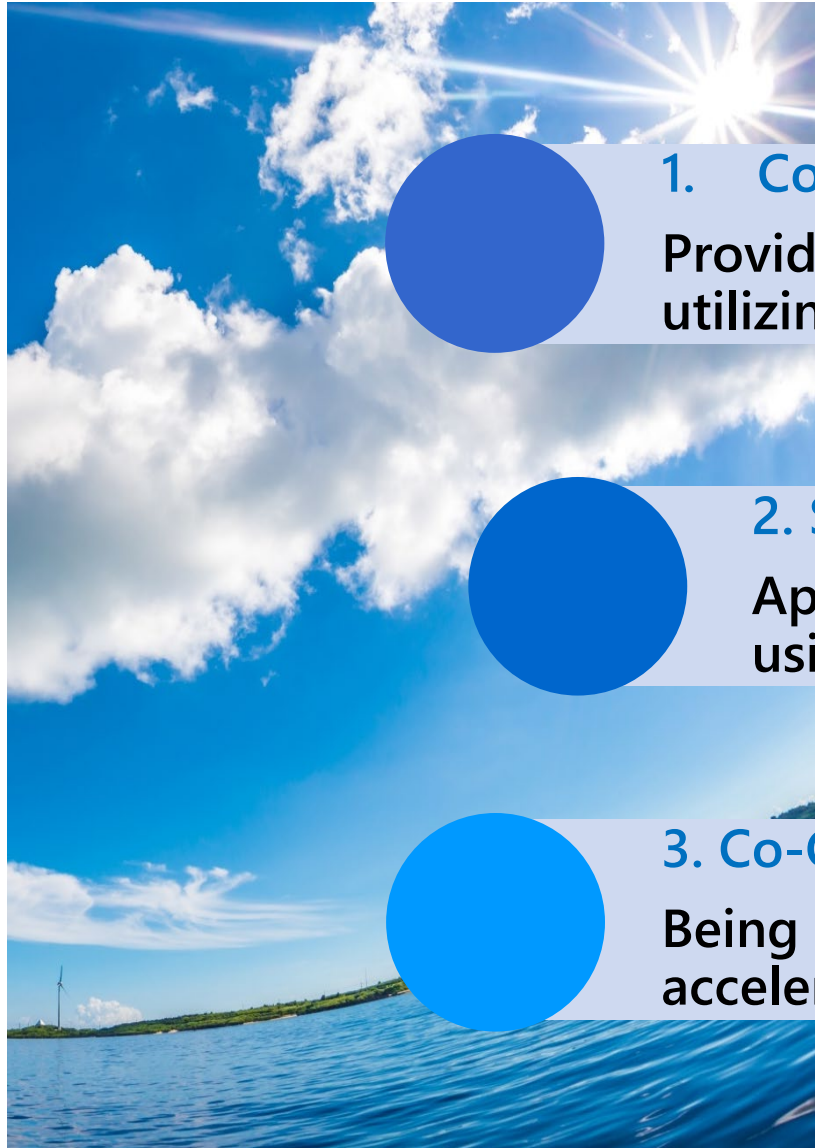




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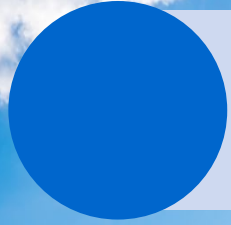
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# Towards the Energy Transition



## 1. Combination of Existing Technologies

Provide Green Ammonia and g-Methanol<sup>®</sup> as clean fuel by utilizing exiting technologies



## 2. Small start to establish a Value chain

Applying available feedstock for early societal implementation using proven technology



## 3. Co-Creation

Being essential element of international development to accelerate the pace of innovation for the energy transition





**TOYO**  
ENGINEERING

***Your Success, Our Pride.***



# GAIA / Green Ammonia Initiative from Aceh



Announcement of Joint Development Agreement in AZEC



Announcement of Shareholder's Agreement in COP29

**Indonesia & Japan Govt. support**

