

IHI's Solution for Carbon Recycling

IHI

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IHI Group Company Profile



Year of establishment

1853



Number of employees
(consolidated)

29,149 (fiscal 2020)



Overseas
representative offices

14 (fiscal 2020)



Capital

107.1 billion yen



Works

6 (fiscal 2020)



Affiliated companies in Japan

63 (fiscal 2020)

[Subsidiaries: 46 Affiliates: 17]



Revenue(Consolidated)

1,172.9 billion yen

(fiscal 2021)



Branches in Japan

8 (fiscal 2020)



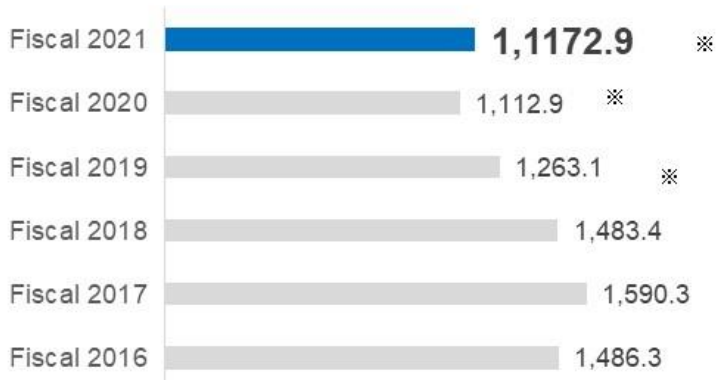
Overseas affiliates

143 (fiscal 2020)

[Subsidiaries: 121 Affiliates: 22]

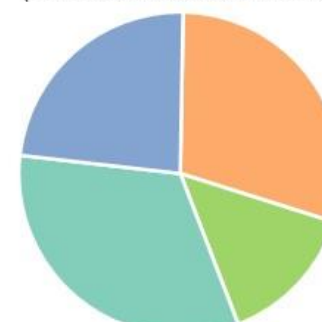
Net sales/Revenue

Consolidated net sales/sales revenue (billions of yen)



※ IHI adopted International Financial Reporting Standards (IFRS) from fiscal 2020, showing sales based on those sales from fiscal 2019.

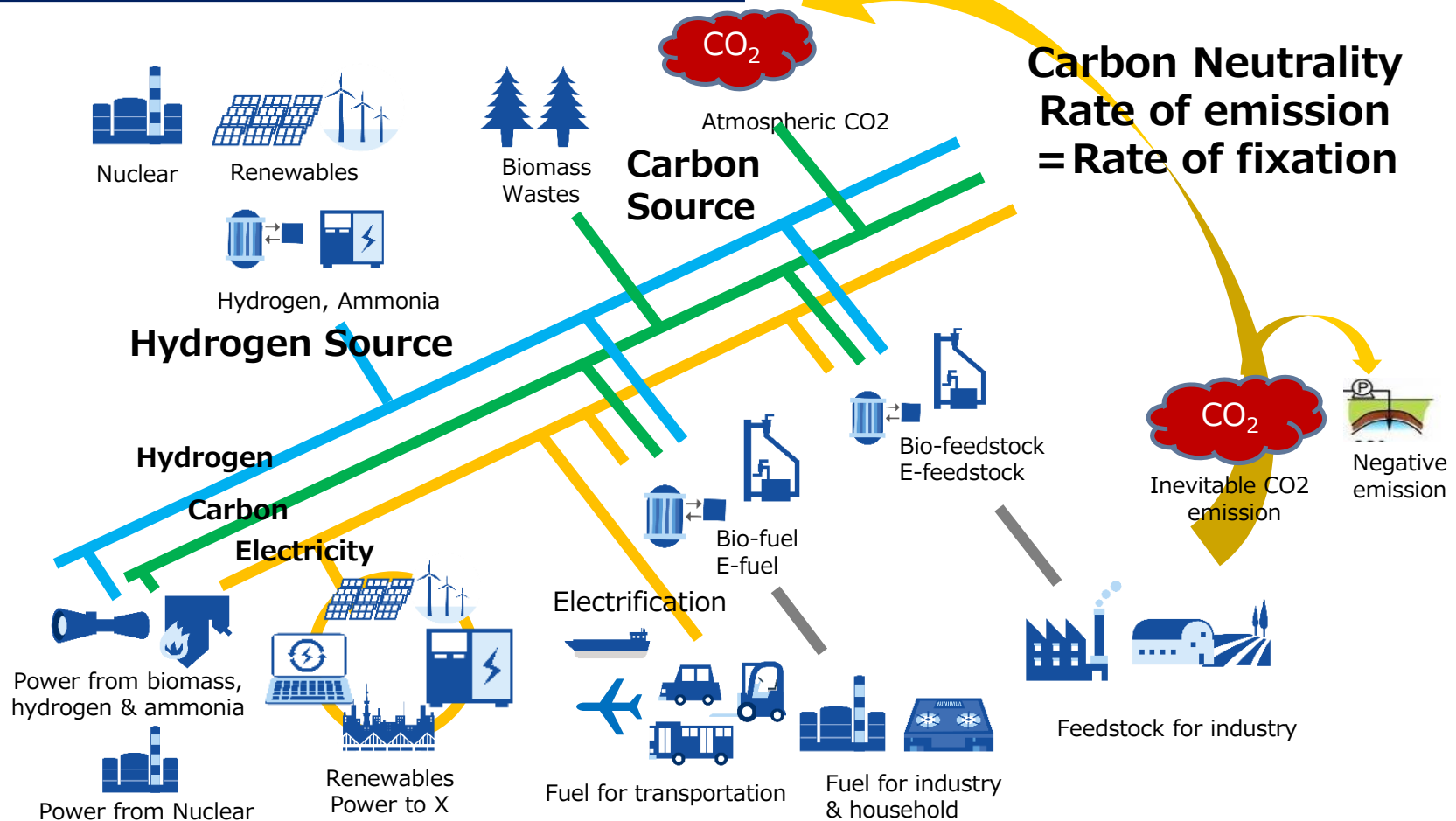
Revenue Compositions by business areas (Consolidated/fiscal 2021)



- Resources, Energy & Environment 29%
- Social Infrastructure & Offshore Facilities 14%
- Industrial Systems and General-Purpose Machinery 32%
- Aero Engine, Space & Defense 23%

Note : The total may not be 100% owing to the exclusion of "Other" and "Adjustments".

Carbon neutrality of primary energy & hydrogen/carbon source



**Carbon Neutrality
Rate of emission
= Rate of fixation**

Carbon neutrality of power generation

Carbon neutrality of fuel

Carbon neutrality of feedstock

Ammonia Power to X

Carbon Recycling / CCU

Carbon Recycling / CCU Technology



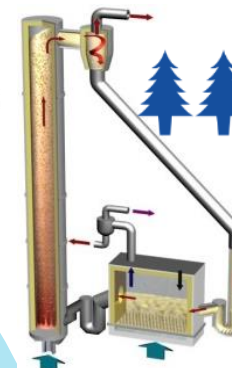
Oxyfuel combustion



Chemical adsorption



Electrolysis



Gasification



Compact reactor for SMR

CO₂ Capture

CCU Technology

Hydrogen, syngas production



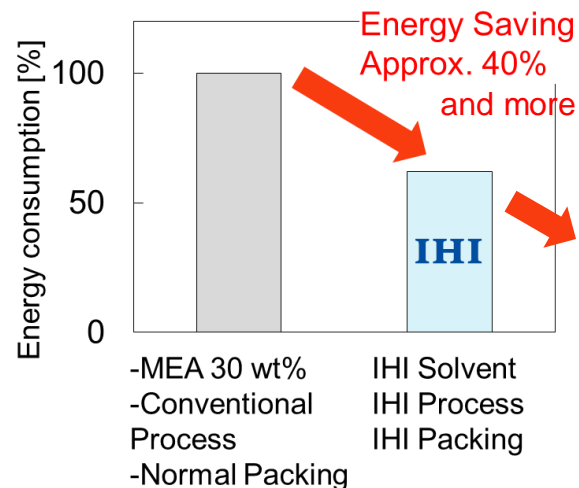
Conversion to valuable resources
Methanation, Olefin production, SAF...

CO₂ Capture: Pilot Plants

20 ton-CO₂/d Pilot Plant *Achieved approximately 40% higher energy efficiency*

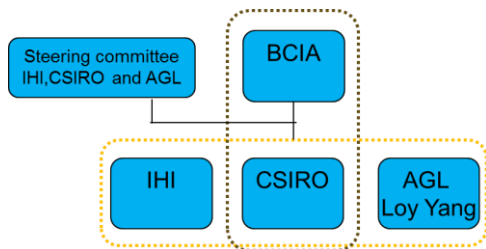


Location	IHI's AIOI Works in Japan
Source Gas	Flue Gas of Coal-Fired Boiler or Propane Gas Boiler
Captured CO₂	20 ton-CO ₂ /d
CO₂ Capture Ratio	90%
Flue Gas Flow Rate	Max 4,000m ³ N/h-wet



PICA Pilot Plant

The 5,000-hour operation successfully completed



Partially funded by BCIA
(Brown Coal Innovation Australia)

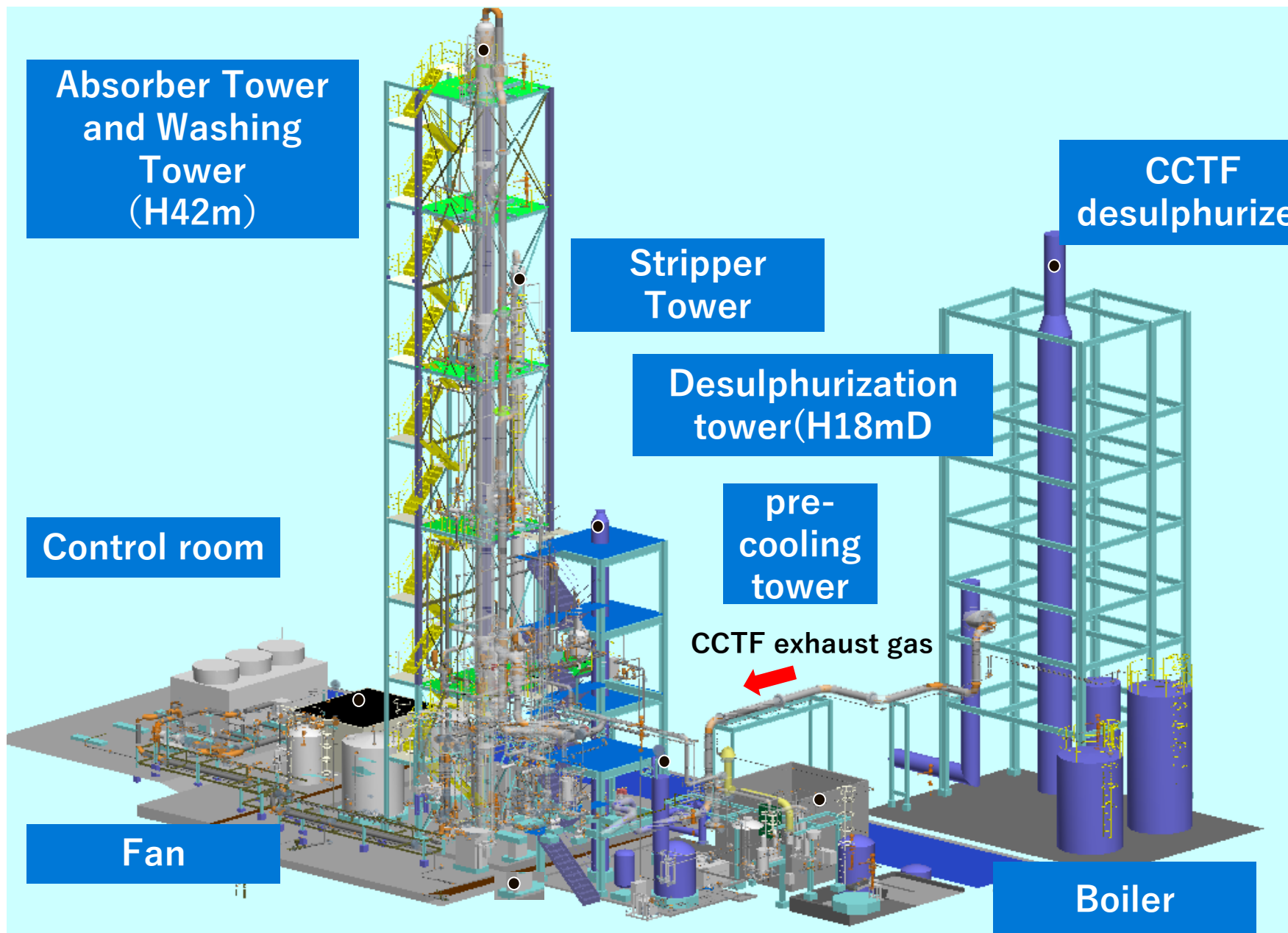


PICA (Post-combustion carbon capture, IHI, CSIRO, AGL)



Location	Loy Yang A Power plant In Australia
Source Gas	Flue Gas of Coal-Fired Boiler
Captured CO₂	0.5 t-CO ₂ /d
CO₂ Capture Ratio	90%
Flue Gas Flow Rate	100 m ³ N/h-wet

20ton-CO₂/d Pilot Plant (Chemical absorption)

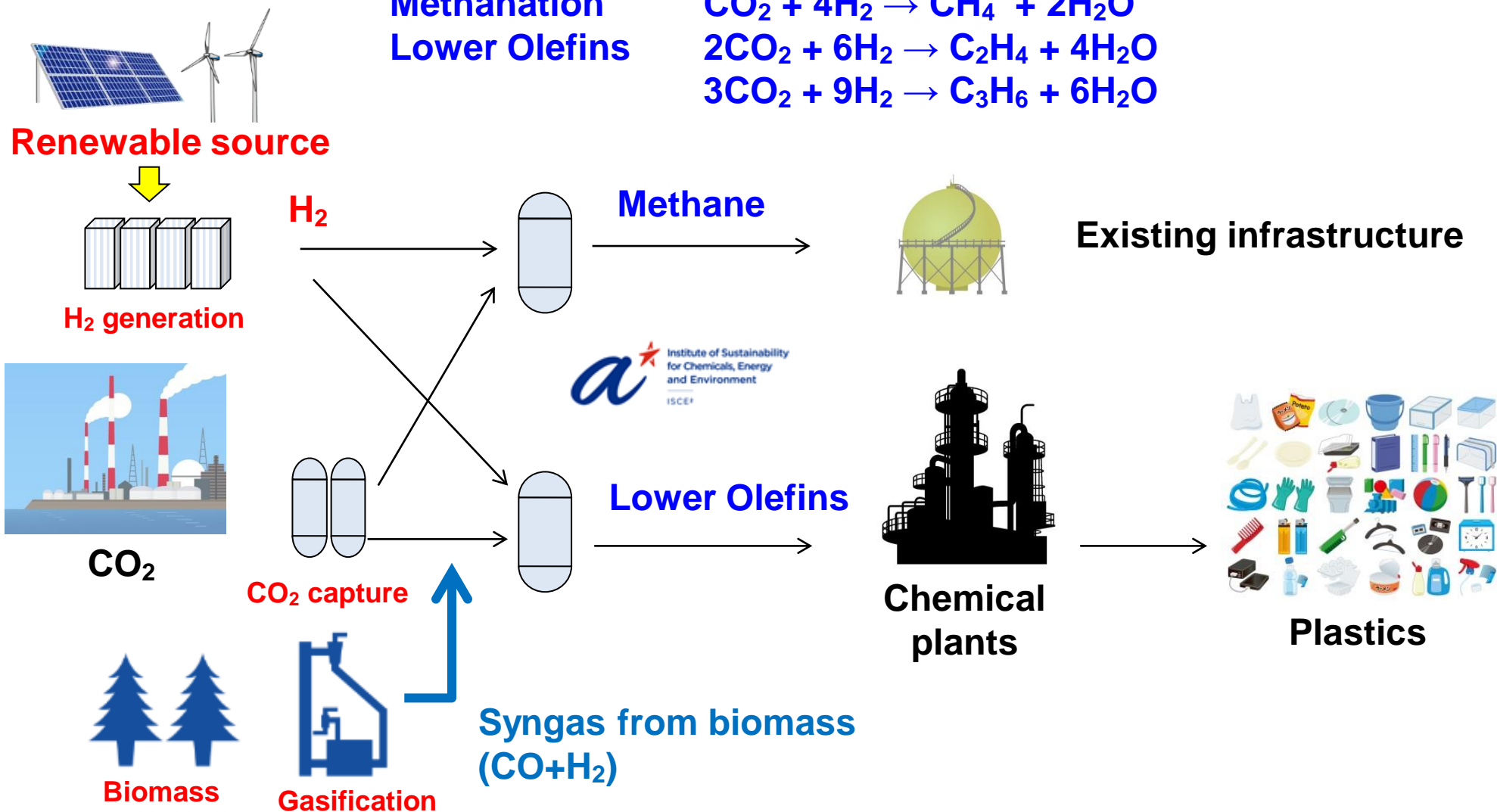
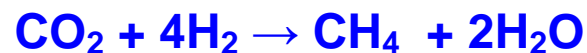


Converting CO₂ into valuable chemicals & fuel

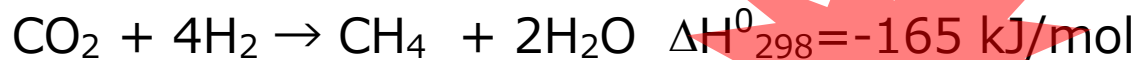
Concept

CO₂ is hydrogenated by H₂ from renewable sources to clean fuel such as methane and useful chemicals such as lower olefins as materials for plastics.

Methanation
Lower Olefins



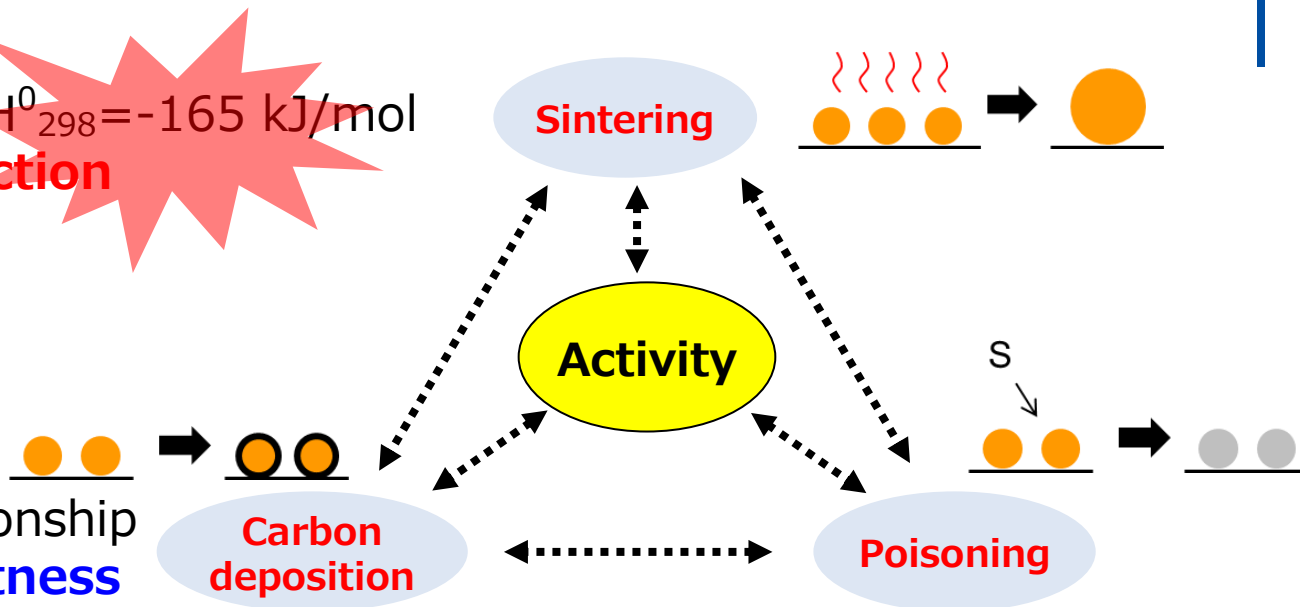
Unique IHI-ISCE² Methanation Catalyst



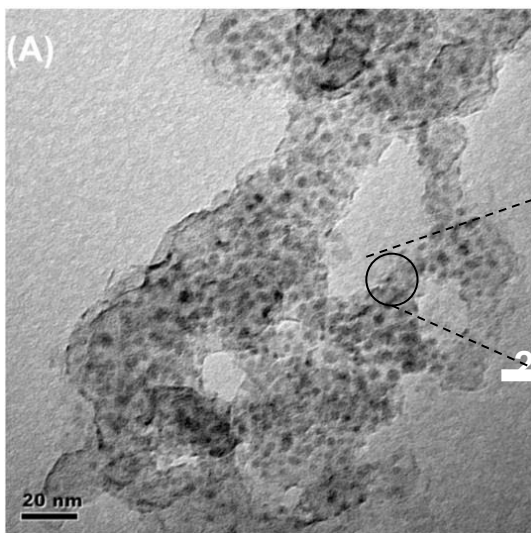
Very high exothermic reaction

Challenges for the catalyst;

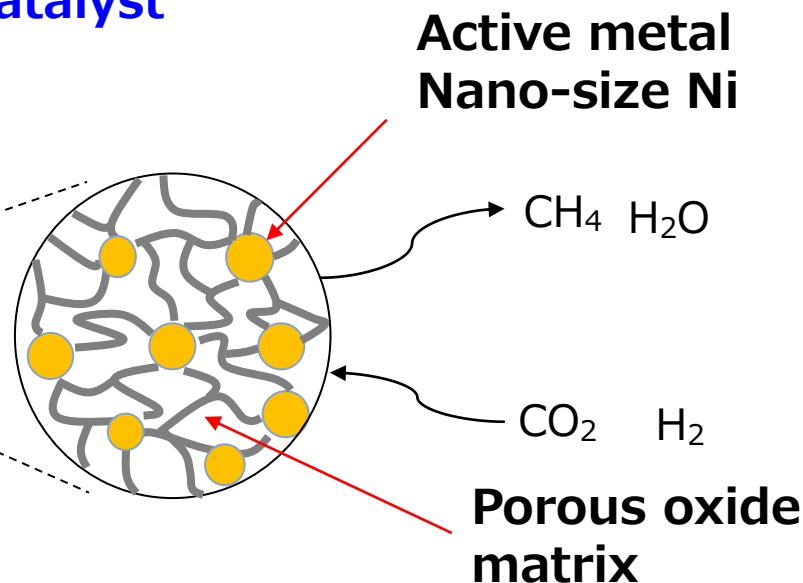
Overcome the trade-off relationship between **Activity** and **Robustness**



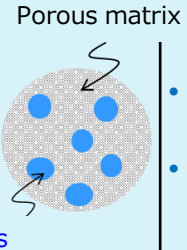
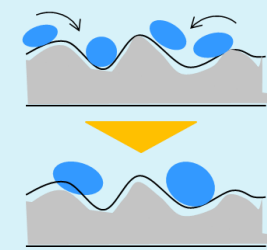
Our solution is **core-shell type Ni catalyst**



TEM Picture

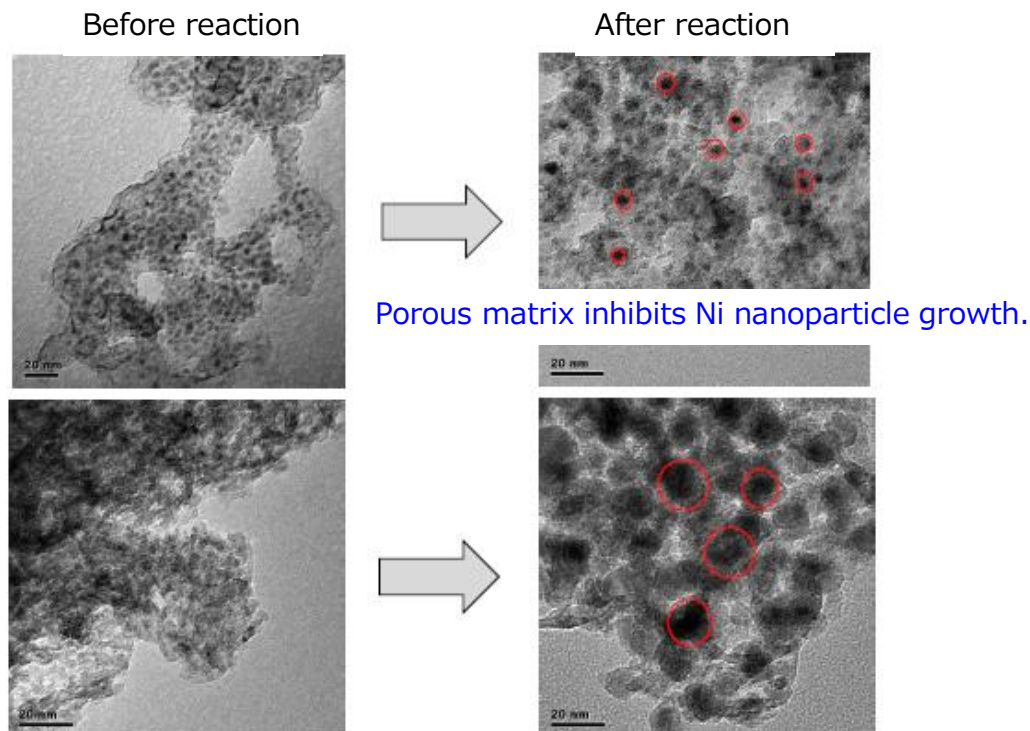


Development of Methanation Catalyst

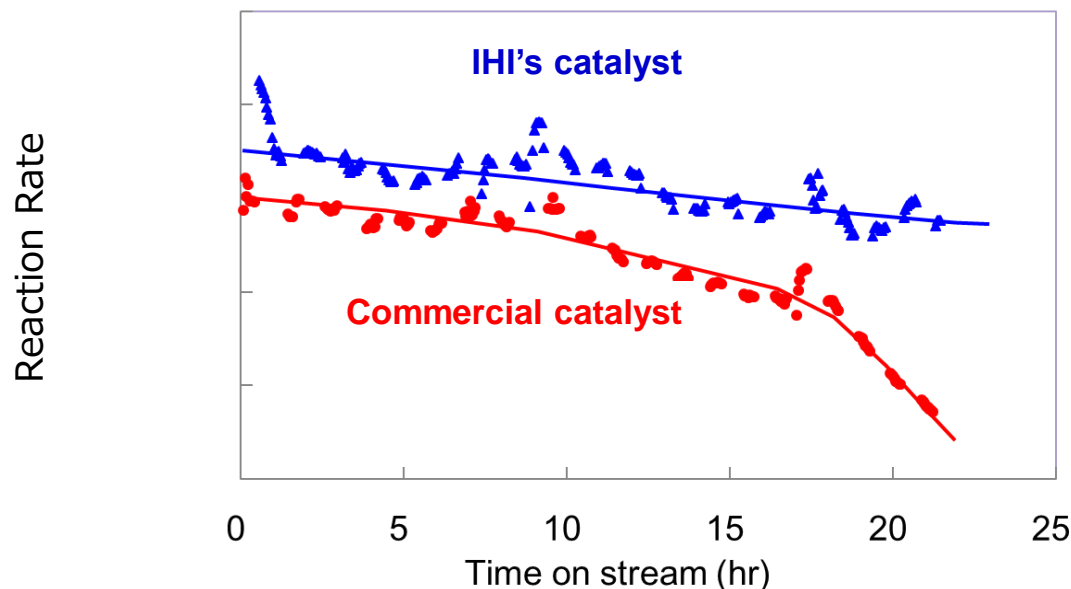
	IHI	General catalyst
Catalyst	<ul style="list-style-type: none"> • Ni nanoparticles in core-shell form Ni@SiO₂ (Patent No.6203375 : IHI, ISCE²) • Small Ni particle size, highly dispersed and independent • Porous matrix prevents particles from contacting each other (See Illustration) • Resistant to poisoning and sintering • Allowable total sulphur concentration high 	<ul style="list-style-type: none"> • General supported catalysts • Ni metal particle size is relatively large and Ni particles are present on the carrier surface • Ni easily moves and assembles on the surface of the carrier (See illustration) • Low to poisoning and sintering • Allowable total sulphur concentration low 
Evaluation	○	△

**IHI – ISCE²
Methanation
catalyst**

**Comparative
catalyst
Ni-based
methanation
catalyst**

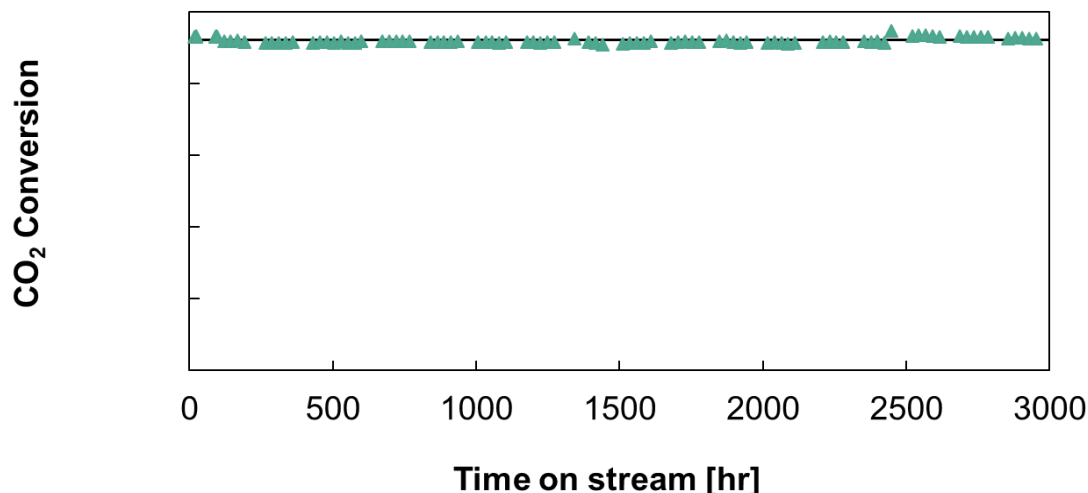


Performance comparison under actual gas from gasified coal



- ✓ Coal gasification gas: conditions with CO/H₂ and poisoning components sulfur, etc. (strict conditions)
- ✓ More stable performance than commercial catalysts was confirmed under these actual gas conditions.

Stability evaluation of CO₂ methanation catalyst



- ✓ Confirmed that methane can be stably produced for more than 3000hrs without performance degradation

Technical Roadmap for Methanation technology

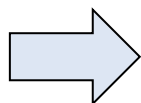
- 2019, Bench Scale test (1.25Nm³-CH₄/h) have been carried out.
- 2020, Demonstration Scale Test (12.5Nm³-CH₄/h) has been started.
- 2022, Small methanation system commercialized.



IHI-ISCE²
Methanation Catalyst



Lab Scale Test
~0.05Nm³-CH₄/h
(IHI Yokohama Engineering Center)



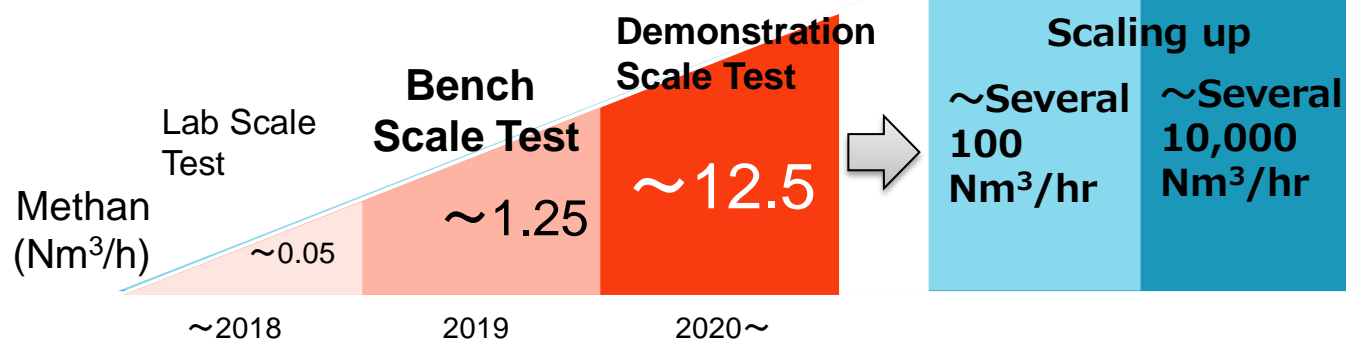
Bench Scale Test
1.25Nm³-CH₄/h
(IHI Yokohama Engineering Center)



Demo-Scale Test 12.5Nm³-CH₄/h

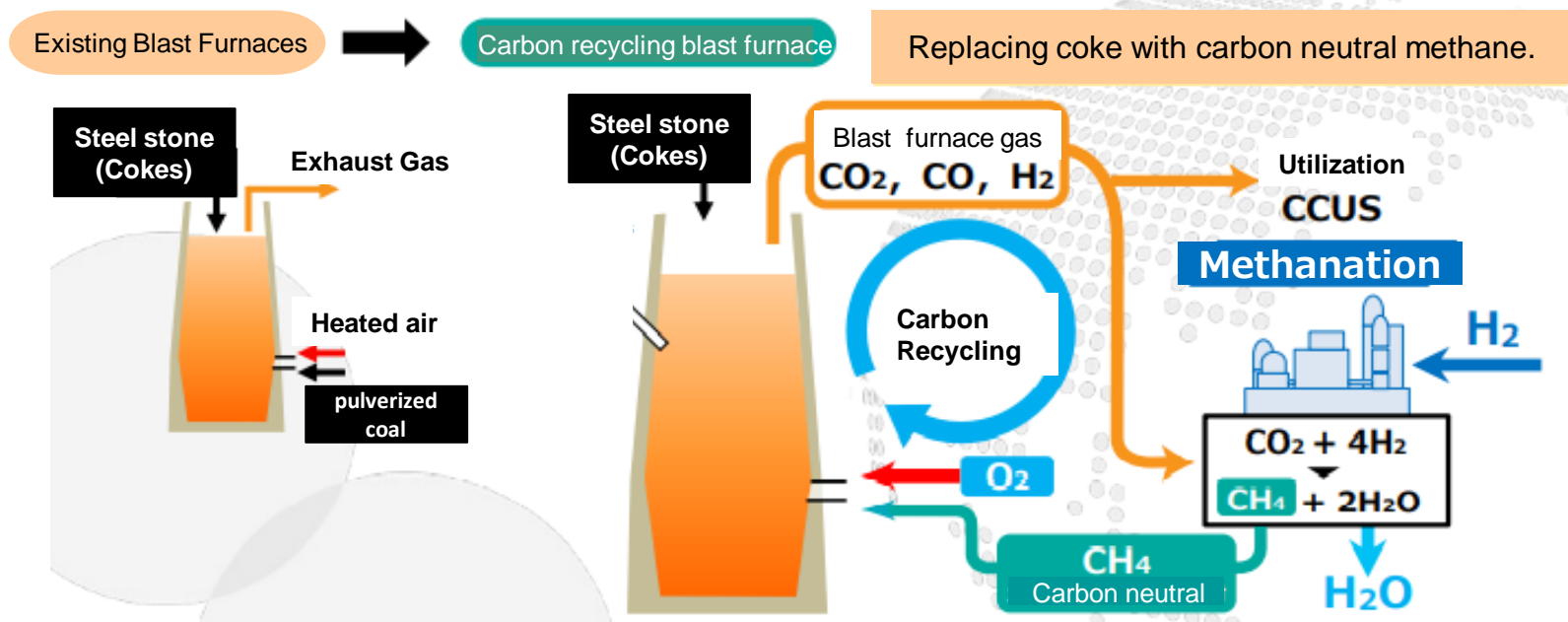


IHI Methanation System



Mid-scale Demonstration Project (500Nm³/h)

- ◆ World's largest methanation facilities (500Nm³/h) and CO₂ Capture
- ◆ Utilizing reaction heat of methanation for CO₂ Capture
- ◆ Demonstration of technology to reduce CO₂ emissions by 50% compared to conventional in the blast furnace process in the steel industry.
- ◆ Realize carbon recycling by replacing coke with synthetic methane as the reducing agent in the blast furnace.
- ◆ The operation will be started in April 2025



Source : https://www.jfe-steel.co.jp/company/pdf/carbon-neutral-strategy_220901_1.pdf

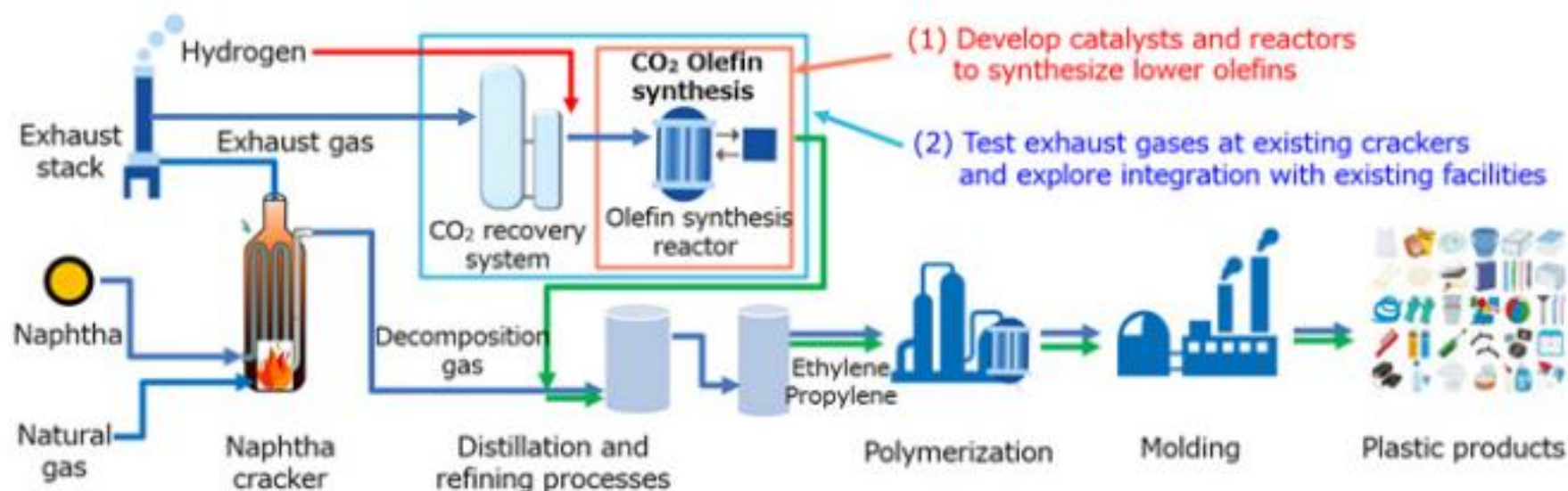
CO₂ to Olefin project

Japan's New Energy and Industrial Technology Development Organization Commissions IHI to Recycle CO₂ and Develop Olefin Manufacturing Technology -Company to recycle carbon as raw material for plastics and resins-

NEDO commissioned project
JPNP16002

-November 11, 2021- **Press Release**

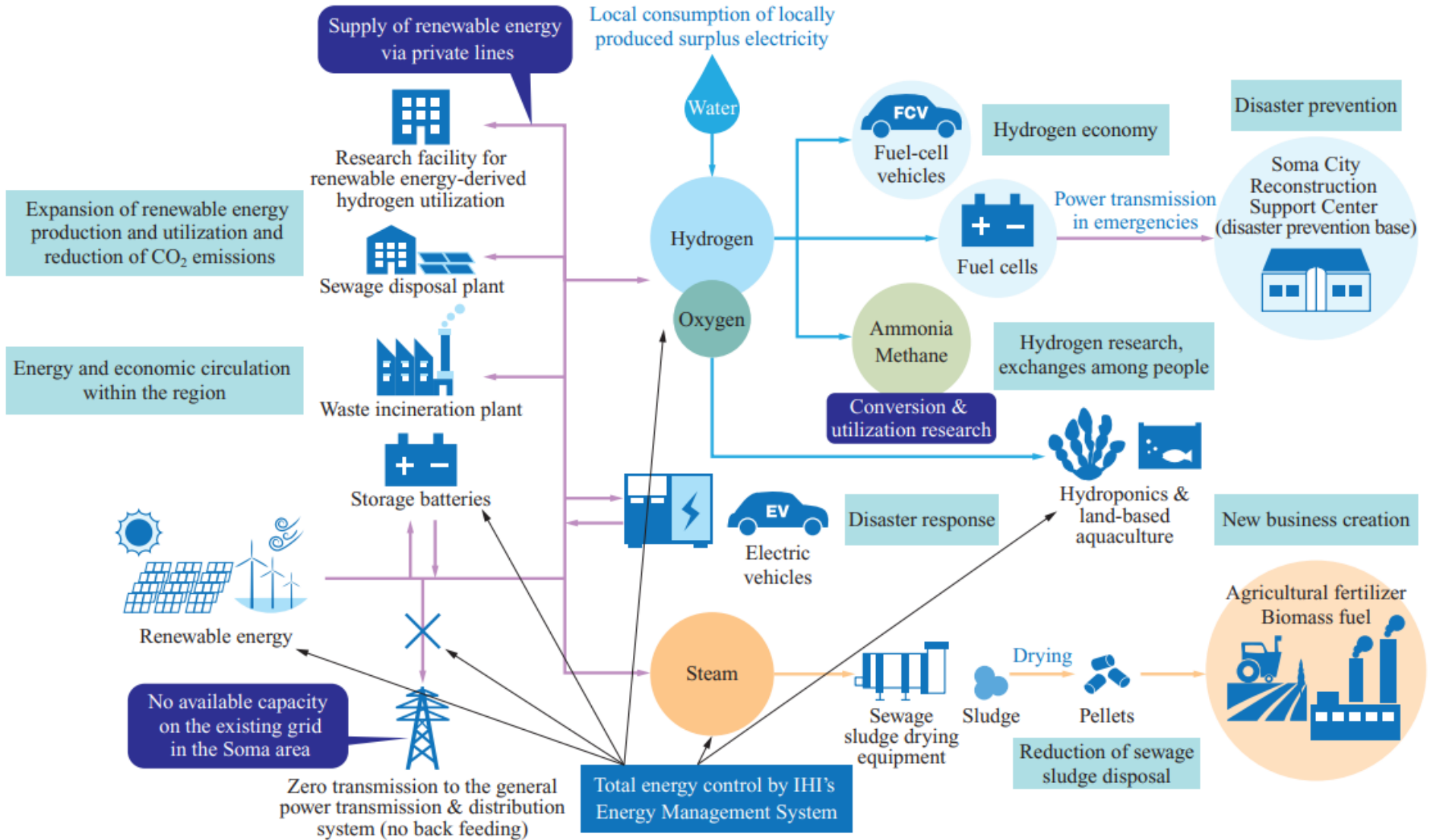
IHI Corporation announced today that the New Energy and Industrial Technology Development Organization has commissioned it to undertake a research project that it will complete in February 2026. The two R&D themes are to develop catalysts and reactors to synthesize lower olefins (see glossary note 1) and to test exhaust gases at existing crackers and explore integration with existing facilities.



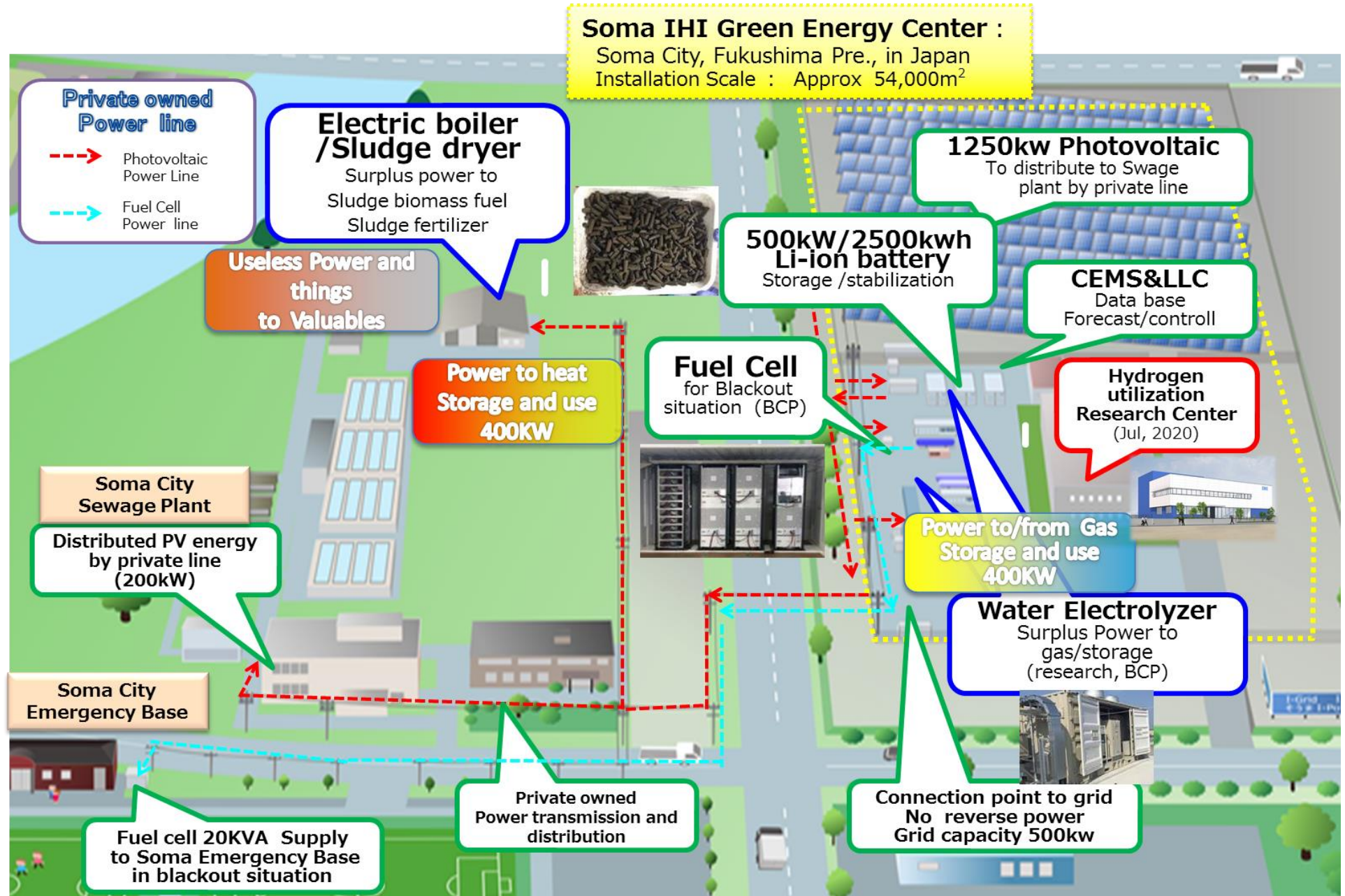
Project's two R&D themes and value chain leveraging existing facilities

Power to X: Soma IHI Green Energy Center

“Local production of renewable energy for local consumption” × “Enhancing resilience to disaster” × “Regional revitalization”



Soma IHI Green Energy Center (SIGC)



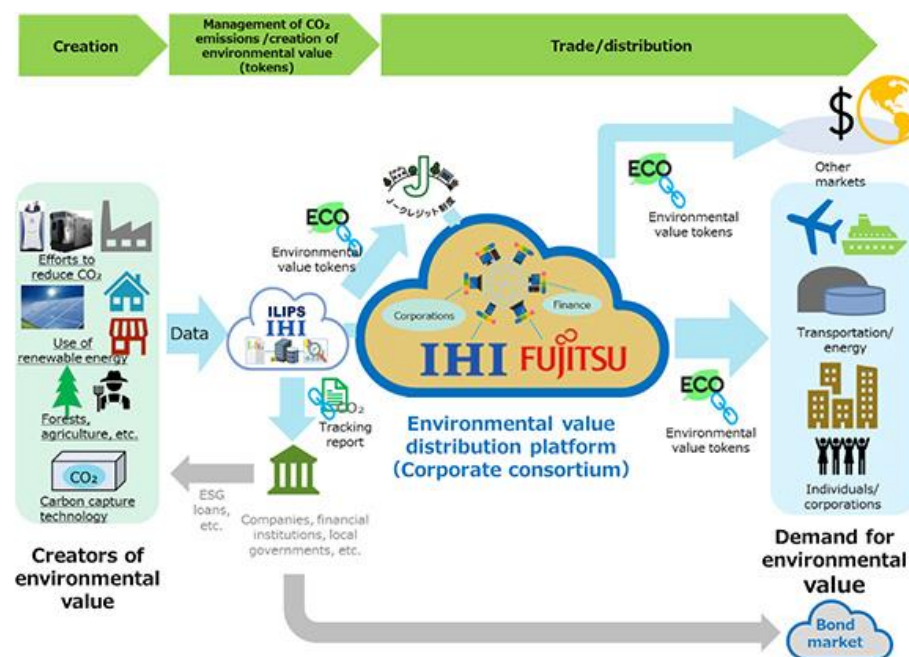
Blockchain for Environmental Value Distribution

IHI and Fujitsu start joint project on new environmental value distribution platform using blockchain technology

- Apr. 12, 2022 -



IHI Corporation (hereinafter IHI) and Fujitsu Limited today announced the launch of a joint project on environmental value trading starting April 1, 2022, with the aim of contributing to the realization of a carbon-neutral society and to revitalize the market of environmental value trading ecosystems.



https://www.ihico.jp/en/all_news/2022/other/1197835_3498.html

IHI

Realize your dreams