

Carbon Neutrality Briefing

March 18, 2022

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Executive Vice President & CTO



- **MISSION NET ZERO**
- **Our Vision of a Carbon Neutral World**
- **Status of Solutions Development**
- **Summary**

MISSION NET ZERO

MISSION NET ZERO

Through our group products, technologies, and services that help reduce CO₂ emissions, as well as new solutions and innovations to be developed with partners around the world, Mitsubishi Heavy Industries Group will contribute to realizing “Net Zero” emissions for the world as a whole.

To this end, each and every one of our employees is embracing and internalizing “Mission Net Zero” and will act to implement a “Net Zero” future.



Target Year	Reduce CO ₂ emissions across MHI Group Scope 1&2	Reduce CO ₂ emissions across MHI’s value chain Scope 3 + reductions from CCUS
2030	-50% (compared to 2014)	-50% (compared to 2019)
2040	Net Zero	Net Zero

Scope 1&2: The calculation standard is based on the GHG Protocol.

Scope 3: The calculation standard is based on the GHG Protocol. However, we also account for reductions achieved by CCUS as an MHI original index.

GHG: Greenhouse Gas CCUS: Carbon dioxide Capture, Utilization and Storage

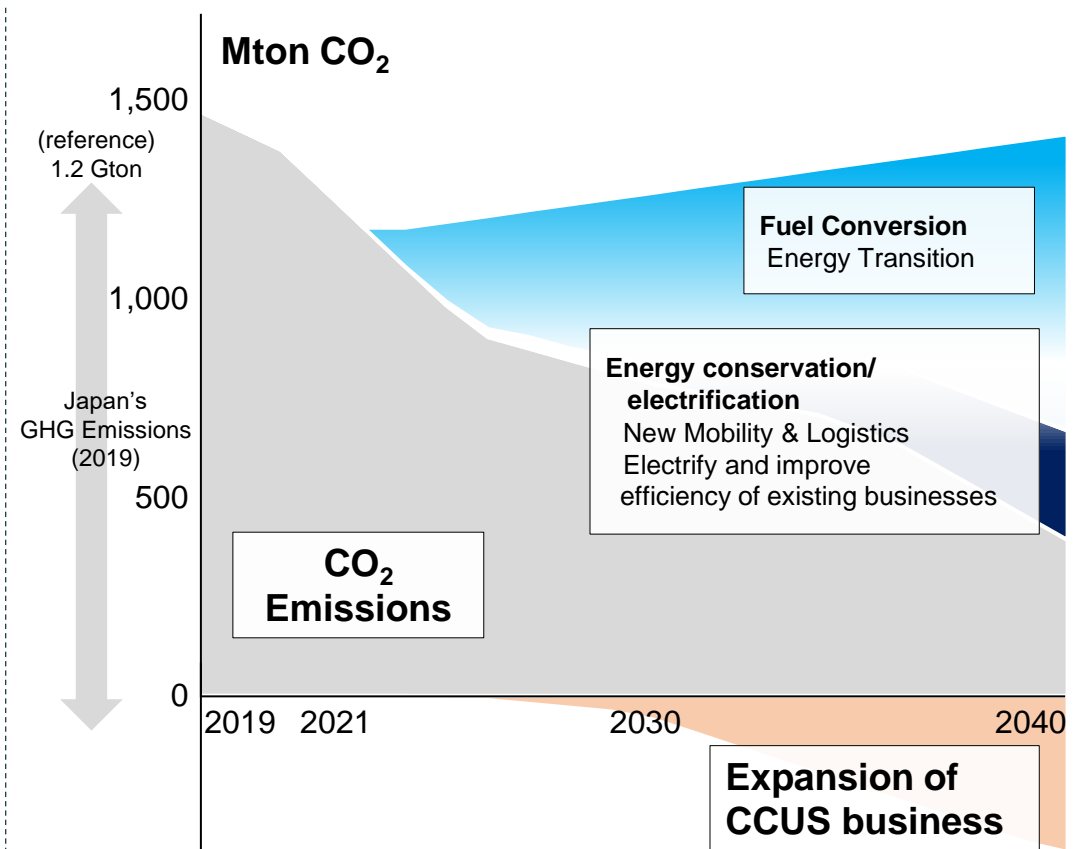
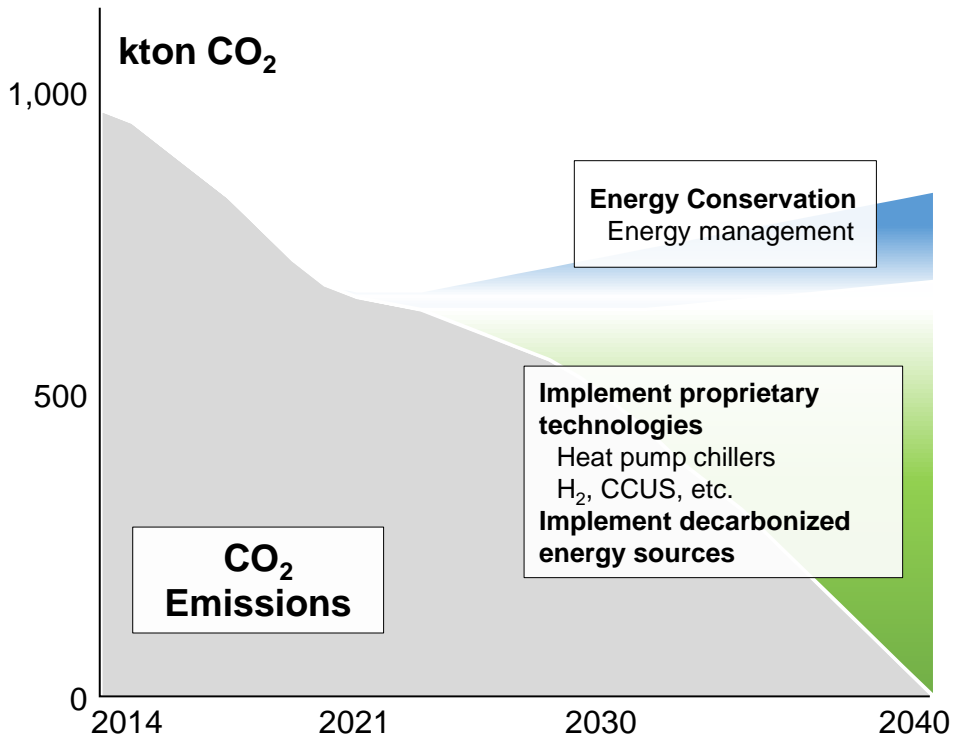
Roadmap to MISSION NET ZERO

Reduce CO₂ emissions across MHI Group
Scope 1&2

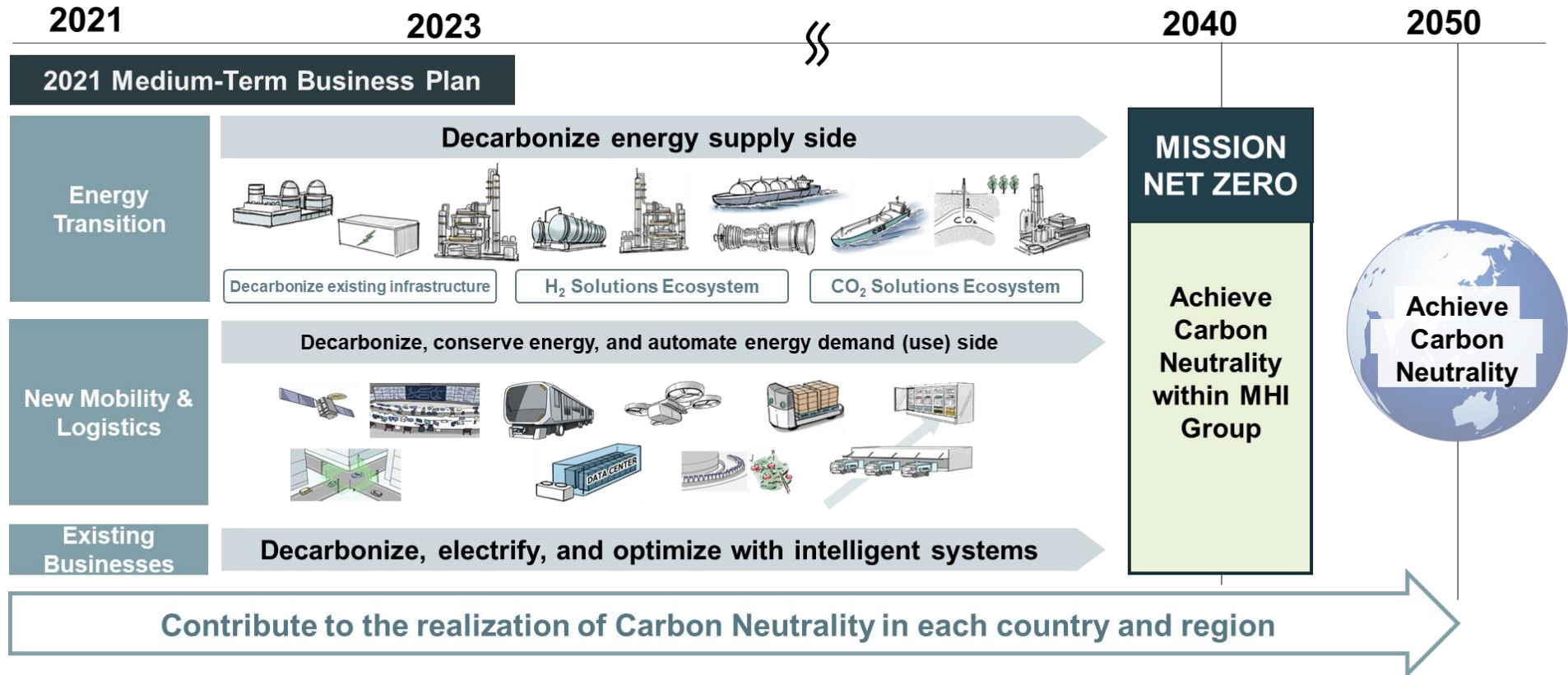
Reduce CO₂ emissions across MHI's value chain
Scope 3 + reductions from CCUS

Implement proprietary technologies at MHI factories

Rapidly establish decarbonization technologies and drive commercialization

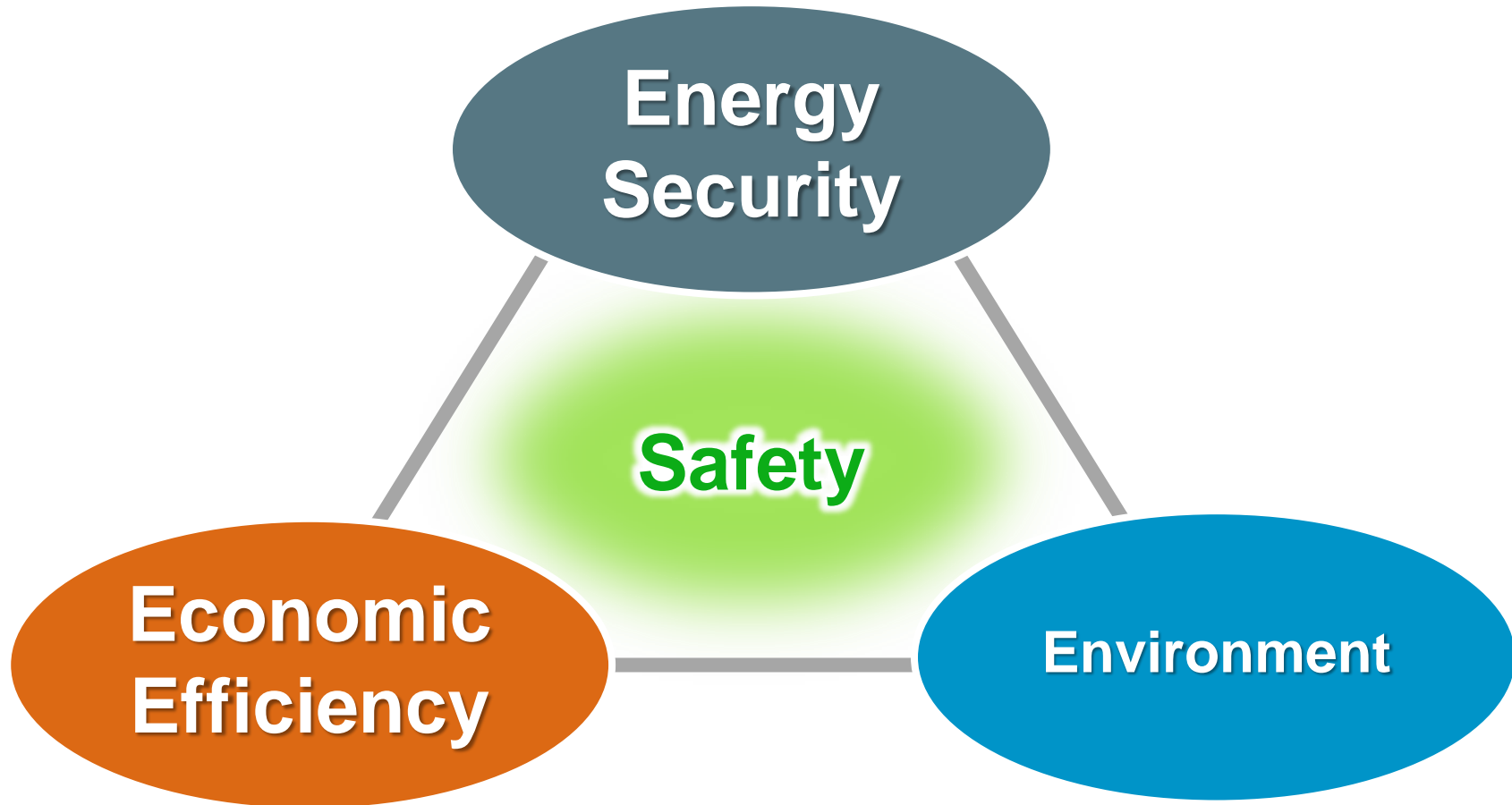


Achieve Carbon Neutrality within MHI Group by 2040 and deploy decarbonization solutions around the world



Our Vision of a Carbon Neutral World

Sustainable increase in environmental value is predicated on balancing stable energy supply with both sound economics and safety



- Not just a value chain
- Create environmental and economic value by connecting diverse industries

→ **Quickly commercialize with MHI's wide range of products and services**

6 keywords for achieving this:



Utilize



Exchange



Separate



Circulate



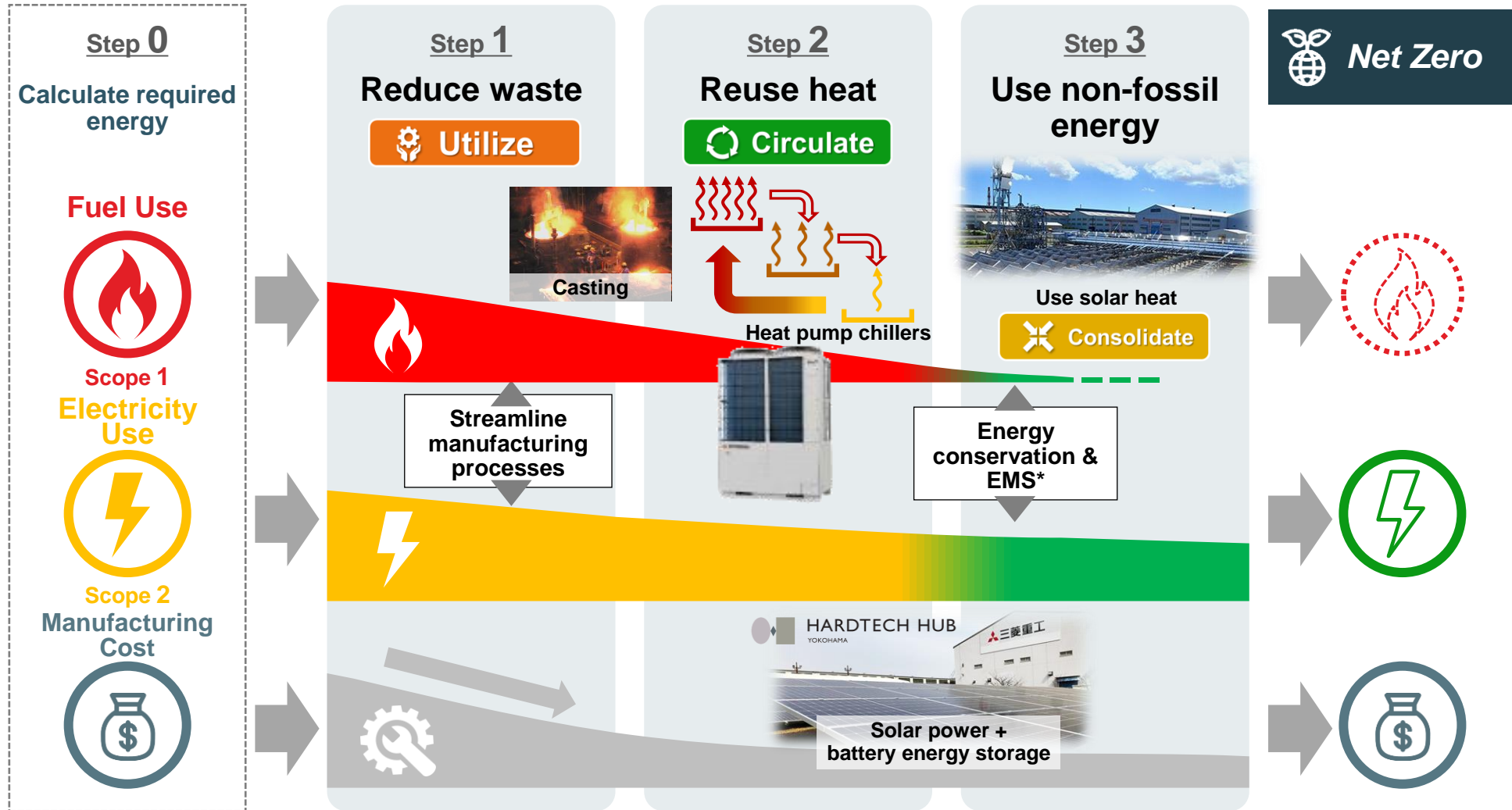
Consolidate



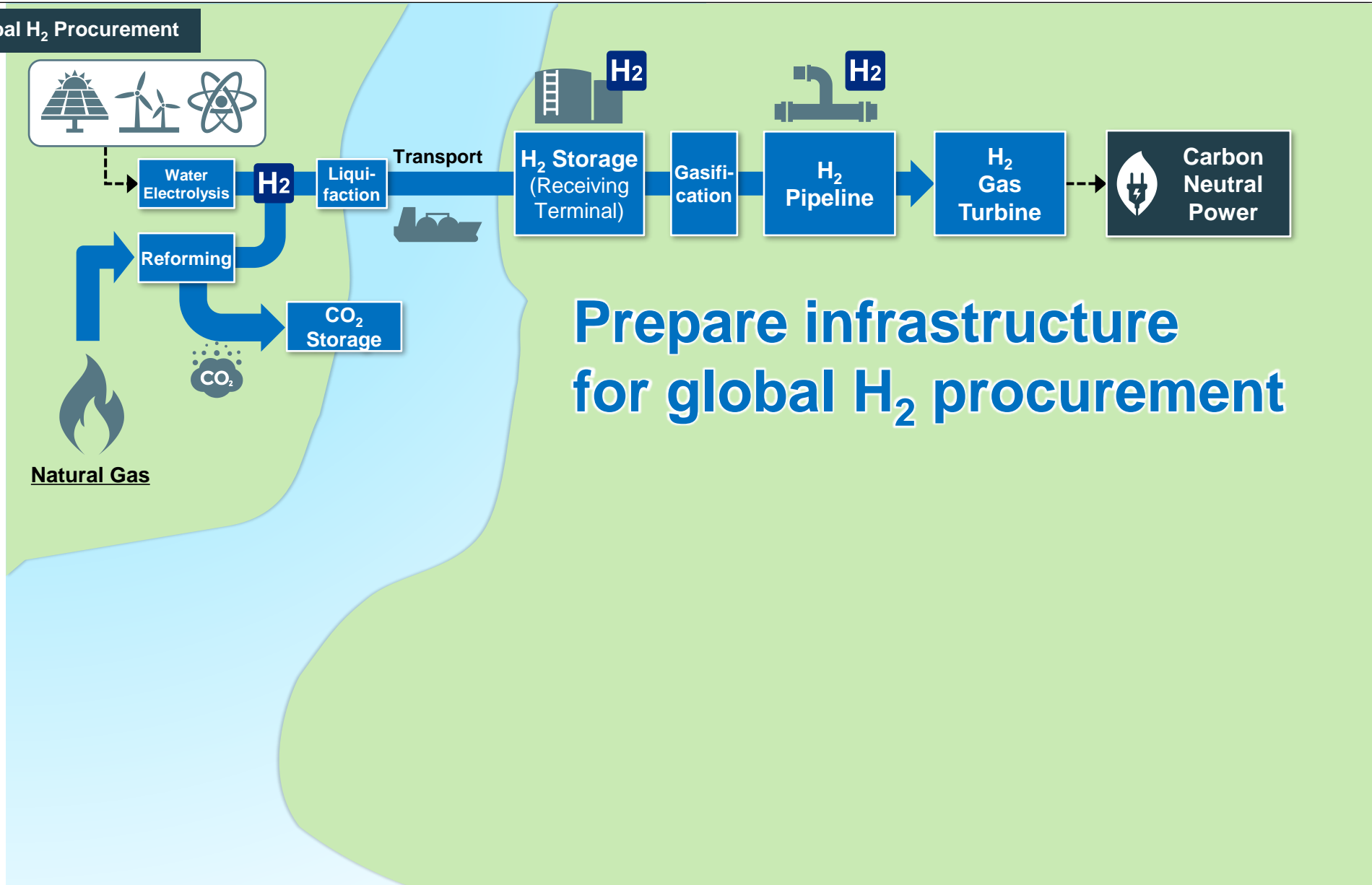
Synthesize

Our Approach to Scope 1&2 Net Zero Achievement

Decarbonize MHI factories and commercialize those solutions



Global H₂ Procurement

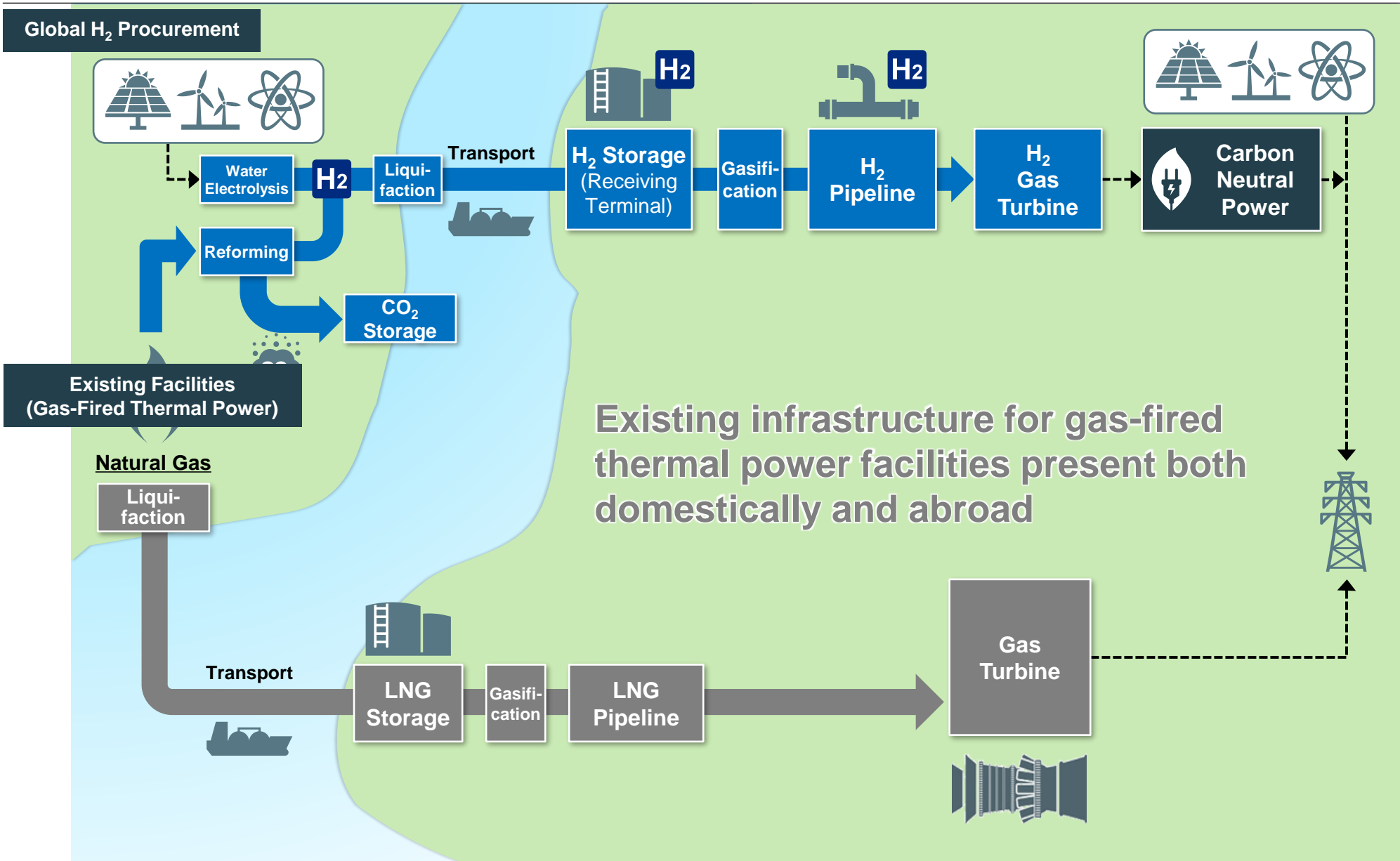


Prepare infrastructure for global H₂ procurement

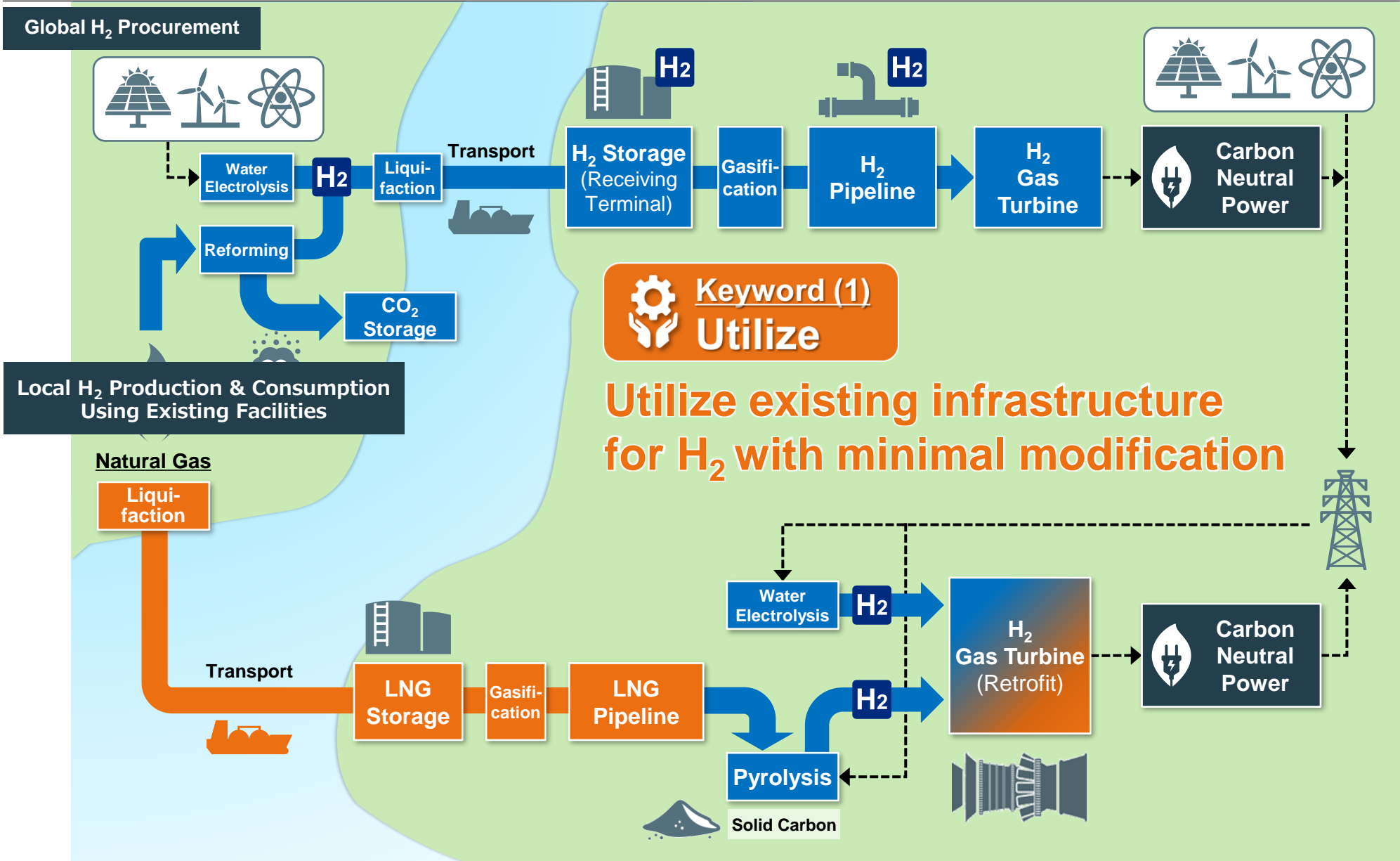
Energy: Local Production & Consumption of H₂

 New Facilities/
Processes

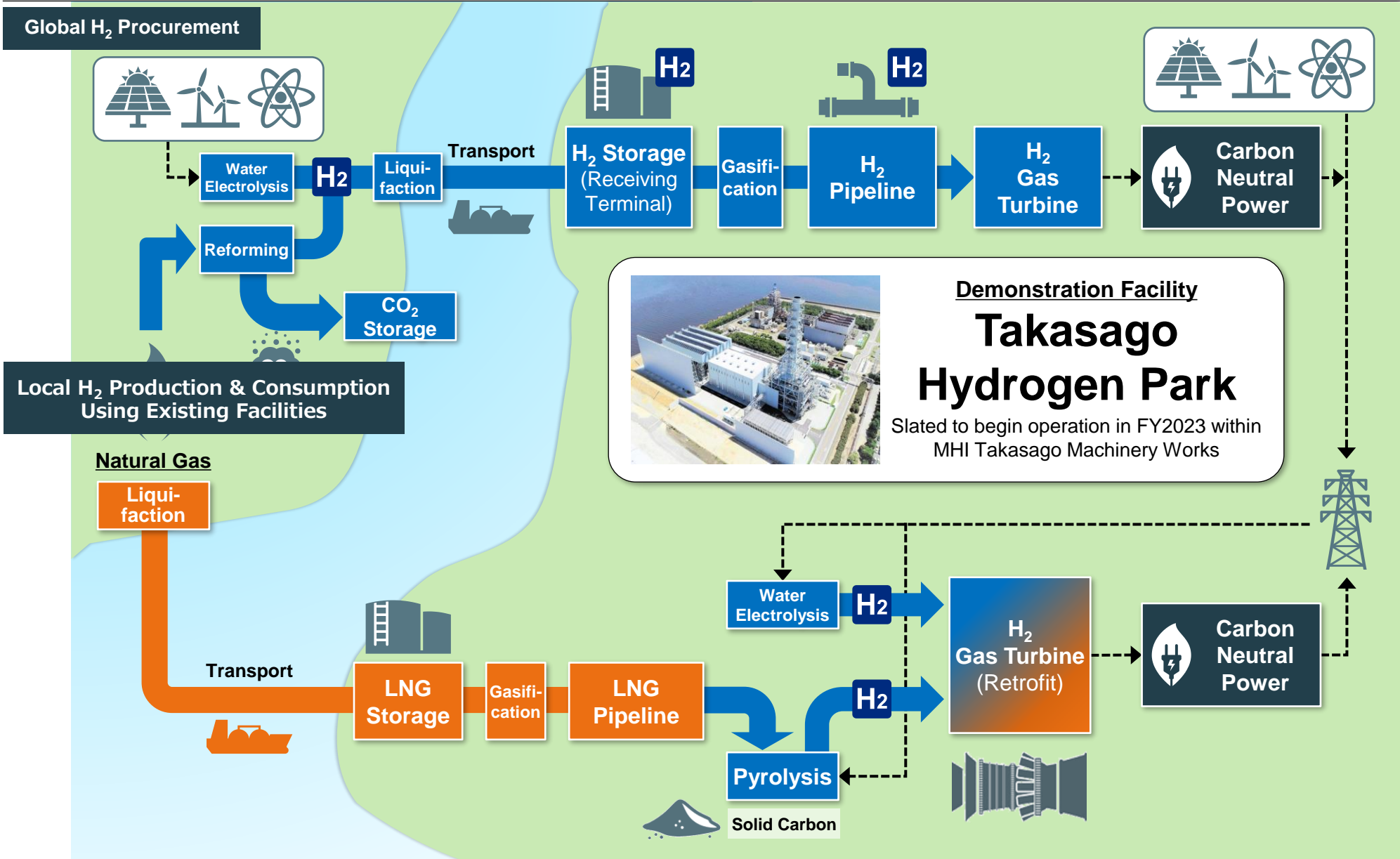
 Existing
Facilities



Energy: Local Production & Consumption of H₂

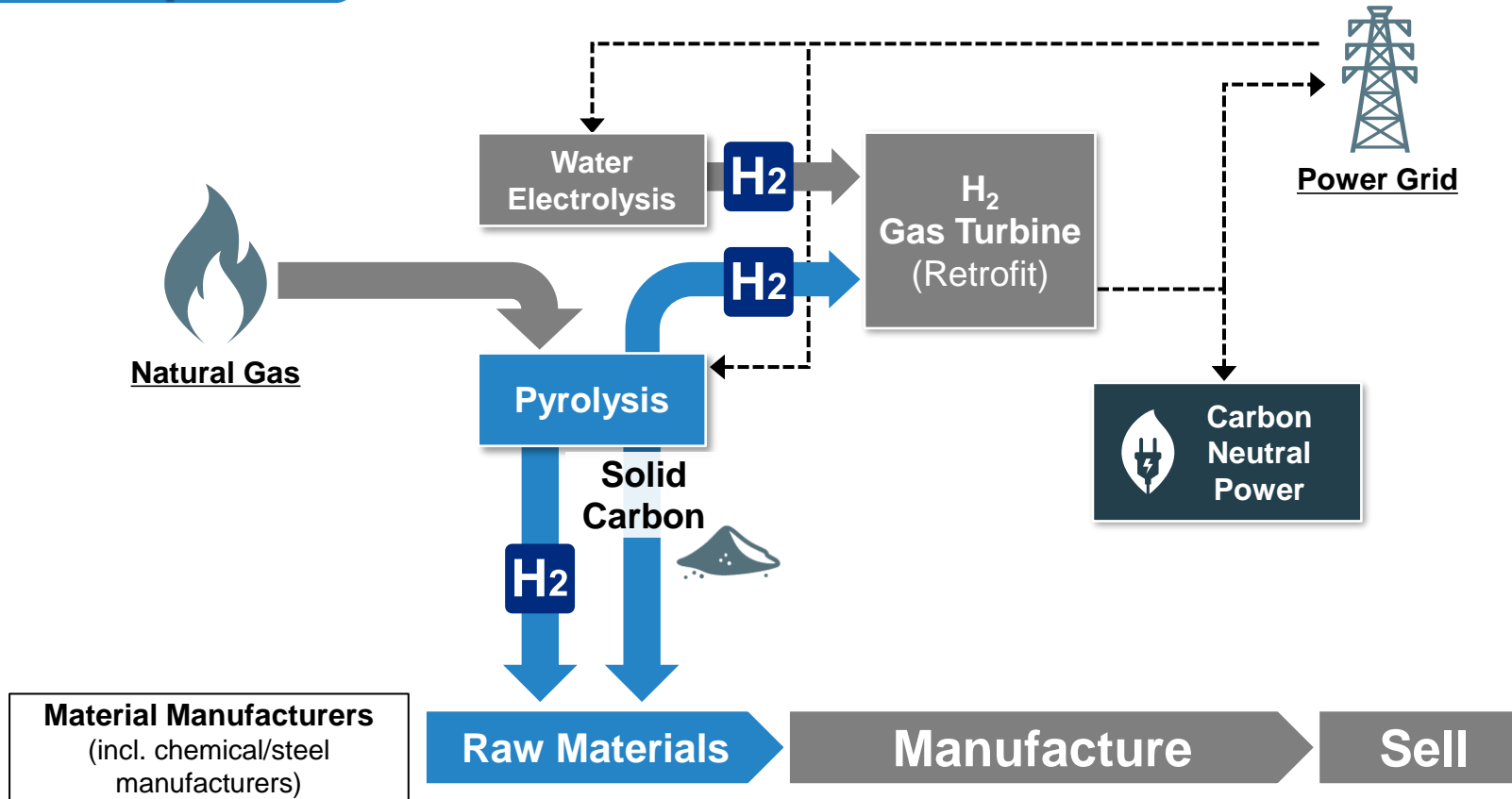


Energy: Local Production & Consumption of H₂



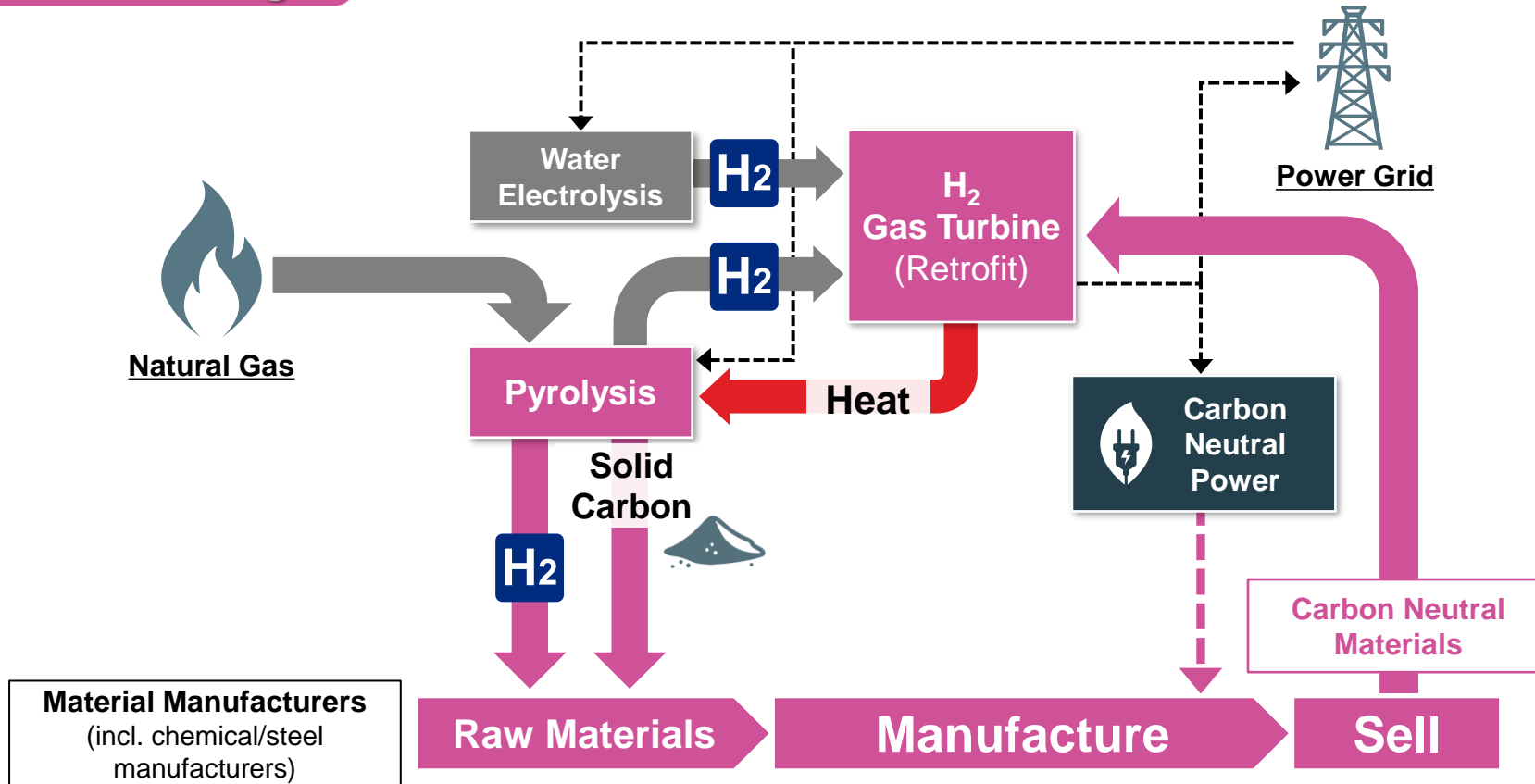
Keyword (2)
Separate

Produce H₂ and solid carbon for use as raw materials

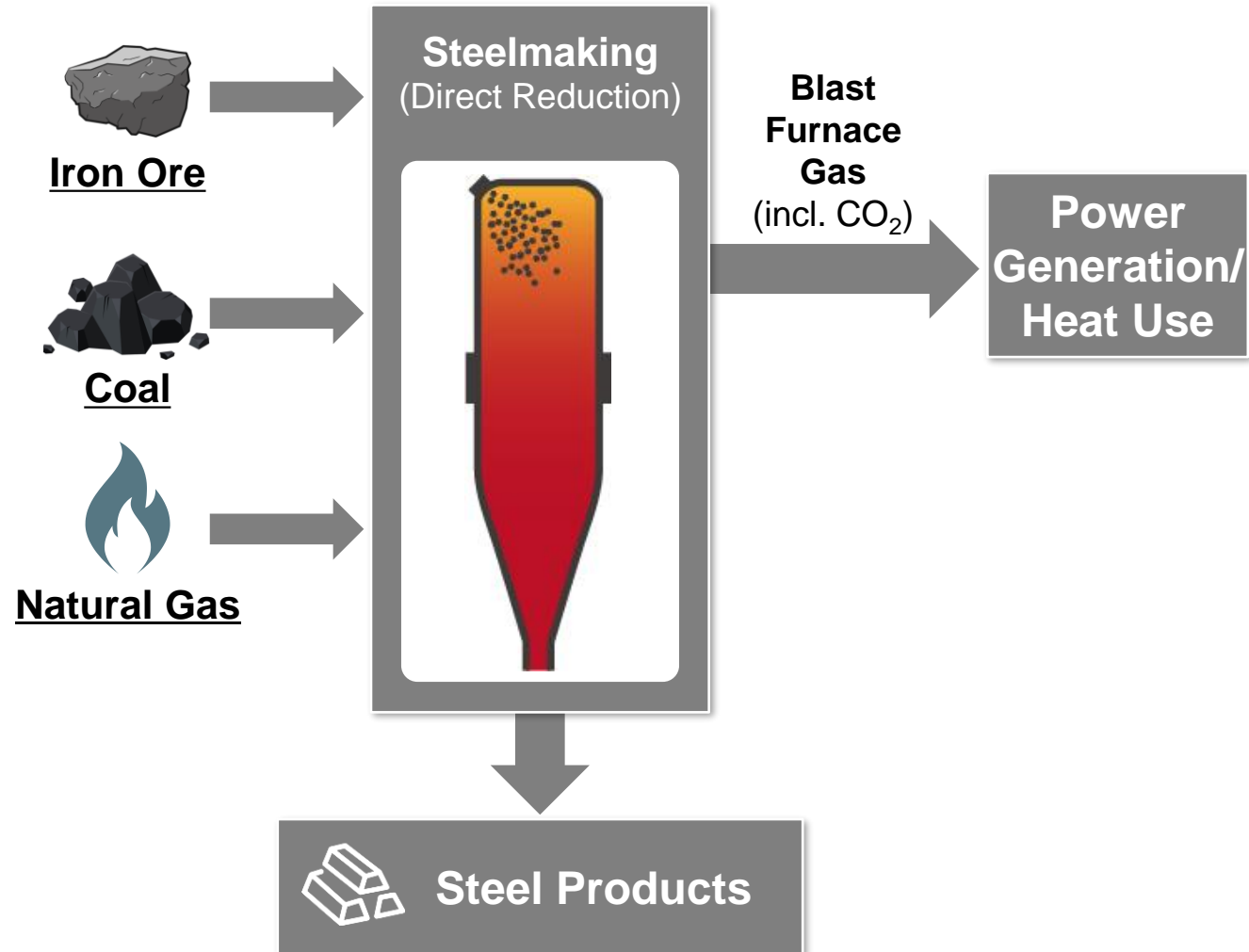


→ Keyword (3)
← Exchange

Exchange for new value or materials



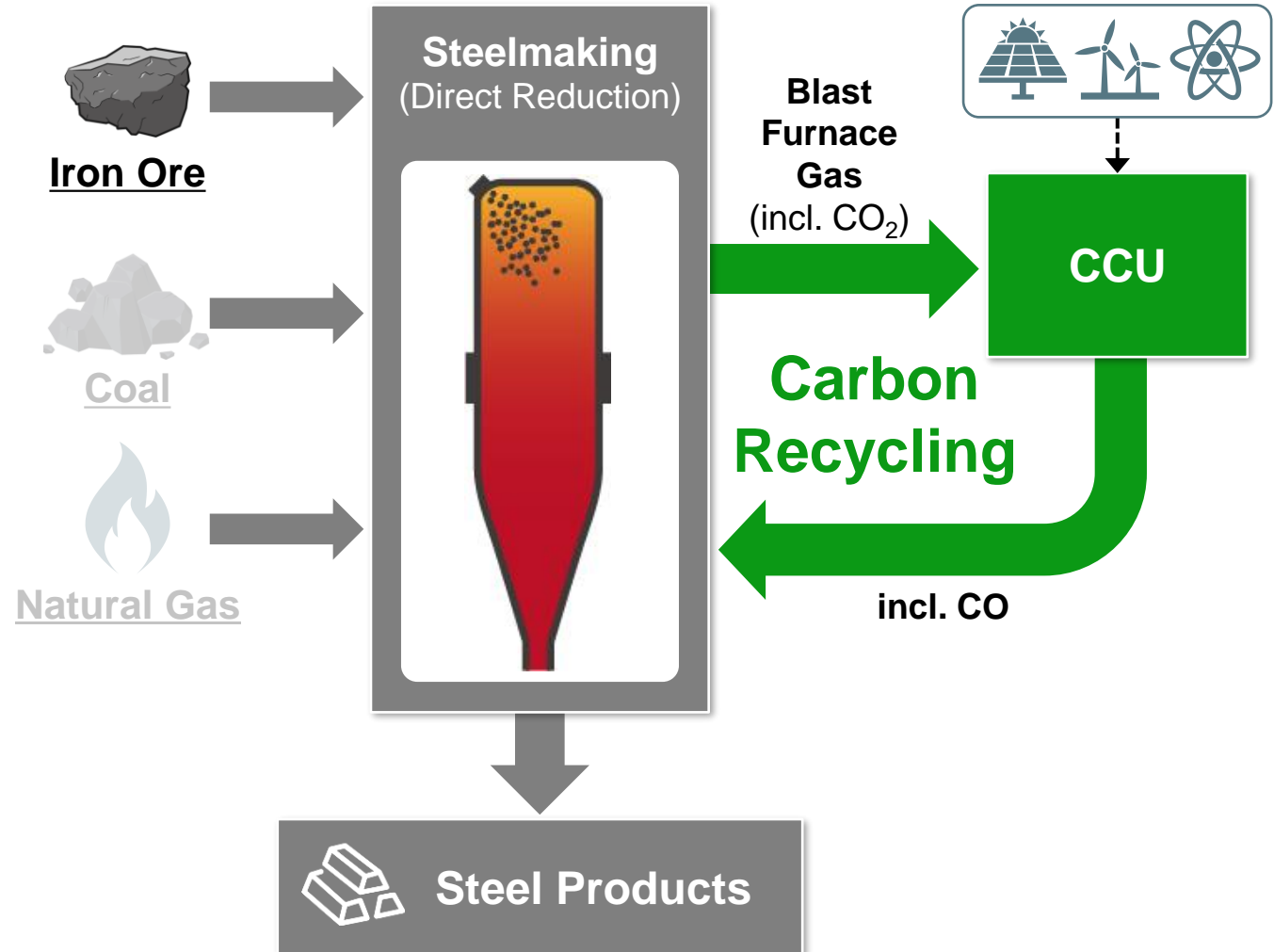
CO₂ Recycling in Steelmaking





Keyword (4)
Circulate

Reuse carbon within the steelmaking process

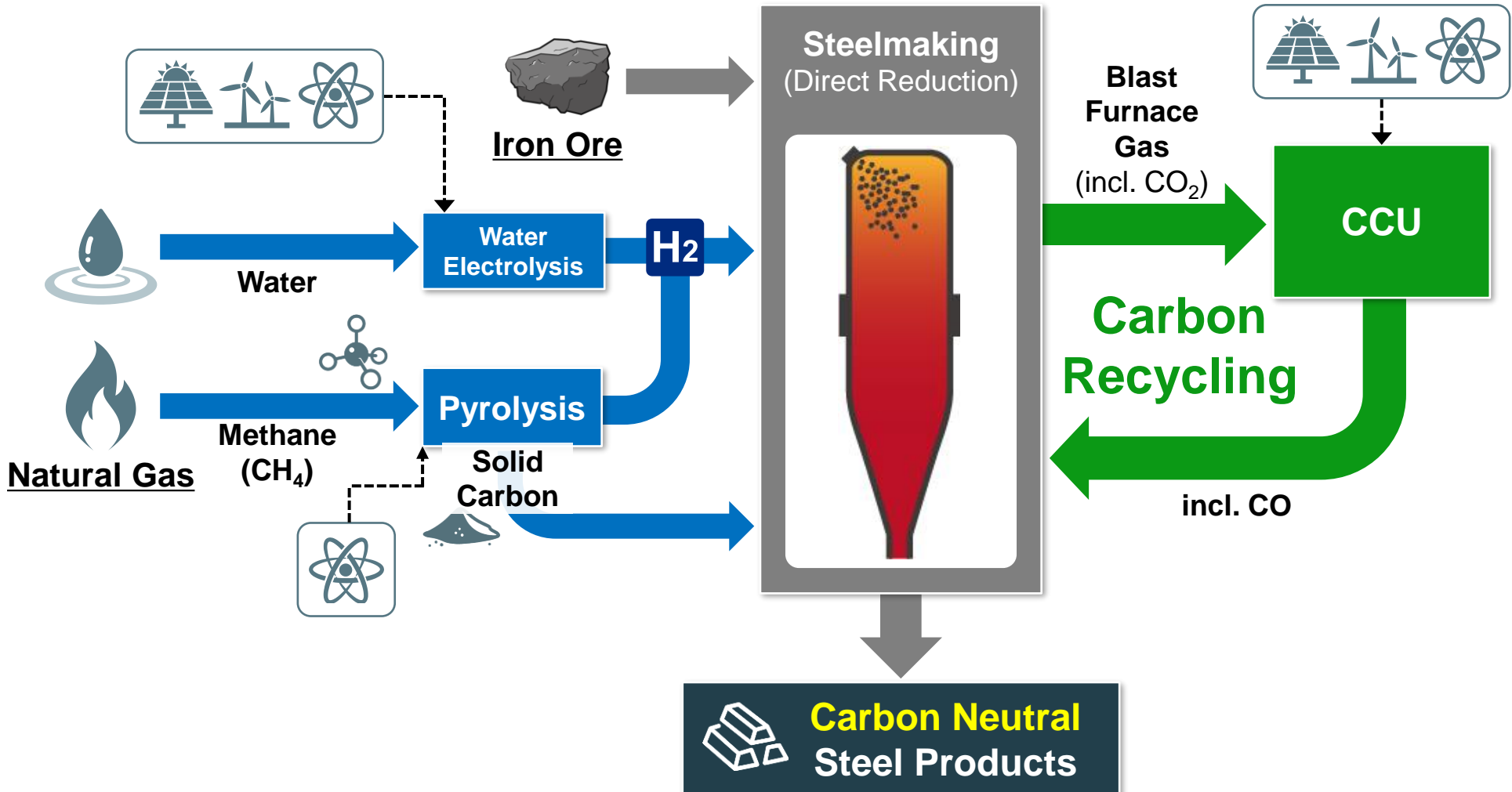


Materials: CO₂ Recycling in Steelmaking



Keyword (4)
Circulate

Reuse carbon within the steelmaking process



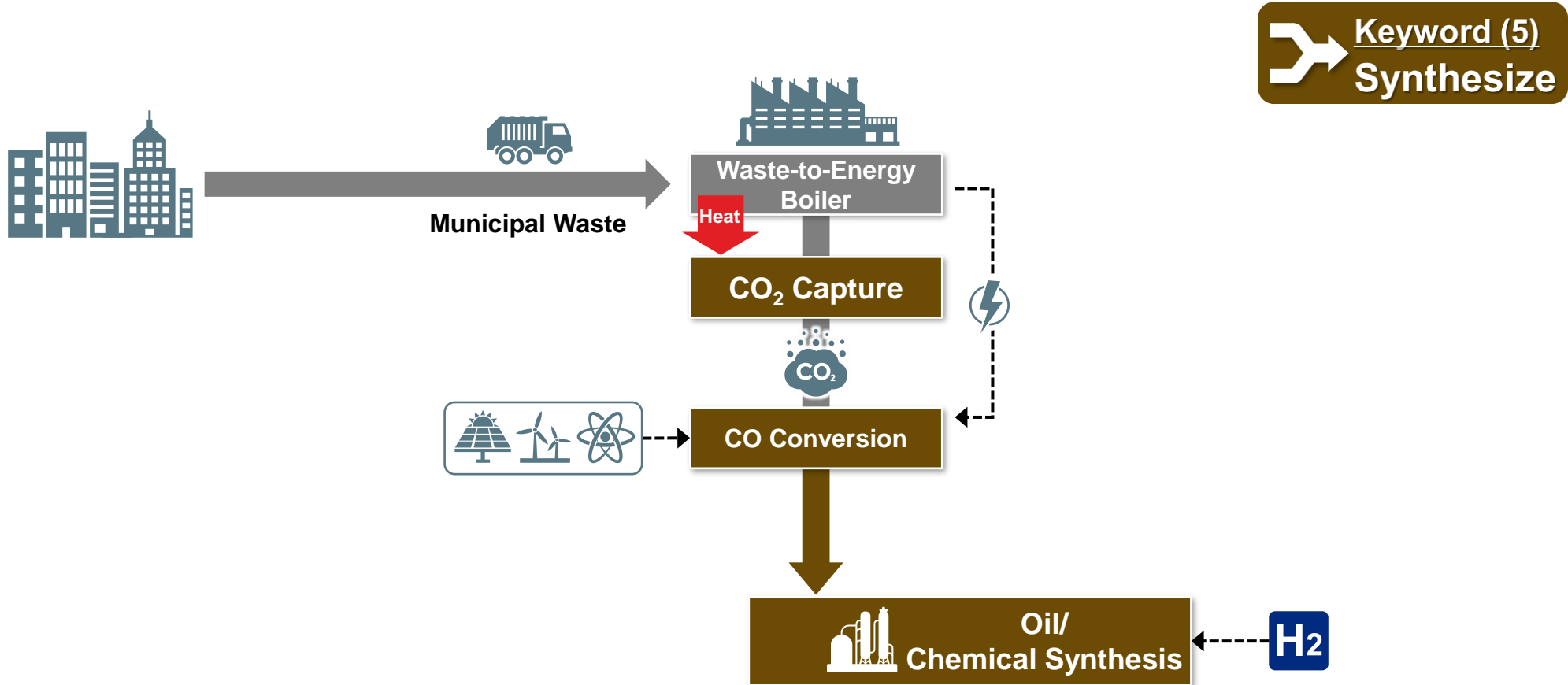
Waste Treatment: The CO₂ Recycling Chain

Existing Facilities



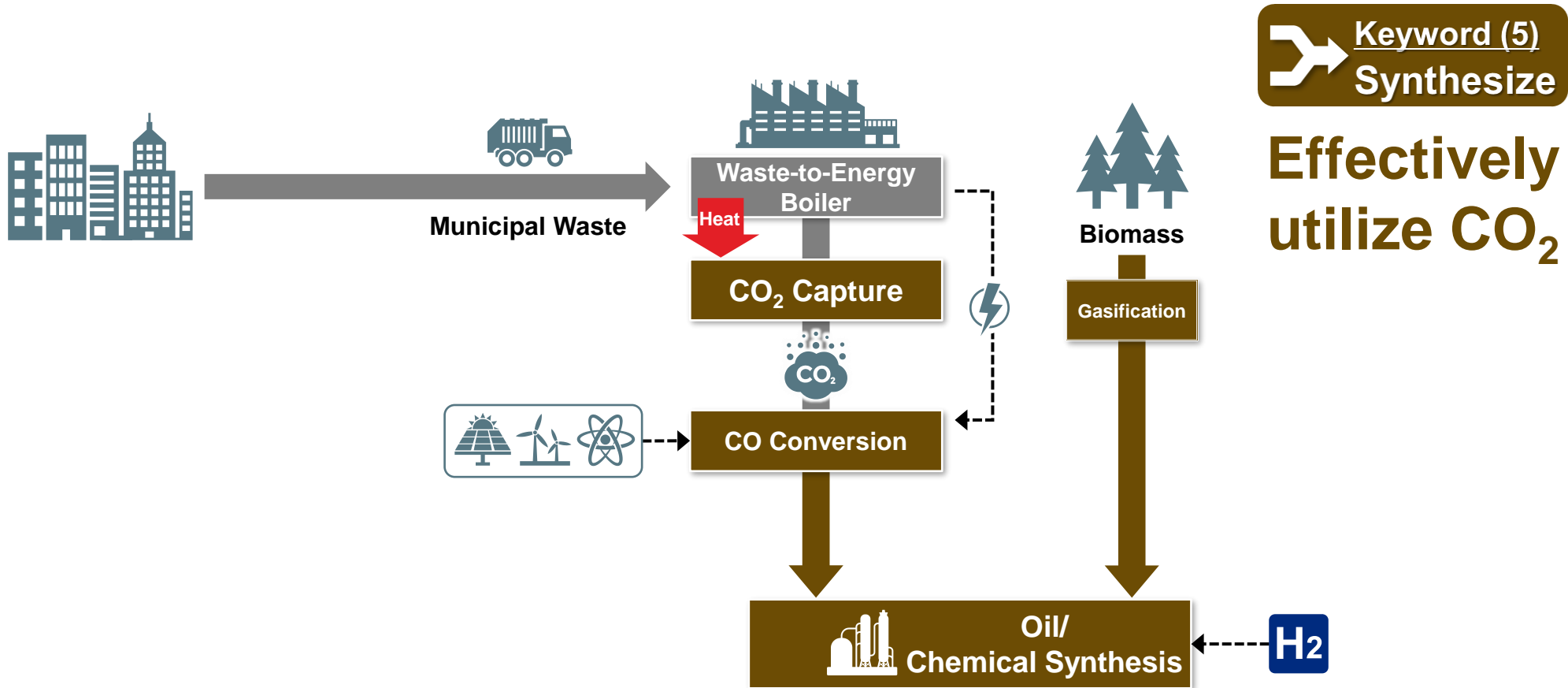
Waste Treatment: The CO₂ Recycling Chain

Existing
Facilities



Waste Treatment: The CO₂ Recycling Chain

Existing Facilities

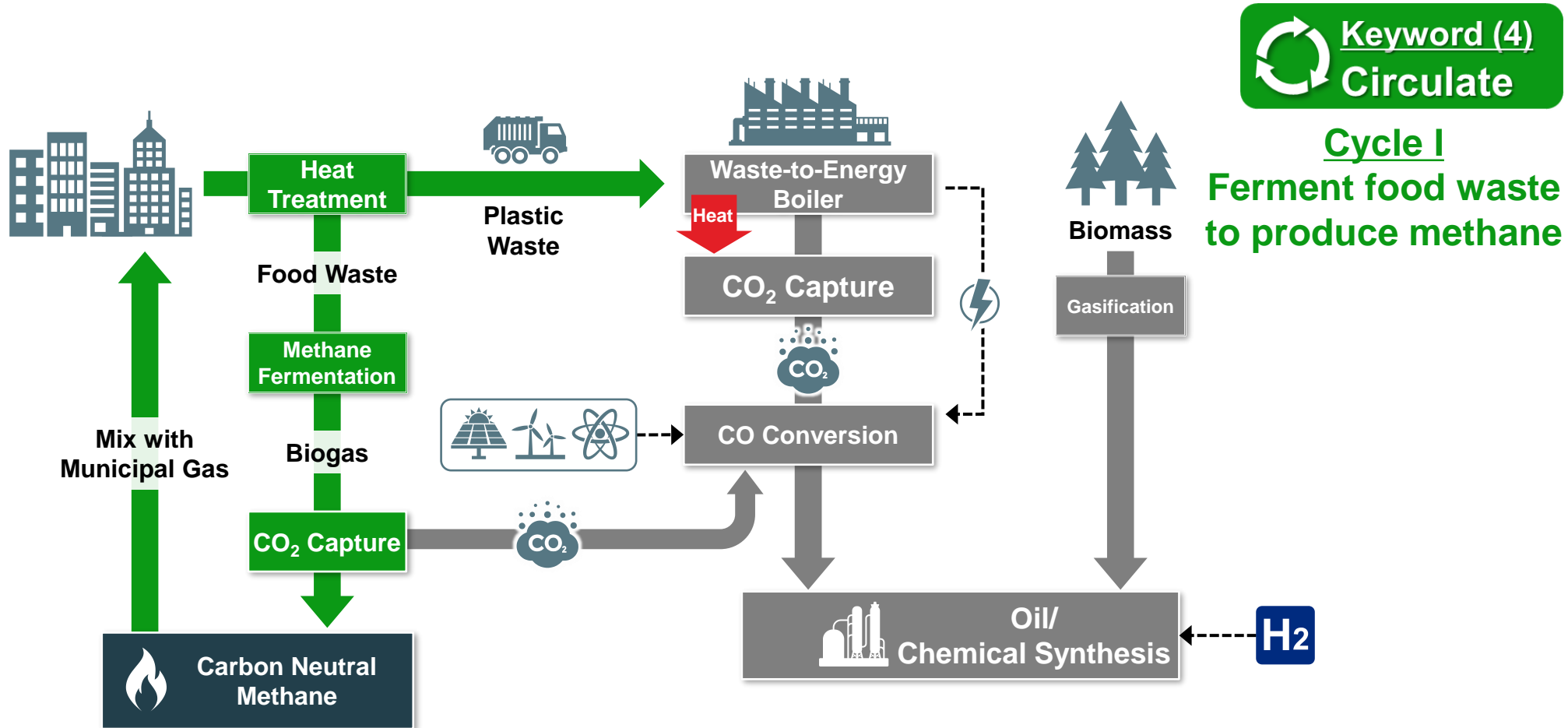


Keyword (5)
Synthesize

**Effectively
utilize CO₂**

Waste Treatment: The CO₂ Recycling Chain


Existing Facilities



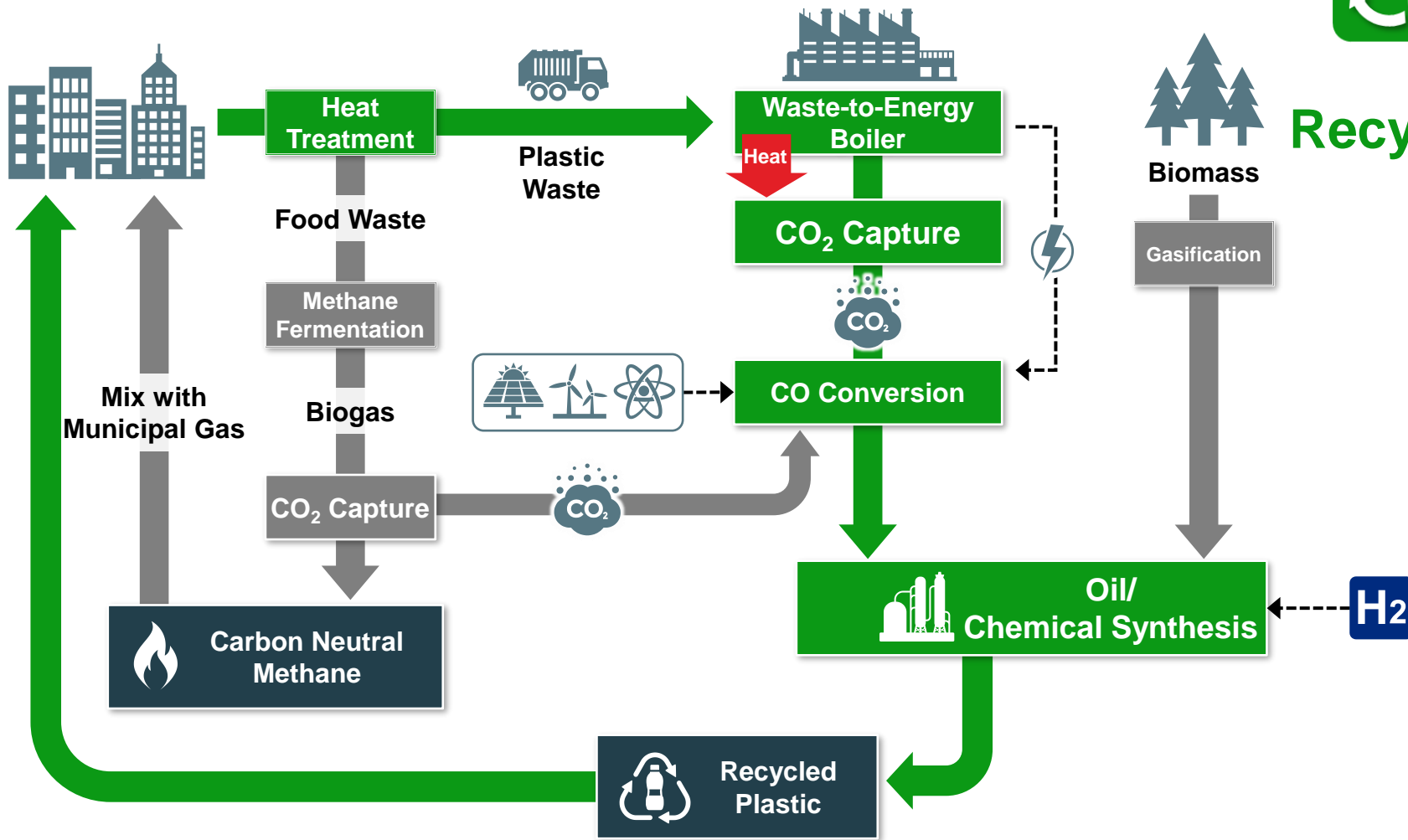
Waste Treatment: The CO₂ Recycling Chain

Existing Facilities



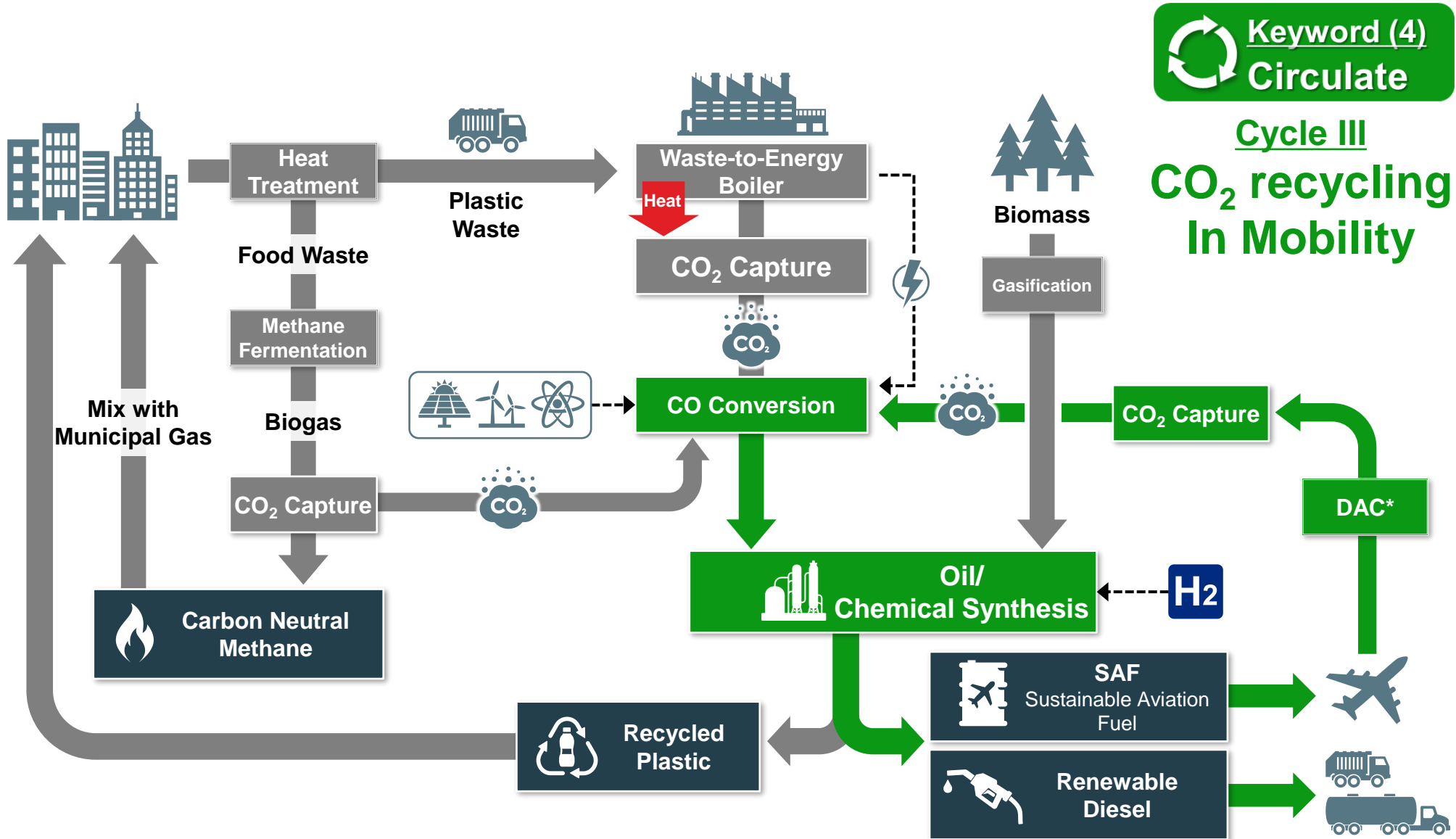
 **Keyword (4)**
Circulate

Cycle II
Recycle plastic waste



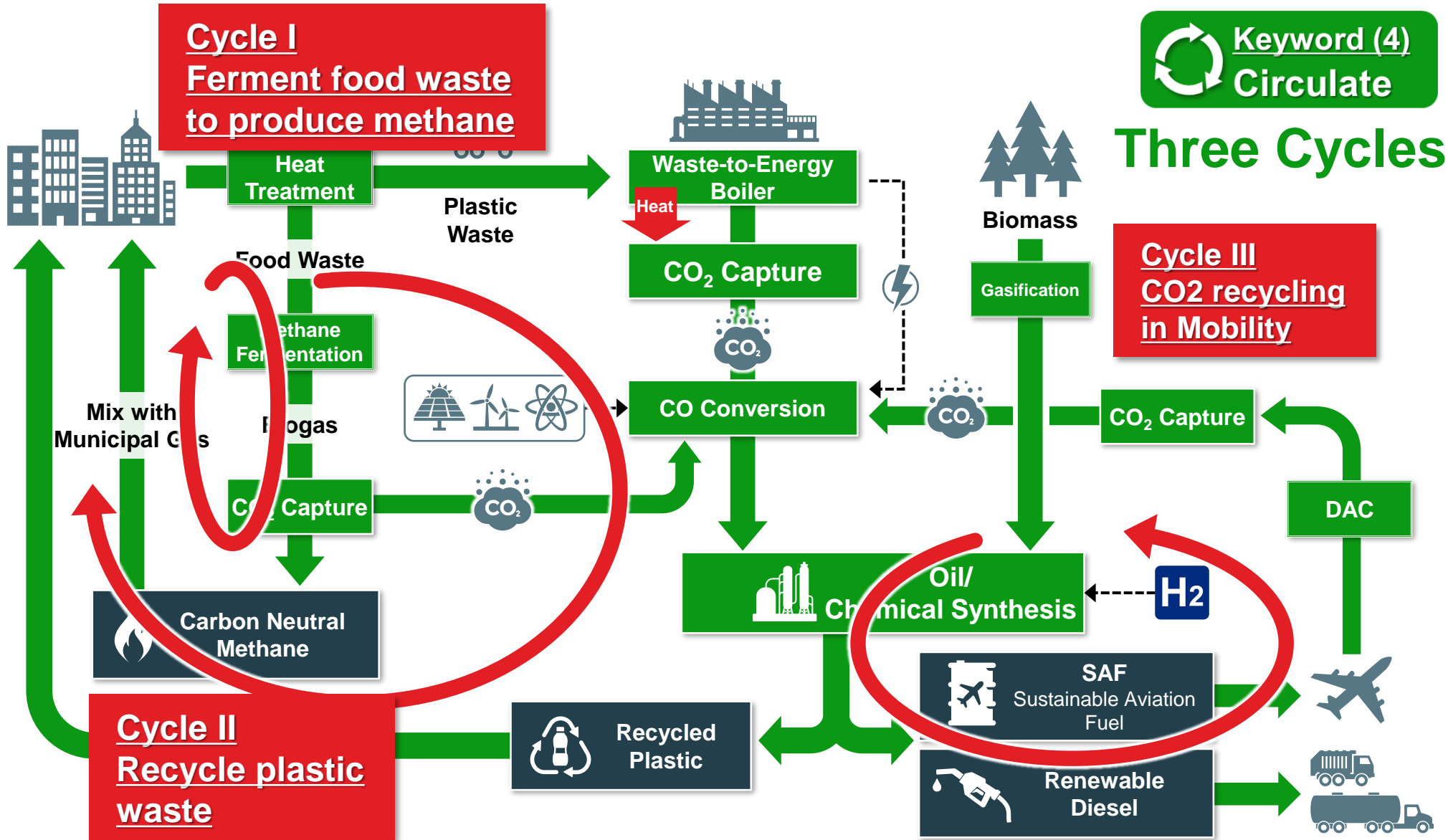
Waste Treatment: The CO₂ Recycling Chain

Existing Facilities



Waste Treatment: The CO₂ Recycling Chain

Existing Facilities

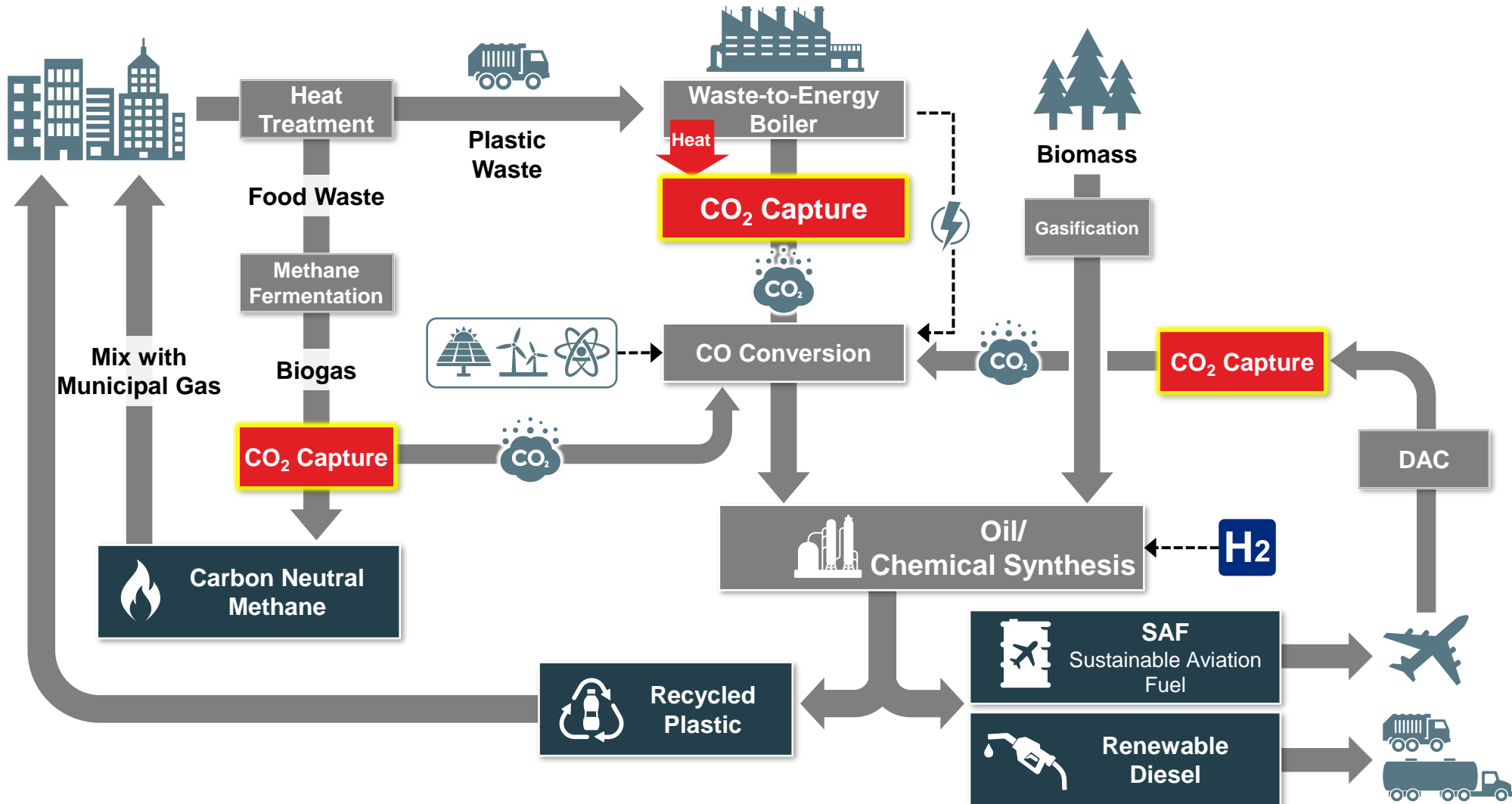


Waste Treatment: The CO₂ Recycling Chain

Existing Facilities



CO₂ Capture Points



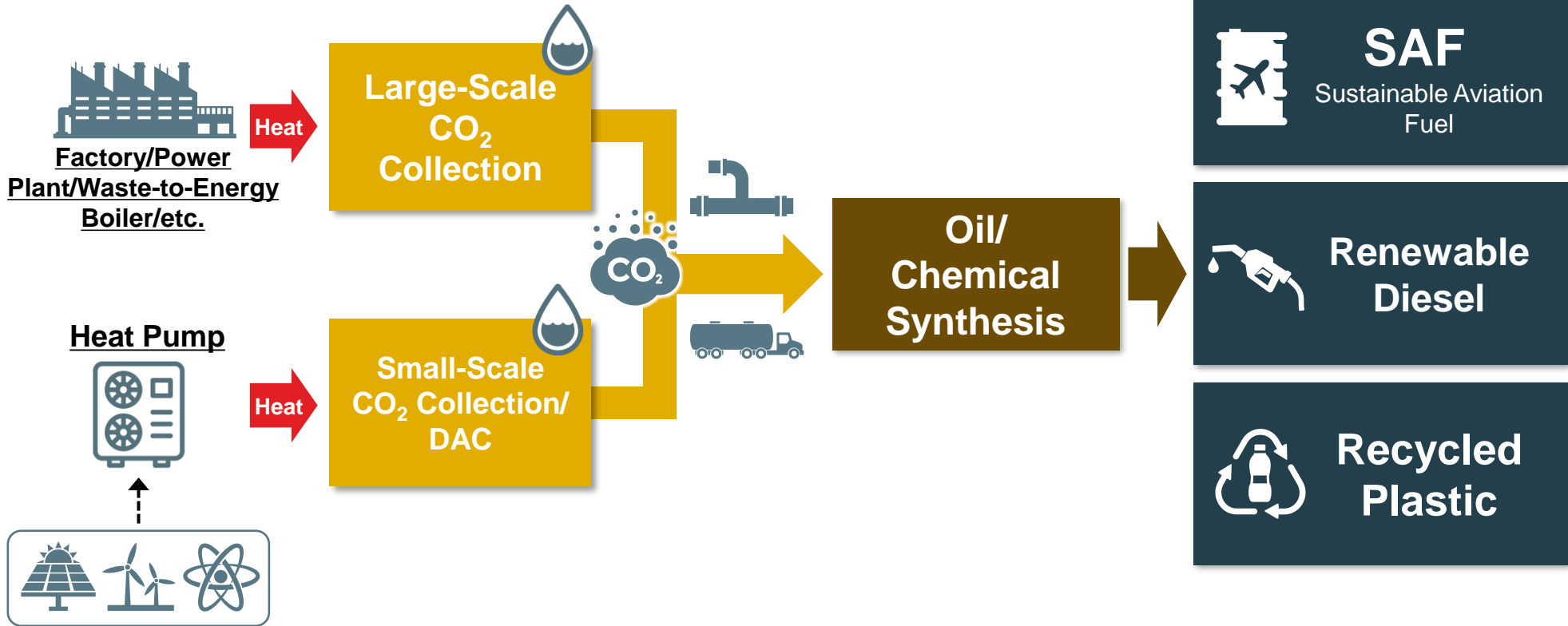
Consolidated CO₂ Processing

 **Keyword (6)**
Consolidate

Provide CO₂ absorbent collection and supply services

 **Keyword (1)**
Utilize

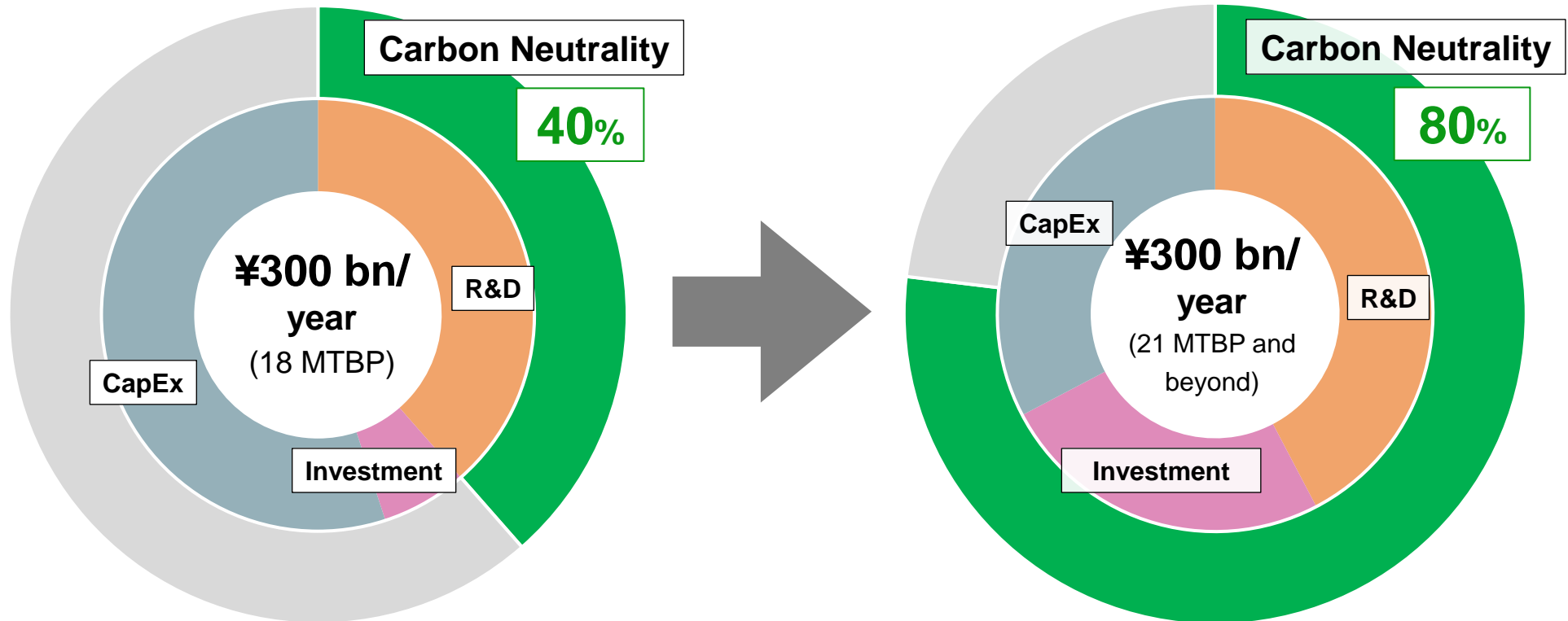
 **Keyword (5)**
Synthesize



Status of Solutions Development

*Investments: Total of capital expenditures, investments, and R&D costs

Execute large shift in funds to R&D and investments, reaching 2 trillion yen by 2030



Shift investment to decarbonization ecosystem development in each business, focusing on six keywords (1. Utilize, 2. Separate, 3. Exchange, 4. Circulate, 5. Synthesize, and 6. Consolidate) mentioned in the previous section

Energy Management System

Begin use in FY2022

Validation to begin in FY2022 as a core part of the MHI Group Integrated Development Plan

■ Leverage position as equipment manufacturer

Utilize knowledge base regarding core energy supply products such as power plants and HVAC to develop algorithms which account for lifecycle costs and operability

■ Compatible with carbon neutral equipment

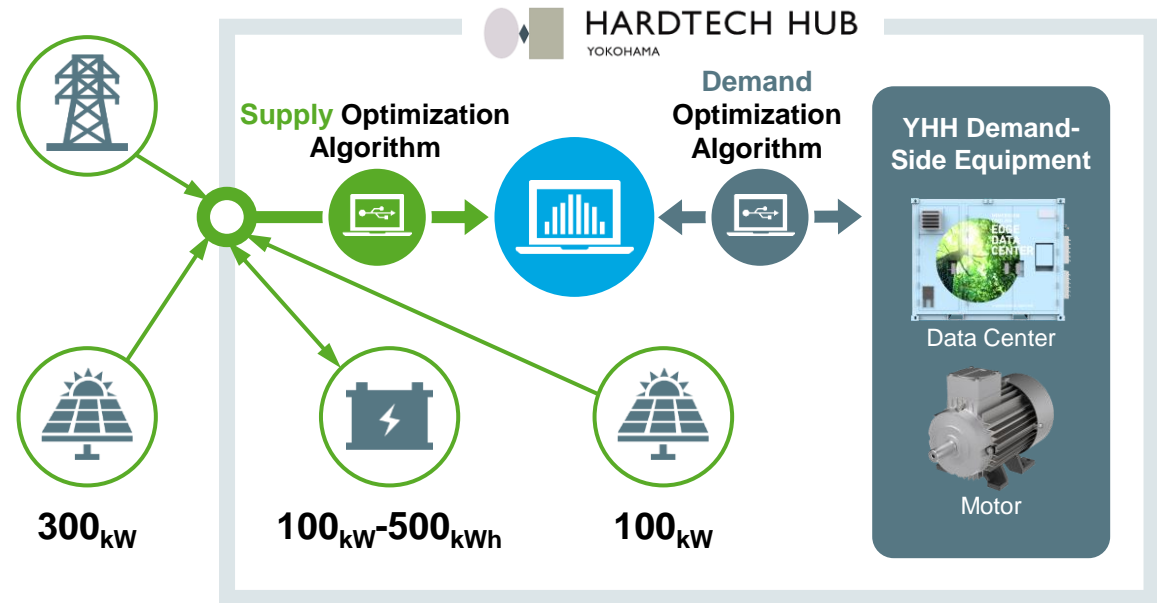
Install solar panels and battery energy storage equipment. Develop carbon neutrality management technologies.

■ Verify effectiveness with simulations

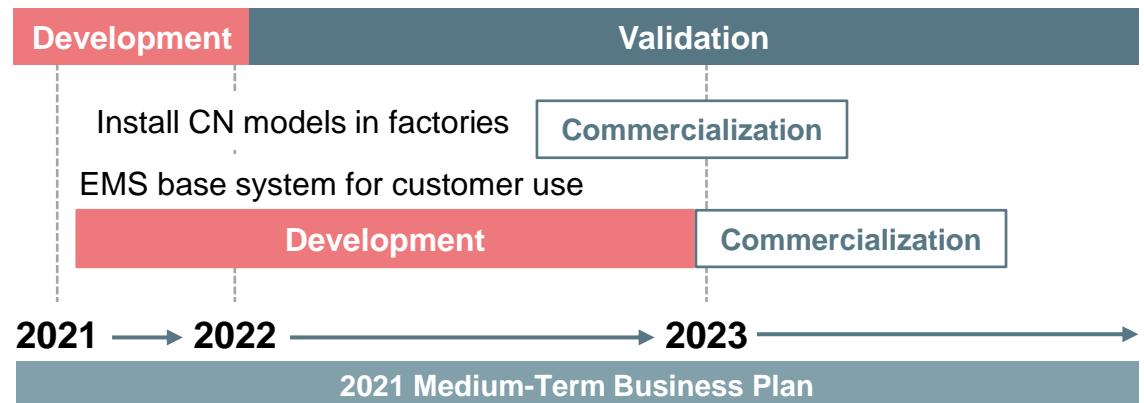
Simulate operational changes and/or installation of new equipment. Quantify cost and decarbonization effectiveness, and increase accuracy of return on investment calculations

■ Use latest evaluation indices

Energy cost and battery charge/discharge cost models using the latest techniques, including levelized lifecycle costing, are included in control algorithms



YHH CN Type EMS Core System Development



Begin validation in FY2022

Complete prototype design and fabrication in FY2022 and validate at in-house manufacturing facilities in FY2023

- **Reduce CO₂ emissions from heating processes**

Electrify heating processes in factories and other facilities. Develop energy conserving heat pump chillers. Achieve large decrease in CO₂ emissions.

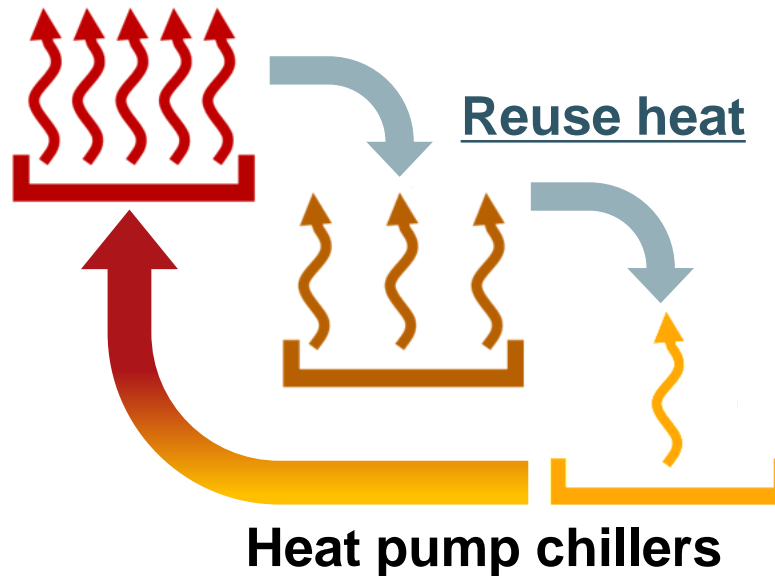
- **Leverage existing product development and manufacturing technologies**

Quickly commercialize while ensuring high reliability

- **Provide decarbonization solutions for heating processes**

Combine heat and energy equipment design and development capabilities with engineering knowledge base cultivated in existing businesses

Factory Decarbonization Solutions



Casting Process
Effectively use high temperature waste heat



Utilize **reused heat** (waste heat) or **atmospheric heat** as heat sources

Decrease CO₂ emissions by replacing fossil fuel boilers

Mihara Carbon Neutral Factory

Achieve a fully Carbon Neutral factory by the end of FY2023

Demonstrate the achievability of MISSION NET ZERO by offsetting 10,000 tons-CO₂/year

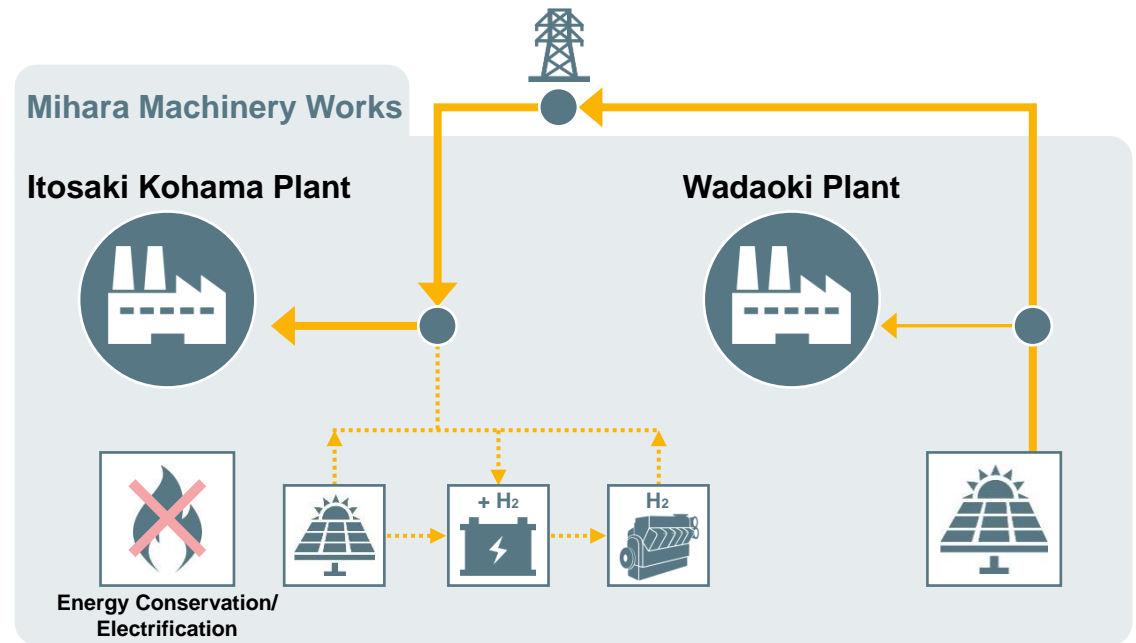
■ Install solar panels


Install an amount of solar panels equivalent to the electricity consumption of Mihara Machinery Works.

Achieve Scope 2 decarbonization with this dedicated renewable energy source.

■ Utilize as R&D proving ground

Execute challenging adoption of energy conservation, electrification, fuel conversion, and renewable energy sources while using as a proving ground for various technologies and carbon neutral solutions



CO₂ = 10,000 tons \doteq  x 700,000 trees



Carbon
Neutrality

2021 Medium-Term Business Plan

2021

2023

Takasago Hydrogen Park

Located in Takasago Machinery Works

Begin operation in FY2023

A one-stop-shop for validating hydrogen-related technologies from hydrogen production to power generation

■ Add hydrogen production and storage equipment to existing demonstration plant

Test and validate water electrolysis, turquoise hydrogen*, SOEC** and other technologies in-house and improve product reliability

*Turquoise hydrogen: H₂ obtained through pyrolysis of methane into H₂ and solid carbon

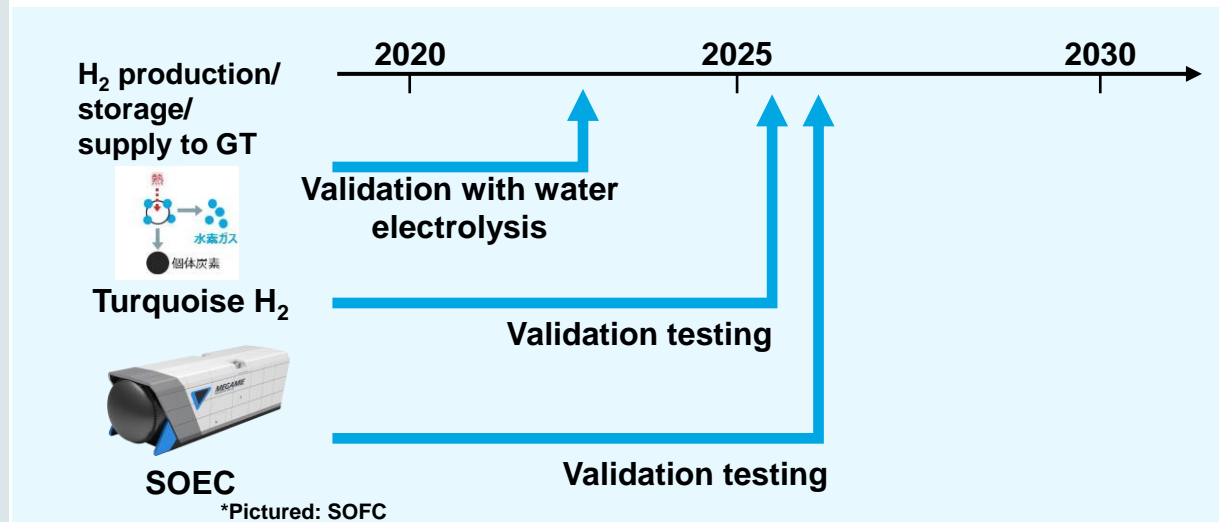
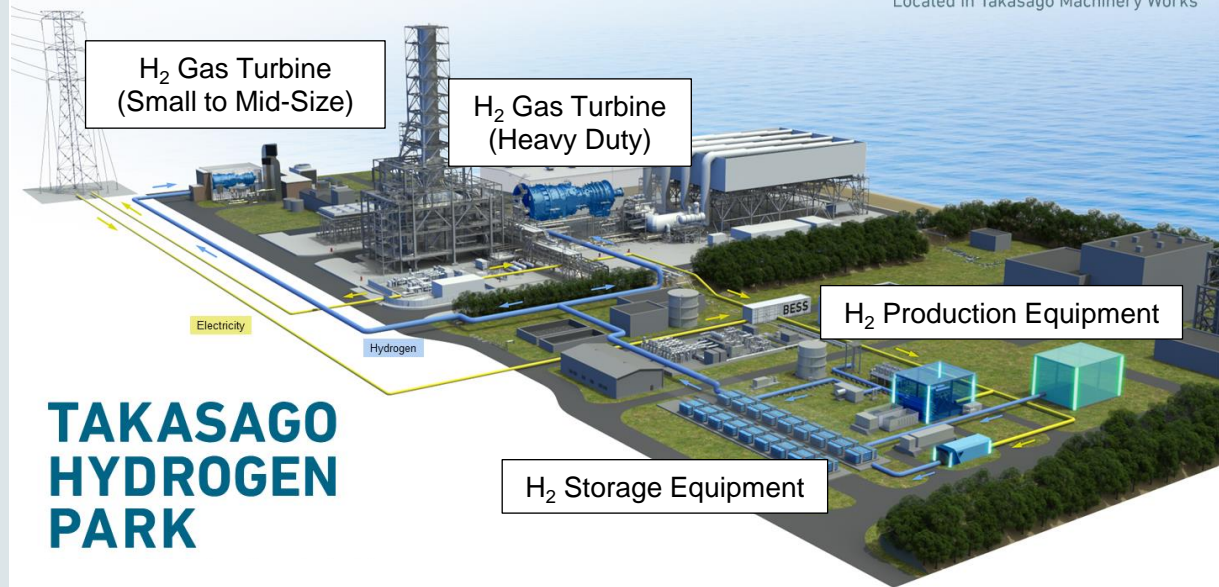
**SOEC (Solid Oxide Electrolyzer Cell): High temperature steam electrolysis

■ Validate hydrogen gas turbine technology

Validate technology in lead up to commercialization of 30% mixed firing in heavy duty gas turbines and 100% hydrogen firing in small to mid-size gas turbines by 2025

■ Combine and evolve energy infrastructure and hydrogen technologies

Make progress toward establishing a hydrogen solutions ecosystem, which will help achieve a sustainable society by linking various industries with hydrogen technologies



*Pictured: SOFC

Hydrogen Gas Turbine (EU Taxonomy Compliant)

EU Taxonomy Compliant

Leveraging Takasago Hydrogen Park, develop hydrogen gas turbine technology that complies with the EU Taxonomy's strict CO₂ emissions standards. Development schedule meets Taxonomy timing requirements as well.

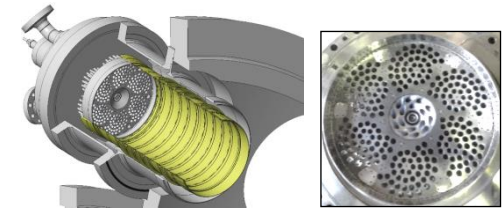
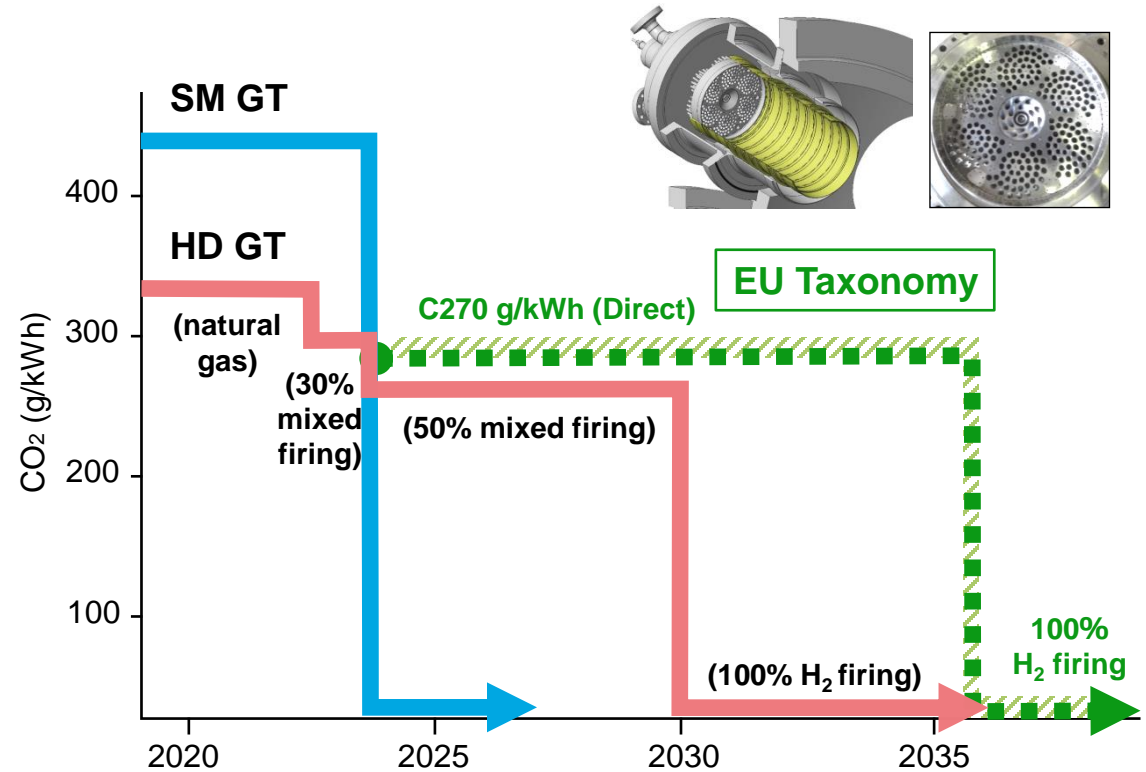
■ Small to mid-size gas turbines

Validate on actual equipment at Takasago Hydrogen Park in preparation for commercialization of hydrogen gas turbines by 2025, meeting the EU Taxonomy deadline

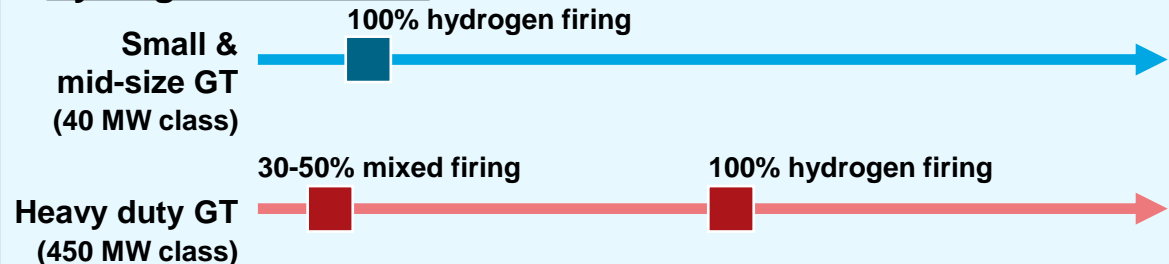
■ Heavy duty gas turbines

Development of 30% mixed hydrogen firing technology was completed in 2018. Validation will be performed at Takasago Hydrogen Park in the lead up to commercialization in 2025.

Forecasted to achieve 100% hydrogen firing by 2030 and meet the EU Taxonomy requirements a full 5 years before the deadline



Hydrogen Combustor



Carbon-free, large-scale power source

Nuclear power is a stable power source, which does not emit CO₂ during operation and also is not affected by weather. Therefore, we believe it will be essential to the achievement of a Carbon Neutrality.

■ Restart existing plants and complete the nuclear fuel cycle

Currently focusing on restarting existing plants, building Specialized Security Facilities*, and completing the nuclear fuel cycle

■ Develop a next-generation light water reactor

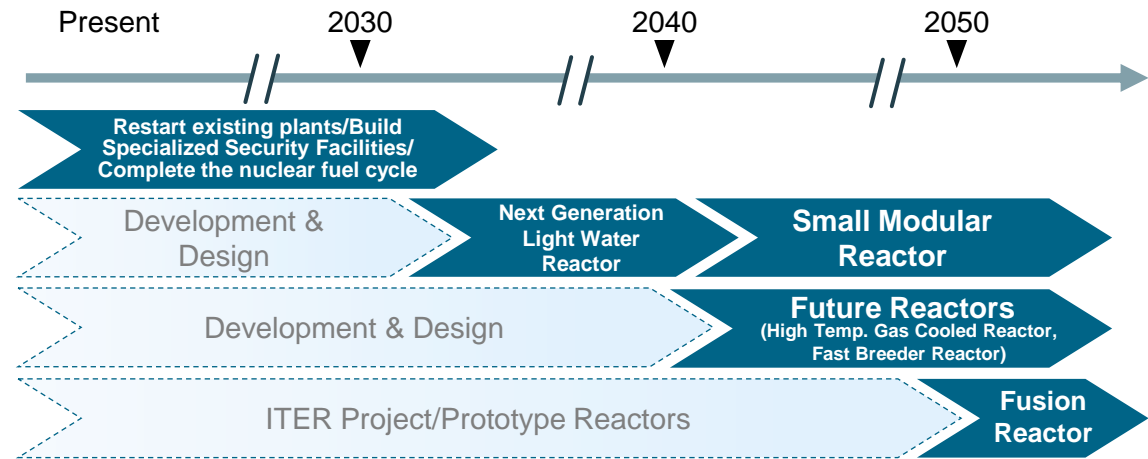
Develop a next-generation light water reactor with further improvements to safety, aiming for commercialization in the mid-2030s

■ Develop future reactors and fusion reactors

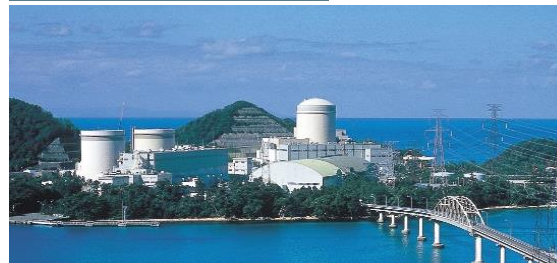
Develop and commercialize small modular reactors, high temperature gas-cooled reactors, and fast breeder reactors to satisfy the diversifying market needs of the future

High-volume, stable, carbon-free hydrogen production using high temperature gas-cooled reactors

Contribute to meeting decarbonization and hydrogen use needs of various industries including steelmaking by achieving high-volume, stable hydrogen production with high temperature gas-cooled reactors



Restarts & Specialized Security Facilities



Next-Generation Light Water Reactor



High Temperature Gas Cooled Reactor



Small Modular Reactor



*Specialized Security Facilities: Isolated, large-scale facilities used to safely shut down a reactor in the event of such security incidents as airplane strikes or terrorist attacks

Biomass Gasifier

Achieved world's first regularly scheduled flight* powered by SAF

Sustainable Aviation Fuel (SAF) produced from wood biomass

■ Integrated biojet fuel manufacturing technology

Established by MHI, JERA, Toyo, and JAXA under contract from NEDO**

■ Validated in a pilot plant

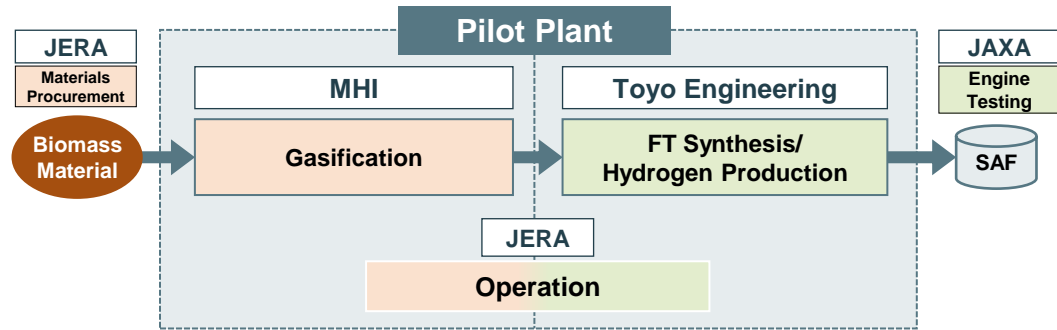
Built a pilot plant and validated the achievability and efficacy of a gasifier with processing capacity of 0.7 ton/day and a gas production output of approx. 1,000 Nm³/day during FY2017-2020.

■ Adaptable to any region

Achieved an SAF production process using captured CO₂ including from DAC

*Outline of domestic regularly scheduled flight powered by SAF produced from wood pulp:

- Date: June 17, 2021
- Flight: JAL 515
- Route: Tokyo-Haneda to New-Chitose (Japan domestic)
- Aircraft: Airbus A350-900



Biomass Gas Equipment



Biojet fuel meeting ASTM quality standards



View of pilot plant (within JERA Shin-Nagoya Thermal Power Station)

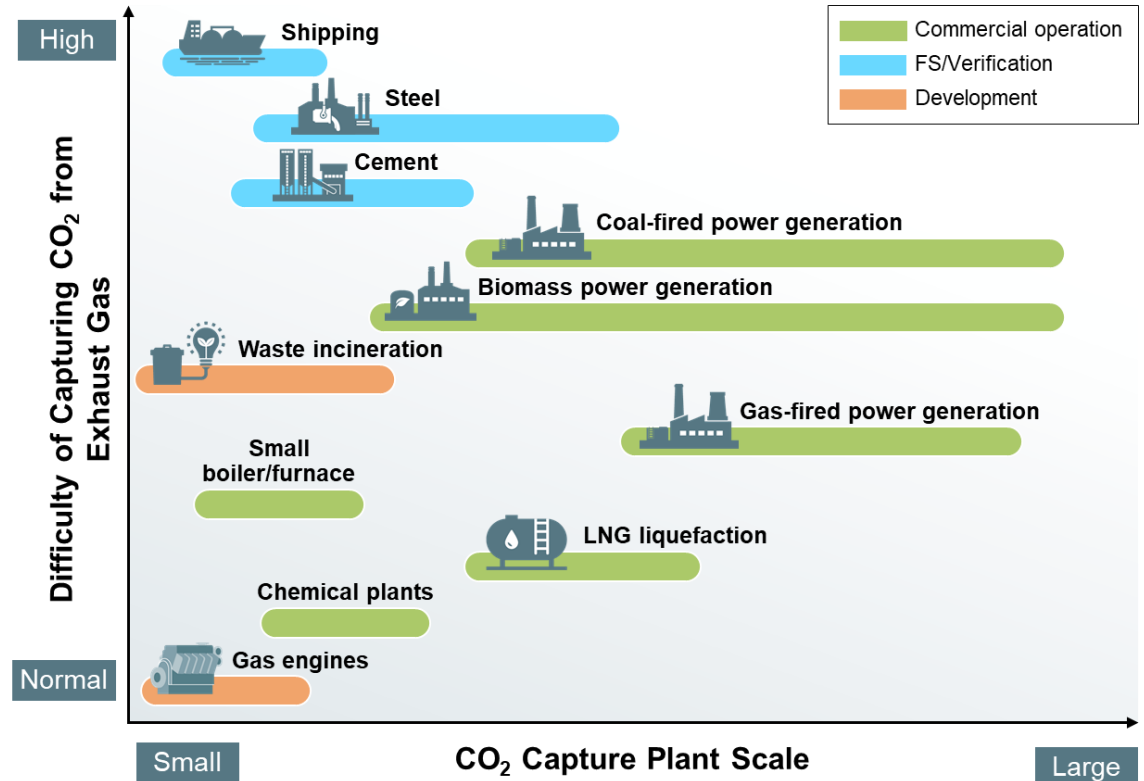
Modular CO₂ Capture Equipment

Shipped first production unit in FY2021

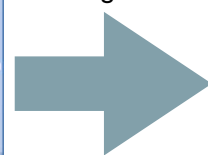
Fill out the product lineup by FY2023

Commercialize units for ships, gas engines, waste incinerators and others

- Proprietary CO₂ capture technology**
 Extensive commercial experience and high capture rate (over 90%) for chemical and thermal power plants
- Expand equipment lineup (0.3-200t/day)**
 Develop equipment targeting not only large but also small- and medium-sized emission sources to diversify CO₂ recovery demand
- Modularize and standardize**
 Development of low-cost general-purpose equipment aiming to reduce size (70% reduction in installation area) and minimize on-site construction (75% reduction compared with conventional equipment)
- Remote monitoring and O&M**
 Option to minimize customer effort. Begin validation testing in 2022. Commercialize CaaS* business in 2024.



Conserve space with container housing

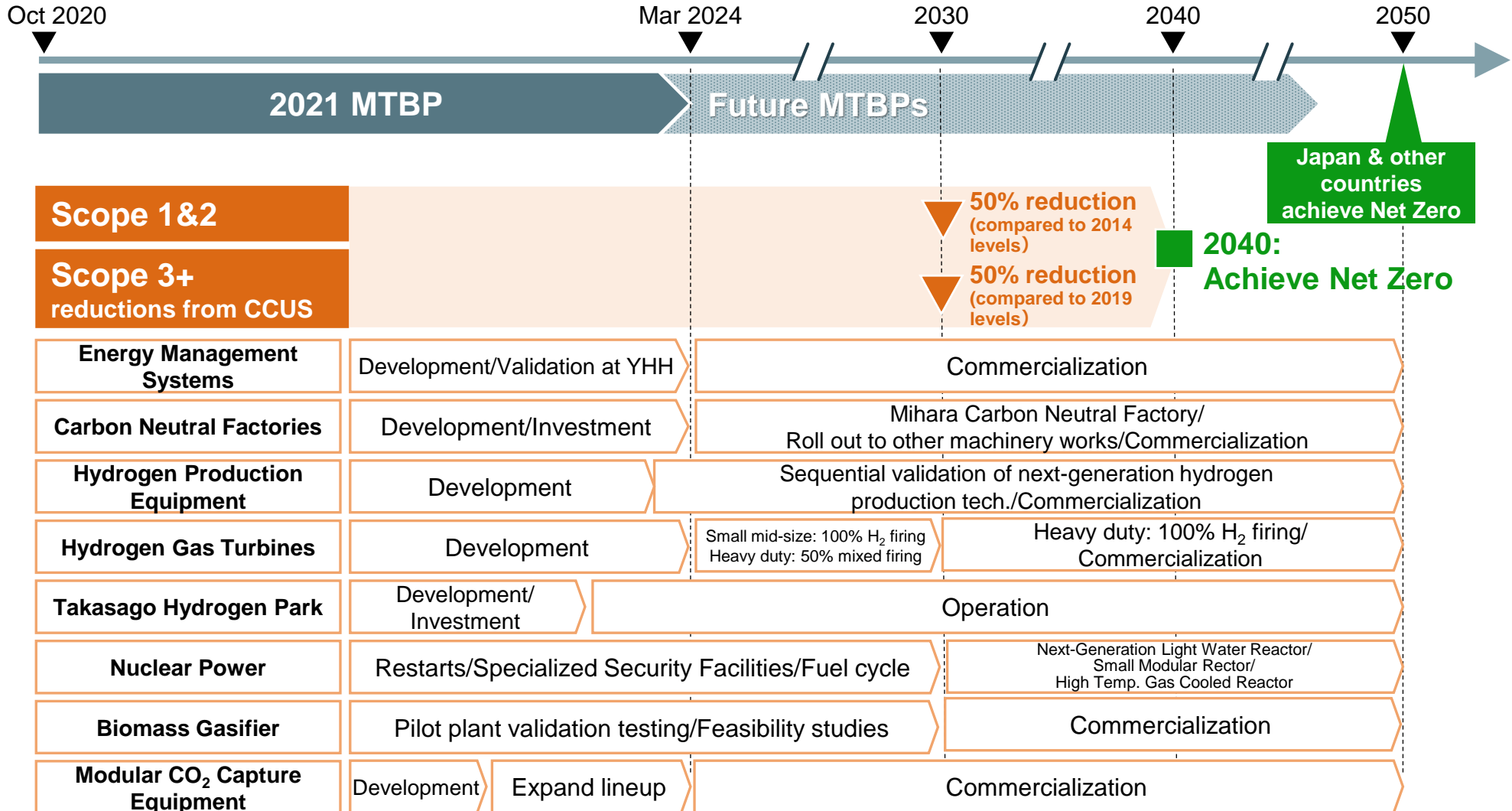


Minimize site construction



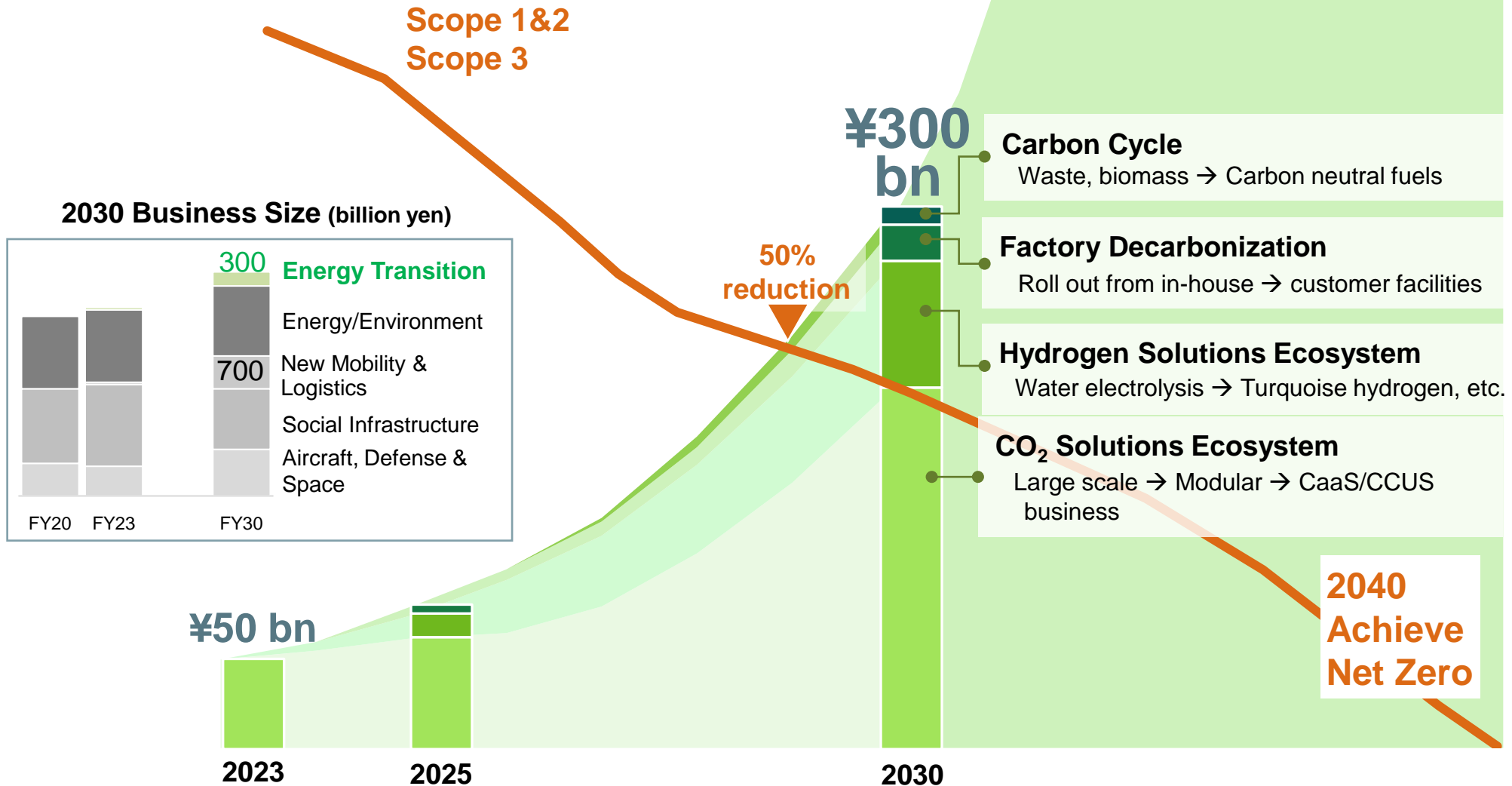
CC-Ocean maritime test of modular CO₂ capture equipment

**Current research will transition to the next phase by 2023.
Will continue to add new research areas**



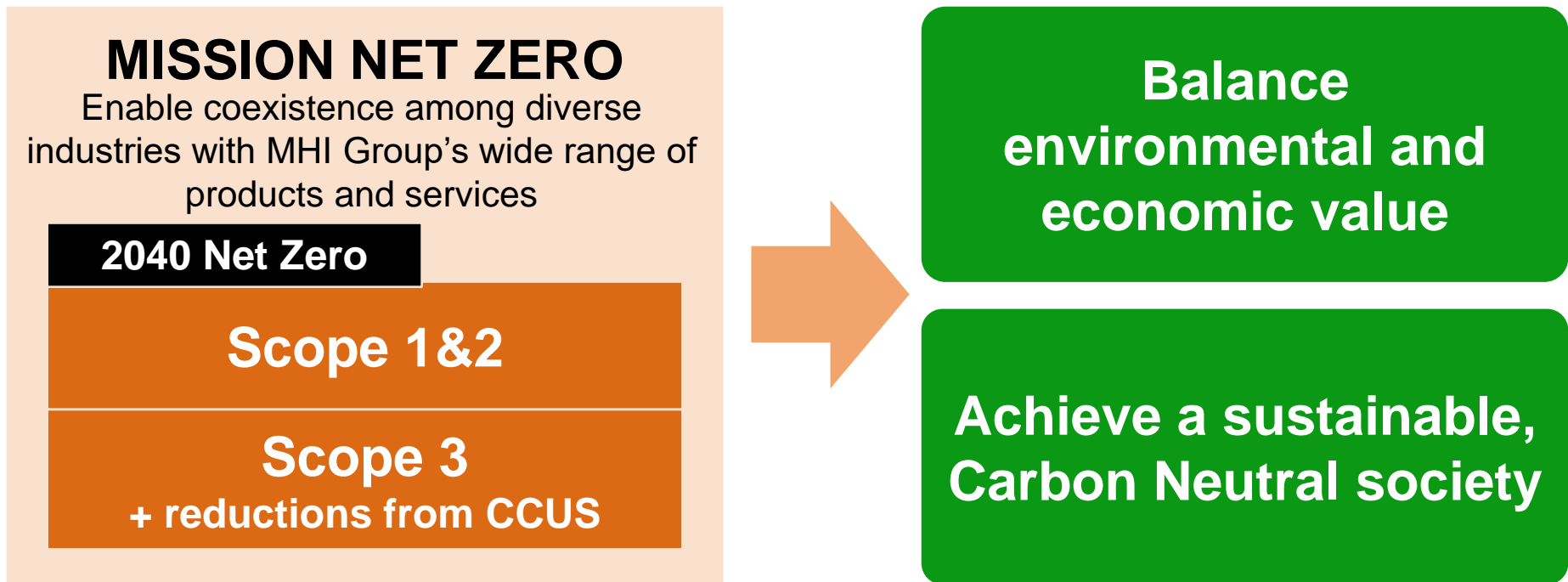
Summary

Seize business opportunities and revolutionize business models through Carbon Neutrality initiatives



Our Principles

- We deliver reliable and innovative solutions that make a lasting difference to customers and communities worldwide
- We act with integrity and fairness, always respecting others
- We constantly strive for excellence in our operations and technology, building on a wide global outlook and deep local insights





ESG Finance

- MHI Group will disclose two climate change scenarios in accordance with the TCFD framework (scheduled for April 2022)
- Plans to issue transition bonds (FY2022)
Selected as model example for the Japan Ministry of Economy, Trade and Industry's 2021 Climate Finance Model Projects (March 17, 2022)
- Issued green bonds for two consecutive years
FY2020: 25 billion yen, FY2021: 15 billion yen
- Executed positive impact finance loan agreement (Amount: 2 billion yen, Date of execution: March 14, 2022)

MOVE THE WORLD FORWARD

**MITSUBISHI
HEAVY
INDUSTRIES
GROUP**