19th February 2020

MOE

CCUS and Hydrogen in Japan
— Overview of Policies and Project —

AIZAWA Hirofumi, Ph.D

Director, Climate Change Projects Office

Global Environment Bureau

Ministry of the Environment, Japan (MOEJ)

SUSTAINABLE DEVELOPMENT GOALS

Re-Style

COOL CHOICE

つなげよう、支えよう 森里川海

Plastics Smart

CCUS and Hydrogen Policies in Japan

Frequent Extreme Weather

- **2019 was the second-hottest year on record after 2016 (WMO).**
- **Average temperatures for the five-year (2015-2019) and ten-year (2010-2019) periods were the highest on record (WMO).**

Extreme Weather in 2019

Arctic sea ice decline
Arctic sea ice minimum tied for second lowest on record in August

Flood in US continent
Unprecedented flood happened

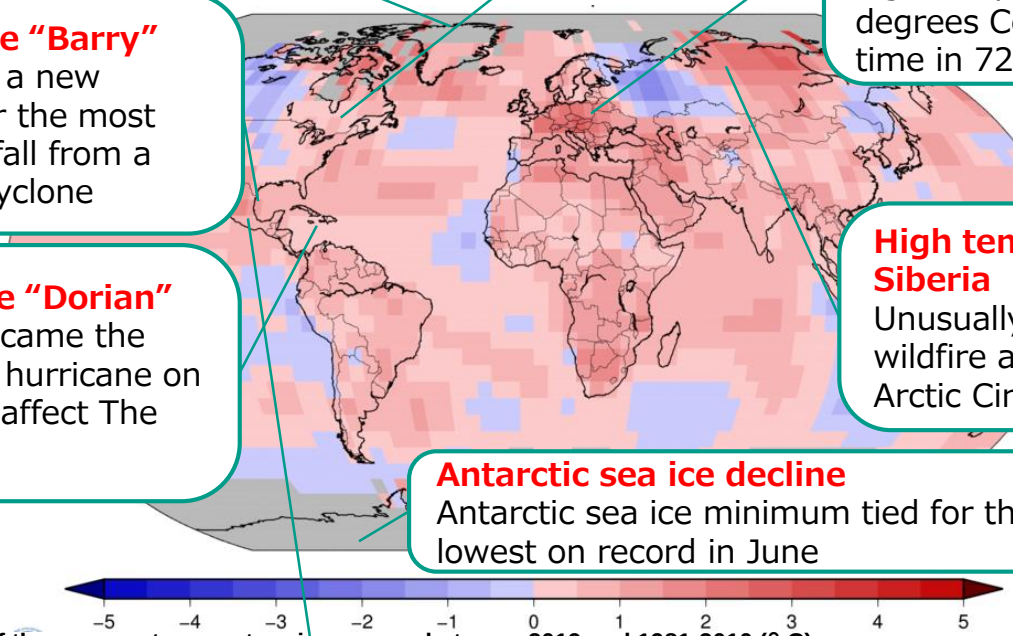
Temperature rise due to heat wave in Europe
Paris recorded an all-time high temperature of 42.6 degrees Celsius for the first time in 72 years

Hurricane "Barry"
Barry set a new record for the most total rainfall from a tropical cyclone

Hurricane "Dorian"
Dorian became the strongest hurricane on record to affect The Bahamas

High temperature in Siberia
Unusually high levels of wildfire activity within the Arctic Circle began in June

Antarctic sea ice decline
Antarctic sea ice minimum tied for the lowest on record in June



Difference of the average temperature in summer between 2019 and 1981-2010 (° C) by NOAA's analysis

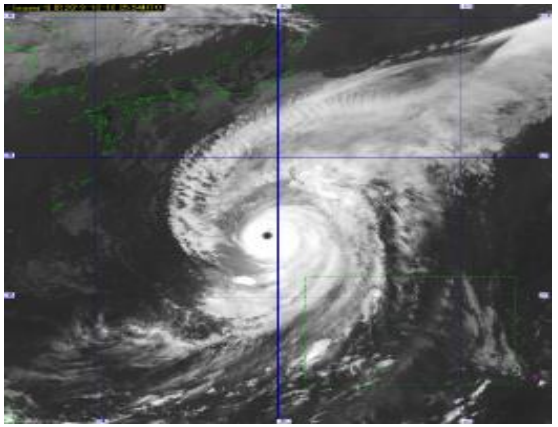
Mass hailstorm in Mexico
Freak hailstorm with 2m high hit Mexico on June 30

Japan
New Year's Eve without snow in Sapporo

Large Typhoon in Japan

Typhoon "Faxai"
Massive power and water outages, communication failures occurred mainly in Chiba Prefecture. The revetment along Tokyo Bay collapsed due to high waves in Yokohama City, Kanagawa Prefecture

Typhoon "Hagibis"
The banks collapsed and landslide occurred mainly in the Kanto area



Typhoon "Hagibis"
Source; Himawari-8 infrared image, provided by the Japan Meteorological Agency

Global Sustainability Trends

Paris Agreement

■ **Adopted by The 21th session of the Conference of the Parties (2015)**

- **To keep a global temperature rise below 2 degree Celsius compared to pre-industrial level**
- To pursue effort to limit even further to 1.5 degree
- Requiring all Parties report on their emissions and efforts

Sustainable Development Goals (SDGs)

■ **Adopted by Sustainable Development Summit (2015)**

- **To set goals by 2030 for humans, the planet and prosperity**
- To consist of 17 goals and 169 goals to achieve these goals

Source: UNFCCC The Paris Agreement, UN Sustainable Development Knowledge Platform, Ministry of the Environment "Results and Future of COP21"

Long-Term Strategy under the Paris Agreement as Growth Strategy

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Chapter 1: Basic Concept

Vision: Proclaiming a "**decarbonized society**" as the ultimate goal and aiming to accomplish it ambitiously **as early as possible in the second half of this century**, while boldly taking measures towards the reduction of GHGs emissions by 80% by 2050 ＊an unconventional vision of an "ideal future model"

* contributing to the achievement of the long-term goals of the Paris Agreement, including efforts to limit the temperature increase to 1.5℃

Basic Principles of Policy ：

Realizing "a virtuous cycle of environment and growth" towards the vision with business-led disruptive innovation, Swift implementation of actions from now, contributing to the world, **Action Towards a bright Society with Hope for the Future**

[Factors: Achievement of SDGs, Co-creation, Society5.0, the Circulating and Ecological Economy, leading country in solving problems]

Chapter 2: The Vision of Each Sector and the Direction of Measures

1.Energy

Pursuing every option for promoting **energy transitions and decarbonization**

2.Industry

Decarbonized manufacturing

3.Transport

Contribution to the challenge of "**Well-to-Wheel Zero Emission**"

4.Community and Living

Realizing **carbon neutrality**, resilient and comfortable **communities and lives** by 2050/ creating the "**Circulating and Ecological Economy**"

5. Measures for Carbon Sinks

Conserving the natural environment and creating sustainable new values in agriculture, forestry and fisheries industries to secure sufficient carbon sink for decarbonized society

Long-Term Strategy under the Paris Agreement as Growth Strategy

Chapter 3: Cross-sectoral Measures to realize "a virtuous cycle of environment and growth"

1. Promotion of Innovation

Promoting innovation for practical application and wider usage of cross-sectoral decarbonization technologies that lead to drastic reduction of GHG, achieving cost that allows commercialization

(1) Progressive environment innovation strategy

(2) Innovation in economic and social systems/Lifestyle innovation

2. Promotion of Green Finance

3. Business-led International Application and International Cooperation

Fuel Cell Buss


CO_2 Capture Plant

TCFD Consortium

ESG Finance High-Level Panel

JCM Partner Countries Meeting

Chapter 4: Other Measures

Chapter 5: Review and Implementation of Long Term Strategy

G20 Ministerial Meeting in Energy Transitions and Global Environment for Sustainable Growth (15-16 June 2019, Karuizawa, JAPAN)

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G20 Karuizawa Innovation Action Plan on Energy Transitions and Global Environment for Sustainable Growth

<Actions to collect wisdom from around the world to encourage innovation>
6. We seek to enhance international cooperation in relevant existing fora and encourage, in a holistic manner, research, development and deployment of innovative technologies and approaches including air and water related technologies, behavioral science for life-style change, bioenergy, Carbon Capture Utilization and Storage (CCUS), clean vehicles, deep renovation and Net Zero Energy Building, demand-side management, energy access technologies, energy efficiency technologies, energy storage, hydrogen, grid digitalization, low carbon technologies, nature-based solutions, renewables, resilient and sustainable cities and communities with integration of technologies, and resource efficient technologies,
depending on national circumstances.

Groundbreaking Environmental Innovation Strategy

Decisions made in the Integrated Innovation Strategy Meeting in January 21, 2021

- Groundbreaking Environmental Innovation Strategy based on the long-term strategy consists of;
  1. “Innovation Action Plan” insisting specific cost targets for 16 technical issues
  2. “Acceleration Plan” showing research systems and investment promotion measures
  3. “Zero Emissions Initiatives” communicating and creating with global leaders for social implementation

  Aiming to establish innovative technologies that enables global carbon-neutral and even reduction of past stock-based CO_2 (beyond zero) by 2050, social implementation is aimed in order to achieve the goals in the long-term strategy

Innovation & Action Plan: CCUS, H2-related technological challenges (from a total of 16)

CCUS

- **Low-cost CO_2 separation and recovery aimed toward CCUS/carbon recycling**
- **Conversion of CO_2 to fuel and other carbon recycling technologies**
- **Reclaiming CO_2 from the atmosphere**

Hydrogen

- **Constructing a low-cost hydrogen supply chain**
- **Establishing green mobility through diverse approaches**

Local Governments:
2050 Declaration of effectively eliminating carbon dioxide emissions

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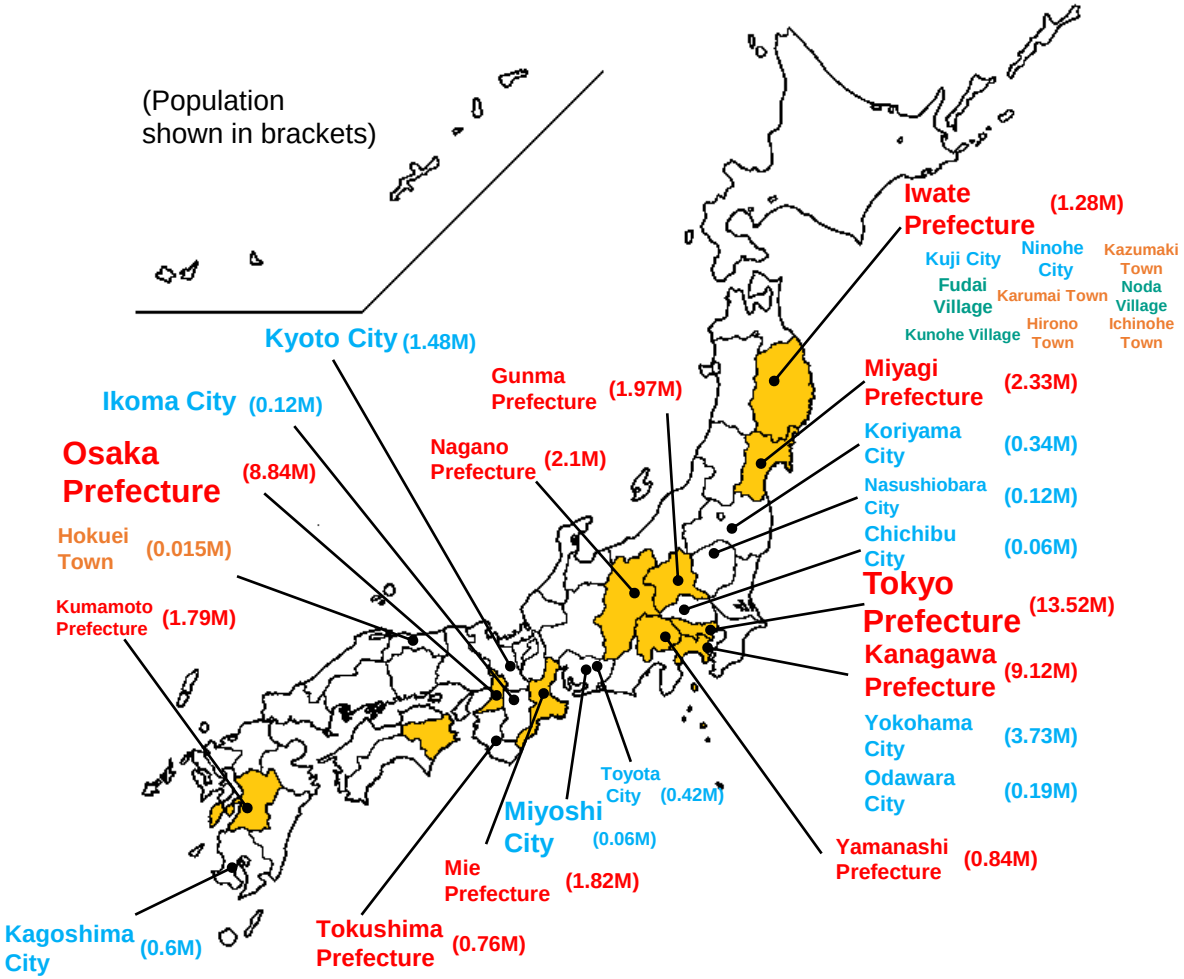
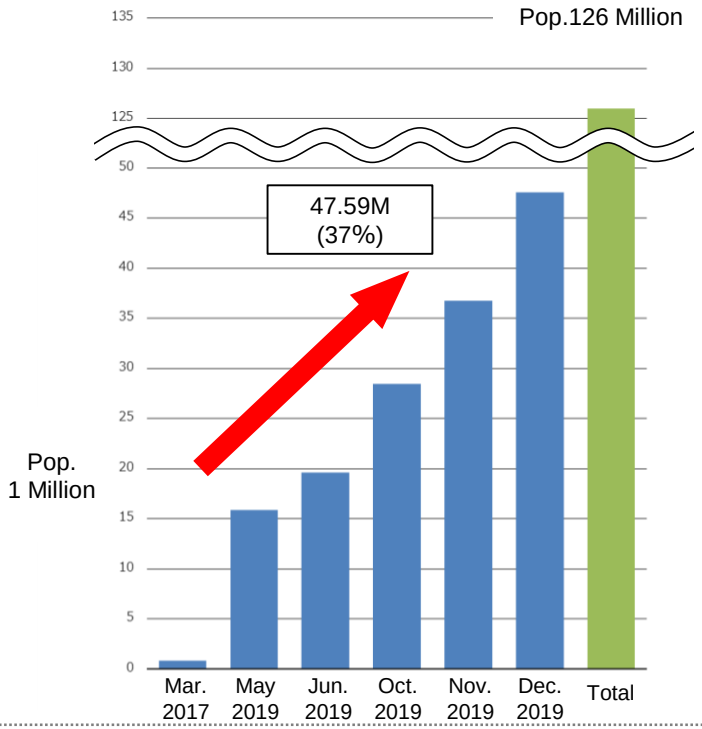
- **31 local governments** (11 prefectures, 12 standard cities, 5 townships, and 3 villages), starting with those of Tokyo, Kyoto, and Yokohama, have declared to "effectively eliminate carbon dioxide emissions by 2050."

- The population of local governments who made this declaration total at approximately **50 million**, with a GDP of 235 trillion yen, and accounting for about 37% of Japan's total population.





A scale exceeding Scandinavian countries' (Sweden, Denmark, Finland, Norway, Iceland) populations of approx. 27 million, the U.S. State of California's approx. 39 million, and at a similar scale to Spain's population of 47 million.

Related site

Businesses:
Initiatives toward carbon-neutral business management

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TCFD TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

- 939 pages (of which 216 are in Japan) of financial institutions, corporations, governments etc., from around the world declare compliance
- **Ranked 1st in Asia (1st Worldwide)**

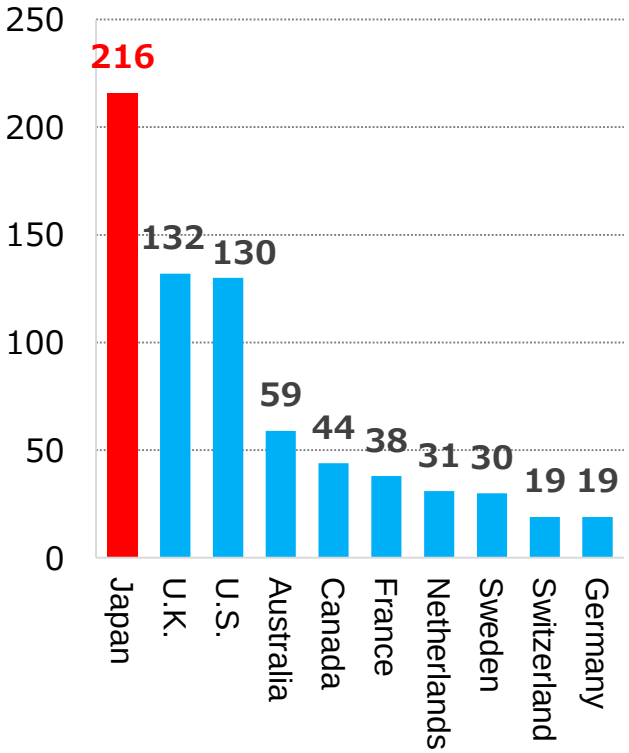
SCIENCE BASED TARGETS

- Number of recognized companies: 317 worldwide (58 of which are Japanese)
- **Ranked 1st in Asia (2nd Worldwide)**

RE 100

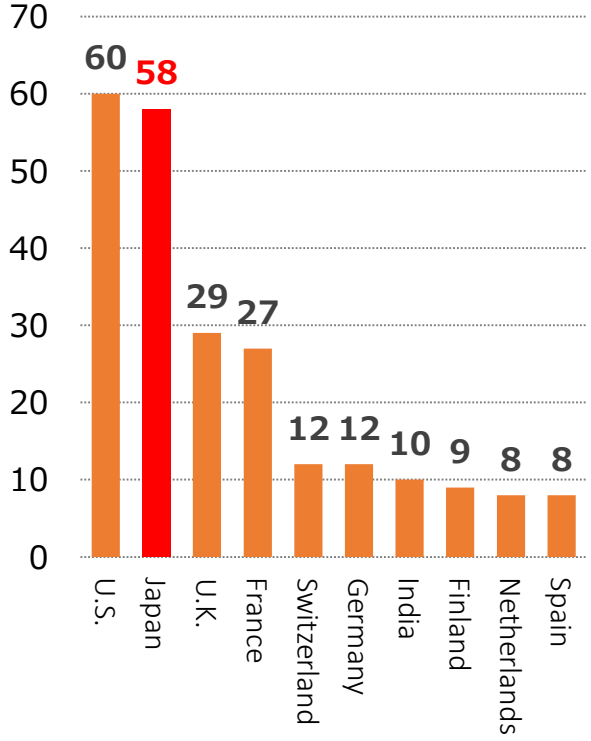
- Number of participating companies: 221 worldwide (30 of which are Japanese)
- **Ranked 1st in Asia (3rd Worldwide)**

Number of TCFD-compliant companies (top 10 countries)



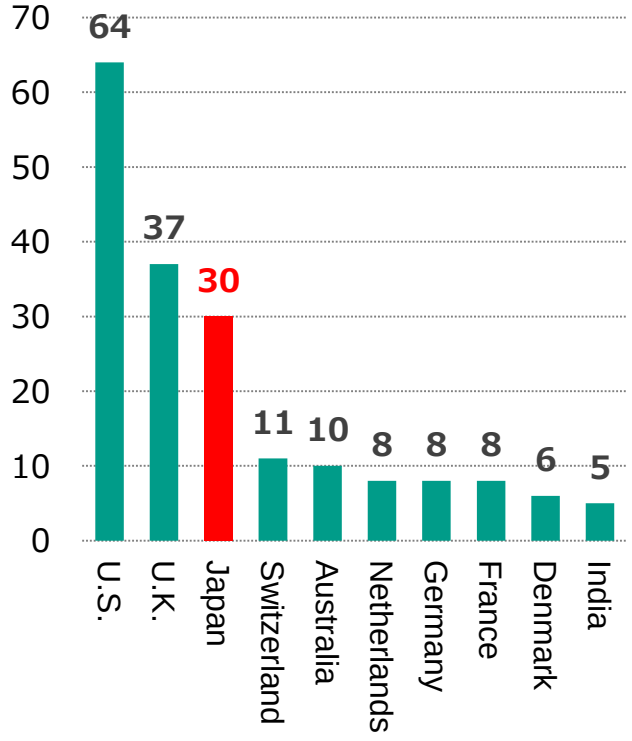
Source:
Taken from TCFD Home Page "TCFD Supporters" (https://www.fsb-tcfd.org/tcfd-supporters/)

Graph showing number of recognized SBT industries by country (top 10 countries)



Source:
Taken from Science Based Targets Home Page "Companies Take Action" (http://sciencebasedtargets.org/companies-taking-action/)

Graph showing number of companies participating in RE 100 by country (top 10 countries)



Source:
Taken from RE100 Home Page (http://there100.org/)

MOE's Initiatives

Interconnection between CCUS and Hydrogen

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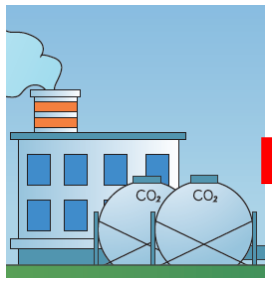
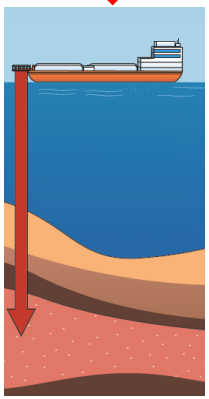
CCUS

Capture



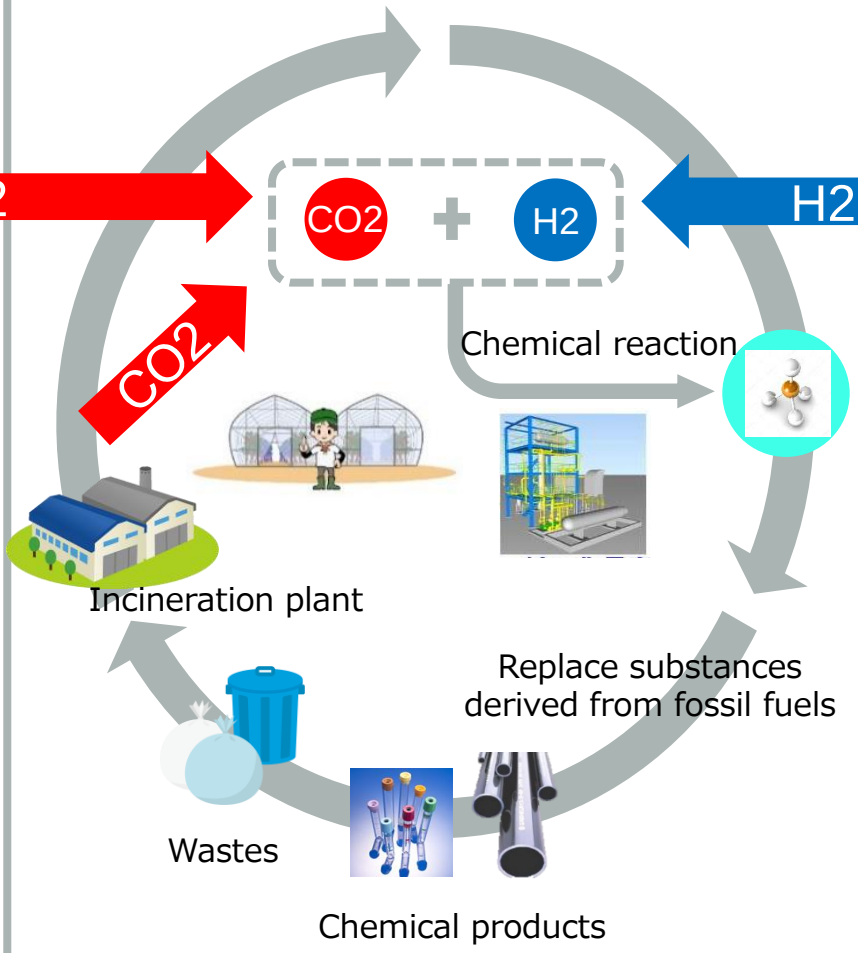
CO2

CO2



Storage

Utilization



Hydrogen

Renewables and other resources

Using Renewable Energy

Reforming biogas

H2

Transportation

Pipelines

Hydrogen-absorbing alloy transported by commercial truck

Applications

Fuel Cell

FC[1] Forklifts

FC[1] Buses

Fish farming

Hotels / Buildings

Significant Reduction of CO2 ✕ **Carbon Circulation** ✕ **Production and Utilization of Low-Carbon Hydrogen**

[1] Fuel Cell

CCS Consortium for MOE projects

MOE

Project leader

Dr. Makoto Akai

Ministry of the Environment

Representative party

TOSHIBA

Participating parties

MIZUHO (Administrator)

UYENO

JGC 日揮株式会社

CHIYODA CORPORATION

MITSUBISHI MATERIALS

TAISEI For a Lively World

電力中央研究所 Central Research Institute of Electric Power Industry

INPEX INPEX CORPORATION

Mitsubishi Corporation Exploration

DIA CONSULTANTS

KYUSHU UNIVERSITY

i²CNER

THE UNIVERSITY OF TOKYO

JANUS JAPAN NUS CO., LTD.

AIST

JCOAL Japan Coal Energy Center

QJ Science

TAIHEIYO CEMENT

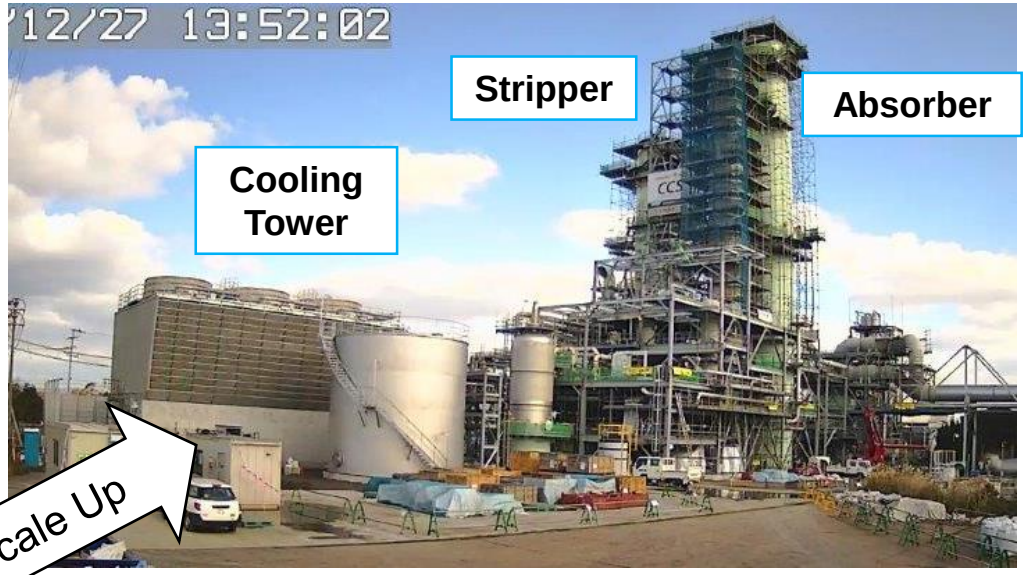
CCS : Capture

- The first commercial scale demonstration project in Japan
- This project may become one of the first BECCS (Bio-Energy CCS) projects in the world.
- Environmental impact assessment of carbon capture.

Mikawa Power Plant, SIGMA POWER Ariake(49MW)
※capable of burning 100% biomass

CO2 Capture Pilot plant,
TOSHIBA
Capture Capacity:10ton-CO2/day
Start of operation :2009～

Scale Up



CO2 Capture Demonstration plant (Under construction)
Capture Capacity:500ton-CO2/day
Start of operation:2020 Summer

CCS : Transport, Storage and Smooth deployment of CCS

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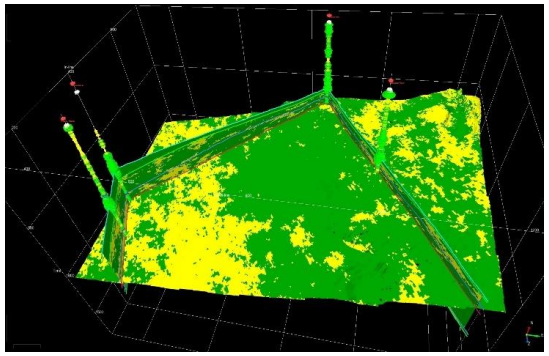
- Consideration of CO2 transport method suitable for Japanese condition

CO2 transport ship（illustrative）

- Storage and Monitoring planning for the candidate sites



Construction of geological model

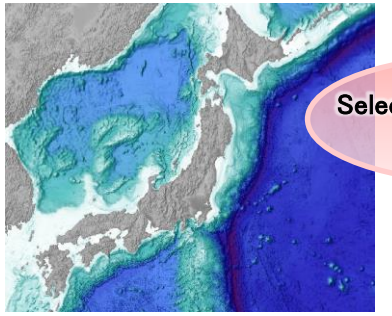
Development of offshore observation technology (CO2 sensor)

- Consideration methods for smooth deployment of CCS

International symposium

International smart digital workshop on CO2 storage

Potential CO2 Storage Sites investigated by Japan CCS Co.,Ltd（with METI)



Surrounded by steep & deep waters

3D exploration with air gun

CCU: First Japanese CCU from waste power generation

- Adding CC equipment to the waste power generation facility in Saga City.
- Carbon dioxide is sold in part to an algae cultivator and commercialized as cosmetics and supplements with anti-aging effect.

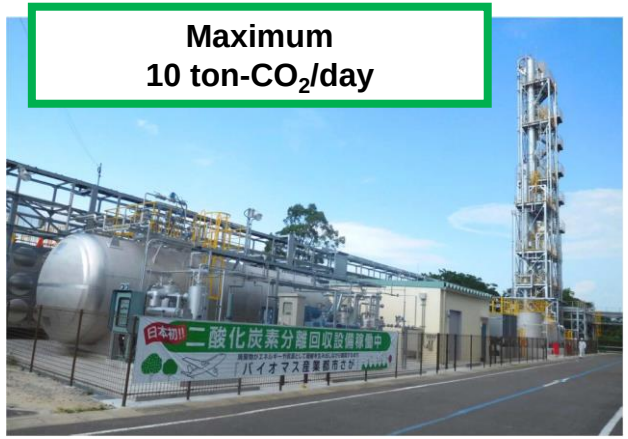
Waste power generation facility (Garbage incineration at Saga)

Generation capacity: 4,500 kW
Garbage disposal: 300 t/day

Exhaust gas
Capture 5%

Based on MOE's subsidy

Maximum 10 ton-CO_2/day



CC facility

Utilization of CO_2

Image of utilization

Algae culture, agricultural crop cultivation, etc.

cosmetics
supplement

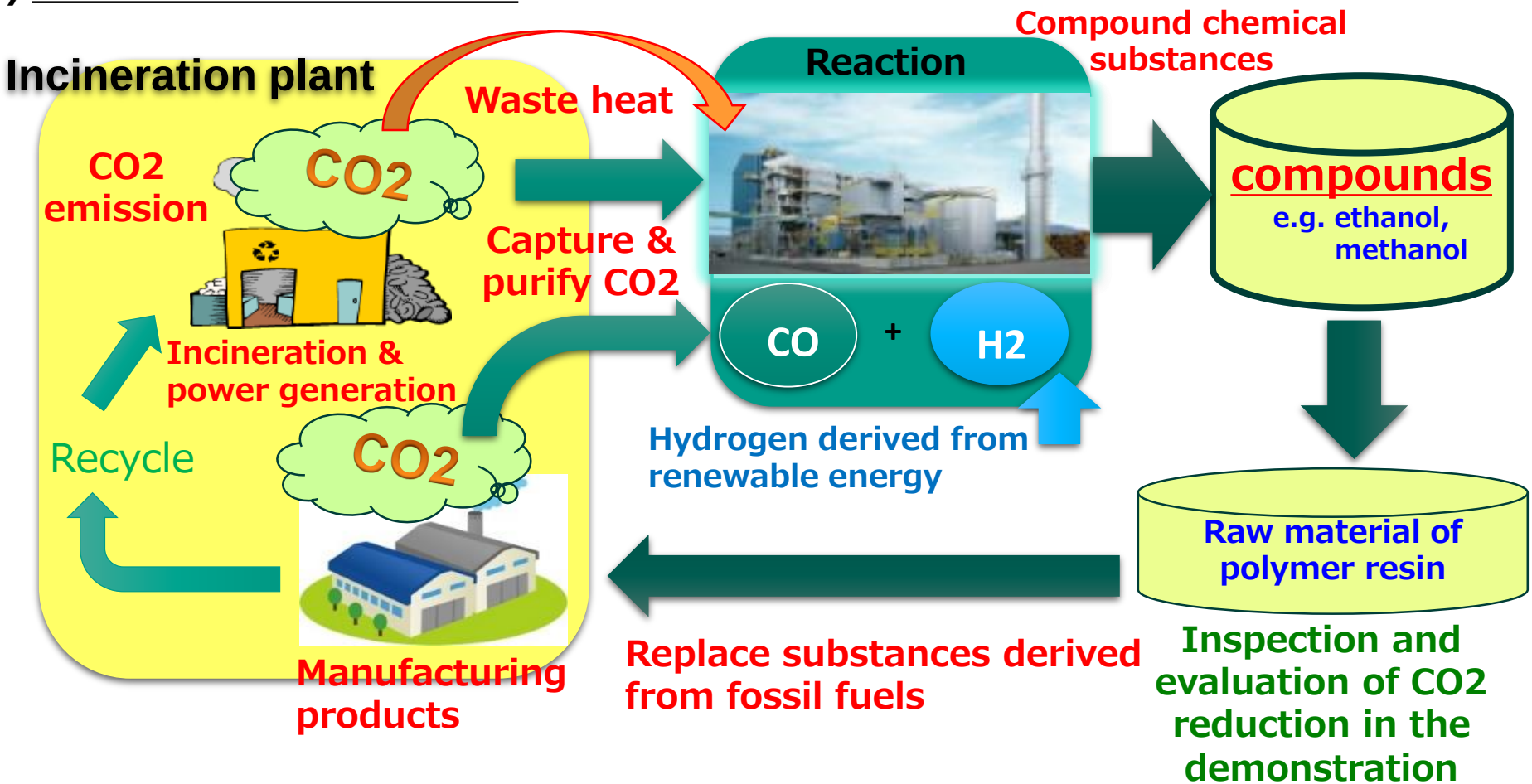
ALVITA Corporation

CCU: 2 ongoing R&D Projects

- Aim to establish commercial scale CCU technology by 2023

Promotion of CO2 cycle circulation society through collecting and utilizing carbon dioxide discharged from incineration plant etc. (FY2018-FY2022)

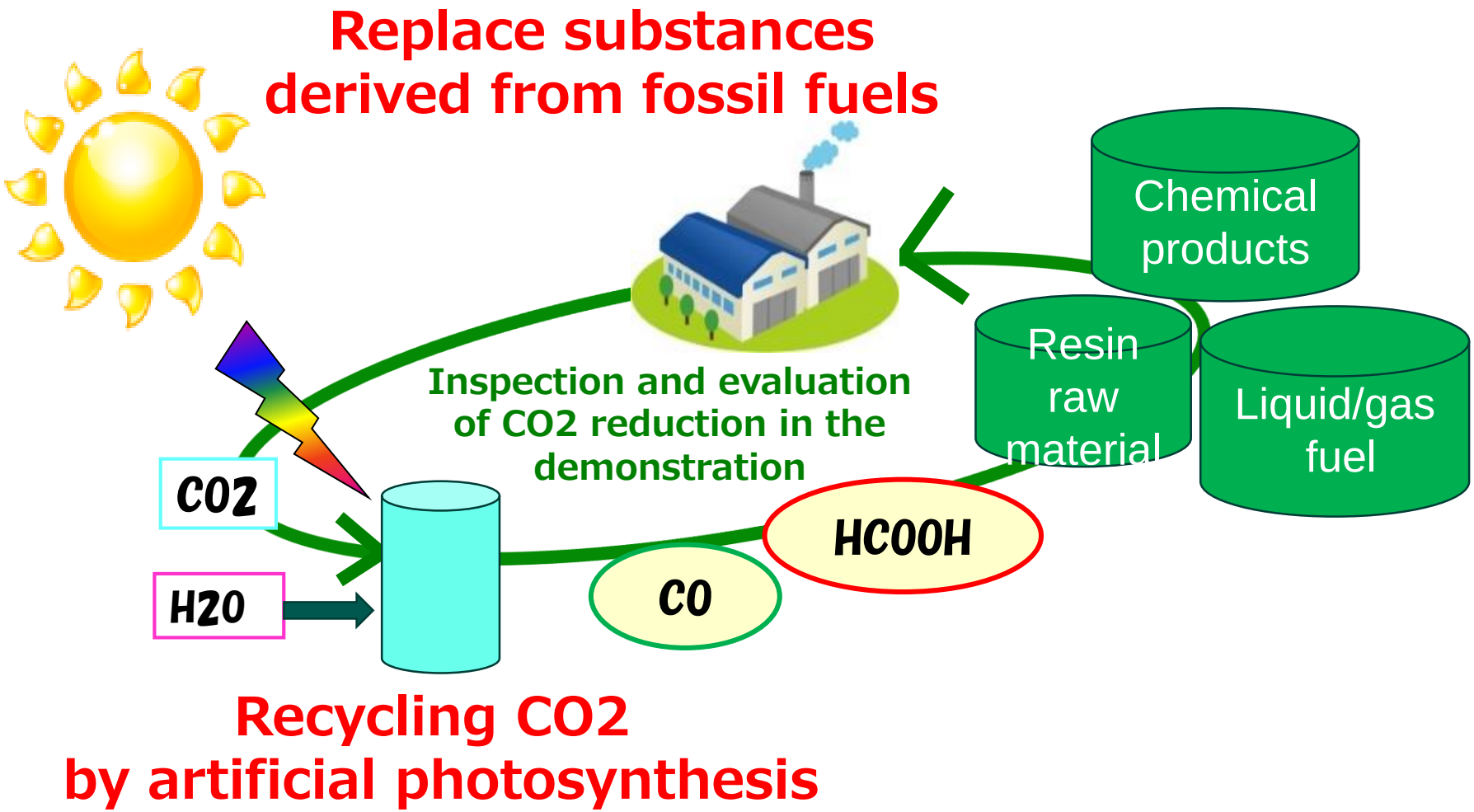
(1) Hitachi Zosen Corporation
(2) Sekisui Chemical Co. Ltd.



CCU: 2 ongoing R&D Projects

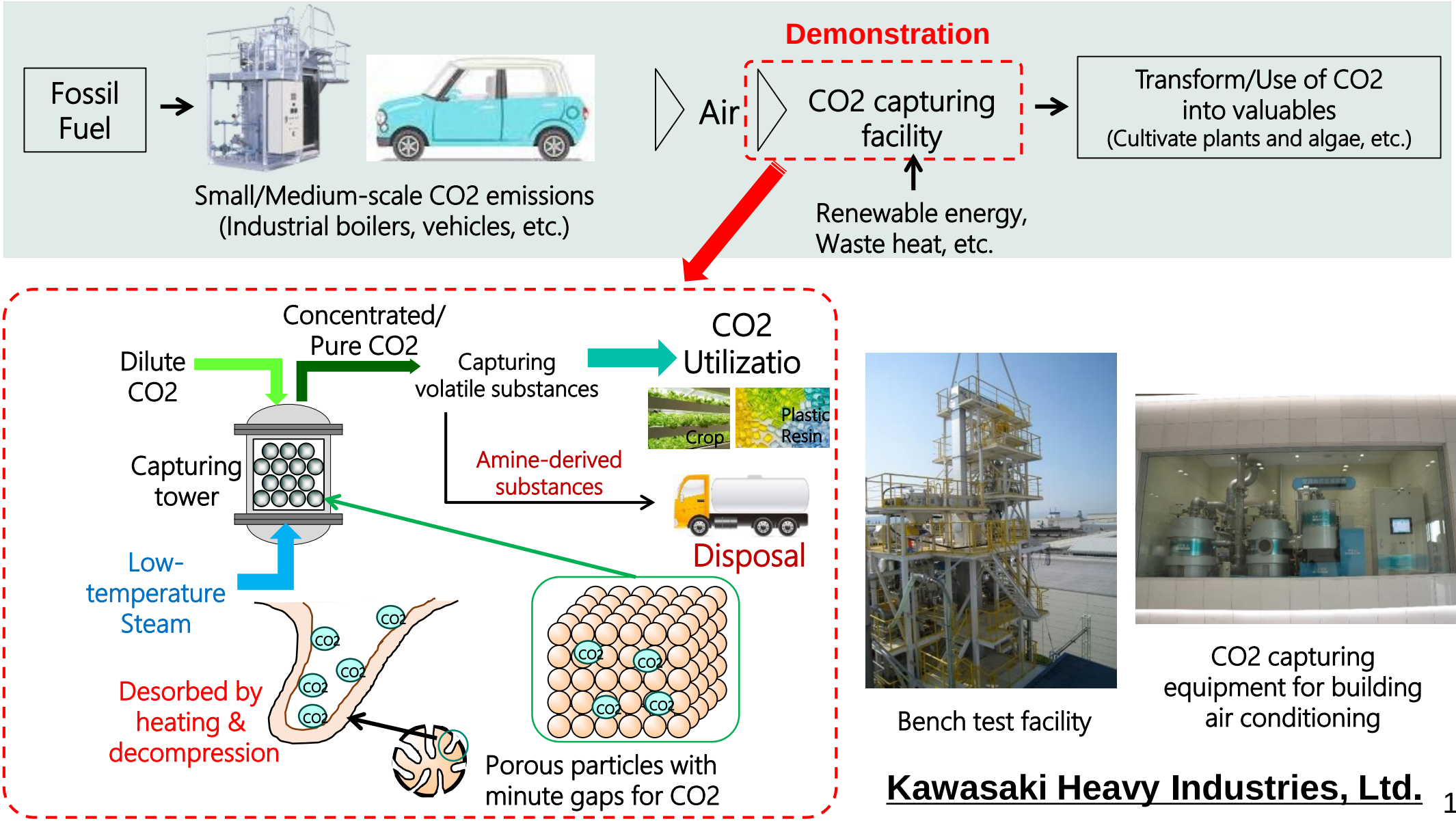
Promotion of CO2 cycle circulation society by artificial photosynthesis (FY2018-FY2022)

(1) Toshiba Corporation
(2) Toyota Central R&D Labs, Inc.



CCU: Ongoing R&D Project for DAC

- Demonstration of capture technology for low-concentration (dilute) CO2 such as the air by solid absorbent material can be used at around 60 ℃.



Bench test facility

CO2 capturing equipment for building air conditioning

Kawasaki Heavy Industries, Ltd.

Hydrogen Supply Chain Depends On Local Conditions - 8 demonstration projects in Japan-

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Production

Water Electrolysis

Using Renewable Energy

By-product

By-product of Caustic soda production, etc.

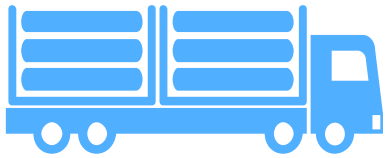
Transformation

Gasification of used plastics

Reforming biogas

Storage & Transportation

High-pressure hydrogen truck



High-pressure hydrogen cylinder bundles

Hydrogen-absorbing alloy transported by commercial truck

Hydrogen fueling truck

Pipelines

Use

Fuel Cell

Swimming Pool

Children's Clubhouse

Fish farming

Hotels / Buildings

FCV[2]s

FC[1] Buses

FC[1] Forklifts

CO2 Free Energy Sources / Sources of H2

Transportation of H2

Applications

[1] Fuel Cell
[2] Fuel Cell Vehicle

Development for Hydrogen Usage Technologies

FC[1] Forklift

Courtesy of Toyota Industries Corp.

- R&D 2013-2015
- Released from 2016

FC[1] Bus

Courtesy of Toyota Motor Corp.

- R&D 2013-2015
- Released from 2017

FC[1] Truck (2016-)

Courtesy of Tokyo R&D Co., Ltd.

FC[1] Vessel (2014-2015)

Courtesy of Toda Corp.

FC[1] Garbage Truck (2015-2017)

Courtesy of Flat Field Co ., Ltd.

[1] **F**uel **C**ell

Challenges in introducing CCUS and Hydrogen future efforts

- In order to achieve a carbon-neutral society, "**a virtuous cycle of environment and growth**" through disruptive **innovations** is important
- Needs for **early establishment of CCUS and Hydrogen technologies** toward carbon neutral society.
- CCU and green hydrogen technologies are interrelated, both could be developed reciprocally within their proper demands.
- CCS could be a pragmatic and quick solution for significant reduction CO_2.
- CO_2 reduction by CCUS and hydrogen will be achieved through **comprehensive initiatives taking into consideration of both CCUS and hydrogen**.

Thank you