

# CCU Projects for Circular Economy

## Challenging to utilize CO<sub>2</sub> as resources



Ministry of the Environment

The Ministry of the Environment of Japan (MOEJ) is promoting a recycling-oriented society by CCU (Carbon dioxide Capture and Utilization), recognizing that CCU technology can play an important role in such a society, helping to achieve the goal of long-term climate change mitigation. MOEJ is working on 5 projects involving the latest technologies for CCU.

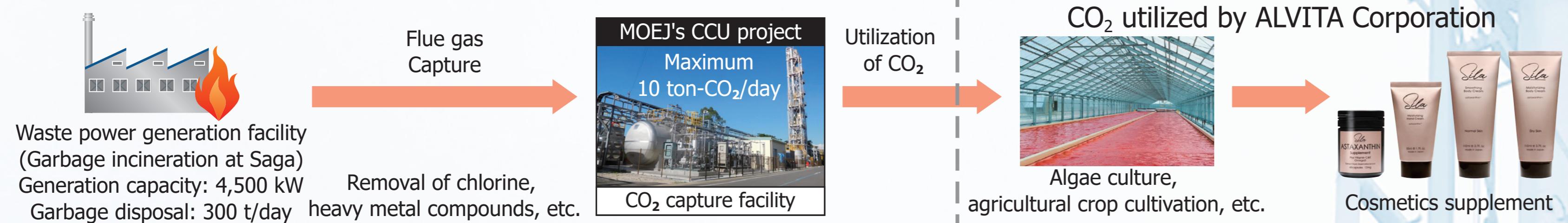
### Predecessor of current CCU projects

#### SAGA CITY

##### Incineration Power Generation with CCU in Saga City

Period: FY2015–FY2016

This is the first demonstration of CCU from waste power generation in Japan. CO<sub>2</sub> capture facility was added to the waste power generation facility in Saga City. A part of CO<sub>2</sub> is sold to algae cultivator and it produces commercial products such as cosmetics and supplements with anti-aging effect, using the CO<sub>2</sub> from the waste power generation facility. This project gives significant additional worth to waste power generation facility, contributing to dissemination of CCU.



### Technology for changing waste CO<sub>2</sub> into valuable material

CCU technologies have the potential to transform waste CO<sub>2</sub> into a valuable raw material or commodity for products that require carbon, reducing greenhouse gas emissions, and in some cases generating positive economic returns. Production of valuable materials will also offset the cost of CO<sub>2</sub> capture, the dominant cost factor of CCS (carbon dioxide capture and storage) which has been considered essential to meet climate goals.

### MOEJ's CCU projects

#### Aim to establish the first CCU technologies for commercial-scale by 2023

##### Recycling-oriented society models with CCU technologies

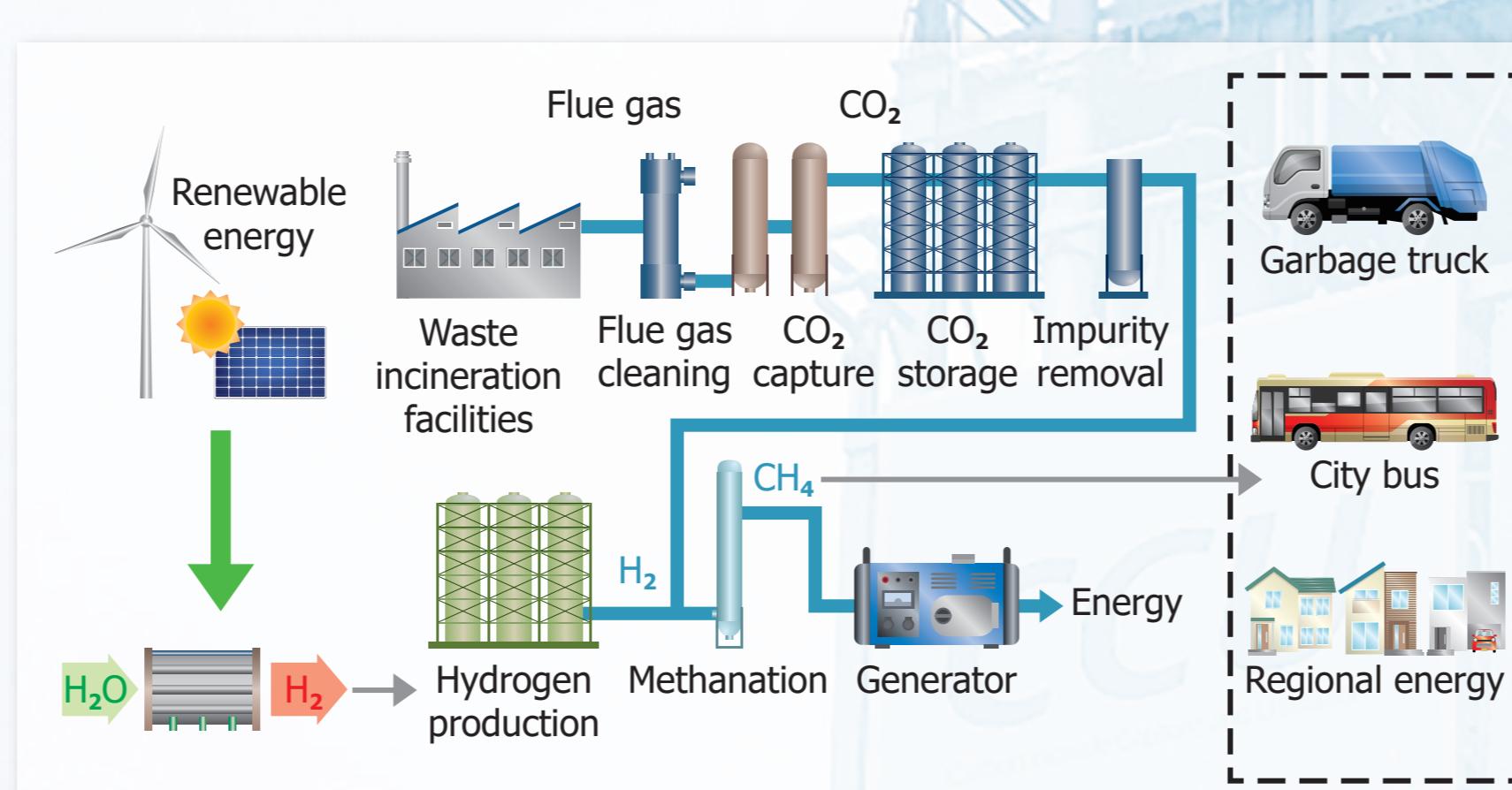
#### HITACHI ZOSEN CORPORATION

##### Methane production from CO<sub>2</sub> in Incineration Plant

Period: FY2018–FY2022

Methane production by reacting H<sub>2</sub> with CO<sub>2</sub> captured from waste incineration facilities.

Aims to produce methane from CO<sub>2</sub> with carbon free H<sub>2</sub> and to use it as a local energy source, reducing natural gas consumption.



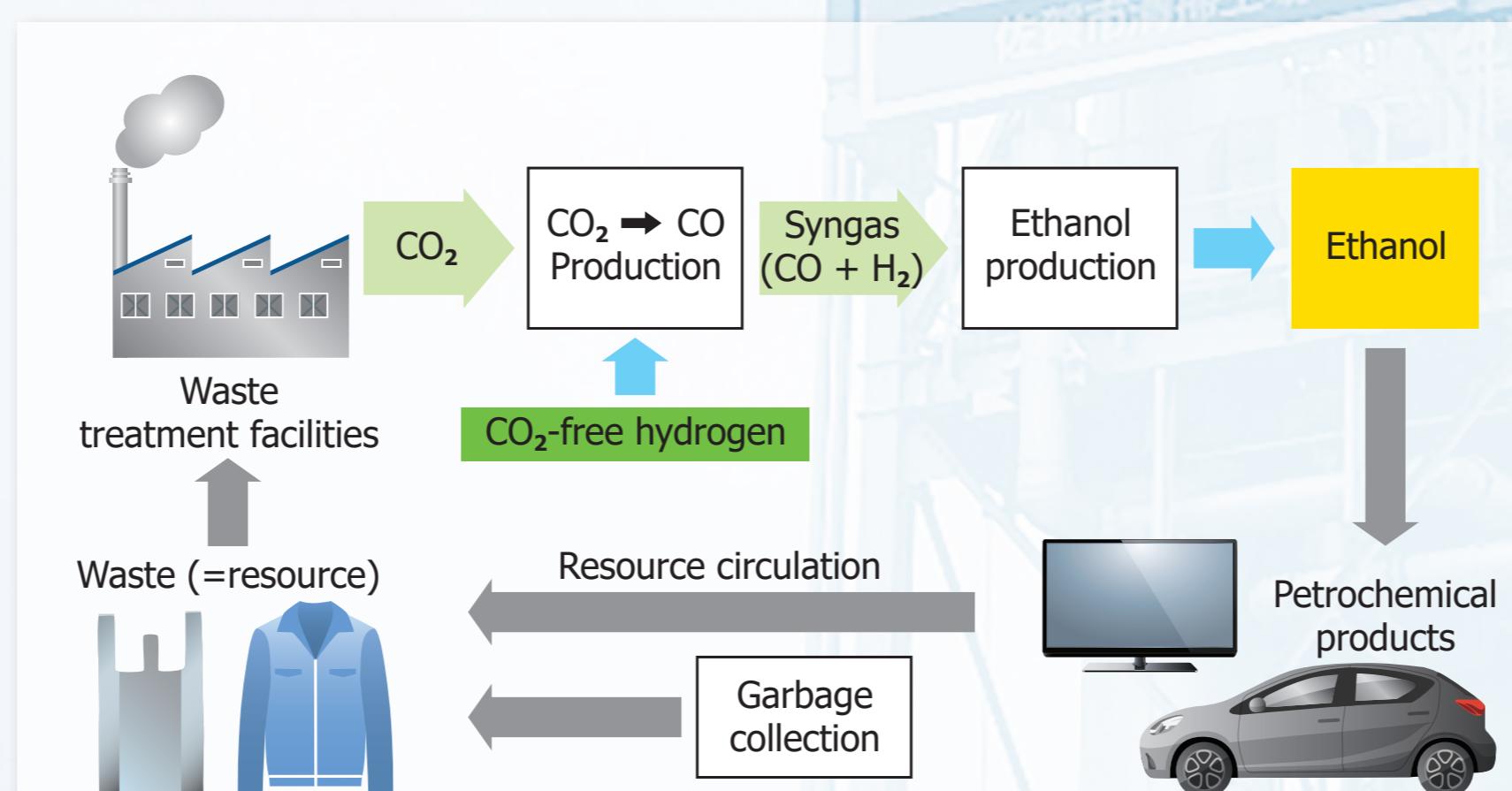
#### SEKISUI CHEMICAL CO., LTD

##### Ethanol production from CO<sub>2</sub> in a Waste Treatment Facility

Period: FY2018–FY2022

Ethanol production by reaction of syngas (CO + H<sub>2</sub>), which is produced from CO<sub>2</sub> contained in flue gas of a waste treatment facility, using microbial catalysts.

Aims to use ethanol for petrochemicals conventionally produced from fossil fuel.



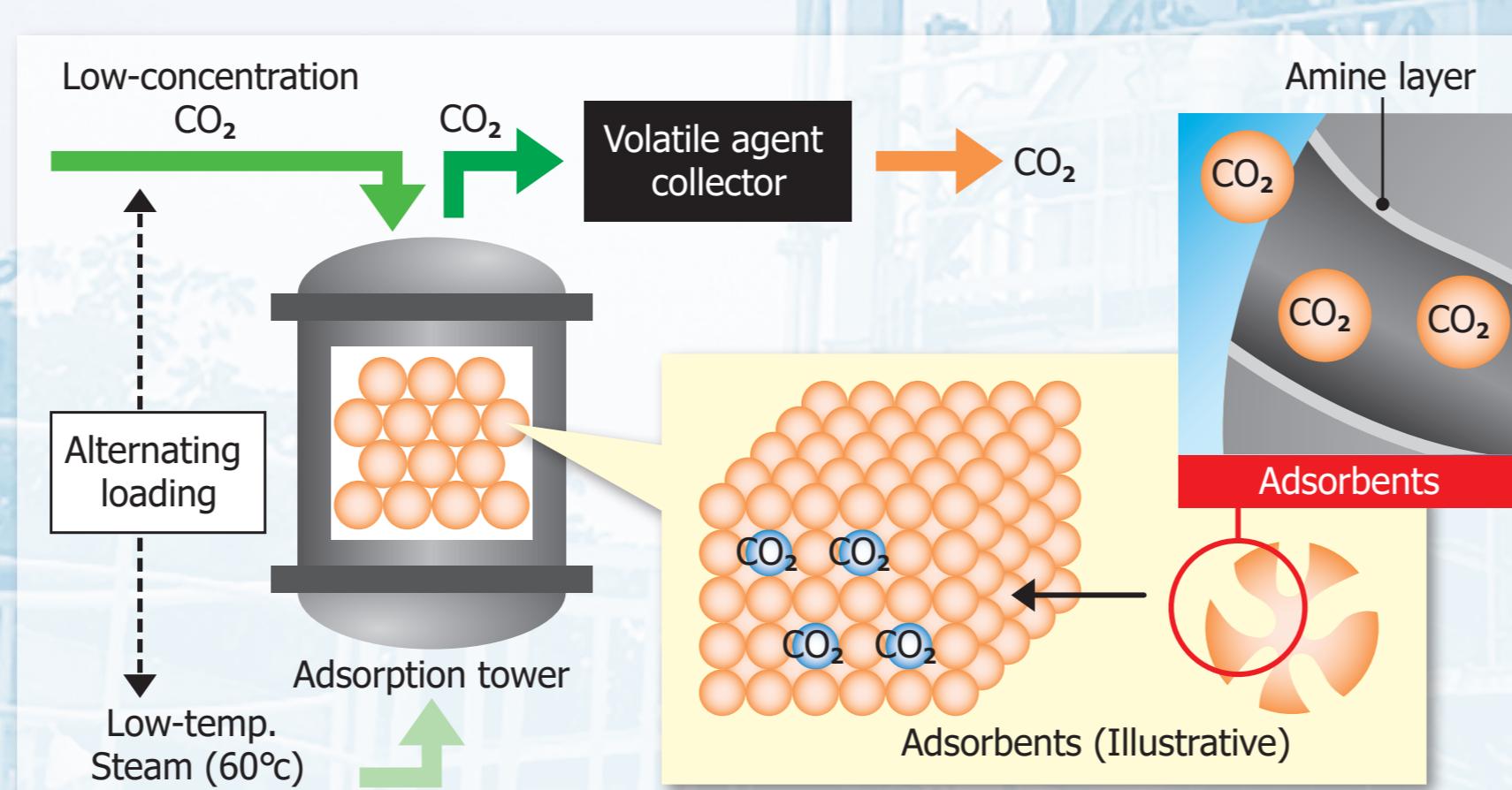
#### KAWASAKI HEAVY INDUSTRIES, LTD.

##### Low-concentration CO<sub>2</sub> Capture and Utilization System

Period: FY2019–FY2021

CO<sub>2</sub> capture technology with lower energy consumption applicable to low-concentration CO<sub>2</sub> flue gas using amine-impregnated solid sorbent.

Aims to use the captured CO<sub>2</sub> for enhanced cultivation of algae and plants in greenhouses or producing chemicals.



##### Recycling-oriented society models with artificial photosynthesis technologies

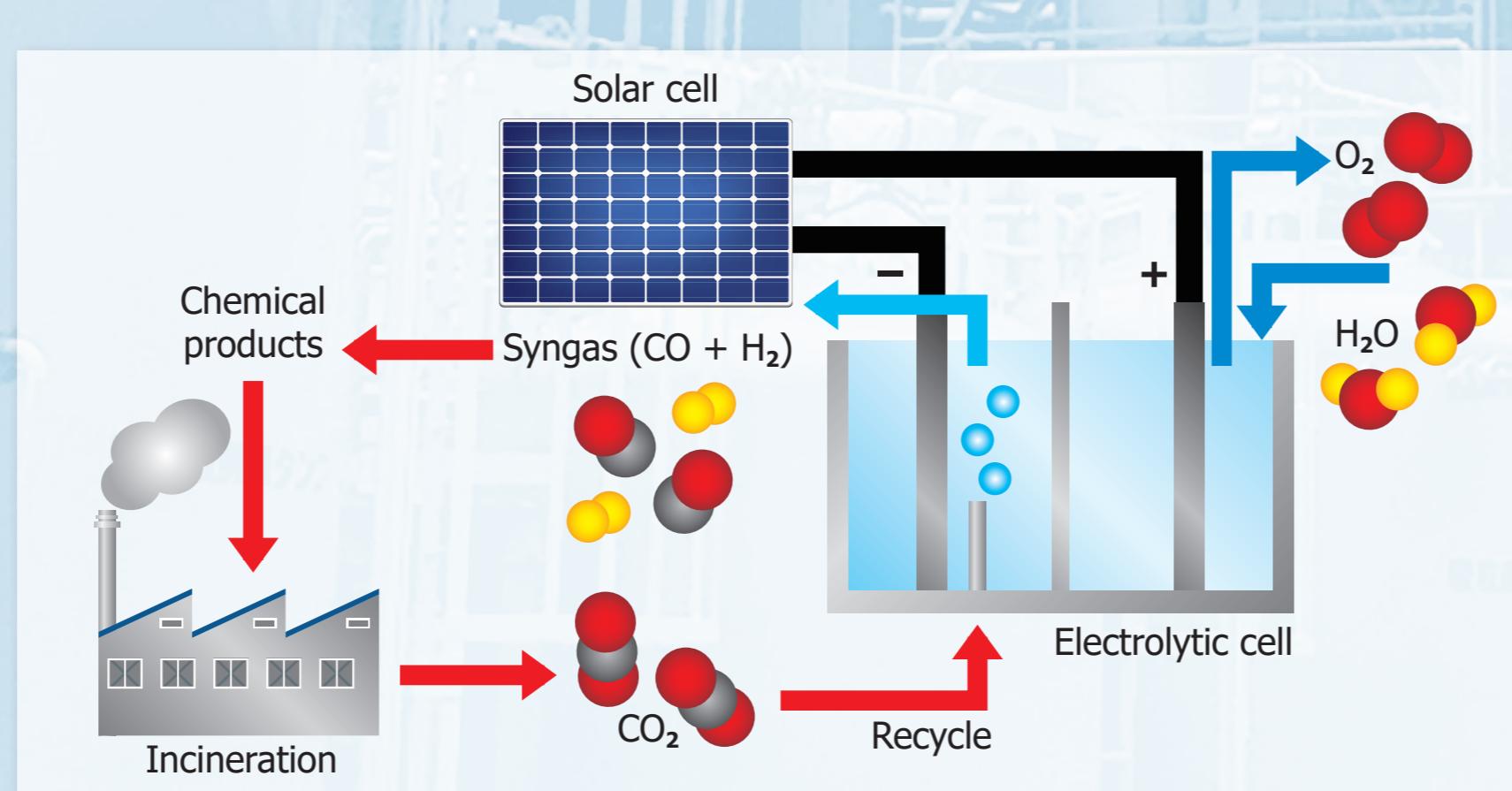
#### TOYOTA CENTRAL R&D LABS., INC.

##### Efficient Syngas Production from CO<sub>2</sub> and Water at Ambient Temperature and Pressure

Period: FY2018–FY2020

Syngas (CO + H<sub>2</sub>) production with high solar conversion efficiency (10%) at ambient temperature and pressure by using CO<sub>2</sub> and water.

Aims to substitute natural gas by the produced syngas for chemical production and heating.



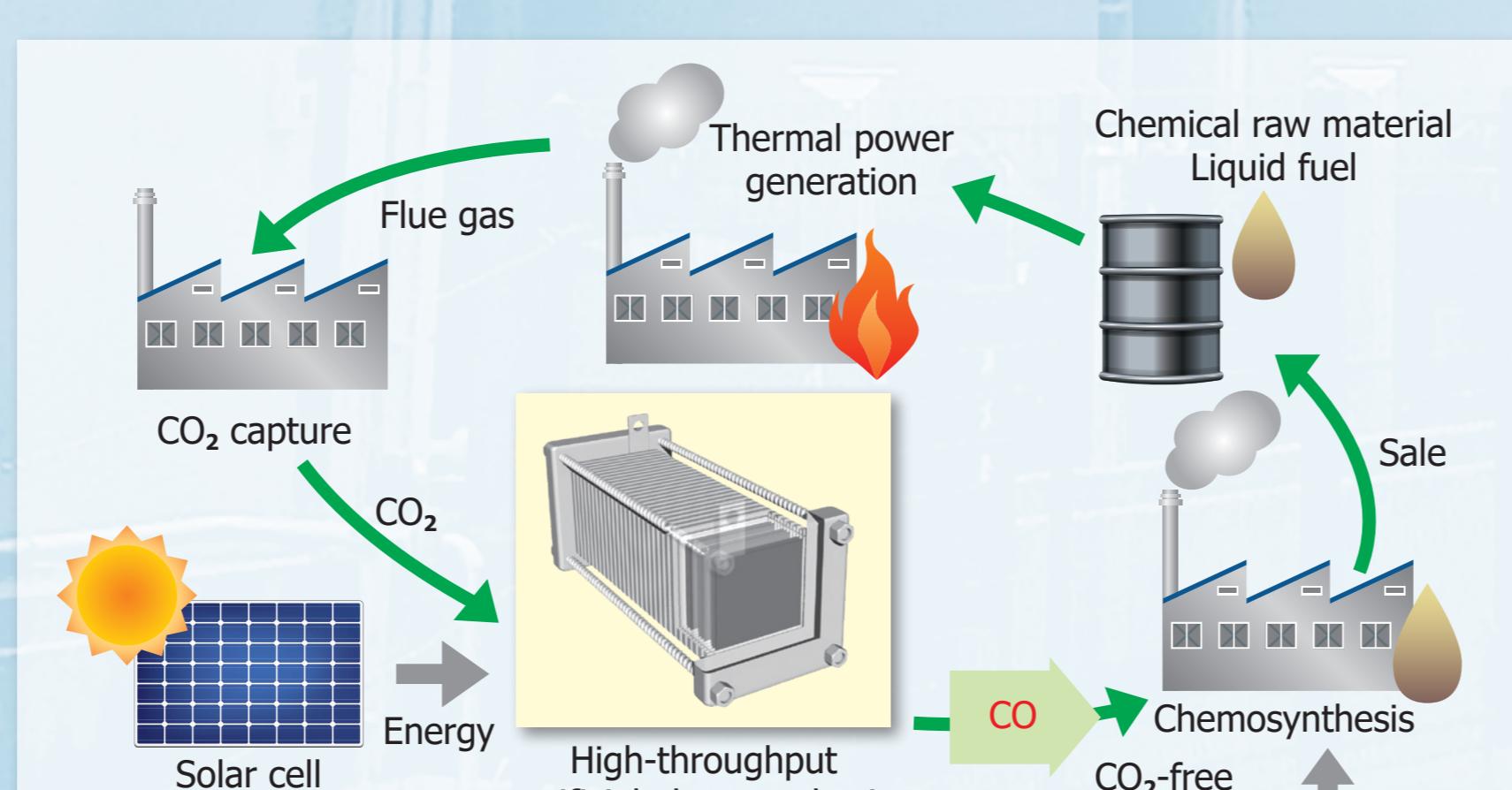
#### TOSHIBA CORPORATION

##### Localized CO<sub>2</sub> Utilization via Artificial Photosynthesis at a Large Emission Source

Period: FY2018–FY2022

CO<sub>2</sub> capture from flue gas of a thermal power plant and CO production using high-throughput artificial photosynthesis technology.

Aims to use the produced CO as raw material for chemicals and fuels in a local society.



### Progress of MOEJ's CCU projects

| FY2015               | FY2016 | FY2017  | FY2018 | FY2019 | FY2020 | FY2021 | FY2022 |
|----------------------|--------|---|--------|--------|--------|--------|--------|
| Project in Saga City |        | Promotion of a CO <sub>2</sub> Recycling Society by CCU |        |        |        |        |        |

### The Long-term Strategy under the Paris Agreement (Cabinet decision, June 11, 2019)

Japan proclaims a "decarbonized society" as its ultimate goal and aims to accomplish it ambitiously as early as possible in the second half of this century. Toward that end, Japan has set a long-term temperature goal of reducing GHG emissions by 80% by 2050, and will boldly take measures towards its realization (Chapter 1: Basic Concepts, 2. Japan's Long-term Vision, p.15).

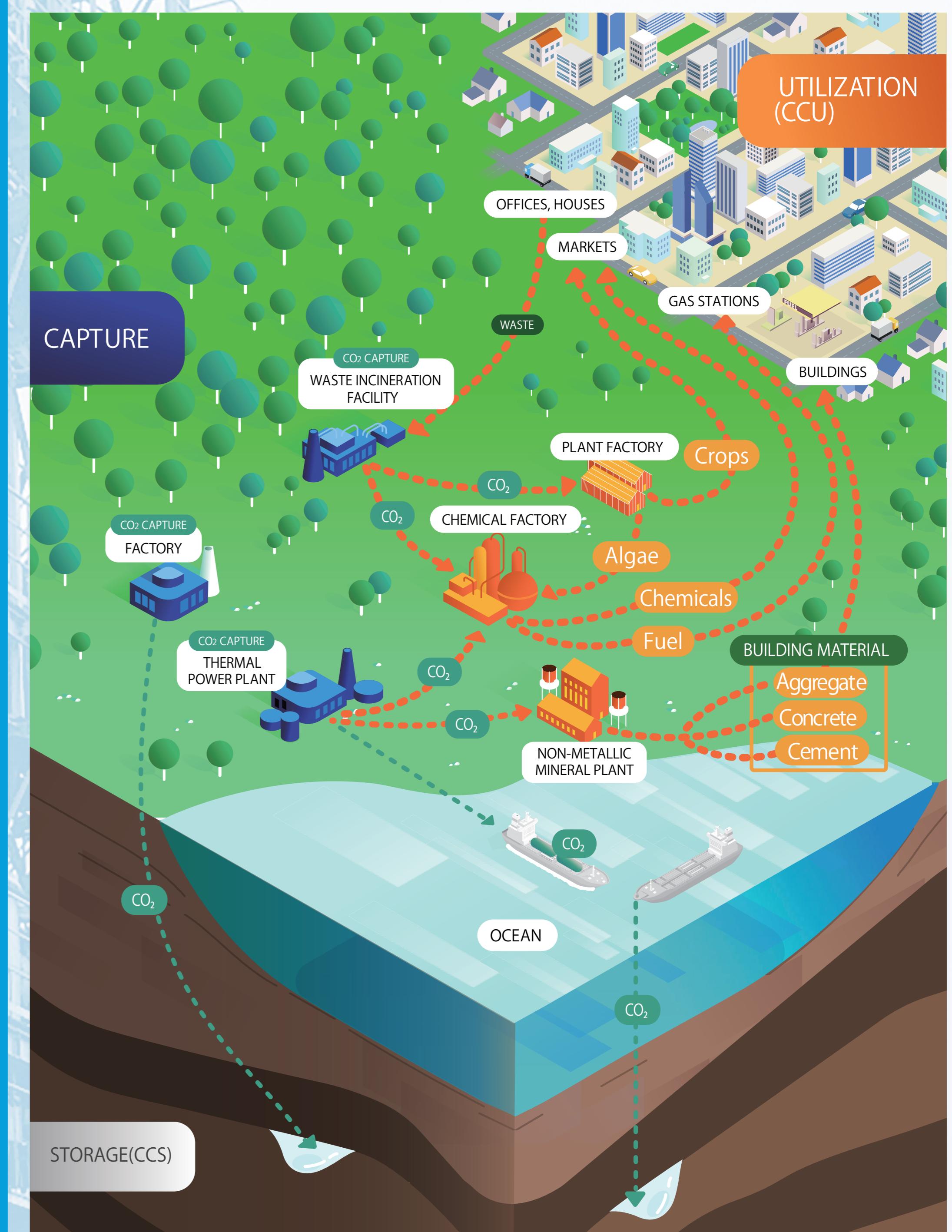
It is also necessary to identify concrete targets in terms of costs and efficiencies in the key areas for decarbonization such as hydrogen, carbon dioxide capture and storage (CCS), carbon dioxide capture and utilization (CCU), renewable energy, storage batteries and nuclear energy, as well as challenges and systems including collaboration both in Japan and overseas (Chapter 1: Basic Concepts, 3. Basic Principles in Policy towards the Long-term Vision, p.16).

### What is CO<sub>2</sub> Capture and Utilization (CCU)?

CCU is the process of using CO<sub>2</sub> captured from various emitters as a feedstock for products or services. The range of applications is very large and includes direct use, where the CO<sub>2</sub> is not chemically or biologically altered (non-conversion), and the transformation of CO<sub>2</sub> to a useful product (conversion).

Most of the existing applications involve direct use of CO<sub>2</sub>, including the production of food and carbonated beverages, gas shielded welding, extraction of plant constituents, water treatment, fire suppression and the enhancement of the growth of plants in greenhouses. In addition to these, CO<sub>2</sub> has been used for Enhanced Oil Recovery (EOR) for several decades.

CO<sub>2</sub> can also act as a feedstock for many industrial processes and biologically or chemically converted into fuels, chemicals and construction materials which substitute products currently produced predominantly from fossil resources. When the energy or hydrogen for the CO<sub>2</sub> conversion process are supplied by renewables, such technologies could dramatically curb greenhouse gas emissions.



CCU = Carbon dioxide Capture and Utilization

### Representatives of MOEJ's CCU projects

