

# Sustainable CCS Project

The Ministry of the Environment of Japan (MOEJ) is proceeding with a major five-year (FY2016-2020) Sustainable CCS Project, recognizing that carbon dioxide capture and storage (CCS) technology is indispensable to achieve the goal of long-term climate change mitigation. Led by a consortium of 16 organizations, the project will implement four tasks, including construction and operation of Japan's first facility for amine-based chemical absorption of CO<sub>2</sub> to capture the majority of emissions from a thermal power plant.

## Outline of preliminary research

In preliminary research conducted in FY2014 and 2015, we assessed the impact on the environment of a CO<sub>2</sub> capture process using amine-based chemical absorption, and studied potential environmental measures, based on the results of a CO<sub>2</sub> separation and capture pilot plant (capture capacity: 10 tons of CO<sub>2</sub> a day) constructed at Mikawa Power Plant by Toshiba. Also, we studied a CCS transport and storage system using ships as one of the methods to transport CO<sub>2</sub> offshore where it is injected into the sea floor. This approach seems to be promising for large-volume storage. We developed a demonstration plan.



Mikawa Power Plant site

## Task 1: Demonstration of CO<sub>2</sub> separation and capture technologies

For operational demonstration, a facility will be constructed to separate and capture over 500 tons of CO<sub>2</sub>, which represents 50% of the daily CO<sub>2</sub> emission from the Mikawa Power Plant of Sigma Power Ariake (Omura City, Fukuoka Prefecture; output: 49,000 kW). In addition to verifying the performance and operability of this facility, technological challenges and costs associated with installation of a CO<sub>2</sub> separation and capture facility at a thermal power plant will be assessed.

In parallel with these activities, there will be studies of possible measures to reduce the environmental burden associated with the operation of a CO<sub>2</sub> separation and capture facility as well as a method to assess the environmental impact.

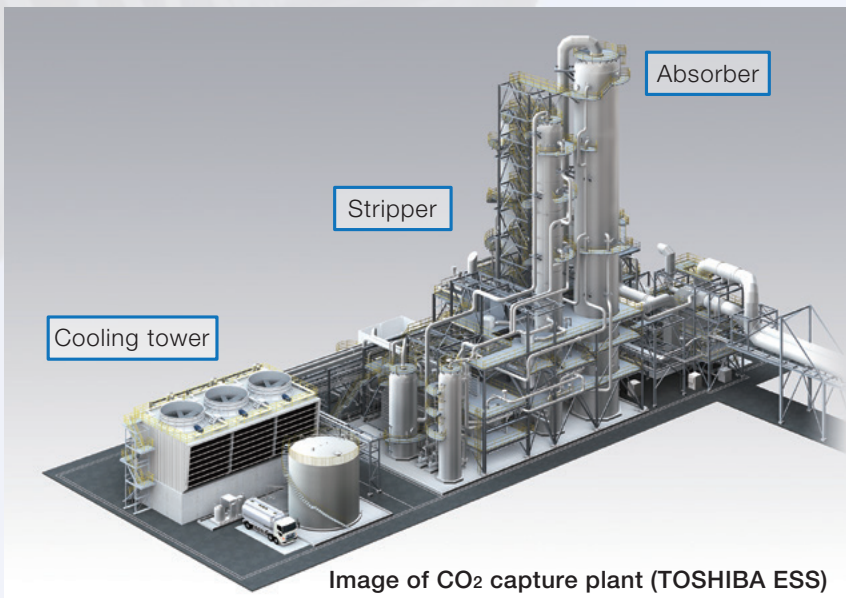
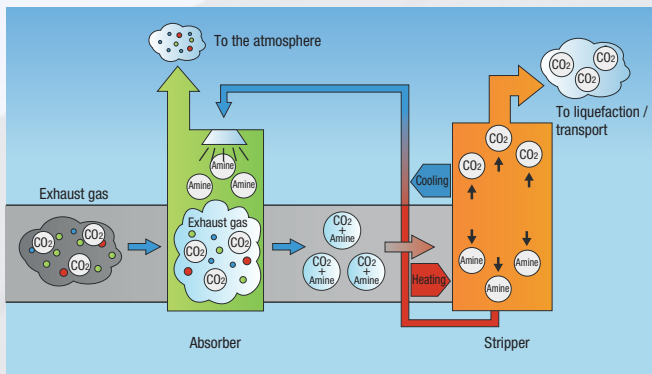


Image of CO<sub>2</sub> capture plant (TOSHIBA ESS)



When the exhaust gas from the thermal power plant contacts the amine solution, the amine absorbs CO<sub>2</sub>. By subsequently heating the solution, the amine and CO<sub>2</sub> are separated and CO<sub>2</sub> at a high concentration can be captured.

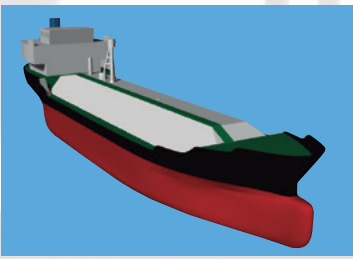
## World's first biomass power plant fitted with a separation and capture facility

The Mikawa Power Plant has already installed an advanced circulation-type fluidized bed boiler that can burn not only coal but also biomass for power generation. The power plant will become the world's first biomass power plant fitted with a CO<sub>2</sub> separation and capture facility, and is scheduled for completion in FY2020. This facility is revolutionary as it captures CO<sub>2</sub> that has been absorbed from the atmosphere by plants, and will lead the way to biomass CCS (BECCS\*) that can reduce the CO<sub>2</sub> concentration in the atmosphere.

\*BECCS : Bio Energy with CCS

## Task 2: Study of CO<sub>2</sub> transport by sea and injection into a geological formation

In Japan, potential areas for CO<sub>2</sub> storage are unevenly distributed in marine areas. Accordingly, a key issue for massive introduction of CCS is to use such storage sites as efficiently as possible by rationally matching them with the large-scale CO<sub>2</sub> emission sources that are widely distributed across the country. Accordingly, in the early stages, this project aims to create technology for CO<sub>2</sub> transport by sea and CO<sub>2</sub> injection to a geological formation, that is widely compatible with the different distances between CO<sub>2</sub> emission sources and storage sites as well as the different water depths at different CO<sub>2</sub> storage sites.



## Task 3: Study of stable undersea CO<sub>2</sub> storage

In order to know exactly how much CO<sub>2</sub> can be stored in our country, we need to judge appropriately whether we can store CO<sub>2</sub> in offshore regions, in addition to coastal regions. For this reason, we are making efforts to identify issues related to stable undersea CO<sub>2</sub> storage, including the potential for leakage of stored CO<sub>2</sub> as well as monitoring methods and leak repair methods. We are also studying and organizing leakage mitigation measures.

## Task 4: Comprehensive study of social environment for CCS suited to Japan

In this project, we are conducting a comprehensive study not only for technological development but also for the smooth introduction of CCS to society as a measure against global warming. In addition to taking account of Japan's various conditions when developing CCS systems, such as the large-scale CO<sub>2</sub> emission sources and the candidate locations for storage, we are researching and studying measures to gain social understanding of CCS and a scheme to implement CCS efficiently.

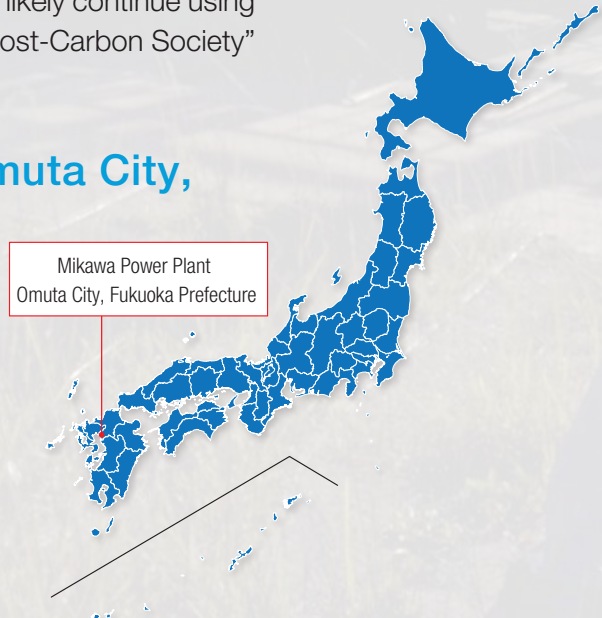
## Technology acting as a bridge to a "Post-Carbon Society"

The world is heading toward a "Post-Carbon Society" with zero CO<sub>2</sub> emissions by promoting widespread use of energy-saving and renewable energy technologies. For the time being, however, we will likely continue using easy-to-use fossil fuels to a certain extent. CCS is a technology acting as a bridge to a "Post-Carbon Society" by reducing CO<sub>2</sub> emissions associated with burning fossil fuels.

## CO<sub>2</sub> separation and capture demonstration starts in Omura City, which once flourished with the coal mining industry

Home to the CO<sub>2</sub> separation and capture demonstration of this project, Mikawa Power Plant is located in Omura City, Fukuoka Prefecture. Between the Meiji and Showa eras, Omura City flourished with the coal mining industry and Miike Coal Mine, Miyahara Pit, and Miike Port were registered on the UNESCO World Heritage List in 2015 as the "Sites of Japan's Meiji Industrial Revolution: Iron and Steel, Shipbuilding and Coal Mining".

Revolutionary CO<sub>2</sub> separation and capture demonstration as a measure against global warming starts in Omura City that once flourished with the coal mining industry.



## Schedule of this project

FY2014	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020
Study for introduction of CCS (Feasibility study)		Demonstration of CO <sub>2</sub> separation and capture technologies				
		Study of CO <sub>2</sub> transport by sea and injection into a geological formation				
		Study of stable undersea CO <sub>2</sub> storage				
		Comprehensive study of social environment for CCS suited to Japan				

## Plan for Global Warming Countermeasures (Cabinet decision on May 13, 2016) Strategic actions towards long-term goal

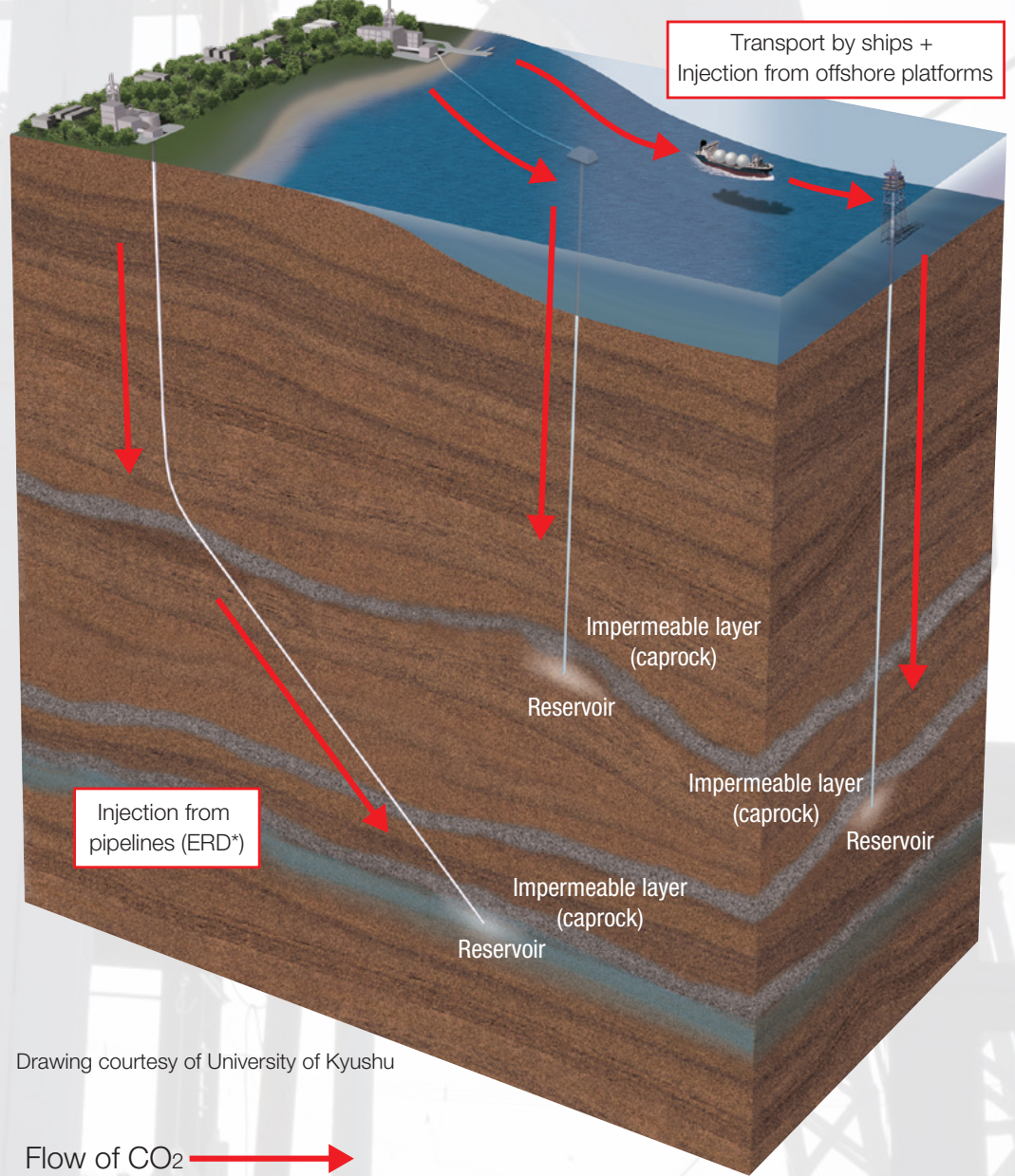
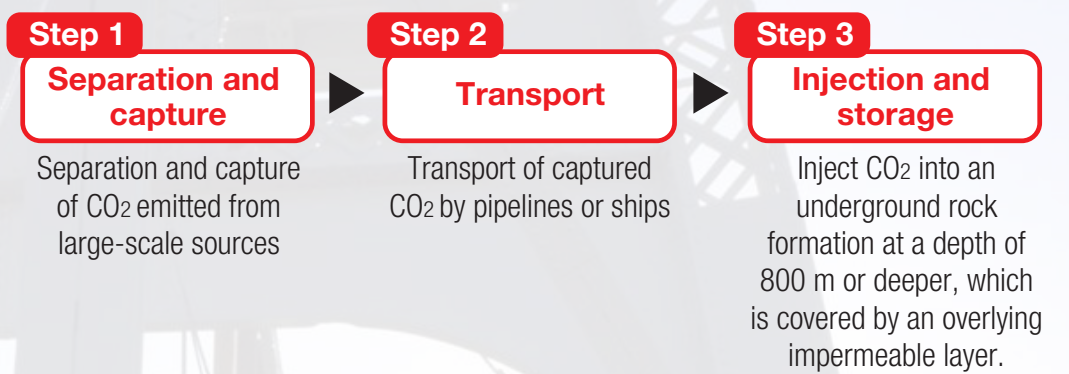
Based on the Paris Agreement, under a fair and effective international framework applicable to all major Parties, Japan leads the international community so that major emitters undertake emission reduction in accordance with their capacities and **aims to reduce greenhouse gas emissions by 80% by 2050 as its long-term goal**, while simultaneously pursuing global warming countermeasures and economic growth. (Partially omitted)

While eyeing the years beyond 2030, we are strongly committed to promoting CCS, building on the "Summary report of the director-general level meeting concerning the bids on thermal power generation facilities of TEPCO" and the "Basic Energy Plan"

## What is CO<sub>2</sub> capture and storage (CCS)?

While the impacts of global warming are getting worse, as we face a series of heavy rains and an increasing number of hot days, the "Paris Agreement" to strengthen global response to the threat of climate change came into effect in November 2016 and the global community is working on reducing emissions of CO<sub>2</sub> and other greenhouse gases.

As a means of mitigating global warming, CO<sub>2</sub> capture and storage (CCS) draws attention, in addition to reducing CO<sub>2</sub> emissions by utilizing energy-saving or renewable energy technologies. CCS is a technology to capture CO<sub>2</sub> generated at thermal power plants, manufacturing facilities, etc. to transport it via pipeline or ships for storage in a geological reservoir located at a depth of 800 m or deeper, which is confined by an overlying impermeable layer (also called a caprock) that prevents leakage.



Drawing courtesy of University of Kyushu

Flow of CO<sub>2</sub> →

\* ERD: Extended Reach Drilling is highly deviated drilling starting from the land area to an undersea reservoir.

CCS  
Carbon dioxide Capture and Storage

Ministry of the Environment

Project Leader: Dr. Makoto Akai



Background photograph: A vertical scaffold at the Miyahara coal mine (World Heritage)