Tokyo Zero-emission Innovation Bay
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＜Hub introduction ②　Large-scale CCS Demonstration Project in Tomakomai＞

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Thank you very much for your introduction. My name is NAKAJIMA, with Japan CCS Co., Ltd.; abbreviated as JCCS. Thank you very much for the opportunity to present today.

Next please.
Today, I will introduce our company profile and the demonstration projects in Tomakomai.

Next please.
First, the company profile. Our company was established in 2008 with investments from 34 private energy-related companies. This was in response to the recognition of the need for CCS at the G8 Hokkaido Toyako Summit in 2008. This is long before the Paris Agreement at COP21 in 2015.

The slide shows the 4 demonstration projects entrusted to our company by the government since 2012.
Firstly, Large-scale CCS Demonstration Project in Tomakomai
Secondly, the nationwide Investigation of Potential Storage Sites
Thirdly, Demonstration Project on CO2 Ship Transportation
Fourthly, investigation and demonstration of synthetic sustainable aviation fuel as carbon recycling

Our company plays a role as the execution unit for the demonstration tests conducted by the government. Today, I will talk about the “Tomakomai CCS Demonstration Project” and “Demonstration on CO2 Ship Transportation”.

Next please.
For the Tomakomai Demonstration Project, we have made a short video on the path to reach the goal of 300,000 tons of cumulative injection. Please watch the video. Video please.

Japan's first Large-scale CCS Demonstration Project is being conducted in the northern lands of Japan. Capturing carbon dioxide emitted by factories and power plants without releasing it into the atmosphere, and sequestering it deep underground. A combination of a reservoir and overlying caprock. Geological structures like these are used to store carbon dioxide underground. This is CCS.

From Tomakomai to the World
- Footsteps and Future of the CCS Demonstration Project

April 2016

Three, Two, One

The injection of CO2 started. Gas supply facility installed in the adjacent Idemitsu Kosan Hokkaido Refinery. Gas containing carbon dioxide was transported from this facility through a pipeline. Facility for capturing CO2 from the gas received. An amine solution was used in the demonstration test and high-purity CO2 from the gas containing CO2 was captured successfully. A two-stage absorption process using 3 towers was adopted to realize energy-saving capture technology. A great deal of progress has been made towards the practical application of CCS. The captured carbon dioxide was sent to an injection facility compressed and injected deep underground.

Two injection wells were drilled in the demonstration project. One well reaches the Moebetsu Fm., 1000-1200m under the seabed. The other well extends to the Takinoue Fm., 2400-3000m under the seabed. Temperature and pressure sensors were installed in the injection wells. In addition to these sensors, seismic sensors were installed in the observation wells drilled for monitoring. In addition to the 3 observation wells, detailed underground conditions are monitored 24 hours a day by ocean bottom seismometers and other equipment. In addition, detailed surveys are carried out each season to grasp the conditions of the ocean. Monitoring will continue after 2019.

On November 22, 2019, the CO2 injection reached the target of 300,000 tons. It's 1:07, we have reached 300,000 tons. The Tomakomai CCS Demonstration Project was promoted jointly by the government, local community and private sector. As a notable demonstration project for CCS, it is receiving much attention from around the world. From Tomakomai to the world. Thank you for your attention.

Please refer to Slide 6. This is the outline of the demonstration project. The maximum CO2 capture capacity is 600 tons per day, 220,000 tons per year. CO2 capture is performed by chemical absorption using an amine solvent, the purity of CO2 captured is over 99%. A notable feature is that the industrial classification is hydrogen production. The offgas received from the refinery consists of 50% CO2, 40% hydrogen and 10% methane. After the CO2 is captured, combustible gas containing about 80% hydrogen remains. The remaining hydrogen is used as on-site energy for the demonstration plant. I believe it can be said that we are producing blue hydrogen.

Now let me explain a little more about what I introduced in the video. Next please.

The Tomakomai CCS Demonstration Project has four objectives. The second objective, "Demonstrate that the CCS system is safe and secure", includes removing concerns about earthquakes. I will now review the operations we conducted based on these four objectives.

Next please.

The path to achieving 300,000 tons in November 2019 is as shown in the video. CO2 injection has been terminated, but monitoring is being continued. We are observing the behavior of CO2 in the reservoir, natural earthquakes and micro-seismicity, and conducting marine environmental surveys.

In addition, the government has announced a policy to make Tomakomai a carbon recycling demonstration base. We are investigating the possibility of the inter-operation of CCS and CCUS while maintaining the facilities and improving the facility capabilities.

Next please.
I will explain the basic scheme for storing CO2 underground. CO2 captured from the emissions of plants, etc. is injected into geological layers through a well drilled to a depth exceeding 1000m in the same manner as for oil and natural gas. In order that the injected CO2 does not leak to the surface, a cap rock, a dense, impermeable layer that does not let liquids and gas pass through must be present and underneath it is necessary to have a permeable layer like sandstone for storing the CO2.

In other words, after drilling oil or natural gas, depleted oil & gas reservoirs after extraction of oil and natural gas are of course suitable sites for CO2 storage, but similar geological structures exist even in layers where there are no oil or gas reserves. CO2 can also be stored in formations called deep saline aquifers where the pores of the reservoir are filled with ancient sea water. Therefore, we believe that the CO2 storage potential is not necessarily small even in Japan, which is not a major oil or gas producing country. It is in this light that we are conducting the investigation of potential CO2 storage sites across Japan. I will not talk about this topic today.

Next please.
This slide shows the entire facility and the flow from capture to storage. We received offgas from the oil refinery, CO2 was captured in the towers of the CO2 capture facility and injected into the reservoir at a scale of about 100,000 tons per year.

Next please.
This is a schematic diagram of the subsurface. We drilled two deviated wells from onshore to the offshore seabed for injection. The drilling is based on oil and gas drilling technology, and safety standards based on the Mining Act and the Mining Safety Act. The drilling was conducted by a Japanese drilling company.

Next please.
This is a picture of the demonstration site and its surroundings. You can see that the demonstration site is near the urban area of Tomakomai City. The solid red lines are the 2 wells that extend from land to the sub-seabed, about 3km and 4km offshore, respectively. In order to conduct CCS safely and securely, it is necessary to monitor the behavior, in other words the migration and distribution of the stored CO2 and verify that there is no leakage or seepage. Various monitoring equipment have been placed inside the dotted orange line, and repeated seismic surveys have been conducted.

Next please.
We often hear of concerns about the relationship between CCS and earthquakes. We believe that we were able to obtain very significant knowledge in the Tomakomai CCS Demonstration Project.

The Hokkaido Eastern Iburi Earthquake occurred in September 2018. In the demonstration center, a seismic intensity of lower 5 was recorded, but there was no abnormality in the ground facilities. The hypocenter was at a depth of 37 km, 30 km in horizontal distance from the injection area. In the figure on the lower left, it is clear that there is no continuity of the strata between the storage area and the hypocenter.

No indication of CO2 leakage due to the earthquake was confirmed in the reservoir pressure and temperature data. There is a temporary data gap in the graph on the lower right. The gap is due to a major power failure caused by the earthquake. You can intuitively see that there is no anomaly in the continuity of the trend of the data. Also, no micro-seismicity, which is sometimes observed when fracturing is conducted in shale oil development, was observed in the Tomakomai CCS Demonstration Project. This analysis was published in a report based on the opinions of experts in seismology and also posted on our website.

Next please.
When the demonstration project was started in 2012, public awareness of CCS was very low. So, it was important to gain the understanding of the local community from the preparation stage through the whole period of injection operation and post-injection monitoring. While focusing on the Tomakomai area, we have continuously carried out information communication and public relations activities widely in Japan through various activities. We strive to enhance the understanding of CCS for a wide range of age groups through site tours, lectures, exhibitions and workshops.

Next please.
We have also conducted information communication at many international events. We have supported the Japanese government in its international activities, for example by introducing the project results in a Clean Energy Ministerial webinar. The project has also received high international recognition. It was certified by the CSLF as a “Recognized Project”. The Global CCS Institute has reported widely on the Tomakomai project. More recently, the IEA website introduced the Tomakomai project as a CCUS project of global significance. At the 11th Trondheim CCS International Conference, our peer-reviewed paper received the Best Paper Award.

Next please.
The storage of 300,000 tons is not large compared to overseas CCS projects. However, this project has received much attention and is highly regarded both in Japan and overseas. The reasons are listed on this slide. In particular, much attention and recognition has been received in view of the fact that a CCS project was conducted close to a large city while gaining the understanding of the local community.

Next please.
This slide summarizes the results of the demonstration project. We have achieved our initial objectives and are continuing our monitoring operations.

Next please.
On the other hand, the project has highlighted issues regarding the social implementation of CCS. In order to commercialize CCS by 2030, costs must be reduced, CO2 transport options established, suitable storage sites secured, and the business environment improved. Recently, the Japanese government compiled an interim summary of the CCS Long-Term Roadmap Study Group. I believe that efforts to resolve these issues will be accelerated in the future.

Next please.
I will now briefly explain the technology development and demonstration project on CO2 ship transportation.

Next please.
In order to realize the social implementation of CCS, there is a need to establish long-distance/mass transportation technology of CO2. Large-scale CO2 emission sources and storage sites are not always in proximity to each other. In order to transport large amounts of CO2 over long distances, we believe it is necessary to develop ship transportation technology that connects the emission sources and storage areas. In June 2021, 4 companies; JCCS, ENAA, ITOCHU and Nippon Steel were jointly entrusted by NEDO, to conduct a technology development and demonstration project on CO2 ship transportation.

Next please.
In this demonstration project, CO2 captured from the Kansai Electric Power, Maizuru Power Plant in another NEDO project will be liquefied and stored at a shipping terminal loaded onto a demonstration ship and transported to a receiving terminal in Tomakomai.

Next please.
The ship to be used in the demonstration project will be 72 meters long and be able to transport 1000 tons of liquefied CO2. Currently, dedicated CO2 vessels in the world are transporting liquefied CO2 for use in the food industry. The pressure of the cargo tank is 2 MPaG and the temperature is -30 °C, which is called the medium temperature and medium pressure condition. In order to ship CO2 in a larger capacity cargo tank, cost-wise, a low-temperature, low-pressure tank that can keep the liquefied state at lower pressure is advantageous. However, low temperatures increase the risk of the CO2 turning into dry ice. Avoiding this risk and creating safe and cost-effective shipping conditions is one of the objectives and technological development points of this demonstration project.

This is a brief overview of our CCS activities in Tomakomai. Thank you for your kind attention.