Chapter 1

Technical Workshops

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Chapter 1

Technical Workshops

1. Overview

This workshop aimed to serve as an opportunity to instil knowledge about the latest technologies and the current trend of CCUS through actual case studies by top-notch lecturers.

The goals of the CCUS technical workshops were to (i) promote knowledge sharing on the latest CCUS technology through lecture sessions, (ii) accelerate further consideration of the application of mainstream CCUS technologies in the ASEAN region, and (iii) exchange ideas on and issues about CCUS technology.

Three workshops were organised on 5–7 October 2021. Two lecturers were invited to speak on their expertise for every daily session. A total of six lecturers with various backgrounds (professors, researchers, and from private companies) were invited.

Day 1 of the workshop focused on the technical aspects of carbon capture technology. Lecturers from the Global Carbon Capture and Storage Institute (GCCSI) and the Mitsubishi Heavy Industries Engineering shared their knowledge on capture technologies.

Day 2 covered the technical aspect of transport and storage technology. Lecturers from the Mitsubishi Research Institute (MRI) and the Research Institute for Innovative Technologies for the Earth (RITE) provided an overview of transportation and storage, respectively.

Day 3 focused on the utilisation of CO2. Lecturers from Pertamina RTC, Indonesia and the National University of Singapore shared CO2 utilisation from the perspective of the oil and gas sector and academia.

Participants averaged around 100 per day and were from various backgrounds in ASEAN member countries.

2. Workshop on Capture Technology (Day 1)

2.1. Agenda

Lecturers from the GCCSI and the Mitsubishi Heavy Industries Engineering were invited to discuss capture technologies.

The GCCSI lecturer presented the overview of carbon capture technologies and expressed his opinions regarding their advantages and disadvantages. In addition, he compared the pros and cons of membrane-based adsorption and solvent/solid-based adsorption used as capture technologies that are mainly used today.

On the other hand, Mitsubishi Heavy Industries Engineering also gave insight into chemical absorption technologies using several case studies. Real cases, such as Petra Nova projects, were introduced, and applications in gas turbine combined cycle power plant, LNG liquefaction plant, cement manufacturing, and steel/iron making were also mentioned.

Table 1.1: Workshop on Capture Technology

	Topic	**Lecturer/Presenter**
1	Overview of Asia CCUS Network	Han Phoumin, Senior Energy Economist, ERIA
2	Introduction to capacity building and overview of CCUS business development in Asia	Kikuko Shinchi, Senior Researcher of Mitsubishi Research Institute
3	Technical aspects of carbon capture technology	
3-1	Overview of carbon capture technologies, their advantages, and disadvantages	David T. Kearns, Principal Consultant CCS Technology, Global CCS Institute
3-2	Case study on chemical absorption technologies	Takashi Kamijo, Chief Engineering Manager/Project Director Decarbonization Business Department, Mitsubishi Heavy Industries Engineering
4	Q&A and discussion	(Details in 1.2.2)

2.1. Main topics of discussion

Capturing cost and technological readiness of available capturing technologies were mainly discussed.

- **What are the challenges of using amine as capturing solvent?**

Amine is often used to capture CO2. The biggest challenge is solvent degradation, a thermal degradation that occurs from repeated heating and cooling. Understanding the mechanism and counteracting the degradation is the first step.

- **What efforts can reduce the capture cost?**

The cost of capturing is currently highest amongst all stages in the CCS value chain, and ways to reduce it remain a big issue. The way forward is to drive new technology development and aim for economies of scale. In other words, bringing the capital cost down is key; beyond that is obtaining low-cost electricity from Iceland, such as geothermal electricity.

- **What actions should be considered if no CO2 user is available nearby?**

If no CO2 users are near the source, or if the CO2 off-taker is far from the source, liquefication of the CO2 for shipping can be an option.

3. Workshop on Transportation and Storage Technology (Day 2)

3.1. Agenda

Lecturers from the MRI and RITE were invited to share the overview of transportation and storage, respectively.

The MRI overviewed transportation technology. The four main methods to transport captured CO2 are pipelines, trains, ships, and trucks. Pipelines and shipping are mainly discussed here. Repurposing existing pipelines and connecting pipelines from several sources based on a hub-and-cluster network are options to reduce the initial investment. However, challenges may appear, such as difficulty managing CO2 streams in multi-source networks with varying flow levels, flow rates, or CO2 quality. Shipping is one of the ways of transporting CO2 when no pipelines exist in certain areas or the distance is too far to reach. However, the main challenge would be when shipping induces more associated CO2 transport emissions than pipelines due to additional energy use for liquefaction and fuel use in ships. The MRI also shared ways and solutions to overcome the challenges of pipelines and shipping.

The RITE chief researcher provided an overview of storage technologies, providing deep insight into what is happening in the reservoir during CO2 injection. During his session, he introduced the correspondent technology to observe CO2 accumulation in reservoirs and CO2 saturation profiles. He also mentioned CO2 monitoring for permanence and safety based on Canada’s Quest project and issues revolving around it.

Table 1.2: Workshop on Transportation and Storage Technology

	Topic	Lecturer/Presenter
1	Overview of Asia CCUS Network	Han Phoumin, Senior Energy Economist, ERIA
2	Introduction to capacity building and overview of CCUS business development in Asia	Kikuko Shinchi, Senior Researcher, Mitsubishi Research Institute (MRI)
3	Technical aspects of carbon transport technology	
3-1	Overview of transportation technologies	Ulysses Coulmas, Researcher, MRI
3-2	Overview of storage technologies	Ziqiu Xue, Chief Researcher, CO2 Storage Technology Group, Research Institute for Innovative Technologies for the Earth (RITE)
4	Q&A and discussion	(Details in 1.3.2)

3.2. Main topics of discussion

- **What are the example projects that utilise existing oil and gas infrastructure (mainly pipelines)?**

  The use of existing oil and gas assets contributes to reducing initial investment costs and increasing the efficiency of the CCS value chains. Examples of industrial-scale projects that have used existing oil and gas infrastructure are Northern Light, and one from the United Kingdom (UK)'s east coast cluster. On the other hand, projects like Porthos (Port of Rotterdam CO2 Transport Hub and Offshore Storage) are using new pipelines. Despite the difference of effort seen here, the main idea is still the same: connecting the CO2 source from several clusters.

- **What should be done to accelerate cross-border CO2 transport within the ASEAN region?**

  ASEAN has been working on cross-border gas pipelines for a long time with limited progress. First, issues must be determined and studied to figure out proper actions and solutions to accelerate CO2 cross-border transportation. Some regions do not have pipelines because of earthquake-related issues, landscape, and soil quality. As for ASEAN countries, the geographical path plays an important role. European countries are connected by land, while ASEAN countries are mostly connected by maritime routes, which are more complicated. Also, cross-border in ASEAN countries is not as strong as in Europe. Europe has more schemes and regulations for a better base to cooperate with multinational companies.

- **How do you see the possibility of CO_2 leaking to the surface?**

  The concept for CO_2 storage is similar to the oil and gas industry. The reservoir structure is made so that oil and gas can be safe in reservoirs overlaid by caprock.

- **How long is CO_2 monitoring needed to prove the safety of post-injection period?**

  The US Environmental Protection Agency requires monitoring post-disclosure for 50 years. Reducing the time length may be considered under several conditions.

4. Workshop on CO_2 Utilisation (Day 3)

4.1. Agenda

Lecturers from Pertamina, Indonesia and the National University of Singapore (NUS) were invited to share CO_2 utilisation from the perspective of the oil and gas sector and academia. Pertamina gave insight into the general knowledge of CO_2 utilisation and Pertamina's ongoing CO_2 utilisation-related research studies. From chemical products such as methanol, polymer to biocapture using algae was covered in the session. The Pertamina lecturer also shared collaboration and partnership opportunities at the end of her session. NUS shared a deeper insight on chemical conversion based on laboratory data and the potential of CCU.

Table 1.3: Workshop on Utilisation Technology

	Topic	Lecturer/Presenter
1	Overview of Asia CCUS Network	Han Phoumin, Senior Energy Economist, ERIA
2	Introduction to capacity building and overview of CCUS business development in Asia	Kikuko Shinchi, Senior Researcher, MRI
3	Utilisation of CO2	
3-1	Research activities CCU technologies in Indonesia	Dewi Mersitarini, Advisor CCUS, Pertamina RTC, Indonesia
3-2	CO2 Utilisation Research Activities and Potential Industrial Application	Ning Yan, Dean's Chair Associate Professor, Head of Green Catalysis Lab, National University of Singapore
4	Q&A and discussion	(Details in 1.4.2)

4.2. Main topics of discussion

- **Can CCU contribute to net CO2 reduction?**

Even if CO2-derived methanol is blended into gasoline used as fuel, the consumption of the fuel will also release CO2, which will eventually re-enter the atmosphere. The important part here is what has been replaced during the process. When methanol is made by CO2, compared to fossil fuel as feedstock, the avoided CO2 from the exploration and production of fossil fuel and the CO2 captured for methanol production are the total CO2 abated that should be considered. The way we look at CCS is slightly different from how we should look at CCU. The comparison must be made on what has been replaced to see the value of CO2 abatement using CCU.

- **Are there any options other than using palladium as a catalyst in producing CO2-derived methanol?**

Copper is another good option, but the effect might not be as good as palladium. In terms of sufficiency for supply, copper might be a better option. From the overall production point of view, the catalyst contributes to less than 10% of the cost; therefore, the cost of the catalyst would not be a major problem. However, from the large gigatonne-level scale production point of view, there is not enough palladium currently; in this case, copper is preferred.