GLOBAL CCS INSTITUTE

Workshop Report

Southeast Asia CCS Accelerator Workshop 2

Jakarta, Indonesia
20-21 November 2023

Asia Natural Gas & Energy Association

Contents

Contents

Southeast East Asia CCS Accelerator Workshop #2

20 and 21 November 2023

Atria Hotel Gading Serpong, Tangerang (Jakarta), Indonesia

Introduction

1. The Southeast Asia CCS Accelerator (SEACA) is an initiative of the Global CCS Institute. It serves as a collaborative platform between governments and its relevant agencies, multilateral organisations, and the private sector, including Carbon Capture and storage (CCS) project developers and proponents, CCS-relevant industries (e.g., steel, cement, petrochemical, and energy), oil and gas exploration and production companies, and governments of developed economies with interests in CCS in ASEAN.
2. SEACA aims to accelerate the commercial deployment of CCS in ASEAN as an essential component of the region's efforts to deliver an energy transition and mitigate climate change. As the output of SEACA in its first year of implementation, the Global CCS Institute and ASEAN Centre for Energy are organising three (3) workshops that will support and cover the three (3) critical pillars of SEACA, namely, CCS Regulation, Enabling Policy & Geological Storage Resource Development.
3. The 2nd SEACA Workshop was held physically on 20 and 21 November 2023 in Tangerang (near Jakarta), Indonesia and was co-organised by the Global CCS Institute, ASEAN Centre for Energy (ACE), and Asia Natural Gas and Energy Association (ANGEA). The Workshop was hosted by the Directorate General of Oil and Gas, Ministry of Energy and Mineral Resources of Indonesia. The detailed agenda of the 2nd SEACA Workshop is attached as ***ANNEX 1***.
4. The 2nd SEACA Workshop was attended by representatives of six ASEAN Member States (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, and Thailand) and Timor Leste. These representatives came from various sectors, including government, regulatory authorities, and state-owned companies. Additionally, invited participants from other government entities, industries, universities, consulting firms, etc. also participated. The list of participants is attached as ***ANNEX 2.***

Day 1 (20 November 2023)

Opening Remarks

5. Mr. Alex Zapantis, General Manager Commercial, Global CCS Institute, delivered his opening remarks. He briefly introduced the upcoming workshops and what will be discussed. He acknowledged the significant support from the Asian Natural Gas and Energy Association for their financial backing and the Indonesia CCS Centre for its engagement with Indonesian stakeholders. He also thanked the Directorate General of Oil and Gas, Ministry of Energy and Mineral Resources of Indonesia, for hosting the event. The Workshop's agenda was focused on gathering diverse perspectives from project developers, governments, and financiers. It aimed to address the challenges and opportunities in CCS. The following day promised interactive panel discussions on policy, regulatory issues, and geological storage development, encouraging active participation from the audience to share ideas and suggestions. This opening session set the stage for a comprehensive discussion on operationalising CCS strategies in Southeast Asia, reflecting a collaborative effort among various stakeholders.
6. Ir. Mustafid Gunawan M.E, Director of Oil and Natural Gas Program Development, Directorate General Oil and Gas, Ministry of Energy and Mineral Resources, delivered his opening statement. He conveyed Indonesia's effort in decarbonisation, such as issuing MEMR Regulation No.2/2023 specifically for CCS and CCUS. He highlighted Indonesia's CO_2 storage potential and the importance of collaborative efforts among government, private sector, and other stakeholders to optimise CCS opportunities and achieve net-zero emissions by 2060.
7. Mr. Alex Yelland, Director of Policy, Asia Natural Gas & Energy Association, delivered his opening statement. He highlighted that forums are critical to CCS and CCUS development and that collaboration between government and industry is essential. He mentioned that there are challenges that are caused geographically such as disparity between source of large emitters and potential sink sites.
8. Dr. Belladonna Maulianda, Executive Director of Indonesia CCS Center, delivered her opening statement. She highlighted the significance of this workshop as a milestone in energy transition in the ASEAN region. She underscored the development of decarbonisation efforts in Indonesia, such as the CCS regulation and the launch of Indonesia's carbon market. She further stated that Indonesia has a large storage capacity, and LEMIGAS has updated the value of research capacity to up to 600 Gigatonnes for domestic and cross-border storage. Lastly, she highlighted the relationship between Indonesia and global partners and investors.

9. Dr. Nuki Agya Utama, Executive Director of ASEAN Center for Energy (ACE), delivered his opening statement. He referenced the 41st ASEAN Ministers on Energy Meeting (AMEM) outcomes, underscoring their focus on accelerating energy transitions and enhancing energy resilience. The statement acknowledges the ASEAN CCUS Deployment Framework and Roadmap, emphasising its importance in setting regional climate milestones and fostering the development of regional carbon markets. He further stated that the meeting agreed to explore avenues to enable cross-border carbon transport and storage as well as support the regional carbon market for the visibility of CCUS projects in the region. Furthermore, he stressed the need for understanding the specific characteristics of CCS and CCUS technologies for effective implementation in ASEAN and calls for collaborative efforts among stakeholders, policy frameworks, and united action to scale CCS deployment and achieve climate goals for a sustainable energy future in Southeast Asia.

Summary of the 1st SEACA Workshop

10. Mr. Alex Zapantis, General Manager Commercial, Global CCS Institute, shared the summary of the first SEACA Workshop, which has the following results:
    a. There are critical issues in the policy area, particularly in investment, there are gaps in policy to attract investors, such as carbon pricing and trans-border movement for storage.
    b. On the regulation pillar, the issue is there are gaps in specific regulations for CCS.
    c. Potential actions: public understanding of CCS, roadmap of CCS in the ASEAN region, and building knowledge in regulating CCS.

Status of CCS and CCUS Development in the ASEAN Region.

11. Suwanto, the representative of ACE, presented the Status of CCS and CCUS development in the ASEAN region. The Workshop noted the following highlights:
    a. The 41st ASEAN Ministers on Energy Meeting (AMEM) underscored the region's commitment to the development of CCUS. Furthermore, cross-border transport and storage possibilities will be investigated to enhance CCS's progress in ASEAN.
    b. In the 7th ASEAN Energy Outlook, the final ASEAN energy consumption will triple from 2020 to 2050, with coal, oil, and gas contributing up to 70%. Even though renewable energy is predicted to contribute 28% based on the most ambitious plan, coal will still play a critical role in satisfying energy demand in the ASEAN region. Coal consumption in the energy sector is predicted to be stable, increasing GHG emissions in the ASEAN region.

c. A solution to decarbonise the power sector is implementing carbon capture technologies, considering the ASEAN region's coal fleets are still young.
d. ASEAN recognises the importance of CCS for energy transition, which is reflected by the current policies in several AMS:
   - Indonesia: high-impact mitigation action such as CCS and CCUS implementation.
   - Malaysia: energy transition roadmap including CCS as part of the energy transition enablers.
   - Singapore and Thailand: Long-term development considers CCS and CCUS to support decarbonisation.
e. Critical elements for the framework were discussed, including CO_2 transportation and storage, incentive regulations, and storage identification and the need for short, medium, and long-term strategies within the roadmap was emphasised.
f. The ASEAN Taxonomy version 2, released in March 2023, was designed to enable a just transition towards sustainable finance adoption. The ASEAN Taxonomy version 2 has criteria for labelling activities as green, including transportation and geological storage, focusing on safety and monitoring.

SESSION 1: South East Asian Government Perspectives

Perspectives from the Indonesian Government

12. Mr. Firdaus Wajdi, a representative of the Ministry of Energy and Mineral Resources, Indonesia, delivered his presentation. The Workshop noted the following highlights:
    a. An update on Indonesia's CCS (Carbon Capture and Storage) initiatives was provided, highlighting the critical role of oil and gas during the energy transition and Indonesia's targets for national oil and gas production by 2030.
    b. Indonesia government has issued ministerial regulation of MEMR Regulation No.2/2023 on the implementation of CCS/CCUS in upstream oil and gas business activities and has 15 CCS-CCUS projects in the study or preparation stage, aiming to be operational by 2030, emphasising the need for technology and financial collaboration.
    c. There are limitations in current regulations, focusing on CCS/CCUS in Oil and Gas in working areas. The need for arrangements regarding the implementation center, CCS hub, and cross-border transportation for cross-country emissions was discussed, and the ongoing work on the first regulation for CCS outside the oil and gas working area was noted.

d. Indonesia is also progressing in drafting a Presidential Regulation on CCS with the following important contents: CO_2 carbon capture working area offering; exploration permit for studying permanent geological storage; storage operation permit for safe CO_2 storage; and CCS methodology and requirements for carbon market initiatives. There are some considerations in drafting the presidential regulation such as the need for clarity of legal ownership and underground geological port space, guaranteed legal and business certainty for attracting investment and encouraging innovation, guidelines for CCS operation, environmental protection and safety standards, and licensing process.

Presentation from Cambodia

13. Mr. Year Chansaravuth, a representative from the Ministry of Mines and Energy, Cambodia delivered his presentation. The Workshop noted the following highlights:
    a. A short update on Cambodia's energy status and policies was provided, highlighting the need for careful consideration of decarbonisation, emphasising affordability, accessibility, and energy security. Cambodia's energy mix was also mentioned, consisting of 52% renewables (hydro power, solar, and biomass) and 38% fossil fuels.
    b. Cambodia has a plan in addressing the high dependency on fossil fuels for power generation, with a focus on reducing the reliance on coal and noting that while no new coal power plants are planned, existing ones will operate until the end of their contracts, with a gradual shift to alternative, cleaner fuels.
    c. The Ministry of Mines and Energy of Cambodia is conducting a study on developing a clean energy transition roadmap to achieve a carbon-neutral society by 2050 considering various technologies, including CCS, natural gas, hydrogen, hydro, and ammonia.
    d. He stated the importance of CCS/CCUS and the need for CCS and CCUS deployment to capture emissions and permanently store them underground, as well as stressing the indispensability of clean power technologies for energy security, affordability, and decarbonisation.

Presentation from Lao PDR

14. Mr. Keopaseuth Ketanoula, representative of the Ministry of Energy and Mines, Lao PDR, delivered his presentation. The Workshop noted the following highlights:
    a. Overview of Lao PDR's energy mix with total energy generation of 51,000 Gwh in 2022, and energy mix of hydropower 82%, Coal-fired power plant 16%, Biomass

0.9%, and Solar 0.4%. He also mentioned key hydropower projects, including the Huapanh and Bualapha Power Plants.

b. Carbon emissions statistics in Lao PDR noted a significant increase in CO_2 emissions from 2010 (under 5,000 Kt CO_2) to 2021 (around 20,000 Kt CO_2), primarily due to industrial development and coal power plants putting emphasis on the prominence of coal power plants as a significant source of the emissions.

c. Identification of potential CCS storage areas based on geological and geographical considerations highlighting two suitable regions: the southern part of the Vientiane Capital and the southern part of Laos.

d. Lao PDR is facing several challenges in implementing CCS, such as lack of specific policies or regulations on carbon dioxide emissions and CCS, limited details on CCS in environmental protection guidelines, financial constraints for CCS management and the need for improvement in human capacity and technical expertise in CCS.

Presentation from Thailand

15. Ms. Apiradee Suwannathong, representative of the Ministry of Energy, Thailand delivered her presentation. The Workshop noted the following highlights:

a. The Department of Mineral Fuels has taken charge of CCS projects, focusing on E&P business and beyond E&P, implementing four pillars for CCS development: Technical approach, Regulation, Economic Incentive, Legal and Legislative Regulation, and Stakeholder Engagement.

b. Exploration of potential CCS projects in five areas: Lampang, Namphong, Saraburi Sandbox, Northern Gulf, and Arthit CCS Projects.

c. Collaboration with academic institutions to improve geological formations in North and South Thailand and establish international standards and guidelines for carbon dioxide geological storage.

d. Key milestone for CCS integration in Thailand includes developing an integrated CCS framework supporting storage, capture, and transportation activities, planning to amend regulations under the Petroleum Act in 2024, development of storage guidelines and initiation of projects like the Sandbox project and proposal of CCS-specific regulations for approval by the authorities.

e. The future plan by Thailand is to focus on accessing geological formations, amending the Petroleum Act and Ministerial regulations to support CCS projects, developing specific CCS regulatory framework, formation of a working group working on CCS projects, collaborating with ASEAN countries and international

partners on CCS projects, and setting up the CCS lab center at Chiang Mai University.

Presentation from Malaysia

16. Mr. Mohan Helmi Zaihan, a representative of the Energy Commission of Malaysia, delivered his presentation. The Workshop noted the following highlights:
    a. Malaysia has committed to reduce carbon intensity by 45% by 2030 and increase renewable energy capacity by 70% by 2050.
    b. Malaysia's global share of CO_2 emissions is around 0.8%, prompting discussions on the necessity of pursuing CCUS to reduce emissions in key sectors, especially heavy industries and power sectors.
    c. In 2023, Malaysia's generation mix consists of 59% coal, 34.8% gas, 4.4% hydro, and 1.8% solar power.
    d. Challenges in CCUS implementation include a lack of demonstrated success stories, ongoing regulatory framework development, high costs, and the need for incentives.
    e. Collaboration between Tenaga National Berhad (TNB) and Petronas for exploring CCUS technology for gas-fired power plants and resulting in 12 CCUS-related projects, including chemical and biological approaches.
    f. He also highlighted the introduction of National Energy Transition Roadmap (NETR) by the government, setting volume targets for CCUS hubs with storage capacity targets for 2030 and 2040.

SESSION 2: CCS Project Developer, Contributor, Financier Perspectives

Presentation from Indonesia CCS Center

17. Rizky Muhammad Kahfie, the General Secretary of Indonesia CCS Center presented the "Opportunities, Challenges, and Current Milestone for CCS Project Development in Southeast Asia. The workshop noted the following highlights:
    a. There are about 40 Gt of CO_2 needed to be removed from the atmosphere, from current and future emissions, to meet the target of 1.5 degree Celsius and 2-degree Celsius global warming limitation. To achieve these targets, an increase in investment of CCS becomes essential. With global CCS capacity is expected to reach 6.2 Gtpa by 2050, about USD 2.4 trillion of investment in CCS is needed. Currently, US acquisition in CCS-related investment is seen to significantly rising.

b. More than 700 million tons of CO_2 was produced in Indonesia in 2022, with the power industry, transportation, and industrial combustion becoming the main contributors to these emissions. Since Indonesia is still a developing country, energy consumption is projected to rise due to its rapid development and various strategic projects, which will consume a substantial amount of energy.
c. There are four points which make Indonesia an important player in CCS. First, Indonesia has huge potential for CCS with up to 400 Gt-CO_2 storage capacity, showing a capability to fulfil domestic and regional demand for carbon storage. Indonesia is also located in a strategic location, allowing the west part of Indonesia to connect with the Southeast Asia countries and the east part to easily link to the East Asia countries. Furthermore, as Indonesia's efforts of down-streaming its industrial sector become more consistent, Indonesia may have a great potential for low-carbon products development. Lastly, Indonesia may answer the cost constraints between the carbon source and the sink. With the relatively short distance between the emitters and storage sites, the transportation cost can be reduced.
d. Some challenges in establishing CCS in Indonesia are the need to upskill the technology and knowledge, nurture stakeholders' understanding, develop new business models, and build partnerships with public and private partners. To tackle these challenges, ICCSC has done some activities in building local capacity, transferring knowledge, benchmarking established CCS hubs, and dealing with private agreements and international collaboration.
e. Several possible emitter and storage site arrangements and conditions may be adopted in Indonesia. Some options of emitter business models and transporter and storage operator business models are also introduced and promoted, especially for the Indonesia case. The presenter also enhanced the possibility of learning the CCS hub's business models from countries which have had clearer business models, such as the United Kingdom, the Netherlands, and Norway.

Presentation from Commercial Law Development Program (CLDP), U.S. Department of Commerce

18. Priya Prasad, Senior Attorney of CLDP, presented the "CCS Deployment: US Perspective. The workshop noted the following highlights:
    a. The United States has a unique system of bifurcation in which the federal government regulates CCUS by the Environmental Protection Agency (EPA), but some states also have their own regulations for CCUS. Notably, two states (North Dakota and Wyoming) in the U.S. have also applied the "primacy" where the

federal government has delegated their authority to the state government, allowing them to obtain approval from the federal government when permitting the CCUS project. This concept benefits in accelerating the permitting process and growing CCUS projects in those states.

b. Some regulations related to air permitting considerations, transport pipeline safety, injection and storage for CO_2 capture facilities, and policy incentives (such as the 45Q tax credit) are still regulated under the federal government.

Presentation from World Bank

19. Harshit Agrawal, Senior Energy Specialist of World Bank, presented "Catalyzing CCUS Deployment in Developing Countries. The workshop noted the following highlights:
    a. The use of CCS in achieving a 1.5-degree scenario is fundamental since it is projected that CCS may contribute about 15-20% in reducing CO_2 emissions. However, this may be a challenging way as CCS is a capital-intensive project and may not be either economical or the best choice to reduce CO_2 emission in the present day. Therefore, answering this question in the first place is important to accelerate the financing of CCS projects.
    b. The important aspect needed to catalyse the CCUS deployment is clarity. The current industries and regulators still do not seem to move toward establishing clear regulations and policies on CCUS, yielding non-optimum funding to CCUS projects. Furthermore, showing a robust technical study and pilots and demonstration projects may also be essential in introducing CCS into the market.

Discussion Session

20. The Workshop noted the following highlights:
    a. World Bank finances come at the request of the government and state-owned enterprises. However, from the current perspective, there are three things that may need to be financed as an initial state in introducing CCS, which are in-depth studies on CCS and knowledge sharing, pilot projects, and technology demonstrations.
    b. Indonesia has launched the carbon exchange platform and there are already a few transactions with transaction value about millions of USD. One example is the transaction between PERTAMINA sub-holdings company in the energy business and another PERTAMINA sub-holdings company in the upstream industry.
    c. As certainty and clarity are what generally industries and investors want to know, starting small steps and solving some of the most significant pain points may be a

good place to start rather than waiting and trying to construct regulations that enclose all problems that we are not sure yet.

SESSION 3: CCS project Developer, Contributor, Financier Perspectives

Presentation from ANGEA

21. Alex Yelland, the Director of Policy of Asia Natural Gas & Energy Association, presented the "Building a CCUS Value Chain in Asia". The Workshop noted the following highlights:
    a. There are several significant actions on CCS development in Asia Pacific, specifically in deploying the technology, including (1) the operation of the world's largest carbon storage project at the Gorgon LNG project, Australia, by Chevron, (2) Japan LNG's Vorwata CCUS development in Indonesia, (3) Mitsui O.S.K. Lines (MOL) studying technology of shipping CO_2 around the region, and (4) ExxonMobil and Japan Gas Corporation (JGC) engaging governments and industry across the Southeast Asia region on CCS projects.
    b. Implementing CCUS in Southeast Asia can balance economic growth and continue fossil fuel use with emission reductions. Recently built power plants and industrial facilities can operate with substantially reduced emissions. However, the challenge remains in scaling the investment. The investment in carbon capture technologies in Southeast Asia would need to reach an average of USD 1 billion per year between 2025 and 2030.
    c. In addressing CCS issues, there are significant differences between the United States (U.S.) and European United (E.U.) and Asia. The U.S. and E.U. have largely held by standards, policy frameworks, and structure, and they have the ability to scale through investment measures, such as inflation reduction. To overcome this hurdle in Asia, commitments, transparency, and cooperation is critical.
    d. Accelerating CCUS development can be done through sharing infrastructure, focusing on regional hubs, and developing a regional carbon market. By sharing infrastructure, access to CO_2 storage capacity can be unlocked for countries where storage is limited. Meanwhile, deploying regional hubs could enable CO_2 capture from multiple industrial power services, providing greater efficiencies in the planning and construction of capital-intensive transport and storage infrastructure.

e. To enable cross-border emissions reductions, Cross Border Emissions Reductions Accreditation needs to be established. Such a system is required for companies to accurately credit the amount of their reductions and capture financial incentives in the region.
f. As the region investigates the opportunity of technology to support decarbonisation efforts and to create new industries and jobs, the robust regulatory framework, regional cooperation, and value chain development are essential.
g. Several policy enablers for a regional CCUS value chain include (1) the development of consistent and compatible regulatory systems, (2) bilateral/multilateral arrangements with corresponding domestic and regional, and (3) the incorporate of established international best practices for export/import of CO_2 for CCS.
h. Additionally, one enabler of effective policy framework that needs to be recognised is to build more support from the community, media, and other key stakeholders. Active industry players, such as ANGEA and their members, can play a key role in advocating, communicating, and educating the benefits and values of CCS.

Presentation from Ministry of Economy Trade and Industry, Japan

22. Kenta Asahina, Specialist for Research & Development at the Ministry of Economy Trade and Industry – Japan, presented “Japan's Initiatives to Launch CCS Business”. The Workshop noted the following highlights:
    a. To secure annual storage of 120-240 million tons of CO_2 by 2050, a business model for CCS that can be cross-sectoral should be established at an early stage. This supporting program will establish various CCS business models by supporting projects with different combinations of CO_2 sources, transportation methods, and CO_2 storage areas.
    b. To install carbon capture process and transportation, an “aggregator” for emitters is necessary to be fostered by promoting outsourcing. Primary transportation for CCS would be by pipelines and shipping.
    c. Japan is aiming for a liquified CO_2 shipping demonstration project which will start in 2024. In the hub and cluster plan for CCS, liquified CO_2 ship transportation is an important technology for transporting CO_2, which is captured at distant emission sources.
    d. The Asia CCUS Network (ACN), an international industry-academia-government platform, was established in June 2021. It aims to share knowledge and develop

a business environment for CCUS utilisation throughout Asia where large-scale CO_2 storage potential is expected.

e. Asian CCUS Network aims to develop projects and a business environment by 2025 and to move toward a decarbonised Asian economy-centred on CCUS by 2030.

Presentation from ExxonMobil

23. Egon van der Hoeven, Senior Vice President of Business Development at ExxonMobil, presented "Advancing CCS in Southeast Asia". The Workshop noted the following highlights:

a. The strong U.S. Gulf Coast CCUS deployment was attributed to the high-quality, well-located position. The ExxonMobil facilities in this location are close to feedstock and CO_2 storage sites. The example of the strategic position of the key players in the U.S. Gulf Coast can provide a vision to build similar strategic position in Asia.

b. Asia Pacific accounts for approximately 52% of global CO_2 emissions. On the one hand, advanced economies have more aggressive decarbonisation plans but limited access to low-carbon sources of energy and CO_2 storage. On the other hand, emerging economies have the potential for large CO_2 storage and low-carbon energy exports.

c. There are several undergoing projects in the Asia CCS ecosystem, such as ongoing advocacy in support of regulations and policy development in Malaysia, MoU execution to explore petrochemical project using Indonesia CCS hub in Indonesia, and ExxonMobil and Mitsubishi Heavy Industries (MHI) in the partnership that adds MHI's carbon capture technology to an integrated CCS offering, as well as testing feasibility of overseas CCS value chain.

d. The implementation of CCS in the Asia Pacific can be classified based on the country types: customer country (CO_2 emitter) and storage country. Challenges for customer countries include (1) the cost of capturing, liquefying and transporting CO_2 and (2) government incentives that drive customer capture/storage, whereas for storage countries, include (1) establishing a CCS regulatory framework, (2) efficient and streamlined permitting process, and (3) public acceptance of storage from third party countries.

e. Several policy enablers for CCS for storage and emitter countries include (1) grants and loans, (2) tax credits and contracts for difference, and (3) carbon price (ETS, carbon tax). Tax credits that magnify governments would provide CCS pioneer industry and reduce income tax. In addition, support towards long-term research, as these carbon reduction policies are considered, is needed.

Presentation from JOGMEC

24. Masumi Takanashi, Project Director of Hydrogen and CCS Project Department at JOGMEC, presented "JOGMEC's Initiatives for CCS Deployment in ASEAN and Japan". The Workshop noted the following highlights:
    a. To reduce emission reduction from industries while ensuring economic growth to commercialise projects, the necessary actions that are required include establishing appropriate legal and regulatory frameworks, securing geological potential for CO_2 storage, and utilising multiple revenue resources.
    b. Regional site screening for CO_2 storage in Southeast Asia has been conducted, resulting in a map that estimates the CCS potential by basin and formation.
    c. CCS project needs multiple revenue streams. It is important to secure revenue options, including international investment, governmental subsidies, financial instruments, and carbon pricing systems.
    d. JOGMEC has selected seven (7) role model projects for CCS projects in Japan. The CO_2 is captured from the industrial clusters and stored in about 13 Mtpa of CO_2 in the Japan, Asia, or Oceania regions.
    e. The case of Northern Lights in Norway was highlighted to demonstrate the concept of leverage to sustain the CO_2 value chain. This concept utilises multiple revenue options, such as carbon tax, EU subsidy, and national complement (subsidies).

Presentation from Shell Asia Pacific

25. Sue-Ern Tan, Head of Policy and Advocacy at Shell Asia Pacific, presented "Shell: A Partner of Choice in CCS". The Workshop noted the following highlights:
    a. Consideration is given to developing commercial CCS hubs that enable the decarbonisation of multiple (industrial) customers. Working with governments to help shape the net-zero emission pathways was emphasised.
    b. The need for carbon capture and storage (CCS) in the region was emphasised, with recognition from governments about the role CCS can play in meeting nationally determined contributions.
    c. It was pointed out to not underestimate the amount of time that it takes to get the necessary policies and regulations on CCS to be in place.
    d. Shell Malaysia has signed a joint study and collaboration with Petronas to explore opportunities and project collaboration in carbon capture and storage. In addition, Shell Singapore and Brunei Shell Petroleum have signed an MoU to explore the feasibility of carbon transport and storage options for Brunei Darussalam and Singapore.

e. To advance CCS implementation in Asia, appropriate policy and regulation (ex., bilateral or regional trade policy and framework) need to be in place. In addition, having strong commitments, such as building and aligning partnerships to develop the value chain, was deemed crucial.

Presentation from Sumitomo Corporation

26. Soichiro Kunihiro, the Carbon Neutrality Team Lead of the Energy Innovation Initiative at Sumitomo Corporation, presented "Towards Asia Zero Emission". The Workshop noted the following highlights:
    a. CCUS team in the Sumitomo Corporation is focusing on (1) CO_2 capturing, (2) transport & storage, and (3) carbon dioxide removal credit. The aim is to build a full value chain from emitters to storage.
    b. Sumitomo has signed a MoU to jointly conduct a feasibility study to establish a CCS value chain between Australia and Japan. The CO_2 emissions from various industries and companies in the Chubu Region, Japan, are captured and liquefied, and they are transported to Australia for injection at the Australian storage site.
    c. Summit Energy Evolution Ltd (SEEL), a subsidiary company owned by Sumitomo, has acquired a storage license in the U.K. with a 10% share. The injection of CO_2 is projected to start in 2031.
    d. Sumitomo Corporation has several business activities in Indonesia, including LNG projects and power plant projects (coal and geothermal plants). Sumitomo Corporation is aiming to contribute towards realising a carbon-neutral society through Indonesia's decarbonisation, stable power supply, and sustainable economic growth. To realise these targets, building the required infrastructure and having the appropriate incentives are needed.

Presentation from Santos

27. Matt Sherwell, Manager of Regulatory and Policy Affairs of Santos, presented "Progress of Santos' CCS projects". The Workshop noted the following highlights:
    a. There are three Santos CCS hubs in operation: Western Australia CCS (3 Mtpa), Darwin & Bayu-Undan CCS (10 Mtpa), and Cooper Basin CCS (20 Mtpa). Currently, Moomba CCS, which can store up to 1.7 Mtpa and is projected for its first injection in 2024, is under construction and at 75% complete.
    b. Carbon credit methodology was mentioned as one of the ways to monetise the CO_2 reduction cost.
    c. Utilising Darwin LNG as an aggregator of emissions that can be transported via existing pipelines is seen as an opportunity to create the region's largest CCS hub.

d. It was mentioned that although the technicality is ready and customers have been identified, the progress of Bayu-Undan transition to CCS is held back due to the progress of the regulations. Focus on regulations in Australia & Timor-Leste needs to be enhanced.

Discussion Session

28. The Workshop noted the following highlights:

a. A question was raised regarding the impact of more and more companies working towards CCS projects, which can build a competing environment instead of collaboration; this could happen because the companies are competing for similar customers. However, it was conveyed that although there might be a specific commercial factor, most companies are looking at their own projects and how they can advance them to their maximum potential. To get to that point, it requires collaboration, whether that is on a bilateral or multilateral basis. Moreover, from the geopolitics point of view, we are particularly interested in how the region can establish a regional carbon market, which can be created by harmonising the different standards of accreditation systems that exist.

b. Regarding the big expectation in advancing CCS development, regulations from the government and appropriate frameworks are deemed necessary for investment. Without proper regulations in place, the CCS development will find difficulty in executing the project.

c. Examining examples from Japan, Korea, and Singapore, several CCS-related projects have been announced. Given that these projects might span approximately 30 years, this highlights the urgent need for regulations that address cross-border concerns within the value chain.

d. From the Japanese government, Japan is aiming to facilitate the closed border transportation discussion.

e. From the investor's point of view, stable cash flow will be needed for investment in the CCS project. Moreover, government support matters and vendor support is also important. In addition, some sort of incentives, such as tax credits, are also crucial for investors and stakeholders to commit to investing.

SESSION 4: CCS project Developer, Contributor, Financier Perspectives

Presentation from Mitsui OSK Lines

29. Masatoshi Numano, the representative of Mitsui OSK Lines Presented “Mitsui OSK Lines CCUS Activities”. The Workshop noted the following highlights:

a. Mitsui OSK Lines declared Net Zero emission in June 2021 and has done numerous CO_2 reduction initiatives such as 8-10% CO_2 reduction by wind power generation.
b. Mitsui OSK Lines is involved in various international projects related to CO_2 transportation and storage as well as partnerships with Cosmo Oil, DeepCStore, JCCS project in Japan, and collaborations with companies like Kansai Electric Power, Chevron, ENEOS JX JPOWER, and Petronas. They also owned a 25% share in Larvik Shipping.
c. Mitsui OSK Lines emphasised its collaboration with Mitsubishi Shipyard, Samsung, and other entities in the development of vessels. The companies have detailed the technical challenges and conducted concept studies for both low-pressure and medium-pressure solutions in CO_2 carriers.

Presentation from Industrial Ecology and Government Lead for CCUS for the Northern Territory of Australia.

30. Howard Smith, representative of Industrial Ecology and Government Lead for CCUS for the Northern Territory of Australia, presented “common ground linking the Northern Territory CCUS hub with Southeast Asia”. The Workshop noted the following highlights:
    a. The global nature of carbon dioxide emissions and the need for collaboration was emphasised, along with acknowledging the challenge of transitioning away from fossil fuels while maintaining essential industries.
    b. The Northern Territory described the Middle Arm planning and plans for a manufacturing hub with low-emission products and highlighted a holistic approach, incorporating industrial symbiosis and minimising waste streams. The low-emissions hub's three phases were outlined, focusing on carbon capture and storage, including connection to energy plants and a saline field. Phase-1 is targeted for operation in late 2026-2027, Phase-2 is targeted for operation in late 2028-2029, and Phase-3 is targeted for full operation in 2030.
    c. The northern territory addressed political and practical challenges, including activist groups associating CCS with oil and gas production and stressed the importance of large fleet vessels for importing CO_2 on a global scale.
    d. Several suggestions were made during this presentation: urges the removal of politics from discussions and emphasises the need for practical applications, recommends establishing a virtual hub across Southeast Asia for collaboration, calls for high-level discussions on technology and the urgency of progressing with

designing and building CCS infrastructure, and advocates for a roadmap and strategy for the development of CCS projects.

Presentation from BP Indonesia

31. Zulfikri Agus, a representative from BP Indonesia, presented “Tangguh CCUS/CCS: An Indonesian National Strategic Project”. The Workshop noted the following highlights:
    a. BP Indonesia explained about the Tangguh L&D Project overview. Tangguh project is located in West Papua, Bintuni, more than 3,000 kilometres from Jakarta. Tangguh Joint Venture involves three blocks: Berau Block, Wiriagar Block, and Muturi Block, operated by BP with Japanese partners.
    b. The Tangguh CCUS project is a national strategic initiative aimed at decarbonising Tangguh assets. Its goal for the first phase is to store approximately 30 million tonnes of CO_2, derived from produced gas, by injecting it permanently back into the reservoir. Additionally, the project plans to boost gas production to enhance Indonesia's energy security. The target is to achieve 12 MBCF per day of gas production by 2030.
    c. BP Indonesia also has signed MoUs for partnerships, including with Pertamina for blue ammonia and electricity production.

Presentation from Mitsubishi Corporation

32. Kite Birzer, a representative from Mitsubishi Corporation, presented "Latest CCS activities by Mitsubishi Corporation". The Workshop noted the following highlights:
    a. Mitsubishi Corporation engaged in various projects across the natural gas value chain, including Tangguh (referencing BP's presentation), blue ammonia, blue hydrogen, and CO_2 capture for the industry.
    b. Mitsubishi Corporation is focused on building international CCS value chains to aggregate CO_2 emissions and collaborating with Exxon and Nippon Steel for an international CCS value chain. Ties with CCS operators globally, strong relationships with key players, and coordination with Japanese government entities were highlighted.
    c. The way forward in the CCS value chain business by Mitsubishi Corporation is to accelerate CO_2 aggregation in Japan, implement an overseas CCS value chain structure, and coordinate with Japanese federal/local and foreign governments.
    d. Mitsubishi Corporation identified challenges in three parts of the CCS value chain: capture and aggregation, transportation, and sequestration. The challenge in capture and aggregation is the difficulty in coordinating multiple CO_2 emitters to

share storage facilities and limited land availability for liquefaction facilities and storage tanks. Transportation challenge includes technological difficulties in buiding large CO_2 carriers and ship specifications facilities. And sequestration challenge includes policy and legal challenges such as liability policies and certification process.

Discussion Session

33. The Workshop noted the following highlights:

a. A question was raised regarding the transformation from gas recovery to CCS. BP Indonesia explained that the first project, the Tangguh CCUS, aims to enhance gas recovery through pressure maintenance and gas sweeping. The project's success will pave the way for more CCS investments, leveraging the large storage capacity in Tangguh, and make Tangguh as CCS hub by 2030.

b. Mitsui OSK Lines highlighted the potential expense as a challenge and emphasised the need for optimisation in finding the right size for aggregation. Additionally, the lack of a low-pressure solution in the Asia-Pacific market poses a challenge such as technicality and concept studies of CO_2 carrier.

c. Regarding standardisation for CCS projects, BP Indonesia affirmed the commitment to follow both Indonesian and international standards, working closely with the government for certification and emphasising compliance with regulations and monitoring project performance.

d. BP Indonesia explained that they are currently studying the feasibility of CCS project including discussion about customer impact or resistance to switch from CCUS to CCS, with both international and domestic emitters. The injection points for CCUS are strategically chosen to minimise impact on production, ensuring a smooth transition.

e. BP Indonesia clarified that although the objective of the Tangguh project is to generate carbon credits by capturing and storing CO_2 from produced gas. However, the primary business model of the Tangguh project may revolve around providing storage for CCUS, resulting in associated storage fees. The focus is placed on the decarbonising assets and the improvement of gas recovery.

Day 2 (21 November 2023)

SESSION 5: Transboundary Movement of CO_2

Presentation from Ashurst

34. Guy Dwyer, Counsel of Ashurst presented "International Environmental Law Considerations for Transboundary Movement of CO_2". The workshop noted the following highlights:
    a. The speaker explained key points from some international conventions and agreements related to the movement of CO_2, including the London Convention and London Protocol, UNCLOS, Basel Convention, Paris Agreement, and some other conventions (SOLAS and MARPOL). The first two are only applicable for involving countries, and they regulate carbon sequestration. The UNCLOS is providing a framework convention on "the constitutions of oceans and seas". The Basel Convention and Paris Agreement provide guidance on transboundary CO_2 movement and accounting of GHG inventories, respectively. The other last two conventions give clarity related to transporting the CO_2, especially in terms of the safety of the merchant ships and eliminating pollution from ships.
    b. The speaker elaborated on four issues and key observations in the transboundary movement of CO_2. First, the states need to take steps to ensure domestic legislation does not frustrate the carrying out of transboundary CO_2 movement. Second, greater knowledge sharing by industry players and the government through good communication and early stakeholder engagement is important. Third, the effort to emphasise CCS not only as a waste disposal service but also as an emission reduction technology still needs to be maximised. Last, CCS project actors and players must have a strong understanding of various legal/regulatory requirements and risks to ensure the progress of their projects.

Presentation from the Department of Climate Change, Energy, the Environment and Water (DCCEEW), Australia

35. Jen Deng Lee, Assistant Manager of DCCEEW presented "Australian Government Legislation Approach and Progress". The workshop noted the following highlights:
    a. There are three key legislations for domestic CCS projects in Australia: the Environment Protection Act of 1981, the Environmental Protection and Biodiversity Act of 1999, and the Offshore Petroleum and Greenhouse Gas Storage Act.
    b. The Australian Government has introduced a new bill that allows countries that do not have suitable offshore geological storage to export their CO_2 to Australia. This could give opportunities to help key regions and partners to reach their

decarbonisation target while maintaining energy security, which in turn would contribute to regional and global emissions reduction.

c. The existence of bills will establish a strong regulatory permitting system to responsibly manage potential risks and will ensure that offshore CCS activities will be regulated against a comprehensive and robust legal framework. This also provides certainty to businesses while considering the environmental impacts. The bill was developed through a comprehensive process for the last 12 months, including public hearings from legal academics, industry proponents, and government agencies, to understand how to address the issues in an appropriate way.

d. The international patron collaboration is important to facilitate removing CO_2 in a new way. In the Australian context, learning the business models and insights from Norway's and the UK's Northern Lights project has helped the country understand and benchmark its readiness levels in exporting CO_2 status of each country's domestic CCS legislation and bilateral instruments.

e. Some points needed to be considered following the London Protocol in a range of legal, economic, technical, and regulatory matters, including but not limited to emissions accounting, assessing and measuring the transport system, and ensuring appropriate and robust regulatory bodies. The extensive industry consultation is also needed to clarify expectations on the roles and responsibilities of exporting CO_2.

Presentation from Santos

36. Matt Sherwell, Manager of Policy & Regulatory Affairs of Santos, presented "Competitive Advantages to Enable CCS Success". The workshop noted the following highlights:

a. The transboundary movement of CO_2 may help the local and domestic economies reduce the cost of CO_2. Some players have the skills to establish the CCS hub, and others have the resources in the geology aspect. Therefore, players around downstream region will certainly help to reduce the cost to make CCS more accessible for other customers.

b. The transboundary movement of CO_2 is talking about exporting rather than importing of CO_2 because the project could not run if there is no ability to export CO_2 to another country. This makes the discussion on how to transport the CO_2, such as through existing pipeline may be also important. The speaker also emphasised some important points from previous speakers, such as the need of bilateral agreements and application of the transboundary CO_2 movement and

how to manage sea dumping permits. The bilateral agreements need to bring together all project proponents, including the importing nations, and list all of the potential requirements for those parties to get an arrangement. The sea dumping permit still has to be managed institutionally, and Australia itself still have much work to do to meet the London Protocol.

Discussion Session

37. The Workshop noted the following highlights:
    a. Australia is still under its way to revisit the current regulation, the Petroleum and Greenhouse Gas Act, to ensure that the regulation still meets the purpose for both offshore petroleum and offshore CCS projects. This revision includes the review for post-closure long-term liabilities. Furthermore, Australia still has a lot of work to do as part of clarifying the roles and responsibilities between governments and private sectors.
    b. Building awareness of the benefits of CCS is a key thing that would also benefit other countries and may help to push governments to provide incentives. In the Australian context, the current government's incentives are mostly given around the capture side because the highest cost of CCS comes from this side. Therefore, trying to push down the cost and accelerate the learning curve in carbon capture technology is important.
    c. Australian government sees the CCS projects as a way to help to reduce regional and global emissions by providing options to support other regions to decarbonise their regions. Therefore, on the dumping aspects, bilateral agreements from both exporting and receiving countries are needed to manage and protect the environment and to reduce the risks when doing the dumping process.
    d. London Convention only refers to dumping the CO_2 into the sea, and it makes no reference to the meaning of "sea" itself (whether seabed or subsoil). However, the London Protocol has revised this confusion and expressed the reference as the activity to put CO_2 onto the seabed.

SESSION 6: Group Discussion 1 - Geological Storage Development

38. The session was led by Chris Consoli and Aishah Hatta, with participation from several AMS delegates. The discussion noted the following highlights:
    a. The Global CCS Institute (GCCSI) 's latest facility updates showed that CCS projects worldwide are mapped through their CO2RE database. A real evolution in Southeast Asia is observed, with Indonesia leading in CCS projects. The

majority of projects are located in Indonesia, with a clear focus on natural gas decarbonisation in various areas of the region.

b. Apart from the Kasawari CCS project, most projects are in the early development phase, and limited public information is available for the entire region. The scarcity of knowledge on basins in the region was highlighted. The GCCSI has conducted basin storage assessments, considering around 40 criteria, including geology and hydrocarbon maturity. The assessment also includes resource estimates for saline formations and oil and gas fields.

c. Accessibility is a crucial factor, considering regulations and basin locations. Challenges in developing storage prospects emphasise the need for guidance on choosing basins for development. The accessibility aspect includes regulatory considerations and the location of basins.

d. The emission sources across various industries, which include cement, chemical, power, refining, steel, gas, and LNG, were covered in the discussion. Clusters of emissions within 100 kilometres are created, indicating prospective basins for hosting CCS networks.

e. The group also worked through each ASEAN country, noting the suitability of basins and storage resources. The group also discussed each of the sources (Comment D above) and sinks (the basins). There was general consensus on the overall findings of the Institute, with exceptions discussed below.

f. Chris highlighted that Vietnam's potential for storage is focused on offshore Southern Vietnam as limited information is available in Northern Vietnam’s Boc Bo-Yinggehai and Phu Khanh basins.

g. Discussion on a trunk line in the centre of Thailand was raised. The Pattani Basin and the Malay Basin are noted as promising ones. The need for data to support CCS projects, particularly in regions with limited information, was deemed critical. Ms. Apiradee Suwannathong from Thailand’s Department of Mineral Fuel (DMF) mentioned that the DMF and the Electricity Generating Authority of Thailand (EGAT) are planning a CCS project in onshore Lampang Basin with potential in Saline formations. However, she highlighted the need for a guideline of methodology, especially for saline formation, to calculate the resources.

h. The Philippines is considered a unique case in terms of geological storage for CO_2. Joseph M Foronda from PNOC highlighted the potential of mineralisation carbon storage with ophiolite basalt in the Luzon and West Luzon basins. He also highlighted that the lack of data has been one of the constraints in determining storage resources within the country. The North Palawan Basin, where offshore mainly gas-oriented with small oil fields are located, is the only region respected

for storage, having been included in every assessment for the past 20 years. The reservoirs nearing depletion in the area have a pipeline extending 500 kilometres, and there is a large coal-fired power plant in that area. However, the pipeline is still in use, and the reservoir is still producing. Moreover, there was a new discovery near the area that complicates the situation.

i. For Malaysia, Brunei and Indonesia, Chris highlighted multiple suitable storage opportunities within the basins with oil and gas field data. A common issue within these countries is limited data and studies on saline formation storage potential.

j. ExxonMobil's Sri Intan Wirya emphasised a critical concern related to storage in depleted reservoirs, specifically regarding flow assurance and wells as leak paths, exemplified by the Arun Field in Aceh, Indonesia. The substantial depletion of reservoir pressure, with the initial pressure at 7000 psi and the latest in 2005 reduced to only 500 psi, amplifies the risk. Additionally, the field has seen the drilling of 140 wells over its lifetime, introducing the potential for CO2 leakage paths and further complicating the risk landscape. She concluded with the need to expand the storage to saline formations to ensure enough storage resources within Southeast Asia.

k. The discussion continued with Chris highlighting how Australia's, the UK's, the US's, and the EU's storage evolution starts with a comprehensive storage database and ends with permitting storage acreage and investment on CCS projects. In Australia, the concept is a focused approach within a certain area and led by the Australian Geological Survey. In the UK, the government outsourced an assessment for the entire offshore region, publishing derived data on an Open Access database, and therefore anyone can download the data, although it was derived data.

l. In the United States, a localised storage atlas was compiled and integrated into the Department of Energy's Carbon Storage Atlas. During the workshop, it was proposed that the existence of this atlas played a pivotal role in prompting the government to establish the 45Q tax credit. Consequently, the implementation of the 45Q tax credit serves as an incentive for companies engaged in carbon capture and storage (CCS), encouraging them to inject CO2 and subsequently receive tradable tax credits. The EU adopted the “collaborate and diversify” approach similar to the US, with each country conducting individual storage analysis and consolidating in EU CCS Atlas, an open-access database. It has resulted in acreage release and permits for storage awarded within a short period.

m. Ms. Apiradee from DMF echoed this sentiment and suggested the establishment of a Storage Working Group. The purpose of this group would be to harmonise

methodologies and guidelines across Southeast Asia, with a particular focus on storage resources within saline formations and the creation of SEA Storage Atlas. The proposal emphasises the collaborative effort needed to streamline and standardise practices, fostering a cohesive approach to CCS initiatives in the region.

n. The conclusion of this session is that the region boasts multiple potentially suitable storage basins, yet the precise location and storage resources of saline formations remain unknown. Current resource estimates surpass the required capacity, but there is a lack of transparency in their details—such as location, methodology, and data sources. The majority of CCS activities in the region are concentrated around oil and gas fields, limiting the diversification of storage sites. Furthermore, access to relevant data is severely restricted, with a scarcity of open information in publications, government and survey reports, and industry databases. Addressing these issues is crucial for the successful implementation and expansion of CCS initiatives in Southeast Asia, necessitating increased transparency, diversified storage sites, and improved accessibility to data for stakeholders and the public alike.

o. The participants agreed to the establishment of the SEA Storage Working Group. This group aims to address the critical issue of the absence of a standardised methodology for calculating storage resources and the lack of a comprehensive database showcasing the storage potential in Southeast Asia that not only impedes a complete understanding of the region's capabilities but also acts as a barrier to attracting investors, financiers, and project developers interested in carbon capture and storage (CCS) initiatives in Southeast Asia.

SESSION 7: CCS Legal & Regulatory Frameworks

Presentation from Faculty of Laws, Chulalongkorn University

39. Piti Eiamchamroonlarp, Program Director, Faculty of Laws, Chulalongkorn University, presented “CCS Legal & Regulatory Frameworks: Recent Development in Thailand. The workshop noted the following highlights:

a. The presenter highlighted that Thailand may use the approach in which establishing law on CCS-related activities could be done by developing its current petroleum law to regulate CCS-activities sufficiently and effectively by looking at other countries’ experiences. One of the approaches is treating CO_2 as a part of petroleum production or by-products. This approach makes the development of CCS-specific law not necessary, however, the amendment of the Petroleum Act

1971 becomes a must by broadening its scope to CCS activities. Therefore, the PTTEP has the right to inject CO_2 back into the reservoir (for EOR purposes).

b. There are two licensing regimes that may be used in Thailand. The first one is by using the existing petroleum operator to obtain a CCS license, and the second is by introducing new CCS operators that need to be invested to obtain the CCS license.

c. In order to operate the project, the operator needs to have both a CCS license and an injection permit. The CCS license approves the rights to carry out operational activities, geographical areas where the activities can be carried out, and rules to be complied. On the other hand, an injection permit provides clarity in where, how long, and how much carbon dioxide can be injected. Moreover, it also consists of a monitoring plan, reporting plan, remedy measures, post-closure responsibilities, and responsibilities after the storage is transferred to the state.

Presentation from Allen & Overy

40. Scott Neilson, Partner, Allen & Overy, presented "CCS Legal and Regulatory Framework". The workshop noted the following highlights:

a. The presentation emphasised the importance of not characterising CO_2 as waste or the worst product in the world. The objectives of CCS (Carbon Capture and Storage) are not merely to dump CO_2 into geological storage, but to address current environmental and climate challenges.

b. The discussion needs to extend beyond simply mentioning the risks associated with CCS (Carbon Capture and Storage) projects. It's important to analyse the magnitude of each potential risk, determining whether it is significant or not. Viewing CO_2 as a valuable resource, akin to high-grade methane, suggests that it may be less hazardous than methane. Moreover, current expertise in geology and reservoir engineering is sufficiently advanced to manage these risks effectively.

c. The primary accelerators or drivers for implementing CCS projects largely stem from financing and government subsidies. This reliance on external funding makes CCS projects particularly challenging in developing countries despite their significant potential for geological storage. Consequently, developed countries should play a crucial role in financing and providing subsidies to these developing nations to facilitate realising these projects.

d. The establishment of an Emissions Trading Scheme (ETS) is essential for CCS (Carbon Capture and Storage) projects. With a well-designed ETS and incentives for CCS projects, the development of these initiatives could become more

straightforward. Additionally, the lack of regulation in Asian countries, including Malaysia and Thailand, further complicates the realisation of CCS projects.

e. Developing countries face numerous challenges when joining international conventions like the London Protocol. This often results in these countries struggling to effectively monitor their CO_2 disposal processes as outlined in the protocol.

Presentation from CDLP, U.S. Department of Commerce

41. Priya Prasad, Senior Attorney, CDLP, U.S. Department of Commerce, presented "Panel Discussion—Legal & Regulatory Frameworks. The workshop noted the following highlights:
    a. Partial involvement of governmental ministries may give a chance of unanswered questions related to CCS' impact on the environment and lack of assessing the safety of the project. Therefore, having collective involvement from all government ministries is important to play in improving regulation and legislation. For example, in Indonesia, MEMR and SKK Migas are likely to be the main regulators of CCS projects, while the Ministry of Environment may not be regulating and have no authority in CCS issues.
    b. Establishing communication with each CCS project location that is knowledgeable about oil and gas is crucial and cannot be overlooked. All sectors within the CCS (Carbon Capture and Storage) project region should be recognised as important stakeholders and actively engaged.
    c. Currently, ISO/TC 265 comprises 26 participating members and 17 observing countries. The establishment of standards within this group could greatly assist in creating a baseline for the CCS (Carbon Capture and Storage) value chain. These standards may be adopted entirely or partially, depending on the specific needs for standardisation. The United States has long referenced standards and best practices in its guidelines and frameworks, a practice that could be emulated by other countries undertaking CCS projects.

Discussion Session

42. The Workshop noted the following highlights:
    a. When no legally binding regulation is established, the use of standards may be useful as an instrument that could make CCS projects move forward. To this extent, the existence of comprehensive standards may act as a guideline to back up decisions chosen by developers and decision-makers. In addition, when drafting the regulation, inviting privates would be beneficial to gain input.

b. Developing countries have different problems with developed countries in deploying CCS projects. For developing countries, CCS projects are not only seen as a way to reduce carbon emissions, but they still need to see the opportunity to return the investment from CCS projects. Therefore, for developing countries, talking only about incentives and subsidies may not be adequate in realising rapid CCS project deployment. The owner of the storage may charge the bodies storing the CO_2 for licensing.

c. Although CCS projects may not always offer direct financial profit from the project for some developing countries, creating the CCS community could still help engage the country's economic activities. CCS projects may allow the countries to master the technology, develop new industries, and create new jobs and taxes from ships that come back and forth to enter the country.

SESSION 8: Group Discussion 2 - Geological Storage Development

43. The session, led by Siti Aishah Mohd Hatta, noted the following highlights:

a. The CCS Roadmap for Countries was presented with four main phases in CCS deployment, which include the Understand, Define, Execute, and Iterate phases. The discussion includes identification of the pain points and the current phase of each country in SEA.

b. The main pain point at the Understand phase is engaging with politicians at the beginning of the project rather than during the execution, which was deemed important. Aligning with politicians at an early stage would increase their understanding and support for the carbon capture and storage projects.

c. Aishah stressed the importance of establishing regulatory frameworks for carbon capture and storage (CCS) before initiating projects at the Define stage. The absence of clear regulations in ongoing projects within Southeast Asia poses a hindrance to the acceleration of CCS deployment, making it challenging for investors to make informed investment decisions.

d. Domingos Guterres from the National Authority of Petroleum Government of Timor-Leste emphasised the need for international storage guidelines, aiming to aid the government in formulating appropriate regulations for Carbon Capture and Storage (CCS). Ms. Apiradee proposed the discussion of ISO and other standards to be within the Storage Working Group to establish a common set of guidelines for Southeast Asia.

e. While Public Engagement and Education are expected at the Execute stage, Domingos, highlighted the experience of Timor Leste that the lack of

understanding about CCS among the general population posed a significant hurdle that needed to be addressed to ensure project success.

f. It was discussed that the current commercial facility could only reach a 75% CO_2 capturing rate, which is less than what was claimed, i.e., around 90%. Ways to improve the technologies to increase the capture rate that is sufficient to decarbonise the energy systems were seen as crucial. However, a discussion was raised on reasons for the lower capture rate, which might not be due to the technical limitation but rather more economical.

g. A number of success stories on CCS exist, but confidentiality is not evident. The Illinois project, which is a bioeconomy project that is operated by Archer Daniels Midland (ADM), involves the injection of 1 million tonnes per annum. Site monitoring has been ongoing for at least the last five years, and it showed smooth progress.

h. The problem of product price increases due to the inability to raise prices is being addressed. Take Singapore as an example; the government has already collected a small carbon tax. The feasibility of implementing CCS is tied to financial considerations, including the potential for host countries to relinquish crediting mechanisms for value chain activation.

i. It was discussed that it would be very challenging for developing economies and countries with lower GDP to be able to afford very expensive carbon payment technologies, including CCS. The challenges are further elevated as every politician for a certain time travel wants to increase their GDP rather than their cost.

p. The lack of standardised methodology for screening potential CCS projects is identified as a common issue across countries. The need for consistent approaches to understanding subsurface conditions and resource calculations is emphasised. The participants agreed that this will be tackled with the SEA Storage Working Group, proposed in Session 6.

j. The Philippines, Timor Leste, Brunei, Lao PDR, Myanmar and Cambodia acknowledged their position in the early stage of CCS development i.e., Understand Phase. Limited data on reservoirs and the absence of a regulatory framework pose challenges.

k. Indonesia, Malaysia, Thailand, Vietnam, Singapore, Japan and South Korea are in Define phase with the focus in on establishing the policy and regulatory framework, cost-benefit analysis and financial incentives.

SESSION 9: Economics, Finance, and Policy

Presentation from Global CCS Institute

44. Mr. Eric Williams, a representative of the Global CCS Institute, delivered his presentation. The Workshop noted the following highlights:
    a. Introduction of GENZO, the Global Economic Net Zero Optimization Model. GENZO is technologically rich, representing various sectors and allowing for trade in energy and commodities.
    b. All scenarios, aligned with net-zero pathways, vary in CO_2 storage growth: low, accelerated, and unconstrained. Despite differences, each achieves net zero through distinct pathways. The low growth scenario prioritises renewables, energy efficiency, and green hydrogen, costing $31 trillion. The accelerated growth scenario involves more CCS in electricity and industry, costing $11 trillion. The unconstrained growth scenario maximises CCS, direct air capture (DAC), and bioenergy, with CCS costing $9 trillion.
    c. Low storage growth, prioritised on bioenergy with CCS, has a significantly higher marginal cost of $4,500 per ton in 2050 than accelerated storage and unconstrained storage of $500 to $300 per ton.
    d. The cost was broken down by country. Low storage growth scenario costs varied by country, with Malaysia having the highest multiple (five times more than the unconstrained scenario). In contrast, Singapore has the lowest multiple (just over two times).
    e. To capitalise on the cost-reduction opportunity offered by CCS, it's essential to establish a policy, legal, and regulatory framework. This framework should result in clear financial incentives that will enable the timely development of storage capacity and investment in carbon capture and transport.

Presentation from Global CCS Institute

45. Ms. Christina Staib, representative of the finance sector from Global CSS Institute, delivered her presentation. The Workshop noted the following highlights:
    a. The Institute focuses on advocacy, finance-focused thought leadership, and collaboration with CCS finance stakeholders to increase capital allocation to CCS projects. Ongoing outreach to the finance sector aims to understand CCS financing status and address challenges. Thought leadership includes reports like "CCS Business Models," examining clean hydrogen, clean ammonia, and CCS retrofit.

b. Several factors affecting CCS financing are the finance-ability of CCS projects, increased policy support worldwide, and total capture capacity of CCS projects in the pipeline increased.
c. Increased investment is predominantly driven by policy tools and regulations that create economic value from climate mitigation investment.
d. Momentum in the U.S. with finance ability dependent on project-specific factors. Factors impacting faster progress include lower cost of capture, large emission volumes, multiple revenue streams, corporate balance sheets financing the CCS project, vertical integration, secure off-take agreements, and limited transportation costs such as accessing existing CO_2 storage infrastructure. Obtaining financing for CCS faces challenges such as permit uncertainties, concerns about well-permitting for CO_2 injection, difficulty in permitting new CO_2 pipelines, and public acceptance.

Presentation from the World Bank

46. Mr. Harshit Agrawal, a representative of the World Bank, delivered his presentation. The Workshop noted the following highlights:
    a. Allocating limited development finance across different sectors is a significant challenge for developing countries. Thus, balancing the need for access to energy, affordability, and climate goals is crucial.
    b. CCS is recognised as a global public good, implying that its return on investment differs from that of commodities like oil and gas. CCS shares similarities with the oil and gas sector in aspects such as expertise, scale, investment size, environmental and social considerations, and permitting processes. However, the most notable difference lies in the project duration; CCS projects typically take longer to complete than oil and gas projects.
    c. CCS projects typically progress through three phases: Studies and Framework Development, Pilots and Demonstration, and Full-scale Project Demonstration. De-risking takes place as projects advance through these phases, attracting private-sector investment. Initial funding often comes from grants, loans, public funds, and international financial institutions. As projects evolve, public-private financing partnerships become more prevalent, with public investment contributing significantly to de-risking.

Presentation from Economic Research Institute for ASEAN & East Asia (ERIA)

47. Dr. Han Phoumin, ERIA, delivered his presentation. The Workshop noted the following highlights:

a. There were some key developments in CCUS, in 2022, there was a significant increase in CCS projects. ASEAN has a great potential for successful deployment of CCUS with regulation development to erase gaps between regulations for CCUS. Lastly, financing is still one of the most critical issues for CCUS development.
b. Technical risks and regulatory risks are significant barriers to CCUS financing and uncertainties in revenue streams due to various assumptions. Government subsidies and risk-sharing arrangements often become necessary for CCUS financing.
c. Recent trends show that for every dollar invested in fossil fuels, $1.7 is invested in clean technology and renewables. Around $2.7 trillion is estimated to be invested in the energy sector, with $1.7 trillion going to clean technology, including CCUS. Data from the Global CCS Institute reflects the growing global presence of CCUS projects, primarily driven by government subsidies. Government support, such as tax incentives and subsidies, is crucial in improving the revenue stream for CCUS projects.
d. The recently released ASEAN taxonomy version two designates CCUS as an enabling sector. Banks should feel more confident in financing various components of the CCUS value chain based on the new taxonomy.
e. Other barriers to CCUS development are mainly policy, regulation and business model issues. To facilitate CCUS deployment, policy/regulation/incentives need to be developed to de-risk investments, banking or financiers need to see if any technical guideline has been developed and adopted in the CCUS value chain for guidance and to investigate a reliable and predictable revenue stream. Lastly, making the project bankable by considering an incentive scheme.

Discussion Session

48. The Workshop noted the following highlights:

a. A cheaper option for Southeast Asia to decarbonise the local economy other than CCS technology was inquired. The potential affordability of CCS in the long run was emphasised along with the need for governments to see the value of CCS in meeting climate goals.
b. Regarding the modelling assumption that resulted in a high incremental cost on CCS deployment in Malaysia, it was clarified that Malaysia does not necessarily have higher incremental costs; the modelling reflects potential savings with CCS deployment. The focus is on the potential savings that Malaysia can achieve with widespread CCS implementation.

c. Regarding the economic drivers that would incentivise financing CCS projects, it was discussed that it is important to reduce uncertainty and de-risk projects along with the development of policy frameworks, legal clarity, and pilots and demonstrations of projects to attract private investments.

d. The importance of carbon pricing and learning from examples like the EU's Emission Trading System was discussed, emphasising the need for ASEAN to initiate discussions and not wait for external forces, ensuring uniform carbon pricing.

e. The challenge and complexity of relying on governments to sustain carbon pricing was acknowledged, particularly with changing leadership.

Closing

49. Ian Havercroft, Acting General Manager of Knowledge & Analysis, at Global CCS Institute, delivered his Closing Remarks. He believed that this Workshop could continue to generate momentum in the context of CCS, address policy, legal, and regulatory issues, and welcome ongoing input from stakeholders. He summarised new project announcements, significant policy initiatives, and emerging legislation that was presented in the Workshop and recognised the huge opportunity for widespread deployment in the region and the benefits of collaboration within the group. He highlighted the importance of fostering close relationships and partnerships with various regional initiatives. He extended thanks to ACE as partner in delivering SEACA and expressed his appreciation for the hospitality of the Indonesian government. He thanked all the speakers and participants for their attendance and acknowledged the effort and support of the Global CCS Institute team.

ANNEX 1 – WORKSHOP AGENDA

Day 1. 20 November 2023

Time	Activities
08:00 – 08:45	**Registration**
08:45 – 08:50	**Welcome & Introduction to SEACA** • **Alex Zapantis**, General Manager External Affairs, Global CCS Institute
08:50 – 08:55	**Statement by Host Government, Indonesia** • **Ir. Mustafid Gunawan** M.E, Director of Oil and Natural Gas Program Development, Directorate General Oil and Gas, Ministry of Energy and Mineral Resources
08:55 – 09:00	**Statement by Asia Natural Gas & Energy Association** • **Alex Yelland**, Director of Policy,
09:00 – 09:05	**Statement by Indonesia CCS Center** • **Belladonna Maulianda**, Executive Director
09:05 – 09:15	**Statement by ASEAN Center for Energy (ACE)** • **Nuki Agya Utama**, Executive Director
09:15 – 09:25	**Summary of First SEACA Workshop** • **Alex Zapantis**, General Manager External Affairs, Global CCS Institute
09:25 – 10:40	**South East Asian Government Perspectives** • **Suwanto**, Senior Research Analyst, ASEAN Center for Energy (ACE), Indonesia • **Firdaus Wajdi,** Directorate General Oil & Gas, Ministry of Energy and Mineral Resources, Indonesia • **Year Chansaravuth**, Deputy Director, General Department of Energy. Ministry of Mines and Energy, Cambodia • **Keopaseuth Ketumala**, Deputy Director, Department of Mining Management, Ministry of Energy and Mines, Lao • **Apiradee Suwannathong**, Senior Geologist, Department of Mineral Fuels, Ministry of Energy, Thailand • **Mohd Helmi Zaiban**, Deputy Director, Energy Commission of Malaysia
10:40 – 11:00	**Break**

11:00 – 12:00	**CCS Project Developer, Contributor, Financier Perspectives** • **Rizky Muhammad Kahfie**, General Secretary, Indonesia CCS Center. "Opportunities, Challenges and Current Milestone for CCS Project Development in South East Asia" • **Priya Prasad**, Senior Attorney, Commercial Law Development Program (CLDP), U.S. Department of Commerce. "CCS Deployment: US Perspective" • **Harshit Agrawal**, Senior Energy Specialist, World Bank. "Catalyzing CCUS Deployment in Developing Economies"
12:00 – 13:00	**Lunch**
13:00 – 15:00	**CCS Project Developer, Contributor, Financier Perspectives** • **Alex Yelland**, Director of Policy, Asia Natural Gas & Energy Association. "Building Asia's CCUS Value Chain" • **Kenta Asahina**, Specialist for Research & Development, Ministry of Economy Trade and Industry – Japan. "Japan's Initiatives to Launch CCS business" • **Egon van der Hoeven**, Senior Vice President, Business Development, ExxonMobil. "Advancing CCS in Southeast Asia" • **Masumi Takanashi**, Project Director, Hydrogen and CCS Project Department, JOGMEC. "JOGMEC's Initiatives for CCS Deployment in ASEAN and Japan" • **Sue-Ern Tan**, Head, Policy and Advocacy, Asia Pacific, Shell, "A Partner of Choice in CCUS" • **Soichiro Kunihiro**, Business Development Manager, CCUS Team, Energy Innovation Initiative, Sumitomo Corporation. "Towards Asia Zero Emission" • **Matt Sherwell**, Manager Regulatory and Policy Affairs, Santos. "Progress of Santos' CCS projects"
15:00 – 15:30	**Break**
15:30 - 1700	**CCS Project Developer, Contributor, Financier Perspectives** • **Masatoshi Numano**, General Manager, CCUS & Offshore Unit, Mitsui OSK Lines. "MOL's CCUS Activities" • **Howard Smith**, Director Industrial Ecologies and Government Lead, CCUS, Northern Territory of Australia. "Common Ground: Linking the Northern Territory CCS Hub with Southeast Asia" • **Zulfikri Agus**, Performance Manager, BP Indonesia. "Tangguh CCUS/CCS: An Indonesian National Strategic Project" • **Kite Birzer**, Manager Business Development, Mitsubishi Corporation. "Latest CCS activities by Mitsubishi Corporation"
17:00 – 17:15	**Day 1 Close** • **Alex Zapantis**, General Manager External Affairs, Global CCS Institute
18:00	**Reception and ANGEA & GCCSI Memorandum of Understanding Signing Ceremony**

Day 2. 21 November 2023

Time	Activities	
0850 – 09:00	**Day 2 Opening** **Alex Zapantis**, General Manager External Affairs, Global CCS Institute • Opening Day 2	
09:00 – 10:30	**Transboundary Movement of CO_2** Panel session facilitated by Ian Havercroft, Acting General Manager - Knowledge & Analysis, Global CCS Institute • **Guy Dwyer**, Counsel – Ashurst • **Jen Deng Lee**, Assistant Manager, DCCEEW **Matt Sherwell**, Manager Policy & Regulatory Affairs, Santos	**Geological Storage Development** Opening Remarks by **Chris Consoli**, Principal Consultant Storage, Knowledge and Analysis, Global CCS Institute. **Group Discussion 1: Storage Development for Deployment** A roundtable discussion focused on creating an enabling environment for storage operators in SE Asia facilitated by **Chris Consoli** Discussion topics: • What can governments do in the pre-competitive data acquisition space? • How can the private sector support the development of storage resources in SEA? • Would a SEA CCS Atlas help?
10:30 – 11:00	**Break**	
11:00 – 12:30	**CCS Legal & Regulatory Frameworks** Panel session facilitated by Ian Havercroft, Acting General Manager, Knowledge & Analysis, Global CCS Institute • **Piti Eiamchamroonlarp**, Programme Director, Faculty of Laws, Chulalongkorn University • **Scott Neilson**, Partner, Allen& Overy • **Priya Prasad**, Senior Attorney, CDLP, US Department of Commerce	**Geological Storage Development - continued** Sharing Session on Storage Roadmap by **Aishah Hatta**, Senior Storage Lead, Global CCS Institute **Group Discussion 2: Storage Development and Pain Points** A roundtable discussion focused on Storage Development and Pain Points facilitated by **Aishah Hatta** Discussion topics: • Current position of each country. • Feedback and challenges faced in storage development. • Discussion on potential solutions and collaborative approaches to address these pain points.
12:30 – 13:30	**Lunch**	

13:30 – 15:00	**Economics, Finance & Policy** Panel session facilitated by Alex Zapantis, General Manager External Affairs, Global CCS Institute • **Eric Williams**, Principal Economist, Global CCS Institute. • **Christina Staib**, Global Public Affairs Lead – Finance Sector - Global CCS Institute. • **Harshit Agrawal**, Senior Energy Specialist, World Bank. • **Han Phoumin**, Senior Energy Economist, Economic Research Institute for ASEAN & East Asia	
15:00 – 15:30	**Break**	
15:30 – 15:45	**Report Back to Plenary**	
15:45 – 16:00	**Workshop Close** • **Alex Zapantis**, General Manager External Affairs, Global CCS Institute	

ANNEX 2 – WORKSHOP DELEGATES

FIRSTNAME	SURNAME	ORGANISATION	COUNTRY
Adhityo	Bhaskoro	ASEAN Centre for Energy (ACE)	INDONESIA
Alex	Zapantis	Global CCS Institute	AUSTRALIA
Alex	Yelland	ANGEA	SINGAPORE
Ang Bee	Ting	Petroleum Authority of Brunei Darussalam	BRUNEI
Ann Nathashia Pelaga Mathiew Paran		Petroleum Sarawak Berhad (PETROS)	MALAYSIA
Apiradee	Suwannathong	Department of Mineral Fuels	THAILAND
Armando Y	Perez Jr.	Department of Energy	PHILLIPINES
Azmi Nanda	Fadilah	Directorate General Oil and Gas, Ministry of Energy and Mineral Resources	INDONESIA
Balada	Amor	The World Bank	INDONESIA
Bobby	P	Directorate General Oil and Gas, Ministry of Energy and Mineral Resources	INDONESIA
Budi Mulia	Haryono	IFC World Bank	SINGAPORE
Caroline	Sanjoyo	International Finance Corporation (IFC) Jakarta	INDONESIA
Cheryl	Whiteley	Global CCS Institute	AUSTRALIA
Chitra Ria	Ariska	Directorate General Oil and Gas, Ministry of Energy and Mineral Resources	INDONESIA
Chris	Consoli	Global CCS Institute	AUSTRALIA

Christina	Staib	Global CCS Institute	USA
Citra	Endah Nur Setyawati	ERIA	INDONESIA
Diofanny	Swandrina Putri	Indonesian CCS Centre	INDONESIA
Domingos	Teixeira Guterres	Autoridade Nacional do Petróleo e Minerais	TIMOR LESTE
Dr Mohammad Rachmat	Sule	Center of Excellence for CCS/CCUS, Bandung Institute of Technology (ITB)	INDONESIA
Dr. Belladonna	Maulianda	Indonesian CCS Centre	INDONESIA
Dr. Harshit	Agrawal	The World Bank	SINGAPORE
Dwi Adi	Nugroho	Directorate General Oil and Gas, Ministry of Energy and Mineral Resources	INDONESIA
Egon	Van der Hoeven	ExxonMobil	INDONESIA
Eric	Williams	Global CCS Institute	AUSTRALIA
Evan lukas satya	karmendra	Indonesian CCS Centre	AUSTRALIA
Fahrur Rozi	Firmansyah	Directorate General Oil and Gas, Ministry of Energy and Mineral Resources	INDONESIA
Firdaus	Firdaus Wadji	Directorate General Oil and Gas, Ministry of Energy and Mineral Resources	INDONESIA
Frederic	Draps	Ashurst	INDONESIA
Guy	Dwyer	Ashurst	AUSTRALIA
Hajah Siti Noor Hafiizah Haji	Mohammad	Petroleum Authority of Brunei Darussalam	BRUNEI

Han	Phoumin	ERIA	INDONESIA
Hasreena Binti	Hashim	Ministry of National Resources, Environment and Climate Change	MALAYSIA
Hendra	Halim	BP	INDONESIA
Hiroshi	Nambo	Global CCS Institute	JAPAN
Howard	Smith	Northern Territory Government, Australia	AUSTRALIA
I Gusti	Suarnaya Sidemen	ERIA	INDONESIA
Ir. Mustafid	Gunawan M.E	Ministry of Energy and Mineral Resources	INDONESIA
Jaturong	Jerdsakulboon	PTT Exploration and Production Public Company Limited (PPTTEP)	THAILAND
Jen Deng	Lee	CCUS & Hydrogen Collaborations, DCCEEW	AUSTRALIA
Jessie	Choi	SK E&S	KOREA
Justin	Oettmeier	ExxonMobil	THAILAND
Kazuki	Kobayashi	Japan Organization for Metals and Energy Security (JOGMEC)	JAPAN
Kenta	Asahina	Ministry of Economy, Trade and Industry of Japan (METI)	JAPAN
Keopaseuth	Ketumala	Ministry of Energy and Mines, Lao PDR	LAO
Khairunissa Syifa Faadhilah	Widodo	PT. Mitsui	INDONESIA
Kite	Birzer	Mitsubishi Corporation	JAPAN

Kwon Seok	Jeong	SK E&S	KOREA
Lee Won	Yeob	SK e&s	KOREA
Long	Nguyen	Vietnam Petroleum Institute	VIETNAM
Luky	Yusgiantoro	SKK Migas	INDONESIA
Luthfi	Rais	PT Mutsui	INDONESIA
Mamik	Cahyono	Directorate General Oil and Gas, Ministry of Energy and Mineral Resources	INDONESIA
Marivic	Uzarraga	Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP)	THAILAND
Masatoshi	Numano	MOL	JAPAN
Masumi	Takanashi	Japan Organization for Metals and Energy Security (JOGMEC)	JAPAN
Matt	Sherwell	Santos	AUSTRALIA
Mohd	Amirulazry Bin Mohd Amin	Energy Commission of Malaysia	MALAYSIA
Mohd	Helmi Mohd Zaihan	Energy Commission of Malaysia	MALAYSIA
Mr.	Kusnandar	Directorate General Oil and Gas, Ministry of Energy and Mineral Resources	INDONESIA
Ms	Sularsih	Directorate General Oil and Gas, Ministry of Energy and Mineral Resources	INDONESIA
Muhamad Ihasani	Prawira	International Finance Coporation	INDONESIA
Muhammad Hafidz Bin Abdul	Halim	PETRONAS	MALAYSIA

Nattaporn	Meetanatharvorn	PTT Exploration and Production Public Company Limited (PPTTEP)	THAILAND
Nazrin	Shaikh	Petroleum Sarawak Berhad (PETROS)	MALAYSIA
Nella	Riskiana	Directorate General Oil and Gas, Ministry of Energy and Mineral Resources	INDONESIA
Nick	Milne	Macquarie Bank	SINGAPORE
Noor Arifin	Muhammad	Ministry of Energy and Mineral Resources	INDONESIA
Nuki	Agya	ASEAN Centre for Energy (ACE)	INDONESIA
Pattanapong	Plukmonton	PTT Exploration and Production Public Company Limited (PPTTEP)	THAILAND
Peter	Gavan	Macquarie Bank	SINGAPORE
Peter	Cockcroft	Asia-Pacific Net-Zero Institute Pte Ltd	TIMOR LESTE
Piti	Eiamchamroonlarp	Faculty of Law, Chulalongkorn University	THAILAND
Priya	Prasad	US Department of Commerce	USA
Rakesh	Ranjan	PETRONAS Carigali Sdn Bhd	MALAYSIA
Reza	Radityastuty	BP	INDONESIA
Rizky Muhammad	Kahfie	Indonesian CCS Centre	INDONESIA
Ryan Wiratama	Bhaskara	ERIA	INDONESIA
San	Sophal	Ministry of Mines and Energy	CAMBODIA

Sangaji Budi	Budi Utomo	Directorate General Oil and Gas, Ministry of Energy and Mineral Resources	INDONESIA
Sawanya	Opaskornkul	PTT Exploration and Production Public Company Limited (PPTTEP)	THAILAND
Scott	Neilson	Allen & Overy	JAPAN
Soichiro	Kunihiro	Sumitomo corp, Energy innovation initiative	JAPAN
Sri Intan	Wirya	Exxon Mobile	THAILAND
Sue-Ern	Tan	Shell	SINGAPORE
Suhaila Binti	Arshad	PETRONAS	MALAYSIA
Sukiman	Mohamed	ExxonMobil	MALAYSIA
Suwanto		ASEAN Centre for Energy (ACE)	INDONESIA
Tanaka	Hideaki	PT JGC	INDONESIA
Valerio Joseph	Foronda	PNOC Exploration Corporation	INDONESIA
Vansit	Vasongsa	Ministry of Energy and Mines	LAO
Venessa Allia	Aiman	Directorate General Oil and Gas, Ministry of Energy and Mineral Resources	INDONESIA
Wuttipong	Kongphetsak	Office of Natural Resources and Environmental Policy and planning (ONEP) Thailand	THAILAND
Year	Chansaravuth	General Department of Energy	CAMBODIA
Yoel	Frederick	Directorate General Oil and Gas, Ministry of Energy and Mineral Resources	INDONESIA

Yoshitake	Kato	Japan Organization for Metals and Energy Security (JOGMEC)	JAPAN
Yuki	Nakatomi	Mitsui O.S.K. Lines, Ltd (MOL)	JAPAN
Zulfikri	Agus	BP	INDONESIA