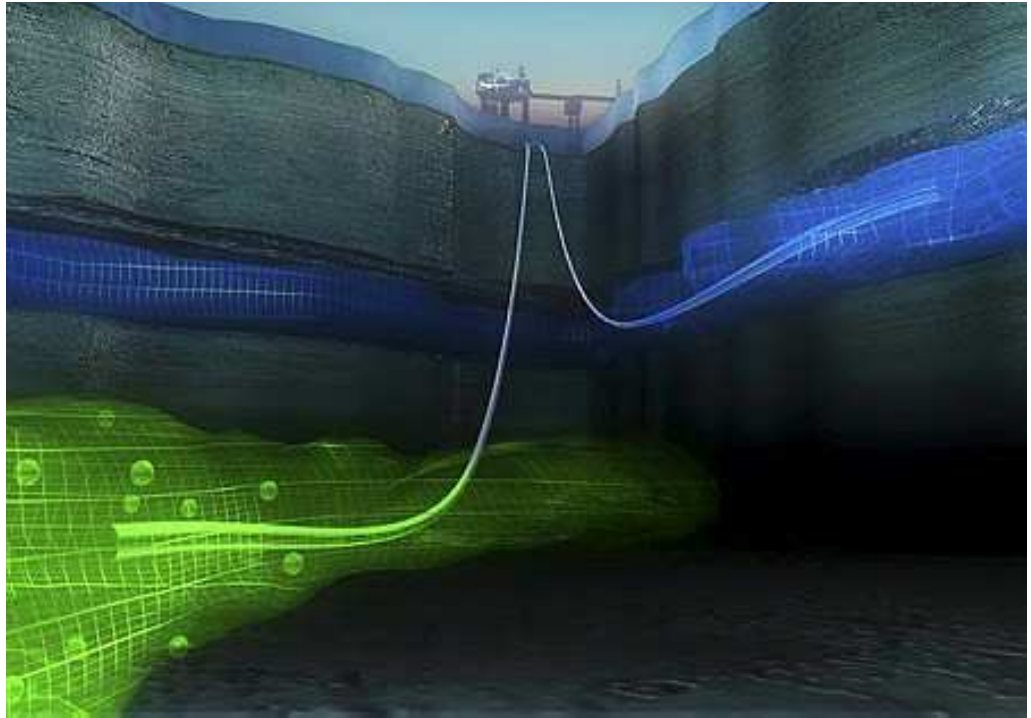


# REPORT

## Workshop on Evaluation of CO<sub>2</sub> Storage Potential



10-11  
December  
2012

Institut Teknologi Bandung

### Organized by

CCOP (Coordinating Committee for Geoscience Programs in East and Southeast Asia), GAI (Geological Agency Indonesia), ITB (Institut Teknologi Bandung), and PETRAD (International Program for Petroleum Management and Administration)



### Supported by

PT Pertamina



## **I Objectives**

This workshop aims to have a better understanding on the role of CCS in mitigating the impact of GHG to climate changes, to enhance the capacities of the participants on the assessment of potential geological storage of CO<sub>2</sub>, and to prepare the participants from Indonesia for their important role as a case study country in the CO<sub>2</sub> Storage Mapping – a new 4-year regional capacity building program of CCOP on CCS.

## **2 Participants and Resource persons**

The workshop has been attended by 67 participants, namely:

1. The representatives from oil and gas regulatory and supervisory agencies, research organizations, national oil and gas companies, data management organization, geological agencies, geo-environmental organizations, and academic institutions with geosciences and environmental programs in Indonesia.
2. Resource persons from Norwegian, Indonesian agencies/organizations and CCOP.

## **3 Date & venue**

1. Date : 10 - 11 December 2012
2. Venue : Campus Center Auditorium, Institut Teknologi Bandung (ITB), Bandung, Indonesia.

## 4 Implementing / coordinating organizations

Implementing or coordinating organizations of this workshop are the PETRAD (International Programme for Petroleum Management and Administration), Geological Agency of Indonesia (Ministry of Energy and Mineral Resources of Republic Indonesia), Institut Teknologi Bandung (ITB), and CCOP Technical Secretariat. The Royal Norwegian Embassy – Jakarta acts as main sponsor of this activity. PT Pertamina was the sponsor during the welcoming dinner conducted on December 10<sup>th</sup>, 2012.

## 5 Achievement and Results

The workshop started with a welcoming message from the workshop organizer and a brief introduction about the workshop agenda and expected deliverables. In the opening ceremony session, the welcoming remark was given by **Dr. R. Sukhyar**, the Chairman of CCOP Steering Committee from Indonesia and also the Head of Geological Agency of Indonesia. The second welcoming remark was delivered by **Prof. Sri Widiyantoro**, the Dean of Faculty of Mining and Petroleum Engineering, Institut Teknologi Bandung. The last remark was given by Ms. Marianne Damhaug, the Minister Counselor of Royal Norwegian Embassy - Jakarta. They welcomed all the participants and highlighted the importance of this event for the common future. The event's opening ceremony ended with the tokens exchange and photo sessions. After short coffee break, the participants got an opportunity to hear a keynote address, which was given by **Dr. Naryanto Wagimin**, the Upstream Director of Directorate General of Oil and Gas. He presented Indonesia's oil and gas overview and challenges on upstream sector.

The workshop was held on December 10 and 11, 2012, and attended by 67 participants. There were 12 presentation topics from 8 presenters started with the CCS overview, regulation, site selection and qualification, CO<sub>2</sub> storage capacity

evaluation, static and dynamic modeling of geological storage, geophysical monitoring of reservoir, storage options with hydrocarbon recovery, case studies of CO<sub>2</sub> storage, Norwegian experience, CCS researches in Indonesia, and was closed with the open discussion on the possibilities of storing CO<sub>2</sub> in geological storage in Indonesia.

The first presenter was **Dr. Per Christer Lund**. He presented the Carbon Capture and Storage (CCS) overview, global challenges and some Norwegian experiences. He revealed that CCS is recognized as an important tool for combating climate change. The key technologies are available, but there are some major challenges, i.e. the large and costly plants, high energy penalty – reducing energy efficiency, and confidence in permanent storage. He mentioned that Norway is a frontrunner on CCS projects and explained several experiences from the Sleipner CO<sub>2</sub> storage project (since 1996), the Snøvit CO<sub>2</sub> storage project (since 2008), and the European CO<sub>2</sub> Technology Centre Mongstad. Currently Norway is actively seeking international collaboration on research and demonstration projects and technology transfer on CCS. In addition, he mentioned that Asia is regarded as one of the most interesting regions for CCS because there are the huge potential for CCS on coal-power plants and the huge potential for CCS and EOR from CO<sub>2</sub>-rich gas fields.

**Ms. Eva Halland** presented the overview of CO<sub>2</sub> geological storage including the characterization of aquifers and structures, reservoir quality, sealing quality, leak risk, data coverage and evaluation process for the safety and effective storage sites of CO<sub>2</sub>. She also presented the regulation and capacity evaluation of CO<sub>2</sub> storage, including the parameters for storage capacity calculation, sample workflow of a quantitative and quantitative analysis, expertise and tools needed and the conditions evaluation for a development of a storage site offshore Norway.

Regarding the CO<sub>2</sub> storage regulation, she revealed the legal framework that has been established by the directive on the geological storage of CO<sub>2</sub> for the environmental safety of CO<sub>2</sub> geological storage. It covers all CO<sub>2</sub> storage in

geological formations in the EU, and lays down requirements covering the entire lifetime of a storage site. Two important things that considered in the legal framework: Ensuring that there is no significant risk of leakage or damage to the health or the environment (extensive requirements for the site selection); and Preventing any adverse effects on the security of the transport network or storage site (The CO<sub>2</sub> stream must consist overwhelmingly of CO<sub>2</sub>, closely monitored, closure and post-closure obligations, financial security)

**Mr. Tor Fjaeran** presented lesson learned from some case studies of CO<sub>2</sub> Storage such as in Sleipner, In Salah, Snøhvit and Mongstad. He also mentioned the CCS commercialization and its barriers, business out of CO<sub>2</sub>, monitoring and development technology needed, and the contribution from governments & private sector to make CCS happen.

**Mr. Utomo Pratama Iskandar** presented the assessment of CCS value chain in Indonesia based on the key findings from the previous study with UK Governments, TOTAL, and LEMIGAS cooperation research. He mentioned that CCS potential in Indonesia, inventory of CO<sub>2</sub> emission and possibility of CO<sub>2</sub> storage and CCS deployment strategy in Indonesia. He concludes that the most suitable short term deployment of CCS in Indonesia will be in the oil and gas upstream sector. The use of CO<sub>2</sub> for EOR provides a driver and early mover for deploying CCS particularly for Indonesia. More than 600 Mt of CO<sub>2</sub> is able to store at the depleted oil and gas in Indonesia while the latest study indicates South Sumatra offers various of geological formation with capacities more than 10 Gt of CO<sub>2</sub>. Low hanging fruit of CO<sub>2</sub> source will be supplied from gas processing plant. To move forward the CCS development in Indonesia, the effort should be based on the developed roadmap. The CCS roadmap developed provides an analytical footing that enables the stakeholders to move forward on specific actions, address unidentified key issues, and take timely action.

**Dr. Benjamin Sapiie** presented the overview of CCS pilot study at Gundih field, Central Java, including G&G characteristic of CCS reservoir target, tentative results and the future plan and target. Gundih field was operated by PT. Pertamina EP, which has initial gas in place 435,96 BSCF and could produce 62 MMSCFD in 12 years. CO<sub>2</sub> content which generated directly from the field is 21% from total gas, whereas if after through CPP the percentage of CO<sub>2</sub> produced is about 15% from total gas in this field. The results show that Ngrayong Formation in Gundih field doesn't have a big closure to inject CO<sub>2</sub>. The formation has an open structure to the northern part that will have a possibility to migrate the injection of CO<sub>2</sub>. In addition, Kujung Formation does not provide sufficient storage capacity. However, uncertainty factor is still large since many assumptions are used to generate the model properties. There is a possibility that the injection at Ngrayong Formation will be leak to the surface or charging into Caluk structure through the northern fault. For future works, it will concentrate in determining possible location in the northern part of Gundih Field with most likely residual trapping mechanism.

**Dr. Roman Berenblyum** presented the site selection and qualification, including the first screening, sample work, as well as data, information, tools and expertise needed. He further explained the static and dynamic modeling of geological storage particularly potential pathways for CO<sub>2</sub> leakage and the effect and risk of tectonics. He also mentioned the storage options with hydrocarbon recovery. In his last presentation, he emphasized other questions remaining that need to be considered such as CO<sub>2</sub> source (volume required is varying with time) and costs, materials, capacity, and legislation.

**Simplicio P. Caluyong** presented the CCOP CO<sub>2</sub> mapping program. The goal of program is to enable government organizations in the CCOP member countries to provide a high level overview of the potential for large-scale CO<sub>2</sub> storage. Whereas the outcomes of this program are to form a consensus on the methodology, enhance the capacity of member countries, develop the Atlas of CO<sub>2</sub> Storage in the CCOP region, facilitate the sharing of information – GIS & metadata system, further

collaboration – CCS & EOR potential, estimate the compatible capacity, and establish the guidelines for National CO<sub>2</sub> Storage Mapping.

During the workshop, there a tour to the Geological Museum and the welcome dinner activities were conducted in the complex of Geological Agency of Indonesia, which is situated at Jalan Diponegoro No. 57 Bandung. In the welcome dinner, the students from ITB gave the Rampak Kendang performance. Rampak Kendang is an Indonesian traditional performance using 'Kendang' as the main instrument and played together in a group ('Rampak'). It is originally from West Java.

In general the workshop was conducted smoothly and successfully.

## 6 Program

### **Program on December 10, 2012**

Time	Item	Person/Organization
08:30	Registration	ITB/GAI/CCOP TS
09:00	<b>Opening Ceremony</b> <ul style="list-style-type: none"> <li>• <u>Welcoming Remarks</u> <ul style="list-style-type: none"> <li>○ Dr. R. Sukhyar</li> </ul> </li> <li>○ Prof. Sri Widianoro</li> <li>• <u>Opening Remarks</u> <ul style="list-style-type: none"> <li>○ Ms. Marianne Damhaug</li> </ul> </li> </ul> <b>Exchange of Tokens</b>	Chairman, CCOP Steering Committee Representative of Indonesia to CCOP and Head of Geological Agency, Ministry of Energy and Mineral Resources  Dean of FTTM Institut Teknologi Bandung  Minister Counselor Royal Norwegian Embassy - Jakarta

09:20	<b>Keynote Address</b> State of the Art on the 40+ years of success for Indonesia E & P Business and what is the next challenge?	<i>Dr. Naryanto Wagimin</i> Upstream Director Directorate General of Oil and Gas
09:40	Group Photo	
09:45	Coffee/Tea	
10:15	<b>Introduction and Background of the seminar</b>	<i>Mr. Simplicio P. Caluyong</i> CCOP Technical Secretariat
10:30	<b>CCS overview – the Norwegian experience</b> <ol style="list-style-type: none"> <li>1. What is CCS and where are we now?</li> <li>2. Climate change issues- the global challenges</li> <li>3. The Norwegian experience</li> </ol>	<i>Dr. Per Christer Lund</i> Norwegian Environmental Technology Center Royal Norwegian Embassy- Tokyo
11:15	<b>Overview of Geological Storage of CO<sub>2</sub></b> <ul style="list-style-type: none"> <li>• R &amp; D</li> <li>• Storage screening and selection overview</li> <li>• Storage options overview</li> <li>• Aquifer potential</li> </ul>	<i>Ms. Eva Halland</i> Norwegian Petroleum Directorate Norway
11:45	<b>Case Studies of CO<sub>2</sub> Storage</b> <ul style="list-style-type: none"> <li>• Lessons learned</li> <li>• What are the barriers for commercialization of CO<sub>2</sub> Storage projects?</li> <li>• How can governments &amp; private sector provide solutions?</li> </ul>	<i>Mr. Tor Fjaeran</i> Statoil Indonesia
12:15	Lunch Break	
13:30	<b>CO<sub>2</sub> Storage Regulation</b> <ul style="list-style-type: none"> <li>• Legal requirements</li> <li>• Technical requirements: exploration, monitoring and abandonment</li> </ul>	Ms. Eva Halland Norwegian Petroleum Directorate, Norway
14:00	<b>CCS in Indonesia:</b> Roadmap of CCS in Indonesia and Preliminary results of CCS Pilot Study in Merbau Field, South Sumatra	Mr. Utomo Pratama Iskandar LEMIGAS
14:30	<b>CCS in Indonesia:</b> Preliminary results of CCS Pilot Study in Gundih Field, Central Java	Dr. Benyamin Sapiie ITB
15:00	Coffee break <i>and transfer from ITB Campus to Geological Museum</i>	



16:30	Tour : Geological Museum	ITB/GA
18:00	Welcome Dinner	Host: Pertamina (Indonesia) <i>Venue- Geological Museum (Auditorium)</i>

### **Program on December 11, 2012**

<b>Time</b>	<b>Item</b>	<b>Person/Organization</b>
09:00	Announcements from the Chair	Chairperson
09:10	<b>Site Selection and Qualification</b> <ul style="list-style-type: none"> <li>What international standards are available as reference?</li> <li>Data and information needed</li> <li>Device/tools and expertise required</li> <li>Sample workflow</li> </ul>	<i>Dr. Roman Berenblyum</i> IRIS AS Norway
09:40	<b>CO<sub>2</sub> Storage Capacity Evaluation</b> <ul style="list-style-type: none"> <li>Key data needed</li> <li>Standard methodologies – for international acceptance</li> <li>Parameters for storage capacity calculation</li> <li>Sample workflow of a quantitative and quantitative analysis</li> <li>Expertise and tools needed</li> </ul>	<i>Ms. Eva Halland</i> Norwegian Petroleum Directorate, Norway
10:10	Coffee/Tea	
10:40	<b>Static and Dynamic modeling of geological storage</b> <ul style="list-style-type: none"> <li>Including potential pathways for CO<sub>2</sub> leakage</li> <li>Effect and risk of tectonics</li> </ul>	<i>Dr. Roman Berenblyum</i> IRIS AS Norway
11:25	<b>Geophysical monitoring of reservoir, overburden and surface</b> <ul style="list-style-type: none"> <li>Tools and devices</li> <li>Where, what &amp; when to monitor? How long?</li> </ul>	<i>Mr. Tor Fjaeran</i> Statoil Indonesia
12:00	Lunch	
13:30	<b>Storage Options with</b>	<i>Dr. Roman Berenblyum</i>

	<b>hydrocarbon recovery</b>	IRIS AS Norway
14:15	<b>The CCOP CO<sub>2</sub> Mapping Program</b> Regional mapping program of CO <sub>2</sub> storage potential in the region	<i>Simplicio P. Caluyong</i> CCOP Technical Secretariat
15:00	Coffee/Tea	
15:30	<b>Open Discussion: Possibilities of Storing CO<sub>2</sub> in Geological Storage in Indonesia</b> <ul style="list-style-type: none"> <li>• What are the opportunities?</li> <li>• What are the barriers?</li> <li>• How to overcome these barriers?</li> </ul>	All
16:30	<ul style="list-style-type: none"> <li>• Summary of the Workshop</li> <li>• Evaluation and feedback</li> <li>• Awarding of Certificates</li> <li>• Final announcements</li> <li>• Closing Remarks</li> </ul>	Chairman and resource persons CCOP CCOP/Norway CCOP/ITB/GAI PETRAD
18:30	Farewell Dinner	Host: CCOP TS <i>Venue- The Valley Restaurant</i>

## 7 Committees

Steering committee :

Dr. Sukhyar (GAI)  
Prof. Dr. Wawan Gunawan Kadir (ITB)  
Simplicio P. Caluyong (CCOP)

Organizing committee:

Dr. Rachmat Sule (ITB)  
Dr. Susanti Alawiyah (ITB)  
Edi Purnomo (GAI)  
Ayu Purnamasari (Secretary)

## 8 List of Participants

No	Name	Position / Address	Distinguished guests/resource persons/participants
1	Dr. R. Sukhyar	Chairman, CCOP Steering Committee Permanent Representative of Indonesia to CCOP Head of Geological Agency Ministry of Energy and Mineral Resources (ESDM)	Distinguished Guests
2	Dr. Øystein Berg	Managing Director, International Programme for Petroleum Management and Administration (PETRAD)	Distinguished Guests
3	Ms. Marianne Damhaug	Minister Counselor Royal Norwegian Embassy - Jakarta	Distinguished Guests
4	Mr. Ole Eikum	Commercial Counselor Royal Norwegian Embassy - Jakarta	Distinguished Guests
5	Mr. Tor Fjaeran	President Director Statoil Indonesia	Resource Persons
6	Ms. Eva Halland	Project Director - Norwegian Petroleum Directorate (NPD)	Resource Persons
7	Dr. Roman Berenblyum	Research Director Field Studies and New Recovery Technology International Research Institute Stavanger (IRIS) AS	Resource Persons
8	Dr. Per Christer Lund	<u>Counselor</u> for Science and Technology Norwegian Environmental Technology Center (NETC) Innovation Norway Royal Norwegian Embassy	Resource Persons

9	Dr. Naryanto Wagimin	Upstream Director Directorate General of Oil and Gas Ministry of Energy and Mineral Resources - Indonesia	Resource Persons
10	Mr. Utomo Iskandar Pratama, S.T.	Researcher - PPPTMBG LEMIGAS Research and Development Centre For Oil and Gas Technology	Resource Persons
11	Prof. Sri Widianoro	Dean of Faculty of Mining and Petroleum Engineering Institut Teknologi Bandung	Resource Persons
12	Ir. Benyamin Sapiie, Ph.D	Geology Institut Teknologi Bandung	Resource Persons
13	Mr. Simplicio P. Caluyong	CCOP Technical Secretariat	Resource Persons
14	Dr. Mohammad Rachmat Sule	Lecturer and Geophysicist, Research Division of Applied Geophysics Faculty of Mining and Petroleum Engineering Institut Teknologi Bandung	Participant
15	Dr. Susanti Alawiyah	Lecturer and Geophysicist, Research Division of Applied Geophysics Faculty of Mining and Petroleum Engineering Institut Teknologi Bandung	Participant
16	Prof. Awali Priyono	Lecturer and Geophysicist, Faculty of Mining and Petroleum Engineering Institut Teknologi Bandung	Participant
17	Dr. Agus Laesanpura	Lecturer and Geophysicist, Faculty of Mining and Petroleum Engineering Institut Teknologi Bandung	Participant
18	Dr. Fatkhan	Lecturer and Geophysicist, Faculty of Mining and Petroleum Engineering, ITB.	Participant

19	Dede Ibnu Suhada, ST	Geologist Center for Geological Resources - Geological Agency	Participant
20	Asep Kurnia Permana	Geological Agency	Participant
21	Cornelia Situmorang	Business Development Engineer Total E&P Indonesia	Participant
22	Imma Nuella	Business Development Engineer Total E&P Indonesia	Participant
23	Dr. Jatmiko Prio Atmojo	Geothermal Subsurface Specialist Pertamina UTC	Participant
24	Siti Sitawati	PT. Medco E&P Indonesia Energy Build 36th Fl., Jl Sudirman, SBD, Jakarta	Participant
25	Harwan Hutagulung	Pertamina UTC	Participant
26	Joko Wahyudiono	Geological Agency	Participant
27	Yudi Rahayudin, ST. MT	Education and Training Center for Geology	Participant
28	Ariesty Asikin, M.T	PhD Student Geophysical Engineering Institut Teknologi Bandung	Participant
29	Putri Diah Ekowati	Magister Student Petroleum Engineering Institut Teknologi Bandung	Participant
30	Eko Januari Wahyudi, MT.	PhD Student at Applied Geophysics Institut Teknologi Bandung	Participant
31	Andri Hendriyana, M.T.	PhD Student at Applied Geophysics Institut Teknologi Bandung	Participant
32	Martanto, ST	Geophysical Engineering Institut Teknologi Bandung	Participant
33	Seiful Huda, ST	Geophysical Engineering Institut Teknologi Bandung	Participant
34	Dadi Abdurrahman, ST	Magister Student of Applied Geophysics, ITB	Participant

35	Sabar P.S.	Graduate Student Institut Teknologi Bandung	Participant
36	Ayunda Aulia Valencia	Magister Student Geophysical Engineering Institut Teknologi Bandung	Participant
37	Fernando Lawrens	Magister Student Geophysical Engineering Institut Teknologi Bandung	Participant
38	Rony Darmawan	Aeronautics & Astronautics Institut Teknologi Bandung	Participant
39	Bima Tesdayu	Geophysical Engineering Institut Teknologi Bandung	Participant
40	Mia Uswatun Hasanah	Magister Student Geophysical Engineering Engineering ITB	Participant
41	Rhesa Garcia Fendri	Undergraduate Student Geophysical Engineering Institut Teknologi Bandung	Participant
42	Anggara Pradipta	Undergraduate Student Geophysical Engineering Institut Teknologi Bandung	Participant
43	Usamah Haritsuddin	Undergraduate Student Geophysical Engineering Institut Teknologi Bandung	Participant
44	Edi Purnomo	Geological Agency	Participant
45	Prof. Eddy A. Subroto	Dean of FITB-ITB Bandung Institute of Technology	Participant
46	Dr. Bambang Priadi	Vice Dean for Academic Affairs of FITB-ITB Bandung Institute of Technology	Participant
47	Dr. Dina Sarsito	Vice Dean for Resources of FITB- ITB Bandung Institute of Technology	Participant
48	Dr. Aisyah Kusuma	ITB & Pertamina Geothermal Energy	Participant

49	Dr. Yunus Kusumahbrata	Secretary of Geological Agency Ministry of Energy and Mineral Resources	Participant
50	Asep Kurnia Permana	Geological Agency Email :permana_ak@yahoo.com	Participant
51	Anggraeni Ratri Nurwini, ST	Directorate of Energy Conservation Directorate General of New Renewable Energy and Energy Conservation - MEMR	Participant
52	Dra. Yanni Kussuryani, M.Si.	Head of PPPTMBG LEMIGAS	Participant
53	Dr. Andri Dian Nugraha	Applied Geophysics Institut Teknologi Bandung	Participant
54	Alditama Prihadi	Magister Student Geophysical Engineering Institut Teknologi Bandung	Participant
55	Akhmad Fanani Akbar	Geophysical Engineering Institut Teknologi Bandung	Participant
56	Mochammad Hafid Rahadi	Geology Institut Teknologi Bandung	Participant
57	Ony Kurnia Suganda	Volcanologist / PVMBG Geological Agency	Participant
58	Alexandra Limbung	Geological Agency	Participant
59	Mimin Iryanti	Geophysical Engineering Institut Teknologi Bandung	Participant
60	Ida Heriwati	Geophysical Engineering Institut Teknologi Bandung	Participant
61	Asep Nursalim	PVMBG - Geological Agency	Participant
62	Putnut P	Geophysical Engineering - UNSOED	Participant
63	Hasbi Ash S	Geophysical Engineering Institut Teknologi Bandung	Participant

64	Ivan	Upstream Director Directorate General of Oil and Gas Ministry of Energy and Mineral Resources - Indonesia	Participant
65	Elenora A	PhD Student Applied Geophysict Institut Teknologi Bandung	Participant
66	Bryan Whildan Arsaha	Undergraduate Student Geophysical Engineering Institut Teknologi Bandung	Participant
67	Medhina Magdalena	P3TB EBTKE – Batlibang ESDM	Participant



## 9 Some Photos taken from the Workshop



Dr. R. Sukhyar



Prof. Sri Widianoro



Ms. Marianne Damhaug

Presenters gave welcoming and opening remarks in the 1<sup>st</sup> day's workshop



Dr. Naryanto Wagimin



Dr. Per Christer Lund



Ms. Eva Halland



Mr. Tor Fjaeran

Presenters gave the presentations in the 1<sup>st</sup> day's Workshop





Mr. Utomo Iskandar Pratama



Ir. Benyamin Sapiie, Ph.D



Dr. Roman Berenblyum



Mr. Simplicio P. Caluyong

Presenters gave the presentations in the Workshop



Workshop's participants were listening the presentations



Workshop's participants were asking the question to presenters of symposium





Presenters and participants of the CCS Workshop at Institut Teknologi Bandung





Pertamina gave sponsorship for welcome dinner  
and Rampak Kendang performance





Rampak Kendang performance  
was given by Students Association of Sundanese Culture, Institut Teknologi Bandung