Heat of Absorption of CO2 in Aqueous Solutions of DEEA, MAPA and their Mixture

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GHGT-11
Conference Programme

11th International Conference on Greenhouse Gas Control Technologies

CCS: Ready to Move Forward

18th - 22nd November 2012
Kyoto International Conference Center - Japan
GHGT-11

Conference Programme

11th International Conference on Greenhouse Gas Control Technologies

CCS: Ready to Move Forward

18th - 22nd November 2012
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www.ghgt.info • ghgt11@ghgt.info
Steering Committee

As you can imagine, a lot of preparation and work goes into the establishment of the GHGT conferences, and a large part of this work is conducted by the Steering Committee. The Steering Committee is comprised of a mix of representatives from the hosts; in the case of GHGT-11, RITE, and the conference custodians, IEAGHG.

The Steering Committee is co-chaired by Prof. Kaya from RITE and Mr Gale from IEAGHG, and under their leadership the committee has arranged the conference, with assistance from the Technical Programme Committee (TPC) who worked from the Expert Review Panel suggestions to formulate the technical programme.

Some committee members perform dual roles, such as Prof. Yamaji and Mr Dixon, who co-chaired the TPC, and Mrs Twinning, who sits on the Steering Committee and acts as secretariat for the TPC.

Mr. John Gale (co-chair)
Prof. Yoichi Kaya (co-chair)
Mr. Tim Dixon
Prof. Kenji Yamaji
Mr. Takashi Honjo
Ms. Akemi Sasaki
Mrs. Siân Twinning
Mr. Toby Aiken

Sponsors / Supporters / Contributors 80
Welcome

The Steering Committee would like to take the opportunity to welcome you to the 11th International Conference on Greenhouse Gas Control Technologies, and to the beautiful city of Kyoto. As you are no doubt aware, the GHGT conference series has established itself as the premier international platform for the presentation of cutting edge research and the latest developments in CO₂ Capture and Storage technologies, and you are part of it.

When the series started in 1992, CCS was very much a novel concept with limited research at the laboratory scale underway around the world. Having seen a significant technological development in recent years, CCS is now at the phase where large demonstration projects operate around the world, which will be followed by commercial deployment.

To facilitate demonstration and deployment, developments are still needed in the areas of CO₂ capture, transportation, storage and the integration of these components, both in terms of reliability and efficiency. Legal and regulatory frameworks, funding, and communication with stakeholders on CCS will all require consideration in the surrounding political and financial environments.

This unique situation, with significant technological developments awaiting the final breakthroughs in the areas outlined above, led to the theme for the conference:

*CCS: Ready to Move Forward.*

Building on Previous Success

Since its 1992 inception, the conference has grown from strength to strength, and we are happy to see this trend continuing for this 11th event. With recent global economic conditions, there was a fear that delegate numbers and attendance would drop, but despite this, and the more remote location for many potential participants, it would appear that GHGT-11 has held its place, and continues to be the conference of choice for many researchers. It is anticipated that GHGT-11 will attract between 1200 and 1400 delegates, demonstrating this continued success.

GHGT-10, held in Amsterdam in 2010 held a very successful exhibition where delegates were able to get in touch with the exhibitors’ technologies and experiences, and enter into free discussions relating to these technologies.

GHGT-11 will also hold an exhibition, to facilitate technology suppliers to get in touch with researchers again, and hopefully overcome barriers for widespread deployment, forge new relationships and partnerships and move CCS technology forward.

Social Programme

The social programme will comprise of a Welcome Reception and registration on Sunday the 18th of November, and a Conference Dinner on Wednesday the 21st of November. More information on this can be found on page 10.
Meet the Organisers

About RITE

The Research Institute of Innovative Technology for the Earth (RITE) was established in 1990 as a centre of excellence to conduct research on technologies for mitigating global warming, by the joint efforts of the government of Japan and Japanese industries.

The direction of its research activities is in line with the concept of the “New Earth 21” plan proposed by the Japanese government which envisages stabilisation of carbon dioxide concentrations in the atmosphere by developing long term innovative technologies for substantial reduction of carbon dioxide emissions.

RITE focusses its attention mainly on the following three areas:

- Bio-refinery technologies for transforming cellulose into biofuels,
- Technologies for carbon dioxide capture and storage (CCS), and
- Scenario studies on future paths toward low carbon society.

RITE has already conducted an experiment in 2003-04 of storing 10,000 tons of CO₂ in the subsurface at a depth of one thousand meters in Nagaoka, a city in Northern Japan, which provided a wealth of useful information on the behavior of CO₂ stored deep underground.

Recognising the international nature of global warming studies, RITE has been conducting research with intense collaboration with international institutions such as IIASA and DOE in USA.

RITE also hosted the second International Conference on Carbon Dioxide Removal (ICCDR-2) in 1994 and GHGT-6 in 2002 both in Kyoto.

About IEAGHG

The IEA Greenhouse Gas R&D Programme (IEAGHG) is an international collaborative research programme established in 1991 as an Implementing Agreement under the International Energy Agency (IEA).

The primary role of IEAGHG is to be an informed source of impartial information on greenhouse gas mitigation options. This is achieved by the instigation and management of research studies, technological evaluations, and maintenance of a series of international research networks that serve as a platform for academics, researchers and industrial parties to share information and experiences and to discuss new developments.

IEAGHG studies and evaluates technologies that can reduce greenhouse gas emissions derived from the use of fossil fuels. The Programme aims to provide its members with definitive information on the role that technology can take in reducing greenhouse gas emissions.

IEAGHG takes pride in being an informed but unbiased source of technical information on greenhouse gas mitigation.

The programme’s main activities are:

- To evaluate technologies aimed at reducing greenhouse gas emissions,
- To help facilitate the implementation of potential mitigation options,
- To disseminate the data and results from evaluation studies, and
- To help facilitate international collaborative research, development and demonstration activities (R,D&D).
Technical Programme Committee and Expert Review Panel

The Technical Programme Committee (TPC) is responsible for the content, organization and programming of all the conference technical programme for GHGT-11. Over 1200 abstracts were received, and the initial task of evaluating these fell to the Expert Reviewers. These consisted of over 140 internationally recognised experts from 16 countries, and each abstract was independently reviewed by at least 2 experts.

The TPC evaluated these reviews, made decisions on the selection of papers, and allocated them to sessions. This task was extremely intensive. The organisers would like to thank both the TPC and the Expert Reviewers for their outstanding and diligent work; without them, there would be no technical programme for you to enjoy.

The TPC was greatly assisted by Mrs Siân Twinning who carried out the TPC secretariat duties.

The TPC are listed here, but the Expert Review Panel is too extensive to list in a printed programme, they are thanked all the same and they are listed with gratitude on the conference website:

www.ghgt.info.
General Information

Cloakroom & Luggage Facilities

The Kyoto International Conference Center has 2 cloakrooms on the ground floor where luggage may be left. All personal belongings must be collected by the end of the day.

Emergency Contact Numbers

While we will ensure that every aspect of the conference runs without a hitch, if for any reason you are in need of emergency assistance, the following numbers should be used while in Japan.

Police: 110
Fire Service / Ambulance: 119

Public Transport - Getting Around Kyoto

The Kyoto International Conference Center has its own stop on the Karasuma Line, and the stop is Kokusaikaikan (K01) Station. Kyoto’s subway system is quick and convenient, and most areas are accessible using the subway. There are two lines, one running North-South; the Karasuma Line, and one running East-West; the Tozai Line. Included in your registration is a 5 day pass for the subway, valid for travel from Sunday the 18th of November to Thursday the 22nd of November.

GHGT-11 Blog and Twitter Hashtag

For the first time, a GHGT conference has its own dedicated blog site and pre-determined Twitter Hashtag. The Blog will be regularly updated with interesting points raised for discussion, and will hopefully generate a lively debate.

Please use #GHGT11 in your tweets, so that all tweets can be easily and quickly found and read. We may even use some of these in the Conference Summary Brochure.

The Blog can be found at www.ghgt-blog.org and is a Wordpress blog, so either download the Wordpress app to comment on the move, or alternatively, view the blog online, and click the Follow link for new posts to be delivered to your email inbox.

Wireless Internet

Wireless LAN will be available in the main lobby and outside the conference rooms while in the Kyoto Conference Center.

Language & Translation

All presentations, plenary, keynote and technical, will be in English, however a subsidy has been made by Global Industrial and Social Progress Research Institute (GISPRI) for simultaneous translation of the plenary, keynote and closing sessions into Japanese.

This money has been donated specifically to fund this, and sits outside of the funding for the conference, and is not paid for in any way by delegate registration fees or sponsorship.

The organisers would like to take this opportunity to thank GISPRI for this facility, and explain a little about the organisation.

GISPRI was established as a public interest corporation on December 1, 1988, under the provisions of Article 34 of the Civil Code and the authorization of the Minister of International Trade and Industry.

Their objective is to conduct research in a broad spectrum of issues related to global resources, environment, international regimes, industry, economy, culture and society, based on its awareness that the role and responsibility of Japan in the international community has been mounting in tandem with Japan’s increasing economic and social presence. GISPRI also seeks to present policy proposals based on its research and surveys for both domestic and international entities, while promoting exchange of information and ideas to help contribute to the prosperity of the global society.

More information is available at www.gispri.or.jp

Orizuru (Folded Crane)

This Orizuru created by Japanese traditional origami paper, is the same one seen flying in the short video screened at the Opening Session.

The production of the video is also specifically funded by GISPRI.
Chair & Presenter Guidelines

Information for Session Chairs

Please take a moment to identify the session you are chairing or co-chairing and identify its location using the conference centre map shown on page 19. Please ensure that you arrive at your session room before the session commences, to allow the technical assistants to explain any specific functionality of the room and to allow session speakers to make themselves known to you.

Information for Speakers in an Oral Session

Again, using the map shown on page 19, please ensure you arrive at your designated session room with plenty of time to spare to ensure that you are familiar with the presentation and AV equipment in the room, and make your presence known to the session chairs.

Each presentation in the technical parallel sessions is allocated 15 minutes for the presentation, and 5 minutes for subsequent questions. All presenters are asked to stick to their allocated time, as the smooth running of the conference relies on strict adherence to the time schedule. The session chair will notify you of how your allocated time is progressing, and will manage the time allocated to questions.

Presenters are asked to upload their presentations no later than the day before your scheduled talk; note that if you are due to present on Monday the 19th, you will be required to upload your presentation on Sunday the 18th at the registration and welcome reception.

Information for Poster Presenters

Presenters of posters are required to locate their allocated poster board and ensure that their poster is mounted by the end of Monday in preparation for the poster sessions on Tuesday and Wednesday.

The event hall will be open between 09.00-17.30 on Monday the 19th of November for presenters to mount their poster. You will be provided with push pins to allow you to mount your poster, and these will be available from the administration desk within the poster hall.

For confirmation of board numbers, please see poster board allocations in the poster session details on pages 42-79. The posters must remain on display until Thursday afternoon as the posters will be accessible during lunch and breaks as well as during the dedicated sessions.

To facilitate discussions and conversations with the poster authors, there are 2 poster sessions scheduled, for further information, please see the poster floorplan and session details from pages 40 onwards.

Posters should be removed during the lunch break on Thursday the 22nd of November. Any posters remaining after 14.00 on this day will be disposed of. Unfortunately the organisers are not able to accept any responsibility to store or return to authors posters that remain on display past this deadline.

Greenman Award, 2012

The GHGT conference series has a tradition of making an award to an individual whose vital contributions towards progressing the CCS technologies, and enhancing our understanding of the process of mitigating greenhouse gas emissions, is recognised.

The 2012 Greenman Award recipient has been identified, and the award will be made at the conference dinner on Wednesday the 21st.

Former recipients of this prestigious award are:

- Meyer Steinberg; 1996
- Wim Turkenburg; 1996
- Yoichi Kaya; 1996
- Olav Kårstad; 2006
- William D. Gunter; 2008
- Howard Herzog; 2010
- Peter Cook; 2010
Social Programme

The GHGT-11 Steering Committee have organised a 2-part social programme for the conference, commencing with a Welcome Reception, and concluding with the Conference Dinner.

Welcome Reception, Sponsored by the Global CCS Institute

The Welcome Reception will run alongside the conference registration on the evening of Sunday the 18th of November, at the Hotel Granvia Kyoto.

The Hotel Granvia Kyoto, Registration & Welcome Reception, Sunday 18th November, 17.30 - 21.00

The Registration and Welcome Reception opens from 17.30 until 21.00 on the 18th of November. Any delegate who is unable to attend the reception can obtain their badge and delegate pack each morning at the conference venue.

The Welcome Reception gives delegates a chance to listen to a few select speakers, welcoming you all to the conference and to Kyoto itself. Delegates will also have ample opportunity for networking, to reaquant with old contacts, and forge new relationships for the future.

The reception will include a welcome address by John Gale of IEAGHG. This will be followed by addresses by the Kyoto Prefectural Governor and the Kyoto City Mayor. Brad Page of the Global CCS Institute will then address the delegates which will be followed by a traditional Kagami-Biraki Ceremony. This involves a ceremonial mallet being used to break the seal of a Japanese Sake barrel.

The delegate pack will also include your 5-day Kyoto subway pass, so be sure to keep this safe as it will facilitate easy travel between the conference venue, your hotel and the beautiful city of Kyoto.
Conference Dinner

The Conference Dinner for GHGT-11 will be held in the Westin Miyako Hotel Kyoto, which stands on the Higashiyama Hills, to the East of the city, overlooking the beautiful ancient capital. Please use your subway pass to reach the hotel which is located close to the subway Keage (T09) station. The use of buses or taxi’s is not recommended due to heavy traffic.

The Conference Dinner is traditionally the highlight of the social programme, and this year it promises to be no different. The relaxed evening provides ample opportunities to reflect on the previous 3 days of successful presentations, and to indulge in a spot of local culture. It also provides a relaxed environment in which to unwind a little and continue to network with colleagues and contacts old and new.

The Westin Miyako Hotel Kyoto, Conference Dinner, Wednesday 21st November, 19.00 - 22.00

There will be a few short presentations and speeches to accompany the dinner, and you are encouraged to come along and celebrate the success of the conference.

The Conference Dinner will also be the point at which the Greenman Award is presented for GHGT-11.

GHGT-11 Student Reception

As with previous GHGT events, the Student Reception enables students to meet and discuss what they have heard with their peers, as well as selected industry experts to help to build the blocks for their future careers within CCS and to forge new connections and business contacts.

The GHGT-11 Student Reception will be held in the Banquet Hall Swan of the Kyoto International Conference Center on the evening of the 20th of November, between 18.00 and 20.00.

Invitations to this event will be restricted to students of the GHGT-11 Student Mentoring Programme, IEAGHG International CCS Summer School Alumni, invited students registered for GHGT-11 and selected experts from industry and academia, chosen to encourage student-expert networking and collaborations.

The evening will include an informal introduction and welcome to the students on behalf of IEAGHG, a keynote presentation from an industry expert and further networking with refreshments available.
Plenary Sessions & Keynote Speakers

Monday 19th November, 09.00 - 11.00
Chair: Dr. Kelly Thambimuthu, Chair of IEAGHG ExCo

Welcome Addresses:

Professor Yoichi Kaya, President, RITE
Graduating from the University of Tokyo in 1957, Professor Kaya joined RITE in 1998 as Director General and became the President in 2011. He specialises in system engineering in the fields of energy and environment, and has a particular interest in global warming issues.

Mr Koichi Akaishi, METI
Mr Akaishi is the Deputy Director General for Global Environmental Affairs at METI. In a long and impressive career history, he has held several other Director level positions within METI, as well as for JETRO based in Brussels. He graduated with an LLB from the University of Tokyo, and will give a welcome address on behalf of the host government.

Keynote Talks:

‘Aiming for True Harmony between Energy and the Environment’
Mr Atsutoshi Nishida, Chairman of the Board, TOSHIBA.
Mr. Nishida joined Toshiba Corporation in 1975, and following assignments that included serving as Senior Vice President of Toshiba Europe and President of Toshiba America Information Systems, he was appointed President and Chief Executive Officer of Toshiba in 2005.

‘International Progress on CCS: Current Status and Recommendations for the Future’
Mr Brad Page, CEO, Global CCS Institute
Prior to his role at the Institute, Brad served as CEO of the Energy Supply Association of Australia, and also served as an active member of the Australian Government Business Roundtable on Climate Change, the CSIRO Energy Transformed Flagship Advisory Committee, and the Australian Government Energy White Paper High-Level Consultative Committee.

‘CCS Projects are Becoming Reality - the USA Demonstration Program’
Dr Jay Braitsch, Senior Advisor, Office of Fossil Energy USDOE.
Jay has worked in various program offices including fossil, renewable, nuclear and energy efficiency. Current activities focus on a variety of cost-reduction CO₂ capture/utilisation technologies, as well as safe and permanent CO₂ storage. Jay earned a BS in Electrical Engineering from Cornell University, and a PhD in Systems Engineering from Ohio State University.

Tuesday 20th November, 08.30 - 09.20
Chair: Mr. John Gale, General Manager, IEAGHG

Technical Plenary Speakers

‘A Global Vision for CCS - Revisiting the IEA CCS Roadmap’
Mr. Juho Lipponen, Head of CCS Unit, IEA
Juho manages a team of six specialists analysing various aspects of CCS, from technical and economic issues to policies, incentives and regulatory frameworks. Prior to joining the IEA, Mr Lipponen worked for the European power industry federation, Eurelectric, as Head of the Energy Policy and Power Production Unit.

‘The Global Gas Supply Revolution - Scale, Cost and the Implications for CCS’
Dr. Francis O’Sullivan, Executive Director, Energy Sustainability Challenge programme, MIT
Frank’s research interests span a range of topics related to energy systems and energy economics. His current work is focused on the energy-water nexus, and on unconventional oil and gas resources, particularly the production dynamics and associated economics of North America shale plays. Prior to joining MIT, he acted as a consultant with McKinsey & Company.
Wednesday 21st November, 08.30 - 09.20
Chair:  Mr. Tim Dixon, Manager: CCS & Regulatory Affairs, IEAGHG

Technical Plenary Speakers
‘GHGT 101: Carbon Storage in Japan’
Dr. Kozo Sato, Director, Frontier Research Centre for Energy and Resources, The University of Tokyo
Studying at the University of Tokyo, and Stanford University, Dr. Sato gained first his B.E. degree, then a Ph.D. in the Petroleum Engineering Department. He went on to work for the Teikoku Oil Company, before joining the University of Tokyo, first as an associate professor, then a full professor, where he remains as Director of the Frontier Research Centre for Energy and Resources.

‘Deployment of CO₂ Capture Technology in Energy Intensive Industry - Challenges Ahead: A Case Study for the Steel Industry’
Henk Reimink, Executive Director, Energy Sustainability Challenge Programme, World Steel Association
Henk joined the World Steel Association in November 2008 being accountable for all activities on Safety and Health, manufacturing processes and systems in the iron and steel industry value chain and Climate Change mitigation techniques as well as a global regulatory overview.

Thursday 22nd November, 08.30 - 09.20
Chair:  Mr. John Gale, General Manager, IEAGHG

Technical Plenary Speakers
‘Overview and Recent Developments on CO₂ Transport Infrastructure’
Chris Hendriks, Managing Consultant, Ecofys
Chris Hendriks is an international consultant on sustainable energy. He received his PhD in 1994, with a thesis on CO₂ removal from coal-fired power plants. He was an initiator of the ICCDR conference series which later merged to form the GHGT conference series. He works as an advisor in the field of CCS, renewables and energy efficiency for both government and private organisations.

‘Beyond Kyoto - More Effective Framework for Climate Change’
Keigo Akimoto, Chief Researcher and Group Leader of the Systems Analysis Group, RITE
Keigo holds a Ph.D. and is a guest professor of the Graduate School of Art and Science, University of Tokyo, and a lead author of Working Group III of the Intergovernmental Panel on Climate Change (IPCC) for the 5th assessment reports. He is also a member of several advisory committees on energy and environmental policy for Japanese government.
Final Panel Discussion and Closing Session

**Final Panel Discussion,**

*Thursday 22nd November, 14.00 - 15.30*

‘As a Countermeasure to Global Warming - Best Mix on Energy Portfolio and Enhancing International Cooperation’

The final panel discussion for GHGT-11 will be chaired by Professor Kenji Yamaji, and will address the topic above by discussion with a panel of leading experts.

Panelists:

- Juho Lipponen, Head of CCS Unit, IEA, France
- James Edmonds, Laboratory Fellow and Chief Scientist, Joint Global Change Research Institute, PNNL, USA
- Jiang Kejun, Director for Energy System Analysis and Market Analysis Center, Energy Research Institute, China
- Takeo Kikkawa, Professor, Graduate School of Commerce and Management, Hitotsubashi University, Japan
- Yoshiharu Tachibana, Research Advisor, Central Research Institute of Electric Power Industry, CRIEPI, Japan

**Closing Session,**

*Thursday 22nd November, 15.30 - 16.00*

This session will be co-chaired by Mr John Gale and Professor Yoichi Kaya, representing the co-hosts of the GHGT-11 conference.

The closing session of a GHGT conference traditionally consists of notes of thanks being presented, and a simple conclusion of key points and themes that have emerged over the past few days technical presentations. Reflections on advances, and developments will be highlighted, and the conference will be formally called to a close.

The last part of the closing session will comprise of an invitation, made by the hosts of GHGT-12 which will be held in 2014.

The new hosts will make a short presentation on their home venue, and invite delegates to return in 2 years to continue to maintain the strong name of the GHGT Conference Series. A short video will be shown, which will showcase the host city, and give delegates a taste of what to expect in 2014.
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<td>07.45 - 09.00</td>
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<td>Lunch</td>
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19.00 - 22.00 Conference Dinner, Westin Miyako Kyoto
### Oral Sessions at a Glance

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<td>Trapping Mechanisms: Case Studies</td>
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<td>Risk Assessment &amp; Management I</td>
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<td>Reservoir Engineering: Pressure Management</td>
<td>Policy: Other</td>
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<tr>
<td>Thursday Nov 22nd</td>
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<td>Risk Assessment &amp; Management II</td>
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<td>11.20 - 12.40</td>
<td>Modelling: Reservoir Scale Flow &amp; Transport</td>
<td>CCS &amp; Geothermal</td>
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### Session Theme Key

- Capture
- Storage
- Integrated Systems
- Industrial Sources
- Public Perception
- Negative CO₂ Emissions
- Panel Discussion
- Demonstration
- Utilisation of CO₂
- Legal Issues
- Policy
- Commercial Issues
- Transport
- Education
- Other Storage Options
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Exhibition Information

The GHGT-11 exhibition aims to facilitate networking between technology suppliers and researchers, and provides an opportunity for partnerships and agreements to be forged for the future. Sponsors are also allocated a booth in the exhibition hall.

The Exhibition will be held in the Banquet Hall Sakura, located close to the main hall.

Sponsors, Supporters and Organisers Booths
- S-01 IEAGHG
- S-02 Research Institute of Innovative Technology for the Earth (RITE)
- S-03 GLOBAL CCS INSTITUTE
- S-04 Schlumberger Carbon Services
- S-05 Hitachi, Ltd.
- S-06 TOSHIBA CORPORATION
- S-07 MITSUBISHI HEAVY INDUSTRIES, LTD.
- S-08 Gassnova / TCM
- S-09 JX Nippon Oil & Energy Corporation
- S-10 JGC CORPORATION
- S-11 Japan Petroleum Exploration Co., Ltd. (JAPEX)
- S-12 CHIYODA CORPORATION
- S-13 IHI
- S-14 Supporters

Exhibiting Companies and Organisations Booths
- E-01 Central Research Institute of Electric Power Industry (CRIEPI)
- E-02 Japan CCS Co., Ltd.
- E-03 KOREA ELECTRIC POWER CORPORATION (KEPCO)
- E-04 CO₂ Capture Project
- E-05 New Energy and Industrial Technology Development Organization (NEDO)
- E-06 Greenhouse Gases: Science and Technology
- E-07 CARBON MANAGEMENT CENTER (CMC)
- E-08 VATTENFALL
- E-09 International Institute for Carbon-Neutral Energy Research (I2CNER), Kyushu University
- E-10 Petroleum Technology Research Centre
- E-11 Nordic CCS Competence Centre NORDICCS / International CCS Research Centre BIGCCS
Conference Floorplan and Room Details

The GHGT-11 conference will utilise 7 different rooms for the parallel streams of the technical sessions, and the layout of the Kyoto international Conference Center can be seen on the maps below.

TS Indicates the location of Technical Sessions

Stream A Main Hall, First Floor
Stream B Room A, Second Floor
Stream C Room B-1, Second Floor
Stream D Room D, First Floor
Stream E Room B-2, Second Floor
Stream F Room C1, First Floor
Stream G Room E, First Floor

Room K is the PC Preview Centre, where oral paper presenters can upload their presentations
Oral Session Details

Technical Session 1

Session 1A - Storage Capacity

Session Chairs: Sally Benson & Zique Xue

Estimating the Supply and Demand for Deep Geologic CO₂ Storage Capacity Over the Course of the 21st Century: A Meta-Analysis of the Literature
James Dooley, Joint Global Change Research Institute; Pacific Northwest National Laboratory

Comprehensive Assessment of Offshore Storage Options in the Netherlands
Filip Neele, Cor Hofstee, Rob Arts, Vincent, Vandeveijer, Manuel Nepveu, Johan ten Veen, Frank Wilschut, TNO

Illustrating the Estimation of CO₂ Storage Capacity for a Hypothetical Injection Site
Guy Allinson, Wanwan Hou, Peter Neal, CO2CRC and University of New South Wales; John Kaldi, CO2CRC and University of Adelaide; Lincoln Paterson, CO2CRC and CSIRO

CCU&S via Stacked Storage—Case Studies from CO2EOR Basins of the United States
Susan Hovorka, David Carr, Stuart Coleman, Khandaka Zahid, Gordon Smith, Rebecca Smyth, Lesli Wood, The University of Texas at Austin

Session 1B - Post-Combustion: Solvent Pilots

Session Chairs: Prachi Singh & Takayuki Higashii

Solvent Development in Post Combustion CO₂ Capture-Selection Criteria and Optimization of Solvent Performance and Environmental Impact
Karl Anders Hoff, Eirik Falck da Silva, Inna Kim, Andreas Grimstvedt, SINTEF

A Guide to Evaluate Solvents and Processes for Post-Combustion CO₂ Capture
Paul Mathias, Satish Reddy, Arnold Smith, Kash Afshar, Fluor Corporation

Advances in Development of CO₂ Capture Solvent
Paul-Emmanuel Just, Cansolv Technologies Inc

Pilot Plant Results with Piperazine
Eric Chen, Tarun Madan, Paul Nielsen, Darschan Sachde, Lynn Li, Gary T. Rochelle, The University of Texas at Austin

Session 1C - Negative CO₂

Session Chairs: Debo Adams

Global Potential for Biogas Production with CCS
Joris Koorneef, Pieter van Breevoort, Paul Noothout, Chris Hendriks, Luchien Luning, Ecofys; Ameena Camps, IEAGHG

The Techno-Economic Potential of Integrated Gasification Co-Generation Facilities with CCS, Going from Coal to Biomass
Hans Meerman, Andrea Ramirez, Wim Turkenburg, Andre Faaij, Utrecht University

Incentivising BECCS in Indonesia

Outdoor Prototype Results for Direct Atmospheric Capture of Carbon Dioxide
Geoffrey Holmes, Kenton Heidel, Matthew Henderson, Paul Klavins, Kevin Nold, Arvinder Singh, David Keith, Carbon Engineering

Session 1D - Technology Assessment I: Cost and Risk

Session Chairs: Kevin McCauley & Howard Herzog

Risk Assessment and Management for CO₂ Capture and Transport Facilities
Angunn Engebo, Jens Garstad, Hamish Holt, Nada Ahmed, DNV

Techno-Economics of CCS in Oil Sands Thermal Bitumen Extraction: Comparison of CO₂ Capture Integration Options
Irene Bolea, CIRCE; Guillermo Ordorica-Garcia, Mehr Nikko, Alberta Innovates - Technology Futures; Michiel Carbo, Energy Research Centre of the Netherlands

Examining CCS Deployment Potential in China via Application of an Integrated CCS Cost Curve
Robert Dahowski, Casie Davidson, Pacific Northwest National Laboratory; Xiaochun Li, Ning Wei, Chinese Academy of Sciences

Potential Cost of Leakage from Geologic Sequestration in the Michigan Basin
Melisa Pollak, Jeffrey Bielicki, Elizabeth Wilson, University of Minnesota; Catherine Peters, Princeton University; Jeffery Fits, Brookhaven National Lab

Session 1E - Techno-Economic Comparisons

Session Chairs: Jay Braitsch & John Davison

Post Combustion Capture on Natural Gas Combined Cycle Plants: A Technical and Economic Evaluation of Retrofit, New Build and the Application of Exhaust Gas Recycle
Desmond Dillion, EPRI
Performance and Costs of CO₂ Capture at Gas Fired Power Plants
Neil Smith, Geoff Miller, Richard Gadsden, Indran Aandi, Parsons Brinckerhoff Ltd; John Davison, IEAGHG

Integrated Techno-Economic and Environmental Assessments of Amine-Based Capture for Different CO₂ Concentration Gases
Xiangping Zhang, Norwegian University of Science and Technology; Amy Brunsvold, Erik Hognes, Jana Jokobsen, Simon Roussanaly, SINTEF Energy Research

Comparison of Costs for Natural Gas Power Generation with CO₂ Capture
Philippe Mathieu, Olav Bolland, NTNU

Session 1F - Wellbore Integrity
Session Chairs: Stefan Bachu & Samantha Neades

Pre-Injection Baseline Data Collection to Establish Existing Wellbore Leakage Properties
Andrew Duguid, Robert Busch, Schlumberger Carbon Services; William Carey, Los Alamos National Laboratory; Michael A. Celia, James Wang, Princeton University; Nikita Chugunov, T.S. Ramakrishnan, Schlumberger-Doll Research; Viki Stamp, True Oil LLC; Sarah Gasda, Integrated Petroleum Research, Uni Research

Cement Sheath Integrity for CO₂ Storage – An Integrated Perspective
Axel-Pierre Bois, CurisTec; Siavash Ghabezloo, Jean Sulem, Ecole des Ponts; Manh-Huyen Vu, André Garnier, Jean-Benoît Laudet, Total

Geomechanical Behavior of Wells in Geologic Sequestration
William Carey, George Zvoloski, Kayla Lewis, Sharad Kelkar, Los Alamos National Laboratory

Development of Reacted Channel during flow of CO₂-Rich Water along a Cement Fracture
Nicolas Huerta, The University of Texas at Austin and National Energy Technology Laboratory; Quinn Wenning, Marc Hesse, Christina Lopano, The University of Texas at Austin; Brian Strazisar, National Energy Technology Laboratory

Session 1G - Industrial Sources
Session Chairs: Stanley Santos & Eemeli Tsupari

Outline of Course 50
Shigeaki Tonomura, Nippon Steel & Sumitomo Metal Corporation

Application of Advanced Technologies for CO₂ Capture from Industrial Sources
Matteo Carmelo Romano, Politecnico di Milano; Rahul Anantharaman, SINTEF Energy Research; Antti Arasto, VTT; Hyungwoong Ahn, Maria-Chiara Ferarri, Imp-See, University of Edinburgh; Jan Wilco Dijkstra, ECN; Dulce Boavida, LNEG - Laboratório Nacional de Energia e Geologia

Techno-Economic Study of an Integrated Steelwork Equipped with Oxygen Blast Furnace (OBF) and CO₂ Capture
Lawrence Hooey, Swerea MEFOS; Andrew Tobiesen, SINTEF; Jeremy Johns, Tata Steel UK Consulting Ltd; Stanley Santos, IEAGHG

Temperature Dependence of Heat Integration Possibilities of an MEA Scrubber Plant at a Refinery
Viktor Andersson, Thore Bersntsson, Chalmers University of Technology; Per-Åke Franck, CIT Industriell Energi

Technical Session 2

Session 2A - CO₂ Injectivity
Session Chairs: Charles Gorecki & Karsten Michael

Snøhvit CO₂ Storage Project: Assessment of CO₂ Injection Performance through History Matching of the Injection Well Pressure over a 32-Month Period
Ji Quan Shi, Claire Imrie, Caglar Sinayuc, Sevket Durucan, Anna Korre, Imperial College; Ola Eiken, Statoil

Experimental and Numerical Study of the Effects of Halite Scaling on Injectivity and Seal Performance during CO₂ Injection in Saline Aquifers
Giacomo Bacci, Anna Korre, Sevket Durucan, Imperial College London

A New Tool to Predict Injection Well Numbers for a Total Injection Rate and Given Formation Properties
Ehsan Azizi, Yildiray Cinar, Guy Allison, The University of New South Wales and CO2CRC, Karsten Michael, CO2CRC and CSIRO

Can We Overcome Thermo-Elastic Limits on CO₂ Injection Rates in Horizontal Wells?
Zhiyuan Luo, Steven Bryant, The University of Texas at Austin
Session 2B - Post-Combustion: Sovent Alternatives
Session Chairs: Peter Ragden & Bernd Schallert

Amine Blends Using Concentrated Piperazine
Le Li, Xe Chen, Yang Du, Stephanie Freeman, Okmar Namjoshi, Thu Nguyen, Alexander Voice, Qing Xu, Gary Rochelle, University of Texas at Austin; Han Li, Tsinghua University

Energy Efficient Solvents for CO₂ Absorption from Flue Gas: Vapour Liquid Equilibrium and Pilot Plant Study
Prachi Singh, IEAGHG; W. P. M. Van Swaaij, Wim Brilman, University of Twente

A Novel Reactive 4-Diethylamino-2-Butanol Solvent for Capturing CO₂ in the Aspect of Absorption Capacity, Cyclic Capacity, Mass Transfer, and Reaction Kinetics
Paitoon Tontiwachwuthikul, Zhiwu Liang, Raphael Idem, University of Regina and Hunan University; Teerawat Sema, Abdulaziz Naami, University of Regina, Canada

Amino Acids Salts for CO₂ Capture at Flue Gas Temperatures
Steven Chiao-Chien Wei, Graeme Puxty, Paul Feron, CSIRO Energy Technology

Session 2C - Demonstration Projects: Storage
Session Chairs: Sue Havorka & Ryozo Tanaka

CCS Large-Scale Demonstration in Japan
Masanori Abe, Shigeru Saito, Daiji Tanase, Yoshihiro Sawada, Yoshiro Hirama, Yoshihiko Motoyama, Japan CCS Co., Ltd.

The In Salah CO₂ Storage Project: Lessons Learned and Knowledge Transfer
Philip Ringrose, Statoil ASA; Allan S. Mathieson, Iain Wright, BP Alternative Energy; Faycal Selama, In Salah Gas

Gorgon CO₂ Injection Project - 2012 Update
John Frontczak, Gorgon Project

CO₂ Storage in the Depleted P18-4 Gas Field Offshore the Netherlands (the ROAD project)
Rob Arts, Cor Hofstee, Vincent Vandeweijer, Maarten Pluymaekers, Daniel Loeve, TNO; Andreas Kopp, E.ON Gas Storage GmbH; Willem-Jan Plug, TAQA Energy BV

Session 2D - Technology Assessment II: Operational Flexibility
Session Chairs: Jim Dooley & Angunn Engebø

Operating Flexibility of Power Plants with CCS
Luca Mancuso, Rosa Domenichini, Noemi Ferrari Foster Wheeler; John Davison, IEAGHG

CO₂ Sequestration at Material Rates: Inherent Limits and Engineering Solutions
Steven Bryant, The University of Texas at Austin

Optimal CO₂ Capture Operation in an Advanced Electric Grid
Stuart Cohen, Michael Webber, Gary Rochelle, The University of Texas at Austin

Composing the Whole CCS System Including CO₂ Buffer
Haruoishi Suzuki, Kyuro Sasaki, Yuichi Sugai, Kyushu University

Session 2E - Membranes
Session Chairs: Teruhiko Kai & May-Britt Hägg

CO₂ Capture by Sub-Ambient Membrane Operation
David Hasse, Sudhir Kulkarni, Ed Sanders, Elizabeth Corson, Air Liquide Delaware Research & Technology Center; Jean-Pierre Tranier, Air Liquide R&D-Centre de Recherche Claude Delorme

Theoretical and Experimental Investigations of N2-Selective Membranes
Jennifer Wilcox, Ekin Ozdogan, Panithita Rochana, Stanford University

Poly (Amidoamine) Dendrimer Containing Polymeric Membrane for Preferential CO₂ Separation over H₂ - Interplay Between CO₂ Separation Properties and Morphology
Ikuo Taniguchi, Teruhiko Kai, Shuhong, Dua, Shingo Kazama, Research Institute of Innovative Technology for the Earth

Pd-Membranes on Their Way Towards Application for CO₂ Capture
Frans van Berkel, Daniel Jansen, ECN; Andreas Goldbach, Hengyong Xu, DCIP; Chunnhai Jiang, Chuanyong Hao, IMR; John Morund, SINTEF; Etienne Soutif, TECHNIP; Bai Song, BP

Session 2F - Modelling: Nanoscale to Core Scale
Session Chairs: Anna Korre & Andrew Cavanagh

Nanosized CO₂ Droplets Injection for Stable Geological Storage
Suguru Uemura, Yohei Matsui, Atsuto Noda, Shohji Tsushima, Shuichiro Hirai, Tokyo Institute of Technology

Molecular Dynamics Simulations of the CO₂/Water/Silica Wettability at Different Pressures
Shinya Tsuji, Makoto Kunieda, Yungfeng Liang, Toshihumi Matsuoka, Kyoto University; Satoru Takahashi, Japan Oil, Gas and Metals National Corporation (JOGMEC)

Pore Scale Models for Imbibition of CO₂ Analogue Fluids in Etched Micro-Model Junctions using Micro-Fluidic Experiments and Direct Flow Calculations
Edo Boek, Emily Chapman, Jianhui Yang, John Cranshaw, Imperial College London
Prediction of CO₂-Brine-Quartz Contact Angles with Molecular Dynamics Computations
Stefan Iglauer, Curtin University; Manu Matthews, Fernando Bresme, Imperial College London

Session 2G - Industrial Sources
Session Chair: Wilfred Maas
Aqueous Ammonia Capture Integrated with Ex-Situ Mineralisation using Recyclable Salts for Industrial CCS
Xiaolong Wang China Huaneng Clean Energy Research Institute; Mercedes Maroto-Valer, University of Nottingham

The Calcium Looping Process for Low CO₂ Emission Cement and Power
Matteo Carmelo Romano, Maurizio Spinelle, Stefano Campanari, Stefano Consonni, Politecnico di Milano; Giovanni Ciniti, Maurizio Marchi, Natale Pimpinelli, CTG - Italcemimenti Group

CO₂ Recovery from Industrial Hydrogen Facilities and Steel Production to Comply with European Emission Regulations:
Bernd Holling, Christine Kandziora, Alfred Bolkart, Linde AG

Oxy-Fuel Retrofitting of Fuel Oil Fired Refinery Heaters – a Two-Step Experimental Approach
Morten Seljeskog, Mario Ditaranto, SINTEF Energy Research

Session 3A - Environmental Impacts of CO₂ Storage
Session Chairs: Jun Kita & Tim Hill
Evaluation of Dissolved CO₂-Induced Metals Mobilization in Groundwater using a Controlled Release Experiment
Robert Trautz, EPRi; Liange Zheng, Yuxin Wu, Charuleka Varadharajan, Nicolas Spycher, Susan Hubbard, Jens Birkholzer, Lawrence Berkeley National Laboratory; John Pugh, Southern Company Services; Dennis Newell, Los Alamos National Laboratory

Laboratory Experiments and Field-Study of a Marine Natural Analogue for Potential Seepage from CO₂ Storage Sites in Aquatic Environments
Giorgio Caramann, Mercedes Maroto-Valer, The University of Nottingham

Potential Environmental Impacts of CO₂ Leakage from Study of Natural Analogue Sites in Europe
Fotini Ziogou, Vasiliki Gemen, Nikolaos Kourkouzas; Hellas Institute; Davide de Angelis, Simone Liberti, Stan Beaubien, Salvatore Lombardi, Universita di Roma ‘La Sapienza’; Julie West, David Jones, Patricia Coombs, T.S. Barlow, British Geological Survey; M. Kruger, Bundesanstalt für Geowissenschaften und Rohstoffe

A Novel Experimental Release of CO₂ in the Marine Environment to Aid Monitoring and Impact Assessment
Jerry Blackford, Plymouth Marine Laboratory

Session 3B - Post-Combustion: Two-Phase Solvents
Session Chairs: Jasmin Kemper & Masaki Iijima
Selection and Characterization of Phase-Change Solvent for CO₂ Capture: Precipitating System
Inna Kim, Sholeh Ma’mum, SINTEF Materials and Chemistry

Overall Process Analysis and Optimization for CO₂ Capture from Coal Fired Power Plants Based on Phase Change Solvents Forming Two Liquid Phases
Ulrich Liebenthal, Alfons Kather, Hamburg University of Technology; Diego Pinto, Julianna Monteiro, Hallvard Svendsen, Norwegian University of Science and Technology

Precipitating Carbonate Solvent Process for CO₂ Capture
Geoff Stevens, Kathryn Mumford, Kohei Endo, Dimple Quyn, Hendy Thee, Kathryn Smith, Sandra Kentish, University of Melbourne; Clare Anderson, Barry Hooper, Abdul Qadar, CO2CRC

Robert Moene, Lodl Schoon, Frank Geuzenbroek, Shell Global Solutions International B.V; Jiri van Streefl Shell (Petroleum Mining) Co. Ltd (NZ)

Session 3C - Demonstration Projects: US Regional Carbon Sequestration Partnerships
Session Chairs: John Litynski & Masanori Abe
Three Million Metric Ton Monitored Injection at the SECARB Cranfield Project - Project Update
Susan Hovorka, The University of Texas at Austin

Early Operational Experience at a One-Million Tonne CCS Demonstration Project, Decatur, Illinois, USA
Robert Finlay, Scott Frailey, Hannes Leetaru, Illinois State Geological Survey; Scott Martsteller, Schlumberger Carbon Services
Evaluating the Suitability for CO₂ Storage at the FutureGen 2.0 Site, Morgan County, Illinois, USA
Alain Bonneville, Tyler Gilmore, Vince Verneul, Delphine Appriou, Bruce Bjornstad, Jack Horner, Frank Spane, Battelle Pacific Northwest Laboratories; Mark Kelley, Jackie Gerst, Neeraj Gupta, Kaitlin McNeil, Mark Moody, FutureGen Industrial Alliance Inc.

Overview of the Bell Creek Combined CO₂ Storage and CO₂ Enhanced Oil Recovery Project
John Hamling, Charles Gorecki, Edward Steadman, John Harju, University of North Dakota EERC

Session 3D - Panel Discussion: CCS in Developing Asia
An overview of the Asian Development Bank’s efforts to promote CCS in the PRC and Southeast Asia, as part of a comprehensive plan to promote clean energy deployment in the region. Highlighting the role of CCS within PRC’s overall energy security and decarbonizing strategy, and presenting ADB’s CCS project portfolio in PRC.
Chairman: Ashok Bhargava, Energy Division ADB
Panelists:
Annika Seiler, Finance Specialist, ADB
Pradeep Tharakan, Climate Change Specialist, ADB
Tong Yiying, Datang International Power Generation Corporation Limited,
Usman Pasarai, LEMIGAS,
Witsarut Thungsuntonkhun, Dept of Mineral and Fuels, Thailand,
Le Van Luc, Ministry of Industry and Trade, Vietnam

Session 3E - Enhanced Hydrocarbon Recovery I
Session Chairs: Sandeep Verma & Kozo Sato

Flue Gas Injection for CO₂ Storage and Enhanced Coalbed Methane Recovery: Mixed Gas Sorption and Swelling Characteristics of Coals
Amer Syed, Sevket Durucan, Ji-Quan Shi, Anna Korre, Imperial College London

Description of a CO₂ Enhanced Coalbed Methane Field Trial Using a Multi-Lateral Horizontal Well
Luke Connell, Zhejun Pan, Michael Camilleri, David Down, John Carras, Cameron Briggs, CSIRO; Shangzhi Meng, Wenzhong Zhang, Banguang Guo, CUCBM

The Altmark Natural Gas Field is Prepared for the Enhanced Gas Recovery Pilot Test with CO₂
Michael Kühn, Andrea Förster, Peter Pilz, Maja Tesmer, GFZ German Research Centre for Geosciences; Jochen Grossman, GICON Grossmann Ingenieur Consult GmbH; Jan Lille, GDF SUEZ E&P Deutschland GmbH; Kurt M. Reinicke, Technische Universität Clausthal; Dirk Schäfer, Christian-Albrechts-Universität Kiel

CO₂ Enhanced Oil Recovery and Geological Sequestration Potential in Northern Niagaran Pinnacle Reef Trend Reservoirs, Northern Lower Michigan, USA
David Barnes, William Harrison, Jason Asmus, Western Michigan University; G. Michael Grammer, Oklahoma State University

Session 3F - Modelling: Managing Uncertainty
Session Chairs: Bill Carey & Lingli Wei

Reducing Uncertainty in Reservoir Model Predictions: From Plume Evolution to Tool Responses
Nikita Chugunov, T.S. Ramakrishnan, Schlumberger-Doll Research; Ozgur Senel, Schlumberger Carbon Services

Model Comparison and Uncertainty Quantification for Geologic Carbon Storage: The Sim-SEQ Initiative
Sumit Mukhopadhyay, Christine Doughty, Jens Birkholzer, Lawrence Berkeley National Laboratory; Jean-Philippe Nicot, Seyyed Hoseini, University of Texas Austin; Diana Bacon, Luke Gosink, Guang Lin, Ramya Ramanathan, Pacific Northwest National Laboratory; Sarah Gasda, Uni Research Norway

Capacity and Injectivity in the Surat/Bowen Basins, Queensland, Australia: Likelihood and Uncertainty Evaluation
Suzanne Hurter, Peter Probst, Sebastian Gonzalez, Sam Guiton, Schlumberger Carbon Services; Andrew Garnet, Formerly CEO & Project Director ZeroGen; Norhafiz Marmin, Schlumberger Carbon Services, Australia and Petroleum Development Oman

Ronald Surdam, Zunsheng Jiao, Yuri Ganshin, Ramsey Bentley, Mario Garcia-Gonzalez, Scott Quilllian, Fred McLaughlin, University of Wyoming Carbon Management Institute; Philip Stauffer, Hailin Deng, Los Alamos National Laboratory

Session 3G - Commercial Issues
Session Chairs: Tony Booer & Richard Esposito

The Implications of the Global Financial Crisis for CCS
Geoff Rumble, Christopher Short, Klaas van Alphen, Gwendaline Jossec, Global CCS Institute

North West Redwater Partnership – Carbon Capture through Innovative Commercial Structuring in the Canadian Oil Sands
Terry Kemp, Kevin Heal, North West Redwater Partnership

A Real Options Analysis of Carbon Dioxide Sequestration for Trinidad and Tobago: A Case Study of the Mahogany Field
Steve Seetahal, David Alexander, The University of Trinidad and Tobago
Value Chain Analysis of CO2 Storage by Using the ECCOTOOL: Storage Economics
Daniel Loeve, Christian Bos, Alin Chitu, TNO; Sigurd Weidemann Løvseth, Per Eilif Wahl, SINTEF; Paula Coussy, IFPEN; Charles Eickhoff, Progressive Energy Ltd 4A Experiences and Case Studies

Technical Session 4

Session 4A - Experiences and Case Studies
Session Chairs: Andy Chadwick & John Kaldi
Snøhvit: The History of Injecting and Storing 1 Mt CO2 in the Fluvial Tubåen Fm
Ola Eiken, Douglas Gilding, Hilde Hansen, Olav Hansen, Bamshad Nazarian, Bård Osdal, Philip Ringrose, Hossein Mehdi Zadeh, Statoil

Calibration and Prediction of the Sleipner CO2 Plume from 2006 to 2012
Andrew Cavanagh, Landmark-Halliburton

Investigations of Alleged CO2 Leakage in Weyburn, Canada in the Context of Longer Term Surface Gas Monitoring
David Jones, Andrew Barkwith, Tom Barlowe, Bob Lister, British Geological Survey; Stan Beaubien, Tiziana Bellomo, Aldo Annunziatellis, Stefano Graziani, Salvatore Lombardi, Gilles Braibant, Università di Roma ‘La Sapienza’

Inducing a CO2 Leak into a Shallow Aquifer (CO2FieldLab EUROGIA+ Project): Monitoring the CO2 Plume in Groundwaters
Frédéric Gal, Eric Proust, Pauline Humez, Gilles Braibant, Michael Brach, Florian Kock, David Widory, Jean-François Girard, BRGM

Session 4B - Post-Combustion: Environmental Characterisation
Session Chair: Phil Sharman & Yuichi Fujioka
Chemical Characterization of 30% MEA Degradation During Post-Combustion Capture of CO2 from a Brown Coal-Fired Power Station
Alicia Reynolds, Vincent Verheyen, Samuel Adelaju, Alan Chahee, Monash University; Erik Meuleman, Paul Feron, CSIRO Energy Technology

Assessing Atmospheric Emissions from Amine-Based PCC Processes and Their Impacts on the Environment - A Case Study
Paul Feron, Merched Azzizi, Erik Meuleman, Brendan Halliburton, Dennys Angrove, CSIRO; Martin Oettinger, Global CCS Institute

Thermal Degradation on Already Oxidatively Degraded Solutions:
Solrun Johanne Velvestad, Hanna Knuutila, Hallvard Svendsen, NTNU; Andreas Grimstvedt, SINTEF

Oxidative Degradation of Amines with High-Temperature Cycling
Alexander Voice, University of Texas and TNO; Fred Closmann, Gary Rochelle, University of Texas

Session 4C - Demonstration Projects: Policy Related Issues
Session Chairs: Brendan Beck & Chris Hendriks
Too Early or Too Late for CCS - What Needs to be Done to Overcome the Valley of Death for Carbon Capture and Storage in Europe?
Peter Radgen, E.ON New Build and Technology GmbH; Robin Irons, E.ON New Build and Technology Ltd.; Hans Schoenmakers, E.ON Benelux Holding B.V.

Key Messages from Active CO2 Storage Sites
Ton Wildenborg, TNO; Andy Chadwick, BGS; Heleen de Coninck, ECN; Jean-Pierre Deflandre, IFPEN; Allan Mathieson, BP; Richard Metcalfe, Quintessa; Conny Schmidt-Hatteberger, GFZ

Establishment of Knowledge Base for Emission Regulation for the CO2 Technology Centre Mongstad
Yolandi Maree, Sissel Nepstad, TCM DA; Gelin De Koeijer, Statoil

Industry Guidance on Safe Handling of CCS CO2 – CO2RISKMAN JIP
Hamish Holt, Kaare Helle, Jorg Aarnes, DNV
Session 4D - Panel Discussion: Understanding the Costs of CCS

The literature reports a wide range of costs for CCS. Furthermore, these costs are reported in various forms, such as capture cost, avoided cost, levelized cost, etc. This can lead to confusion and misuse of the costing data. To help provide clarity to this subject, this panel will address several critical questions about CCS costs, including understanding costing methodologies, comparing real project costs to generic cost studies, and examining “first-of-a-kind” costs.

Chairman: Howard Herzog MIT
Panelists:
Chris Short, Global CCS Institute
Chris Greig, University of Queensland
Cheryl Wilson, Bloomberg

Session 4E - Enhanced Hydrocarbon Recovery II

Session Chairs: Kozo Sato & Steve Whittaker

Deploying Combined EOR and CCS Projects
Kurt House, Ernst van Neiro, Antonio Baclig, Shipeng Fu, Mark Henly, Charles Brankman, Kelly Bergman, Robert Selover, C12 Energy

Comparing Alternatives for Early CCS Projects in the United States via EOR
Eric Larson, Robert Wiliams, Princeton University; Guangjiang Liu, North China Electric Power University

Assessment of Factors Influencing CO₂ Storage Capacity and Injectivity in Eastern U.S. Gas Shales
Michael Godec, George Koperna, Robin Petrusak, Anne Oudinot, ARI Inc.

The Economics of CO₂ Sequestration Through Enhanced Oil Recovery
Klaas van ‘t Veld, Charles Mason, University of Wyoming; Andrew Leach, University of Alberta

Session 4F - Monitoring: Pressure Methods

Session Chairs: Millie Basava-Reddi & Randy Locke

Tracing Back the Pressure-Impact Zone of the CO₂ Geological Storage Through a Cyclic Injection Strategy
Jeremy Rohmer, BRGM

Leakage Fingerprints During Storage: Modeling Above-Zone Measurements of Pressure and Temperature
Qing Tao, Steven Bryant, Timothy Meckel, The University of Texas at Austin

Maximizing the Value of Pressure Monitoring Data from CO₂ Sequestration Projects
Srikanta Mishra, Mark Kelley, Evan Zeller, Nick Slee, Neeraj Gupta, Battelle Memorial Institute; Indra Bhattacharya, Mike Hammond, American Electric Power

Session 4G - Retrofitting

Session Chairs: John Davison & Chris Satterley

Retrofitting CO₂ Capture to Existing Power Plants
Jon Gibbins, Hannah Chalmers, Mathieu Lucquiaud, University of Edinburgh; John Davison, IEAGHG; Jia Li, Xi Liang, University of Exeter; Nial McGlashan, Imperial College London

Summary Results and Insight from EPRI’s Engineering and Economic Study of Post Combustion Capture Retrofit Applied to Various North American Host Sites
Desmond Dillon, EPRI

Carbon Capture Retrofit Options with the On-Site Addition of Gas Turbine Combined Heat and Power Cycle
Mathieu Lucquiaud, Maria Sanchez, Laura Herreia, Jon Gibbins, The University of Edinburgh

Enhancement and Long-Term Testing of Optimized Post-Combustion Capture Technology – Results from the Second Phase of the Testing Programme at the Pilot Plant Niederassem
Peter Moser, Sandra Schmidt, Sarah Wallus, RWE Power AG; Georg Sieder, Javier Garcia-Palacios, BASF SE; Torsten Stoffregen, Linde-Engineering Dresden GmbH, Dieter Mihlawitsch, Linde AG

Session 5A - Monitoring: Demonstration and Pilot Projects

Session Chairs: Toshifumi Matsuoka & Susan Hovorka

Microseismic Monitoring and Interpretation with Associated Injection Data from the In Salah CO₂ Storage Site (Krechba), Algeria
Volker Oye, Daniela Kühn, NORSAR; Eyvind Aker, Bahman Bohlooli, Norwegian Geotechnical Institute; Thomas M. Daley, Valeri Korneev, Lawrence Berkeley National Laboratory
Feasibility of Time-Lapse Seismic Methodology for Monitoring Injection of Small Quantities of CO₂ into a Saline Formation, CO2CRC Otway Project
Roman Pevzner, Milovan Urosevic, Eva Caspari, Mahair Maddi, Curtin University and CO2CRC; Tess Dance, Valeriy Shulakova, CSIRO; Boris Gurevich, Curtin University, CSIRO and CO2CRC; David Lumley, University of Western Australia; Vladimir Tcheverda, SB RAS; Yildiray Cinar, University of New South Wales and CO2CRC

Evaluation of CO₂ Saturation at Nagaoka Pilot-Scale Injection Site Derived from the Time-Lapse Well Logging Data
Takahiro Nakajima, Ziqiu Xue, Research Institute of Innovative Technology for the Earth

Assessment of Alleged CO₂ Leakage at the Kerr Farm Using a Simple Process-Based Soil Gas Technique: Implications for Carbon Capture, Utilization, and Storage (CCUS) Monitoring
Katherine Romanak, The University of Texas GCCC

Session 5B - Post-Combustion: Modelling
Session Chairs: John Topper & Hanne Kvamsdal

Dynamic Behaviour of the Solvent Regeneration Part of a CO₂ Capture Plant – Validation of the CO2SIM Model
Finn Andrew Tobiesen, Hanne Kvamsdal, Olaf Trygve Berglihn, Thor Mejdell, SINTEF Materials & Chemistry; Nina Enaasen, Magen Hillestad, NTNU

Rate-Based Modeling of CO₂ Capture Pilot Plant with Aqueous Monoethanolamine Solution
Chau-Chyun Chen, Ying Zhang, Aspen Technology, Inc.

Energy Performance of Advanced Stripper Configurations
Peter Frailie, Tarun Madan, Brent Sherman, Gary Rochelle, The University of Texas at Austin

Design Parameters Affecting the Commercial Post Combustion CO₂ Capture Plants
Ahmed Aboudheir, Walid Elmouedir, HTC CO₂ Systems Corp.

Session 5C - Demonstration Projects: Capture and Transport
Session Chair: Klaus Schöffel

The Alberta Carbon Trunk Line
Susan Cole, Enhance Energy Inc.

ELCOGAS Pre-Combustion Carbon Capture Pilot. Real Experience of Commercial Technology
Pedro Casero Cabezón, Francisco García Peña, ELCOGAS, S.A.; Javier Trujillo Rivera, Universidad Castilla la Mancha

Oxy-Combustion Technology Development for Fluid Catalytic Crackers (FCC) – Large Pilot Scale Demonstration
Leonardo de Mello, Rodrigo Gobbo, Gustavo Moure, Petrobras; Ivanо Miracca, ENI

30 MWth CIUDEN Oxy-CFB Boiler - First Experiences
Monica Lupion, Inaki Alvarez, Pedro Otero, Vincente Cortes, CIUDEN; Reiji Kuivalainen, Jouni Lantto, Arto Hotta, Horst Hack, Foster Wheeler North America Corp.

Session 5D - Panel Discussion: The Intersection of Large Scale Renewable Energy and CCS Deployment within the Electricity Sector

There is a growing body of literature that sees large scale renewable energy generation as a hinderance to the large scale deployment of CCS technologies, and suggests the deployment of renewable electricity generation will place additional burdens on CCS-enabled power plants, e.g., needing flexible CCS power plants to compensate for intermittency from large wind power farms. On the other hand, there is near unanimity that if climate goals such as not exceeding a change of more than 2°C this century, the scale of CCS deployment will be driven by our ability to grow hundreds of exajoules of bioenergy per year and use this bioenergy in dedicated BECCS power plants. This session is designed to examine from macroeconomic and engineering perspectives the ways in which large scale renewable energy and large scale CCS deployments can, and perhaps must, work together.

Chairman: Jim Dooley, PNNL, USA
Panelists:
Toshihiko Masui, NIES, Japan
Jae Edmonds, PNNL, USA
Sean McCoy, IEA-Paris, France
Howard Herzog, MIT, USA

Session 5E - Post-Combustion: Environmental Nitrosamines
Session Chairs: Paul Feron & Helle Brit Mostad

Nitrosamine Management in Aqueous Piperazine for CO₂ Capture
Nathan Fine, Gary Rochelle, Mandana Ashouripashaki, Alexander Voice, Steven Fulk, Lynn Li, Omar Namjoshi, University of Texas, Austin

Ultra-Violet Treatment as a Strategy for Destruction of Degradation Products from Amine Based Post Combustion CO₂ Capture
Moetaz Attalla, Phil Jackson, CSIRO
Destruction of Nitrosoamines with UV-Light
Hanna Knuutila, Hallvard Svendsen, Naveed Asif, NTNU

Health and Environmental Impact of Amine Based Post Combustion CO₂ Capture
Eik Gjernes, Laila Iren Helgesen, Gassnova SF; Sissel Nepstad, TCM DA

Session 5F - Reservoir Engineering: Multi-Phase Flow of CO₂ and Brine
Session Chairs: Steve Bryant & Pascal Audigane
Stability Analysis of CO₂-Brine Immiscible Displacement
Holger Ott, Steffan Berg, Shell Global Solutions International

Drainage and Imbibition CO₂/Brine Relative Permeability Curves at In-Situ Conditions for Sandstone Formations in Western Canada
Stefan Bachu, Alberta Innovates - Technology Futures

Multiphase Flow Properties of the CO₂/Brine System for Carbon Sequestration
Sam Krevor, Imperial College London; Ronny Pini, Sally Benson, Stanford University

Influence of Heterogeneity on Relative Permeability for CO₂/Brine: CT Observations and Numerical Modeling
Yi Zhang, Testuya Kogure, Shun Chiyonobu, Ziqiu Xue, RITE; Xinglin Lei, Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology

Session 5G - Transport and Infrastructure
Session Chairs: Wolfgang Böser & Chris Hendriks

The Influence of Impurities, Material Development and Changing Prices on the Costs of CO₂ Transport
Marlinde Knoope, Andrea Ramírez, André Faaij, University Utrecht

Cost of CO₂ Transportation Infrastructures
Wim Mallon, Janneke van Wingerden, Han Lemmens, Luuk Buit, KEMA/Gasunie

Modelling Large-Scale CCS Development in Europe – Linking Techno-Economic Modelling to Transport and Storage Infrastructure
Jan Kjärstad, Mikael Odenberg, Filip Johnsson, Chalmers University of Technology; Joris Morbee, Evangelos Tzimas, European Commission

Economic CO₂ Network Optimization Model - COCATE European Project (2010-2013)
Paula Coussy, IFPEN Energies nouvelles; Simon Roussan, SINTEF; Gaelle Bureau-Cauchois, GEOGREEN; Ton Wildenborg, TNO

Session 6A - Site Characterisation and Selection
Session Chairs: Rajesh Pawar & Jonathan Pearce
CO₂ Storage Atlas of the Norwegian Part of the North Sea

Depositional Environment as an Indicator of Favorable Regional Sequestration Targets: Examples from the USGS CO₂ Storage Resource Assessment
Matthew Merrill, U.S. Geological Survey

Effects of Geological Heterogeneity on CO₂ Distribution and Migration – A Case Study from the Johansen FormaStion, Norway
Anja Sundal, Johan Petter Nystuen, Henning Dypvik, Per Aagaard, University of Oslo

Evaluation of CO₂ Storage Potential in the Skagerrak/Kattegat Area
Per Eirik Strand Bergmo, Szczepan Polak; SINTEF Petroleum Research, Per Aagaard, University of Oslo; Peter Frykman, Geological Survey of Denmark and Greenland; Hans Hasken Haugen, Dag Bjørnsen, Tel-Tek

Fault Stability Analysis Related to CO₂ Injection at Tomakomai, Hokkaido
Yuki Kano, Takahiro Funatsu, Shinsuke Nakao, Kinichiri Kusunose, Tsuneo Ishido, Xinglin Lei, Toshiyuki Toshia, Geological survey of Japan/AIST

Session 6B - Sorbent Systems
Session Chairs: Sven Unterberger & Mohammad Abu Zahra

Testing Post-Combustion CO₂ Capture with CaO in a 1.7 MWt Pilot Facility
Calros Adanades, Borja Arias, Spanish Research Council; CSIC-INCAR, Andrés Sánchez-Biezma, Jesús Paniagua, Endesa Generación; Luis Diaz, Maria Lorenzo, Grupo Hunosa, Javier Alvarez, Diego Martinez, Foster Wheeler Energia S.L.U

Progress in Calcium-Looping Post-Combustion CO₂ Capture: Successful Pilot Scale Demonstration
Heiko Dieter, Craig Hawthorn, Mariusz Zieba, Günter Scheffknecht, IFK University of Stuttgart

Assessment of Solid Sorbents as a Competitive Post-Combustion CO₂ Capture Technology
Justin Cole Gler, Edward Rubin, Carnegie Mellon University
Continuous CO₂ Capture from Flue Gases Using Dual Fluidized Bed Reactors with Supported Amine Sorbent
Zhen-shan Li, Wen-ying Zhao, Zhi Zhang, Li-xiang Wang, Ning-sheng Cai, Tsinghua University

The Role of Water in Adsorption-Based CO₂ Capture Systems
Dorian Marx, Lisa Joss, Max Hefti, Marco Mazzotti; ETH Zurich, Ronny Pini, Stanford University

Session 6C - Demonstration Projects: Post-Combustion Capture

Session Chairs: Howard Herzog & Richard Rhudy

Operational Experience and Initial Results from the First Test Period at the CO₂ Technology Centre Mongstad
Vibeke Andersson, Knut Sanden, Aker Clean Carbon; Kristina Wittmeyer, Yolandi Maree, TCM DA

Project Status and Research Plans of 500 TPD CO₂ Capture and Sequestration Demonstration at Alabama Power’s Plant Barry
Michael Ivie, Nick Irvin, Chethan Acharya, Southern Company; Yasuo Kubota, Hiromitsu Nagayasu, Takuya Hirata, Paul Wood, Takahito Yonekawa, Tatsuya Tsujiuchi, MHI

Aqueous Ammonia Based Post-Combustion Capture: Results from Pilot Plant Operation, Challenges and Further Opportunities
Hai Yu, Paul Feron, CSIRO Energy Centre

Initial Results from Fluor’s CO₂ Capture Demonstration Plant Using Econamine FG Plus Technology at E.ON Kraftwerke’s Wilhelmshaven Power Plant
Satish Reddy, Jeff Scherffius, Fluor Corporation; Peter Ragden, Helmut Rode, E.ON New Build & Technology GmbH

CCPLOT100+ Operating Experience and Test Results
J. Carey, SSE, F.D. Fitzgerald, R.A Gardiner, Doosan Power Systems

Session 6D Panel Discussion: 24Mt of CO₂ and Counting: What Has Weyburn-Midale Taught Us About CCUS?
The Weyburn and Midale oilfields in southern Saskatchewan, Canada, now store approximately 24 million tonnes of anthropogenic CO₂ – making these CO2-EOR operations the world’s largest CCUS project and allowing the allied IEAGHG Weyburn-Midale CO₂ Monitoring and Storage Project to provide over a decade of world class applied scientific research. The panel session will highlight numerous technical achievements including the successful application of 3D seismic surveys, characterisation of the storage complex and adjacent environment to allow comprehensive risk assessment, and development of new tools to aid in the assessment of wellbore integrity. The session will also describe how the research project helped the unequivocal disproval of leakage allegations made against the Weyburn site in 2011.

Chairman: Malcolm Wilson, PTRC
Panel Members:
Neil Wildgust, PTRC
Ben Rostron, University of Alberta
Chris Hawkes, University of Saskatchewan
Jim Johnson, Schlumberger-Doll Research
Rick Chalaturnyk, University of Alberta
Don White, NRCAN

Session 6E - Oxy-Combustion: Combustion Fundamentals

Session Chairs: Takashu Kiga & Monica Lupion

Sulfur Oxide Emissions Under Dust-Fired Oxy-Fuel Combustion of Coal
Reinhold Spörl, Jörg Maier, Günter Scheffknecht; Universität Stuttgart

Development of Hitachi Oxy-Fuel Combustion Technologies

Fireside Corrosion of Applied and Modern Superheater-Alloys Under Oxyfuel Conditions
Gosia (Malgorzata) Stein-Brzozowska, Jörg Maier, Günter Scheffknecht, IFK University of Stuttgart; Danila Cumbo, Silvia Masci, Enrico Tosi, Enel Engineering and Innovation; Giovanni Coraggio, Marco Faleni, Leonardo Biasci, International Flame Research Foundation (IFRF)
Technology Assessment of Oxy-Firing of Process Heater Burners
Cliff Lowe, Nick Brancaccio, Chevron Energy Technology Company; Jamal Jamaluddin, Shell Projects and Technology; Charles Baukal, Erwin Platvoet, Jaime Erazo, John Zink Co.

Evaluation of the Performance of a Power Plant Boiler Firing Coal, Biomass and a Blend Under Oxy-Fuel Conditions as a CO₂ Capture Technique
Alessandro Pranzitelli, Sandy Black, Penelope Edge, Janos Szuhánszki, Lin Ma, Mohamed Pourkashanian, University of Leeds

Session 6F - Legal and Regulatory
Session Chairs: Tim Dixon & Juho Lipponen
Liability for Sequestered CO₂: The Path Forward for Alberta
Michael Fernandez, Alberta Energy

Regulating Carbon Dioxide Storage Operations Near Oil and Gas Fields, Australia's Approach
Ian Walker, Steve Tantala, Willie Senanayake, Department of Resources, Energy and Tourism, Australian Government; Greg Leamon, Geoscience Australia, Australian Government

Implications of Alternative Post-Injection Regulatory Guidance Upon CO₂ Storage in Dipping Open Aquifers
Aaron Goater, Andy Chadwick, British Geological Survey

Carbon Capture and Storage and the London Protocol: Recent Efforts to Enable Transboundary CO₂ Transfer
Justine Garrett, Sean McCoy, International Energy Agency

CCS Directive Transposition into National Laws in Europe: Progress and Problems by the End of 2011
Alia Shogenova, Kazbulat Shoganova, Tallinn University of Technology; Kris Piessens, Geological Survey of Belgium; Sam Holloway, BGS; Roberto Martinez, IGME; Kristin M. Flornes, IRIS; Niels E. Poulsen, Geological Survey of Denmark and Greenland; Adam Wójcicki, Polish Geological Institute; An Alexandria Duda, GeoEcoMar; Sergio Persoglia, OGS

Session 6G - Transport and Infrastructure
Session Chairs: Jim Dooley & Joris Koornneef
Regional Specific Challenges of a CO₂ Pipeline Infrastructure in the West Mediterranean Area
Machteld van den Broek, Niels Berhout, Ramírez, Utrecht University; Paulo Mesquita, Júlio Carneiro, José Rafael Silva, University of Évora; João Pedro Gouveia, Júlia Seixas, Universidade Nova de Lisboa; Helena Cabal, CIEMAT; Roberto Martinez, IGME; Abdelkrim Rimi, ISR; Mariana Sardinha, Dulce Boavida, LNEG; GianCarlo Tosato, ASATREM srl

Flow Assurance CCS Project ROAD
Wolfgang Boeser, Stefan Belfroid, E.ON Ruhrgas AG
Integration of Pipeline Operations Sourced with CO₂ Captured at a Coal-Fired Power Plant and Injected for Geologic Storage: SECARB Phase III CCS Demonstration
Richard Esposito, Southern Company Generation; Christina Harvick, Rusty Shaw, Denbury Resources, Inc.; Doug Mooneyham, Cardno Entrix; Jerry Hill, Southern State Energy Board; Robert Trautz, EPRI

Planning CCS Development in the West Mediterranean
Dulce Boavida, Laboratório Nacional de Energia e Geologia - LNEG; Julio Carnerio, University of Évora; Roberto Martinez, IGME; Machteld van den Broek, Andrea Ramirez, Utrecht University; Abdelkrim Rimi, UM5A-ISR; Giancarlo Tosato, ASATREM; Marie Gastine, BRGM

The Study on Prospects and Early Opportunities for Carbon Capture and Storage in Guangdong Province, China
Ying Huang, Diaqing Zhao, Chinese Academy of Sciences; Hongxu Guo, Chinese Academy of Sciences and Graduate School of the Chinese Academy of Science

Session 7A - Trapping Mechanisms: Case Studies
Session Chairs: John Bradshaw & Charles Gorecki
Determining Residual CO₂ Saturation Through a Dissolution test - Results from a CO2CRC Field Experiment
Ralf Haese, Chris Boreham, CO2CRC/Geoscience; Jonathan Ennis-King, Lincoln Paterson, CO2CRC/CSIRO; Barry Freifeld, Lawrence Berkeley National Laboratory; Ulrike Schacht, University of Adelaide

Brine Geochemistry Changes Induced by CO₂ Injection Observed Over a 10 Year Period in the Weyburn Reservoir
Maurice Shevalier, Michael Nightingale, Berhard Mayer, Ian Hutcheson, University of Calgary

Assessment of the Contribution of CO₂ Trapping Mechanisms at the Ketzin Pilot Site
Thomas Kempka, Elisa Klein, Marco de Lucia, Elena Tillner, Michael Kühn, GFZ

Geochemical Trapping of CO₂ in Saline Aquifers: Results of the Repeated Formation Fluid Sampling at the Nagaoaka Site
Saeko Mito-Adachi, Ziqiu Xue, RITE
Session 7D - Panel Discussion: Making CCS Demonstrations Happen: Lessons Learned

Fossil fuels, both coal and gas, are expected to dominate in the world power generation mix for the next several decades. The IEA estimates that methods to deal with emissions from these sources should make up about one fifth of the effort required to meet the 2 degree Celsius goal for avoiding dangerous climate change. Worldwide, a number of institutions and technology suppliers have invested considerable money in research and development of capture and storage methods for CO₂. Some $26 billion in support has been pledged by governments towards major demonstrations of the technology. Yet few of these demonstrations have gone ahead and, in the electricity sector, none are yet operational. What has gone wrong, and how can the situation be improved?

Chairman: Gwen Andrews, Alstom
Panel Members:
Tony Wood, Clinton Climate Foundation
Masanori Abe, Japan CCS Co.
Peter Radgen, E.On
Greg Everett, Delta Energy

Session 7C - System Integration I: Power Systems

Session Chairs: Kevin McCauley & Kenji Yamaji

The Flexibility Requirements for Power Plants with CCS in a Future Energy System with a Large Share of Intermittent Renewable Energy Sources
Anne Sjoerd Brouwer, Utrecht University and Energy Research Centre of the Netherlands; Ad Seebregts, Energy Research Centre of the Netherlands; André Faaij, Utrecht University

Integration and Operation of Post-Combustion Capture System of Coal-Fired Power Generation: Load Following and Solvent Storage
Robert Brasington, Howard Herzog, Massachusetts Institute of Technology

Performance and Cost Impacts of Cycling Coal and Natural Gas-Fired Power Plants with CCS in a System with High Wind Penetration

The Value of CCS in Power Systems with High Levels of Renewables Penetration
Sean McCoy, Dennis Volk, International Energy Agency; Joachim Bertsch, Stefan Nagl, Christian Growitsch, University of Cologne; Mathias Finkenrath, University of Applied Sciences Kempten; John Davison, IEAGHG
Session 8A - Risk Assessment and Management I
Session Chair: Kenneth Hnottavange-Telleen
Quantification of Risk Profiles and Impacts of Uncertainties as Part of US DOE's National Risk Assessment Partnership (NRAP)
Rajesh Pawar, Philip Staufer, Los Alamos National Laboratory; Grant Bronhal, Robert Dilmore, National Energy Technology Laboratory; Curt Oldenberg, Lawrence Berkeley National Laboratory; Bill Foxall, Edwin Jones, Lawrence Livermore National Laboratory; Stephen Unwin, Pacific Northwest National Laboratory
Quantifying Basin Scale Leakage Risk and Stakeholder Impacts
Jeffrey Bielicki, Melissa Pollak, Elizabeth Wilson, University of Minnesota; Catherine Peters, Jeffrey Fitts, Princeton University
Induced Seismicity; Observations, Risks and Mitigation Measures at CO2 Storage Sites
Andy Nicol, Matt Gerstenberger, CO2CRC & GNS Science; Paul Viskovic, Chris Bromley, Susan Ellis, GNS Science; Charles Jenkins, CSIRO Canberra; Tony Siggins, CSIRO Melbourne
Key Site Abandonment Steps in CO2 Storage
Michael Kühn, Mario Wipki, Stefan Lüth, GFZ German Research Centre for Geosciences; Sevket Durucan, Imperial College London; Jean-Pierre Deflandre, IFP Energies nouvelles; Jens Wollenweber, TNO - Nederlandse Organisatie voor; Andy Chadwick, British Geological Survey; Gualtiero Böhm, Istituto Nazionale di Oceanografia e Geofisica Sperimentale

Session 8B - Post-Combustion: Advanced Solvents
Session Chairs: Kazuya Goto & Gary Rochelle
Chemical Absorption Kinetics in MEA Solution with Fine Particles
Bo Zhao, Meng Cao, Shujuan Wang, Yuqun Zhao, Changhe Chen, Key Laboratory for Thermal Science and Power Engineering of Ministry of Education
Optimization of CO2 Capture from Flue Gas with Promoted Potassium Carbonate Solutions
Peter Behr, Andre Maun, Alexander Tunnat, Gerd Oeljeklaus, Randi Görner, University Duisburg-Essen
Alternative Layouts for the Carbon Capture with the Chilled Ammonia Process
Gianluca Valenti, Davide Bonalumi, Ennio Macchi, Dominic Gatti, Politecnico di Milano; Philip Fosbøl, Kaj Thomsen, Technical University of Denmark
New Energy Efficient Processes and Newly Developed Absorbents for Flue Gas CO₂ Capture
Koji Kadono, Asao Suzuki, Kansai Electric Power; Masaki Iijima, Toyishi Ohishi, Mitsubishi Heavy Industries; Hiroshi Tanaka, Takuya Hirata, Masami Kondo, Mitsubishi Heavy Industries

Session 8C - System Integration II: Infrastructure
Session Chairs: Keigo Akimoto & Angunn Engebø

Infrastructure for CCS in the Skagerakk/Kattegat Region, Southern Scandinavia: A Feasibility Study
Hans Askel Haugan, Nils Eldrup, Ragnhild Skagestad, Anette Mathisen, Dag Bjørnsen, Tel-Tek; Per Aagaard, Thor Axel Thorsen, University of Oslo; Jan Kjärstad, Chalmers University of Technology; Per Bergmo, SINTEF Petroleum Research
Pathways for Deploying CCS at Australian Power Plants
Minh Ho, Dianne Wiley, UNSW and CO2CRC

CCS Infrastructure Development Scenarios for the Integrated Iberian Peninsula and Morocco Energy System
Amit Kanudia, KanORS EMR, India; Dulce Boavida, INETI; Mactheld van den Broek, Utrecht University; Helena Cabal, CEMAT; Maurizio Gargiulo, E4SMA srl; João Pedro Gouveia, CENSE; Maryse Labriet, ENERIS; Gian Carlo Tosato, ASATREM srl

Basin-Scale Impacts of Industrial-Scale CO₂ Injection on Petroleum and Groundwater Resources in the Gippsland Basin, Australia
Karsten Michael, Sunil Varma, CSIRO Earth Science & Resource Engineering; Elise Bekele, CSIRO Land & Water; Monica Campi, Geoff O'Brien, GeoScience Victoria, Department of Primary Industries

Session 8D - Panel Discussion: Storage Capacity – What Do We Know and What Has Changed?
This panel will discuss the critical issue of storage capacity. How to we define it? How do we know how much is available? What progress has been made in the past few years in refining global, regional and local estimates? In addition we will address important issues such as, how might pressure buildup limit storage capacity and how could this be managed; and to what extent microseismicity and associated changes to the seal constrain the locations where CO₂ is stored. Research leaders from around the world will provide a status report about these issues and insights about what more is needed to improve our confidence in storage capacity estimation.

Chairman: Sally Benson, Stanford University
Panelists:
Sam Holloway, BGS
Susan Hovorka, University of Texas at Austin
Sean Brennan, US Geological Survey
Stefan Bachu, Alberta Innovates - Technology Futures
Matt Gerstenberger, GNS Science

Session 8E - Novel Systems
Session Chairs: Katsunori Yogo & Rebecca Gardiner

Higher Efficiency and Lower Cost Electricity Generation from Fossil Fuels while Eliminating Atmospheric Emissions, Including Carbon Dioxide
Rodney Allam, Miles Palmer, G. William Brown, Jeremy Fetvedt, NET Power LLC; Hideo Nomoto, Nobuo Okita, Masao Itoh, Toshiba Corporation; Bo Jones, Shaw Power Group

Electrochemically-Mediated Gas Separation Processes for Carbon Abatement
Fritz Simeon, Mike Stern, Krisitn Vicari, Howard Herzog, T. Alan Hatton, Massachusetts Institute of Technology; Thomas Hammer, Harald Landed, Siemens Corporate Technology

Development of an Energy-Efficient CO₂ Capture Process using Thermomorphic Biphasic Solvents
Jiafei Zhang, Yu Qiao, Wanzhong Wang, Khuram Hussain, David Agar, Technical University of Dortmund

Low Temperature CO₂ Capture for Near-Term Applications
Nikolett Sipöcz, Alvaro Hernandes, Miguel A, Gonzalez-Salazar, GE Global Research; Roger Shisler, VITALI Lissianski, GE Global Research

Session 8F - Monitoring: Geophysical Imaging
Session Chairs: Pascal Audigane & Curtis Oldenburg

Geochemical Interactions Between CO₂ and, and Minerals within the Utsira Caprock: A 5-year Experimental Study
Keith Bateman, Christopher Rochelle, Gemma Purser, Simon Kemp, Doris Wagner, British Geological Survey

Geochemical Clogging in Fracture and Porous Rock for CO₂, Mineral Trapping
Seung Youl Yoo, Yoshitada Mito, Toshifumi Matsuoka, Kyoto University; Akira Ueda, University of Toyama

The Impact of Geomechanics on Monitoring Techniques for CO₂ Injection and Storage
Tom Lynch, Doug Angus, Quentin Fisher, Piroska Lorinczi, University of Leeds
Changes in Pore Structure and Connectivity Induced CO₂ Injection in Carbonates: a Combined Pore-Scale Approach
Oussama Gharbi, Branko Bijeljic, Martin Blunt, Imperial College London; Edo Boek, Imperial College London

Session 8G - Education
Session Chairs: Jürgen-Friedrich Hake & Malcolm Wilson
Scope, Characteristics and Quality of Education Materials on CCS for the School Sector Around the World: Addressing and Trialling the Gaps
Anne-Marie Dowd, Talia Jeanneret; CSIRO
Creating a Sequestration Capacity Building and Knowledge Sharing Center
Sallie Greenberg, Illinois State Geological Survey
Developing National CCS Capacity and Skills: Examples from the UK
Robin Cathcart, Elizabeth Van der Meer, UK CCS Community Network; Hannah Chalmers, Jon Gibbins, UK CCS Community Network and University of Edinburgh; Colin Snape, University of Nottingham
China-Australia Capacity Building Program on the Geological Storage of Carbon Dioxide - Results from Phase I
Richard Causebrook, Aleksandra Kalinowski, Jessica Gurney, Liuqi Wang, Geoscience Australia; Jiutian Zhang, Jia Li, Administrative Centre for China’s Agenda 21

Dissipation of Overpressure into Ambient Rocks During CO₂ Storage
Kyung Won Chang, Marc Hesse, The University of Texas at Austin; Jean-Philippe Nicot, The University of Texas

Session 9A - Reservoir Engineering: Pressure Management
Session Chairs: Chris Hawkes & Neil Wildgust
An Integrated Economic and Engineering Assessment of Opportunities for CO₂ Injection with Water Production in the South-East Queensland, Australia
Peter Neal, Yildiray cinar, Guy Allinson, CO2CRC, Australia and School of Petroleum Engineering, The University of New South Wales

Four-Site Case Study of Water Extraction from Carbon Dioxide Storage Reservoirs
Guoxiang Liu, Charles Gorecki, Jordan Bremer, Ryan Klapperich, Robert Cowan, Yevhen Holubnyak, Damion Knudsen, Dayanand Saini, EERC

Reservoir Management of CO₂ Injection: Pressure Control and Capacity Enhancement
Bramshad Nazarian, Rudolf Held, Lars Høier, Philip Ringrose, NTNU

Magnitude and Duration of Temperature Changes in Geological Storage of Carbon Dioxide
Tara LaForce, Jonathan Ennis-King, Lincoln Paterson, CO2CRC/CSIRO Earth Science and Resource Engineering

Session 9B - Chemical Looping
Session Chairs: Olav Bolland & Jasmin Kemper
10 MW CLC Field Pilot
Song P. Sit, Alex Reed, Cenovus Energy Inc.; Ulrich Hohenwarter, Viktoria Horn, Andritz Energy & Environment; Tobias Proll, Marx Klemens, Vienna University of Technology

Chemical-Looping Combustion of Solid Fuels – Operational Experiences in 100 kW Dual Circulating Fluidized Bed System
Anders Lyngfelt, Pontus Markström, Carl Linderholm, Chalmers University of Technology

Next Scale Chemical Looping Combustion: Process Integration and Part Load Investigation for a 10MW Demonstration Unit
David Riestenberg, Shawna Cyphers, Karine Schepers, Gergeo Koperna, BERTSCHenergy, Josef Bertsch Gesellschaft m.b.H. & Co. KG

Integration of Coal Gasification and Packed Bed CLC Process for High Efficiency and Near-Zero Emission Power Generation
Matteo Carmelo Romano, Paolo Chiesa, Vincenzo Spallina, Giovanni Lozza, Politecnico di Milano

Use of Chemical-Looping Processes for Coal Combustion with CO₂ Capture
Juan Adanez, Pilar Gayan, Iñaki Adanez-Rubio, Ana Cuadrat, Alberto Abad, Francisco García-Labiano, Luis Francisco de Diego, Instituto de Carboquímica- CSIC

Session 9C - Policy: Other
Session Chairs: Tim Dixon & Helle Brit Mostad
Analysing Uncertainties for CCS: from Historical Analogues to Future Deployment Pathways in the UK
Jim Watson, University of Sussex; Florian Kern, Nils Markusson, Hannah Chalmers, Stuart Haszeldine, Jon Gibbins, Mark Winkel, University of Edinburgh; Rob Gross, Phil Heptonstall, Imperial College London; Peter Pearson, University of Cardiff
Session 9E - Oxy-Combustion: CO₂ Processing Unit

Session Chairs: Stanley Santos & Phil Sharman

Modelling the Fate of Sulphur During Pulverized Coal Combustion under Conventional and Oxyfuel Conditions
Michael Müller, Uwe Schnell, Günter Scheffknecht, University of Stuttgart

Optimized Multi-Pollutant Removal in Oxy-Fuel Power Plants with CO₂ Capture
Ahmed Shafeen, Kourosh Zanganeh, Ashkan Beigzadeh, Natural Resources Canada

Offgas Treatment After the Gas Processing Unit of a Coal-Fired Oxyfuel Power Plant with Polymeric Membranes and Pressure Swing Adsorption
Jens Dickmeis, Alfons Kather, Hamburg University of Technology

Optimization of Cryogenic CO₂ Purification for Oxy-Coal Combustion
Hailong Li, Mälardalens University; Yukun Hu, Royal Institute of Technology; Mario Ditaranto, SINTEF Energy; David Wilson, Stanbridge Capital; Jinyue Yan, Mälardalens University and Royal Institute of Technology

Simultaneous NOx and SOx Reduction from Oxyfuel Exhaust Gases using Acidic Solutions Containing Hydrogen Peroxide
Isabelle Liémans, Diane Thomas, Chemical Engineering Department, University of Mons

Session 9D - Public Perception: Communication Activities and Experiences

Session Chairs: Peta Ashworth & Kenshi Itaoka

It's Not Only About Safety: Beliefs and Attitudes of 811 Local Residents Regarding a CCS project in Barendrecht
Bart Terwel, Emma ter Mors, Dancker Daamen, Leiden University

Lessons Learned from the Public Perception and Engagement Strategy - Experiences in CIUDEN's CCS Facilities in Spain
Monica Lupion, Andrea Pérez, Fernando Torrecilla, Fernando Torrecilla, CIUDEN

Application of Social Site Characterisation to Inform Public Engagement Efforts in Poland and the UK
Suzanne Brunsting, Mariëtte Pol, ECN; Marta Kaiser, Rene Zimmer, UFU; Simon Shackley, Leslie Mabon, The University of Edinburgh; Fiona Hepplewhite, Scottish Government; Marcin Mazurowski, Dorota Polak-Osiniak, PGNiG

The Evolution of Stakeholder Perceptions of Deploying CCS Technologies in China: Survey Results from Three Stakeholder Consultations in 2006, 2009 and 2012
Xi Liang, University of Edinburgh; David Rainer, University of Cambridge

Visual Message Mapping for CCS Outreach
Daniel Daly, EERC; Lydia Cumming, Pacific Northwest Laboratory; Gary Garrett, Southern States Energy Board; Marian Stone, Bevilacqua-Knight, Inc.; Mark Cather, New Mexico Tech; Lindsey Tolleson, Big Sky Carbon Sequestration Partnership; Sarah Wade, WADE, LLC
Session 10A - Risk Assessment and Management II
Session Chairs: Max Prins & Isabelle Czernichowski-Lauriol

Geomechanical Modeling of Fault Responses and the Potential for Notable Seismic Events During Underground CO2 Injection
Jonny Rutqvist, Frederic Cappa, Alberto Mosaldi, Antonio Rinaldi, Lawrence Berkeley National Laboratory

Safety-Based Injection Strategy for Carbon Dioxide Geological Sequestration in a Deep Saline Aquifer with Complex Sandstone-Shale Sequences: A Case Study from Taiwan
Bieng-Zih Hsieh, Cheng-Yueh Wu, Zsay-Shing Lin, National Cheng Kung University; Ch-Chung Tseng, Ta-Lin Chen, CPC Corporation

Migration of CO2 Through the Overburden and Potential Effects of Leakage on the Seafloor Environment: A Summary from QICS Work Package 1
Beil Burnside, Mark Naylor, University of Edinburgh; Karen Kirk, British Geological Survey; Simon Mathias, University of Durham; Fiona Whittaker, University of Bristol

The Bubble/Slug Flow Model for Methane Leakage from Natural Gas Wells as an Analogue for Shallow CO2 Migration
Ian Duncan, BEG, University of Texas at Austin

Session 9G - Transport and Infrastructure
Session Chair: Andrea Ramirez

Accurate Thermodynamic-Property Models for CO2-Rich Mixtures
Roland Span, Johannes Gernert, Andreas Jäger, Ruhr-Universität Bochum

Combining Thermodynamic and Fluid Flow Modelling for CO2 Flow Assurance
Svend Tol Munkejord, Mona Mølnvik, SINTEF Energy Research; Christian Bernstone, Vattenfall Research and Development AB; Sigmund Clausen, Gassco AS; Gelein de Koeijer, Statoil R&D

Heat Transfer Characteristics of a Pipeline for CO2 Transport with Various Surrounding Substances
Michael Drescher, Øivind Wilhelmsen, Peder Aursand, SINTEF Energy Research; Gelein de Koeijer, Rudolf Held, Jan H. Borch, Statoil ASA

Corrosion in Dense Phase CO2 – the Impact of Depressurisation and Accumulation of Impurities
Arne Dugstad, Bjørn Morland, Malgorzata Halseid, Anne Olaug Svivertsen, Institute for Energy Technology

Corrosion Mechanism and Impact Factor Analysis of Pipeline Steel in Supercritical CO2 with Impurities
Yong Xiang, Zhe Wang, Zheng Li, Weidou Ni, Tsinghua University
Session 10C - Emerging Technologies
Session Chair: Steve Goldthorpe
Enhanced Oil Recovery Method using Carbonated Water Flooding
Lin Zuo, Sally Benson, Energy Resources Engineering, Stanford University; Changyon Zhang, Environmental Molecular Sciences Laboratory, Richland

Utilization of Carbon Dioxide as a Cushion Gas for Compressed Air Energy Storage
Curtis Oldenburg, Lehua Pan, Lawrence Berkeley National Laboratory

Identification of New Microbial Mediators for Electromethanogenic Reduction of Geologically-Stored Carbon Dioxide
Qian Fu, Hajime Kobayashi, Hideo Kawaguchi, Javier Vilcaéz, Kozo Sato, The University of Tokyo

CO₂ Utilization from “Next Generation” CO₂ Enhanced Oil Recovery
Vello Kuuskraa, Tyler Van Leeuwen, Advanced Resources International, Inc.; Phil Dipietro, U.S. DOE/ National Energy Technology Laboratory

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Vello Kuuskraa, Tyler Van Leeuwen, Advanced Resources International, Inc.; Phil Dipietro, U.S. DOE/ National Energy Technology Laboratory

Session 10D - Public Perception: Social Science Research
Session Chairs: Peta Ashworth & David Reiner
Relating Individual Perceptions of Carbon Dioxide to Perceptions of CCS: An International Comparative Study
Kenji Itaoka, Aya Saito, Mizuho Information & Research Institute; Anne-Marie Dowd, Peta Ashworth, CSIRO; Marjolein de Best-Waldhober, ECN

Exploring Media Representation of Carbon Capture and Storage: An Analysis of Japanese Newspaper Coverage in 1990-2010
Shinichiro Asayma, Atsushi Ishii, Tohoku University

CO2CRC Otway Project Social Research: Assessing CCS Community Consultation
Tony Steeper, CO2CRC

The Potential of Host Community Compensation in Facility Siting
Emma ter Mors, Bart W. Terwel, Dancker Daamen, Leiden University

Session 10E - Pre-Combustion: Technology
Session Chairs: Daan Jansen & John Davison
A Novel Adsorbent Material (MOF/MCM-41) for Pre-Combustion CO₂ Capture by Pressure Swing Adsorption
Nathalie Cass, Johanna Schell, Lisa Joss, Marco Mazzotti, Institute of Process Engineering, ETH Zurich; Richard Blom, SINTEF Materials and Chemistry

Advanced CO₂ Separation Technologies: Coal Gasification, Warm-Gas Cleanup, and Hydrogen Separation Membranes
Joshua Stanislow, Scott Tolbert, Tyler Curran, EERC

High Performance CO₂ Capture by Autothermal AGR System
Yasushi Mori, Mitsubishi Heavy Industries Compressor Corporation; Jonathan Forsyth, BP Alternative Energy International Ltd

Coal-CO₂-Slurry Feed for Pressurised Gasifiers: Slurry Preparation System Characterisation and Economics
Cristina Botero, Howard Herzog, Ahmned Ghoniem, Massachusetts Institute of Technology

Session 10F - Trapping Mechanisms: Capillarity and Heterogeneity
Session Chairs: James Sorensen & Sam Holloway
Clay Hydration/Dehydration in Dry to Water-Saturated Supercritical CO₂: Implications for Caprock Integrity
John Loring, Todd Schaef, Chris Thompson, Quinn Miller, Jianzhi Hu, David Hoyt, Paul Martin, Eugene Ilton, Andrew Felmy, Kevin Rosso, Pacific Northwest National Laboratory

Capillary Heterogeneity in Sandstones Rocks During CO₂/Water Core-Flooding Experiments
Ronny Pini, Mike Krause, Sally Benson, Stanford University; Sam Krevor, Imperial College London

Seal Integrity of the Rousse Depleted Gas Field Impacted by CO₂ Injection (Laqc Industrial CCS Reference Project - France)
Dominique Pourtoy, Marc Lescanne, Sylvian Thibeau, Atef Onaisi, Calire Viaud, TOTAL E&P

Estimation of Local Capillary Trapping Capacity from Geologic Models
Eshan Saadatpoor, Steven Bryant, Kamy Sepehrnoori, The University of Texas at Austin
Potential Subsurface Impacts of CO₂ Stream Impurities on Geologic Carbon Storage
Jean-Philippe Nicot, Katherine Romanak, Patrick Mickler, Silvia Solano, Changbing Yang, Jiemen Lu, Tongwei Zhang, Bureau of Economic Geology, The University of Texas at Austin

Session 11B - Post-Combustion: Solvent Fundamentals

Corrosion Investigations in MEA Based Post-Combustion CO₂ Capture Pilot Plants
Séverine De Vroey, Pascale Absil, Marie-Laure Thielens, Laborelec

Corrosivity of Single and Blended Amines in CO₂ Capture Process
Prakashpathi Gunasekaran, Amornvadee (Amy) Veawab, Adisorn Aroonwilas, University of Regina

Prediction of N₂O Solubilities in Alkanolamine Solutions from the Excess Volume Property
Ardi Hartono, Emmanuel Mba, Hallvard Svendsen, NTNU

Solids Modelling and Capture Simulation of Piperazine in Potassium Solvents
Philip Loldrup Fosbøl, Bjørn Maribo-Mogensen, Kaj Thomsen, The Technical University of Denmark

Session 11C - CCS and Geothermal

Thomas A. Buscheck, Mingjie Chen, Yunwei Sun, Yue Hao, Chuanhe Lu, Thomas J. Wolery, Roger D. Aines, Lawrence Livermore National Laboratory; Michael A. Celia, Princeton University

Geothermal Energy Production Coupled With CCS: Field Demonstration at the SECARB Cranfield Site, Cranfield, Mississippi, USA
Barry Frielfeld, Christine Doughty, Lawrence Berkeley National Laboratory; Bruce Cuthrig, University of Texas; Steve Zakim, Ming Sheu, Timothy Held, Echogen Power Systems, LLC

From Competition to Synergy - Support Geothermal Exploitation by Geological CO₂ Storage
Elena Tillner, Thomas Kempka, Egbert Jolie, Michael Kühn, GFZ German Research Centre for Geosciences

Synergy Benefits in Combining CCS and Geothermal Energy Production
Carsten M. Nielsen, Peter Frykman, Geological Survey of Denmark and Greenland; Finn Dalhoff, Vattenfall Research & Development AB
Session 11D - Risk Management: Contingency Planning and Remediation
Session Chairs: Bill Senior & Rajesh Pawar
CO2 Storage Contingencies Initiative: Detection, Intervention and Remediation of Unexpected CO2 Migration
Scott Imbus, Chevron Energy Technology Co.; Kevin Dodds, BP AlternativeEnergy; Robert Trautz, Electric Power Research Institute; Claus Otto, Shell Global Solutions International; Charles Christopher, CO2Store; Sally Benson, Stanford University

How to Establish CO2 Flow/Concentration Warning Levels Based on the Geochemical Monitoring Baseline: Specific Case of CO2 Storage at Clayes-Souilly (Paris Basin)
Natalia Quisel, Stéphane Thomas, VEOLIA Environnement Recherche & Innovation; Jacques Pironon, Philippe de Donato, Judith Saussea, Odile Barres, MAGES group, Université de Lorraine-CNRS; Zbigniew Pokryszka, INERIS, Parc Technologique Alata

Natural Mitigation of CO2 Leakage Accumulations:
Jean-Charles Manceau, Jérémy Rohmer, Arnaud Réveillére, BRGM

Estimating CO2 Leakage Rate Along a Fault: Model and Field Application
Qing Tao, Steven Bryant, The University of Texas at Austin; David Alexander, The University of Trinidad and Tobago

Session 11E - System Integration III: Other
Session Chairs: Shunsuke Mori & Andrea Ramirez

Evaluation of CO2 Post Combustion Capture Integration with Natural Gas Power Plant and Desalination Co-Generation Plant
Stephen Fadeyi, Hassan Fath, Mohammad Abu-Zahra, Masdar Institute of Science and Technology

Investigating Flexible Carbon Capture Opportunities in the Australian Electricity Market
Yuanfei Zhang, Monh Ho, Dianne Wiley, The University of New South Wales and CO2CRC

Climate Mitigation’s Impact on Global and Regional Electric Power Sector Water Use in the 21st Century
Evan Davies, University of Alberta; Page Kyle, James Dooley, Pacific Northwest National Laboratory

CCS Feasibility Improvement in Industrial and Municipal Applications by Heat Utilisation
Janne Kärki, Eemeli Tsupari, Antti Arasto, VTT Technical research centre of Finland

Session 11F - Ex Situ Mineralisation of CO2
Session Chair: Millie Basava-Reddi

Integrated Mineral Carbonation Reactor Technology for Sustainable Carbon Dioxide Sequestration: ‘CO2 Energy Reactor’
Rafael Santos, Wouter Verbeek, Jens van Bouwel, Tom Van Gerven, Yiannis Pontikes, KU Leuven; Pol Knops, Keesjan Rijnsburger, Innovation Concepts B.V.

Carbon Storage by Mineralisation (CSM): Serpentinite Rock Carbonation Via Mg(OH)2 Reaction Intermediate Without CO2 Pre-Separation
Ron Zevenhoven, Johan Fagerlund, Experience Nduagu, Inês Romão, Åbo Akademi University; Jie Bu, James Highfield, ICES - A*STAR

Assessment of the Energy Requirements for CO2 Storage by Carbonation of Industrial Residues
Renato Baciocchi, Giulia Costa, Daniela Zingaretti, University of Rome Tor Vergata

Carbonation of Activated Serpentine for Direct Flue Gas Mineralization
Mischa Werner, Subrahmaniam Harihar, Marco Mazzotti, ETH Zurich; Renato Baciocchi, Daniela Zingaretti, University of Rome Tor Vergata

Session 11G - Oxy-Combustion: Large Scale Implementation
Session Chair: Olav Bolland

Initial Operation Results of Oxyfuel Power Plant in Callide Oxyfuel Project
Takahiro Gotou, Terutoshi Uchida Toshihiki Yamada, Tetsuya Hori, IHI Corporation; Chris Spero, CS Energy Ltd.

Young Dong Unit 1 Oxyfuel Feasibility Study and FEED
Michael Maloney, Konrad Kuczynski, MAKESH Kaliyaperumal, Doosan Power Systems; H.P. Kim, Doosan Heavy Industries & Construction

The Air Products–Vattenfall Oxyfuel CO2 Compression and Purification Pilot Plant at Schwarze Pumpe
Vince White, Andrew Wright, Air Products PLC, Stephanie Tappe, Vattenfall Europe Generation AG; Jinying Yan, Vattenfall Research & Development AB

Oxycombustion for Carbon Capture on Coal Power Plants: Advantages, Technical Challenges and Innovative Mitigation Solutions
Nicolas Perrin, Richard Dubettier, Jean-Pierre Tranier, Air Liquide
The Poster Sessions will be held in the Event Hall, as indicated on the floorplan on page 19.

Posters shown here in Blue will be presented in Poster Session A on Tuesday the 20th of November, between 13.40 - 15.40.

Posters shown here in Black, will be presented in Poster Session B on Wednesday the 21st of November, between 13.40 - 15.40.
Poster Session Details

On the following pages you will find the details of all posters on display at GHGT-11.

Posters listed in Blue will be presented in Poster Session A, while those listed in Black, will be presented in Poster Session B.

Session A: Tuesday 20th November: 13.40 - 15.40
Session B: Wednesday 21st November: 13.40 - 15.40

**Advances in CO₂ Capture Technology Development Adsorption**

1. **Studies of Ca-Based High Temperature Sorbents for CO₂ Capture**
   Bjørnar Arstad, Richard Blom, Joanna Prostak, SINTEF
2. **Carbon Dioxide Capture from Flue Gases by Solid Sorbents**
   Mustafa Abunowara, Libyan Petroleum Institute; Mohammed Elgarni, HTe Purenergy Inc.
3. **Optimizing Solid Sorbents for CCS**
   Adam Berger, Abhoyjit Bhown, SINTEF
4. **On the Development of Vacuum Swing Adsorption (VSA) Technology for Post-Combustion CO₂ Capture**
   Anne Anderson, Jasmina Hafizovic Cavka, Aud Spjelkavik, Richard Blom, SINTEF Materials & Chemistry; Amar N. Goswami, Anshu Nanoti; Indian Institute of Petroleum
5. **Efficient and Rapid Screening of Novel Adsorbents for Carbon Capture in the UK IGSCC Project**
   Stefano Brandani, Enzo Mangano, Maria-Chiara Ferarri, The University of Edinburgh; Magdalena Malgorzata Lozinka, Paul Anthony Wright, Juergen Kahr, Russell Morris, University of St. Andrews; Matthew Crad, Neil McKeown, Cardiff University; Peter Budd, The University of Manchester
6. **Characterisation of an Automated Dual Piston Pressure Swing Adsorption (DP-PSA) System**
   Daniel Friedrich, Wenli Dang, Stefano Brandani, Institute for Materials and Processes, University of Edinburgh
7. **Post-Combustion CO₂ Capture using Solid Sorbents: 1 MW Pilot Scale Evaluation**
   Holly Krutka, Sharon Sjostrom, Travis Starns, Cody Wilson, ADA Environmental Solutions
8. **Development of in-Situ CO₂ Capture Coal Utilization Technologies**
   Shiyong Lin, Hironobu Oshima, Japan Coal Energy Center
   Shu-Yuan Pan, Pen-Chi Chiang, National Taiwan University; Yi-Hung Chen, National Taipei University of Technology; E-E Chang, Taipei Medical University
10. **The Status of the Development Project for the 10 MWe-Scale Dry-Sorbent Carbon Dioxide Capture System to the Real Coal-Fired Power Plant in Korea**
11. **Dynamic Cyclic Performance of Phenol-Formaldehyde Resin-Derived Carbons for Pre-Combustion CO₂ Capture: An Experimental Study**
    Susana Garcia, Claudia F. Martin, Jose J. Pis, Fernando Rubiera, Cova Pevida, INCAR-CSIC
12. **Postcombustion CO₂ Capture Adsorbents from Spent Coffee Grounds**
    Ana Silvia González, Marta G. Plaza, Jose, J. Pis, Fernando Rubiera, Cova Pevida, INCAR-CSIC
    Matteo Carmelo Romano, Politecnico di Milano; Isabel Martinez, Ramón Murillo, Instituto de Carboquímica (ICB-CSIC); Dursun Can Ozcan, Hyungwoong Ahn, IMP-SEE, The University of Edinburgh, Richard Blom, SINTEF Material and Chemistry
14. **Alkylamine-Based Adsorbents Synthesized using High Internal Phase Emulsion Technique for Carbon Dioxide Adsorption**
    Chintana Saiwan, Pailin Muchan, Petroleum and Petrochemical College, Chulalongkorn University; David deMontigny, Petroleum and Petrochemical College, Chulalongkorn University
15. **Study of Carbon Dioxide (CO₂) Adsorption for Fossil Fuel Based Power Plant Flue Gas Application using Quaternized Biopolymer**
   Chintana Saiwan, Nattida Sotthinirandorn, Petroleum and Petrochemical College, Chulalongkorn University; Raphael Idem, Paitoon Tontiwachwuthikul, Teeradet Supap, International Test Centre for CO₂ Capture, University of Regina; Panya Wongpanit, Faculty of Agricultural Product Innovation and Technology, Srinakharinwirot University

16. **Effect of Polyethyleneimine Loading into High Internal Phase Emulsion Polymer for Carbon Dioxide Adsorption**
   Chintana Saiwan, Pacharakhorn Dejburum, Petroleum and Petrochemical College, Chulalongkorn University; Petroleum and Petrochemical College, Chulalongkorn University

17. **Comparison of Commercial and New Adsorbent Materials for Pre-Combustion CO₂ Capture by Pressure Swing Adsorption**
   Joanna, Schell, Nathalie Casas, Dorian Marx, Marco Mazzotti, Institute of Process Engineering ETH Zürich, Zürich, Switzerland; Richard Blom, SINTEF materials and chemistry, Oslo, Norway

18. **Nanoparticle-Supported Amine for High Capacity CO₂ Adsorbents**
   Fritz Simeon, T. Alan Hatton, Massachusetts Institute of Technology

19. **CO₂ Capture by Mesoporous SBA-15 Grafted with 3-Aminopropyl Triethoxysilane in Supercritical Propane**
   Chung-Sung Tan, Worsasung Klinthong, Chih-Hung Huang, Department of Chemical Engineering, National Tsing Hua University

20. **Qualification of the ALKASORB Sorbent for the Sorption-Enhanced Water-Gas Shift Process**
    Edward Van Selow, Paul Cobden, Eric Van Dijk, Paul Verbraeken, Daniel Jansen, Energy Research Centre of the Netherlands

21. **Calcium Looping Process: Oxyfuel Sorbent Regeneration Experimental Validation of a Carbonator Model & Investigation of Sorbent Performance Regenerated under High CO₂ Partial Pressure**
    Glykeria Varela, Ajay Ramesh Bidwe, Craig Hawthorn, Lucia Bernard, Mariusz Zeiba, Günter Scheffknecht, Uni. Stuttgart/ IFK

22. **Development of Amine-Modified Solid Sorbents for Post Combustion CO₂ Capture**
    Katsunori Yogo, Shingo Kazama, Research Institute of Innovative Technology for the Earth (RITE), Chemical Research and Nara Institute of Science and Technology (NAIST); Tsuyoshi Watabe, Research Institute of Innovative Technology for the Earth (RITE), Chemical Research; Yosuke Nishizaka, Nara Institute of Science and Technology (NAIST)

23. **Enhancing Sorption Performance of Solid Amine Sorbents for CO₂ Capture by Additives**
    Zhonghua Zhang, National Institute of Clean-and-Low-Carbon Energy, and China University of Mining and Technology; Boadong Wang, Qi Sun, National Institute of Clean-and-Low-Carbon Energy; Xiaoliang Ma, Kuwait Institute for Scientific Research and EMS Energy Institute; Yonggang Wang, China University of Mining and Technology

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### Advanced Solvents

24. **Evaluation of Amine-Blend Solvent Systems for Post-Combustion Capture Applications**
    Adewale Adeson, Mohammad Abu Zahra, Masdar Institute of Science and Technology

25. **Developments in the CO₂CRC UNO Mk 3 Process - a Multi-Component Solvent Process for Large Scale CO₂ Capture**
    Calre Anderson, Trent Harkin, Abdul Qader, Narry Hooper, CO₂CRC; Mihn Ho, The University of NSW

26. **Understanding Precipitation in Amino Acid Salts at Process Conditions**
    Ugochukwu E. Aronu, Innas Kim, SINTEF Materials and Chemistry; Adri Hartono, Department of Chemical Engineering, Norwegian University of Science and Technology

27. **Strategic Vapor Suppressing Additives for Ammonia Based CO₂ Capture Solvent**
    Moetz Attalla, Stefan Salentinig, Phil Jackson, CSIRO; Ben Ballinger, University of Queensland

    Peter Behr, Alexander Tunnat, Andre Maun, Klaus Görner, University Duisburg-Essen
29. Solvent Selection for Post-Combustion CO₂ Capture  
Juan Salizer, Urmila, Diwekar, Vishwamitra Research Institute; Kevin Joback, Molecular Knowledge Systems; Adam Beger, Abhoyjit Bhown, Electric Power Research Institute

30. Synthesis and Characterization of New Absorbents for CO₂ Capture  
Firoz Alam Chowdhury, Hidetaka Yamada, Takayuki Higashii, Shingo Kazama, Research Institute of Innovative Technology for the Earth (RITE); Yoichi Matsuzaki, Nippon Steel Corporation

31. CO₂-Binding Organic Liquids Gas Capture with Polarity-Swing-Assisted Regeneration  
David Heldebrand, Charles Freeman, Feng Zheng, Phillip Keoch, Mark Bearden, Michael Elliot, Pacific Northwest National Laboratory

32. Screening and Characterization of Advanced Amine Based Solvent Systems for CO₂ Post-Combustion Capture  
Ali Imran, Adewalw Adeosun, Mohammad Abu Zahra, Masdar Institute of Science and Technology

33. Oxidative Degradation of AMP/MEA Aqueous Blends  
Klaus-J Jens, Telemark University College; Teillin Wang, Telemark Technological R & D Institute and Telemark University College

34. Evaluation of Carbon Dioxide Absorption by Amine Based Absorbent  
Yasuhiro Kato, Shinji Murai, Daigo Miraoka, Takehiko Muramatsu, Satoshi Sato, Toshiba Corporation

35. Real Time Mechanistic Insights for CO₂ Capture with Liquid Amine Absorbents  
Pavel Kortunov, Lisa Baugh, David Calabro, Micahel Siskin, Jand Thomann, ExxonMobil Research and Engineering

36. Absorption Rates and CO₂ Solubility in New Piperazine Blends  
Le Li, Yang Du, Omkar Namjoshi, Gary Rochelle, Department of Chemical Engineering, University of Texas at Austin; Han Li, State Key Laboratory of Chemical Engineering, Tsinghua University

37. Modeling Pilot Plant Results for CO₂ Stripping using Piperazine in a Two Stage Flash  
Tarun Madan, David Van Wagener, Eric Chen, Gary Rochelle, University of Texas at Austin

38. Ab Initio Study of CO₂ Capture Mechanisms in Monoethanolamine Aqueous Solution: Reaction Pathways from Carbamate to Bicarbonate  
Yoichi Matsuzaki, Masami Onoda, Nippon Steel Corporation; Firoz Alam Chowdhury, Takayuki Higashii, Shingo Kazama, Research Institute of Innovative Technology for the Earth (RITE)

39. Location-Specific Technoeconomic Evaluation of a Novel Amine Technology  
Dale Jones, Thomas McVey, Julio Friedmann, Lawrence Livermore National Laboratory

40. Development of Hindered New Amine Absorbents for CO₂ Capture  
Shinji Murai, Yasuhiro Kato, Yukishige Maezawa, Takehiko Muramatsu, Satoshi Sato, TOSHIBA

41. Promoting CO₂ Absorption in Aqueous Amines with Benzylamine  
Gilles Richner, CSIRO

42. Lab-Scale Characterization of CO₂ Absorbents Containing Various Amine Species  
Hiroshi Sato, Kumiko Yoshiiha, Nobuhiko Kubota, Research Laboratory, IHI Corporation; Katsumi Takahashi, IHI Technology Solutions Inc.; Ario Matsumoto, Yasuhiro Yamanaka, Power Plant Division, IHI Corporation; Yukio Furukawa, Department of Chemistry and Biochemistry, Graduate School of Advanced Science and Engineering, Waseda University

43. Aqueous 2-Methylpiperazine/Piperazine for Carbon Capture  
Brent Sherman, Xi Chen, Thu Nguyen, Stephanie Freeman, Gary Rochelle, University of Texas at Austin

44. Mixed Alkanolamines with Low Regeneration Energy for CO₂ Capture in a Rotating Packed Bed  
Cheng-Hsiu Yu, Chung-Sung Tan, Department of Chemical Engineering, National Tsing Hua University

45. Demonstration Test Result of High Pressure Acid-Gas Capture Technology (HiPACT)  
Koji Tanaka, Yasushi Fujimura, JGC Corporation; Takehiro Komi, INPEX CORPORATION; Torsten Katz, Oliver Spuhl, BASF SE; Erick Contreras, BASF East Asia Headquarters Ltd.

46. Study on Potential Biphasic Solvents: Absorption Capacity, CO₂ Loading, and Reaction Rate  
Zhicheng Xu, Shujuan Wang, Changhe Chen, Tsinghua University
47. Effect of Alcohol Chain Length on Carbon Dioxide Absorption into Aqueous Solutions of Alkanolamines
Hidetaka Yamada, Firoz Chowdhury, Kazuya Goto, Takayuki Higashii, Shingo Kazama, Research Institute of Innovative Technology for the Earth; Yoichi Matsuzaki, Nippon Steel Corporation

48. Development of Chemical CO₂ Solvent for High-Pressure CO₂ Capture
Shin Yamamoto, Takayuki Higashii, Shingo Kazama, Chemical Research Group, Research Institute of Innovative Technology for the Earth; Hiroshi Machida, Department of Chemical Engineering, Graduate School of Engineering, Nagoya University; Yuicho Fujioka, Department of Environmental Sciences, International College of Arts and Sciences, Fukuoka Women's University

49. United State National Carbon Capture Center Status
Frank Morton, Roxann Laird, John Northington, Southern Company

50. ZrO₂-Supported CuO Oxygen Carriers for Chemical-Looping with Oxygen Uncoupling (CLOU)
Mehdi Arjmand, Henrik Leion, Chalmers University of Technology, Division of Environmental Inorganic Chemistry; Tobias Mattisson, Anders Lyngfelt, Chalmers University of Technology, Division of Energy Technology

51. Characterization of Spray-Dried NO Oxygen Carrier Supported on Alpha Alumina
Jeom-In Baek, Joong Beom Lee, Tae-Hyoun Eom, Kyeong-Sook Kim, Seug-Ran Yang, Chong Kul Ryu, KEPCO Research Institute

52. Reactor Choices for Chemical Looping Combustion (CLC) – Dependencies on Materials Characteristics
Erin Kimball, W.A.P. van den Bos, W.A.P. van den Bos, TNO; Arnold Lambert, Elodie Comte, IFPEN; Richard Blom, Anita Fossdal, Yngve Larring SINTEF

53. 3D Hydrodynamic Simulation of a Chemical Looping Combustion with Two Interconnected Fluidized Beds
Jian Chang, Kai Zhang, Honggang Chen, Yongpin Yang, North China Electric Power University; Yanjun Guan, China University of Petroleum

54. Operation and scale-Up of Fixed Bed Chemical Looping Combustion
Erin Kimbal, Patricia van der Bos, Arthur Bezuijen, Judith Jahn, Aral Gooetheer, Peter van den Broeke, TNO

55. Evaluation of a Highly Reactive and Sulfur Resistant Synthetic Fe-Based Oxygen Carrier for CLC using Gaseous Fuels
Pilar Gayan, Arturo Cabello, Francisco Garcia-Labiano, Alberto Abad, Luis de Diego, Juan Adanez, Miguel Angel Pans, Cristina Dueso, Instituto de Carboquimica-CSIC

56. Coal Chemical-Looping Combustion for Electricity Generation: Investigation for a 250 MWe Power Plant
Yann Le Moullec, Olivier Authier, EDF R&D

57. Chemical-Looping Combustion of Solid Fuels in a 10 kW Reactor System using Natural Minerals as Oxygen Carrier
Carl Linderholm, Anders Lyngfelt, Chalmers tekniska högskola; Cristina Dueso, Instituto de Carboquimica (ICB-CSIC)

58. Chemical Looping for Pre-Combustion CO₂ Capture – Performance and Cost Analysis
Hari Mantripragada, Edward Rubin, Carnegie Mellon University

59. Process Design of a Hydrogen Production Process for Power Generation Based on a Cu-Ca Chemical Loop
Isabel Martinez, Ramon Murillo, Gemma Grasa, Instituto de Carboquimica (Consejo Superior de Investigaciones Científicas); Jose Ramon Fernandez, Juan Carlos Adanades, Instituto Nacional del Carbón

60. Innovative Oxygen Carrier Materials for Chemical Looping Combustion
Tobias Mattisson, Magnus Ryden, Peter Hallberg, Anders Lyngfelt, Dazheng Jing, Ali Hedayati, Chalmers University of Technology; Jasper Van Noyen, Frans Snijkers, VITO-Flemish Institute for Technological Research
61. Chemical-Looping Combustion with Liquid Fuels
   Tobias Mattisson, Patrick Moldenhauer, Magnus Ryden, Anders Lyngfelt, Dazheng Jing, Ali Hedayati, Chalmers University of Technology; Bandat Fadhel, Jean-Pierre Ballaguët, Saudi Aramco

Costs (capture related)

62. Cost Analysis for CO₂ Capture Process using Aqueous Ammonia at RIST
   Je Young Kim, Kunwo Han, Chi Kyu Ahn, Man Su Lee, Chang Houn Rheee, Hee Dong Chun, RIST

Environmental Impacts of CO₂ Capture

63. Preliminary Studies into the Environmental Fate of Nitrosamine and Nitramine Compounds in Aquatic Systems
   Andy Booth, Eirik Falck da Silva, Odd Gunnar Brakstad, Kolbjørn Zahl, SINTEF Materials and Chemistry

64. The Use of Amine Reclaimer Wastes as a NOx Reduction Agent
   Deshai Botheju, Lars-Andre Tokheim, Telemark University College, Norway; Peter Garborg, Technical University of Denmark, Denmark

65. Nitrosamine Degradation by UV Light Radiation in Post-Combustion CO₂ Capture: Demonstration
   Ferran de Miguel, Henk Trap, Earl Goetheer, TNO; Alexander Voice, University of Texas at Austin

66. A New Test Rig for Studies of Degradation of CO₂ Absorption Solvents at Process Conditions; Comparison of Test Rig Results and Pilot Plant Data for Degradation of MEA (Mono-Ethanolamine)
   Aslak Einbu, Eirik Falck da Silva, Geir Haugen, Andreas Grimsstvedt, Kristin Lauritsen, Terje Vassbøtn, SINTEF Materials and Chemistry

67. Evaluation of Amine Emissions from the Post-Combustion CO₂ Capture Pilot Plant
   Koshito Fujita, Daigo Muraoka, Takashi Ogawa, Hideo Kitamura, Kensuke Suzuki, Satoshi Saito, Toshiba Corporation

68. Potential Toxicological Effects of Amines Used for Carbon Capture and Storage and their Degradation Products
   Annette Rohr, Stephanie Shaw, Eladio Knipping, Electric Power Research Institute; Jacob McDonald, Melanie Doyle-Eisele, Dean Kracko, Lovelace Respiratory Research Institute

69. Evaluation of Monoethanolamine-Based CO₂ Capture Processes By-Product Handling Approaches Considering Regulation in UAE
   Laila Nurrokhmah, Toufic Mezher, Mohammad Abu Zahra, Masdar Institute of Science and Technology
86. Development of Poly(Amidoamine) Dendrimer/ Polyvinyl Alcohol Hybrid Membranes for CO₂ Capture at Elevated Pressures
Shuhong Duan, Ikuo Taniguchi, Teruhiko Kai, Shingo Kazama, Research Institute of Innovative Technology for the Earth

87. Modelling and Multi-Stage Design of Membrane Processes Applied to Carbon Capture in Coal-Fired Power Plants
Davide Bocciardo, Maria-Chiara Ferrari, Setfano Brandani, Scottish Carbon Capture and Storage Centre

88. CO₂ Removal from Multi-Component Gas Stream using Porous Ceramic Membranes Infiltrated with Molten Carbonates
Marie-Laure Fontaine, Thijs Peters, Michael McCann, Partow P. Henriksen, Rune Bredesen, SINTEF Materials and Chemistry

89. CO₂ Absorption with Membrane Contactors vs. Packed Absorbers-Challenges and Opportunities in Post Combustion Capture and Natural Gas Sweetening
Karl Anders Hoff, SINTEF, Hallvard Svendsen, Norwegian University of Science and Technology

90. Molecular Gate Membrane: Poly(Amidoamine) Dendrimer/Polymer Hybrid Membrane Modules for CO₂ Capture
Teruhiko Kai, Ikuo Taniguchi Shuhong Duan, Shingo Kazama, Research Institute of Innovative Technology for the Earth (RITE)

91. Optimization of CO₂ Concentration Captured by Membrane Technology - Possibility of Reduction in CO₂ Capture Energy and Cost
Shingo Kazama, RITE; Kenji Haraya, AIST

92. Membrane Systems Engineering for Post-Combustion Carbon Capture
Rajab Khalilpour, Ali Abbas, University of Sydney

93. The Effect of pH on CO₂-Separation from Post Combustion Gas by Polyvinylamine based Composite Membrane
Taek-Joong Kim, Helène Vrålstad, Marius Sandru, SINTEF Materials and Chemistry; May-Britt Hägg, NTNU

94. Preparation of CO₂ Permselective Li₄SiO₄ Membranes by Using Mesoporous Silica as a Silica Source
Mikihiro Nomura, Tesuya Saknishi, Youichiro Nishi, Keisuke Utsumi, Ryutaro Nakamura, Shibaura Institute of Technology

Membranes

85. Natural Gas Upgrading Through Hydrogen Selective Membranes: Application in Carbon Free Combined Cycles
Konstantinos Astionios, Kyriakos Panopoulos, Aggelos Doukelis, Antionos Koumanakos, Emmanouil Karakas, National Technical University of Athens

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95. Preparation of Thin Li4SiO4 Membranes by Using a CVD Method
Mikihiro Nomura, Tesuya Saknishi, Youichiro Nishi, Keisuke Utsumi, Ryutaro Nakamura, Shibaura Institute of Technology

96. Benchmarking of Hydrogen Selective Membranes
JAZ Pieterse, D. Jansen, J. Boon, JW Dijkstra, ECN

97. Dense Membranes for Efficient Oxygen and Hydrogen Separation (DEMOYS): Project Overview and First Results
Pietro Pinacci, RSE; Jochen Haering, Sulzer Markets and Technology Ltd

98. Membrane – Solvent Absorption Hybrid Processes for Pre- and Post-Combustion Capture from Brown Coal Plants
Colin Scholes, Robyn Cuthbertson, Geoff Stevens, Sandra Kentish; CRC for Greenhouse Gas Technologies (CO2CRC)

99. CACHET-II: Carbon Capture and Hydrogen Production with Membranes
Bai Song, Jonathan Forsyth, BP Alternative Energy

100. Effects of Membrane Properties on CO₂ Desorption from Chemical Absorbents using a Membrane Flash Process
Nobuhide Takashi, Kei Matsuzaki, Tetsuya Funai, Takuya Wada, Hiroshi Fukunaga, Shinshu University; Toru Takatsu, Hiroshi Mano, Research Institute of Innovative Technology for the Earth

101. Comparison and Selection of Amine-Based Absorbents in Membrane Vacuum Regeneration Process for CO₂ Capture with Low Energy Cost
Zhen Wang, Mengxian Fang, Yili Pan, Zhongyang Luo, Zhejiang University; Shuiping Yan, Huazhong Agricultural University

102. Pore-Fill-Type Palladium-Porous Alumina Composite Membrane for Hydrogen Separation
Katsunori Yogo, RITE, Chemical Research Group and NAIST; Hiromichi Takeyama, NAIST; Kensuke Nagata, RITE, Chemical Research Group

103. CO₂/CH₄ Mixed Gas Separation Using Carbon Hollow Fiber Membranes
Miki Yoshimune, Kenji Haraya, AIST

104. The Effects of Membrane-Based CO₂ Capture System on Pulverized Coal Power Plant Performance and Cost
Haibo Zhai, Edward Rubin, Carnegie Mellon University

105. Investigation of Cascaded Membrane Process for Real Flue Gas Simulation in Post-Combustion Capture
Li Zhao, Michael Weber, Detlef Stolten, Forschungszentrum Juelich, Germany

106. Efficient Low CO₂ Emissions Power Generation by Mixed Conducting Membranes
Paolo Chiesa, Matteom Romano, Vincenzo Spallina, David Turi, Politecnico di Milano; Luca Mancuso, Foster Wheeler

Novel Separation

107. Carbon Dioxide Capture from Flue Gases by Solid Sorbents
Mustafa Abunowara, Libyan Petroleum Institute; Mohammed Elgarni, HTC Purennergy Inc. Canada

108. Combined SO₂-CO₂ Removal Towards Significant Investment Cuts
Cristina Sanchez Sanchez, Katarzyna Misiak, Monique Oldenburg, Earl Goetheer, TNO; Erik Meuleman, CSIRO

109. Development of New CO₂ Capture Processes Based on Phase Change Amino Acid Solvents
Eva Sanchez Fernandez, Katarzyna Misiak, Earl Goetheer, Ferran de Miguel Mercader, TNO

110. Conception of a Pulverized Coal Fired Power Plant with Carbon Capture around a Supercritical Carbon Dioxide Brayton Cycle
Yann Le Moulec, EDF R&D

111. Removal of Carbon Dioxide from Indoor Air Using a Cross-Flow Rotating Packed Bed
Chia-Chang Lin, Chang Gung University

112. CO₂ Capture System Using Lithium Silicate for Distributed Power Supply
Mamoru Mizunuma, Masayuki Tsuda, Yasuko Maruo, NTT Energy and Environment Laboratories; Takao Makagaki, Waseda University

113. Studies of Crosslinked Quaternized Biopolymer for Separation of Heat Stable Salts in Amine Absorption Solution for CO₂ Capture
Chintana Saiwan, Chariya Seelarak, Chulalongkorn University; Teeradet Supap, Raphael Idem, Paitoon Tontiwawuthikul, University of Regina; Panya Wongpanit, Srinakharinwirot University

114. Carbon Dioxide Separation Technology from Biogas by Membrane/Absorption Hybrid Method
Takafumi Tomiokasakai, Toru Sakai, TAIYO NIPPON SANSO CORPORATION; Hiroshi Mano, RITE

115. Study of Heat Integration Between the Units of a Circulating Fluidized Bed Reactor Operating Sorption Enhanced Steam Methane Reforming
Rafael Antonio Sanchez, Hugo Atle Jakobsen, Jannike Solsvik, Zhongxi Chao, Norwegian University of Science and Technology

116. Application of Free Piston Stirling Cooler (SC) on CO₂ Capture Process
Chun Feng Song, Yutaka Kitamura, University of Tsukuba; Wei Zhong Jiang, China Agricultural University
117. Amine Sorbents for Use in the Electrochemically-Mediated Gas Scrubbing of Carbon Dioxide
Michael Stern, Fritz Simeon, Howard Herzog, Alan Hatton, Massachusetts Institute of Technology

118. Synthesis of Calcium Aluminates Granule with TiO₂ Binder for High-Temperature CO₂ Capture
Ching Tsung Yu, WEiChin Chen, Yau Pin Chyou, Institute of Nuclear Energy Research; San Yaun Chen, National Chiao Tung University

Oxyfuel Technologies

119. Effect of Temperature and Flue Gas Recycle on the SO₂ and NOₓ Emissions in a Oxyfuel Fluidised Bed Combustor
Juan Adanez, Margarita de las Obras-Loscertales, Arancha Rufas, Luis Francisco de Diego, Francisco Garcia-Labiano, Pilar Gayan, Alberto Abad, Instituto de Carboquimica-Csic

120. Experimental Investigations on Deposit Formation on External Fluidized Bed Heat Exchanger Surfaces in Oxy-Fired CFB Boilers
Theodor Beisheim, Mariusz Zieba, Günter Scheffknecht, IFK - University of Stuttgart

121. Oxyfuel Combustion: Technical & Economic Considerations for the Development of Carbon Capture from Pulverized Coal Power Plants
Kyle Borget, Edward Rubin, Carnegie Mellon University

122. Retrofit of Bubbling Fluidized Boilers to Oxyfuel Combustion using Wood Wastes as Fuel
Gabriel Faé Gomes, Liandro Dalla Zen, CIENTEC; Antônio Vilela, UFRGS

123. Restrictions and Limitations for the Design of a Steam Generator for a Coal-Fired Oxyfuel Power Plant with Circulating Fluidised Bed Combustion
Claas Guenther, Matthias Weng, Alfons Kather, Hamburg University of Technology

Jens Hetland, SINTEF Energy Research

125. Pathway for Advanced Architectures of Oxy-Pulverized Coal Power Plants: Minimization of the Global System Exergy Losses
Yann Le Moulliec, EDF R&D; Hayato Hagi, EDF R&D and Mines ParisTech CEP, Rodrigo Rivera-Tinoco, Chakib Bouallou, Mines ParisTech CEP

126. Ignition and NO Emissions of Coal and Biomass Blends Under Different Oxyfuel Atmospheres
Juan Riaza, Lucía Álvarez, María Victoria Gil, Cova Pevida, Jose J. Pis, Fernando Rubiera, INCAR-CSIC

127. Predicting Behaviour of Coal Ignition in Oxyfuel Combustion
Cahyadi Soeharto, University of Indonesia

128. Impact of Oxyfuel Combustion on Fly Ash Transformations and Resulting Corrosive Behavior of Austenitic Superalloys
Gosia (Malgorzata) Stein-Brozowska, Hasbeidy Diaz Castro, Jörg Maier, Günter Scheffknecht, IFK, University of Stuttgart

129. Flue Gas Concentrations and Efficiencies of a Coal-Fired Oxyfuel Power Plant with Circulating Fluidised Bed Combustion
Matthias Weng, Claas Günther, Alfons Kather, Hamburg University of Technology / Institute of Energy Systems

Post Combustion

130. Optimal Operation of Solvent-Based Post-Combustion Carbon Capture Processes
Zhengxiong Li, Ali Abbas, Rajab Khalilpour, The University of Sydney

131. Optimization of an Existing 130 Tonne per day CO₂ Capture Plant from a Flue Gas Slipstream of a Coal Power Plant
Ahmed Aboudheir, Walid Elmoudir, HTC CO₂ Systems Corp.

132. Process Simulation of Aqueous MEA Plants for Post-Combustion Capture from Coal-Fired Power Plants
Hyungwoon Ahn, Stefano Brandani, Mauro Luberti, Zhengyi Liu, The University of Edinburgh

133. Heat of Absorption of CO₂ in Aqueous Solutions of DEEA, MAPA and their Mixture
Muhammad Arshad, Kaj Thomsen, Technical University of Denmark; Hallvard F. Svendsen, Norwegian University of Science and Technology

134. Validation of a Process Model of CO₂ Capture in an Aqueous Solvent, using an Implicit Molecular Based Treatment of the Reactions
Charles Brand, Javier Rodriguez, Amparo Galindo, George Jackson, Claire Adjiman, Imperial College London
135. Selection of Amine Amino Acids Salt Systems for CO₂ Capture
   Arlinda Fejzo Ciftja, Adri Hartono, Hallvard F. Svendsen, NTNU

136. Carbamate Formation in Aqueous - Diamine - CO₂ Systems with NMR Spectroscopy
   Arlinda Fejzo Ciftja, Adri Hartono, Hallvard F. Svendsen, NTNU

137. eNRTL Parameter Fitting Procedure for Blended Amine Systems: MDEA-PZ Case Study
   Diego Di Domenico Pinto, Julianna, Garcia Moretz-Sohn Monteiro, Anita Bersås, Tore Haug-Warberg, Hallvard Fjosne Svendsen, NTNU

138. Aqueous Piperazine/Aminoethylpiperazine for CO₂ Capture
   Yang Du, Omkar Namjoshi, Le li, Thu Nguyen, Gary Rochelle, The University of Texas at Austin

139. Study of the Post Combustion CO₂ Capture by Absorption into Amine(s) Based Solvents: Application to Cement Flue Gases
   Lionel Dubois, Diane Thomas, University of Mons

140. Postcombustion CO₂ Capture by Chemical Absorption: Screening of Aqueous Amine(s)-Based Solvents
   Lionel Dubois, Diane Thomas, University of Mons

141. A Numerical Solution Strategy for Dynamic Simulation of Post-Combustion CO₂ Capture
   Nina Enaasen, Andrew Tobiesen, Magne Hillestad, Norwegian University of Science and Technology; Hanne Kvamsdal, SINTEF Materials and Chemistry

142. Thermal Decomposition of Nitrosamines in Aqueous Piperazine
   Nathan Fine, Mandana Ashouripashaki, Gary Rochelle, University of Texas, Austin

143. Removal of Acid Gases and Metal Ion Contaminants from Power Plant Flue Gases with PostCapTM Technology
   Bjørn Fischer, Diego Andrés-Kuettel, markus Kinzl, Ralph Joh, Rüdiger Schneider, Siemens AG, Sector Energy

144. Theoretical Study of Equilibrium Constants for CO₂ Capture Solvents
   Mayuri Gupta, Hallvard F. Svendsen, Norwegian University Of Science and Technology; Eirik Falck Da Silva, SINTEF Materials and Chemistry

145. Mass Transfer Between Carbon Dioxide and Liquid Droplets formed by A Novel Experimental Set-Up
   Jingyi Han, Melaaen Morten, Eimer Dag, Tel-Tek

146. Experimental and Modelling Study of the Binary and Ternary VLE of the AMP/Pz/H₂O System with Ebulliometer and NMR
   Ardi Hartono, Muhammad Saaed, Arlinda, Ciftja, Hallvard Svendsen, NTNU

147. Development of a Dynamic Model of a Post Combustion CO₂ Capture Process
   Sanoja Jayarathna, Bernt Lie, Telemark University College, Morten Melaen, Telemark University College and Tel-Tek

148. Experimental Study on CO₂ Solubility in Aqueous Piperazine/Alkanolamines Solutions at Stripper Conditions
   Shota Inoue, Takuya Itakura, Taka Nakagaki, Yuki Furukawa, Waseda University; Hiroshi Sato, IHI Corporation; Yasuho Yamakata, IHI Corporation

149. Oxidative Degradation of Aqueous Amine Solutions of MEA, MDEA, AMP, PZ: A Review
   Klaus J. Jens, Telemark University College and Telemark Technological R & D Institute; Siw B. Fredriksen, Norner AS

150. Advanced CO₂ Capture Process using MEA Scrubbing: Configuration of a Split Flow and Phase Separation Heat Exchanger
   Jaeheum Jung, Yeong Su Jong, Youngsub Lim, Chonghun Han, Seoul National University; Chi Seob Lee, KEPCO Engineering & Construction Company, INC

151. SO₂ Impact on Amine Emission and Emission Reduction Technology
   Takashi Kamijo, Yoshinori Kajiya, Hiromitsu Nagayasu, Mitsubishi Heavy Industries, Ltd.; Takahito Yonekawa, Tatsuya Tsujiiichi, Mitsubishi Heavy Industries America, Inc.

152. Demonstration of Hitachi’s CO₂ Capture System for Flue Gas from Power Plants
   Terafumi Kawasaki, Yoshiro Inatsune, Kengo Sano, Hitachi Ltd.; Toshiro Katsube, Jun Shimamura, Babcock-Hitachi K.K.

153. Vacuum Regeneration of Amine Solvent for Post-Combustion Carbon Capture with Compression Train Integration: a Way Forward?
   Yann Le Moullac, EDF R&D

154. Improved Flow Scheme and Operational Parameters for Amine-Based CO₂ Capture Processes: A Rigorous Optimization Approach
   Yann Le Moullac, Thibaut Neveux, EDF R&D; Jean Pierre Corriou, Eric Favre, LRGP

155. Oxidative Degradation of Alkanolamines with Inhibitors in CO₂ Capture Process
   In-Young Lee, No-Sang Kwak, Ji-Hyun Lee, Jae-Goo Shim, Kyung-Ryung Jang, Korea Electric Power Corporation
156. Rate Based Modeling of Chilled Ammonia Process (CAP) in Aspen Plus®
Mu Li, Eddie Vuddagiri, Xi Chen, Rameshwar Hiwale, Frederic Vitse, Alstom Power Carbon Capture R&D Execution

157. Experimental Study of Energy Requirement of CO₂ Desorption from Rich Solvent
Xiaofei Li, Shujuan Wang, Changhe Chen, Tsinghua University

158. Modelling, Simulation and Pilot-Plant Validation of CO₂ Capture Process Using Amine Absorbent for Coal Based Power Plant in South Korea
Youngsub Kim, Ung Lee; Yeong Su Jeong, Seeyub Yang, Jeongnam Kim, Chonghun Han, Seoul National University; Chi Seob Lee, Jaehyoung Kim, KEPCO E&C

159. Representation of Piperazine-CO₂-H₂O System Using Extended-UNIQUAC and Computational Chemistry
Hamid Mehdizadeh, Mayuri Gupta, Hallvard F. Svendsen, Norwegian University of Science and Technology; Eirick Flack da Silva, SINTEF

160. Activity-Based Kinetics of the Reaction of Carbon Dioxide with Aqueous Amine Systems. Case Studies: MAPA and MEA
Juliana Monteiro, Diego Pinto, Xiaso Luo, Hanna Knuutila, Ardi Hartono, Saddam Hussain, Emmanuel Mba, Hallvard Svendsen, NTNU

161. IHI’s Amine-Based CO₂ Capture Technology for Coal Fired Power Plant
Shiko Makamura, Yasuho Yamanaka, Toshiya Matsuyama, Shinya Okuno, Hiroshi Sato, IHI Corporation

162. Thermal Degradation of Piperazine Blends with Diamines
Omkar Namjoshi, Le Li, Yang Du, Gary Rochelle, The University of Texas at Austin

163. Piperazine Degradation in Pilot Plants
Paul Nielsen, Lynn Li, Gary Rochelle, The University of Texas at Austin

164. Development of Carbon Dioxide Removal System from the Flue Gas of Coal Fired Power Plant
Yukio Ohashi, Takashi Ogata, Toshihisa Kiyokuni, Toshiba Corporation

165. Laboratory Rig for Atmospheric CO₂ Absorption and Desorption Under Pressure
Lars Erik Øi, Joachim Lundberg, Morten Pedersen, Per Morten Hansen, Morten Christian Melaan, Telemark University College

166. Babcock & Wilcox Power Generation Group’s RSAT™ Process and Field Demonstration of the OptiCap™ Advanced Solvent at the National Carbon Capture Center
Christopher Poling, Ted Parsons, Jeb Geyheart, Stephen Moorman, Babcock & Wilcox Power Generation Group

167. Development of a Rate-Based Model for CO₂ Absorption Using Aqueous NH₃ in a Packed Column
Guojie Qi, CSIRO and Tsinghua University; Hai Yu, Paul Feron, CSIRO; Shujuan Wang, Chnaghe Chen, Tsinghua University

168. The Impact of Design Correlations on Rate-Based Modeling of a Large Scale CO₂ Capture with MEA
Neda Razi, Hallvard Svendsen, Olav Bolland, Norwegian University of Science and Technology

169. Modeling Pilot Plant Performance of an Absorber with Aqueous Piperazine
Darshan Sachde, Jorge Plaza, Eric Chen, Gary Rochelle, The University of Texas at Austin

170. Equilibrium of MEA, DEA, MDEA and AMP with Bicarbonate and Carbamate: A Raman Study
Gamunu Lasantha Samarakoon Perumbuli Arachchige, Klaus Jens, Telemark University College; Niels Andersen, University of Oslo

171. Multivariate Data Analysis for Parameters’ Effect on CO₂ Removal Efficiency
Udara Arachchige, Neelakanta Ayyal, Pramod Ghimire, Maths Halstensen, Morten Melaen, Telemark University College, Porsgrunn, Norway

172. Vapour-Liquid Equilibrium for Novel Solvents for CO₂ Post Combustion Capture
Anastasia Trollebo, Muhammad Saeed, Hallvard Svendsen, The Norwegian University of Science and Technology; Inna Kim, SINTEF Materials and Chemistry
173. Measurement and Calculation of CO₂ Solubility and Absorption Kinetic Rate in Aqueous Solutions of TEDA and DMEA
Chuan Tong, Carlos Cebamanos Perez, Yanmei Yu, Jian Chen, Tsinghua University; Jose Carlos Valle Marcos, EDF Beijing R&D Center; Yan Le Moulec, Fabrice Chopin, EDF R&D

Rens Veneman, Sascha Kersten, Eim Brilman, University of Twente

175. Process Control Strategies for CO₂ Regeneration in a 2-Stage Flash
Matthew Walters, Ricardo Dunia, Thomas Edgar, Gary Rochelle, University of Texas at Austin; Christopher Hundham, Technische Universität München

176. A Hybrid Separation Process for the Recovery of Carbon Dioxide from Flue Gases
Krzysztof Warmuzinski, Marek Tanczyk, Manfred Jaschik, Aleksandra Janusz-Cygant, Polish Academy of Sciences

177. Dynamic Simulation of Post-Combustion Capture System
Zhaoqiang Xu, Yali Xue, Zheng Li, Tsinghua University; Yongqi Lu, University of Illinois at Urbana-Champaign

178. CO₂ Absorption by Using a Low-Cost Solvent: Biogas Slurry Produced by Anaerobic Digestion of Biomass
Shuiping Yan, Liqiang Zhang, Ping Ai, Yuanyuan Wang, Yanlin Zhang, Huazhong Agricultural University

179. A Study of Mass Transfer Kinetics of Carbon Dioxide in (Monoethanolamine + Water) by Stirred Cell
Jiru Ying, Telemark Technological R&D Institute; Dag A. Eimer, Telemark University College

180. Hitachi’s Carbon Dioxide Scrubbing Technology with H3-1 Absorbent for Coal Fired Power Plants
Koichi Yokoyama, Miho Honoki, Eiji Miyamoto, Shigeito Takamoto, Hirofumi Kikkawa, Babcock-Hitachi K. K. Kure Research Laboratory; Brandon Pavlish, EERC; Takenori Nakamoto, Tosho Katsube, Babcock-Hitachi K. K. Kure Division; Terufumi Kawasaki, Hitachi Ltd; Song Wu, Hitachi Power Systems America, Ltd

181. Improved Hydrotalcite-Type Compounds for Post-Combustion CO₂ Abatement
Emiliana Dvininov, Hazel Stephenson, MEL Chemicals; Holly Krutka, ADA Environmental Solutions

Pre Combustion

182. Detailed Process Simulation of Pre-Combustion IGCC Plants using Coal-Slurry and Dry Coal Gasifiers
Hyungwoong Ahn, Stefano Brandani, Zoe Kapetaki, The University of Edinburgh

183. Low-Temperature CCS from an IGCC Power Plant and Comparison with Physical Solvents
David Berstad, Rahul Anantharaman, Petter Nekså, SINTEF Energy Research

184. Elevated Temperature Adsorption Characteristics of K-Promoted Hydrotalcites for Pre-Combustion Capture of Carbon Dioxide
Shuang Li, Yixiang Shi, Ningsheng Cai, Tsinghua University

185. Overview of, and Experimental Methology for, Sorption Enhanced Hydrogen Production
Alissa Cotton, Kumar Patchigolla, John E. Oakley, Cranfield University

186. SEWGS Knocks Down Capture Costs by 40%; Technology is Now Ready for Scale-Up
Daniel Jansen, Edward van Selow, Paul Cobden, ECN; Giampaolo Manzolini, Ennio Macchi, Matteo Gazzani, Politecnico di Milano; Richard Blom, Partow Henriksen, SINTEF; Rich Beavis, BP; Andrew Wright, Air Products PLC

187. Solubility of Carbon Dioxide in 1-Butyl-3-Methylimidazolium Phenolate
Ki Tae Park, Jung Hoon Park, Soo Hyun Choi, Seong-Pil Kang, Il-Hyun Baek, Korea Institute of Energy Research

188. Multi-Level Dynamic Simulation of Elevated Temperature Pressure Swing Adsorption System for Pre-Combustion CO₂ Capture
Yan Zheng, Yixiang Shi, Ningsheng Cai, Shuang Li, Tsinghua University

189. Improving a Pre-Combustion CCS Concept in Gas Turbine Combined Cycle for CHP Production
Marjut Suomalainen, Antti Arasto, VTT Technical Research Centre of Finland; Sari Siitonen, Gasum Oy

190. Fundamental Modelling of a Membrane Reactor with in situ Hydrogen Separation and Combustion
Torleif Weydahl, Andrea Gruber, SINTEF Energy Research; Prashant S. Samilath, NTNU
Retrofitting

191. The Techno-Economic Prospect of Retrofitting Natural Gas Combined Cycle Power Plants in China: a Case Study of CCGT Power Plants in Huizhou and Shenzhen, Guangdong
Jia Li, Jon Gibbins, University of Exeter; Mathieu Lucquiaud, University of Edinburgh; David Reiner, University of Cambridge; Di Zhou, Chinese Academy of Sciences

Techno-Economic Comparisons

192. Evaluation of CO₂ Purification Requirements and the Selection of Processes for Impurities Deep Removal from the CO₂ Product Stream
Zeina Abbas, Mohammad Abu Zahra, Toufic Mezher, Masdar Institute of Science and Technology

193. Evaluation of Performance and Cost of Combustion Based Power Plants with CO₂ Capture in the UK
Elena Catalanotti, Kevin Hughes, Richard Porter, Mohamed Pourkashanian, University of Leeds; John Price, Centre for Low Carbon Futures

194. Evaluation and Comparison of the Part Load Behaviour of the CO₂ Capture Technologies Oxyfuel and Post-Combustion
Volker Roeder, Christopher Hasenbein, Alfons Kather, Hamburg University of Technology

Adel Seif El Nasr, Mohammad Abu Zahra, Masdar Institute of Science and Technology; Thomas Nelson, RTI International

Other

196. Addressing Technology Uncertainties in Power Plants with Post-Combustion Capture
Mathieu Lucquiaud, Hannah Chalmers, Olivia Errey, Jon Gibbins, The University of Edinburgh; Xi Liang, University of Exeter

197. The Role of SO₂ in the Chemistry of Amine-Based CO₂ Capture in PCC
Yaser Beyad, Robert Burns, Marcel Maeder, University of Newcastle; Graeme Puxty, CSIRO Energy Technology

CO₂ Utilisation Options

CO₂ for Enhanced Geothermal

199. CO₂ Utilization for Enhanced Geothermal Energy Recovery: Effects of Salt Precipitation in a Fractured Reservoir
Andrea Borgia, Karsten Pruess, Timothy Kneafsey, Lehua Pan, Curtis Oldenburg, Lawrence Berkeley National Laboratory

200. Geothermal Energy Production at Geologic CO₂ Sequestration Sites: Expanding Opportunities for Renewable Power and CCS
Jimmy Ranpolph, University of Minnesota and Heat Mining Company, LLC; Ben Adams, Thomas Kuehn, Martin Saar, Jeffrey Bielicki, Melissa Pollak, Nathan Paine, University of Minnesota, Steven Taff, Geological Storage Consultants, LLC

201. Numerical Investigation of Enhanced Geothermal System with CO₂ as Working Fluid
Feng Iuo, Ruina Xu, Peixue Jiang, Beijing Key Laboratory of CO₂ Utilization and Reduction Technology and Tsinghua University

202. Potential Global Implications of Gas Production from Shales and Coal for CO₂ Geological Storage
Michael Godec, Hunter Jonsson, Advanced Resources International, Inc.; Ludmilla Basava-Reddi, IEAGHG

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