RITE
Research Institute of Innovative Technology for the Earth

CCS ワークショップ 2008

CCS 技術開発の現状と課題

CCS Workshop 2008

日　時
平成 20 年 9 月 26 日(金) 10：00～16：35
September 26, 2008

会　場
ホテルグランドパレス 2F「ダイヤモンドルーム」
Hotel Grand Palace

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日　程：2008年9月26日(金)
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Date　: September 26th, 2008
Venue : Hotel Grand Palace (Kudanshita, Tokyo)

主　催　財団法人地球環境産業技術研究機構（RITE）
共　催　財団法人エンジニアリング振興協会
後　援　経済産業省、
独立行政法人新エネルギー・産業技術総合開発機構（NEDO）、
独立行政法人産業技術総合研究所、
財団法人石炭エネルギーセンター、
財団法人電力中央研究所、石油技術協会、
エネルギー・資源学会、
社団法人物理探査学会、
社団法人資源・素材学会

Organized by　Research Institute of Innovative Technology for the Earth (RITE)
Co-organized by　Engineering Advancement Association of Japan(ENAA)
Supported by　Ministry of Economy, Trade and Industry (METI),
New Energy and Industrial Technology Development Organization (NEDO),
National Institute of Advanced Industrial Science and Technology (AIST),
Japan Coal Energy Center (JCOAL),
Central Research Institute of Electrical Power Industry (CRIEPI),
Japan Association for Petroleum Technology,
Japan Society of Energy and Resources,
Society of Exploration Geophysics of Japan,
Mining and Materials Processing Institute of Japan

CCS ワークショップ 2008

― CCS 技術開発の現状と課題 ―

趣　　旨：温暖化対策の有望な技術の一つとして注目を集めている二酸化炭素回収・貯留（CCS）技術は、洞爺湖サミットG８首脳宣言において、2020年までに広範な展開を始めるために、2010年までに世界的に20の大規模な CCS の実証プロジェクトが開始されることを強く支持することが発表されました。日本においては、低炭素社会実現に向けて、CCS 技術の大規模実証事業に着手し、2020年までに実用化を目指した段階に入ろうとしています。

今回のワークショップでは、日本国内の CCS の実用化に向けた取組みとともに、海外における CCS 実証試験や事業事例を紹介することにより、CCS に対して理解を深めていただくことを目的としています。

プログラム

（敬称略）

10：00-	開会挨拶	茅　　陽一	（財）地球環境産業技術研究機構　副理事長・研究所長
10：10-	基調講演１	三橋　敏宏	経産省地球環境技術室
		「日本の二酸化炭素回収・貯留（CCS）技術の実用化に向けて」	
11：00-	基調講演２	AK (Tony) Booer	Schlumberger Carbon Services
		「CCS の世界動向について」	
12：00-13：30		〈昼食休憩〉	
13：30-	講演１	Rachel Crisp	Department for Business, Enterprise and Regulatory and Reform,UK
		「英国での CCS の取組みについて」	
14：10-	講演２	Dennis R Van Puyvelde	Cooperative Research Center for Greenhouse Gas Technologies
		「豪州での CCS 実証プロジェクト」	
14：50-15：20		〈コーヒー・ブレイク〉	
15：20-	講演３	Bader Saeed Al Lamki	Abu Dhabi future energy company (MASDAR), UAE
		「アブダビでの CCS-EOR の紹介」	
16：00-	講演４	阿部　正憲	日本 CCS 調査株式会社
		「CCS 調査会社の発足と事業計画の紹介」	
16：25-	閉会挨拶	本庄　孝志	（財）地球環境産業技術研究機構　専務理事

CCS Workshop 2008

Program

Opening Remarks	10：00-	Yoichi Kaya	*Director–General, RITE*
Key Note Speech 1	10：10-	Toshihiro Mitsuhashi	*Director, Environment Negotiation, METI*
		"Japan's Efforts toward Practical Implement of Carbon Capture and Storage"	
Key Note Speech 2	11：00-	AK (Tony) Booer	*Schlumberger Carbon Services*
		"CCS : Trends and Possible Futures"	
Lunch Break	12：00-13：30		
Lecture 1	13：30-	Rachel Crisp	*Department for Business, Enterprise and Regulatory Reform, UK*
		"Towards Global Deployment of CCS"	
Lecture 2	14：10-	Dennis R Van Puyvelde	*Cooperative Research Center for Greenhouse Gas Technologies*
		"Carbon Capture and Storage Activity in Australia"	
Coffee Break	14：50-15：20		
Lecture 3	15：20-	Bader Saeed Al Lamki	*Abu Dhabi future energy company (MASDAR),UAE*
		"MASDAR CCS Project : An Integrated Solution for a Low Carbon Future"	
Lecture 4	16：00-	Masanori Abe	*JAPAN CCS CO., LTD*.
		"Japan CCS has embarked upon a full-scale enterprise"	
Closing remark	16：25-	Takashi Honjo	*Senior Managing Director, RITE*

三　橋　敏　宏

現　職：経済産業省 環境交渉官、地球環境技術室長、京都メカニズム推進室長

経　歴：平成２年　東京大学卒業

平成２年　経済産業省入省

Toshihiro Mitsuhashi

Current Positions:

Director, Environment Negotiation

Director, Global Environment Technologies Office

Director, Kyoto Mechanisms Office

Ministry of Economy, Trade and Industry (METI)

Carrier:

Joined the Ministry of International Trade and Industry (*)

(*)Ministry of International Trade and Industry was reorganized as METI in 2001.

日本の二酸化炭素回収・貯留（CCS）技術の実用化に向けて

■講演要旨

日本の二酸化炭素回収・貯留(CCS)技術の実用化に向けた取り組みについて概要を紹介する。

まず、エネルギー大臣会合、Ｇ８サミット、エネルギーフォーラムなど今年にはいって開催された主要な国際会議で CCS がどのように言及されたかを概観する。

次に、昨年６月の独ハイリゲンダム・サミットで我が国が提案した「美しい星（クールアース50)」や、本年３月に新エネルギー技術開発計画有識者会議にてまとめられた「Cool Earthーエネルギー革新技術計画」の中での CCS の位置づけなど日本の CCS 技術の実用化施策のアウトラインを説明するとともに、京都議定書以降の枠組み及び長期的な展望において、2050年の排出量半減に向けた大幅な CO_2 削減技術としての CCS の役割と期待を述べる。

日本の取り組みの例として、岩野原での１万トン規模の地中貯留パイロット実験や、回収技術の開発；国際的に競争力のある膜技術や低コストのアミン溶液の開発など、これまでの我が国の CCS 推進の施策及び今後の取り組みについて紹介する。さらに、日本で実施予定の年間10万トン規模の CCS 実証試験の貯留サイト選定と安全指針の策定の取り組みについて述べる。

以上の国内の取り組みと平行して、主要な諸外国、先進国パートナーと役割を分担して行う国際協力についても紹介する。

Japan’s Efforts toward Practical Implement of Carbon Capture and Storage

Abstract

This presentation provides an overview of Japan’s efforts to implement a practical carbon dioxide capture and storage (CCS) solution.

First, current status of CCS is outlined by highlighting references to CCS stated at the Energy Ministers Conference, the G8 Summit and the Energy Forum held this year.

Next, Japan’s CCS implementation policies are described, along with how CCS fits into Japan’s “Cool Earth 50” initiative unveiled at the Heiligendamm summit in Germany last year, and into the “Cool Earth Energy Innovative Plan” proposed by New Energy Technology Development Plan Advisory Panel last March. The role of CCS in the post Kyoto Protocol framework and the long-term perspective will be discussed as the potential promise of mitigation measures in helping cut CO_2 emissions in half by the year 2050.

Examples of Japan’s past and future efforts to promote CCS will be introduced including the10,000-ton-capacity CO_2 injection pilot project at Iwanohara, the development of capture technologies such as an internationally competitive membrane technology, and the development of low-cost amine solution. Also introduced here is Japan’s commitment to select a site of a100,000 ton-CO_2 / year CCS RD&D project and to develop appropriate safety guidelines.

Paralleling Japan’s domestic initiatives, Japan’s involvement in international cooperation will be outlined including participation in key international organizations, and as a partner and sharing responsibilities with other advanced nations.

AK (Tony) Booer

Current Position:

Business Development Manager, Schlumberger Carbon Services

Education and Degrees:

B.Sc.(Eng.) in Electrical Engineering, University of London, 1975

Ph. D. in Geophysics, University of London, 1979

M.B.A. Open University1994

Career Details:

25 years experience at Schlumberger in various roles including :

Research Director for Geoacoustics in US research laboratory, 1994

Research Director for Reservoir Imaging in UK research laboratory, 1996

Technology Centre Manager for both seismic processing development, 1999

Technology Centre Manager for well completion answer products, 2001

Business Development Manager, Carbon Services, 2006

Expertise Area:

Signal processing and Geophysics.

Site selection, characterization, and monitoring for the geological storage of CO_2

Awards:

Society of Exploration Geophysicists award : Best Paper in Geophysics 1980

Institution of Electrical Engineers award : J.J.Thompson Premium 1981

Activities in Universities and Academic Societies:

Member, Institute of Electrical & Electronic Engineers, USA, since 1976

Member of Strategic Advisory Group, Department of Electrical & Electronic Engineering,

Imperial College London.

External Examiner for MSc course in Communications and Signal Processing,

Imperial College London, 2003-2007

Reviewer for SEG Geophysics , IEE “Electronics Letters”, SPE papers

Governmental Activities:

Technology Advisory Group, UK Environmental Knowledge Transfer Network.

Industry related activities:

Board Member, UK Carbon Capture and Storage Association

Executive Committee Member, International Energy Agency - Clean Coal Centre

Executive Committee Member, International Energy Agency - Greenhouse Gas R&D

International Activities:

Board member, CO_2 NET - European Carbon Dioxide Network

Principal Publications (only books):

“Underground Geophysics of Coal Seams”, Chapter 1 of

“Developments in Geophysical Exploration Methods -3” Ed. A.A.Fitch,1982.

CCS: Trends and Possible Futures

Abstract

The story of CCS is still at a very early stage, but enough has already happened to look back at where we have come from, to review where we are, and to imagine the directions in which we might go.

Let us accept the link between man-made CO_2 and climate change, and agree on the urgent need to develop renewable energy sources, and to use energy more efficiently. But the plain fact is that fossil fuels will still continue to be used for many decades to come. We will take that as a starting point. CCS is set of technologies which will allow us to use fossil fuels and yet significantly reduce atmospheric emissions. But we see that this is not just a technological problem. There are significant social, economic, political, legal, and environmental issues attached to the topic, and some of these will be addressed in parts of this very workshop.

Turning to the technologies of CO_2 capture, transportation and storage, we see that we already have options in each of these areas, demonstrated at industrial scale, but as yet, nowhere in the world is a full-scale, operational, fossil-fuel power station which uses CCS. A significant policy issue at the moment in Europe, and elsewhere, is whether to insist that new power plants are built 'Capture Ready', in advance of commercial technology being available. To be commercial, that is, economic, the technologies need to have been demonstrated working together at scale, and improved to reduce costs and increase efficiency. We can only learn through doing. So there is now an imperative worldwide to develop full-scale demonstration plants.

This initial phase of CCS requires special support from governments in areas of policy and regulation as well as special funding mechanisms to overcome the inevitable first-of-a-kind project costs. In Europe, for example, auctioning of allocations within the emissions trading scheme could provide ample finance for the 12 or so projects that Europe is hoping to establish by 2015. Another complication to the CCS story is the use of CO_2 for enhanced oil recovery, which may well become an important issue in parts of the world.

A review of some of the existing CO_2 storage projects worldwide can show how different drivers have encouraged the development of these projects. There are also already examples of proposed CCS projects which will not, now, be followed up. Understanding why this has happened is also useful.

Trends in the technological development of CCS will inevitably be coupled to the particular world future in which we find ourselves. Consideration of some possible scenarios gives rise to rather different outcomes for the take up of CCS.

One thing is certain for the future of CCS - the technologies involved will continue to evolve rapidly, to reduce overall costs, and to make routine that which seems difficult to do today. So despite the challenges, CCS remains the best chance we have to reduce fossil fuel emissions and help, along with renewables and efficiency measures, to mitigate global climate change.

Rachel Crisp

Ms. Rachel Crisp is currently deputy director, Cleaner Fossil Fuels Unit, Department for Business, Enterprise and Regulatory Reform

She has undertaken several roles within the Energy Group in the Department for Business and Enterprise including working on strategic energy issues and developing and implementing the UK Government's policy on microgeneration. In my current post I am responsible for developing and implementing a strategic approach to international CCS issues and I also work on the UK's commercial-scale demonstration project.

Memo

Towards Global Deployment of CCS

Memo

Dennis R Van Puyvelde

Current Positions:

Technical and International Project Manager, CO2CRC, Canberra, Australia

Director and Branch President, Australian Institute of Energy

Key Prior Positions:

Assistant Manager, Australian Greenhouse Office, Canberra, Australia (2004–2007)

Branch Secretary, Australian Institute of Energy, Canberra, Australia (2004–2006)

Research Scientist, Department of Defence, Adelaide and Canberra, Australia (2001–2004)

Post Doc Fellow, CRC for Clean Power from Lignite, Adelaide, Australia (2000–2001)

Research Student, University of Technology, Sydney & Southern Pacific Petroleum, Sydney, Australia (1997-2000)

Degrees & Awards:

PhD, University of Technology, Sydney, Australia (2000)

BE (Chem)(Hons), University of New South Wales, Sydney, Australia (1997)

Grad Dip (public sector leadership), Griffith University, Canberra, Australia (2004)

Australian Postgraduate Award – Industry, University of Technology, Sydney, Australia (1997–1999)

Chemeca Prize, Chemical Engineering Conference, Rotorua, New Zealand (1997)

Shell Prize, University of New South Wales, Sydney, Australia (1996)

Affiliations:

Member of the Australian Institution of Engineers (and Chemical College)

Member of the Society for Sustainability and Environmental Engineering

Member of the Australian Institute of Energy

Expertise:

Carbon capture and storage

Australian greenhouse gas emissions

Particle technology

Project and research management

Rotary kiln simulation

Career & Key Achievements:

Developing CO2CRC's strategic framework

Modelling Australia's industrial greenhouse gas emissions from 2005 to 2020

Simulation of an industrial oil shale process

Recent Papers & Publications:

Van Puyvelde, D.R.(2007), *Dynamic modelling of retort thermodynamics of oil shales*, Oil Shale, 24 - 4, 509-525.

Van Puyvelde, D.R., Golab, A., Arthur, S.A.(2007), *Greenhouse Gas Emissions in Australia,* CO2CRC Annual Symposium, Swan Valley, WA.

Australian Greenhouse Office (Lead Author), *Tracking to the Kyoto Target-2006,* December 2006, ISBN1 921120 94 0.

Van Puyvelde, D.R.(2006), *Simulating the mixing and segregation of solids in the transverse section of a rotating kiln,* Powder Technology,164 1-12.

Carbon Capture and Storage Activity in Australia

Abstract

The IPCC Fourth Assessment Report on climate change states that urgent action is needed to reduce global greenhouse gas emissions within the next few years to avoid catastrophic climate change. There is a widespread recognition that CCS is a priority technology for making large cuts to global CO_2 emissions, while continuing to use the abundant natural fossil fuel resources of many countries such as China and Australia. While significant work has been completed domestically and internationally to advance CCS technology, much more remains to be done to resolve uncertainties and reduce costs before CCS is widespread commercially.

CO2CRC recognises that this requires active national and international collaborations between research organisations, governments and industry including fossil fuel producers and users as well as industrial equipment and services providers. The challenge is multi faceted as it requires improvements in capture technology, a better understanding of storage capacity as well as an acceptable regulatory regime for storage, monitoring and long term liability. Overall, there is an expectation that CCS will start to be introduced at a commercial level by the middle of the next decade to meet the greenhouse gas reduction targets set by many countries.

Australia is active in nearly all technology areas of CCS including the :

- development of oxygen fired power generation process through a 30 MW demonstration plant ;
- improving solvent based separation techniques and investigating new separation techniques including membranes and adsorbents through a number of research programs and demonstration plants ;
- assessing the storage potential of a number of areas ;
- gaining a better understanding of the CO_2 behaviour during and after injection through a multi disciplinary research program and the CO2CRC Otway Project, which aims to inject up to 100,000 t of CO_2 in a depleted gas reservoir, and subsequently to also inject CO_2 into saline aquifers ;
- developing a suite of monitoring technologies to provide assurance to the regulator and the community that geological storage of CO_2 is a safe mitigation option ; and
- a range of other demonstration projects planned in the next decade.

The paper will provide an overview of CCS technology developments within Australia covering the CO2CRC research and demonstration projects, and giving an overview of other demonstration projects planned for Australia in the next decade.

Bader Saeed Al Lamki

Current Position:

CCS Project Manger of Abu Dhabi Future Energy Company (MASDAR)

Academic Education:

B.Sc. in Chemical Engineering

Career:

Mr. Bader Saeed Al Lamki has over a decade experience in multidiscipline project engineering and management in the oil & gas industry. And he is currently managing director of two mega world class ground breaking projects namely the CCS & Hydrogen fuelled power plant that underpins Abu Dhabi's leadership, vision & commitment to combat global warming challenge.

Memo

MASDAR CCS Project: An Integrated Solution for a Low Carbon Future

MASDAR aims at capturing CO_2 from existing and future power plants, industrial facilities and oil & gas processing plants. The captured CO_2 will be utilized to develop a national CO_2 network which in turn will be used for injection in UAE oil reservoirs for enhanced oil recovery. The CCS project removes harmful CO_2 from our atmosphere and be the world leader in carbon capture projects.

This presentation would aim at addressing the business drivers, the technical challenges ; road map & key consideration in this important development endeavor.

Memo

阿　部　正　憲

現　　職：日本 CCS 調査株式会社 技術企画部 部長
主要経歴：昭和60年　新潟大学理学部地質鉱物学科卒業
昭和61年　石油資源開発株式会社入社
平成15年　(財)地球環境産業技術研究機構出向
平成18年　石油資源開発株式会社復帰
平成20年　日本 CCS 調査株式会社出向
専門分野：CO_2 回収・貯留技術、石油地質

Masanori Abe

Current Position :
General Manager, Technology and Planning Department, Japan CCS Co., Ltd.
Education and Degrees :
B.Sc. in geology at Niigata University, 1985
Career :
Japan Petroleum Exploration Company Limited (JAPEX), 1986
Research Institute of Innovative Technology for the Earth (RITE), 2003
Japan Petroleum Exploration Company Limited. (JAPEX), 2006
Japan CCS Company Limited, 2008
Specialty :
CO_2 Capture and Storage, Petroleum Geology

CCS 調査会社の発足と事業計画の紹介

■講演要旨

平成20年５月26日、日本 CCS 調査株式会社は、わが国における CCS 事業の新たな担い手として設立された。株主構成は、電力会社11社、石油元売り５社、エンジニアリング会社５社、石油開発会社３社、鉄鋼会社２社、化学会社１社、総合商社１社、および非鉄金属・セメント製造会社１社からなる。

当社の設立目的は、地球温暖化防止に最も有効とされる CCS の事業化調査及び研究開発業務であり、その設立は日本での CCS が研究段階から事業段階に第１歩を踏み出したことを意味する。株主各社は、CCS に必要な各専門分野で世界を凌駕する技術力を保有しており、これらの企業が１つに連合したことによって、日本が CCS において世界をリードする準備ができたことになる。

今年度、当社は２つの事業を行う。その１つは、NEDO による「革新的ゼロエミッション石炭ガス化発電プロジェクト」事業で、この内「発電から CO_2貯留に至るトータルシステムのフィジビリティー・スタディー」の委託先として正式に決定された。東京電力㈱及び帝国石油㈱協力を得て、㈱クリーンコールパワー研究所の勿来（なこそ）IGCC 実証機において CO_2を分離し、沖合い40km にある磐城沖ガス田（帝国石油㈱とエッソグループ所有）の枯渇型ガス層に貯留することを想定して、３年間をかけて FS を実施する。

もう１つは、経済産業省地球環境技術室の補助事業である「二酸化炭素地中貯留技術研究開発（実証試験に適する地下帯水層等に係る評価技術開発）」である。これまで RITE/ENAA が実施してきた全国貯留層賦存量調査の結果に企業データを加え、本格的実証試験に適する地点の評価手法を提案する。この手法が、今後の適地評価手法の雛形になる。

去る７月29日に「低炭素社会づくり行動計画」が閣議決定された。革新的技術開発の一環として、CCS に関しては2009年度以降早期に大規模実証試験に着手するとされている。当社は、子どもたちに優しい地球を残すことを目指して、まずはこの大規模実証試験にも積極的に取り組んで行きたい。

Japan CCS has embarked upon a full-scale enterprise.

Abstract

Japan CCS Company Limited was incorporated through the investments of a total of 29 companies : 11 electric power companies, 5 petroleum companies, 5 engineering companies, 3 petroleum resource development companies, 2 iron and steel manufacturing company, 1 chemical company, 1 general trading company and 1 nonferrous metal and cement company, and to become a new leader in CCS technology, regarded as the “trump card” in global warming countermeasures, and has embarked upon a full-scale enterprise in CCS.

The establishment of the company signifies that Japanese CCS technology has taken an important first step from the research to the demonstration stage. Additionally, as each of the shareholder companies possesses world-class technical capabilities in each of the specialized areas required for CCS, this alliance of firms has placed Japan in a position to lead the world in CCS technology.

This year we will carry out two government funded projects. One is “Research and Development of Underground Storage Technology for Carbon Dioxide (Development of Assessment Technologies for a Deep Aquifer Appropriate for Demonstration)”, being spearheaded by the Ministry of Economy, Trade and Industry’s Environmental Policy Division, and the other is “Feasibility Study on a Total System from Electric Power Generation to CO_2 Storage”, which forms a part of the “Innovative Zero Emission Coal Gasification Electric Power Project”, being initiated by the New Energy and Industrial Technology Development Organization (NEDO).

In the former project a sequence of techniques will be established to assess appropriate sites for full-scale CCS demonstration projects in Japan. This technical sequence will be used in Japan when candidate sites for CCS are investigated afterwards. And in the latter project a feasibility study will be done on an IGCC with CCS. Actual IGCC demonstration plant in Nakoso, southern Fukushima Prefecture, is assumed to be retrofitted with a CO_2 capture system, CO_2 will be transferred through a subsea pipeline and will be injected into a depleting gas reservoir off Fukushima Prefecture.

The Japanese Cabinet approved the Action Plan for Establishing a Low Carbon Society on 29th July 2008. In the action plan a demonstration project is planned to be launched as soon as possible in and after the next fiscal year as a part of the Innovative Technology Development. We will actively support the Action Plan and contribute to mitigating the global warming in order to keep a better future for our children.

Memo

Research Institute of Innovative
Technology for the Earth

事　務　局

(財)地球環境産業技術研究機構
CO_2 貯留研究グループ

〒619-0292　京都府木津川市木津川台9-2
TEL：0774-75-2309／FAX：0774-75-2316

Secretariat

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