Development and Implementation of the Midwest Geological Sequestration Consortium CO_2-Technology Transfer Center

Final Report

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U.S. Department of Energy
National Energy Technology Laboratory
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ABSTRACT

In 2009, the Illinois State Geological Survey (ISGS), in collaboration with the Midwest Geological Sequestration Consortium (MGSC), created a regional technology training center to disseminate carbon capture and sequestration (CCS) technology gained through leadership and participation in regional carbon sequestration projects. This technology training center was titled and branded as the Sequestration Training and Education Program (STEP). Over the last six years STEP has provided local, regional, national, and international education and training opportunities for engineers, geologists, service providers, regulators, executives, K-12 students, K-12 educators, undergraduate students, graduate students, university and community college faculty members, and participants of community programs and functions, community organizations, and others. The goal for STEP educational programs has been on knowledge sharing and capacity building to stimulate economic recovery and development by training personnel for commercial CCS projects. STEP has worked with local, national and international professional organizations and regional experts to leverage existing training opportunities and provide stand-alone training. This report gives detailed information on STEP activities during the grant period (2009-2015).

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Executive Summary

Since its development in 2009, STEP has worked towards the goal of developing a work force to support the commercial development of carbon capture and sequestration (CCS). Over the course of the grant period, STEP has successfully trained personnel on the applied engineering and science of CCS for site developers, geologists, engineers, technicians, and others, while providing a technology transfer platform for the permanent storage of $C0_2$. STEP-developed programs have resulted in 13,439 educational contact hours and have issued 1,092 continuing education units (CEU's) to 1,327 people. In addition to formal education programs, STEP has conducted over 140 events or presentations impacting an additional 27,000 people.

STEP is committed to supporting the highest quality, best value educational experience and has leveraged connections with the Midwest Geological Sequestration Consortium (MGSC), the University of Illinois and the Illinois State Geological Survey to develop regional, national, and international training opportunities. As CCS technology continues to evolve, STEP recognized the importance of providing diverse training opportunities across the multiple disciplines involved in CCS. STEP programs have focused on the technology (geology, geophysics, geomechanics, geochemistry, and reservoir engineering disciplines), regulatory, financial, and societal aspects of CCS. In addition to diverse topics, STEP has also developed multiple approaches to education including short courses, conferences, workshops, site visits, teacher training, curriculum development, college-level course development, and general outreach. Knowledge sharing and capacity building activities undertaken during this project have helped to develop a future generation of geologists, scientists, and engineers that will provide the human capital and skills required for implementing and deploying CCS technologies when the political and economic arena is ready to accept long-term geological storage of carbon dioxide.
Program highlights include:

- Hosting the 2011 IEA Greenhouse Gas R&D Programme (IEAGHG) Summer School. The Summer School was developed by the IEAGHG to provide students and young professionals from diverse academic backgrounds with a broad understanding of the issues surrounding carbon capture and sequestration and to encourage their active participation in future developments. The program in Champaign, IL represented the first time the program was offered in the United States. Fifty-three students from twenty-six countries participated.

- Development of the Midwest Carbon Sequestration Science Conference Series. This annual conference has been offered 4 times and showcases CCS developments at the Illinois Basin Decatur Project (IBDP). Four hundred and twenty-two people have participated in the conference series.
- Extending knowledge sharing and capacity building to international audiences. STEP programs have served international audiences through programs offered in the United States and has been an invited presenter at twenty-nine presentations outside the United States. (Note: No contract funds were used for international travel.)

STEP outreach activities have educated thousands of stakeholders, including citizens, lawmakers, government officials, media representatives, scientists, educators and students. These efforts have long-term social and economic benefits for the future development of the CCS industry by providing capacity building and knowledge sharing opportunities and by creating increased awareness and acceptance of carbon sequestration. By laying the ground work now, these efforts have established bridges to adoption and implementation of CCS at the commercial scale. STEP activities have contributed to advancing the United States in its position as a leader in CCS technology by training and developing a workforce necessary for growth in the CCS industry.

Lessons learned include:

- Leverage what you have.
- Build it and they will come.
- Be open to expansion.
- Knowledge sharing and capacity building alone cannot further the implementation of CCS.
- Devine and fulfill niches.

At the close of this grant, the STEP brand is a well-established, recognized provider of high quality knowledge sharing and capacity building programs. Moving forward, STEP will continue serving the outreach and education initiatives of the MGSC.

Introduction

Figure 1. STEP Milestones

In 2009 the Illinois State Geological Survey (ISGS) in collaboration with the Midwest Geological Sequestration Consortium (MGSC) submitted a proposal to the U.S. Department of Energy (DOE) through the National Energy Technology Laboratory (NETL), to create a regional technology training center to disseminate carbon capture and sequestration (CCS) technology gained through leadership and participation in regional carbon sequestration projects (Figure 1). The MGSC Sequestration Technology Transfer Center, later to be branded as the Sequestration Training and Education Program (STEP), was designed to provide education and training opportunities for engineers, geologists, service providers, regulators, executives, and others. STEP was designed to stimulate economic recovery and development by training personnel for commercial CCS projects. During the course of the grant, STEP worked with professional organizations and regional experts to leverage existing training opportunities, and provide stand-alone training. Phase 1 (2009-2010) concentrated on developing the infrastructure with a focus on management, staffing, development, branding and basic organizational issues. Phase 2 (2010-2015) focused on program development, capacity building, and knowledge sharing.

Early work during Phase I, included development of a project management plan (PMP); appointment of an advisory board (AB), and development of a vision and mission statement for STEP.

- Mission Statement: To ensure the highest quality, best value educational experience through regional, national and international exchange programs, and be a recognized leader in the design and implementation of CCS curricula and educational products.
- Vision Statement: To be a high–performing organization expert in providing hands-on learning experiences and information sharing on cutting-edge climate mitigation technology, including carbon capture and storage, through exceptional outreach and education programs, and which is characterized by diverse, high quality, high value learning opportunities.

Phase 1 also included development of a sustainable infrastructure to facilitate STEP programs. This included the hiring of dedicated staff to help facilitate STEP development and growth; and the development of a logo, promotional materials, website, and newsletter; and development of a sponsorship program.

During Phase II, STEP began, with AB support, to research and develop a list of topics for course development, professional organization partnerships, a schedule for stand-alone training events and co-sponsored event opportunities. STEP worked with CCS experts to develop course materials, lectures, and curriculum for modular training events. Additionally, early in Phase II a quarterly newsletter was initiated, a system or e-alerts was developed as well as a response system for technical inquires.

Figure 2 on the following page details the project deliverables and timeline.

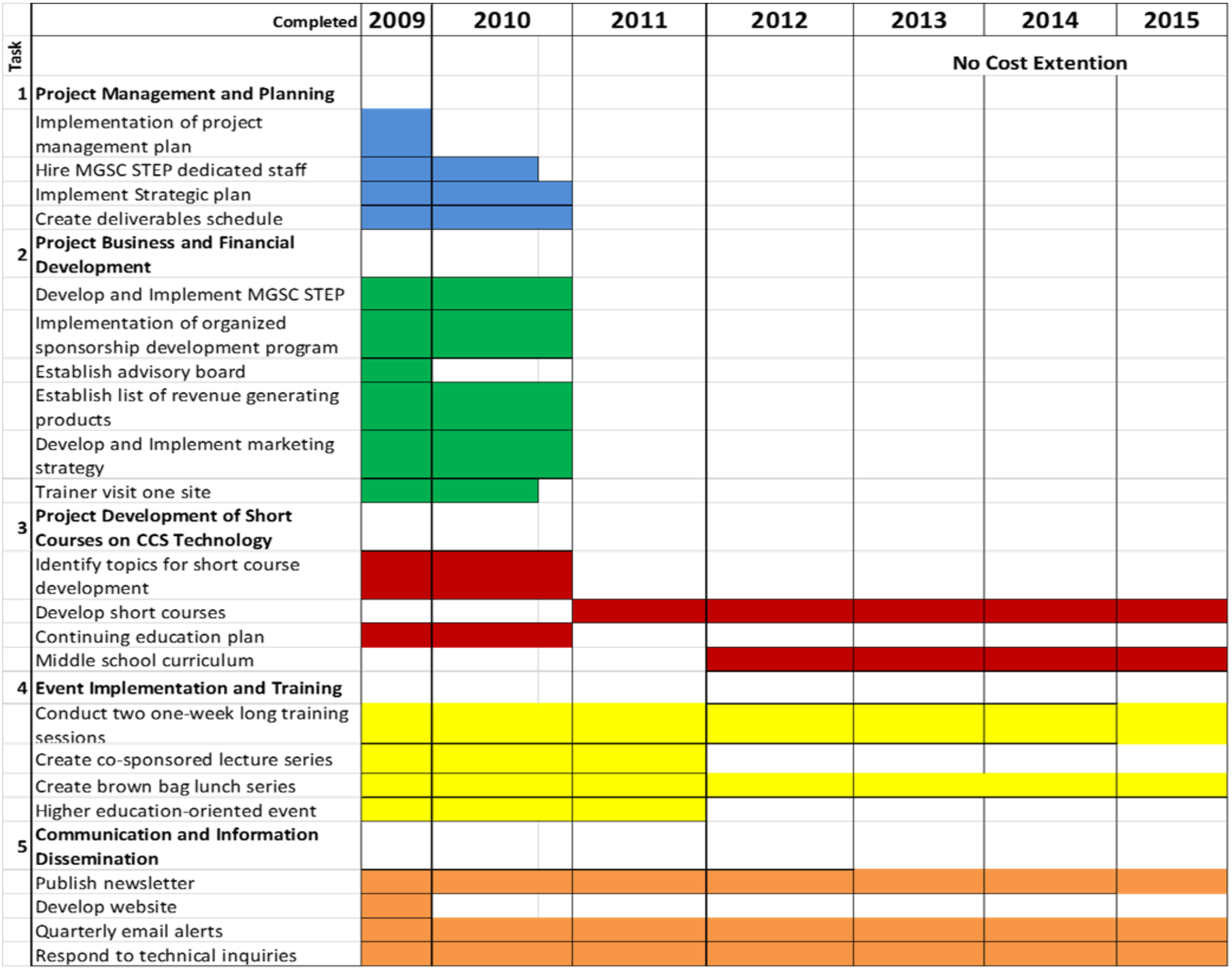


Figure 2. STEP Task Completion Timeline

Review Statement of Project Objectives

A revised Statement of Project Objectives (SOPO) was developed and submitted to the US Department of Energy in April 2011 (a copy of the SOPO is attached as Attachment A.) In addition to the objectives and scope of work this document outlined tasks and program deliverables which have all been completed as noted below:

Task 1.0 – Project Management and Planning

COMPLETED - *Subtask 1.1 Implementation of the project management plan (PMP)*

- The final PMP has been revised and updated in collaboration with the DOE Project Officer. The revised plan was submitted to DOE on March 26, 2010. (A copy of the PMP is included as attachment B.)

COMPLETED - *Subtask 1.2 Coordinate and monitor regional CCS project performance*

- During the course of this grant period there were at least three CCS projects in various stages of development in the Illinois Basin. The STEP Director has been an integral part of the MGSC team, participating in project management meetings, briefings, and presentations. The STEP Director was also involved with the FutureGen Alliance and has assisted with community outreach and education. Additionally, the STEP program has a very cooperative relationship with the Illinois Industrial Carbon Capture and Storage (ICCS) project and has assisted with outreach when requested. All three programs are featured in the STEP quarterly newsletters which allows the project leaders to submit text highlighting activities and accomplishments.

COMPLETED - *Subtask 1.3 Implement strategic planning as directed by Advisory Board*

- A report, based on AB recommendations, outlining a strategic plan, business model, and marketing strategy was produced in December 2010. (A copy is included as attachment C.)

COMPLETED - *Subtask 1.5 Participate in organized regional sequestration technology training centers working group*

- STEP developed a cooperative working relationship with all regional sequestration technology training centers and participated in all working group discussion between training centers. Additionally, the STEP Director has been a speaker and/or attended programs for the Southwest Regional Partnership, PCOR, and SECARB.

COMPLETED - *Subtask 1.6 Create and provide required deliverables to DOE*

- Deliverables were submitted to DOE in accordance with the "Federal Assistance Reporting Checklist."

COMPLETED - *Subtask 1.7 Maintain appropriate fiscal and accounting systems*

- ISGS contract specialists coordinated and maintained fiscal and accounting systems in accordance with DOE and U of I requirements.

Task 2.0 – Project Business and Financial Development

COMPLETED - *Subtask 2.1 Develop and implement a regional carbon sequestration technology training center*

- The Sequestration Training and Education Program (STEP) was established and branded in 2010. A vision statement, mission statement, and website were developed. A diversified business model and marketing plan was developed in conjunction with the STEP Advisory Board. Revenue generating programs were developed and executed.

COMPLETED - *Subtask 2.2 Implementation of organized sponsorship development program*

- A corporate sponsorship program was developed to solicit industry, service providers and independent operators in order to support program growth (a copy of the sponsorship brochure is attached as C).

COMPLETED - *Subtask 2.3 Establish an advisory board*

- An Advisory Board (AB) comprised of six CCS experts from industry, academia, state agencies, and service providers was established to provide input on the development of a diversified business model, marketing strategy, and short course and job training curriculum. The AB was later reduced to three CCS experts to focus on course development.

COMPLETED - *Subtask 2.4 Establish a list of revenue generating products*

- With input from the AB, STEP staff developed a comprehensive list of viable of revenue generating products. The list of products included rock sets, models, short courses, conferences, webinars, and workshops. The list was continually refined to provide the most viable list of opportunities for STEP.

COMPLETED ***Subtask 2.5 Develop and implement marketing strategy***

- With input from the AB, STEP developed and implemented a marketing strategy to maximize capacity building opportunities. This strategy included a dedicated website, brochures, newsletters, e-alerts, and participation in trade shows.

Task 3.0 – Project Development of Short Courses on CCS Technology

COMPLETED - ***Subtask 3.1 Identify topics for short course development***

- An on-going list of potential short course ideas was developed and refined over the grant period. The list of current and potential programs was included in each quarterly report

COMPLETED ***Subtask 3.2 Work with CCS experts to develop training opportunities to include, but not limited to, short courses, lectures, school programs, community programs, rock kits, physical models, and course materials***

- Over the course of the grant period, STEP worked with experts from multiple disciplines to develop workshops, webinars, a lecture series, conferences, short courses, teacher training, and community outreach programs. STEP has recorded 13,439 contact hours for 1,327 people.

COMPLETED - ***Subtask 3.3 Identify and work with professional societies to provide Professional Development Units (PDU) or Continuing Education Unit (CEU)***

- STEP worked with the University of Illinois, and other PDU/CEU providing organizations to provide 1,092 CEU's, and 475 PDH/CPDU's to over 800 people.

Task 4.0 – Event Implementation and Training

COMPLETED - ***Subtask 4.1 Participate in co-sponsored CCS training events***

- STEP has engaged in multiple co-sponsored training programs with Universities, Associations, Corporations, Government entities, and Research and Training Institutes. A complete list of organizations STEP has engaged to provide knowledge sharing opportunities is included as Attachment D.

COMPLETED ***- Subtask 4.2 Organize, prioritize, and participate in CCS events***

- STEP has developed and organized, at minimum, 39 CCS related events during this grant period. This list includes, workshops, short courses, site visits, guest lectures, and conferences.

COMPLETED - ***Subtask 4.3 Develop and hold higher education-oriented event***

- In 2011, STEP hosted the 5th IEAGHG International CCS Summer School for 53 graduate students from 26 countries and in 2014. STEP developed a college level course Geology 315 Energy, Climate and Carbon, which was offered at Western Kentucky University to 15 students.

Task 5.0 – Communication and Information Dissemination

COMPLETED - ***Subtask 5.1 Publish a training newsletter***

- An electronic newsletter was developed and distributed to the STEP mailing list each quarter.

COMPLETED - ***Subtask 5.2 Develop a training website***

- A dedicated website (www.sequestration.org/step) was developed to provide information about STEP programs and activities.

COMPLETED - ***Subtask 5.3 Provide quarterly e-mail technology alerts***

- Quarterly newsletters and e-alerts were developed using an on-line content delivery provider (Constant Contact). Newsletters continue to be delivered quarterly and e-alerts as needed.

COMPLETED - ***Subtask 5.4 Coordinate and leverage regional efforts***

- STEP had the unique opportunity to leverage work done on the Illinois Basin – Decatur Project (IBDP), a DOE project to inject one-million tonnes of anthropogenic carbon dioxide into a saline reservoir in Decatur, IL. in developing educational programs. In addition, the STEP Director and instructors participated in national and international CCS networking events & conferences which issued up-to-date knowledge of regional, national, and international CCS activities.

COMPLETED - ***Subtask 5.5 Respond promptly to technical inquires***

- An inquiry response procedure was established on the STEP website so that technical inquiries and questions could be answered quickly and easily.

COMPLETED -***Subtask 5.6 Coordinate funding source required activities***

Working with the University of Illinois accounting offices, STEP established separate accounts to facilitate funds from sponsorship activity and registration fees. These funds were then made available to supplement grant funds in the development and execution of educational programs.

Deliverables

The Recipient shall submit periodic, topical, and final reports in accordance with the Federal Assistance Reporting Checklist and the instructions accompanying the checklist for regular and ARRA reporting.

ARRA Reporting Requirements

COMPLETED. Under the direction and advisement of the DOE project manager, all ARRA reporting requirements were submitted.

STEP shall also provide specific deliverables listed below:

1. Updated Project Management Plan - **COMPLETED**
2. Advisory Board Roster - **COMPLETED**
3. Website Event Calendar - **COMPLETED**
4. Sponsorship Development and Marketing Plan (*Strategic Plan Report*) - **COMPLETED**
5. Regional Technology Training Plan **COMPLETED**
6. University Lecture Series and Training Events Report- **COMPLETED**
7. CEU and PDU Tracking - **COMPLETED**

Review of Program Highlights and Accomplishments

Hiring Staff

In order to effectively manage the STEP program it was essential to hire professional staff to coordinate specific aspects of the program. Specific needs were identified and used to develop job descriptions for a Sequestration Technology Training Specialist and a Graphic Designer (copies of job descriptions are included as Attachment E). Kathy Atchley was hired in October 2010 as a Sequestration Technology Training Specialist. Kathy brought strong marketing, event development and management skills to assist with the program development and execution.

Jonathan Cox was hired as a Graphic Designer in January 2012. He is an experienced graphic designer and his skillset includes design and production of various graphics for informational, educational and promotional purposes; as well as website development and maintenance.

Advisory Board

In developing an Advisory Board (AB), STEP looked for CCS experts from industry, academia, state agencies and service providers who would be willing to provide input on the development of the training center. Members were strategically selected with experience in marketing, course development and capacity building.

The AB met for face-to-face meetings two times and was then consulted on an ad hoc basis when input was needed. The inaugural meeting of the AB was held in Champaign, IL, August 5-6, 2010. The group conducted a SWOT (strengths, weaknesses, opportunities and threats) analysis and focused on input for the development of a business plan. The last face-to-face meeting of the AB was held in Charleston, SC, July 2014, to review STEP accomplishments and develop a strategy for taking STEP past the end of the grant period.

The original Advisor Board consisted of:

- **Doug Brauer**, Vice President of Development, Richland Community College, Decatur, IL. Doug has experience in regional business development and job training. He is also closely aligned with Archer Daniels Midland one of the project partners on the IBDP. (Term ended in 2012)
- **Robert Finley**, Director, Advanced Energy Technology Initiative, Illinois State Geological Survey, Champaign, IL. Rob is a Ph.D. trained geologist and the Principal Investigator of the DOE MGSC Regional Partnership. He is extremely knowledge of CCS and has an extensive list of professional contacts available to help with program development. (Current AB)

- **John Harju,** Associate Director for Research, Energy & Environmental Research Center, Grand Forks, North Dakota. John has partnership experience with the PCOR group. His professional responsibilities include research, development, demonstration, and commercialization of energy and environmental technologies. (Current AB)
- **Cynthia Lane,** Director of Engineering and Technical Services, American Water Works Association, Washington, DC. Cynthia brings an NGO perspective to the development of educational programs and services to serve a diverse clientele. (Term ended in 2012)
- **Dwight Peters,** North American Business Manager, Schlumberger Carbon Services, Sugar Land, TX. In addition to strong management and marketing skills, Dwight brings vast experience in commercialization of CCS. He represents the private industry perspective and training needs. (Term ended June 2015)
- **Chiara Trabucchi,** Principal, Industrial Economics, Inc. Chiara brings expertise in corporate finance and environmental economics. As a Principal with Industrial Economics, Incorporated, Chiara is a nationally recognized expert in financial risk management and related indemnity frameworks. (Term ended in 2011)

Sponsorship Development

STEP developed a Corporate Affiliate Program to support program development costs. The program was originally developed and promoted in 2011 to raise funds to offset program expenses for the IEAGHG Summer School. Sponsors were identified and solicited by leveraging personal relationships and was successful in securing $78,500 for Summer School related expenses. A copy of the sponsorship brochure is attached as Attachment F.

The Corporate Affiliate Program was continued after the Summer School and allowed donors to become an active part of the STEP mission to ensure the highest quality, best value educational experience through regional, national and international exchange programs. In many cases, donors were recruited for specific events (like the Welcome Reception, Lunches, Field Trip, etc.) and were acknowledged in promotional material for the meeting, from the podium at the meeting, on the STEP website, and in the STEP newsletter. Figure 3 shows a summary of donations received by STEP.

Sallie Greenberg acknowledging sponsors from podium at IEAGHG Summer School

Figure 3. Donations to STEP Program Development

Year	Event	Donor	Amount
2011	IEAGHG Summer School	International Institute for Carbon-Neutral Energy Research	$20,000
2011	IEAGHG Summer School	US Department of Energy	$20,000
2011	IEAGHG Summer School	Illinois Department of Commerce and Economic Opportunity	$20,000
2011	IEAGHG Summer School	Duke Energy	$10,000
2011	IEAGHG Summer School	Alstom	$6,000
2011	IEAGHG Summer School	Schlumberger Carbon Services	$5,000
2011	IEAGHG Summer School	Illinois State Geological Survey	$5,000
2011	IEAGHG Summer School	Denbury	$2,500
2011	Midwest Carbon Sequestration Science Conference	Schlumberger Carbon Services	$5,000
2012	Midwest Carbon Sequestration Science Conference	Schlumberger Carbon Services	$5,000
2013	Midwest Carbon Sequestration Science Conference	Schlumberger Carbon Services	$5,000
2014	Midwest Carbon Sequestration Science Conference	Schlumberger Carbon Services	$2,000
2014	National CCS Conference – Australia (Travel funds for Sallie Greenberg)	CO2CRC	$2,000
		Total Donations to STEP	**$97,500**

Continuing Education

When developing programs for STEP we placed an emphasis on the design and delivery of continuing professional education and training for individuals of all ages and a variety of organizations. These programs included many workshops that offered Professional Development Hours (PDHs), Continuing Professional Development Units (CPDUs) or Continuing Education Units (CEUs) to participants and helped to meet the requirements for professional development or licensure renewal for a wide range of professions. (Figures 4, 5 and 6 show total distribution of CEU's, PDH's and CPDU's in various formats.)

CPDUs

According to the State of Illinois State Board of Education (ISBE) teachers must be actively engaged in professional development by accruing CPDUs in order to maintain their teaching license. The sole purpose of professional development is to increase educators' knowledge and skills specifically to impact student growth, achievement, and well-being, specifically the programs must:

(A) Advance both the licensee's knowledge and skills as a teacher consistent with the Illinois Professional Teaching Standards and the Illinois Content Area Standards in the licensee's areas of certification, endorsement, or teaching assignment in order to keep the licensee current in those areas.

(B) Develop the licensee's knowledge and skills in areas determined to be critical for all Illinois teachers defined by the State Board of Education, known as "State priorities".

(C) Address the knowledge, skills, and goals of the licensee's local school improvement plan, if the teacher is employed in an Illinois public or State-operated elementary school, secondary school, or cooperative or joint agreement with a governing body or board of control.

(D) Expand the licensee's knowledge and skills in an additional teaching field or toward the acquisition of another teaching license, endorsement, or relevant education degree.

STEP worked with the University of Illinois Outreach and Public Service office to qualify the Keystone Teachers Workshop "CSI: Climate Status Investigations, An Interdisciplinary Curriculum Module" for CPDUs for teachers attending the course. By attending and participating in the entire workshop attendees qualified for 14 hours of CPDUs. Additionally, STEP continues to work with the University to qualify the STEP teacher's "Workshop on Exploring Energy Issues" which will showcase the new STEP developed supplemental curriculum for middle school learners.

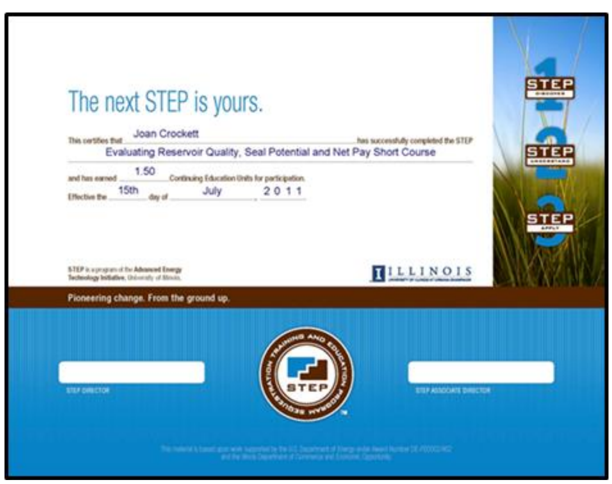
Professional Development Hours – PDH's

Professional Development Hour (PDH) is defined as one contact hour of instruction, presentation or study. The term PDH is commonly used in the engineering community. PDH's were granted for a webinar held jointly with the Society of Petroleum Engineers (SPE).

Continuing Education Units - CEUs

At the University of Illinois (which granted the STEP CEU's) a CEU is defined as 10 contact hours of participation in an organized noncredit continuing education activity under 1) responsible, competent sponsorship, 2) capable academic direction, and 3) qualified instruction. The University has established a CEU Review Committee which uses very rigid criteria for determining program eligibility. STEP applied for CEU accreditation for nine programs and received approval for all programs. A total of 1,092 CEU's have been awarded for participation in STEP programs.

Participants at these programs were informed that the program had been approved for CEU's from the Office of Continuing Education at the University of Illinois at Urbana Champaign and upon request were given certificates of completion (pictured below). The Office of Continuing Education at the University of Illinois maintains a database with limited information for each program. Requests for additional information can be sent to the CEU Review Committee, Office of Continuing Education, Suite 101, 901 East University Avenue, Urbana, IL 61801.



STEP Certification of Completion for CEU's

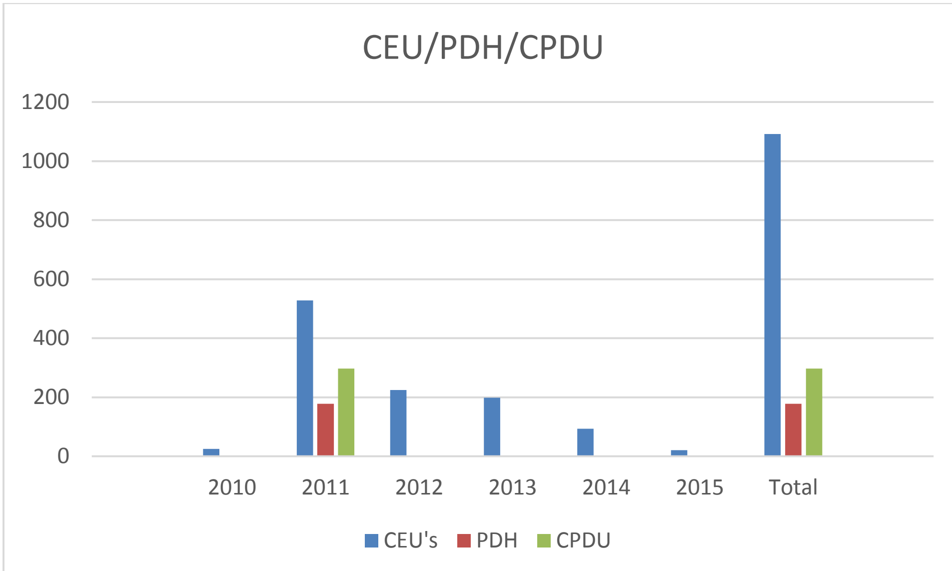


Figure 4. STEP CEU/PDH/CPDU’s by year graphic

CEU/PDH by Year								
		2010	**2011**	**2012**	**2013**	**2014**	**2015**	**Total**
CEU's		25	528	225	199	94	21	1092
PDH		0	178	0	0	0	0	178
CPDU		0	297	0	0	0	0	297

Figure 5. STEP CEU/PDH/CPDU by year

Figure 6. Total Continuing Education Units and Professional Development Hours Issued for STEP Programs

Course Name	Date of Course	Number of Participants	Number of CEUs per Course*	Number of PDHs per Course*	Total Number of CEUs	Total Number of PDHs
CCS 101 - Taylorville Energy Center	05/27/10	35	0	0	0	0
The STEP Illinois Basin - Decatur Project Site Visit Course	09/14/10	25	1	0	25	0
Communication, Project Planning & Management for CCS Projects - Lessons Learned	03/17/11	6	1	0	6	0
The STEP Illinois Basin - Decatur Project Site Visit Course	03/01/11	3	1	0	3	0
Webinar Series - Geological Sequestration for Petroleum Engineers (joint with SPE)	05/16/11	178	0	1	0	178
The STEP Illinois Basin - Decatur Project Site Visit Course	05/18/11	4	1	0	4	0
Evaluating Reservoir Quality, Seal Potential and Net Pay	07/14/11	19	2	0	29	0
IEA-GHG International CCS Summer School	07/17/11	53	5	0	265	0
Climate Change Teacher Training Course (Keystone Center)	09/29/11	22	0	14	0	297
Midwest Carbon Sequestration Science Conference	11/07/11	123	2	0	209	0
The STEP Illinois Basin - Decatur Project Site Visit	11/13/11	12	1	0	12	0
The STEP Illinois Basin - Decatur Project Site Visit	03/08/12	8	1	0	8	0
The STEP Illinois Basin - Decatur Project Site Visit	04/27/12	1	1	0	1	0
The STEP Illinois Basin - Decatur Project Site Visit	06/05/12	13	1	0	13	0
2012 Midwest Carbon Sequestration Science Conference	09/17/12	120	2	0	204	0
The STEP Illinois Basin - Decatur Project Site Visit	01/24/13	8	1	0	8	0
The STEP Illinois Basin - Decatur Project Site Visit	02/22/13	2	1	0	2	0
The STEP Illinois Basin - Decatur Project Site Visit	04/22/13	10	1	0	10	0
The STEP Illinois Basin - Decatur Project Site Visit	05/17/13	2	1	0	2	0
2013 Midwest Carbon Sequestration Science Conference	10/07/13	104	2	0	177	0
The STEP Illinois Basin - Decatur Project Site Visit	10/02/14	11	1	0	11	0
2014 Midwest Carbon Sequestration Science Conference	11/05/14	75	1	0	83	0
The STEP Illinois Basin - Decatur Project Site Visit	2/15/2015	6	1	0	6	0
The STEP Illinois Basin - Decatur Project Site Visit	4/27/2015	3	1	0	3	0
The STEP Illinois Basin - Decatur Project Site Visit	6/4/2015	2	1	0	2	0
The STEP Illinois Basin - Decatur Project Site Visit	6/12/2015	10	1	0	10	0
TOTAL		**855**		**15**	**1092**	**475**

Event Implementation and Training

With assistance and input from the STEP Advisory Board, a preliminary list of potential training and development opportunities was first identified in August 2010. This initial list was modified and expanded as new opportunities became available over the grant period. STEP worked with ISGS staff, IBDP researchers and other CCS experts to develop course materials for workshops, short courses, lectures, curriculum, and conferences. The evolving list of potential events was included in the quarterly reports to DOE and as event details were confirmed they were promoted in the STEP newsletters, e-alerts, and on the STEP website.

Since 2010, STEP has developed or sponsored 39 capacity building events (Figure 8). Over the grant period, STEP has issued 1,092 CEU's and instructed 1,327 people over 13,439 hours of course work. This list includes conferences, short course, workshops, guest lectures, webinars, and a summer school. Speakers for these events were invited from academia, government, and research institutions. More than 75 individuals from around the globe were invited to present at STEP developed or sponsored events (Figure 7). A complete list of speakers with affiliation is included as Attachment G.

STEP Speakers		
Rebecca Adwell	Jared Freiburg	Scott McDonald
Richard Aldous	Lori Gauvreau	Ray McKaskle
Klaas van Alphen	Sallie Greenberg	John Medler
Ahsan Alvi	Georg Grathoff	Edward Mehnert
Kathy Atchley	Satya Harpalani	Curtis Oldenburg
Bob Bauer	Ken Hnottavange-Telleen	Graham Payne
Brendan Beck	Ana Houseal	Dwight Peters
Larry Bengal	Cheol Huh	Matthias Raab
Tony Booer	Abbas Iranmanesh	Warren Riemer
Bruce Brown	Phil Jagucki	Bryan Robinson
Ningsheng Cai	John Kaldi	Ozgur Senel
Ameena Camps	Jim Kirksey	Philip Sharman
Zheng Chang	David Larssen	Dianna Shelander
Kipp Coddington	Donald Lee	Valerie Smith
Marcia Couselan	Hannes Leetaru	Malgorzata Stein-Brzozowska
Syrie Crouch	Clare Lehane	Martin Streibel
Darin Damiani	Yu-Feng Lin	John Thompson
Briony Daw	John Lityneski	John Tombari
Tim Dixon	Randy Locke	ChiaraTrabucchi
Eric Drosin	Yongqi Lu	Rosemary Whitbread
Andrew Duguid	Monica Lupion	Steve Whittaker
Terry Engelder	Scott Marsteller	Bob Will
Giacomo Falorni	Franz May	Bracken Wimmer
John Filiatrault	John McBride	Li Xisochun
Robert Finley	Kevin McCauley	
Scott Frailey	Jeff McDonald	

Figure 7. STEP Speakers

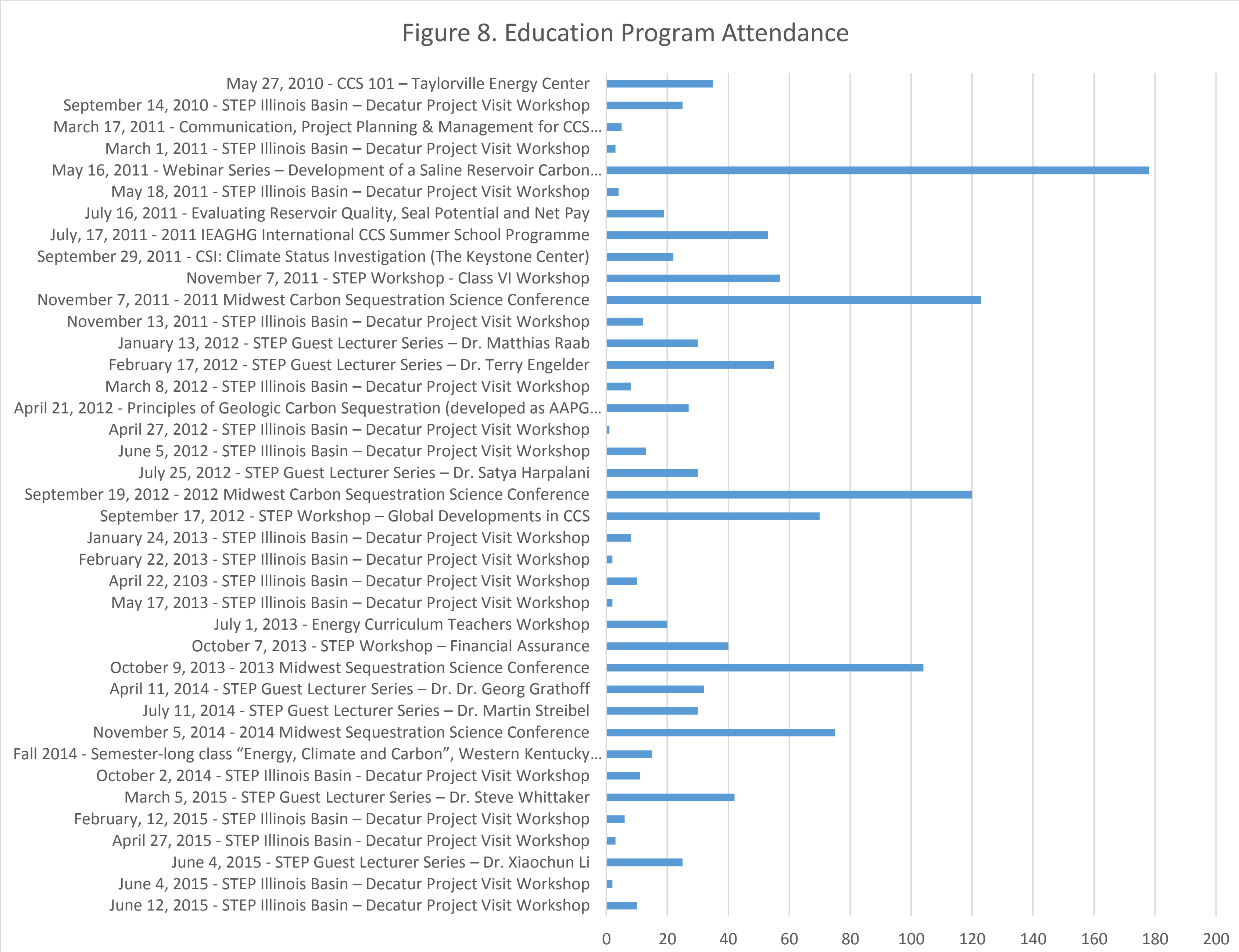


Figure 8. Education Program Attendance
May 27, 2010 - CCS 101 – Taylorville Energy Center
September 14, 2010 - STEP Illinois Basin – Decatur Project Visit Workshop
March 17, 2011 - Communication, Project Planning & Management for CCS...
March 1, 2011 - STEP Illinois Basin – Decatur Project Visit Workshop
May 16, 2011 - Webinar Series – Development of a Saline Reservoir Carbon...
May 18, 2011 - STEP Illinois Basin – Decatur Project Visit Workshop
July 16, 2011 - Evaluating Reservoir Quality, Seal Potential and Net Pay
July, 17, 2011 - 2011 IEAGHG International CCS Summer School Programme
September 29, 2011 - CSI: Climate Status Investigation (The Keystone Center)
November 7, 2011 - STEP Workshop - Class VI Workshop
November 7, 2011 - 2011 Midwest Carbon Sequestration Science Conference
November 13, 2011 - STEP Illinois Basin – Decatur Project Visit Workshop
January 13, 2012 - STEP Guest Lecturer Series – Dr. Matthias Raab
February 17, 2012 - STEP Guest Lecturer Series – Dr. Terry Engelder
March 8, 2012 - STEP Illinois Basin – Decatur Project Visit Workshop
April 21, 2012 - Principles of Geologic Carbon Sequestration (developed as AAPG...
April 27, 2012 - STEP Illinois Basin – Decatur Project Visit Workshop
June 5, 2012 - STEP Illinois Basin – Decatur Project Visit Workshop
July 25, 2012 - STEP Guest Lecturer Series – Dr. Satya Harpalani
September 19, 2012 - 2012 Midwest Carbon Sequestration Science Conference
September 17, 2012 - STEP Workshop – Global Developments in CCS
January 24, 2013 - STEP Illinois Basin – Decatur Project Visit Workshop
February 22, 2013 - STEP Illinois Basin – Decatur Project Visit Workshop
April 22, 2103 - STEP Illinois Basin – Decatur Project Visit Workshop
May 17, 2013 - STEP Illinois Basin – Decatur Project Visit Workshop
July 1, 2013 - Energy Curriculum Teachers Workshop
October 7, 2013 - STEP Workshop – Financial Assurance
October 9, 2013 - 2013 Midwest Sequestration Science Conference
April 11, 2014 - STEP Guest Lecturer Series – Dr. Dr. Georg Grathoff
July 11, 2014 - STEP Guest Lecturer Series – Dr. Martin Streibel
November 5, 2014 - 2014 Midwest Sequestration Science Conference
Fall 2014 - Semester-long class “Energy, Climate and Carbon”, Western Kentucky...
October 2, 2014 - STEP Illinois Basin - Decatur Project Visit Workshop
March 5, 2015 - STEP Guest Lecturer Series – Dr. Steve Whittaker
February, 12, 2015 - STEP Illinois Basin – Decatur Project Visit Workshop
April 27, 2015 - STEP Illinois Basin - Decatur Project Visit Workshop
June 4, 2015 - STEP Guest Lecturer Series – Dr. Xiaochun Li
June 4, 2015 - STEP Illinois Basin – Decatur Project Visit Workshop
June 12, 2015 - STEP Illinois Basin – Decatur Project Visit Workshop
0
20
40
60
80
100
120
140
160
180
200

Figure 9. Summary of STEP Events

Summary of STEP Developed or Sponsored Event

As of June 2015

Date	Event	Attendees	CEU/(CPDU)
12 June 2015	STEP Illinois Basin – Decatur Project Visit Workshop	10	10
4 June 2015	STEP Illinois Basin – Decatur Project Visit Workshop	2	2
4 June 2015	STEP Guest Lecturer Series – Dr. Xiaochun Li (1 hr)	25	N/A
27 April 2015	STEP Illinois Basin – Decatur Project Visit Workshop	3	3
12 February 2015	STEP Illinois Basin – Decatur Project Visit Workshop	6	6
5 March 2015	STEP Guest Lecturer Series – Dr. Steve Whittaker (1hr)	42	N/A
Fall 2014	Semester-long class "Energy, Climate and Carbon" Western Kentucky University (3 credit hrs/16 weeks)	15	N/A
5 November 2014	2014 Midwest Sequestration Science Conference	75	83
2 October 2014	STEP Illinois Basin – Decatur Project Visit Workshop	11	11
11 July 2014	STEP Guest Lecturer Series – Dr. Martin Streibel (1hr)	30	N/A
11 April 2014	STEP Guest Lecturer Series – Dr. Dr. Georg Grathoff (1 hr)	32	N/A
9 October 2013	2013 Midwest Sequestration Science Conference	104	177
7 October 2013	STEP Workshop – Financial Assurance (3 hrs)	40	N/A
1 July 2013	Energy Curriculum Teacher Workshop (16 hrs)	20	N/A
17 May 2013	STEP Illinois Basin – Decatur Project Visit Workshop	2	2
22 April 2013	STEP Illinois Basin – Decatur Project Visit Workshop	10	10
22 February 2013	STEP Illinois Basin – Decatur Project Visit Workshop	2	2
24 January 2013	STEP Illinois Basin – Decatur Project Visit Workshop	8	8
17 September 2012	STEP Workshop – Global Developments in CCS (3 hrs)	70	N/A
19 September 2012	2012 Midwest Carbon Sequestration Science Conference	120	204
25 July 2012	STEP Guest Lecturer Series – Dr. Satya Harpalani (1 hr)	30	NA
5 June 2012	STEP Illinois Basin – Decatur Project Visit Workshop	13	13
27 April 2012	STEP Illinois Basin – Decatur Project Visit Workshop	1	1
21 April 2012	Principles of Geologic Carbon Sequestration (developed as AAPG Short Course) (7 hrs)	27	N/A
8 March 2012	STEP Illinois Basin – Decatur Project Visit Workshop	8	8
17 February 2012	STEP Guest Lecturer Series – Dr. Terry Engelder (1 hr)	55	N/A
13 January 2012	STEP Guest Lecturer Series – Dr. Matthias Raab (1hr)	30	N/A
13 November 2011	STEP Illinois Basin – Decatur Project Visit Workshop	12	12
7-9 November 2011	2011 Midwest Carbon Sequestration Science Conference	123	209
7 November 2011	STEP Workshop - Class VI Workshop (3 hrs)	57	N/A

29-30 Sept. 2011	CSI: Climate Status Investigation (The Keystone Center)	22	(297)
17-23 July 2011	2011 IEAGHG International CCS Summer School Programme	53	265
16-17 July 2011	Evaluating Reservoir Quality, Seal Potential and Net Pay	19	29
18 May 2011	STEP Illinois Basin – Decatur Project Visit Workshop	4	4
16 May 2011	Webinar Series – Development of a Saline Reservoir Carbon Sequestration Demonstration Project (joint with SPE)	178	(178)
01 March 2011	STEP Illinois Basin – Decatur Project Visit Workshop	3	3
17 March 2011	Communication, Project Planning & Management for CCS Projects – Lessons Learned	6	6
14 Sept. 2010	STEP Illinois Basin – Decatur Project Visit Workshop	25	25
27 May 2010	CCS 101 – Taylorville Energy Center (2 hrs)	35	N/A
	Total	**1,327**	**1,092/(475)**

Summary of Formal Education Contact

CEU Contact

10,920 hours (1,092 CEU's; 619 people)

PDH or CPDU Contact

475 hours (200 people)

General course work contact (non-CEU, non-PDH, non CPDU)

2,044 hours (508 people)

Total – 13,439 hours to 1,327 people

Figure 10. Point of origin for participants of STEP Developed Events.

Summary of STEP Developed Training Programs

STEP programs attracted a diverse audience. Attendees were researchers, practitioners, regulators, educators, students, legislators, engineers, government officials, and developers. Attendees represented a cross-section of the global CCS marketplace from 28 countries. The map on the previous page shows the point of origin for STEP program attendees (Figure 10).

CCS 101 - Taylorville Energy Center. Taylorville, Illinois

May 27, 2010. 35 Participants.

Instructors: Sallie Greenberg, Robert Finley

At the request of the Taylorville Energy Center this training program was developed for land and permit acquisition professionals in central Illinois. In addition to the land permitting team, regional stakeholders also participated. Presentations included an overview of basic CCS principles and a summary of the Illinois Basin – Decatur Project by Dr. Robert Finley and Dr. Sallie Greenberg. In addition to the technical presentations, a visual demonstration of CCS was provided by Sallie Greenberg using the MGSC-developed Sequestration Model.

Communication, Project Planning & Management for CCS Projects - Lessons Learned, Washington DC

March 17, 2011. 5 participants. 5 CEU's awarded.

Instructors: Sallie Greenberg, Gretchen Hund, Sarah Wade

This workshop drew on the experience of the workshop instructors in planning and implementing communication programs in international CCS projects, with a focus on a recent, international research project in which they participated that compared public communication and outreach practices associated with five large-scale CCS projects. The five case studies included Barendrecht Project – The Netherlands, Carson Project – United States of America, FutureGen Project – United States of America, and Otway Basin Project – Australia, Zerogen Project – Australia.

The researchers concluded that, whilst there are key lessons around what constitutes best practice in communication and outreach, these alone are not sufficient to ensure successful CCS project deployment. The findings from the study suggest that a project's ability to adjust its planning and management to its social context is more likely to ensure a positive outcome for all involved in the project. A fundamental conclusion is that communication should not be seen as an add-on to a project. Successful projects integrate communication and outreach as a critical component of project management from the beginning.

This overview workshop presents a summary of the findings of the case studies and then elaborates on the notions of adaptive project management and two-way communication based on an assessment of the studies. It was hoped that these findings will assist project developers to go beyond "best practice" communication and outreach in order to integrate them more fully into their management approach and contribute to more successful outcomes for the commercial deployment of CCS projects.

Webinar - Development of a Saline Reservoir Carbon Sequestration Demonstration Project at Decatur, Illinois USA (joint with Society of Petroleum Engineers).

May 16, 2011. 178 participants. 178 PDH's awarded.

Instructor: Robert Finley

The Society of Petroleum Engineers approached STEP about development of a co-sponsored webinar on the IBDP. This web seminar lasted one hour and featured Dr. Robert Finley discussing the MGSC geologic sequestration program focusing on the IBDP. This presentation covered all aspects of developing a deep saline sequestration project from site characterization through geophysical and geochemical monitoring techniques, modeling, well construction and drilling, and much more.

Evaluating Reservoir Quality, Seal Potential and Net Pay. Champaign, Illinois

July 14-15, 2011. 19 participants. 29 CEU's awarded

Instructor: John Kaldi

This STEP-sponsored course was designed for geologists, reservoir engineers and personnel involved in hydrocarbon exploration, and development or CO_2 sequestration. Attendees heard a straightforward and intuitive presentation of principles governing petroleum and CO_2 migration and accumulations as well as practical applications to determine net pay and seal evaluations. The course was presented in workshop format and participants were given the opportunity to work with data in several practical exercises.   The course demonstrated the use of basic rock properties, wireline logs, capillary pressure and relative permeability data to evaluate reservoir rock quality, seal capacity (thickness of hydrocarbon or CO_2 column a seal can hold before it leaks), recovery efficiency and location of reservoir fluid contacts. The course also explained the main controls on fault seals, and methods used in evaluating these.

The course was presented by John Kaldi, CO2CRC, Australian Resources Research Center, University of Adelaide.   John Kaldi attended Queens College, City University of New York for the Bachelors and Masters degrees. He then received a Ph.D from Cambridge University, England. Dr. Kaldi has worked with the Saskatchewan Geological Survey in Regina, Saskatchewan, with Shell Canada in Calgary, with ARCO Oil and Gas Co. in Plano, Texas, with ARCO, Indonesia, in Jakarta, and with VICO in Jakarta as Chief Geologist. In 1998, he became Director of the National Centre for Petroleum Geology and Geophysics (NCPGG) at the University of Adelaide, Australia. In 2003, Prof. Kaldi was appointed as the Inaugural Head of the Australian School of Petroleum (ASP), and presently holds the Australian Chair of Geosequestration at the University of Adelaide. Since July, 2005, he has been Chief Scientist for the CO2CRC. He is committed to providing continuing education courses for the oil and gas sector and has been teaching courses around the world for various petroleum companies.

He is active in professional societies, serving as President of the AAPG Asia Pacific Region (2002 – 2005) and Chair of AAPG’s International Regions Committee. He is also a delegate representing Australia on the AAPG House of Delegates. He was organizer of two AAPG Hedberg research conferences on Seals, and was the Technical Program Chair for the Perth 2006 AAPG International Conference & Exhibition (ICE), and is in the same role for the 2012 ICE. Dr. Kaldi received AAPG's Special Commendation Award for Significant Contributions to Petroleum Geology in 1997, the 2006 AAPG Distinguished Service Award and in 2009 was named an AAPG Honorary Member.

Course Evaluation & Testimonials:

- 100% of respondents stated they would recommend the course to a colleague.
- 100% of respondents stated the course met or exceeded their expectations.
- 90% of attendees gave an excellent rating for the volume of information, effectiveness of speaker and knowledge of speaker.

- "Great Speaker – enthusiastic, good level for audience and great illustrations."
- "Great. Learned a lot! Course at a level that I can actually try to apply data."
- "Very good course. Nice review of old material and introduction of new material."
- "There is a big need for Illinois Basin reservoir to be better understood/evaluated using these methods – both CCS and hydrocarbon reservoirs."

IEAGHG Summer School, Champaign, IL

July 17-23, 2011. 53 Students. 265 CEU's awarded.

Instructors: Brendan Beck, Anthony Booer, Ningsheng Cai, Ammena Camps, Kipp Coddington, Syrie Crouch, Briony Daw, Tim Dixon, Eric Drosin, John Filatrault, Robert Finley, Saran Forbes, Scott Frailey, Lori Gaubreau, Sallie Greenberg, John Kaldi, Clare Lehane, Randy Locke, Monica Lupion, Franz May, Kevin McCauley, Ed Mehnert, Warren Riemer, Phiip Sharman, Malgorzata Stein-Brzozowska, John Thompson, and Klaas van Alpen

In July 2010, the MGSC and STEP were selected by the IEAGHG organization to serve as the local hosts for the 2011 IEAGHG Summer School. The Summer School was held in Champaign, Illinois, July 17-23, 2011. The 2011 event in Champaign marked the fifth year for the conference and the first time the program was offered in the United States. This rich history includes programs in Kloster Seeon, Germany (2007); Vancouver Island, Canada (2008); Lorne, Australia (2009); and Spitsbergen, Norway (2010).

Summer School attendees gathering for field trip departure.

The IEAGHG is an international collaborative research programme established in 1991 as an Implementing Agreement under the International Energy Agency (IEA). IEAGHG studies and evaluates technologies that can reduce greenhouse gas emissions derived from the use of fossil fuels. IEAGHG takes pride in being an informed but unbiased source of technical information on greenhouse gas mitigation.

The IEAGHG Summer School (Summer School) is designed to address a gap in education being provided on CCS by existing courses at institutes of higher education around the world. It was developed by the IEAGHG to provide students and young professionals from diverse academic backgrounds with a broad understanding of the issues surrounding CCS and to encourage their active participation in future developments. The Summer School series addresses a shortfall in available education programs in the CCS field. Through a week long program with presentations and discussion groups led by international experts in the field of CCS, students take away a clear understanding of all aspects of CCS.

From the 120 students who applied, fifty-three students from twenty-six countries were selected by an international committee and invited to attend the 2011 Summer School. The 2011 Summer School was a week-long program with presentations and discussion groups led by international experts in the field of CCS. The program covered every aspect of CCS and presented up-to-date information on sources of CO_2; capture of CO_2; transportation of CO_2; underground geological storage; safety; costs and economic potential of CCS; regulatory issues as well as other topics. Also included was a visit to the MGSC Illinois Basin – Decatur Project to receive an overview of a project that was about to begin injection and storage of one million metric tonnes of CO_2 in a deep saline reservoir. (A copy of course materials is included in the addendum.)

In addition to the field visit and structured technical presentations, students were divided into six working groups to undertake short research activities on a range of topics important to the future success of CCS. At the conclusion of the week, each group made a presentation to their instructors and peers. Ample time was also allocated for networking and for information discussions with the assembled experts. Students leaving at the end of the week left with a well-developed network of contacts in the field of CCS as well as a broad overview of the issues surrounding technology development and implementation of CCS.

One of the primary goals of the Summer School is to improve the CCS knowledgeable human resource pool to provide a basis for future CCS research and development.   Specifically, 1) to encourage young researchers to stay in the field and make a career of CCS; 2) to create CCS awareness and understanding for those moving careers into other areas, but who may influence decision makers for CCS in the future; and 3) to create for the students their own global network of international peers and contacts in CCS at the start of their careers.

These objectives were met by broadening the student's knowledge base beyond their own fields of research; by providing students a wider context for their specific CCS areas of research; by raising awareness and interest in new areas of CCS study and by facilitating the development of a global network of students and international experts which they can use throughout their careers.

Technical Program

The International Organizing Committee, which consisted of members of the IEAGHG, MGSC, STEP, Schlumberger Carbon Services, CO2CRC, and Tsinghua University, met monthly by conference call (with follow up by e-mail) over a 10 month period.   The initial directive was to develop a technical program to cover every aspect of CCS with up-to-date information. Speakers were selected because of their expertise, reputation and willingness to mentor the next generation of CCS practitioners.

Day One.

The first day of the technical program began with an overview of CCS given by Sarah Forbes, World Resources Institute (WRI) USA, followed by a presentation of Site Selection, Capacity, Injectivity by Robert Finley, MGSC, USA and John Kaldi, CO2CRC, Australia. Franz May, Federal Institute for Geosciences and Natural Resources (BGR), Germany and Tony Booer, Schlumberger Carbon Services, United Kingdom, partnered on a storage presentations on Containment, including Migration Pathways and Wellbore Integrity. Three members of the ISGS, Scott Frailey, Ed Mehnert, and Randy Locke presented on Enhanced Oil Recovery, Modelling and Monitoring & Verification presentations.

Tony Booer, Schlumberger Carbon Services, speaks on wellbore integrity

Day Two.

Day two featured a presentation by John Filiatrault, Denbury Resources, USA, on Transport. Syrie Crouch, Shell, USA, followed with a presentation on Risk and Uncertainty. Philip Sharman from Alstom, United Kingdom, covered Economics and Financing and Sallie Greenberg, ISGS, USA and Lori Gauvreau, Schlumberger Carbon Services, United Kingdom teamed up to present on Public Acceptance and Communications. Brendan Beck from the South African Centre for CCS covered International Policy and Tim Dixon, IEAGHG, United Kingdom covered International Legal & Regulatory, Carbon Accounting. Kipp Coddington from Mowry, Meezan, Coddington, Cloud, USA, addressed National Policy & Legal. Sallie Greenberg, ISGS, USA presented US National Regulatory Framework. Ningshen Cai, Tsinghua University, China, shared his perspectives on China CCUS Developments.

Day Three.

The third day, Field Trip Day, started off with Rosemary Whitbread, HSE, United Kingdom who covered Health & Safety prior to our departure to the well site. Robert Finley, ISGS, USA, then gave an overview of the IBDP including a description of the project.

Day Four.

Day Four focused on capture technologies and industry perspectives with Kevin McCauley, Babcock & Wilcox, USA covering Oxyfuel Combustion and Monica Lupion, CIUDEN, Spain covering Pre- and Post-

Combustion. Industrial Sources for CCS was presented by Tim Dixon, IEA and a panel of industry partners participated in a panel discussion on Project Integration. John Thompson, Clean Air Task Force, USA, covered the NGO Perspective. The day concluded with a panel discussion on Industry Perspectives.

Day Five.

Day Five featured the informative student group presentations and ended with a presentation from Clare Lehane, Elesvier, United Kingdom on publishing technical papers.

Field Trip

An important element to the Summer School experience was the opportunity to show the participants an active CCS site. All meeting participants were transported to the Illinois Basin – Decatur Project which began storage in the fall of 2011. Upon arrival at the well site, the group was welcomed by Bill Hoback from the Illinois Department of Commerce and Economic Opportunity, the field day sponsor. Scott Marsteller, Schlumberger Carbon Services and Hannes Leetaru, ISGS, gave a presentation on the injection well and core sampling. Groups were then taken to the compression/dehydration facility and attended presentations on the verification well; monitoring, verification and accounting (MVA), and finished with a presentation on the Real-Time Acquisition data system.

Bill Hoback, IL DCEO, welcoming students to project site


Students at the injection well

Student Team Presentations

In addition to the standard instructional methods (lecture with power point presentation, panel discussions, etc.) used throughout the week, the IEAGHG employed a more interactive teaching method by dividing students into working groups and giving them a topic to research with instructions to discuss, investigate, research and develop a team presentation to be given at the end of the week. This team work was conducted at the end of each full day of technical presentations with student groups often working late into the night. Speakers and mentors were on hand during these evening hours to give input when requested, answer questions when needed and offer advice when asked. Each team was expected to make a 15 minute group presentation followed by questions from a panel of experts.

Topics for research/presentation included:

- How can CCS be applied to small and medium CO_2 sources and sinks?
- How can societal acceptance of CCS be addressed?
- How can the USA set up a series of regionally integrated CO_2 capture, transport and storage networks?
- How can CCS be made part of a commercially viable integrated, sustainable and secure energy system?
- Is CCS a viable option for developing countries?

- Should CCS be mandatory in the developed world? What are the pros and cons?

The groups used a variety of interesting and engaging methods to present their research. All groups were commended on their research and understanding of the assigned topic; however, the group who researched Mandatory CCS in Developing Countries was awarded highest honors and received an award for best group.

One of the student groups giving an interactive presentation.

CEU's

The IEAGHG Summer School was approved for five CEU's from the University of Illinois Office of Continuing Education. Each Student received a certificate of completion which noted the CEU's earned. A total of 265 CEU's were issued.

Survey Results

Student participants responded to Summer School Evaluation Forms designed to give feedback on all aspects of the week. Fifty-two of the fifty-three students returned conference evaluation forms. Survey results were overwhelmingly positive, for example:

- 91% of students rated the technical program excellent/good.
- 96% of students rated the presenters and mentors as excellent/good.
- 100% of students rated the conference organization as excellent/good.

- 100% of students felt the course met or exceeded their expectations.

The student's favorite part about the summer school was the team work/networking followed closely by the field trip and the team building night.

Student Testimonials

> "I now have an idea how to speak to people about CCS to increase awareness in my community."
>
> "I really liked learning about economics and finance since, as a geologist, it is so outside of my field."
>
> "I will use the social connections I made to foster international professional relationships."
>
> "The field trip was really educational. I have never seen an injection site before."
>
> "My favorite part of the summer school was the engagement with industry leaders – they are open and easy to talk to."
>
> "Arrangements of this type of events are really important to spread the awareness on the topic. Good work."
>
> "I know better how to frame CCS and how to talk about it."
>
> "I serve on my state's air quality board, and CCS is an issue. They have been working on a regulatory framework. I also work closely with students and this meeting has been an excellent background."
>
> "Excellent organization. The mentors were great. I thought the general idea of the student projects was very good, and this was a great experience."

“I think the summer school gave me a good basic knowledge of CCS and will help me in my scientific career in The Netherlands.”

“I am learning international, global ideas that will (or should) affect us all and I am so glad I was able to attend.”

“The summer school has exceeded my expectations. It is great that you are able to get so many leading experts to come support us.”

“CCS as an important technological choice for China to meet a climate change problem, will certainly need to be fully understood by the Chinese people. So my participation will help the Chinese people around me to know more about it and help us to make the right decision in the future.”

Students were very inquisitive and encouraged to ask questions.

IBDP Site Tour Course. Champaign, IL

2011-2015. 598 participants. 598 CEU's

Instructors: Sallie Greenberg, Robert Finley, Randy Locke, John Medler, Scott Marsteller, Scott McDonald, Tom Stone, Dave Morris, Jim Kirksey, and others

In response to outside interest in the Illinois Basin – Decatur Project, a customizable workshop providing knowledge-sharing opportunities for scientists, project developers, graduate students, and other interested parties was developed. This course qualifies for 1 CEU from the University of Illinois. In addition to printed materials regarding the project, attendees are given one-on-one time to engage with Illinois Basin – Decatur Project leaders and personnel during an interactive presentation and demonstration as part of a field site visit; and an in-depth discussion and question/answer session. Course content includes communication and outreach, real-time data acquisition system demonstration; MVA field studies (soil flux, water sampling, eddy covariance, groundwater wells), verification well operations (drilling, operation), compression/dehydration facilities, pipeline & well design. The course is designed so attendees take away a clear understanding of all aspects of a working carbon capture and sequestration site. Course instructors include Dr. Robert Finely, Dr. Sallie Greenberg, and Randy Locke from the Illinois State Geologic Survey; John Medler and Scott Marsteller from Schlumberger Carbon Services, and Tom Stone and Scott McDonald from Archer Daniels Midland. During the STEP contract period this course has been offered 21 times to 598 people from 28 countries.

Randy Locke speaking to attendees.

Visiting delegation from China.

IBDP Site Tour Dates:

September 14, 2010	*25 participants*
March 23, 2011	*3 participants*
May 18, 2011	*4 participants*
July 17, 2011	*56 participants*
November 9, 2011	*123 participants*
November 13, 2011	*12 participants*
March 8, 2012	*8 participants*
April 27, 2012	*1 participants*
June 5, 2012	*13 participants*
September 19, 2012	*120 participants*
January 24, 2013	*8 participants*
February 22, 2013	*2 participants*
April 22, 2013	*10 participants*
May 17, 2013	*2 participants*
October 9, 2013	*104 participants*
October 2, 2014	*11 participants*
November 5, 2014	*75 participants*
February 12, 2015	*6 participants*
April 27, 2015	*3 participants*
June 4, 2015	*2 participants*
June 12, 2015	*10 participants*


Attendees visiting the MVA trailer.


Dave Morris explaining core samples.

Midwest Carbon Sequestration Science Conferences and STEP Developed Workshops

Each year the MGSC hosts a meeting for the Project Advisory Group (PAG). The PAG is comprised of more than 40 government, industry, and environmental organizations and provide valuable input and review of MGSC activities and research. STEP used the annual PAG meeting as a platform to develop a full scientific conference on CCS and opened registration to a global audience. These meetings took place in 2011, 2012, 2013, and 2014. In general, the meetings provided a full day of IBDP research presentations covering all aspects of the MGSC research activities. These presentations were supplemented with STEP developed workshops to meet the needs of an expanded audience. (Copies of conference programs are included in the addendum.)

2011 Midwest Carbon Sequestration Science Conference, November 7-9, 2011, Champaign, IL.
123 participants. 209 CEU's awarded
Instructors: Robert Finley, John Tombari, John Litynski, Sallie Greenberg, Ken Hnottavange-Telleen, Hannes Leetaru, Marcia Coulsealan, Randy Locke, Bryan Robinson, Ray McKaskle, Bracken Wimmer, Dwight Peters, Scott Frailey, Ozgur Senel, Ed Mehnert, Donald Lee, and Curtis Oldenburg

This program included a full day of IBDP research presentations covering all aspects of the MGSC Phase III research activities; a STEP developed workshop on UIC Class VI regulations; and a site visit to the IBDP. An opening plenary talk was provided by John Tombari of Schlumberger Carbon Services and framed the global CCS context while bringing focus to success at the project level. Dr. Robert Finley presented a project overview followed by individual technical presentations.

Technical Program

CCS: Think Global, Act Local - John Tombari , Schlumberger Carbon Services

US Department of Energy Program Overview - John Litynski, US DOE

IBDP Overview and Project Organization – Robert Finley, ISGS

Managing CCS Projects Through Integrative Components – Sallie Greenberg, ISGS

Project Integration and Risk Assessment: Parasitic, Entangled, or Symbiotic? – Ken Hnottavange – Telleen, Schlumberger Carbon Services

Illinois Basin – Decatur Project Subsurface Geoscience Program: An Anatomy of a Reservoir - Hannes Leetaru, ISGS

Illinois Basin – Decatur Project Seismic Program: Success in the Face of Adversity - Marcia Couselan, Schlumberger Carbon Services.

Characterizing Brine Quality for the Illinois Basin – Decatur Project – Randall Locke, ISGS

Use of the Westbay System for Multilevel Reservoir Monitoring at the IBDP Carbon Capture and Storage Site – Bryan Robinson, Schlumberger Water Services

Development of Surface Facilities: An In-Depth View of Compression/Dehydration at IBDP – Ray McKaskle, Trimeric Corp

Establishing Baseline Conditions of Shallow Groundwater Quality at the IBDP – Bracken Wimmer, ISGS

Integrated Modeling of CO_2 in the CCS Process – Dwight Peters, Schlumberger Carbon Services

Geologic and Reservoir Characterization and Modeling – Scott Frailey, ISGS

CO_2 Injection in a Saline Formation: Pre-injection Reservoir Modeling and Uncertainty Study for Illinois Basin – Decatur Project – Ozgur Senel, Schlumberger Carbon Services

Basin-Scale Modeling of CO_2 Sequestration in the Mount Simon Sandstone of the Illinois Basin – Status Report – Ed Mehnert, ISGS

Geomechanics for the Illinois Basin – Decatur Project Mt. Simon Injection – Donald Lee, Schlumberger

Modeling Atmospheric Dispersion of CO_2 for Pipeline Leakage Risk Assessment, Curtis Oldenburg, Lawrence Berkeley National Laboratory

Future Directions: Industrial Sources, Robert Finley, ISGS

Question and answer sessions followed each presentation and were continued throughout the evening program. Technical presentations were supplemented by poster presentations at the evening event. In addition to the full day of IBDP presentations, participants were given the option of attending a STEP developed workshop on UIC Class VI regulations.

Class VI Workshop, Champaign, Illinois, November 7, 2011.

57 participants.

Instructors: Sallie Greenberg and Jeff Turner

This workshop was developed to introduce and educate project developers, industry leaders, and regulators to the newly developed Underground Injection Control Class VI regulations specific to permitting wells for geologic storage of carbon dioxide. This course focused on the educational needs of the project developers with specific attention paid to gaining greater understanding of the new regulations, geologic and engineering technical challenges, and permit application development. In addition, a review of guidance documents was provided. Other topics included the current state of knowledge about tools used for gaining geologic knowledge of the subsurface and creating models for area of review.

2012 Midwest Carbon Sequestration Science Conference, September 17, 2012.

120 participants. 204 CEU's awarded

Instructors: Robert Finley, John Tombari, John Litynski, Scott Frailey, Randy Locke, Giacomo Falorni, Ahsan Slvi, Ray McKaslke, Jared Frieburg, Marcia Couselan, Bob Will, Ed Mehnert, Ozgur Senel, and Dwight Peters

This program included a full day of IBDP research presentations covering all aspects of the MGSC Phase III research activities and a STEP developed workshop on global developments in CCS; a general poster session; and a site visit to the IBDP.

John Tombari from Schlumberger Carbon Services provided the opening plenary talk for the conference and framed the global CCS context while reminding the audience that long term success for CCS must focus on storage. Dr. Robert Finley presented a project overview followed by individual technical talks. The day closed with a presentation on adapting IBDP lessons to project development.

Technical Program

Opening Remarks, Robert Finley

Keynote, John Tombari, Schlumberger Carbon Services

US Department of Energy Program Overview, John Litynski

IBDP Overview and Project Organization, Robert Finley, ISGS

Enhanced Oil Recovery in the Illinois Basin: Phase II Results, Scott Frailey, ISGS

Monitoring, Verification, and Accounting - Near Surface and Surface, Randy Locke, ISGS

Satellite Interferometry Results, Giacomo Falorni, TRE Canada Inc.

Monitoring, Verification, and Accounting – Deep Subsurface, Schlumberger Carbon Services

RTAC – responses, uses, interpretations, project management through integrated data system, Ahsan Alvi, Schlumberger Carbon Services

Optimization of Surface Facilities: In-Depth View of Compression/Dehydration and Dehydration at IBDP, Ray McKaskle, Trimeric Corporation

Rock Petrophyics, Jared Freiburg, ISGS

Geophysics: Repeat 3-D Seismic Results, Marcia Couselan, Schlumberger Carbon Services

Geophysics: Microseismic Results, Bob Will, Schlumberger Carbon Services

Basin-Scale Modeling, Ed Mehnert, ISGS

Integrated Project Modeling, Ozgur Senel, Schlumberger Carbon Services

Implementation Discussion: Adapting IBDP Lessons to Project Development, Dwight Peters, Schlumberger Carbon Services

Global Developments in Carbon Capture and Storage, Champaign, Illinois

September 17, 2012. 70 Participants.

Instructors: Tony Booer, Martin Streibel, Brendan Beck, Cheol Huh, Zheng Chang, Richard Aldous, and Sallie Greenberg.

In recognition of the regulatory, social and economic issues which continue to impact the development of CCS technologies worldwide, STEP developed a workshop to give meeting attendees the opportunity to explore the CCS developments from six countries on four continents. Attendees heard firsthand accounts of ongoing and planned CCS projects as well as the unique issues and challenges faced in these respective countries. Participants gained insight into global project development including site selection, operations, regulatory frameworks, community engagement, and monitoring. Presenters discussed specific challenges and share lessons learned. A panel discussion allowed participants to leverage these global experiences for future developments. Speakers included: Tony Booer, UK; Martin Streibel, Germany; Brendan Beck, South Africa; Cheol Huh, Korea; and Zheng Chang, China.

2013 Midwest Carbon Sequestration Science Conference, October 7-9, 2013

104 Attendees. 177 CEU's.

Instructors: Robert Finley, Darin Damiani, Jared Freiburg, John McBride, Bob Bauer, Dianna Shelander, Valerie Smith, Marchia Coulsean, Michael Carney, Scott McDonald, Bob Wills, Ed Mehnert, Dwight Peters.

This conference showcased current research by the IBDP project team and was organized around three main themes: Reservoir and Basin Framework, Integrated Insights, and Increased Storage Scale. Each session featured in-depth scientific presentations and closed with an interactive panel discussion with Q&A. Also included in the conference was a STEP developed "Financial Assurance 101 Workshop". The conference also included a guided field trip to the IBDP project site at the Archer Daniels Midland (ADM) Company in Decatur.

At the well site, participants viewed real-time well data from the RTAC* real-time acquisition and control software system; were taken to the verification well to view on-going MVA activities; and were taken to the compression and dehydration facilities within the ADM complex.

Technical Program

Introductory Comments and Review:

Opening Remarks, Robert Finley, ISGS

US Department of Energy Program Overview, Darin Damiani

Project Progress and the Year in Review, Robert Finley, ISGS

Reservoir and Basin Framework:

Reservoir and Seal Sedimentologic Insights, Jared Freiburg, ISGS

Illinois Basin Basement and Structure, John McBride,

Review of Illinois and Indiana Seismicity, Bob Bauer, ISGS

3D Seismic at Decatur Revisited, Dianna Shelander, Schlumberger Carbon Services

Discussion: Expanding Site Characterization (led by Robert Finley, ISGS)

Integrated Insights:

History of Microseismic Events at IBDP, Valerie Smith, Schlumberger Carbon Services

Plume Monitoring through VSPs, Marcia Couselan, Schlumberger Carbon Services

Discussion: Assessing the Response to Plume and Pressure (led by Michael Carney, Schlumberger Carbon Services)

Increased Storage Scale:

A Second Project Takes Shape, Scott McDonald, Archer Daniels Midland

Reservoir Engineering Update, Bob Wills, Schlumberger Carbon Services

Basin-Scale Modeling of Large Injected Volumes, Ed Mehnert, ISGS

Discussion: Moving Upward from Demonstration-Scale (led by Dwight Peters, Schlumberger Carbon Services)

Financial Assurance – Champaign, Illinois

October 7, 2013. 40 Participants.

Instructor: Chiara Trabucchi, Larry Bengal, and Dwight Peters

This STEP workshop provided an overview of financial assurance with specific focus on the regulations underpinning the UIC Class VI well operator. STEP sub-contractor, Ms. Chiara Trabucchi from Industrial Economics, Inc. led the workshop. The elements of this workshop included: financial assurance terms and concepts; discussion of the current financial assurance framework for Class VI wells, with focus on the mix of regulatory requirements under 40 CFR 146.85 and recommendations proffered by EPA's July 2011 FR guidance document; overview of the six financial instruments allowed under 40 CFR 146.85; and discussion of financial assurance requirements by geological sequestration phases. The workshop concluded with a panel discussion featuring financial, technical, and industry perspectives on issues related to pre-operational, operational, and post-operational liabilities in the geologic storage of carbon dioxide. Mr. Larry Bengal, Director of the Arkansas Oil and Gas Commission, led the panel discussion with a brief presentation on the work being conducted by the Interstate Oil and Gas Compact Commission's (IOGCC) Carbon Geologic Task Force on liability related to CCS. Co- panelists included Ms. Chiara Trabucchi and Mr. Dwight Peters, Schlumberger Carbon Services.

Sallie Greenberg introducing Chiara Trabucchi

2014 Midwest Carbon Sequestration Science Conference, Champaign, IL

November 5-6, 2014. 75 attendees. 83 CEU's.

Instructors: Darin Damiani, Robert Finley, Sallie Greenberg, Abbas Iranmanesh, Bob Will, Jared Freiburg, Bob Bauer, and Dwight Peters.

This conference featured a full day of technical presentations focused on the impact of three years of CO_2 injection at the IBDP; an expanded poster session and a field trip to the IBDP.

Technical Program:

DOE Overview, Darin Damiani

Impacts of three years of CO_2 injections, Robert Finley, ISGS

Permitting at IBDP, Sallie Greenberg, ISGS

Ground Water: Pre-injection and Injection Results, Abbas Iranmanesh, ISGS

Results From the IBDP Geophysics Program, Bob Will, Schlumberger Carbon Services

Understanding the Mt. Simon Reservoir Constraints, Hannes Leetaru, Jared Freiburg, ISGS

Micro-seismic Monitoring at IBDP, Bob Bauer, ISGS

Setting the Stage for Future: What Comes Next, Robert Finley, ISGS

Facilitated Discussion and/or Presentation by Schlumberger, Dwight Peters

Midwest Carbon Sequestration Science Conference Attendee Comments:

"Well executed and informative meeting."

"Excellent organization and time keeping of talks. Excellent balance between talks and networking time. Very enjoyable and worthwhile overall."

"Continue the great work.""

Principles of Geologic Carbon Sequestration, Long Beach, CA.

April 21, 2012. 27 participants.

Instructors: Hannes E. Leetaru, Scott Frailey, Sallie Greenberg, Marcia L. Couëslan, and Mike Bruno

(Developed as a short course for the American Association of Petroleum Geologists, AAPG)

This short course was developed to introduce and educate petroleum geologists to the basics of site selection and characterization for carbon sequestration projects. The course discussed the importance of different types of geophysical and geologic well control for initial site selection and later monitoring and verification of the CO_2 plume with a focus on deep saline reservoir sequestration. In addition, the workshop showed how enhanced oil recovery is intimately involved with the business of carbon sequestration.

Topics discussed will included the process of site selection, site characterization, reservoir modeling, geophysical monitoring and verification, permitting and outreach.

Workshop elements:

•Sequestration: an emerging industry

•Site selection and reservoir characterization

•CO_2 trapping mechanisms and caprock considerations

•CO_2 plume migration (reservoir modeling)

•CO_2 enhanced oil recovery and CO_2 storage

•Application and development of tools for sequestration projects

•Geophysical and subsurface well monitoring

•Verification of the CO_2 plume

•Saline reservoir sequestration

•Regulatory framework and the new class VI U.S. EPA rules

•Effective communication and outreach

•California sequestration project update

Keystone Workshop

CSI: Climate Status Investigation, Decatur, IL

September 29-30, 2011. 22 participants. 297 CPDU's

Instructors: Wendi Liles, Larry Jozwik, Carol Carroll, Sallie Greenberg, Rebecca Adwell, and Kathy Atchley

On September 29-30, 2011, STEP organized and hosted a Keystone Center (Keystone) climate workshop for 22 Illinois teachers in Decatur, IL. Keystone is a non-profit 501(c)(3) organization based in Keystone, Colorado, which strives to foster critical thinking and problem-solving through education, analysis, and dialogue with all segments of civil society. Keystone accomplishes its mission through its three centers of excellence: Science and Public Policy, Center for Education, and Keystone Science School. Together, they teach people of all ages, from all over the world, how to review critical information, find common ground among diverse interests, and use scientific reasoning and processes. (Visit www.keystone.org for more information.)

Sallie Greenberg presenting at the climate workshop

The Keystone Center partnered with the Department of Energy - National Energy Technology Laboratory to develop interdisciplinary middle school and high school curricula designed to explore the issue of global climate change. Both curricula lead students through an exploration of the various economic, environmental, and social factors at play in the climate change debate. Keystone designed a national teacher professional development Institute, CSI: Climate Status Investigations (CSI), to provide middle and high school educators with the skills and confidence to investigate the issue of global climate change with their students.

Science teachers from Illinois were recruited by e-mail (direct e-mail and through the STEP Newsletter). Teachers who attend the CSI workshop learn hands-on, inquiry-based lessons that explore the science of global climate change, the primary sources of greenhouse gases, and potential responses, ranging from adaptation to terrestrial and geologic sequestration. By providing a non-advocacy, non-biased scientific framework to teachers to examine the issues around global climate change, the curriculum is intended to improve the decision-making abilities of students.


Teachers building a carbon dioxide generator

Instructors: Wendi Liles-Program Director, Keystone Center for Education, Larry Jozwik-Facilitator, Keystone Center for Education, Carol Carroll-Facilitator, Keystone Center for Education, Sallie Greenberg, STEP Director, Rebecca Adwell, STEP Education Consultant, Kathy Atchley, Sequestration Technology Training Specialist

Continuing Education Units:

The University of Illinois Office of Continuing Education approved this course for 13.5 Continuing Professional Development Units (CPDU's). As proof of participation, attendees were required to sign in each day and the sheet was given to the University of Illinois. Each participant was given a certificate of completion from the University of Illinois to be used for official registration of the CPDU's. A total of 297 CPDU's were given at this course.

Materials:

- All course attendees received from the Keystone Center:
    - a 2 inch binder/workbook with detailed lesson plans and experiments,
    - a CD on World Population, and
    - a book by Peter Menzel titled "Material World. A Global Family Portrait".
- All course attendees received from STEP:
    - a STEP flash drive containing resources and materials to help incorporate activities into the classroom,
    - a book titled "Clean Sky, the Global Warming Story"
    - the MGSC three classroom posters on CCS, and
    - a teacher's kit for conducting EOR CCS experiments.

    - Kits were packaged in boxes with STEP Sequestration Lab Supplies labels and contained: three 200 ml flasks, two 2-holed stoppers, flexible tubing, 5g of phenol red, a bag of marbles, two 12 ml syringes, a micro spoon, one piece of rigid tubing, plastic beaker. (Note: teachers were very complimentary about receiving supplies/materials to conduct the activities with their classes)
- Several teaching aids were also given as raffle prizes at various times throughout the 2 day period (thermometer, extra flasks and various teaching aids) .
- STEP Certificates of completion were mailed to participants at the conclusion of the conference.
- A full set of the course materials and handouts is available in the STEP office.

Course Evaluation & Attendee Comments:

- The Keystone Center asked attendees to complete an evaluation after each session. Participants rated 98% of the lessons as above average or outstanding.
- 22 attendees (of 22 participants) completed and returned the survey.
- Responses were overwhelmingly positive.
- 100% of respondents stated the program increased their knowledge and skills.

"The lessons were amazing! The presenters were excellent! Everything was extremely organized."

"All of the resources were ready to use- binder, web links, equipment, etc. AND the schedule was timely and organized."

"Hands-on activities that are simple and cheap to implement. Talking to experienced teachers, scientists, web developers gave us first-hand knowledge of the background and issues involved. We learned how, why, and what next."

"This is the best workshop I have ever taken in 30 years! No time was wasted – very knowledgeable presenters with very useful and inexpensive lessons. Thank you! This was great!"

Guest Lecturer Series

STEP developed a lecture series to highlight high level geoscience experts who visitor the University of Illinois and the MGSC. The STEP Guest Lecturer Series was an opportunity to capitalize on the widespread interest in the IBDP. The MGSC attract exceptionally high caliber researchers who are selectively invited to present lectures on topics related to carbon capture, storage and utilization to staff and visitors at the Illinois State Geological Survey. The first Guest Lecture was held in January of 2012. Since that time we have hosted seven world-renowned researchers and served 244 people (Figure 11).

Date	Presenter	Title	Attendance
Jan. 13, 2012	Dr. Matthias Raab, CO2CRC, Australia	Carbon Storage at the Otway Project	30 people
February 17, 2012	Dr. Terry Engelder, Penn State University	Organic Black Shales – Reservoirs or Seals	55 people
July 25, 2012	Dr. Satya Harpalani, Southern Illinois University	Understanding/Modeling coalbed Methane Production Trends	30 people
April 11, 2014	Dr. Georg Grathoff, University of Greifswald, Germany	New Insights Into Shale Research from Slice & View FIB-SEM Microscopy	32 people
July 11, 2014	Dr. Martin Streibel, German Research Centre for Geosciences	The Ketzin Pilot Site for CO_2 Storage in a Nut Shell	30 people
March 5, 2015	Dr. Steve Whittaker, CSIRO, Australia	Carbon Storage Down Under	42 people
June 4, 2015	Dr. Xiaochun Li, Chinese Academy of Sciences	CO_2 Geological Utilization and Storage in China: Potential and Status	25 people

Figure 11. Presenters at STEP Guest Lecturer Series

Dr. Matthias Raab presenting at the ISGS

STEP Presentations Worldwide

STEP is internationally recognized organization, known for providing excellent instruction and information on CCS. STEP instructors, primarily Sallie Greenberg, Robert Finley and others, were often invited to give presentations domestically and internationally. Over the course of this grant there were 140 technical presentations in 12 states and 13 countries reaching over 28,000 people. (NOTE: No contract funds were used for international travel.)

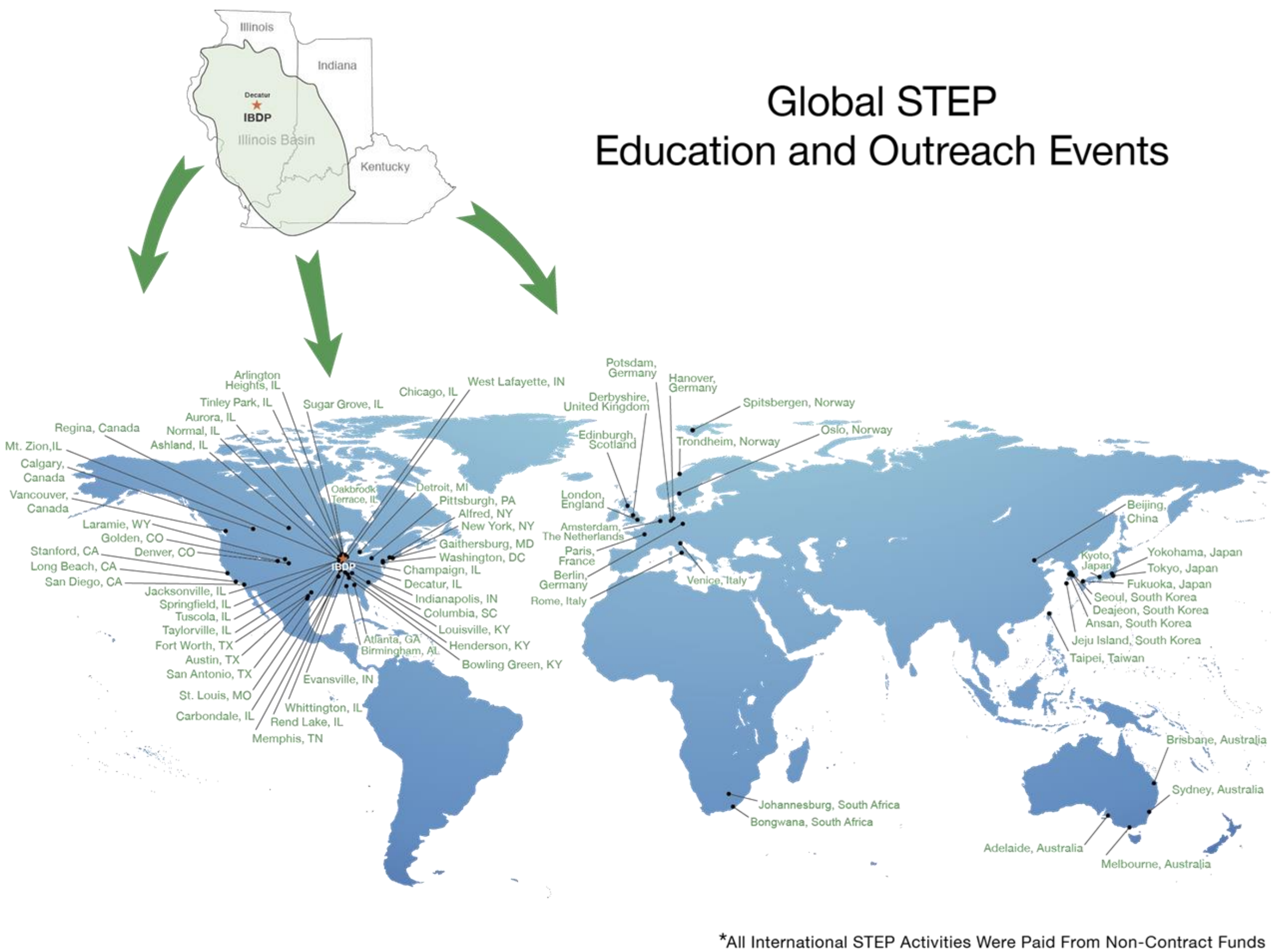


Figure 12. Locations for STEP presentations world-wide.

Community Outreach, Knowledge Sharing and Capacity Building

In addition to STEP developed programs, STEP personnel were actively engaged in community outreach, knowledge sharing, and capacity building by participating as a speaker or exhibitor at CCS events hosted by other organizations. Presentations included academic institutions, scientific conferences, public meetings, research institutions, and governmental agencies.

Public awareness of climate change and energy-related issues continues to increase. This creates an opportunity to discuss and present new or improved energy solutions including geologic sequestration. Attending public meetings, presenting at conferences, participating in exhibits, addressing students and teachers, and meeting with governmental and industry representatives proved to be an effective way to inform and educate people on geologic sequestration. STEP personnel participated in a variety of engagement opportunities and used many different instructional tools to serve individual audiences (includes posters, brochures, fact sheets, energy activity sets, rock samples, demonstrations of the geologic sequestration model and/or powerpoint presentations).

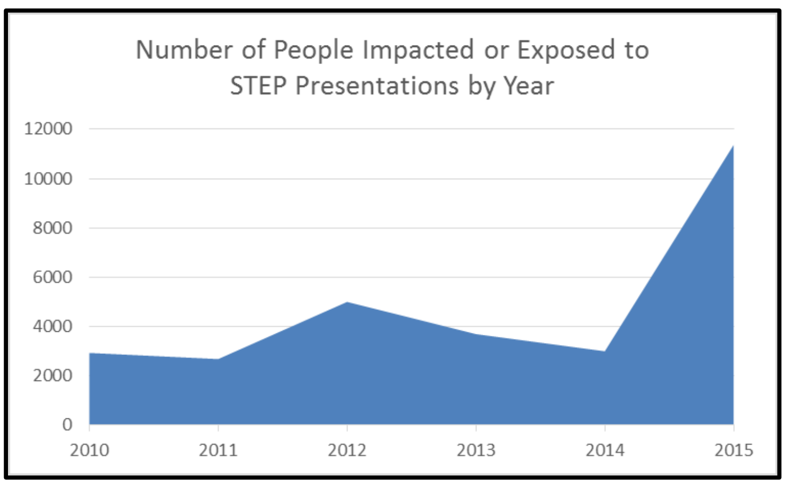


Figure 12. STEP reached over 28,000 people from 2010-2015

The following pages include a listing of all STEP presentations (developed or invited) from 2010-2015.

Presentation/Event	Location	Date	Attendance
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	12-Jun-15	10
STEP DEVELOPED: Guest Lecture, Xiaochun Li	Champaign, IL	4-Jun-15	25
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	4-Jun-15	2
CO2GEONET	Venice, Italy	13-May-15	300
Indiana Geological Survey/Indiana University	Bloomington, IN	15-Apr-15	30
2015 Naturally Illinois Expo	Champaign, IL	17-Apr-15	1200
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	27-Apr-15	3
SECARB Stakeholder Briefing	Atlanta, GA	12-Mar-15	100
National Science Teachers Association Meeting	Chicago, IL	12-Mar-15	9,500
Prairie Council Boy Scouts Merit Badge Seminar	Champaign, IL	7-Mar-15	40
STEP DEVELOPED: Guest Lecture, Steve Whittaker	Champaign, IL	5-Mar-15	42
KIOST	Seoul, Korea	23-Feb-15	10
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	12-Feb-15	5
Fourth Annual Americas Forum: Call to action on CCUS policy and deployment	Washington, DC	5-Feb-15	100
STEP DEVELOPED: 2014 Midwest Carbon Sequestration Science Conference	Champaign, IL	5-Nov-14	75
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	2-Nov-14	75
Chicago Park District Fall Adventure Day	Chicago, IL	11-Oct-14	100
GHGT 12 Conference	Austin, Texas	5-Oct-14	1600
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	2-Oct-14	11
South African Centre for Carbon Capture and Storage (SACCS) Workshop	Bongwana, South Africa	9-Sep-14	50
STEP DEVELOPED: GEOL 315, Energy, Climate and Carbon, WKY	Bolling Green, KY	1-Sep-14	15
CCS in Action, Today, Tomorrow and Beyond Conference	Sydney Australia	31-Aug-14	100
DOE Carbon Storage R&D Project Review Meeting	Pittsburgh, PA	12-Aug-14	187
International Workshop on Public Education, Training, and Community Outreach for Carbon Capture, Utilization, and Storage	Decatur, IL	30-Jul-14	50
STEP DEVELOPED: Guest Lecture, Martin Streibel	Champaign, IL	11-Jul-14	30
Workshop on Pre-feasibility Study of Large Scale CCUS Demonstration Project,	Beijing, China	8-Jul-14	100
Stanford Center for Carbon Storage Annual Meeting	Stanford, CA	22-May-14	25
CSIRO	Brisbane, Australia	5-May-14	15

Presentation/Event	Location	Date	Attendance
University of Melbourne, School of Earth Sciences	Melbourne, Australia	2-May-14	30
Univeristy of Adelaide, Geology Department	Adelaide, Australia	29-Apr-14	30
3rd International Low Rank Coal Industry Symposium	Melbourne, Australia	28-Apr-14	100
STEP DEVELOPED: Guest Lecture, Georg Grathoff	Champaign, IL	11-Apr-14	30
Energy Council of Illinois Chamber of Commerce	Springfield, IL	24-Mar-14	20
Illinois Community Environmental Council	Decatur, IL	6-Mar-14	20
Prairie Council Boy Scouts Merit Badge Seminar	Champaign, IL	1-Mar-14	40
4th Korea CCS International Congress	Jeju Island, Korea	24-Feb-14	250
IEAGHG Social Research Network Meeting	Calgary, AB, Canada	14-Jan-14	43
Mid-term Meeting of the Korean Institute of Ocean Science and Technology	Seoul, Korea	19-Nov-13	50
Geological Society of America Annual Meeting	Denver, CO	27-Oct-13	25
SUCCESS Centre Workshop, University of Oslo	Oslo, Norway	24-Oct-13	20
Illinois Science Teachers Association Meeting & Expo	Tinley Park, IL	24-Oct-13	150
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	9-Oct-13	104
STEP DEVELOPED: 2013 Midwest Carbon Sequestration Science Conference	Champaign, IL	8-Oct-13	104
STEP DEVELOPED: Financial Assurance Workshop	Champaign, IL	7-Oct-13	40
Department of Thermal Engineering, Tsinghua University	Beijing, China	Sep-13	35
DOE Carbon Storage R&D Project Review Meeting	Pittsburgh, PA	21-Aug-13	191
Enhanced Oil Recovery Institute (EORI)	Laramie, Wyoming	2-Jul-13	20
STEP DEVELOPED: Teacher Professional Development Workshop	Laramie, Wyoming	1-Jul-13	23
RECS Program	Birmingham, Alabama	25-Jun-13	50
IEA International CCS Regulatory Meeting	Paris, France	18-Jun-13	100
2013 DCEO Coal Education Conference	Whittington, IL	18-Jun-13	94
IEAGHG Modeling and Risk Networking	Trondheim, Norway	10-Jun-13	20
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	17-May-13	2
US Canada Clean Energy Dialogue	Champaign, IL	23-Apr-13	25
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	22-Apr-13	10
CO2GeoNet Open Forum	Venice, Italy	9-Apr-13	150
Robeson School Science Night	Champaign, IL	27-Mar-13	250

Presentation/Event	Location	Date	Attendance
Junior Professional CCS Legal and Regulatory Tutorial Group	WEBINAR	10-Mar-13	15
2013 Naturally Illinois Expo	Champaign, IL	8-Mar-13	2000
AAPG GeoScience Technology Workshop	Fort Worth, TX	25-Feb-13	40
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	22-Feb-13	2
Western Kentucky University, Geology Department Seminar	Bowling Green, KY,	15-Feb-13	25
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	24-Jan-13	8
Research Institute of Innovative Technology for the Earth (RITE)	Tokyo, Japan	22-Jan-13	137
2012 Taiwan Symposium on CO_2 CCUS	Taipei, Taiwan	25-Nov-12	250
GHGT - 11 Conference	Kyoto, Japan	18-Nov-12	1250
Illinois Science Teachers Association Meeting & Expo	Springfield, IL	1-Nov-12	400
Prairie Research Institute Lighting Mini-Symposium	Champaign, IL	20-Sep-12	150
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	19-Sep-12	120
STEP DEVELOPED: 2012 Midwest Carbon Sequestration Science Conference	Champaign, IL	18-Sep-12	122
STEP DEVELOPED: Global Developments in CCS	Champaign, IL	17-Sep-12	70
DOE: Developing the Technologies and Building the Infrastructure of CCUS	Pittsburgh, PA	21-Aug-12	200
STEP DEVELOPED: Guest Lecture, Satya Harpalani	Champaign, IL	25-Jul-12	30
2012 DCEO Coal Education Conference	Whittington, IL	19-Jun-12	95
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	5-Jun-12	13
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	27-Apr-12	1
STEP CO-SPONSORED: Principles of Geologic Carbon Sequestration, AAPG short course	Long Beach, CA,	21-Apr-12	27
National Association for Research in Science Teaching Meeting	Indianapolis, Indiana	27-Mar-12	25
2nd Korea CCS Conference	Jeju, Republic of Korea	15-Mar-12	350
Naturally Illinois Expo	Champaign, IL	9-Mar-12	1500
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	8-Mar-12	8
AAAS Annual Meeting	Vancouver, BC, Canada	20-Feb-12	40
STEP DEVELOPED: Guest Lecture, Terry Engelder	Champaign, IL	17-Feb-12	55
Decatur Science Day	Decatur, IL	14-Feb-12	55
Jonan High School	Fukuoka, Japan	1-Feb-12	150

Presentation/Event	Location	Date	Attendance
Korean Ocean Research & Development Institute	Daejeon, Republic of Korea	27-Jan-12	25
Korean Ocean Research & Development Institute	Daejeon, Republic of Korea	26-Jan-12	25
Illinois Legislator Briefing	Washington, DC	18-Jan-12	5
STEP DEVELOPED: Guest Lecture, Matthias Raab	Champaign, IL	13-Jan-12	30
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	12-Jan-12	1
DOE Carbon Storage Program Infastructure Annual Review Meeting	Pittsburgh, PA	15-Nov-11	186
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	13-Nov-11	12
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	11-Nov-11	3
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	9-Nov-11	123
STEP DEVELOPED: Class VI Workshop	Champaign, IL	7-Nov-11	57
STEP DEVELOPED: 2011 Midwest Carbon Sequestration Science Conference	Champaign, IL	7-Nov-11	123
2nd South African CCS Week	Johannesburg, South Africa	24-Oct-11	65
STEP SPONSORED: CSI Climate Status Investigation (Keystone)	Decatur, IL	29-Sep-11	22
STEP DEVELOPED: EPA Wireline Training	Chicago, IL	1-Aug-11	12
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	23-Jul-11	85
STEP SPONSORED: 2011 IEAGHG Summer School	Champaign, IL	17-Jul-11	53
STEP DEVELOPED: Evaluating Reservoir Quality, Seal Potential and Net Pay Short Course	Champaign, IL	14-Jul-11	19
2011 DCEO Coal Education Conference	Whittington, IL	16-Jun-11	100
FutureGen Public Scoping Meeting	Jacksonville, IL	9-Jun-11	200
FutureGen Public Scoping Meeting	Tuscola, IL	8-Jun-11	35
FutureGen Public Scoping Meeting	Taylorville, IL	7-Jun-11	15
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	18-May-11	4
STEP CO-SPONSORED WEBINAR - Society of Petroleum Engineers	Webinar	16-May-11	178
Cass-Morgan County Farm Bureau Meeting	Ashland, IL	26-Apr-11	60
MacMurray College	Jacksonville, IL	19-Apr-11	15
University of Illinois, Geology 380 Class	Champaign, IL	18-Apr-11	27
FutureGen Public Meeting	Jacksonville, IL	30-Mar-11	14

Presentation/Event	Location	Date	Attendance
STEP CO-SPONSORED WORKSHOP: Effective Communication, Project Planning and Management Strategies for CCS Projects.	Washington, DC	17-Mar-11	5
Naturally Illinois Expo	Champaign, IL	12-Mar-11	1100
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	1-Mar-11	3
Carbon-Neutral Energy Research (I2CNER)	Fukuoka, Japan	1-Feb-11	75
STEP SPONSORED EVENT: Introduction to Geology - Junior Geologists	Mt. Zion, IL	25-Jan-11	25
FutureGen Public Meeting	Vandalia, IL	14-Jan-11	19
FutureGen Public Meeting	Tuscola, IL	13-Jan-11	22
FutureGen Public Meeting	Alexander, IL	12-Jan-11	20
FutureGen Public Meeting	Jacksonville, IL	6-Dec-10	90
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	9-Nov-10	2
Council of Energy Research & Education Leaders (CEREL) Conference	Golden, CO,	4-Nov-10	75
FutureGen Public Meeting	Springfield, IL	28-Oct-10	20
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	27-Oct-10	1
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	22-Oct-10	3
DOE-NETL Regional Carbon Sequestration Partnerships Annual Review Meeting	Pittsburgh, PA	5-Oct-10	90
GHGT-10 Conference	Amsterdam, The Netherlands	19-Sep-10	2000
2010 MGSC PAG Meeting	Champaign, IL	14-Sep-10	40
The STEP Illinois Basin - Decatur Project Site Visit Course	Decatur, IL	14-Sep-10	25
2010 IEAGHG Summer School	Svalbard, Norway	22-Aug-10	86
UK CCSC Academic Research Strategy Meeting	Edinburgh, Scotland	4-Jul-10	75
2010 DCEO Coal Education Conference	Rend Lake, IL	17-Jun-10	110
Taylorville Energy Center	Taylorville, IL	27-May-10	35
Illinois Academy of Sciences Annual Meeting	Decatur, IL	10-Apr-10	100
Waubonsee Community College	Sugar Grove, IL	8-Apr-10	25
University of Illinois, Geology Class	Champaign, IL	5-Apr-10	50
Purdue University, Geology Class	West Layfatte, IN	30-Mar-10	50
University of Illinois , Geology Class	Champaign, IL	22-Feb-10	50

Higher Education-oriented event summary

An important element of capacity building is looking at students at institutions of higher learning. STEP recognized the importance of reaching out to the next generation of scientists who may hold the key for solving global energy problems. In addition to the IEAGHG Summer School, STEP has made presentations to over 500 students at 15 academic institutions around the world, developed a college level energy course, developed a curriculum for middle school learners and offered a teacher training workshop.

Academic Presentations:

- Waubonsee Community College, April 2010, Aurora, IL
- University of Illinois, Champaign, IL, April 2010, April 2011, November 2012
- New Mexico Tech & University of Utah, November 2010
- Kyushu University, Fukuoka, Japan, February 2011
- Johan High School, Fukuoka, Japan, February 2012
- Western Kentucky University, February 2013, fall semester 2014
- University of Wyoming, July 2013
- Tsinghua University, Beijing, China, September 2013
- Seoul National University, Seoul, South Korea, November 2013
- University of Oslo, Oslo, Norway, October 2013
- Stanford University, May 2014
- University of Adelaide, Australia, April 2014
- University of Melbourne, Australia, May, 2014
- Richland Community College, March 2015
- Indiana University, April 2015

College Course - Geology 315 Energy, Climate and Carbon, Western Kentucky University

Fall 2014. 15 students.

Instructor: Fred Siewers

Dr. Fred Siewers, a geologist at Western Kentucky University, was issued a subcontract to assist with the development of capacity building workshops focused on CCS. (A copy of the sub-contract report is included in the addendum.) Most of the development team's work focused on a workshop for individuals and organizations interested in the details of CCS and the steps necessary to adequately identify, characterize and monitor a CCS site. During development, it was suggested that much of the material covered in the workshop could be used to develop a University level course for college students. Dr. Siewers developed this course on CCS entitled "Energy, Climate and Carbon" which was accepted by Western Kentucky University administrators as a class for the Fall 2014 semester. Eleven undergraduates and four graduate students took the class. Most undergraduate and graduate students were geology majors; one undergraduate student was pursuing a Bachelor of Interdisciplinary Studies; one graduate student was pursuing an MA in Social Responsibility and Sustainable Communities.

Purpose of the Course: Energy, Climate and Carbon examines our current reliance upon carbon-based sources of energy, the effect of fossil-fuel emissions on climate, and current efforts to limit fossil-fuel emissions and global climate change. The course is particularly focused on carbon-capture technologies and geological carbon sequestration. Laboratory work focused on real-world issues pertaining to site selection, permitting, and monitoring of carbon stored in subsurface settings.

Text Resources

Archer, David, 2011, Global Warming: Understanding the Forecast, 2nd Edition. John Wiley and Sons, Inc., p. 203.

Cook, Peter J., 2012, Clean Energy, Climate and Carbon. CRC Press/Balkema, Leiden, The Netherlands. p. 215.

Lynas, Mark, 2008, Six degrees: Our Future on a Hotter Planet. National Geographic Society, Washington DC. p. 335.

Outside Speakers:

Ms. Christian Ryan - WKU Sustainability Coordinator

KY State Representative Jim DeCesare on Kentucky Green Building Initiatives

Lecture Topics Included:

- The Carbon Cycle
- Energy Consumption

- Greenhouse Gases and Climate Forcings
- Global Warming Events in Earth History
- Societal Impacts of Global Warming
- International Climate Change Treaties
- Sources of Anthropogenic CO_2
- CCS and Geological Sequestration
- DOE Regional Sequestration Partnerships
- Fluid Injection, Hydraulic Fracturing, and Subsurface Monitoring
- The 2014 IPCC 5th Assessment
- Terrestrial Sequestration
- Nuclear Energy and Renewables

Supplementary Videos and Documentaries:

- Switch!
- Beyond the Light Switch
- PCOR 5-video Educational Series
- Gasland and Fracknation
- EERC CO_2 Goes Canadian (Weyburn CO_2-EOR Project)
- AMNH Science Bulletin: Storing CO_2 to Protect the Climate (Sleipner Project)
- Google Tech Talk: Carbon Dioxide Capture and Sequestration: Hype or Hope? (Sally Benson, Stanford, University)
- Pandora's Promise

Learning Outcomes: After the completion of Geol. 315, students were able to discuss:

- our current and changing energy landscape
- the carbon cycle and the flow of carbon through the Earth System
- climate forcings and the causes of global warming
- how CO_2 is sequestered in geological settings
- renewable energy and nuclear power
- the probable consequences of a warming world

Teaching Energy for a Sustainable Future

STEP Energy Curriculum and Teacher Professional Development (Pilot) Research, University of Wyoming.

July 1-3, 2013. 23 participants.

Instructors: Heath Brown, John Reinersten, Ana Housseal, Sarah Ramsey, and Sallie Greenberg

Recognizing that climate change and energy usage are confusing to most Americans, STEP contracted a team of educators from Decatur, Illinois and the University of Wyoming (UW) to assist in the development of a balanced energy education curriculum for middle level learners. (A copy of the subcontract report is included in the addendum.) The topic of energy literacy is only one of many that K-12 teachers must address, and yet, the essential principles and fundamental concepts span all science and several social science disciplines. Given that K-8 teachers generally do not hold post-secondary science degrees, it is a daunting task to get this topic into classrooms. Both effective curriculum and professional development for teachers are important to produce lasting results in the classroom.

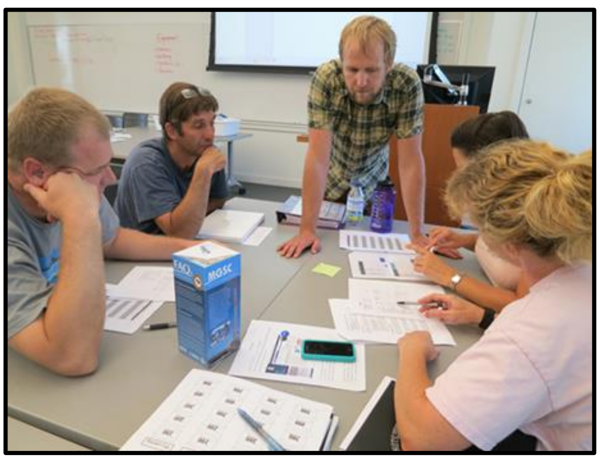
Teacher Professional Development Workshop

Professional Development for teachers is much more effective when developed and designed in such a way that teachers are experiencing the content and scientific processes in the same manner in which they will be expected to teach them. With this in mind, STEP partnered with the University of Wyoming to pilot test the curriculum with teachers enrolled in a Masters in Natural Science – Science and a Masters in Natural Science – Mathematics program. The Science and Mathematics Teaching Center (SMTC) at the University of Wyoming runs a program for these graduate students each summer. Most students were practicing teachers and when their course work is completed the program provides a middle level endorsement in either science or mathematics. The professional development workshop was offered, in the summer of 2013, as a part of the master's coursework.

The professional development workshop was held at the University of Wyoming, July 1-2, 2013. Twenty-three graduate students (who are also school teachers) participated in the interactive workshop to introduce and demonstrate the newly developed energy curriculum. Teachers became the students and were given the opportunity to experience the lessons/activities as their classroom students would. The teachers eagerly participated in the workshop and provided additional insights on how to best present the materials to middle-school learners. Participants received electronic copy of activities and some classroom supplies to reproduce the activities in their classrooms.

Professional Development Hours were not assigned for this workshop since teachers participated as part of their master's degree educational requirements.

Results from these pilot studies were used as a basis for a non-thesis manuscript for John Reinersten (Reinertsen, J. C. (2013). Uncovering 9th Grade Understandings of Energy via Concept Sketches: A Learning Tool for Students and Educators. Unpublished Master's of Science non-thesis manuscript, Science and Mathematics Teaching Center, University of Wyoming, Laramie, WY.); was presented at the International Workshop on Public Education, Training and community Outreach for Carbon Capture, Utilization and Storage, Decatur, IL, July 2014; was presented at the Illinois Science Teachers Association meeting, Tinley Park, IL, October 2013; and was presented at the 2013 Geological Survey of America (GSA), Denver, CO, October 2013.



Instructor Heath Brown helps teachers work through an activity from the energy curriculum

Energy Curriculum for Middle School Learners

An increased need for energy-based educational materials is emerging in order to meet Next Generation Science Standards (NGSS) and address a societal need for greater scientific understanding of energy and environmental issues. Energy issues are complex and most students and teachers bring many misconceptions to the classroom. Presenting energy in a balanced, scientific framework that makes connections between where energy comes from, how we use energy, and the impacts of energy use can help address pre-existing misconceptions.

The STEP energy curriculum was developed as supplemental curricular to address these misconceptions about the subsurface, engage students in experiences that built new knowledge, and provide a balanced perspective through structured reflection. The NGSS were used to help guide the curriculum development and each lesson is tied to the standards. Each activity set contains scientific content and a balance of perspectives and explores local as well as global issues within the complex energy landscape. The goal is to increase students understanding of energy-related issues while allowing them to become critical decision makers. The UW researchers both piloted the curriculum in several 9th grade classrooms in Wyoming during 2012-2013 school year and presented the lessons to Wyoming teachers at a professional development workshop for in-service teachers in July 2013.

The supplemental curricular, "STEP up to the Challenge: Exploring Energy Issues," contains four activity sets and 20 individual activities:

Activity Set 1: Exploring Energy Resources
Guiding Question: What is our relationship to energy?

- Pre-Assessment
- Activity 1- Lesson A: Energy Use in the United States
- Activity 1- Lesson B: Energy Resources Throughout Human History
- Activity 1- Lesson C: Electricity: An Energy Carrier
- Activity 1- Lesson D: Electricity Generation
- Activity 1- Lesson E: Plugged into CO_2
- Activity 1- Lesson F: Energy Flows: Trace it to the Source

Activity Set 2: Carbon Dioxide (CO_2) and Climate Change
Guiding Question: What is the link between CO_2 and temperature?

- Activity 2- Lesson G: The Carbon Cycle
- Activity 2- Lesson H: What is CO_2?
- Activity 2- Lesson I: The Greenhouse Effect
- Activity 2- Lesson J-1: Evaluating the Evidence of Climate Change
- Activity 2 Lesson J-2: Evaluating the Evidence of Climate Change: Addressing Misconceptions
- Activity 2 Lesson K: Examining Your Carbon Footprint: Human Impact Through Transportation

Activity Set 3: Exploring the Science of CCS as One Option in a Balanced Energy Portfolio

Guiding Question: How can new technologies help reduce the impact of increasing CO_2 levels in the atmosphere?

- Activity 3- Lesson L: What Is Under Your Feet: Basic Geology of the Illinois Basin
- Activity 3- Lesson M: Exploring Porosity and Permeability
- Activity 3- Lesson N: What Is CCS & EOR and How DO They Work?

Activity Set 4: Taking It to the Next STEP

Guiding Question: How can we become agents of change to address current and future energy issues?

- Activity 4- Lesson O: Starting Local: The Energy Saving Challenge
- Activity 4- Lesson P: Local Energy Debate
- Activity 4-Lesson Q: Energy Summit: Global Wedge Game
- Activity 4-Lesson R: Career Opportunities
- Activity 4-Lesson S: Science Fair Opportunities

In addition to the curricula, teachers who attend the STEP Teacher Professional Development Workshop will be given a kit with a variety of materials and supplies necessary to conduct the activities in their classrooms.

Supplies and materials included with STEP curricula

The curriculum development team included: Ana Houseal, Assistant Professor and Science Outreach Educator, John Carl Reinerten, Graduate Student, Heath Brown, 9th Grade Teacher and Graduate

Student, Sarah Ramsey-Walters, PhD Student, University of Wyoming; Rebecca Adwell, Science Educator, Decatur, IL; and Sallie Greenberg, Associate Director, and Kathy Atchley, Program Coordinator, Advanced Energy Technology Initiative, ISGS.

Teacher, Student and Community Outreach

Teacher

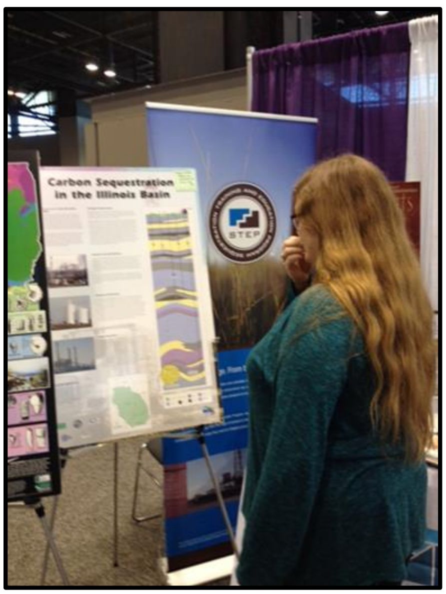
Illinois Science Teachers Association Meeting, Springfield, Illinois, November 1-2, 2012
Illinois Science Teachers Association Meeting, Tinley Park, Illinois, October 24-25, 2013

This conference is designed for science educators and the technical program has a focus on the Next Generation Science Standards. There are traditionally over 100 breakout sessions and over 900 teachers in attendance. The exhibit hall is always full of interesting exhibits – from non-profits to corporate entities serving the educational community. STEP was present in the exhibit hall for the 2012 and 2013 meetings. This was a good outreach activity for STEP and our booth was very busy. The teachers were genuinely interested in CCS and asked many questions. Many of the attendees were science teachers from downstate and had heard about CCS – either from the Decatur projects or the FutureGen activities. As teachers struggle to keep up with the new curriculum mandates (Next Generation Science Standards and Common Core) there is an increased emphasis on energy related curriculum. The teachers were very interested in our energy curriculum, and related materials on CCS. . The teachers loved the posters, pens and the pop ups and told me that these handouts will help facilitate classroom discussions. In addition to the teachers, many of the other exhibitors visited the booth to receive general information.

STEP Booth at the 2011 ISTA Conference

National Science Teachers Association Meeting, Chicago, IL March 12-15, 2015

In addition to the Illinois Science Teachers Association meetings, STEP also had the opportunity to participate in the National Science Teachers Associations Meeting in 2015. This large national meeting attracted over 9,000 educators and had an overriding goal to promote excellence and innovation in science teaching. Presenters shared methods that can identify and provide opportunities for diverse learners. Sessions targeted themes in STEM education with an emphasis on the Next Generation Science Standards. The STEP presence in the conference exhibit hall promoted the STEP Energy Curriculum as well as sharing information about the Illinois Basin – Decatur Project and CCUS.



Science teachers visits the STEP booth at the NSTA meeting in Chicago

International Workshop on Public Education, Training, and Community Outreach on Carbon Capture, Utilization, and Storage, July 30-31, 2014, Decatur, IL

This workshop was developed and sponsored by the NETL (USDOE), Archer Daniels Midland, Schlumberger Carbon Services, Illinois State Geological Survey and Richland Community College. The technical program featured cutting-edge tools and techniques for public education, training and community outreach on CCUS. A STEP presentation on developing a balanced energy curriculum for middle school learners was included in the technical program as well as a STEP demonstration of these activities during an interactive teacher session.

Kathy Atchley demonstrates a lesson from the STEP Energy Curriculum at the teacher's workshop

DCEO Coal Education Conference

June 14-17, 2011, June 19-22, 2012, June 18-21, 2013

Each year educators are invited to attend the Annual Coal Education Conference at the Rend Lake Resort in Whittington, Illinois, sponsored by the Coal Office of the Illinois Department of Commerce and Economic Opportunity. STEP, and a presentation on carbon capture and sequestration, was included on the program in 2011, 2012, and 2013. The goal of the conference is to give teachers the knowledge and learning tools to incorporate into their lesson plans coal education, from mining to electric power generation, as well as other uses of coal. The four-day conference included lectures, tours and hands-on activities correlated to the Illinois Learning Standards. The break-out session topics give the teachers comprehensive information on coal formation/geology, the economics of coal, coal to electricity, carbon sequestration and other clean coal technologies, careers in mining, coal mine permitting and environmental protection, past and present surface mining and reclamation, underground mining, mine safety/ventilation, handling and use of coal byproducts, and state science standards. A highlight of the conference is a tour of an underground coal mine, a surface coal mine and a power plant using clean coal technology. Teachers at all grade levels were interested in learning about carbon capture and sequestration and ways to include this in their curriculum. At the conclusion of the meeting, teachers attend a learning standards session where teacher facilitators use hands on lessons to demonstration how the coal information received during the conference and their first-hand experiences on the tours received could be incorporated into teaching plans.   Approximately 100 teachers attend this conference each year.

Kathy Atchley and teachers entering underground coal mine.

Jane Chang gives CCS presentation at 2013 Coal Conference

Student Outreach

Decatur Public School – Science Day, February 14, 2012

STEP assisted in the development and execution of a Science Day for middle school students in Decatur, Illinois. This all-day event allowed students to learn about CCS by participating in hands-on experiments; listening to local experts; and by playing games designed to make them think about global climate change and the impacts to our environment. The day was designed to pique the student's interest in

CCS, help students better assess all sides of current and future factors impacting global climate change, and make decisions based on sound scientific data and social considerations.

Kathy Atchley helps student build a CO_2 generator for an experiment

Kathy Atchley working with local Boy Scout Troops

Boy Scouts, January 25, 2011, March 1, 2014, March 7, 2015

Local scouting organizations have invited STEP to give presentations at scouting events. These events allow STEP to introduce geology and carbon capture and sequestration concepts to the scouts.

Demonstrations and hands-on activities help to capture their attention as we discuss properties of carbon dioxide and geologic sequestration.

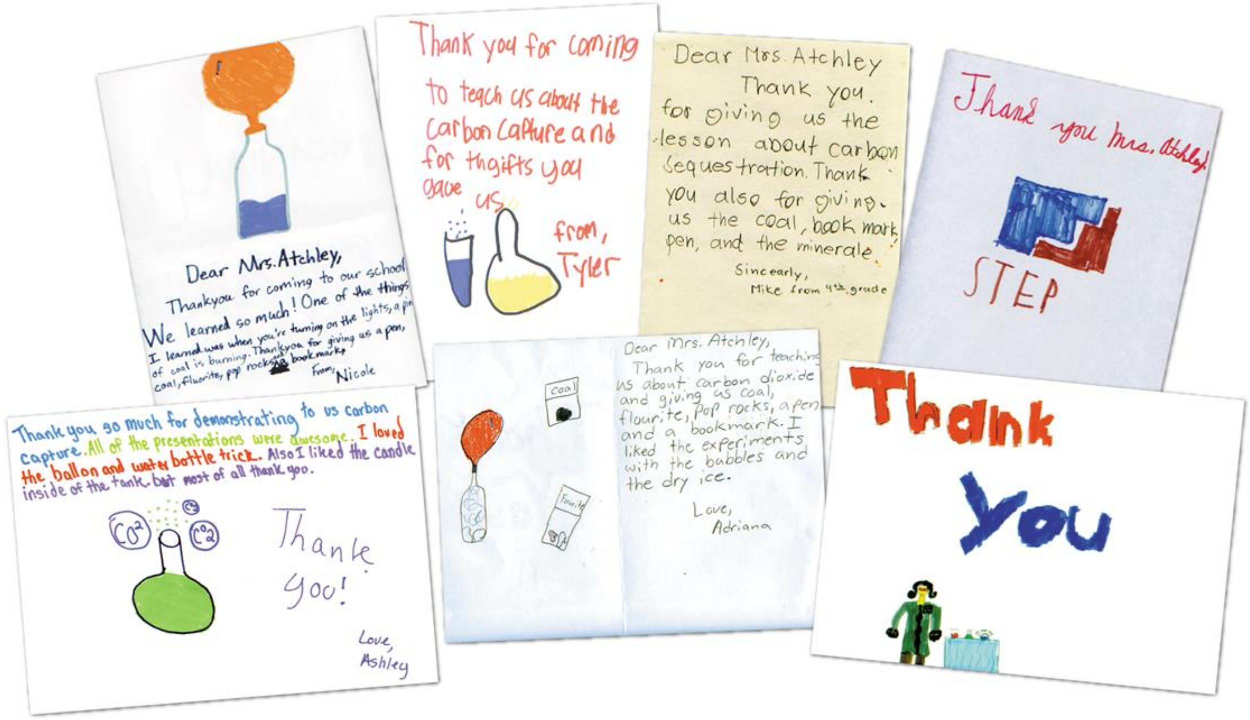
Sallie Greenberg helps a cub scout with mineral identification

Robinson School Science Night, Champaign, IL, March 27, 2013

STEP was invited to participate at the Science Night for the Robinson Elementary School in Champaign, IL on March 27, 2013. The program was designed to expose elementary school children and their families to science in an interactive and fun format. Kathy Atchley engaged the children, and their parents, with a demonstration on the properties of carbon dioxide gas. Approximately 250 people attended this event.

St. Alphonsus/St. Patrick School, Lamont, IL, April 10, 2015

At the request of the 5-6th grade science teacher, Kathy Atchley gave a presentation to 55 students of St. Alphonsus/St. Patrick Grade School in Lamont, IL on April 10, 2015. In addition to an introduction of carbon capture and sequestration technology, students also participated in hands-on activities to demonstration the porosity and permeability of rocks and the properties of carbon dioxide.



Thank-you notes from students of St. Alphonsus/St. Patrick's Grade School

Community Outreach

Naturally Illinois Expo, March 12-13, 2010, March 11-12, 2011, March 9-10, 2012, March 8-9, 2013, and April 17-18, 2015.

STEP regularly participated in the Naturally Illinois Expo (Expo), Champaign, IL. The Expo was designed as an opportunity for local constituents to learn about science and the natural resource of Illinois. The goal was to give them objective, timely, relevant science and solutions necessary to manage the state resources, environment, and economy wisely. Over 50 exhibits were involved and presented hand-on activities and demonstrations to engage attendees. The STEP exhibit featured a demonstration on the properties of carbon dioxide gas and included materials, posters, and handouts on the carbon sequestration. Approximately 2,000 community members attend the Expo each year.

Kathy Atchley explains properties of carbon dioxide at the expo.

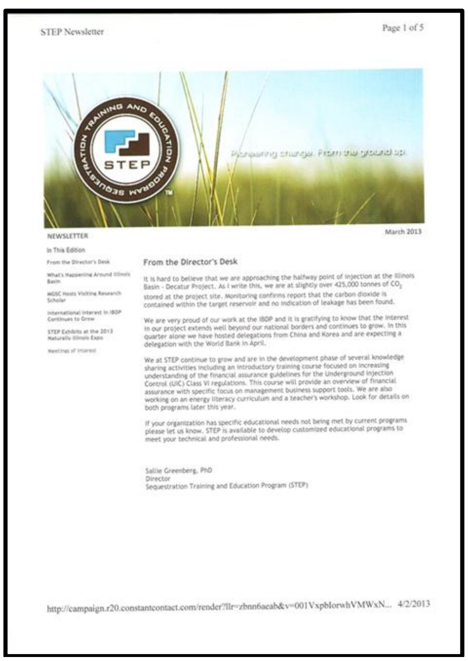

Expo attendees watching the bubble demonstration at the expo.

Chicago Park District Fall Adventure Days, October 11, 2014, Chicago, IL

The Chicago Park District invited the Illinois State Geological Survey to co-sponsor their annual Fall Adventure Day at Northerly Island in Chicago. The event was promoted as an opportunity to enjoy the beautiful park while while learning about the history and geology of the area. Carbon capture and storage was one of the areas promoted during the event. The STEP exhibit table at the outdoor event introduced the concept of carbon capture and storage in the Illinois Basin.

Communication and Information Dissemination

Using Constant Contact, Inc., an online marketing company offering email marketing, social media marketing, and online survey functions, STEP distributed 18 quarterly newsletters and 25 e-alerts from 2011 – 2015 (Figure 13). Quarterly newsletters traditionally included 3-4 pages of news and were designed to update readers on CCS activities in the Illinois Basin, including updates on IBDP, ICCS, and FutureGen. The newsletters also summarized STEP activities and alerted readers to upcoming CCS events or opportunities. E-alerts were brief in nature and traditionally alerted readers to upcoming meetings or brief announcements. E-communications were distributed to a constantly evolving mailing list that included professional CCS contacts from the STEP Director, ISGS staff, DOE Project Partners, contacts from meetings and exhibits, contacts referred by current readers, and people who asked to be included on the mailing list. There are currently over 1,000 names on the list including government, academic and industry representatives.


STEP Newsletter

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NEWSLETTER

March 2013

In This Edition

From the Director's Desk

What's Happening Around Illinois Basin

MGSC Hosts Visiting Research Scholar

International Interest in IBDP Continues to Grow

STEP Exhibits at the 2013 Naturally Illinois Expo

Meetings of Interest

From the Director's Desk

It is hard to believe that we are approaching the halfway point of injection at the Illinois Basin - Decatur Project. As I write this, we are at slightly over 425,000 tonnes of CO_2 stored at the project site. Monitoring confirms report that the carbon dioxide is contained within the target reservoir and no indication of leakage has been found.

We are very proud of our work at the IBDP and it is gratifying to know that the interest in our project extends well beyond our national borders and continues to grow. In this quarter alone we have hosted delegations from China and Korea and are expecting a delegation with the World Bank in April.

We at STEP continue to grow and are in the development phase of several knowledge sharing activities including an introductory training course focused on increasing understanding of the financial assurance guidelines for the Underground Injection Control (UIC) Class VI regulations. This course will provide an overview of financial assurance with specific focus on management business support tools. We are also working on an energy literacy curriculum and a teacher's workshop. Look for details on both programs later this year.

If your organization has specific educational needs not being met by current programs please let us know. STEP is available to develop customized educational programs to meet your technical and professional needs.

Sallie Greenberg, PhD
Director
Sequestration Training and Education Program (STEP)

http://campaign.r20.constantcontact.com/render?llr=zbnn6aeab&v=001VxpblorwhVMWxN... 4/2/2013

STEP Newsletter

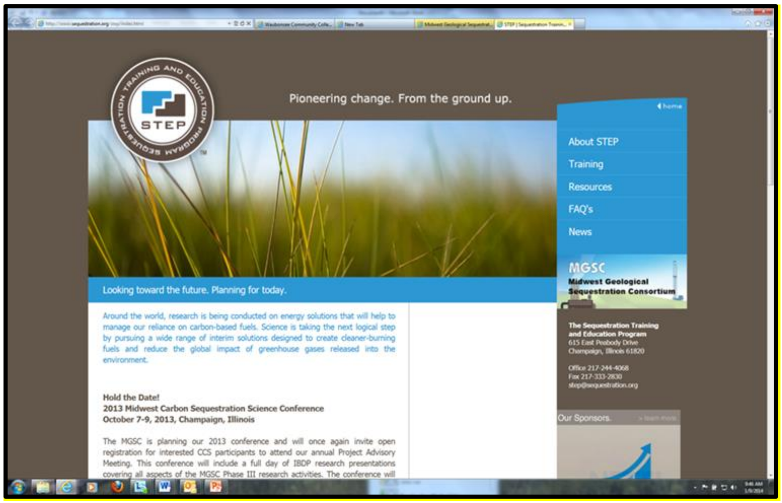
Summary of STEP E-Communications

Date	Type	Topic
24-Feb-11	E-alert	Announcement of IEAGHG Summer School
31-Mar-11	Newsletter	STEP Quarterly Newsletter
31-Mar-11	Newsletter	STEP Quarterly Newsletter
6-May-11	E-alert	Announcement of SPE Webinar
6-May-11	E-alert	SPE Webinar Announcement
17-Jun-11	E-alert	Reservoir short course announcement
13-Sep-11	E-alert	Announcement of Midwest Carbon Sequestration Science Conference
13-Sep-11	E-alert	MGSC meeting announcement - sent to Schlumberger list
26-Sep-11	Newsletter	STEP Quarterly Newsletter
20-Oct-11	E-alert	MGSC housing deadline
31-Oct-11	E-alert	MGSC meeting promotion
1-Nov-11	E-alert	MGSC meeting promotion sent to SPE
22-Nov-11	E-alert	MGSC Injection begins
16-Dec-11	Newsletter	STEP Quarterly Newsletter
2-Apr-12	Newsletter	STEP Quarterly Newsletter
2-Jul-12	E-alert	Hold the date for Midwest Carbon Sequestration Science Conference
12-Jul-12	Newsletter	STEP Quarterly Newsletter
23-Jul-12	E-alert	Registration open for Midwest Carbon Sequestration Science Conference
2-Aug-12	E-alert	Reminder to register for Midwest Carbon Sequestration Science Conference
5-Sep-12	E-alert	Reminder to register for Midwest Carbon Sequestration Science Conference
5-Oct-12	Newsletter	STEP Quarterly Newsletter
19-Dec-12	Newsletter	STEP Quarterly Newsletter
2-Apr-13	Newsletter	STEP Quarterly Newsletter
18-Jun-13	E-alert	500,000 Tonne Milestone
18-Jul-13	Newsletter	STEP Quarterly Newsletter
25-Jul-13	E-alert	Save the Date for Midwest Carbon Sequestration Science Conference
28-Aug-13	E-alert	Register for Midwest Carbon Sequestration Science Conference
26-Sep-13	Newsletter	STEP Quarterly Newsletter
25-Nov-13	E-alert	Midwest Carbon Sequestration Science Conference Papers available on website
20-Dec-13	Newsletter	STEP Quarterly Newsletter
24-Jan-14	E-alert	Register for CCUS Workshop at Richland
7-Feb-14	E-alert	Register for Financial Assurance Workshop
4-Mar-14	E-alert	Reminder to register for Financial Assurance Workshop
27-Mar-14	Newsletter	STEP Quarterly Newsletter
20-Jul-14	Newsletter	STEP Quarterly Newsletter
1-Oct-14	E-alert	IBDP Papers at the GHGT 12 Conference
2-Oct-14	E-alert	Register for Midwest Carbon Sequestration Science Conference
3-Oct-14	Newsletter	STEP Quarterly Newsletter
16-Oct-14	E-alert	Reminder to register for Midwest Carbon Sequestration Science Conference
9-Jan-15	Newsletter	STEP Quarterly Newsletter
15-Apr-15	Newsletter	STEP Quarterly Newsletter
27-May-15	E-alert	Call for CCS papers - Eastern Section AAPG meeting
22-Jun-15	E-alert	Promotion of Richland Teachers Workshop

Figure 13. STEP E- Communications Summary

STEP Website and Promotional Materials

In late 2009, STEP engaged Spinlight, an award-winning local graphic design company to assist in developing a branded look for the new training center. With their guidance and direction a STEP logo, website, brochure, letterhead, business cards, and a pop-up banner for tradeshow displays were developed. (Copies of STEP branded materials is included in the addendum.)



STEP Website

STEP Brochure

STEP promotional materials

Model and rock sets

Using ISGS core samples, STEP developed sets of rock samples for presenters to use when demonstrating carbon sequestration. These rock sets include a slice of Mt. Simon Sandstone and New Albany Shale, along with a water bottle dropper. The rock sets are designed to demonstrate properties related to geologic sequestration, such as porosity and permeability, in meetings and educational settings. The individual core samples are easy to hold and allow viewers to observe and differentiate the different properties of these rocks. Viewers are given an up-close view of what happens when a drop of water is placed on a porous sandstone such as the Mount Simon – it will quickly be absorbed into the available pore space; as opposed to the drop of water placed on the more impermeable New Albany Shale – it will not be absorbed. This rock set is routinely used by ISGS staff in public outreach and educational settings. The rock sets are easy to carry in a briefcase or bag and continue to be used by presenters at local, national, and international meetings. Interest in the rock sets has been very positive and sets have been sold to many outside organizations including the Taylorville Energy Center land and permit acquisition team, Tenaska, and the South African Center for CCS. The rock sets were originally envisioned as a revenue generating product, however, the availability of core samples has limited the economic viability of the product.

STEP Rock Set

Financial Summary

As directed by the “Federal Assistance Reporting Checklist,” ISGS contract specialists coordinated and maintained detailed fiscal and account records in accordance with DOE and the University of Illinois requirements. A summary of budgeted project expenses and actual expenses is included in Figure 14. The University of Illinois submitted quarterly financial statements and a final financial summary to DOE as required. A copy of the final quarterly cost status report is included on the next page as Figure 15.

Figure 14. Project Budget Summary

	Budget	Actual
Personnel	391,219.58	389,669.08
Supplies	34,727.00	40,560.54
Travel*	25,030.70	22,276.26
Other Direct Costs	379,749.88	373,633.39
Indirect Costs	164,263.84	163,278.88
Total	994,991.00	989,418.15

*Note: no grant funds were used for international travel

Personnel – STEP personnel and fringe benefits

Supplies – educational supplies, conference supplies, equipment, printing costs, telecommunications

Travel – Staff travel to conferences, meetings and exhibits

Other Direct Costs – Sub contracts and contractual services

Indirect Costs – Facilities and administration as stipulated by the University of Illinois

Figure 15. Final Cost Status Report submitted quarterly to DOE.

Base Line Reporting	Budget Period 1 - FY10 11/16/09 - 11/15/10					Budget Period 2 11/16/10 - 11/15/11					Budget Period 3 11/16/11 - 11/15/12					Budget Period 4 11/16/12 - 09/30/13				Budget Period 5 10/01/13 - 09/30/14				Total
	FY10 Q1	FY10 Q2	FY10 Q3	FY10 Q4	FY11 Q1	FY11 Q1	FY11 Q2	FY11 Q3	FY11 Q4	FY12 Q1	FY12 Q1	FY12 Q2	FY12 Q3	FY12 Q4	FY13 Q1	FY13 Q1	FY13 Q2	FY13 Q3	FY13 Q4	FY14 Q1	FY14 Q2	FY14 Q3	FY14 Q4	
Federal Share	47,404	78,853	87,750	75,645	100,607	40,693	59,160	65,801	70,597	66,122	37,264	58,397	130,824	59,412	16,463									994,991
Baseline non-Federal Share	1,446	2,168	2,168	2,168	723	7,979	11,968	11,968	11,968	3,989	7,013	10,520	10,520	10,520	3,507									98,626
Baseline Cumulative Cost	48,850	81,021	89,919	77,813	101,330	48,672	71,128	77,769	82,565	70,111	44,277	68,917	141,344	69,932	19,970									1,093,617
Federal Share	0	12,530	13,045	16,883	6,550	18,483	22,926	28,402	66,880	20,756	10,531	89,100	56,179	46,541	24,102	26,497	59,055	80,964	71,268	39,206	36,930	36,119	111,509	894,459
Federal Share	0	0	6,813	619	2,017	4,033	10,251	10,365	11,318	7,177	3,589	9,838	9,838	10,410	5,374	5,374	4,399	0	0	0	0	0	0	101,414
Actual Cumulative Cost	0	12,530	19,858	17,502	8,567	22,516	33,177	38,767	78,198	27,933	14,120	98,938	66,018	56,951	29,476	31,871	63,454	80,964	71,268	39,206	36,930	36,119	111,509	995,873
Federal Share	47,404	66,323	74,706	58,761	94,057	22,210	36,234	37,399	3,716	45,366	26,733	-30,704	74,645	12,871	-7,639	-26,497	-59,055	-80,964	-71,268	-39,206	-36,930	-36,119	-111,509	100,532
Variance non-Federal Share	1,446	2,168	-4,645	1,550	-1,294	3,945	1,717	1,603	650	-3,188	3,424	682	682	110	-1,867	-5,374	-4,399	0	0	0	0	0	0	-2,788
Variance Cumulative Cost	48,850	68,491	70,061	60,311	92,764	26,156	37,951	39,002	4,366	42,178	30,157	-30,022	75,327	12,981	-9,506	-31,871	-63,454	-80,964	-71,268	-39,206	-36,930	-36,119	-111,509	97,744

Lessons Learned

Leverage what you have.

STEP was fortunate to have access to one of the premier CCS sites in the world (IBDP); and an affiliation with one of the most recognized state geological surveys (ISGS) and a world renowned research institution (University of Illinois). In addition to these affiliations, STEP was also had access to a wide network of professional contacts and resources within the global CCS community. STEP was able to leverage this access and connections to maximize program development opportunities.

Build it and they will come.

One of the first programs STEP developed, The STEP Illinois Basin – Decatur Project Site Visit, proved to be one of our most successful programs. STEP petitioned the Office of Continuing Education at the University of Illinois at Urbana Champaign to issue CEU's to participants for this one-day visit to an actual carbon capture and storage site. The program attracted world-wide attention and provided attendees with a first-hand experience and access to key site personnel.

Be open to expansion.

The IBDP is well known internationally and has generated much interest from the international audience. Of the more than 600 people who have visited the project site, 30% of them were international visitors representing 28 countries. While domestic interest in CCS seems to be waning a bit international interest in CCS continues to be steady.

Knowledge sharing and capacity building alone cannot further the implementation of CCS.

Widespread acceptance and use of CCS is not solely dependent on science; but must attain public confidence and support as well as a regulatory component or incentive to be successfully adopted. Research promoted through STEP has shown that the science of CCS is sound and the technology for CCS has been developed but this has not been enough to generate wide-spread acceptance and adoption of CCS technologies.

Define and fulfill niches.

There is a huge need for information in the K-12 group and they are very receptive. STEP experience with teachers has highlighted a need within the education community for more geo-science information at the K-12 level. The Next Generation Science Standards have pushed not only for more earth science material but also placed an emphasis on crosscutting concepts such as energy. Teachers have eagerly accepted the STEP Energy Curriculum and are adopting it in classroom use.

The next STEP – Sustainable Activities Moving Forward.

A stated objective of the Technology Transfer Grant funding was that centers become sustainable beyond the grant period. All program planning was approached with sustainability in mind. After consultation with the Advisory Board in the summer of 2014, it was determined that STEP has the opportunity to continue serving the outreach and education initiatives of the MGSC. The STEP brand is well established and identified as a provider of knowledge sharing and capacity building opportunities. By leveraging STEP achievements we can create sustainable outreach activities for MGSC and since STEP has already been associated with MGSC the transition should be seamless.

Newsletter and E-alerts.

The newsletter template will be modified slightly to incorporate the MGSC logo but the content will remain largely the same. We will continue to highlight CCS in the Illinois Basin and promote knowledge sharing and capacity building events.

Site Visits

Interest in CCS in the Illinois Basin remains steady. We will continue to offer the STEP Illinois Basin – Decatur Project Visit Workshop and offer CEU's to attendees. With input and advisement from the ICCS project team, the original workshop may be modified to include information about the ICCS project.

Lecturer Series

We will continue to look for opportunities for knowledge sharing by leveraging high level visitors to the IBDP and inviting them to present to local CCS researchers at the University of Illinois and the Illinois State Geological Survey as part of the STEP Guest Lecturer Series.

CCS Project Management Workshop

STEP, in conjunction with developers from Schlumberger Carbon Services and Western Kentucky University continues to refine the comprehensive, capacity building, learning experience on Carbon Capture and Sequestration Project Management. The program is designed to build on the experiences of the IBDP to help attendees in developing and managing multiple aspects of a successful carbon capture and storage project. The program will include a series of workshops on important aspects of a CCS project including, project development, permitting, monitoring, MVA, and modeling. The workshops stresses experiential learning and includes small group discussions, hands-on-activities, and group projects. These workshops will be taught and facilitated by a wide variety of professionals who have practical and hands-on experience with CCS projects. The first workshop, CCS Project Development, was presented as a pilot program at the SUCCESS Centre at the University of Oslo, October 24-25, 2013. SUCCESS (Subsurface CO_2 Storage – Critical Elements and Superior Strategy) is one of several Norwegian centres for environment-friendly energy research, funded by the Norwegian Research Council and industry partners. The workshops continue to be developed and the Project Development Workshop is tentatively scheduled for presentation in early 2016.

Phil Jagucki working with attendees from the SUCCESS Workshop in Norway

Midwest Carbon Sequestration Science Conference

The Midwest Carbon Sequestration Science Conference has been a reoccurring conference focusing on CCS in the Illinois Basin. This conference has interest from a broad range of attendees and is well recognized as an annual conference. Using this reputation there is an opportunity to continue serving the CCS community by highlighting current research.

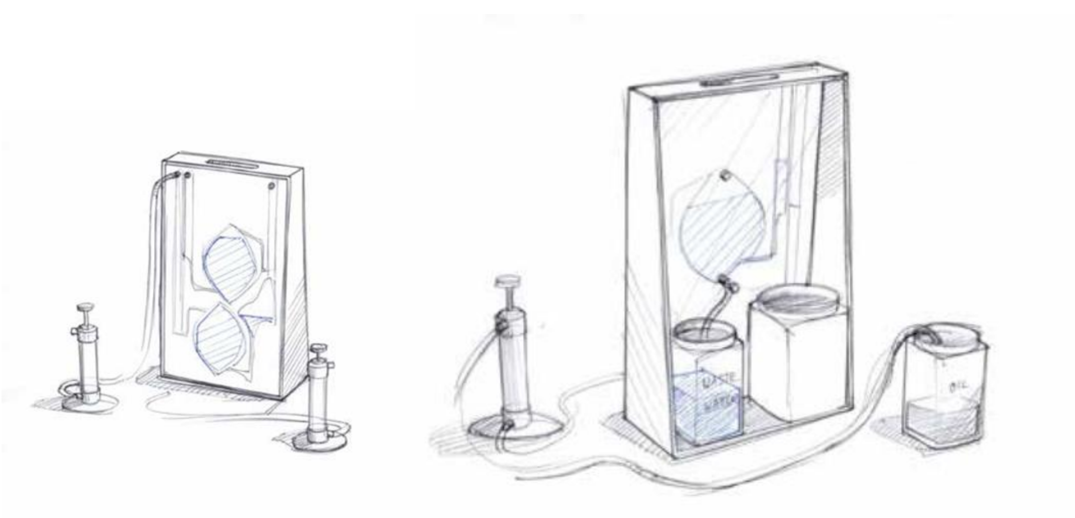
Teacher training and curriculum development

Using the STEP Energy Curriculum we are developing a teacher workshop to introduce the curriculum, provide background information and demonstrate classroom activities for teachers. Teachers attending the workshop would be given a kit with materials necessary to conduct activities in their classroom.

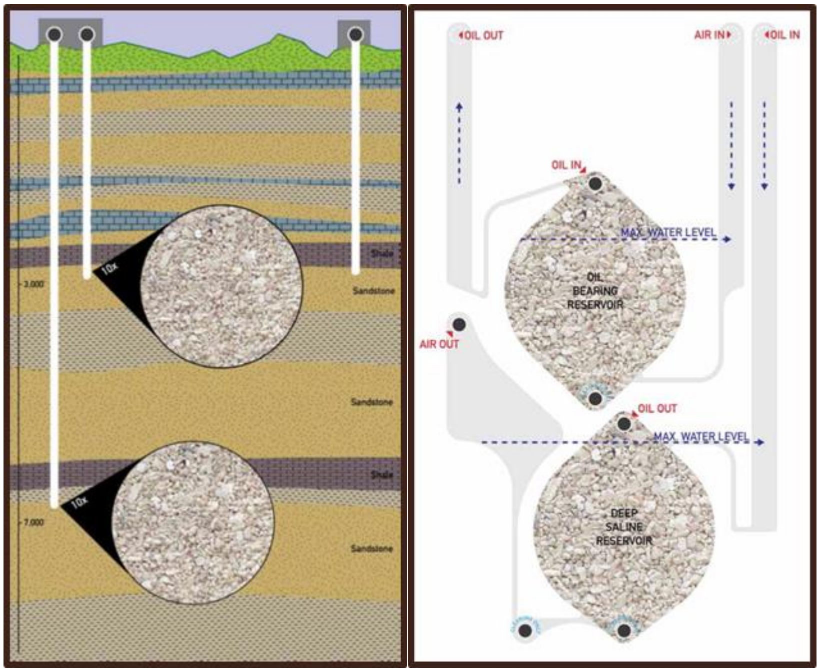
Redesign of Sequestration Model

In 2005, Sallie Greenberg began work with fellow ISGS staff members on the development of a 3-dimensional sequestration model to demonstrate carbon sequestration. The model allows presenters to demonstrate concepts related to enhanced oil recovery, enhanced coal bed methane recovery, and storage of carbon dioxide in a deep saline reservoir. The model was a stand-alone unit, fabricated at the ISGS, and includes all accessories necessary for demonstrations. The model proved to be a very effective way to demonstrate geologic carbon sequestration and there was a high level of interest by CCS educators and others who need to explain CCS to a non-technical audience. However, the model developed in 2005 is a heavy, complex system which is labor and time intensive to reproduce; requires trained personnel to operate and maintain the system; and cleaning the model is problematic and time consuming. In order to be effective and useful to a wide audience the model would need to be redesigned.

Original Sequestration Model and Accessories.



Artist rendition of new sequestration model



Design of new Sequestration Model

In 2014, Sallie Greenberg and Daniel Byers met with several model making companies and design firms to discuss potential commercialization scenarios. Norden Designs, Champaign, IL was selected as the vendor to redesign the model. The goal for the project was to: a) redesign the original model to create a simple-to-use teaching tool which can be operated without special training; b) the redesigned model should be simple to maintain and c) affordable to produce. Several model designed were developed and reviewed. After careful evaluation of the proposed designs it was agreed to proceed with a rectangular shaped model based on a simple, easy to construct concept. The new design concept is light weight; easy for first-time users to set up and present; and easy to clean-up and store. The final design concept for the new model is thinner and has smaller reservoirs which make it quicker and easier to use and reuse for multiple presentations.

Project Videos

STEP has been fortunate to have the services of a semi-professional photographer available to help document not only STEP activities but also those of the IBDP. STEP has been developing a number of project videos from the IBDP which can be used for promotional purposes and as educational tools for teachers. These videos are in development and will be available for use on the MGSC website in late 2015.

List of Acronyms and Abbreviations

AAPG – American Association of Petroleum Geologists

AB – Advisory Board

CO2CRC - Cooperative Research Centre for Greenhouse Gas Technologies

CCS – Carbon, Capture and, Storage

CEU – Continuing Education Unit

CPDU – Continuing Professional Development Unit

DCEO – Department of Commerce and Economic Opportunities

EPA – Environmental Protection Agency

IBDP – Illinois Basin – Decatur Project

ICCS – Illinois Industrial Carbon Capture and Storage

ISGS – Illinois State Geological Survey

ISTA – Illinois Science Teachers Association

MGSC – Midwest Geological Sequestration Consortium

MVA – Monitoring, Verification, and Accounting

NGSS – Next Generation Science Standards

NSTA – National Science Teachers Association

PCOR – Plains CO_2 Reduction Partnership

PDU – Professional Development Units

IEAGHG – International Energy Agency Greenhouse Gas

SECARB – Southeast Regional Carbon Sequestration Partnership

SOPO – Statement of Project Objectives

STEP – Sequestration Training and Education Program

SPE – Society of Petroleum Engineers

U of I – University of Illinois

WKU – Western Kentucky University

ATTACHMENTS

A. **Modified SOPO – April 26, 2011**
B. **Project Management Plan- (updated March 26 2010)**
C. **Business/Marketing Plan – 2010**
D. **List of organizations STEP has engaged in knowledge sharing**
E. **Job Descriptions for STEP support staff**
F. **Sponsorship Brochure**
G. **Speaker list with organizations**

Attachment A.

Modified SOPO – April 26, 2011

Development and Implementation of the Midwest Geological Sequestration Consortium CO_2-Technology Transfer Center

Statement of Project Objectives

Updated: 26 April 2011

A. OBJECTIVES

The Illinois State Geological Survey (ISGS), in collaboration with the Midwest Geological Sequestration Consortium (MGSC), will create a regional technology training center to disseminate carbon capture and sequestration (CCS) technology gained through leadership and participation in regional carbon sequestration projects. The MGSC Sequestration Technology Transfer Center will be entitled Sequestration Training and Education Program (STEP) and will provide local, regional, national, and international education and training opportunities for engineers, geologists, service providers, regulators, executives, K-12 students, K-12 educators, undergraduate students, graduate students, university and community college faculty members, and community programs, community organizations, and community functions including, but not limited to, scout troops, service clubs, public meetings, focus groups, and others. STEP will work with state and regional job development programs to stimulate economic recovery and development by training personnel for commercial CCS projects. STEP will work with national and international professional organizations and regional experts to leverage existing training opportunities and provide stand-alone training. Phase I will be concentrated in the first nine months and focus on management, development, and communication/information dissemination with some tasks lasting the entire three year period. Phase II will be two years focused on implementation and training, communication/information dissemination, and management.

B. SCOPE OF WORK

During Phase I, STEP will put a project management plan (PMP) into place and appoint an Advisory Board (AB) to provide business development, strategic implementation, and oversight. Upon AB recommendations, STEP will research and develop lists of topics for course development, professional organization partnerships, a schedule for stand-alone training events, and will co-sponsor event opportunities. STEP will work with CCS experts to develop CCS content to be delivered through, but not limited to, course materials, lectures, products, and curriculum for modular training events, K-16 school programs, K-16 professional development for teachers, and community organization presentations. A system for coordinating and monitoring project management progress will be implemented. STEP will publish a quarterly newsletter, create a training website, produce e-mail tech alerts, and establish a response system for technical inquires. During Phase II, the strategic plan will be put into place and training events including, but not limited to, modular conferences, workshops, short courses, lectures, K-12 school programs, community programs, community functions, professional development programs, site visits, field trips, web seminars, and others will be conducted.

C. TASKS TO BE PERFORMED - PHASE 1

Task 1.0 – Project Management and Planning

Subtask 1.1 Implementation of the project management plan (PMP) - STEP shall coordinate with the DOE Project Officer to modify and update the PMP submitted as part of this application. STEP shall submit a revised PMP within 60 calendar days of the award. The DOE Project Officer shall then have 30 calendar days from receipt to review and provide comments to STEP. Within 20 days after the receipt of the DOE comments, STEP shall submit a final PMP to the DOE. As the project proceeds the STEP will work in conjunction with the Advisory Board (AB) to implement and update the PMP as needed. If found to be necessary, a risk management plan will be developed and updated periodically to reflect changes in STEP operations.

Subtask 1.2 Coordinate and monitor regional CCS project performance - STEP will monitor the activities of on-going and developing regional CCS projects and coordinate STEP activities with CCS project events when feasible and in accordance with AB recommendations. STEP staff and MGSC scientific team will attend conferences to remain up-to-date on current CCS projects and activities, which will allow training to capitalize on the most current information during instruction. This information will be provided in the newsletter. Monitoring activities may include subscribing to regional, national, and international CCS information sources.

Subtask 1.3 Implement strategic planning as directed by Advisory Board - A report, based on AB recommendations, outlining a strategic plan, business model, and marketing strategy will be produced.

Subtask 1.5 Participate in organized regional sequestration technology training centers working group
STEP will participate in a formal working group created between the TTCs if one is developed. STEP will informally collaborate with other TTCs to co-host workshops and meetings.

Subtask 1.6 Create and provide required deliverables to DOE - Deliverables will be submitted to DOE in accordance with the "Federal Assistance Reporting Checklist," and outlined in Section D – Deliverables.

Subtask 1.7 Maintain appropriate fiscal and accounting systems - ISGS contract specialists will coordinate and maintain fiscal and accounting systems in accordance with DOE and U of I requirements.

Task 2.0 – Project Business and Financial Development

Subtask 2.1 Develop and implement a regional carbon sequestration technology training center – A regional carbon sequestration technology training center will be developed incorporating, but not limited to, multi-track short courses, lecture series, regional training conferences, K-12 school programs, community programs, community functions, professional development programs, site visits, field trips, web seminars, and other technology transfer events. A diversified business model will be developed and will incorporate a marketing strategy designed to achieve a self-sustaining program at the conclusion of the project period.

Subtask 2.2 Implementation of organized sponsorship development program - A corporate sponsorship program will be established to support current and future costs from industry, service providers, and independent operators over a range of revenue levels.

Subtask 2.3 Establish an advisory board – An AB comprised of CCS experts from industry, academia, state agencies, and service providers will be established to provide input on the development of a diversified business model, marketing strategy, and short course and job training curriculum. Administrative support will be provided. The AB will meet on an as needed basis to discuss STEP activities, make recommendations, and review STEP business plans. AB members will travel to meeting at their own expense. Meeting rooms will be secured for full day meetings including lunch and refreshments for AB participants. AB meetings may be coordinated with national CCS conferences.

Subtask 2.4 Establish a list of revenue generating products - A diverse portfolio of revenue generating products will be developed throughout the project. Potential products will include, but are not limited to, short course notes, lecture presentations, workshops, educational programs, Junior STEP Geologist program, sequestration rock kits, web seminars, and conference proceedings. The business model for the STEP will include recommendations for a set of products to be developed.

Subtask 2.5 Develop and implement marketing strategy - With input from the AB, STEP will develop and implement a marketing strategy generating annual funding to support one full-time and one half-time staff member after three years. The program will be self-sustaining after three years and continue to provide training courses through the organized sponsorship program and fees collected during the initial three year start-up. Separate accounts will be established to facilitate sponsorship gifts and to collect fees for services provided, products sold, and funds associated with all other STEP related training products. The marketing strategy will include website, electronic newsletter, and trade shows.

Task 3.0 – Project Development of Short Courses on CCS Technology

Subtask 3.1 Identify topics for short course development - STEP will consult AB and use surveys to identify short course topics and training needs. STEP staff will coordinate with other TTCs to leverage programs and provide multiple opportunities. A report reviewing existing and potential training possibilities and recommendations for providing optimal technology training will be written.

Subtask 3.2 Work with CCS experts to develop training opportunities to include, but not limited to, short courses, lectures, school programs, community programs, rock kits, physical models, and course materials – STEP will work with experts from MGSC, Schlumberger Carbon Services, law and policy, financial, communications, and other sectors to develop short courses that provide technology transfer from existing and upcoming field projects. Courses will be modular so individuals can select from a menu of options to customize training to their needs. Information dissemination will be multi-level to benefit early, mid-, and late-career audiences. Educational and community programs will be developed on an on-going, as needed basis correspondent to demonstrated need to growing training and education.

Development may include, but is not limited to, printing, product design, curriculum design, web design, and consultation with outside experts.

Subtask 3.3 Identify and work with professional societies to provide Professional Development Units (PDU) or Continuing Education Unit (CEU) - STEP will work with the University of Illinois, American Water Works Association, PAG members, and other PDU/CEU providing organizations to provide workshops at regional conferences and member convenient-venues.

TASKS TO BE PREFORMED - PHASE II

Task 4.0 – Event Implementation and Training

Subtask 4.1 Participate in co-sponsored CCS training events - STEP will participate in training and educational opportunities to include, but not limited to, technology training events, modular conferences, workshops, short courses, lectures, K-12 school programs, community programs, community functions, professional development programs, site visits, field trips, web seminars, outreach opportunities, and networking with CCS associations, professional societies, state agencies, oil and gas operators, coal companies, utilities, MGSC and RCSPs, education sector, and service sector. STEP will attend conferences to provide training for professional organizations. Co-sponsored CCS lecture and brown-bag lunch series will be developed by STEP and U of I for the U of I educational and technological community. A report on co-sponsored STEP events will be prepared, summarizing speakers, participants, benefits to community and industry as a result of CCS training. STEP will seek co-sponsorship opportunities to conduct education and training, to include but not limited to the above mentioned, on an on-going as needed basis. Meeting rooms and refreshments will be provided for co-sponsored events. Lunch will be provided for full-day events. Event materials may include, but are not limited to printed material, rock samples, flash drives, event commemoratives, nametags and lanyards, course binders and/or packages, and sustainability-promoting tools.

Subtask 4.2 Organize, prioritize, and participate in CCS events - A series of stand-alone, modular short courses will be designed so courses can be conducted individually or at conferences and co-sponsored events in the Midwest and nationally. Lecture series, short courses, brown-bag seminars, workshops will provide maximum impact of training while supporting the schedules of expert trainers. At least two significant conferences will be conducted during Phase II. STEP will provide CCS events for local, regional, national, and international engineers, geologists, service providers, regulators, executives, K-12 students, K-12 educators, undergraduate students, graduate students, university and community college faculty members, and community organizations, community programs, and community functions including, but not limited to, scout troops, service clubs, public meetings, focus groups, and others. Meeting rooms and refreshments will be provided for STEP events. Lunch will be provided for full-day events. Event materials may include, but are not limited to printed material, rock samples, flash drives, event commemoratives, nametags and lanyards, course binders and/or packages, and sustainability-promoting tools.

Subtask 4.3 Develop and hold higher education-oriented event - A joint STEP and U of I CCS conference will be organized and held in Champaign, Illinois. The conference will include opportunities for students, faculty, and researchers to visit the Illinois Basin – Decatur Phase III large-scale deep saline injection project during critical phases of the project such as drilling, injection, and monitoring. CCS experts from the MGSC, universities, and government will be gathered to participate in the event. Housing and meals may be provided for events lasting more than one day on the University of Illinois campus or other locations. Event materials may include, but are not limited to printed material, rock samples, flash drives, event commemoratives, nametags and lanyards, course binders and/or packages, and sustainability-promoting tools.

Task 5.0 – Communication and Information Dissemination

Subtask 5.1 Publish a training newsletter - An electronic newsletter will be published quarterly. The quarterly newsletter will be created and distributed using an online service.

Subtask 5.2 Develop a training website – In Phase I, a website will be developed with course information, training calendars, technology related information, advertisements/promotional space, and products. Additional educational and training modules may be developed in Phase II to provide CCS content, subject to AB recommendation and market analysis of STEP business plan.

Subtask 5.3 Provide quarterly e-mail technology alerts - CCS technology and training information alerts will be distributed quarterly in e-mail technology alerts. e-Alerts will be distributed on an on-going basis when significant or interesting events occur, STEP has news to deliver, and will be used as a marketing tool for STEP programs. e-Alerts will be distributed using an online service.

Subtask 5.4 Coordinate and leverage regional efforts - STEP will work with U of I, the Indiana and Kentucky Geological Surveys, government agencies, and commercial CCS project developers to coordinate and leverage technology transfer and information delivery by participating in regional working groups, attending conferences, and coordinating efforts with other CCS professional programs.

Subtask 5.5 Respond promptly to technical inquires - An inquiry response procedure will be established to insure prompt response to technical CCS inquires.

Subtask 5.6 Coordinate funding source required activities- STEP will work with funding sources to conduct necessary project work during budget period. STEP will be a self-sustaining organization after three years and continue to provide training and education programs including, but not limited to those outlined in the SOPO, established through the organized sponsorship program and fees collected during the initial three year start-up. Separate accounts will be established to facilitate sponsorship gifts and to collect fees for services provided, products sold, and funds associated with all other STEP related training products.

D. DELIVERABLES

The Recipient shall submit periodic, topical, and final reports in accordance with the Federal Assistance Reporting Checklist and the instructions accompanying the checklist for regular and ARRA reporting.

ARRA Reporting Requirements

In addition to reporting requirements defined within the Federal Assistance Reporting Checklist, the Recipient may submit quarterly to the DOE Project Manager, no later than 7 days after the end of the quarter, the following information: (1) initial start and finish dates for each task, (2) percent complete for each task, (3) total project costs by month, (4) training course name, date and number of CEUs and PDH awarded, (5) Milestones and (6) FTE's for each quarter.

NOTE: All teaching materials, lesson plans, website data, newsletters, etc. collected in this effort shall be delivered to DOE/NETL for review and approval that can be used for internal purposes at NETL. Teaching materials include but are not limited to CDs/DVDs and all workshop and seminar materials.

STEP shall also provide specific deliverables listed below:

1. Updated Project Management Plan
2. Advisory Board Roster
    - The Advisory Board Roster shall include complete list with personnel, title, area of expertise, role of each member, and short biography.
3. Website Event Calendar
    - This calendar shall be maintained and updated with training events and other CCS activities for the training center.
4. Sponsorship Development and Marketing Plan (*Strategic Plan Report*)
    - Sponsorship Development and Marketing plan shall include a diversified business model including types of participation that shall include but not be limited to speakers, workshop materials, technology bulletins, and event sponsorship; as well as a plan to develop a “sustainable” program that shall reliably generate annual funding.
    - Updated Sponsorship Development and Marketing Plan shall be submitted to account for any changes to business model and marketing plans to meet the goal of creating a “sustainable” program incorporating any lessons learned that can be shared throughout all Regional Technology Training Centers to establish a successful national program.
5. Regional Technology Training Plan (*Professional Training Needs Survey and Findings*)
    - An initial Regional Technology Training Plan shall include short courses and other planned CCS events (lecture series, brown-bag, half- and full-day workshops, conferences) to be developed and experts who will collaborate in development; content of short courses and other events; plan for revisions of courses based on feedback from participants; initial proposed timeframe to implement courses and other events; identification of organizations and verification that courses to be taught are in the process of being registered for PDU and CEUs.

- Final Regional Technology Training Plan is the final version of the Initial Regional Technology Training Plan and discuss the implementation of actual training and include a detailed schedule for short courses/other events (such as lecture series topics/dates; seminar topics/materials/dates; conferences planned sessions and dates; short course and workshop final content, instructors/speakers) and verification that any short courses taught are officially registered for professionals to receive CEUs and PDHs.

6. University Lecture Series and Training Events Report
7. CEU and PDU Tracking
    - As per the ARRA reporting requirements, excel spreadsheets shall be utilized to document and report the number of CEU's and PDH's awarded in each training event, per event, by training date as well as cumulative for the training center. Individual award certificates in PDF format for each individual who successfully completes the course will be submitted with each quarterly report as verification documentation for CEU's and PDHs reported.

E. BRIEFINGS/TECHNICAL PRESENTATIONS

The Recipient shall participate in a Project Kick-off Meeting that will be held as part of the Annual Regional Partnership Meeting, at the Pittsburgh Hilton, November 16-19, 2009. The Recipient is required to prepare and present an overview of their newly awarded Regional Sequestration Technology Training.

The Recipient shall prepare annual detailed briefings for the following:

- Presentation to the DOE Project Officer at the NETL facility located in Pittsburgh, PA or Morgantown, WV. Briefings shall be given by the Recipient to explain the plans, progress, and results of the technical effort at least once per year. DOE may substitute attendance of meetings at NETL for recipient participation in external merit reviews. The Recipient shall provide an annual debriefing meeting for all interested parties discussing project progress and results either at DOE or other selected location.
- Present a technical paper(s) at the DOE/NETL Annual Contractor's Review Meeting to be held at the NETL facility located in Pittsburgh, PA or Morgantown, WV or at an alternative conference with the location to be agreed upon by the DOE and Recipient.
-

The Recipient shall deliver technical presentations, both oral and poster, at conventions, annual symposiums, and/or other local, regional, and national technical meetings.

Attachment B.

Project Management Plan

(Updated March 26, 2010)

PROJECT MANAGEMENT PLAN

Development and Implementation of the Midwest Geological Sequestration Consortium Sequestration Technology Transfer Center

SUBMITTED BY

Illinois State Geological Survey

Board of Trustees of the University of Illinois

1901 S. First St., Suite A

Champaign, IL 61820

PRINCIPAL INVESTIGATOR

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Updated: 26 March 2010

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A. EXECUTIVE SUMMARY

The Illinois State Geological Survey (ISGS) in conjunction with the Midwest Geological Sequestration Consortium (MGSC) will create a regional technology training center to disseminate carbon capture and sequestration (CCS) technology gained through leadership and participation in regional carbon sequestration projects. The MGSC Sequestration Technology Transfer Center (MGSC STTC) will provide education and training opportunities for engineers, geologists, service providers, regulators, executives, and others. MGSC STTC programs will work in accordance with state and regional job development programs to stimulate economic recovery and support development of trained personnel for commercial CCS projects. MGSC STTC will work with professional organizations and regional experts to leverage existing training opportunities while providing additional stand-alone training events. Training topics will include CCS project development, site characterization, permitting, reservoir engineering, monitoring, verification, and accounting (MVA), simulation and risk assessment, and communications. Training will utilize a modular multi-track approach allowing different professional participants to customize training. Phase I will be concentrated in the first nine months and focus on management, development, and communication/information dissemination with some tasks lasting the entire three year period. Phase II will be two years focused on implementation and training, communication/information dissemination, and management. During Phase I, MGSC STTC will put a Project Management Plan (PMP) into place and appoint an Advisory Board (AB) to provide business development, strategic implementation, and oversight. Upon AB recommendations, MGSC STTC will research and develop lists of topics for course development, professional organization partnerships, a schedule for stand-alone training events, and will co-sponsor event opportunities. MGSC STTC will work with CCS experts to develop course materials, lectures, and curriculum for modular training events. A system for coordinating and monitoring project management progress will be implemented. MGSC STTC will publish a quarterly newsletter, create a training website, produce e-mail tech alerts, and establish a response system for technical inquires. During Phase II, the strategic plan will be put into place and training events will be conducted.

MGSC STTC will benefit the Illinois Basin region by providing curriculum, outreach, and networking on five focal areas for carbon sequestration technology development: 1) capture, 2) geologic carbon storage, 3) MVA, 4) CO_2 use, and 5) simulation and risk assessment. Further benefits will result from links between MGSC STTC, independent research entities, utilities, CO_2 producers, and technology providers to develop CCS technology training and job development opportunities. MGSC STTC work result in advancing the United States in its position as a leader in CCS technology, developing a training center, production of teaching materials, and production of workforce necessary for the CCS industry.

B. RISK MANAGEMENT

The primary risk associated with the MGSC STTC activities are represented by schedule and cost delays due to timing related to MGSC projects and MGSC STTC activities, which may be outside of the control of MGSC STTC staff and organizers. In the event that timing delays occur, the following actions will be taken:

1. MGSC STTC director will seek input from Advisory Board with respect to potential risks and mitigation strategies.
2. MGSC STTC director will keep in close contact with MGSC project management and keep up-to-date with projected timelines and will schedule events in accordance with known dates.
3. MGSC STTC director will notify DOE Project Manager of potential delays.
4. The following occasions are likely to trigger an update:
    - Significant change in project goals or emphasis
    - Significant MGSC project delays
    - Special events unanticipated in original proposal
    - Requested events unanticipated in original proposal
    - Input from Advisory Board

C. MILESTONE LOG

Table 1 outlines milestones for each period of the project. Progress will be reported in quarterly progress reports with current status and progress; specific progress achieved, and proposed changes in project schedule to complete milestones. Items highlighted in blue represent DOE Project Manager tracked Success Milestones. Items highlighted in green represent DOE Head Quarters Milestones. Items highlighted in yellow are complete.

Table 1. Milestone Log

Phase I				
ID	**Title/Description**	**Planned Completion Date**	**Actual Completion Date**	**Verification Method**
Task 1	**Project Management and Planning**			
T1-M1	Implementation of project management plan	3/31/2010	03/26/10	Creation of updated project management plan
T1-M2	Hire MGSC STTC dedicated staff	2/28/2010		Staff hired and working on project tasks
T1-M3	Implement Strategic plan	6/30/2010		Written report outlining strategic plan, business model, and marketing strategy (Deliverable 1.4)
T1-M4	Create deliverables schedule	6/30/2010		Schedule and tracking system deployed
T1-M5-HQ	HQ Milestone Project Kick-off Meeting	3/31/10	11/18/09	All project developers participated in the official kick-off meeting on November 18, 2009, Pittsburgh Hilton.
T1-M6-HQ	HQ Milestone Program Instituted	6/30/10		Initial Tech Training Plan Completed and Submitted
Task 2	**Project Business and Financial Development**			

T2-M1	Develop and Implement MGSC STTC	10/31/2010		Development of policies and procedures for conducting technology training
T2-M2	Implementation of organized sponsorship development program	9/30/2010		List of potential sponsors and plan for approaching sponsorship providers
T2-M3	Establish advisory board	3/31/2010		List of advisory board members and initial meeting notes
T2-M4	Establish list of revenue generating products	6/30/2010		List of revenue generating products
T2-M5	Develop and Implement marketing strategy	11/1/2010		Written marketing strategy report (Deliverable 3.1)
T2-M6-HQ	Trainer visit one field site	12/31/10		Provide summary of field visit by Director and staff
Task 3	**Project Development of Short Courses on CCS Technology**			
T3-M1	Identify topics for short course development	9/30/2010		List of short course topics
T3-M2	Develop short courses	9/30/2011		Course instructors identified and short course notes produced
T3-M3	Continuing education plan	9/30/2010		Develop list and agreements with professional organizations to provide short courses
T3-M4-HQ	Updated Tech Training Plan	12/31/2010		Completion and Submittal of Updated Training Plan
Phase II				

Task 4	**Event Implementation and Training**			
T4-M1	Conduct two one-week long training sessions	10/31/2012		Successful workshop delivery
T4-M2	Create co-sponsored lecture series	8/30/2011		Report on co-sponsored events (Deliverable 4.1)
T4-M3	Create brown bag lunch series	8/30/2011		Report on co-sponsored events (Deliverable 4.1)
T4-M4	Higher education-oriented event	4/30/2012		Successful event
T4-M5-HQ	Host one training event	9/30/2010		Demonstration that one training event (webinar, short course, seminar, brown bag, etc…) has been held
Task 5	**Communication and Information Dissemination**			
T5-M1	Publish newsletter	6/30/2010		Newsletter editions
T5-M2	Develop website	6/30/2010		Website launch
T5-M3	Quarterly email alerts	10/31/2012		Email alert summary
T5-M4	Respond to technical inquiries	8/30/2010		Development of inquiry response system
T5-M5-HQ	Semi-Annual Progress Report	9/30/2010		Completion and submittal of semi-annual progress report

D. FUNDING AND COSTING PROFILE

Table 2 provides a summary of the total project budget broken down into funding per project team member for three years covering one budget period. A cost plan of direct costs is provided in Table 3. For each year of the budget period, project costs were projected by month showing the planned expenditures for each month the cumulative total. This cost plan will be used as the framework for reporting actual costs incurred and the variance from the baseline cost plan.

Table 2. Total Project Budget by Project Team Member

	Year 1	Year 2	Year 3	Total Budget
ISGS	$319,759.00	$236,873.00	$257,359.00	$813,991.00
Schlumberger	$ 45,500.00	$ 45,500.00	$ 33,000.00	$124,000.00
AJW, Inc.	$ 25,000.00	$ 20,000.00	$ 12,000.00	$ 57,000.00
Total	$390,259.00	$302,373.00	$302,359.00	$994,991.00

Table 3. Cost Plan by Year

Year 1													
	N-09	D-09	J-10	F-10	M-10	A-10	M-10	J-10	J-10	A-10	S-10	O-10	Total
ISGS Salaries & Benefits	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 116,294.00
AJW Group Subcontractor	$ 1,500.00		$ 2,350.00	$ 2,350.00	$ 2,350.00	$ 2,350.00	$ 2,350.00	$ 2,350.00	$ 2,350.00	$ 2,350.00	$ 2,350.00	$ 2,350.00	$ 25,000.00
Schlumberger Subcontractor	$ 1,500.00		$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 5,857.14	$ 5,857.14	$ 5,857.14	$ 5,857.14	$ 5,857.14	$ 5,857.14	$ 5,857.14	$ 45,500.00
Workshop Vendor 1 (tbd)												$ 24,000.00	$ 24,000.00
Workshop Vendor 2 (tbd)												$ 12,000.00	$ 12,000.00
Workshop Vendor 3 (tbd)												$ 24,000.00	$ 24,000.00
Lecture Series						$ 2,500.00					$ 2,500.00	$ 2,500.00	$ 7,500.00
Commodoties & Supplies	$ 200.00	$ 200.00	$ 1,500.00	$ 880.00	$ 252.50	$ 252.50	$ 252.50	$ 252.50	$ 252.50	$ 252.50	$ 252.50	$ 252.50	$ 4,800.00
Expensed Equipment			$ 8,500.00										$ 8,500.00
Travel	$ 2,400.00						$ 1,200.00				$ 1,200.00		$ 4,800.00
Services													$ -
Website		$ 10,000.00			$ 10,000.00								$ 20,000.00
Printing & Copying	$ 625.00	$ 625.00	$ 625.00	$ 625.00	$ 625.00	$ 625.00	$ 625.00	$ 625.00	$ 625.00	$ 625.00	$ 625.00	$ 625.00	$ 7,500.00
Trade show fees							$ 2,500.00				$ 2,500.00		$ 5,000.00
Registration							$ 600.00				$ 600.00		$ 1,200.00
New employee ad costs	$ 1,200.00												$ 1,200.00
Software	$ 200.00		$ 800.00			$ 200.00		$ 400.00	$ 200.00			$ 200.00	$ 2,000.00
Equipment						$ 7,900.00							$ 7,900.00
Indirect	$ 4,380.99	$ 5,190.59	$ 6,189.94	$ 3,680.18	$ 6,051.42	$ 5,433.38	$ 5,838.18	$ 4,851.48	$ 4,059.95	$ 3,268.42	$ 4,988.82	$ 19,131.64	$ 73,065.00
Monthly Total	$ 21,697.16	$ 25,706.76	$ 30,656.11	$ 18,226.35	$ 29,970.09	$ 34,809.19	$ 28,913.99	$ 24,027.29	$ 23,035.76	$ 22,044.23	$ 30,564.63	$ 100,607.45	$ 390,259.00

Year 2													
	N-10	D-10	J-11	F-11	M-11	A-11	M-11	J-11	J-11	A-11	S-11	O-11	Total
ISGS Salaries & Benefits	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 116,294.00
AJW Group Subcontractor	$ 1,666.67	$ 1,666.67	$ 1,666.67	$ 1,666.67	$ 1,666.67	$ 1,666.67	$ 1,666.67	$ 1,666.67	$ 1,666.67	$ 1,666.67	$ 1,666.67	$ 1,666.67	$ 20,000.00
Schlumberger Subcontractor	$ 3,791.67	$ 3,791.67	$ 3,791.67	$ 3,791.67	$ 3,791.67	$ 3,791.67	$ 3,791.67	$ 3,791.67	$ 3,791.67	$ 3,791.67	$ 3,791.67	$ 3,791.67	$ 45,500.00
Workshop Vendor 1 (tbd)												$ 6,000.00	$ 6,000.00
Workshop Vendor 2 (tbd)												$ 6,000.00	$ 6,000.00
Workshop Vendor 3 (tbd)												$ 6,000.00	$ 6,000.00
Lecture Series			$ 2,500.00			$ 2,500.00					$ 2,500.00		$ 7,500.00
Commodoties & Supplies	$ 318.18	$ 318.18	$ 318.18	$ 318.18	$ 318.18	$ 318.18	$ 318.18	$ 318.18	$ 318.18	$ 318.18	$ 318.18	$ 4,000.00	$ 7,500.00
Travel	$ 2,400.00						$ 2,400.00				$ 2,400.00		$ 7,200.00
Services													$ -
Printing & Copying	$ 272.73	$ 272.73	$ 272.73	$ 272.73	$ 272.73	$ 272.73	$ 272.73	$ 272.73	$ 272.73	$ 272.73	$ 4,500.00	$ 272.73	$ 7,500.00
Trade show fees							$ 2,500.00				$ 2,500.00		$ 5,000.00
Registration	$ 600.00						$ 600.00				$ 600.00		$ 1,800.00
Software	$ 200.00		$ 800.00			$ 200.00		$ 400.00	$ 200.00			$ 200.00	$ 2,000.00
Room Rental & Catering												$ 16,250.00	$ 16,250.00
Indirect	$ 3,410.97	$ 2,601.37	$ 3,436.27	$ 2,601.37	$ 2,601.37	$ 3,284.47	$ 3,992.87	$ 2,702.57	$ 2,651.97	$ 2,601.37	$ 5,694.87	$ 12,249.59	$ 47,829.00
Monthly Total	$ 22,351.37	$ 18,341.77	$ 22,476.67	$ 18,341.77	$ 18,341.77	$ 21,724.87	$ 25,233.27	$ 18,842.97	$ 18,592.37	$ 18,341.77	$ 33,662.55	$ 66,121.81	$ 302,373.00

Table 3. Cost Plan by Year (Cont.)

	Year 3												
	N-11	D-11	J-12	F-12	M-12	A-12	M-12	J-12	J-12	A-12	S-12	O-12	Total
ISGS Salaries & Benefits	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 9,691.17	$ 116,294.00
AJW Group Subcontractor	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 12,000.00
Schlumberger Subcontractor	$ 2,750.00	$ 2,750.00	$ 2,750.00	$ 2,750.00	$ 2,750.00	$ 2,750.00	$ 2,750.00	$ 2,750.00	$ 2,750.00	$ 2,750.00	$ 2,750.00	$ 2,750.00	$ 33,000.00
Workshop Vendor 1 (tbd)						$ 12,000.00							$ 12,000.00
Workshop Vendor 2 (tbd)						$ 12,000.00							$ 12,000.00
Workshop Vendor 3 (tbd)						$ 12,000.00							$ 12,000.00
Lecture Series			$ 2,500.00			$ 2,500.00					$ 2,500.00		$ 7,500.00
Commodoties & Supplies	$ 181.82	$ 181.82	$ 181.82	$ 181.82	$ 181.82	$ 4,000.00	$ 181.82	$ 181.82	$ 181.82	$ 181.82	$ 181.82	$ 181.82	$ 6,000.00
Travel	$ 2,400.00						$ 2,400.00				$ 2,400.00		$ 7,200.00
Services													$ -
Printing & Copying	$ 272.73	$ 272.73	$ 272.73	$ 272.73	$ 4,500.00	$ 272.73	$ 272.73	$ 272.73	$ 272.73	$ 272.73	$ 272.73	$ 272.73	$ 7,500.00
Trade show fees							$ 2,500.00				$ 2,500.00		$ 5,000.00
Registration	$ 600.00						$ 600.00				$ 600.00		$ 1,800.00
Software	$ 462.50		$ 462.50			$ 462.50		$ 462.50					$ 1,850.00
Room Rental & Catering						$ 16,250.00							$ 16,250.00
Indirect	$ 3,442.88	$ 2,566.87	$ 3,316.38	$ 2,566.87	$ 3,636.37	$ 17,501.63	$ 3,958.37	$ 2,683.88	$ 2,566.87	$ 2,566.87	$ 4,590.87	$ 2,567.19	$ 51,965.00
Monthly Total	$ 20,801.09	$ 16,462.58	$ 20,174.59	$ 16,462.58	$ 21,759.35	$ 90,428.02	$ 23,354.08	$ 17,042.09	$ 16,462.58	$ 16,462.58	$ 26,486.58	$ 16,462.90	$ 302,359.00

E. RESOURCE LOADED SCHEDULE

A summary timeline is provided in Figure 1 that shows the start and end dates of each project task and graphically represents the time, by quarter, during which the activities of each task will take place. Figure 2 provides a Gantt chart for the project. The start and end dates of all tasks and subtasks are indicated in addition to noting milestones.

Figure 1. Timeline Summary

FIGURE 1. PROJECT TIMELINE	Year 1				Year 2				Year 3			
	Qtr	Qtr	Qtr	Qtr	Qtr	Qtr	Qtr	Qtr	Qtr	Qtr	Qtr	Qtr
TASKS	1	2	3	4	1	2	3	4	1	2	3	4
Task 1 - Management												
Task 2 - Business Development												
Task 3 - Course Development												
Task 4 - Implementation												
Task 5 - Communication												

A schematic of the Work Breakdown Structure (WBS) is provided in Figure 3 showing breakdown by Task and Subtask. Table 4 provides the WBS by Task and Subtask as described in the Statement of Project Objectives (SOPO – Appendix A) and links scope, schedule, and budgeted cost for specific WBS elements.

Figure 2. Project Gantt Chart by Task and Sub-task

WBS	Activity Name	Duration (Work Months)	Start Date	Finish Date	Milestones	Planned Completion	Actual Completion
1	**Task 1 - Project Management and Planning**						
1.1	*Implement project management plan*	4.98	11/3/09	4/5/10	T1-M1	3/31/10	
1.2	*Coordinate and monitor regional CCS project performance*	35.55	11/2/09	10/31/12			
1.3	*Maintain sufficient regional staff*	35.55	11/2/09	10/31/12	T1-M2	1/31/10	
1.4	*Implement strategic planning as directed by advisory board*	7.82	11/2/09	6/30/10	T1-M3	6/30/10	
1.5	*Participate in organized regional sequestration technology training centers*	35.55	11/2/09	10/31/12			
1.6	*Create and provide required deliverables to DOE*	4.87	11/2/09	3/31/10	T1-M4	3/31/10	
1.7	*Maintain appropriate fiscal and accounting systems*	35.55	11/2/09	10/31/12			
2	**Task 2 - Project Business and Financial Development**						
2.1	*Develop and implement a regional carbon sequestration technology training center*	11.82	11/2/09	10/29/10	T2-M1	10/29/10	
2.2	*Implementation of organized sponsorship development program*	11.00	11/2/09	10/6/10	T2-M2	10/6/10	
2.3	*Establish an advisory board*	4.87	11/2/09	3/31/10	T2-M3	3/31/10	
2.4	*Establish a list of revenue generating products*	7.82	11/2/09	6/30/10	T2-M4	6/30/10	
2.5	*Develop and implement marketing strategy*	11.82	11/2/09	11/1/10	T2-M5	11/1/10	
3	**Task 3 - Project Development of Short Courses on CCS Technology**						
3.1	*Identify topics for short course development*	7.82	11/2/09	6/30/10	T3-M1	6/30/10	
3.2	*Work with CCS experts to develop short courses, lectures, and course materials*	14.90	6/30/10	9/30/11	T3-M2	9/30/11	
3.3	*Identify and work with professional societies to provide PDU or CEU*	10.82	11/2/09	9/30/10	T3-M3	9/30/10	
4	**Task 4 - Event Implementation and Training**						
4.1	*Participate in co-sponsored CCS training events*	27.75	7/1/10	11/1/12	T4-M1, M2	10/31/12, 8/30/11	
4.2	*Organize, prioritize, and participate in CCS events*	35.55	11/2/09	10/31/12	T4-M3	8/30/11	
4.3	*Develop and hold higher education-oriented event*	8.00	8/29/11	4/30/12	T4-M4	4/30/12	
5	**Task 5 - Communication and Information Dissemination**						
5.1	*Publish a training newsletter*	35.55	11/2/09	10/31/12	T5-M1	4/30/10	
5.2	*Develop a training website*	5.87	11/2/09	4/30/10	T5-M2	4/30/10	
5.3	*Provide quarterly e-mail technology alerts*	24.70	10/1/10	10/31/12	T5-M3	10/31/12	
5.4	*Coordinate and leverage regional efforts*	35.55	11/2/09	10/31/12			
5.5	*Respond promptly to technical inquires*	9.82	10/30/09	8/30/10	T5-M4	8/30/10	
5.6	*Coordinate funding source required activities*	35.55	11/2/09	10/31/12			

Figure 3. Work Breakdown Schematic by Task and Subtask

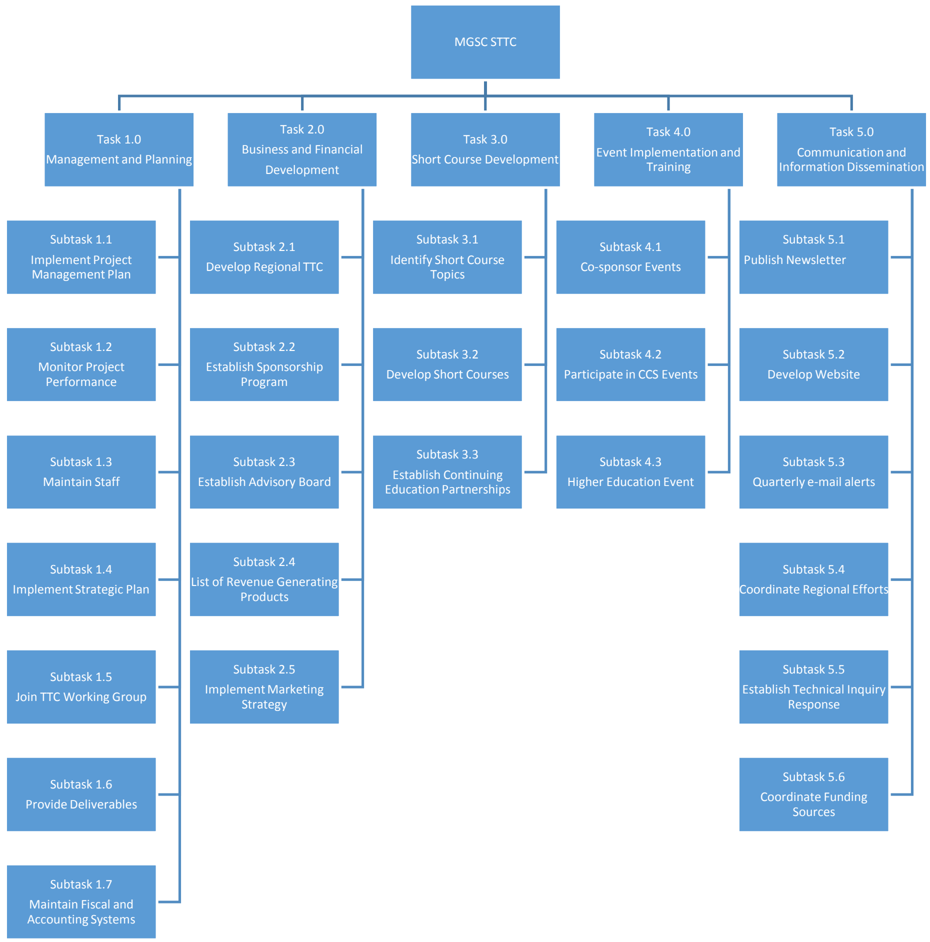

Table 4. Work Breakdown Structure Dictionary

Index	Description	Responsible	Total Project Cost Allocation	Period of Performance	Relationship to Other Tasks
1.0	**PROJECT MANAGEMENT AND PLANNING**	**Sallie Greenberg – ISGS** **MGSC STTC Coordinator – ISGS** **Sarah Wade – AJW**	**$124,091**	**November 2009 - October 2012**	**This task relates to Tasks 2, 3, 4, and 5 as part of the fundamental framework for all management of the project.**
1.1	*Implementation of the project management plan (PMP)* - The PMP will be implemented upon funding. Project team will work in conjunction with the AB to implement and update the plan as needed.			November 2009 - April 2010	
1.2	*Coordinate and monitor regional CCS project performance* - MGSC STTC will coordinate and monitor regional CCS project performance in accordance with the PMP and AB recommendations. MGSC STTC staff and MGSC scientific team will attend conferences to expand CCS knowledge.			November 2009 - October 2012	
1.3	*Maintain sufficient regional staff* - MGSC STTC Director, Coordinator, and Graphics Specialist will be supported through contract funding. Technical training staff will be provided through vendors, subcontractors, and cost-share MGSC experts.			November 2009 - February 2012	
1.4	*Implement strategic planning as directed by advisory board* - A report, based on AB recommendations, outlining for strategic plan, business model, and marketing strategy will be produced.			November 2009 - July 2010	
1.5	*Create and provide required deliverables to DOE* - Deliverables will be submitted to DOE in accordance with the “Federal Assistance Reporting Checklist,” and outlined in Section D – Deliverables.			November 2009 - April 2012	
1.6	*Maintain appropriate fiscal and accounting systems* - ISGS contract specialists will coordinate and maintain fiscal and accounting systems in accordance with DOE and U of I requirements.			November 2009 - October 2012	

Table 4. Work Breakdown Structure Dictionary (cont.)

2.0	**PROJECT BUSINESS AND FINANCIAL DEVELOPMENT**	**Sallie Greenberg – ISGS** **Sarah Wade - AJW**	**$135,578**	**November 2009-December 2010**	**This task relates to all other tasks in the project as the framework for the business model, marketing strategy, and product development.**
2.1	*Develop and implement a regional carbon sequestration technology training center* - A regional carbon sequestration technology training center will be developed incorporating multi-track short courses, lecture series, regional training conferences, and other technology transfer. Information dissemination will be multi-level to benefit early, mid-, and late-career audiences.			November 2009-November 2010	
2.2	*Implementation of organized sponsorship development program* - A corporate sponsorship program will be established to support current and future costs from industry, service providers, and independent operators over a range of revenue levels.			November 2009-October 2010	
2.3	*Establish an advisory board* - AB comprised of CCS experts from industry, academia, state agencies, and service providers will be established to provide input on diversified business model, marketing strategy, short course and job training development. Administrative support will be provided.			November 2009-April 2010	
2.4	*Establish a list of revenue generating products* - A diverse list of revenue generating products will be developed throughout the project period. Potential products will include, but are not limited to, short course notes, lecture presentations, workshops, and conference proceedings. The business model for the MGSC STTC will include recommendations for a set of products to be developed.			November 2009-July 2010	
2.5	*Develop and implement marketing strategy* - With input from the AB, MGSC STTC will develop and implement marketing strategy generating annual funding to support one full-time and one half-time staff member after three years. The program will be self-sustaining after three years and continue to provide training courses through the organized sponsorship program and fees collected during the initial three year start-up. The marketing strategy will include website, electronic newsletter, and trade shows.			November 2009-November 2010	

Table 4. Work Breakdown Structure Dictionary (cont.)

3.0	**PROJECT DEVELOPMENT OF SHORT COURSES ON CCS TECHNOLOGY**	**Sallie Greenberg – ISGS** **Sarah Wade – AJW** **Scott Marsteller – SCS** **Vendors (tbd)**	**$225,772**	**November 2009 - October 2011**	**This task relates to all other tasks as the main initial product of the MGSC STTC.**
3.1	*Identify topics for short course development* - MGSC STTC will consult AB and use surveys to identify short course topics and training needs. MGSC STTC staff will coordinate with other TTCs to leverage programs and provide multiple opportunities. A report reviewing existing and potential training possibilities and recommendations for providing optimal technology training will be written.			November 2009 - July 2010	
3.2	*Work with CCS experts to develop short courses, lectures, and course materials* - MGSC STTC will work with experts from MGSC, Schlumberger Carbon Services, law and policy, financial, communications, and others to develop short courses that provide technology transfer from existing and upcoming field projects. Courses will be modular so individuals can customize training to their needs.			July 2010 - October 2011	
3.3	*Identify and work with professional societies to provide Professional Development Hours (PDH) or Continuing Education Unit (CEU)* - MGSC STTC will work with American Water Works Association, PAG members, and other PDH/CEU providing organizations to provide workshops at regional conferences and member convenient-venues.			November 2009 - September 2010	

Table 4. Work Breakdown Structure Dictionary (cont.)

4.0	**EVENT IMPLEMENTATION AND TRAINING**	**Sallie Greenberg – ISGS** **MGSC STTC Coordinator – ISGS** **Sarah Wade – AJW** **Scott Marsteller – SCS** **Vendors (tbd)**	**$354,040**	**November 2009 - October 2012**	**This task relates to Tasks 1, 3, and 5 as the fundamental product delivery activity of the project.**
4.1	*Participate in co-sponsored CCS training events* - MGSC STTC will participate in technology training events, outreach opportunities, and networking with CCS associations, professional societies, state agencies, oil and gas operators, coal companies, utilities, MGSC and RCSPs, and service sector. MGSC STTC will attend conferences to provide training for professional organizations. Co-sponsored CCS lecture and brown-bag lunch series will be developed by MGSC STTC and U of I for U of I educational and technological community. A report on co-sponsored MGSC STTC events will be prepared, summarizing speakers, participants, benefits to community and industry as a result of CCS training.			July 2010 - October 2012	Task 1
4.2	*Organize, prioritize, and participate in CCS events* - A series of stand-alone, modular short courses will be designed so courses can be conducted individually or at conferences and co-sponsored events in the Midwest and nationally. Lecture series, short courses, brown-bag seminars, workshops will provide maximum impact of training while supporting the schedules of expert trainers. At least two modular and one university conference will be conducted during Phase II.			November 2009 - October 2012	
4.3	*Develop and hold higher education-oriented event* - A joint MGSC STTC and U of I CCS conference will be organized and held in Champaign, Illinois. The conference will include opportunities for students, faculty, and researchers to visit the Illinois Basin – Decatur Phase III large-scale deep saline injection project during critical phases of the project such as drilling, injection, and monitoring. CCS experts from the MGSC, universities, and government will be gathered to participate in the event.			August 2011 - April 2012	

Table 4. Work Breakdown Structure Dictionary (cont.)

5.0	**COMMUNICATION AND INFORMATION DISSEMINATION**	**Sallie Greenberg – ISGS** **MGSC STTC Coordinator - ISGS** **Sarah Wade - AJW**	**$155,509**	**November 2009-October 2012**	**This task relates to all Tasks as mechanism for communication about project and dissemination of information produced.**
5.1	*Publish a training newsletter* - An electronic newsletter will be published quarterly			November 2009 - October 2012	
5.2	*Develop a training website* – In Phase I, a website will be developed with course information, training calendars, technology related information, advertisements/promotional space, and products.			November 2009 - May 2010	Task 4
5.3	*Provide quarterly e-mail technology alerts* - CCS technology and training information alerts will be distributed quarterly in e-mail technology alerts.			October 2010 - October 2012	Task 4
5.4	*Coordinate and leverage regional efforts* - MGSC STTC will work with U of I, the Indiana and Kentucky Geological Surveys, government agencies, and commercial CCS project developers to coordinate and leverage technology transfer and information deliver by participating in regional working groups, attending conferences, and coordinating efforts with other CCS professional programs.			November 2009 - October 2012	
5.5	*Respond promptly to technical inquires* - An inquiry response procedure will be established to insure prompt response to technical CCS inquires.			November 2009 - August 2010	
5.6	*Coordinate funding source required activities*- MGSC STTC will work with funding sources to conduct necessary project work during budget period.			November 2009 - October 2012	

F. SUCCESS CRITERIA AT DECISION POINTS

Task 1 – Project Management and Planning

The implementation of comprehensive project management is critical to accomplishing all other tasks. The success of Task 1 will be demonstrated by the implementation of the project management plan to guide the development, management, and reporting of the MGSC STTC. The successful project management plan will be updated with input from the negotiation process and with input from the newly formed Advisory Board. Other critical components of Task 1 include the creation and implementation of the strategic plan which guide the business development for the MGSC STTC, hiring staff, ,and establishing accounting systems. Successful completion of Task 1 activities in the three year budget period will result in the establishment of a project framework so that all other tasks can be carried out, reported on, and completed in a timely manner.

Task 1 will be advantageous to DOE, project staff, and other stakeholders by providing a framework for developing and implementing the MGSC STTC. Successful project management and planning will help establish the MGSC STTC as a premier CCS training and technology transfer organization. Task 1 success criteria for the single budget period include:

- Presentation of revised project management plan
- Presentation of strategic plan
- Timely completion of deliverables and milestones

Task 2 – Project Business and Financial Development

The success of Task 2 over the course of the three year project period will be demonstrated by the creation and development of a regional carbon sequestration technology training center, the MGSC STTC, that provides modular short courses and workshops for multiple audiences, co-sponsors a lecture series, offers brown bag lunches, and other technology transfer opportunities Audiences that will benefit from the development of the MGSC STTC include, but are not limited to early to late-career geologists, engineers, technicians, executives, regulators, and support staff. Critical components of Task 2 include establishment of an organized sponsorship development program, an advisory board, and a list of revenue generating products. Development and implementation of a marketing strategy, with input from the Advisory Board is also critical.

Task 2 will benefit the MGSC STTC, DOE, and regional and national participants of MGSC STTC events by providing a business model and marketing strategy that provide for the MGSC STTC to conduct successful training events while planning and preparing for future opportunities beyond the initial three year project period. The organized sponsorship development program and Advisory Board will benefit the developing MGSC STTC and others by ensuring high quality, expert training is developed and distributed. A critical go/no-go decision point in Task 2 will be to determine if the MGSC STTC should continue after the initial budget period. This decision will be made based on data collected through Task 2 and an assessment of the business viability and demonstrated need for technology training. Task 1 success criteria for the single budget period include:

- Establishment of organized sponsorship development program
- Presentation of marketing plan
- Establishment of Advisory Board

Task 3 – Project Development of Short Courses on CCS Technology

Development of short courses and preparation for the teaching of short courses is the critical activity in Task 3. Surveys will be used to identify topics of interests to potential participants. The data from surveys will be used in conjunction with MGSC STTC staff expertise and Advisory Board recommendations to decide what short courses to develop and which short courses to develop first. The MGSC STTC will also work with professional organizations in Task 3 to establish synergistic relationships whereby MGSC STTC workshops can be taught at professional organization conferences and member-convenient venues with an opportunity for professional development hours (PDHs) or continuing education units (CEUs) where appropriate.

Task 3 success criteria for the single budget period include:

- Presentation of list of short course topics
- Presentation of instructional materials developed for short courses
- Presentation of agreements with professional organization to co-sponsor, host, and support MGSC STTC events

Task 4 – Event Implementation and Training

Successful event implementation and training will be demonstrated by the completion of two week-long technology training seminars. Additional training short courses and workshops will be implemented at MGSC STTC hosted events, at professional organization annual meetings and events, and other available venues. Task 4 critical success criteria include the successful establishment of a lecture series and brown bag luncheons, as well as a CCS higher education conference to be held in conjunction with the University of Illinois.

Task 4 events will benefit MGSC STTC short course participants, University of Illinois faculty, staff, and technical staff, and Midwest regional job training programs through instruction about key CCS components, such as characterization, regulatory frameworks, well design and well integrity, and monitoring, verification, and accounting. Task 4 success criteria for the single budget period include:

- Completion of two week-long short course events
- Completion of co-sponsored university lecture series
- Completion of higher-education CCS conference

Task 5 – Communication and Information Dissemination

The success of Task 5 will be demonstrated by the creation of communication tools for the MGSC STTC including a training newsletter, website, quarterly e-mail alert system. A responses system for handling technical inquires will be established as a critical component of Task 5. Communication about CCS and about the events and opportunities available through DOE, RCSPs, MGSC, other funding sources, and the MGSC STTC is critical to establishing effective information dissemination. The MGSC STTC will be successful if considered the go-to place for information about CCS in the Midwest.

Multiple stakeholders will benefit from the successful completion of Task 5 by gaining access to information about CCS-related activities and opportunities for technology transfer. Success criteria for Task 5 for the single budget period include:

- Presentation of the training newsletter
- Presentation of the Website

APPENDIX A – STATEMENT OF PROJECT OBJECTIVES

Development and Implementation of the

Midwest Geological Sequestration Consortium CO2-Technology Transfer Center

Statement of Project Objectives

A. OBJECTIVES

The Illinois State Geological Survey (ISGS) in collaboration with the Midwest Geological Sequestration Consortium (MGSC) will create a regional technology training center to disseminate carbon capture and sequestration (CCS) technology gained through leadership and participation in regional carbon sequestration projects. The MGSC Sequestration Technology Transfer Center (MGSC STTC) will provide education and training opportunities for engineers, geologists, service providers, regulators, executives, and others. MGSC STTC will work with state and regional job development programs to stimulate economic recovery and development by training personnel for commercial CCS projects. MGSC STTC will work with professional organizations and regional experts to leverage existing training opportunities and provide stand-alone training. Phase I will be concentrated in the first nine months and focus on management, development, and communication/information dissemination with some tasks lasting the entire three year period. Phase II will be two years focused on implementation and training, communication/information dissemination, and management.

B. SCOPE OF WORK

During Phase I, MGSC STTC will put a project management plan (PMP) into place and appoint an advisory board (AB) to provide business development, strategic implementation, and oversight. Upon AB recommendations, MGSC STTC will research and develop lists of topics for course development, professional organization partnerships, a schedule for stand-alone training events, and will co-sponsor event opportunities. MGSC STTC will work with CCS experts to develop course materials, lectures, and curriculum for modular training events. A system for coordinating and monitoring project management progress will be implemented. MGSC STTC will publish a quarterly newsletter, create a training website, produce e-mail tech alerts, and establish a response system for technical inquires. During Phase II, the strategic plan will be put into place and training events will be conducted.

C. TASKS TO BE PERFORMED - PHASE 1

Task 1.0 – Project Management and Planning

Subtask 1.1 Implementation of the project management plan (PMP) - MGSC STTC shall coordinate with the DOE Project Officer to modify and update the PMP submitted as part of this application. MGSC STTC shall submit a revised PMP within 60 calendar days of the award. The DOE Project Officer shall then have 30 calendar days from receipt to review and provide comments to MGSC STTC. Within 20 days after the receipt of the DOE comments, MGSC STTC shall submit a final PMP to the DOE. As the project proceeds the MGSC STTC will work in conjunction with the Advisory Board (AB) to implement and update the PMP as needed. If found to be necessary, a risk management plan will be developed and updated periodically to reflect changes in MGSC STTC operations.

Subtask 1.2 Coordinate and monitor regional CCS project performance - MGSC STTC will monitor the activities of on-going and developing regional CCS projects and coordinate STTC activities with CCS project events when feasible and in accordance with AB recommendations. MGSC STTC staff and MGSC scientific team will attend conferences to remain up-to-date on current CCS projects and activities, which will allow training to capitalize on the most current information during instruction. This information will be provided in the newsletter.

Subtask 1.3 Maintain sufficient regional staff – MGSC STTC Director, Coordinator, and Graphics specialist will be supported through contract funding. Technical training staff will be provided through vendors, subcontractors, and cost-share MGSC experts.

Subtask 1.4 Implement strategic planning as directed by Advisory Board - A report, based on AB recommendations, outlining a strategic plan, business model, and marketing strategy will be produced.

Subtask 1.5 Create and provide required deliverables to DOE - Deliverables will be submitted to DOE in accordance with the "Federal Assistance Reporting Checklist," and outlined in Section D – Deliverables.

Subtask 1.6 Maintain appropriate fiscal and accounting systems - ISGS contract specialists will coordinate and maintain fiscal and accounting systems in accordance with DOE and U of I requirements.

Task 2.0 – Project Business and Financial Development

Subtask 2.1 Develop and implement a regional carbon sequestration technology training center – A regional carbon sequestration technology training center will be developed incorporating multi-track short courses, lecture series, regional training conferences, and other technology transfer. A diversified business model will be developed and will incorporate a marketing strategy designed to achieve a self-sustaining program at the conclusion of the project period.

Subtask 2.2 Implementation of organized sponsorship development program - A corporate sponsorship program will be established to support current and future costs from industry, service providers, and independent operators over a range of revenue levels.

Subtask 2.3 Establish an advisory board – An AB comprised of CCS experts from industry, academia, state agencies, and service providers will be established to provide input on the development of a diversified business model, marketing strategy, and short course and job training curriculum. Administrative support will be provided.

Subtask 2.4 Establish a list of revenue generating products - A diverse portfolio of revenue generating products will be developed throughout the project. Potential products will include, but are not limited to, short course notes, lecture presentations, workshops, and conference proceedings. The business model for the MGSC STTC will include recommendations for a set of products to be developed.

Subtask 2.5 Develop and implement marketing strategy - With input from the AB, MGSC STTC will develop and implement a marketing strategy generating annual funding to support one full-time and one half-time staff member after three years. The program will be self-sustaining after three years and continue to provide training courses through the organized sponsorship program and fees collected during the initial three year start-up. The marketing strategy will include website, electronic newsletter, and trade shows.

Task 3.0 – Project Development of Short Courses on CCS Technology

Subtask 3.1 Identify topics for short course development - MGSC STTC will consult AB and use surveys to identify short course topics and training needs. MGSC STTC staff will coordinate with other TTCs to leverage programs and provide multiple opportunities. A report reviewing existing and potential training possibilities and recommendations for providing optimal technology training will be written.

Subtask 3.2 Work with CCS experts to develop short courses, lectures, and course materials – MGSC STTC will work with experts from MGSC, Schlumberger Carbon Services, law and policy, financial, communications, and other sectors to develop short courses that provide technology transfer from existing and upcoming field projects. Courses will be modular so individuals can select from a menu of options to customize training to their needs. Information dissemination will be multi-level to benefit early, mid-, and late-career audiences.

Subtask 3.3 Identify and work with professional societies to provide Professional Development Hours (PDH) or Continuing Education Unit (CEU) - MGSC STTC will work with American Water Works Association, PAG members, and other PDH/CEU providing organizations to provide workshops at regional conferences and member convenient-venues.

TASKS TO BE PREFORMED - PHASE II
Task 4.0 – Event Implementation and Training

Subtask 4.1 Participate in co-sponsored CCS training events - MGSC STTC will participate in technology training events, outreach opportunities, and networking with CCS associations, professional societies, state agencies, oil and gas operators, coal companies, utilities, MGSC and RCSPs, and service sector. MGSC STTC will attend conferences to provide training for professional organizations. Co-sponsored CCS lecture and brown-bag lunch series will be developed by MGSC STTC and U of I for the U of I educational and technological community. A report on co-sponsored MGSC STTC events will be prepared, summarizing speakers, participants, benefits to community and industry as a result of CCS training.

Subtask 4.2 Organize, prioritize, and participate in CCS events - A series of stand-alone, modular short courses will be designed so courses can be conducted individually or at conferences and co-sponsored events in the Midwest and nationally. Lecture series, short courses, brown-bag seminars, workshops will provide maximum impact of training while supporting the schedules of expert trainers. At least two significant conferences will be conducted during Phase II.

Subtask 4.3 Develop and hold higher education-oriented event - A joint MGSC STTC and U of I CCS conference will be organized and held in Champaign, Illinois. The conference will include opportunities for students, faculty, and researchers to visit the Illinois Basin – Decatur Phase III large-scale deep saline injection project during critical phases of the project such as drilling, injection, and monitoring. CCS experts from the MGSC, universities, and government will be gathered to participate in the event.

Task 5.0 – Communication and Information Dissemination

Subtask 5.1 Publish a training newsletter - An electronic newsletter will be published quarterly.

Subtask 5.2 Develop a training website – In Phase I, a website will be developed with course information, training calendars, technology related information, advertisements/promotional space, and products.

Subtask 5.3 Provide quarterly e-mail technology alerts - CCS technology and training information alerts will be distributed quarterly in e-mail technology alerts.

Subtask 5.4 Coordinate and leverage regional efforts - MGSC STTC will work with U of I, the Indiana and Kentucky Geological Surveys, government agencies, and commercial CCS project developers to coordinate and leverage technology transfer and information delivery by participating in regional working groups, attending conferences, and coordinating efforts with other CCS professional programs.

Subtask 5.5 Respond promptly to technical inquires - An inquiry response procedure will be established to insure prompt response to technical CCS inquires.

Subtask 5.6 Coordinate funding source required activities- MGSC STTC will work with funding sources to conduct necessary project work during budget period.

D. DELIVERABLES

The Recipient shall submit periodic, topical, and final reports in accordance with the Federal Assistance Reporting Checklist and the instructions accompanying the checklist for regular and ARRA reporting.

ARRA Reporting Requirements

In addition to reporting requirements defined within the Federal Assistance Reporting Checklist, the Recipient is responsible for updating and submitting an excel workbook to the DOE Project Manager no later than 10 days after the end of the quarter. The Recipient shall populate the initial excel workbook with the following information:

(1) initial start and finish dates for each task,

(2) percent complete for each task,

(3) total project costs by month,

(4) training course name, date and number of CEUs and PDH awarded,

(5) Milestones and

(6) FTE's for each quarter.

NOTE: All teaching materials, lesson plans, website data, newsletters, etc. collected in this effort shall be delivered to DOE/NETL for review and approval that can be used for internal purposes at NETL. Teaching materials include but are not limited to CDs/DVDs and all workshop and seminar materials.

MGSC STTC shall also provide specific deliverables listed below:

8. Updated Project Management Plan
9. Advisory Board Roster
    - The Advisory Board Roster shall include complete list with personnel, title, area of expertise, role of each member, and short biography.
10. Website Event Calendar
    - This calendar shall be maintained and updated with training events and other CCS activities for the training center.
11. Sponsorship Development and Marketing Plan (Strategic Plan Report)
    - Sponsorship Development and Marketing plan shall include a diversified business model including types of participation that shall include but not be limited to speakers, workshop materials, technology bulletins, and event sponsorship; as well as a plan to develop a “sustainable” program that shall reliably generate annual funding.

- Updated Sponsorship Development and Marketing Plan shall be submitted to account for any changes to business model and marketing plans to meet the goal of creating a "sustainable" program incorporating any lessons learned that can be shared throughout all Regional Technology Training Centers to establish a successful national program.

12. Regional Technology Training Plan (Professional Training Needs Survey and Findings)
    - An initial Regional Technology Training Plan shall include short courses and other planned CCS events (lecture series, brown-bag, half- and full-day workshops, conferences) to be developed and experts who will collaborate in development; content of short courses and other events; plan for revisions of courses based on feedback from participants; initial proposed timeframe to implement courses and other events; identification of organizations and verification that courses to be taught are in the process of being registered for PDH and CEUs.
    - Final Regional Technology Training Plan is the final version of the Initial Regional Technology Training Plan and discuss the implementation of actual training and include a detailed schedule for short courses/other events (such as lecture series topics/dates; seminar topics/materials/dates; conferences planned sessions and dates; short course and workshop final content, instructors/speakers) and verification that any short courses taught are officially registered for professionals to receive CEUs and PDHs.
13. University Lecture Series and Training Events Report
14. CEU and PDH Tracking
    - As per the ARRA reporting requirements, excel spreadsheets shall be utilized to document and report the number of CEU's and PDH's awarded in each training event, per event, by training date as well as cumulative for the training center. Individual award certificates in PDF format for each individual who successfully completes the course will be submitted with each quarterly report as verification documentation for CEU's and PDHs reported.

E. BRIEFINGS/TECHNICAL PRESENTATIONS

The Recipient shall participate in a Project Kick-off Meeting that will be held as part of the Annual Regional Partnership Meeting, at the Pittsburgh Hilton, November 16-19, 2009. The Recipient is required to prepare and present an overview of their newly awarded Regional Sequestration Technology Training.

The Recipient shall prepare annual detailed briefings for the following:

- Presentation to the DOE Project Officer at the NETL facility located in Pittsburgh, PA or Morgantown, WV. Briefings shall be given by the Recipient to explain the plans, progress, and results of the technical effort at least once per year. DOE may substitute attendance of meetings at NETL for recipient participation in external merit reviews. The Recipient shall provide an annual debriefing meeting for all interested parties discussing project progress and results either at DOE or other selected location.

- Present a technical paper(s) at the DOE/NETL Annual Contractor's Review Meeting to be held at the NETL facility located in Pittsburgh, PA or Morgantown, WV or at an alternative conference with the location to be agreed upon by the DOE and Recipient.

The Recipient shall deliver technical presentations, both oral and poster, at conventions, annual symposiums, and/or other local, regional, and national technical meetings.

Attachment C

Business/Marketing Plan 2010

STEP Business/Marketing Plan

December 2010

Sequestration Training and Education Program (STEP)

STEP is a program of the Advanced Energy Technology Initiative, University of Illinois and is supported by the US Department of Energy under Award Number DE-FE0002462 and the Illinois Department of Commerce and Economic Opportunity #09-484002.

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STEP Business/Marketing Plan

Sequestration Training and Education Program (STEP)

Executive Summary

STEP in conjunction with the Illinois State Geological Survey (ISGS) and the Midwest Geological Sequestration Consortium (MGSC) is working to create a regional technology training center to disseminate carbon capture and sequestration technology gained through leadership and participation in regional CCS projects. STEP will provide education and training opportunities for engineers, geologists, service providers, regulators, executives, and others to stimulate economic recovery and development by training personnel for commercial carbon capture and sequestration (CCS) projects. The program will generate sufficient funds to support one full-time and one half time staff member after three years. After three years, this program will receive sufficient funds through sponsorship and fees collected for conferences and workshops to continue providing expertise and educational programs for the CCS community.

Mission Statement: To ensure the highest quality, best value educational experience through regional, national and international exchange programs, and be a recognized leader in the design and implementation of CCS curricula and educational products.

Vision Statement: To be a high–performing organization expert in providing hands-on learning experiences and information sharing on cutting-edge climate mitigation technology, including carbon capture and storage, through exceptional outreach and education programs, and which is characterized by diverse, high quality, high value learning opportunities.

Situational Analysis

Industry summary: While demand for energy continues to grow, our reliance on fossil fuels in the medium term is a certainty, yet the CO_2 produced from these fossil fuels presents us with an unprecedented situation as greenhouse gases increase. It is widely accepted that CCS can play an important role in reducing green house gas emissions generated from these fossil fuels. However, widespread acceptance and use of CCS is not solely dependent on science; but must include a regulatory component and public confidence and support.

Existing customers: As a newly formed entity, STEP has a limited database of contacts, however STEP has access to some relationships developed through MGSC and the ISGS and can build on this base.

A major goal going forward will be to create a database of contracts and customers. In support of this goal, a mechanism for self-addition to the STEP mailing list and database has been added to the STEP website. This database is under development and currently contains over 500 names generated from personal contacts, attendee lists from targeted conferences, and inquiries received electronically.

Products/services description

Training Courses. STEP will train personnel in the implementation of CCS technology. CCS technologies offer great potential for reducing CO_2 emissions and mitigating global climate change. Deploying these technologies will require a significantly expanded workforce trained in the various specialties that are currently under represented in the United States. Education and training activities undertaken in this project will develop a future generation of geologists, scientists, and engineers that will provide the human capital and skills required for implementing and deploying CCS technologies. The training activities will focus on the applied engineering and science of CCS for site developers, geologists, engineers, and technicians, while providing a technology transfer platform for CO_2 sequestration. The training resulting from the selected projects will produce the workforce necessary for the CCS industry with skills and competencies in geology, geophysics, geomechanics, geochemistry, and reservoir engineering disciplines. When applicable these training courses will provide CEU's and PDH's.

Proposed list of training opportunities for 2011

- **Climate change teacher training course for Teachers in the Illinois Basin** . Program will be developed in collaboration with The Keystone Center and will be offered at Richland Community College in late May. This program will draw primarily from educational institutions within driving distance from Decatur, Illinois.
- **Earth Explorer Decatur**. Using a pre-existing program to provide content for an after school program and/or a five day summer program for gifted students.
- **IEAGHG International CCS Summer School**. Program will be developed in collaboration with the International Energy Agency Greenhouse Gas R&D Program. STEP will serve as the local host organization and will coordinate all conference details. The Summer School will be held in Champaign, Illinois July 17-21, 2010 and will attract 50-60 international graduate students.
- **Carbon Capture and Sequestration, Complete Project Development**. This 2-3 day program is intended to give a complete CCS picture for engineers, geologist and service providers. Course will touch upon project development, site characterization, permitting, reservoir engineering, Monitoring, Verification and Account (MVA), simulation and risk assessment and communication. Course will be held in central Illinois in early November and is projected to draw a national audience (exact date and location are still being developed). It is also possible that this course could be developed as an add-on to the PAG meeting in September.
- **Site Visits and Demonstrations.** A full-day workshop providing knowledge-sharing opportunities for scientists, project developers, graduate students and other interested parties. This course outline has already been submitted for CEU certification (through the U of I).

Attendees are provided one-on-one time to engage with Illinois Basin-Decatur Project leaders and personnel. The course will include extensive course materials; an interactive presentation and demonstration as part of a field site visit; as well as in-depth discussion and question/answer periods. The course is designed so attendees take away a clear understanding of all aspects of a working carbon capture and sequestration site – including but not limited to: 1) capture, 2) compression/dehydration, 3) monitoring, verification and accounting, 4) well construction, 5) data gathering and management, 6) project development and 7) best-practices and project management – lessons learned. This workshop is usually arranged on an ad hoc basis for specific groups and has traditionally been held 3-4 times per year. In addition to these, the workshop will now be offered once per year to a general audience.

In addition to the traditional education programs listed above it is our intention to develop a Webinar program to reach targeted groups for specific topics. Webinars are a quick and easy way to disseminate information and are seen as low cost method to reach new audiences. Webinars are relatively easy to coordinate and can be produced quickly to address current issues and concerns. These webinars may be sponsored to cover participation fees and encourage greater attendance. Information about the webinars will be posted on the STEP website and they will be promoted using our e-alerts. It is our goal to have one webinar each quarter of 2011. These one hour webinars will be recorded and available on the STEP website for access to others at a later date. Topics are still being developed and we are seeking input from the board before committing to particular topics. Potential webinar topics may include:

- *CCS 101 for Policy Makers*. Course developed for largely non-science attendees. Potential audience would be regulators, legislators, municipal employees and other governmental agencies. Would include an overview of CCS – what it is and how it works and how this can impact the environment; will touch upon current EPA regulations and other safeguards; examples of existing sites; costs and other financing issues; and research on public perception and social engagement.
- *Ways to incorporate CCS* into traditional geology courses. Material developed for current geology educators and would highlight ways to incorporate CCS and this new technology into existing programs.
- *What's new in CCS technology?* This course is developed for those already in the field who want to stay current on new technologies and practices (like new wire line technology).

- *Financing CCS.* This course is designed for venture capitalists who are interested in green technology. Course would include project overview, timelines, associated costs and potential funding agencies.

Proposed 2011 STEP Timeline

January	
February	Webinar (topic TBD)
March	1st quarter newsletter
April	
May	**Climate change teacher training course for the Illinois Basin Teacher** Webinar (topic TBD)
June	2nd quarter newsletter
July	**IEAGHG International CCS Summer School**. (July 17-21, 2011)
August	Webinar (topic TBD)
September	3rd quarter newsletter; **Site Visits and Demonstrations**
October	Webinar (topic TBD)
November	**Carbon Capture and Sequestration Short Course**
December	4th quarter newsletter

Sponsorship program. Industry support is fundamental to a strong STEP program. Not only will it provide the financial base for a continued program but it will provide shared expertise and knowledge for a stronger CCS program. A multilevel sponsorship program is designed to attract financial support at all levels. Low level sponsors will be solicited for specific items used at training courses (pens, paper, portfolios, etc.) Higher levels could support things like speaker expenses and meeting related expense (i.e. receptions, field trips, etc.). Each level of sponsorship will have a corresponding level of benefits for our corporate partners. We will use two different approaches for sponsorship – one will solicit donations through STEP, to become a STEP Corporate Affiliate. Corporate Affiliates will have the opportunity to sponsor meeting related events and activities throughout the year while being recognized year- round as a STEP sponsor. Another approach will be to solicit donations specifically for the 2011 IEAGHG Summer School, recognition for these sponsor will center on summer school audience. A highly refined list of potential sponsors is being cultivated and will include local, national and international entities involved in all aspects of CCS

Quarterly Newsletters. These quarterly newsletters will focus on activities and events happening in and around the Illinois Basin but will also include broader informational items that may be of interest to the CCS audience. Understanding that everyone on our current mailing list is already involved in the CCS, the newsletters will be written with this in mind. We will use a standard template each quarter so it will have a branded look. Depending on activities/time of year the newsletters may include: what's happening at the site (new development, visitors, etc.); what's new at STEP (staff, presentations, training programs, webinars, outreach, etc.); what's happening at the DOE (RFP's, new announcements, etc.); in the news; new published CCS research; meetings of interest; legislation updates; notes from the director; featured news items or invited article. Newsletters will be delivered electronically and will give receivers the opportunity to opt-out of newsletter delivery (while staying on our list for other purposes). A tentative timeline proposes newsletters in March, June, September and December with a delivery date on/around the 15th of the month.

E-Alerts. These e-alerts will be periodic electronic communications between STEP and our database. These alerts will be used as information becomes available outside of the regularly scheduled quarterly newsletter. This could be milestones related to the project or just a reminder about a course registration. We are aware of the danger of sending out too many e-alerts as the audience will be less receptive if they are overused. It is conceivable to assume one e-alert per month – in non-newsletter months. This results in no more than eight e-alerts per year. Recipients will also be given the opportunity to opt-out of receiving these alerts.

Web Library. We will begin to archive webinars and record other presentations with the goal of developing a web based library of CCS presentations. This would allow visitors to our website to review previously presented material to meet their specific educational needs.

Competition Assessment

In addition to STEP, US DOE-NETL has selected six other technology transfer centers to receive funding through the ARRA to help develop regional sequestration technology training centers in the United States. The seven centers will facilitate the transfer of knowledge and technologies required for site development, operations, and monitoring of commercial CCS projects. These include:

- EOS Alliance, Seattle WA
- Southwestern US Carbon Sequestration Training Center, Socorro, NM
- Carbon Capture and Storage in the Permian Basin, Tulsa, OK
- The Southeast Regional CO_2 Sequestration Technology Training Program, Norcross, GA
- STORE, Austin, TX
- Wyoming Carbon Capture and Sequestration Technology Institute, Laramie, WY
- STEP, Champaign, Illinois.

Each of these organizations is structured to potentially offer training programs and projects in direct competition to STEP. However, representatives from each group came together for a collaborative discussion at the NETL Regional Partnerships Annual Review Meeting October 6, 2010 in Pittsburgh, PA. It was agreed that the centers would benefit from a collaborative, non-competitive working relationship with open communication.

In addition there are other private and public sector firms conducting CCS training which will compete for the same audiences. An analysis of these organizations and their programs is in progress and may impact STEP course development.

STEP SWOT Analysis (conducted with AB August 2010)

Strengths:

- CCS injection demonstration site in Decatur with injection from 2011 to 2014 and access to on-site meeting facility.
- Involvement in multiple CCS projects (IBDP, New ADM project, Regional Knox CCS Study, FutureGen 2.0, Taylorville Energy Center, EOR Pilots, ECBM Pilot)
- Significant technical expertise
- Location
- University conference facilities
- Ability to host conferences, summer programs, brown bag seminars for academic community
- Advisory board brings expertise and connections
- MGSC Partnership involvement
- Long history of conducting education programs
- Petroleum Technology Transfer Council – ISGS has hosted for several years, will draw on experience and contacts.

Weaknesses:

- Staff resources limited
- Staff time limited
- Scheduling of events is challenging due to programs, conferences, staff time
- Uncertainty of need, audience, and value
- Success defined by long-term sustainability, given no defined support beyond three year contract.
- Juggling multiple projects and programs
- No existing experience with sponsorship programs

Opportunities:

- Engage MGSC and other industry partners
- Engage public through programs
- Engage academic community through programs
- Develop workforce through programs
- Develop program with Richland Community College through Industrial Sources project at ADM
- Create new partnerships for wider audience (PTRC, PCOR, US EPA, RCC)
- Provide short courses here in Champaign

- Provide short courses at national meetings
- E-learning
- Linkage with Washington-based EOS Alliance
- Additional external funding for projects
- Connection with energy literacy and new energy initiatives
- Discussion on-going to expand Advanced Energy Technology Initiative
- Overseas opportunities with special focus on China and Japan
- Engage decision makers as consumers of sequestration services

Threats:

- Six other organizations funded to do exactly the same thing
- Competition for same audience – dilutes audience and impact potential
- Political uncertainty
- Director and staff potentially over-committed as other mandates develop.

Marketing Strategy

Profile of target markets: Domestic and international individuals or organizations seeking high quality information and/or training on CCS.

Customers and potential customers:

- International community
- Early career scientists and researchers
- Policy makers – briefings
- Communicators
- Government agencies developing alternative fuels programs
- MVA providers
- Project developers
- Educational community – University faculty seeking to input sequestration into curriculum; K-12 & Community Colleges to partner with Richland Community College for a certificate program.

Marketing strategies: A variety of strategies and tactics are being used to successfully position STEP projects and services. These include, but are not limited to:

Completed:

- Developed STEP brand to position it as a leader in CCS training.
- Developed attractive and useful STEP website to disseminate information on all aspects of CCS. Website has broad appeal and is functional for professionals seeking information as well as community members (teachers, environmentalists, news agencies, etc.). Website to include course information, training calendars, technology relate information, advertisements/promotional space

On-going:

- Website allows interested parties to sign up for quarterly e-mail alerts
- Developing a comprehensive database of individuals and companies interested in CCS technologies
- Developing multilevel sponsorship program to attract financial support at all levels. Then leverage these relationships with corporate sponsors to develop mutually beneficial programs and projects

Up-coming:

- Conducting market survey to assess current needs
- Research existing CCS courses and training programs

- Participating in technology training events, outreach opportunities and networking with CCS associations, professional societies, state agencies, oils and gas operators, coal companies, utilities, MGSC and RCSP's and service sector. Co-sponsorship of programs and projects including: related associations, state geological surveys, MGSC, US EPA Region V, Illinois Department of Commerce and Economic Opportunity, IEA
- STEP will attend and participate in exhibits at select industry meetings and conferences.
- Use social media (wikis, blogs, tweets, etc.) to facilitate communication with wide audience.
- Use the quarterly e-mail technology alerts to broadcast STEP activities and accomplishments.
- Press releases to announce news worthy accomplishments.

Pricing: Pricing for all projects and services will be competitive with industry standards. In some cases corporate sponsorship may help underwrite conference fees.

Management and Implementation: STEP Director will work with the Advisory Board to develop and review all programs and projects. Implementation of strategies will be the responsibility of the STEP staff under the supervision of the STEP Director.

Evaluation: Routine evaluation of all programs and projects is necessary to ensure the long term viability of STEP. All training programs and educational activities will include a course evaluation. Marketing strategies will be monitored to maximize impact.

Assessment: Pre and post-event surveys and interviews may be conducted to assess achievement of learning goals.

Attachment D.

List of organizations STEP has engaged in knowledge sharing.

Since its inception in 2009, STEP engaged with the following organizations to provide quality knowledge sharing programs:

Associations
American Association of Petroleum Geologists (AAPG)
Association of Professional Energy Consultants (APEC)
Council of Energy Research & Education Leaders (CEREL)
Illinois Science Teachers Association (ISTA)
International Standards Organizations (ISO)
National Association of Science Teachers (NSTA)
National Association for Research in Science Teaching (NARST)
Society of Petroleum Engineers (SPE)
The Geological Society of America (GSA)

Academia
Decatur Public School District 61
Kyushu University - Japan
New Mexico Institute of Mining and Technology
Queensland University of Technology - Australia
Richland Community College
Seoul National University, South Korea
Stanford University
Tsinghua University, Beijing, China
University Adelaide, Australia
University of Illinois, I-STEM Education Initiative
University of Illinois, Office of Continuing Education
University of Melbourne, Australia
University of Oslo, Norway
University of Utah
University of Wyoming
Western Kentucky University

Corporate

Archer Daniels Midland
FurtureGen Alliance
Industrial Economics Inc.
Schlumberger Carbon Services
Tenaska Inc.

Government

Illinois Department of Commerce and Economic Opportunity
U.S. EPA Region V – Underground Injection Control

Research and Training

CO2CRC - Australia
Enhanced Oil Recovery Institute
EOS Alliance
GreenGen – China
Health and Safety Laboratory (HSL) – United Kingdom
International Energy Agency Greenhouse Gas (IEAGHG)
Indiana Geological Survey
Industrial Technology Research Institute - Taiwan
International Institute for Carbon-Neutral Energy Research - Japan
Korea CCS Association – Korea
Korean Ocean Research & Development Institute - Korea
Korea Maritime Institute - Korea
Petroleum Technology Resource Center
Plains CO_2 Reduction Partnership (PCOR)
RECS Program
Research Institute of Innovative Technology for the Earth (RITE) – Japan
Southeast Regional Carbon Sequestration Partnership (SECARB)
Shaanxi Provincial Institute of Energy Resource and Chemical Engineering - China
South African Centre for CCS
SUCCESS, Centre for Environmental Energy Research, Norway
Taiwan Institute of Economic Research - Taiwan
Taiwan’s Clean Coal Master Project – Taiwan
The Keystone Center
UNIS Norway
World Resources Institute

Attachment E.

Job Descriptions

POSITION DESCRIPTION

Illinois State Geological Survey
Prairie Research Institute

Job Title: Sequestration Technology Training Specialist

Organizational Relationships:

Section/Unit: Advanced Energy Technology Initiative (AETI)
Center/Initiative Office of the Director
Supervision Exercised: None

Interaction with other Units/Sections/Centers: Interacts with 1) ISGS scientific staff engaged in carbon sequestration projects, ISGS IT staff, 2) Midwest Geological Sequestration Consortium partners, 3) various constituent groups including the MGSC Sequestration Technology Transfer Center clients, instructors, advisory board, as well as, the public, the education community, the regulatory community, funding agencies, other agencies and institutions, industry, and the scientific community.

Reporting Structure:

Reports to the AETI Assistant Director, who reports to the AETI Director, who reports to the Division Director, who reports to the Executive Director of the Institute, who reports to the Vice Chancellor for Research.

Function:

Assist in the development, organization, and operation of the Midwest Geological Sequestration Consortium's (MGSC) Sequestration Technology Transfer Center (STTC).

Responsibilities:

30%

Work closely with AETI Assistant Director to develop, promote, and market the STTC educational programs to disseminate sequestration education opportunities to multiple audiences, including short courses for professionals, government officials, policy makers, graduate and undergraduate students, educational community, and community colleges, including updating and coordinating course development, website development, and making presentations at national educational, government, and scientific conventions.

Work with instructors and contractors to develop new teaching materials that include course materials, hands-on activities, demonstrations, models, posters, videos, and interactive web materials.

Assist in the development of partnerships with other agencies, institutions, and professional societies.

Assist in the cultivation and facilitation of international partnerships with carbon capture and sequestration researchers, energy researchers, social science networks, and other special interest groups.

30%

Perform event planning, organizing, and managing, including brown-bag series, lecture series, modular conference workshops, and other educational events.

30%

Coordinate integration of data and communication needs through website.

Develop and maintain STTC newsletter, web calendar, and mailing lists.

Assist in the preparation, distribution, and tracking of reports for funding source, Advisory Board, and STTC clients.

Create and maintain STTC tracking, filing, and reporting system.

Provide support for STTC Advisory Board.

Communicate and coordinate with instructors to produce course materials, final reports, graphics, and presentations.

Develop, track, and coordinate STTC distribution of Continuing Education Units and Professional Development Hours.

Maintain STTC project bibliography.

10%

Work with the media staff to produce communications materials, website, and other STTC media-based products.

Qualifications:

Required:

Bachelor’s degree in communications, business, or similar discipline with at least 5 years experience.

Demonstrated business development, communication, and event planning experience.

Demonstrated ability to effectively communicate (written and oral) complex scientific subjects for multiple audiences and prepare materials for workshops and seminars and effectively communicate with the public, industry, and other agencies.

Demonstrated computer skills in word processing, spreadsheet, and database management.

Demonstrated organizational and planning skills to meet deadlines in a timely and efficient manner.

Demonstrated ability to work independently and meet goals and deadlines with minimal direction.

Effective interpersonal skills to actively collaborate in a team environment.

Ability to travel frequently to give presentations, demonstrations, and attend technical meetings.

Preferred:

Experience providing technical information and briefings to national and international policy makers, private industry, and government officials.

Experience working with non-governmental organization working groups and other expert panel processes to collaborate and reach consensus on emerging societal impacts of technological concepts.

Experience in social science research, teaching, and conducting workshops and seminars.

Experience developing new programs and program management.

Experience with international travel and communication, ability to communicate with international scientists, policy makers, and government officials.

Specific knowledge and understanding of fossil fuel energy resources, carbon sequestration science and Illinois coal resource development efforts, along with broad knowledge of geology and earth science.

Environmental Demands:

The work of this position takes places in an office setting. Must be able to use a computer, monitor, mouse and keyboard for extended periods of time. Must be able to travel frequently to give presentations, demonstrations, and attend technical meetings.

POSITION DESCRIPTION

Position Title: Graphic Designer
Department: Illinois State Geological Survey
Administrative Unit: Office of the Director/Advanced Energy Technology Initiative

FUNCTION:

Prepare and produce graphic artwork that may be used for informational, educational, and promotional purposes in multiple media forms such as print, video, displays, exhibits, Internet, and other computer formats. Support the graphic needs of a scientific unit by providing technical graphics, presentation materials, and other products as needed. Conduct post-production management of digital imagery.

ORGANIZATIONAL RELATIONSHIP:

The incumbent reports to the Media and Information Technology Administrator, who reports to the AETI Director, who reports to the ISGS Director, who reports to the Executive Director of the Institute, who reports to the Vice Chancellor for Research. The incumbent does not supervise the work of others.

DUTIES AND RESPONSIBILITIES:

80%
Resolve or advise on complex design problems and/or design projects that may have multiple media applications (such as design to be used on the Internet, in print, and in video) or when other complex production issues are involved.
Coordinate production of materials with outside vendors (as needed).
Help resolve problems or disputes with outside vendors (such as printers) when a high level of technical knowledge and expertise is required.
Advise supervisor of equipment and software needs and assist in budget preparation.
Provide cost/time estimates and procedural information for jobs, which require outside services and/or materials.
Create highly technical graphic designs.
Produce/coordinate multimedia projects, Web development.
Assist personnel and external clients in determining the most efficient and economical means of producing artwork to convey the client's information.
Plan and produce illustrations, animations and technical drawings.
Determine project objectives and prepares specifications, e.g., methods, supplies, and equipment needed.
Contribute to the generation and archiving of photographic or other images for the unit; may perform photographic work personally.
Contribute images and products to digital archives.
Produce final graphic images from electronic and other formats for slides, print, computer-aided presentations, Internet sites, external requests, and other purposes.
Examine proofs of completed jobs before and during the printing process.
Communicate with printers to ensure quality and compliance with specifications.

Produce in-house, print-on-demand products, e.g., posters, brochures, documents.

15%
Contribute to, document, and participate in outreach efforts, including conferences, workshops, exhibits, public field trips, the annual expo (open house), and other events.

5%
Perform other related duties as assigned.

KNOWLEDGE REQUIRED:

Knowledge of complex, multi-faceted design techniques. Knowledge of and experience with print production techniques and processes. Knowledge of compilation of cost estimates. Skill in dealing with a variety of persons (such as clients, printers, and vendors). Skill in operation of cutting-edge technology to provide client with effective products. Skill in solving highly technical design problems. Ability to meet client's need while also working within budgetary and time constraints. Ability to creatively manage and solve design problems. Ability to elucidate complex design options and present the merits of multiple solutions.

DIFFICULTY:

Under general direction of supervisor the incumbent must use judgment, initiative, and extensive knowledge to independently complete tasks.

PERSONAL RELATIONSHIPS:

The incumbent interacts with staff members, representatives of industry, government agencies, universities, and the public.

ENVIRONMENTAL DEMANDS:

The work of this position takes place primarily in an office setting. The work generally is sedentary and involves sitting for extended periods working at a computer, using a keyboard and mouse, and using repetitive hand motions for data entry. Routine tasks such as copying and filing require standing and bending. Preparation of occasional large products requires stretching, standing, bending, and lifting (up to 40 pounds).

Attachment F.

Sponsorship Brochure

STEP Corporate Affiliate Program.

Becoming a Corporate Affiliate means being an active part of the STEP mission to ensure the highest quality, best value educational experience through regional, national and international exchange programs. As the carbon capture and sequestration industry continues to evolve it is even more important to stay abreast of new technology. Partnering with STEP allows us to work together to disseminate carbon capture and sequestration technology gained through leadership and participation in regional CCS projects.

Join this like-minded group of industry partners working together to identify the most cost effective applications of CCS technologies to reduce CO_2 emissions. By working together we can leverage our shared expertise and knowledge to further the understanding of carbon capture and sequestration.

I hope you'll join us and promote the latest in scientific advances and discoveries and demonstrate not only your commitment to education but your support for the CCS community.

Silver, Gold, Platinum, Diamond (Plus a category for non-profit supporters.)

These signature items build your company's brand image and help you gain exclusive attention from those who purchase and use your products and services.

Put your company's name and logo in front of researchers, students, service providers, regulators, investors and industry executives from the international carbon sequestration industry. Build and reinforce your name recognition for your company and your products and services.

All corporate affiliates receive:

- Recognition as a sponsor in all meeting correspondences.
- Recognition as a sponsor on the STEP website.
- Signage recognizing sponsors at all STEP training events
- Recognition as a sponsor in the meeting program guides
- Recognition of sponsorship at the opening session.
- Complimentary registration at one STEP training program
- A link from the STEP website to your company page
- Product displays or table top displays at STEP programs
- Logo placement on promotional materials
- Literature inserted in conference materials
- Newsletter advertisement
- Banner advertisement on STEP website

EXCLUSIVE OPPORTUNITES FOR CORPORATE AFFILIATES

Secure your sponsorship today!

Don't miss the chance to showcase your company's products and services before the CCS community. By becoming a ***Corporate Affiliate*** you are given exclusive sponsorship opportunities at all STEP sponsored meetings and conferences, including the upcoming IEA GHG CCS Summer School, July 17 -22, 2011. Sponsorship opportunities for the summer school include but are not limited to:

Student Support

Sponsor an individual student or a group of students from a particular region of the world. Your sponsorship will help subsidize travel and conference expenses to allow for a complimentary educational experience for student participants. Students will have the opportunity to acknowledge their sponsors who will also be noted in conference literature.

Welcome desk at local airport

Work with Summer School organizers to host the welcome desk at the destination airport. This desk will be branded for the Summer School and will be instantly identified by Summer School attendees. Welcome desk will greet attendees with a hot or cold drink and snacks and will guide them in securing transportation the meeting hotel.

Portfolio Bags

Your logo or name will appear (along with sponsoring organization) on the side of the portfolio bag each Summer School attendee will receive at registration. This bag contains all program material needed for Summer School. Your company logo will be carried everywhere. Sponsorship also includes one company insert into the portfolio bag (brochure, flyer, or CD-ROM).

Lanyards

Each Summer School attendee is provided an official Summer School badge for entrance into the exhibit hall and educational sessions each badge is attached to a neck cord (lanyard); these neck cords are approximately ¾ wide and 19 inches long and will have your logo or name printed on them. This convenient cord offers your company great exposure and your logo will be seen by everyone, everyday, even after the Summer School ends.

Opening Reception

This fun and festive event officially opens the 2011 GHG-Summer School meeting. This themed event includes hors d'oeuvres, drinks and lively entertainment. Sponsorship includes a table top space for your company material and public recognition during the event and public acknowledgement as sponsor from the podium.

Lunch or Dinner

All social events encourage the sharing of knowledge and networking so vital to the CCS industry. Sponsoring a group meal provides an effective way to support continuing development. Sponsors can personalize the meal event to enhance the experience. Signage will be placed on all tables and sponsors will be thanked prior to the meal.

Beverage Breaks

These breaks are an important part of the social networking that occurs during the summer school. Coffee, tea, soft drinks, water and snacks are provided several times each day for all attendees. As a sponsor of the coffee breaks you will be recognized with signs and customized napkins (provided by donor).

Field Trip

Sure to become a high light of the conference, this all day excursion allows students a break from the traditional conference format to explore some of the unique features in central Illinois. Students and mentors will leave the hotel and travel by motor coach to (site to be determined). Sponsors will be recognized throughout the day as appropriate for the destination.

Other sponsorship opportunities:

- Summer School Notepads (with logo) – given to all attendees
- Pens (ballpoint with logo) – given to all attendees
- Summer School snack pack (with logo) – delivered to all attendees hotel room
- Summer School water bottles and coffee mugs – to be used throughout the meeting at designated drink stations.

Note: *Some sponsorship opportunities are subject to availability – please contact Sallie Greenberg as quickly as possible to build the best possible package for your company.*

Attachment G.

Speaker list with organization.

STEP Speakers

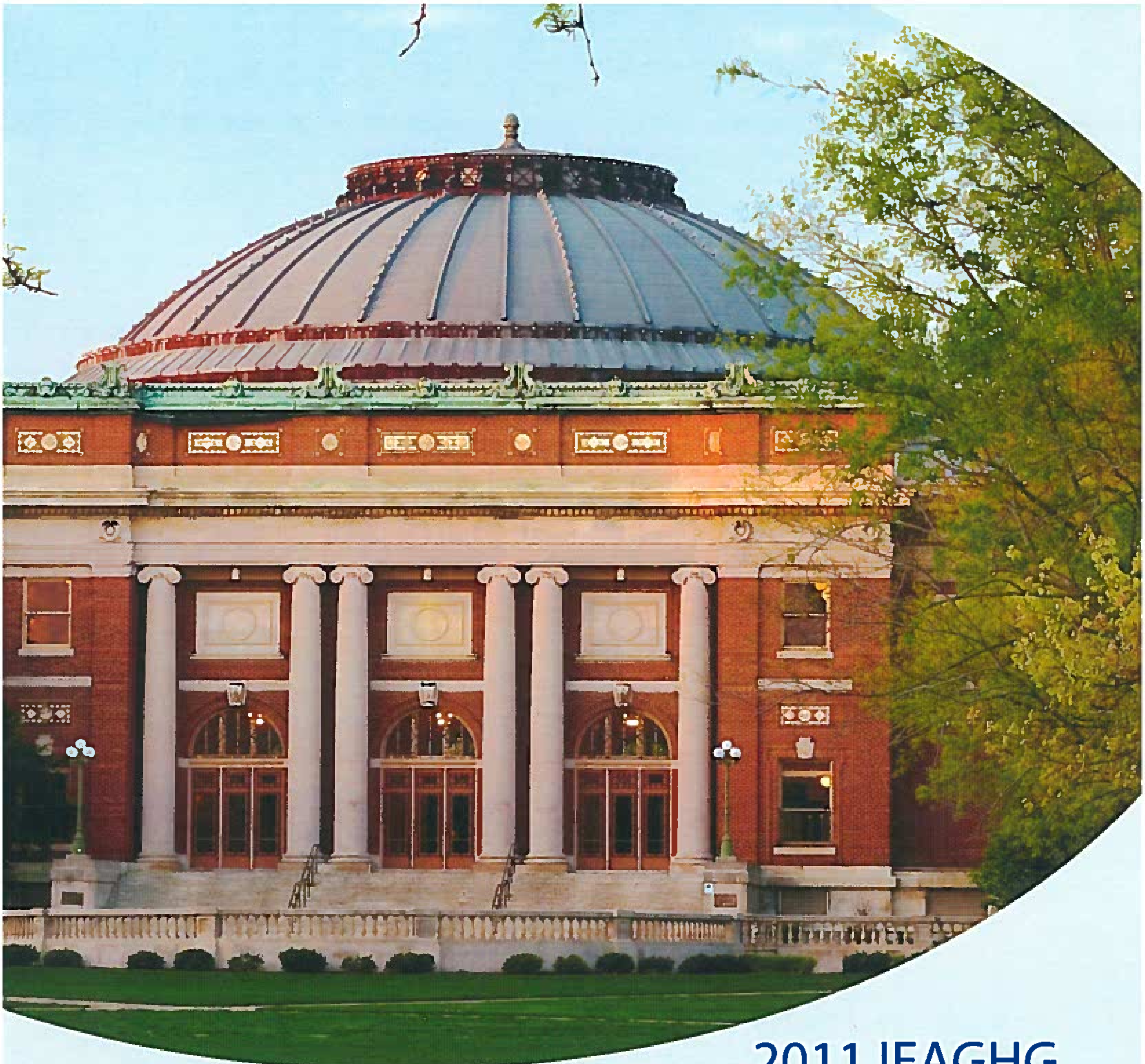
Name	Title	Organization
Rebecca Adwell	Education Consultant	Genesis Learning
Richard Aldous	CEO	CRC for Greenhouse Gas Technologies
Klaas van Alphen	Senior Adviser	Global CCS Institute
Ahsan Alvi	Project Manager	Schlumberger Carbon Services
Kathy Atchley	Program Coordinator	Illinois State Geological Survey
Bob Bauer	Quaternary and Engineering Geology	Illinois State Geological Survey
Brendan Beck	Manager	South African Centre for CCS
Larry Bengal	Director	Oil and Gas Commission
Tony Booer	Marketing & Technique Manager	Schlumberger Carbon Services
Bruce Brown	RCSP Coordinator	DOE/NETL
Ningsheng Cai	Professor, Deputy Director	Dept. of Thermal Engineering, Tsinghua University
Ameena Camps	Senior Project Officer	IEGHG
Zheng Chang	Post Doctoral Research Associate	Illinois State Geological Survey, Prairie Research Institute, UIUC
Kipp Coddington	Environmental Lawyer	Kazmarek Mowrey Cloud Laseter LLP
Marcia Couselan	Senior Geophysicist	Schlumberger Carbon Services
Syrie Crouch	Quest CCS Sequestration Manager	Shell
Darin Damiani	NETL Project Manager	DOE/NETL
Briony Daw	Senior Policy Advisor	Office of Carbon Capture and Storage, UK Dept. of Energy and Climate Change
Tim Dixon	Manager	IEAGHG
Eric Drosin	Director of Communication	Zero Emissions Platform
Andrew Duguid	Principal Engineer	Schlumberger Carbon Services
Terry Engelder	Professor	Penn State University
Giacomo Falorni	Operations Manager	TRE Canada
John Filiatrault	Vice President, CO2 Supply and Pipelines	Denbury Resources
Robert Finley	Director, AETI	Illinois State Geological Survey
Scott Frailey	Senior Reservoir Engineer	Illinois State Geological Survey
Jared Freiburg	Geologist	Illinois State Geological Survey
Lori Gauvreau	Marketing Communications	Schlumberger Carbon Services
Georg Grathoff	Professor	University of Greifswald
Satya Harpalani	Professor	Southern Illinois University
Ken Hnottavange-Telleen	Risk and Performance Manager	Schlumberger Carbon Services
Ana Houseal	Professor	University of Wyoming
Cheol Huh	Senior Research Scientist	Korean Ocean Res & Dev Institute
Abbas Iranmanesh	Senior Research Specialist	Illinois State Geological Survey
Phil Jagucki	Project Manager	Schlumberger Carbon Services
John Kaldi	Chief Scientist	CO2CRC

Name	Title	Organization
Jim Kirksey	Well Engineering Manager	Schlumberger Carbon Services
David Larssen	Westbay Technical Service Manager	Schlumberger Water Services
Donald Lee	Principal Geoscientist	Schlumberger Carbon Services
Hannes Leetaru	Senior Petroleum Geologist	Illinois State Geological Survey
Clare Lehane	Executive Publisher	Elsevier
Yu-Feng Lin	Hydrogeologist	Illinois State Geological Survey
John Lityneski	Sequestration Technology Manager	US Department of Energy
Randy Locke	MGSC MVA Coordinator	Illinois State Geological Survey
Yongqi Lu	Chemical/Environmental Engineer	Illinois State Geological Survey
Monica Lupion	External Affairs Director	CIUDEN
Scott Marsteller	Project Manager	Schlumberger Carbon Services
Franz May	Geologist- Project Head	Federal Institute for Geosciences and Natural Resources (BGR)
John McBride	Professor and Dept. Chair	Dept. of Geological Sciences, BYU
Kevin McCauley	Director, Advanced Technology Development	Babcock & Wilcox
Jeff McDonald	Geologist	US EPA Region V
Scott McDonald	Biofuels Development Director	Archer Daniels Midland
Ray McKaskle	Senior Engineer	Trimeric
John Medler	Project Manager	Schlumberger Carbon Services
Edward Mehnert	Senior Geohydrologist	Illinois State Geological Survey
Curtis Oldenburg	Staff Scientist	Lawrence Berkeley National Lab
Graham Payne	Geologist	Schlumberger Carbon Services
Dwight Peters	President	Schlumberger Carbon Services
Matthias Raab	Program Manager Geological Carbon Storage	CO2CRC
Warren Riemer	Student	University of Regina
Bryan Robinson	General Manager	Schlumberger Carbon Services
Ozgur Senel	Reservoir Engineer	Schlumberger Carbon Services
Philip Sharman	Director	Alstom Power
Dianna Shelander	Principal Geophysicist	Schlumberger
Valerie Smith	Reservoir Geophysicist	Schlumberger Carbon Services
Malgorzata Stein-Brzozowska	Process Engineer	Institute of Combustion and Power Plant Technology (IFK), University of Stuttgart
Martin Streibel	Project Manager	Centre for CO2 Storage, GFZ - German Research Centre for Geosciences
John Thompson	Director	Clean Air Task Force
John Tombari	Vice President	Schlumberger Carbon Services
ChiaraTrabucchi	Principal	IEc
Rosemary Whitbread	Programme Manager	Health & Safety Executive
Steve Whittaker	Group Leader	CSIRO
Bob Will	Principal Reservoir Engineer	Schlumberger Carbon Services
Bracken Wimmer	Senior Research Specialist	Illinois State Geological Survey
Li Xisochun	Professor	Chinese Academy of Sciences

Addendum

1. Printed program from IEAGHG Summer School (2011)
2. Printed programs from Printed programs from Midwest Carbon Sequestration Science Conference (2011-2014)
3. Samples of STEP branded materials
4. Subcontract report from Ana Houseal, University of Wyoming (August 2014)
5. Subcontract report from Fred Siewers, Western Kentucky University (June 2015)
6. PowerPoint Presentation from final DOE Project Overview (July 2015)

Addendum 1.
Printed programs from IEAGHG Summer School (2011)



2011 IEAGHG International CCS Summer School Programme

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Evaluating technology options to mitigate greenhouse gas emissions

STEP
SEQUESTRATION TRAINING AND EDUCATION PROGRAM

MGSC

Locally Hosted by STEP and MGSC
Univeristy of Illinois, Champaign, Illinois, USA
17th - 23rd July 2011

Welcome

On behalf of IEAGHG I would like to welcome all the students, experts and student mentors to the 5th IEAGHG International CCS Summer School. I hope that you find the technical programme to be of value and that you enjoy the summer school atmosphere as a whole. We are beginning to see considerable growth in the CCS industry, and expect this to increase in the years to come. We hope therefore that you will find this introductory programme to CCS encouraging and of great value when you start to look for a career in this industry in the near future.

I would like to take this opportunity to thank the committment and significant support offered by the sponsors and hosts, without whom this event would not be possible. A full list of all the sponsors can be found on page 4 of this programme.

Finally, I would like to extend our thanks to the local organisers, the Midwest Geological Sequestration Consortium (MGSC) and the Sequestration Training and Education Program (STEP) for all their assitance in helping to develop this event and in arranging the local logistics.

John Gale

General Manager

IEAGHG

Aims and Objectives

The IEAGHG CCS Summer School was initiated to provide students with diverse academic backgrounds, a broad understanding of the issues surrounding CCS and encourage their active participation in this area. The inaugural Summer School was held in Kloster Seeon, Germany in 2007 and the success of this event prompted IEAGHG to commit to an annual series at different locations around the world. The second event was held at Tigh-Na-Mara on Vancouver Island, Canada in 2008, the third event was held at Mantra Erskine Beach Resort, Lorne in Victoria, Australia in 2009 and the fourth School was held in Svalbard, Norway in 2010.

The summer school will be a week long exercise with presentations and discussion groups led by international experts in the field of CCS. In addition to the discussion programme, the students will be broken into teams to undertake short research activities on issues of importance within the CCS area, with a presentation to their peers at the end of the week. Time will also be allocated for networking and for informal discussions with the assembled experts. Students leaving at the end of the week will have developed a network of contacts in the field of CCS and will have gained a broad overview of the issues surrounding technology development and implementation in CCS.

For more information on the Summer Schools and IEAGHG's other activities, visit www.ieaghg.org

Committee Details

Local Organising Committee

The members of the Local Organising Committee are responsible for arranging logisitics of the Summer School. Their roles cover arrangements for the venues, travel arrangements, and social programme.

For the 2011 Summer School the Local Organising Committee comprises:

Kathy Atchley, ISGS

Daniel Byers, ISGS

Robert Finley, MGSC (ISGS)

Lori Gauvreau, Schlumberger Carbon Services

Sallie Greenberg, STEP (ISGS)

LaDonna Pearl, ISGS

International Organising Committee

The members of the International Organising Committee are responsible for organising the programme of the Summer School. Their roles cover arrangements for the speakers, mentors and development of the programme.

For the 2011 Summer School the International Organising Committee comprises:

Tim Dixon, IEAGHG (Chair)

Sallie Greenberg, STEP (ISGS) (Co-Chair, Host)

Ameena Camps, IEAGHG (Co-Chair)

Robert Finley, MGSC (ISGS) (Host)

Kathy Atchley, STEP (Host)

Lori Gauvreau, Schlumberger Carbon Services

Jürgen-Friedrich Hake, Forschungszentrum Jülich

John Kaldi, CO2CRC

Siân Twinning, IEAGHG

Klaas van Alphen, GCCSI

Ningsheng Cai, Tsinghua University

International Steering Committee

The members of the International Steering Committee are responsible for overseeing the continual progression and development of the Summer School.

The International Steering Committee comprises:

Jürgen-Friedrich Hake, Forschungszentrum Jülich (Chair)

Tim Dixon, IEAGHG (Vice Chair)

Olav Bolland, NTNU

Tony Booer, Schlumberger Carbon Services

Ameena Camps, IEAGHG

Isabelle Czernichowski, CO_2Geonet

Briony Daw, DECC

Eric Drosin, EU ZEP

John Kaldi, CO2CRC

Mónica Lupión, CIUDEN

Max Prins, Shell

Philip Sharman, Alstom

Aage Strangeland, Gassnova

Tore Torp, Statoil

Klaas van Alphen, GCCSI

Michael Whitehouse, RWE

Malcolm Wilson, PTRC

Contents

Important Information / Emergency Contacts

Emergency Contact Numbers: STEP staff members, Sallie Greenberg +1-217-766-7174 and Kathy Atchley +1-217-369-3219 are available 24/7 for emergency situations, as are the Welfare Mentors, John Kaldi +61-(0)418-801-896 and Lori Gauvreau +44-7-584-607-115.

Use of mobile phones is prohibited in technical session rooms; please turn off mobile phones and pagers before entering the room. Use of flash photography is prohibited in the technical session room.

Sponsors & Supporters

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).

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.
- To help facilitate international collaborative research, development and demonstration activities (R,D&D)

For more information, please visit www.ieaghg.org

About MGSC

The Midwest Geological Sequestration Consortium (MGSC) was awarded a U.S. Department of Energy - National Energy Technology Laboratory (U.S.DOE – NETL) contract to assess the safety and efficiency of carbon dioxide (CO_2) storage in the Illinois Basin, a 60,000 square-mile subsurface geological feature, which runs throughout Illinois, southwestern Indiana, and western Kentucky. The main objective of the MGSC is to determine the technical and economic feasibility of using these geologic formations for long-term storage. The MGSC is led by the Illinois State Geological Survey (ISGS), in conjunction with the Indiana Geological Survey and the Kentucky Geological Survey.

For more information please visit www.sequestration.org

About STEP

The Sequestration Training and Education Program (STEP) is a regional technology training center created by the ISGS, in collaboration with the MGSC, to facilitate knowledge sharing about CCS technology gained through leadership and participation in regional carbon sequestration projects. STEP is funded by the United States Department of Energy and provides local, national and international education and training opportunities for those interested in CCS technology.

For more information please visit www.sequestration.org/step

About Global CCS Institute

The Global Carbon Capture and Storage Institute is a bold new initiative aimed at accelerating the worldwide commercial deployment of at-scale CCS.

Announced by the Australian Government in September 2008, the Global CCS Institute was formally launched in April 2009 and because an independant legal entity in July 2009.

Its central objective is to accelerate the commercial deployment of carbon capture and storage (CCS) projects to ensure their valuable contribution in reducing carbon dioxide emissions. The Global CCS Institute has more than 38 national governments and over 274 leading corporations, non-government bodies and research organisations as foundation members or collaborating participants.

For more information, please visit www.globalccsinstitute.com

Sponsors & Supporters Continued

About The Prairie Research Institute

PRAIRIE RESEARCH INSTITUTE

The Prairie Research Institute is home of the State Scientific Surveys at the University of Illinois, including the Illinois Natural History Survey, Illinois State Archaeological Survey, Illinois State Geological Survey, Illinois State Water Survey, and Illinois Sustainable Technology Center. Institute scientists work to support economic development and natural and cultural resource sustainability for Illinois and beyond.

For more information please visit: www.prairie.illinois.edu.

About The Illinois State Geological Survey

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

The Illinois State Geological Survey (ISGS) is part of the Prairie Research Institute at the University of Illinois at Urbana-Champaign. The ISGS is a premier state Geological Survey serving the needs of Illinois with earth science information relevant to the State's environmental quality, economic vitality, and public safety. Some 200 scientists and technical support staff conduct basic and applied research in geology, compile geologic maps, and gather and manage the state's geological data to provide information to industry, governmental agencies and the public about the geology and mineral resources of Illinois.

Signature Sponsors

I²CNER

U.S. DEPARTMENT OF ENERGY

Collaborating Sponsors

DCEO

State of Illinois

Duke Energy®

DUKE is pleased to sponsor student participation from around the world and in their service area.

Sponsors

Denbury

ALSTOM

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

Schlumberger
Carbon Services

IEAGHG Summer School Series Sponsors

In addition to the sponsors and supporters listed above, the CCS Summer School also has Series Sponsors who have contributed to and support the ongoing work of the IEAGHG Summer School Programme. These sponsors are noted on the back cover of this programme.

Programme

Sun. July 17th

18.00 - 20.00
Welcome Reception, Illinois Ballroom A

Mon. July 18th

07.30 - 08.15
Breakfast Buffet

08.15 - 08.45 Welcome
E.Donald McKay, ISGS, Robert Easter, University of Illinois, William Shilts, Prairie Research Institute

08.45 - 09.15 Welcome
Rob Finley, MGSC (ISGS), Sallie Greenberg, STEP (ISGS), Tim Dixon, IEAGHG

09.15 - 09.45 CCS Overview
Sarah Forbes, WRI

09.45 - 10.15
Coffee Break

10.15 - 11.30 Storage I: Site Selection, Capacity, Injectivity
Rob Finley, MGSC (ISGS) & John Kaldi, CO2CRC

11.30 - 12.30 Storage II: Containment, including Migration Pathways and Wellbore Integrity
Franz May, BGR & Tony Booer, Schlumberger Carbon Services

12.30 - 13.30
Lunch

13.30 - 14.15 Storage III: EOR
Scott Frailey, ISGS

14.15 - 15.00 Storage IV: Modelling
Ed Mehnert, ISGS

15.00 - 15.45 Storage V: Monitoring & Verification
Randy Locke, ISGS

15.45 - 16.15
Coffee Break

16.15 - 16.30 IEAGHG Overview
Tim Dixon, IEAGHG

16.30 - 17.00 Introduction to Group Work
John Kaldi, CO2CRC & Ameena Camps, IEAGHG

17.00 - 18.00
Group Work/Free Time

18.00
Team Building Dinner at Gateway Park
Sponsored by Alstom

Tues. July 19th

07.30 - 08.30
Breakfast Buffet

08.30 - 09.15 Transport
John Filiatrault, Denbury Resources Inc.

09.15 - 10.00 Risk & Uncertainty
Syrie Crouch, Shell

10.00 - 10.30
Coffee Break

10.30 - 11.00 Economics
Phil Sharman, Alstom

11.00 - 11.30 Financing
Phil Sharman, Alstom

11.30 - 12.30 Public Acceptance & Communications
Sallie Greenberg, STEP (ISGS) & Lori Gauvreau, Schlumberger Carbon Services

12.30 - 13.30
Lunch
Sponsored by Denbury Resources Inc.

13.30 - 14.00 Policy - International
Brendan Beck, SACCCS

14.00 - 14.45 Legal & Regulatory, Carbon Accounting - International
Tim Dixon, IEAGHG

14.45 - 15.15 Policy & Legal - National
Kipp Coddington, M2C2

15.15 - 15.45 Regulatory - National
Sallie Greenberg, STEP (ISGS)

15.45 - 16.15
Coffee Break

16.15 - 16.45 China CCUS Developments & Perspective
Professor Ningsheng Cai, Tsinghua University

16.45 - 19.00
Group Work

19.00
Dinner (Illinois Ballroom C)

20.00 - 23.00
Opportunity for Group Work

22.00
Evening Snack

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Breakfast Buffet

08.30 - 09.15 He
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09.15 -10.00 Intr
Rob Finley, MGS(

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' Commerce and
ɔortunity (DCEO)

- 23.00
for Group Work

Thurs. July 21st

07.30 - 08.30
Breakfast Buffet

08.30 - 09.00 Capture I: Oxyfuel
Kevin McCauley, Babcock & Wilcox

09.00 - 09.30 Capture II: Pre-combustion
Mónica Lupión, CIUDEN

09.30 - 10.00 Capture III: Post-combustion
Mónica Lupión, CIUDEN

10.00 - 10.30
Coffee Break

10.30 - 11.00 CCS of Industrial Sources
Klaas van Alphen, GCCSI

11.00 - 11.45 Project Integration Panel Discussion
Led by Klaas van Alphen, GCCSI,
Panelists: Alstom, Babcock&Wilcox, CIUDEN, Schlumberger Carbon Services

11.45 - 12.30 NGO Perspective
John Thompson, Clean Air Task Force

12.30 - 13.30
Lunch

13.30 - 14.45 Industry Perspective Panel Discussion
Chaired by Ameena Camps, IEAGHG and Sallie Greenberg, STEP (ISGS)
Panelists: Alstom, Babcock&Wilcox, EUZEP, Schlumberger Carbon Services

14.45 - 19.00
Group Work

19.00
Dinner (Illinois Ballroom C)

20.00 - 23.00
Opportunity for Group Work

22.00
Evening Snack

Fri. July 22nd

07.30 - 08.30
Breakfast Buffet

08.30 -09.00 Outline of the Day

09.00 - 09.45 Final Preparations

09.45 - 12.45 Group Presentations

12.45 - 13.45
Lunch

13.45 - 14.30 Technical Writing
Clare Lehane, Elsevier

14.45 - 19.00
Free Time

19.00
Dinner & Awards Banquet
Cocktails at 19.00
Dinner at 19.45
(Illinois Ballroom A)
Sponsored by Duke Energy and Schlumberger Carbon Services

Sat. July 23rd

05.30 Assemble in the lobby ready for departure

06.00 Buses depart

Experts & Mentors

Brendan Beck	SACCCS, South Africa
Tony Booer	Schlumberger Carbon Services, UK
Ningsheng Cai	Tsinghua University, China
Ameena Camps	IEAGHG, UK
Kipp Coddington	Mowrey Meezan Coddington Cloud LLP, USA
Syrie Crouch	Shell, USA
Briony Daw	DECC, UK
Tim Dixon	IEAGHG, UK
Eric Drosin	ZEP, Belgium
Robert Easter	University of Illinois, USA
John Filiatrault	Denbury Resources Inc., USA
Robert Finley	MGSC (ISGS), USA
Sarah Forbes	WRI, USA
Scott Frailey	ISGS, USA
Lori Gauvreau	Schlumberger Carbon Services, UK
Sallie Greenberg	STEP (ISGS), USA
John Kaldi	CO2CRC, Australia
Clare Lehane	Elsevier, UK
Randy Locke	ISGS, USA
Mónica Lupión	CIUDEN, Spain
Franz May	BGR, Germany
Kevin McCauley	Babcock & Wilcox, USA
Ed Mehnert	ISGS, USA
Warren Reimer (Student Mentor)	University of Regina, Canada
Philip Sharman	Alstom, UK
Gosia Stein-Brzozowska (Student Mentor)	Universität Stuttgart, Germany
John Thompson	Clean Air Task Force, USA
Klaas van Alphen	GCCSI, Australia
Rosemary Whitbread	HSE UK

Students

Samer Gheyath Abdulrida	Iraq
Nate Adams	United States of America
Mustafa Al-Khabbaz	United States of America
Viktor Andersson	Sweden
Muhammad Waseem Arshad	Denmark
Caitlin Augustin	United States of America
Ahmet Bayrak	Germany
Sarah Bouquet	France
Tory Boyd	United States of America
Anne Sjoerd Brouwer	The Netherlands
Parvinee Chaemchaeng	Thailand
George Chen	Australia
Tomas Coca Stefaniak	Spain
Hang Deng	United States of America
Gláucia dos Santos Costa	Brazil
Marc Duchesne	Canada
Andrea Dunn	United States of America
Oscar Garcia-Cabrejo	United States of America
Manuel Gomez	Spain
Abigail Gonzalez	Mexico
Bin Guo	United States of America
Edlyn Gurney	Australia
Kodagoda Gamage Harinda Kodagoda	Thailand
Jessica Hinton	United States of America
Xiaolong Jiang	China
Mary Kang	United States of America
Kerry Kelly	United States of America
Marlinde Knoope	The Netherlands
Nai Yeen Gavin Lai	Malaysia
Selma L'Orange	Switzerland
Jianrong Lu	China
Tshifhiwa Maphala	South Africa
Anjana Meel	United States of America
Amanda Metcalf	Spain
Kioshi Mishiro	Japan
Thembane Mlambo	South Africa

Students Continued

Kahila Mokhtari Jadid	Turkey
Lakshmi Natarajan	United Arab Emirates
Saeid Nikoosokhan	France
Adebola Ogunlade	United Kingdom
Anamaria Padurean	Romania
Lingying Pan	China
Anna Pawlaczyk	Poland
Amy Peichun	United States of America
Carrie Petrik-Huff	United States of America
Peter Rendel	Israel
Jose Hugo Rodriguez Martinez	Mexico
Shameem Shah	United Kingdom
Daniel Sutter	Switzerland
Agnes Szamosfalvi	Hungary
Nuria Tavera-Valero	Norway
Amit Verma	India
Tao Wang	United States of America
Zhicheng Xu	China
Khandaker Zahid	United States of America

Guide to Organisations mentioned in this programme

BGR	Bundesanstalt für Geowissenschaften und Rohstoffe
CIUDEN	Fundación Ciudad de la Energía" ("Energy City Foundation")
CO2CRC	The Cooperative Research Centre for Greenhouse Gas Control Technologies
DECC	Department of Energy and Climate Change, UK
EU ZEP	European Union Zero Emissions Platform
GCCSI	Global Carbon Capture and Storage Institute
GFZ	Forschungszentrum Jülich
HSE UK	Health and Safety Executive UK
IEAGHG	IEA Greenhouse Gas R&D Programme
ISGS	Illinois State Geological Survey
M2C2	Mowrey Meezan Coddington Cloud LLP
MGSC	Midwest Geological Sequestration Consortium
PTRC	Petroleum Technology Research Centre
STEP	Sequestration Training and Education Program
WRI	World Resources Institute

Field Trip Information

For safety reasons all visitors must have closed-toe shoes and long pants to participate in the field trip. Be advised that we will be outdoors for most of the day so sunscreen is recommended.

Visitors to the Illinois Basin - Decatur Project (IBDP) are prohibited from taking any photographs or videos while on Archer Daniels Midland property. Use of mobile phones is not allowed on the ADM property.

10.00	Receive Group Assignments
10.15	Depart Champaign
11.15	Arrive at Illinois Basin - Decatur Project (IBDP), Decatur
11.15 - Noon	Lunch Break
Noon - 16.00	Divided groups will visit five stations for 45 minutes each to discuss project details
16.30	Buses depart Decatur for return to Champaign
17.30	Buses arrive at Jupiters at the Crossing for dinner
19.45	Buses depart Jupiters
20.00	Buses arrive at Hotel

IEAGHG Summer School Series Sponsors:

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Zep Zero emissions platform

IEA Greenhouse Gas R&D Programme

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Cheltenham, Glos. GL52 7RZ, UK

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Fax: +44 1242 680758 www.ieaghg.org

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PRAIRIE
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WELCOME CCS STUDENTS, SPEAKERS, AND MENTORS

The Prairie Research Institute at the University of Illinois, through the Institute's Illinois State Geological Survey, is a leader in CCS research technology, and education. The Prairie Research Institute is pleased to host the Midwest Geolgical Sequestration Consortium and the Sequestration Training and Education Program (STEP) as research and technology transfer programs of the U.S. Department of Energy – National Energy Technology Laboratory.

The Prairie Research Institute is home of the State Scientific Surveys. With 700 staff plus 400 student employees annually and a budget of more than $77 million, the Institute is one of the largest institutes within the University. Prairie Research Institute scientists work to support economic development and natural and cultural resource sustainability for Illinois and beyond. Scientists around the world refer to the work of the Institute in fields such as carbon capture and storage, geologic mapping, aquatic ecology, invasive species, atmospheric sciences, water resource research, floodplain mapping, clean technologies, energy conservation, transportation archaeology, and others.

For more information please visit www.prairie.illinois.edu.

Home of the Illinois State Scientific Surveys

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ILLINOIS STATE WATER SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS SUSTAINABLE TECHNOLOGY CENTER
PRAIRIE RESEARCH INSTITUTE

WELCOME TO THE IEAGHG INTERNATIONAL CCS SUMMER SCHOOL

The IEAGHG CCS Summer School was initiated to provide students with diverse academic backgrounds, a broad understanding of the issues surrounding CCS and encourage their active participation in this area. The inaugural Summer School was held in Kloster Seeon, Germany in 2007 and the success of this event prompted IEAGHG to commit to an annual series at different locations around the world. The second event was held at Tigh-Na-Mara on Vancouver Island, Canada in 2008, the third event was held at Mantra Erskine Beach Resort, Lorne in Victoria, Australia in 2009 and the fourth School was held in Svalbard, Norway in 2010.

The summer school will be a week long exercise with presentations and discussion groups led by international experts in the field of CCS. In addition to the discussion programme, the students will be broken into teams to undertake short research activities on issues of importance within the CCS area, with a presentation to their peers at the end of the week. Time will also be allocated for networking and for informal discussions with the assembled experts. Students leaving at the end of the week will have developed a network of contacts in the field of CCS and will have gained a broad overview of the issues surrounding technology development and implementation in CCS.

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). 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.

For further information visit www.ieaghg.org

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Mentors

Brendan Beck
Manager, South African Centre for CCS
South Africa

Brendan is the Manager of the South African Centre for CCS in Johannesburg. The Centre, established in 2009 is looking to further understanding and capacity around CCS in South Africa and work towards a national CO_2 test injection and CCS demonstration project. Brendan recently joined the Centre from the International Energy Agency (IEA) in Paris where he managed the CCS legal and regulatory work programme. Prior to joining the IEA, Brendan worked for the IEA Greenhouse Gas R&D Programme where he focussed on the legal and regulatory aspects of CCS as well as technical aspects of CO_2 storage and monitoring. Brendan completed his Bachelor of Engineering with Honours at the Australian National University.

Anthony Booer
Schlumberger Carbon Services
United Kingdom

Tony Booer is a Technologist and Manager. His role is currently Marketing & Technique Manager, for Schlumberger Carbon Services, a business unit formed in 2005 to provide technologies and services for the long-term geological storage of carbon dioxide. He has 28 years experience at Schlumberger in various roles in their UK and US research laboratories, technology centres and commercial environments. Tony holds a B.Sc.(Eng) in electronic engineering, a Ph.D. in geophysics and an MBA. He is a Director of the UK's Carbon Capture and Storage Association and serves on the Executive Committees of both the IEAGHG and IEA Clean Coal Centre.

Ningsheng Cai
Professor, Deputy Director
Tsinghua University
China

Professor Ningsheng Cai is deputy director of Department of Thermal Engineering, National Engineering Research Center of Clean Coal Combustion and Key Laboratory for Thermal Science and Power Engineering of Ministry of Education at Tsinghua University, Beijing, China. His current research activities encompass CO_2 capture for coal combustion with solid sorbents, combustion/catalytic gasification and oxygen/hydrogen production based on chemical looping, IGCC and poly-generation systems evaluation, and SOFC & hybrid system analyses.

A multi-disciplinary geoscientist by training, Ameena is a Senior Project Officer within the CCS and Regulatory Affairs team at IEAGHG. Since joining she has managed numerous IEAGHG activities including the IEAGHG-GCCSI Student Mentoring Programme, the 2010 Natural Releases of CO_2 Workshop, involvement within EU FR6 CO2ReMoVe and EU FR7 RISCS projects and, as Chair of the International Steering Committee for the 2011 IEAGHG Risk Assessment Network Workshop; actively participating in a number of additional activities including EU ZEP, the CSLF, and the LC/LP Scientific Group. Prior to joining IEAGHG, Ameena worked as a Research Fellow at CICCS, the University of Nottingham and as a Research Assistant within the Borehole Research Group at the University of Leicester. Ameena received her PhD from the University of Leicester in 2007. She also has an MSc in Applied Physical Oceanography from the University of Wales, Bangor and a BSc in Geology with Biology from the University of Birmingham.

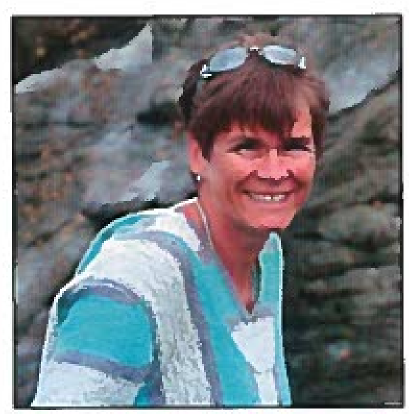
Ammena Camps
IEAGHG
United Kingdom

Kipp Coddington represents investors in and developers of conventional and renewable energy projects in the United States and abroad. His conventional energy experience focuses on projects with a carbon management component. His renewable energy experience focuses on projects that monetize carbon reductions, such as the Kyoto Protocol's Clean Development Mechanism and Joint Implementation programs.

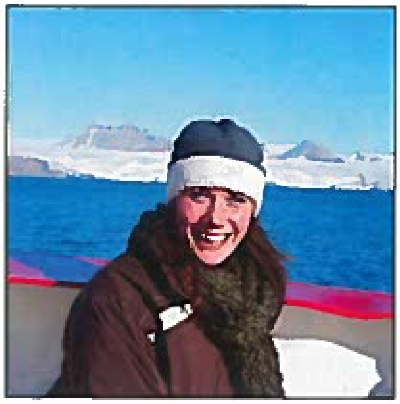
Kipp received his J.D., magna cum laude, from Georgetown University in 1993. He received his B.S. in chemical engineering, with highest distinction, from Purdue University in 1986, where he received the Outstanding Senior Engineer award. He is a member of the State Bars of the District of Columbia and Virginia.

Kipp Coddington
Mowry, Meezan, Coddington, Cloud, LLP
USA

Syrie is currently the Subsurface Manager for the Quest CCS Project. She has been employed with Shell for the past 20 years, during this period she has held a variety of both individual contributor and technical team lead roles across the global Shell group, and the project lifecycle from exploration through appraisal, development and into production. Prior to joining the Quest team Syrie has been involved in CO_2 EOR screening studies, Gas substitution and acid gas disposal projects for the last 5 years in the Middle East and Canada. As the Quest Subsurface Manager Syrie has been responsible for an exploration and appraisal program, site selection, acquiring Canada's first saline aquifer pore space tenure and is currently finalising a development plan for the CSLF recognised Quest project. Syrie is currently a member of the Albertan Government Regulatory Framework Assessment with a focus on MMV. As the Subsurface Manager for a CCS scheme her main interests are: Site selection exploration and appraisal in terms of storage capacity, injectivity, and containment.



Syrie Crouch
Shell
USA



Briony Daw
Office of Carbon Capture and Storage,
UK Dept. of Energy and Climate Change
United Kingdom

After reading Geography with Ecology at the University of Sussex, I accepted a job in conservation and climate change policy at a leading UK environmental NGO (RSPB), before joining the UK Government's Office of Carbon Capture and Storage (OCCS) in February 2010. I work on how the OCCS communicates the UK CCS Demonstration Programme of four projects to the public and CCS stakeholders, during a time of high political interest; the communication of the Front End Engineering Design Studies for Demonstrator 1; and managing a ministerial led Developers Forum, which addresses key barriers to the successful uptake of CCS in the UK.

Tim Dixon
IEAGHG
United Kingdom

Tim Dixon is the Programme Manager CCS and Regulatory Affairs for IEAGHG, an international research programme established since 1991. He is responsible for ensuring IEAGHG activities provide the evidence-base to support the growing regulatory and policy developments for carbon dioxide capture and storage (CCS). Previously he worked in related areas for UK Department of Trade and Industry and AEA Technology.

Eric Drosin
Director of Communication Zero Emissions Platform
Belgium

Mr. Drosin oversees the communications strategy, activities and media relations for ZEP, a unique coalition of stakeholders (companies, scientists, academics and environmental NGOs) united in their support for CO_2 Capture and Storage (CCS) as a key technology for combating climate change. He has accumulated extensive experience in the field of environmental and corporate communications, having developed Toyota Motor Europe's award-winning "Aim: Zero Emissions" communications strategy which supported the company's activities to become the automotive leader in environmental technologies. Prior to his work for Levi Strauss Europe and Toyota Motor Europe, Mr. Drosin worked as a journalist for Dow Jones Newswires and as an editor and front page columnist for The Wall Street Journal Europe.

John Filiatrault joined Denbury Resources as the Vice President of CO_2 Supply and Pipelines in June 2010. Prior to joining the company, his career spanned 23 years in the energy industry with Natural Gas Pipeline Company of America, El Paso Corporation, and Kinder Morgan in a variety of assignments relating to engineering and operations. His most recent assignments were Director of Risk Engineering and Director of Gas Pipeline Operations with Kinder Morgan. Mr. Filiatrault received his Bachelor of Science degree in Civil Engineering from Valparaiso University in 1988, and his MBA from Samford University in 2001.

John Filiatrault
Vice President, CO_2 Supply and Pipelines, Denbury Resources
USA

Dr. Robert J. Finley is the Director of the Advanced Energy Technology Initiative at the Illinois State Geological Survey, University of Illinois, Champaign, Illinois. He joined the Illinois Survey in 2000 after serving as Associate Director at the Bureau of Economic Geology, The University of Texas at Austin. Rob's area of specialization is fossil energy resources and carbon sequestration, areas in which he has a combined 30 years of experience. His work has ranged from large-scale energy resource assessment, addressing hydrocarbon resources at national and state scales, to evaluation of specific fields and reservoirs for coal, oil, and natural gas. He currently leads a major project on carbon sequestration in the Illinois Basin, the Midwest Geological Sequestration Consortium, one of the U.S. Department of Energy's regional carbon sequestration partnerships. In 2009 and 2010, he visited China as part of a World Resources Institute-U.S. Department of State sponsored exchange of U.S. and Chinese experts on geological carbon sequestration. vHe was recently appointed to the Illinois Carbon Capture and Sequestration Legislative Commission by Governor Pat Quinn.

Dr. Robert Finley
Illinois State Geological Survey, University of Illinois
USA

Sarah M. Forbes has led the World Resources Institute's (WRI) work on Carbon Dioxide Capture and Storage since May 2008, including the stakeholder processes that resulted in the publication of the Guidelines for Carbon Dioxide Capture, Transport and Storage, a robust set of technical guidelines for how to responsibly proceed with safe CCS projects, and the Guidelines for Community Engagement in CCS Projects, best practice guidelines for engaging local communities around planned demonstration projects. In her work, Sarah applies an ecological perspective to the regulatory, political and engineering challenges associated with demonstrating and deploying CCS technology. Prior to joining WRI, Sarah worked at the National Energy Technology Laboratory (NETL), serving in a number of capacities. Notably she led the roadmap development for the Department of Energy's carbon sequestration research program and conducted analyses on environmental aspects of CCS, the energy-water nexus, and climate change. Sarah lives in the Maine woods with her husband, son, and a dog named Moose. Her hobbies include cycling, kayaking, and cross-country skiing.

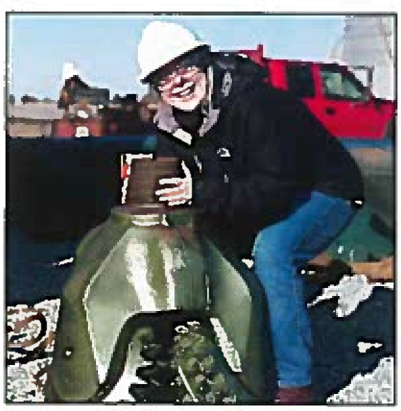
Sarah Forbes
World Resource Institute (WRI)
USA

Scott Frailey is a Senior Reservoir Engineer at the Illinois Geological Survey, and the Deputy Project Manager for the Midwest Geological Sequestration Consortium, one of the seven US DOE Regional Carbon Sequestration Partnerships. He has over 20 years of reservoir engineering experience in academia and industry specializing in CO_2 sequestration and EOR, reservoir simulation and reservoir characterization. Scott has a PhD from the University of Missouri-Rolla in Petroleum Engineering and is registered professional engineer in Texas, New Mexico, and Illinois.

Dr. Scott Frailey
Illinois State Geological Survey,
University of Illinois
USA

Lori has been with Schlumberger since 1998. For eight years prior to joining the Schlumberger Carbon Services team in May 2007. Since then Ms. Gauvreau worked with the Personnel group, the Marketing team, the Canadian Global Accounts group, then as communications and Events Manager for Schlumberger Canada, all based in the Calgary, Alberta office. Currently Lori resides in Oxford, UK and looks after Communications and Outreach for Global CCS projects.

Lori Gauvreau
Marketing Communications
Schlumberger Carbon Services
United Kingdom



Sallie Greenberg is the Sequestration Communications Coordinator for the Illinois State Geological Survey (ISGS) and Midwest Geological Sequestration Consortium (MGSC), one of the U.S. Department of Energy's seven regional sequestration partnerships. As the Assistant Director for the ISGS's Advanced Energy Technology Initiative, she helps lead a team of scientists working on several carbon capture and geologic sequestration projects, including the Illinois Basin – Decatur Project (IBDP) and FutureGen 2.0. Sallie spearheaded the Class 1 – Non-hazardous UIC permit process for the IBDP and recently received funding to launch the Sequestration Training and Education Program (STEP) to disseminate information and provide training and education for the public, educational community, and emerging carbon sequestration industry. Her combined training as an environmental geologist and a geoscience educator provide a unique perspective on understanding public challenges related to carbon sequestration and energy. She is currently working on a Ph.D. in Curriculum and Instruction at the University of Illinois.

Sallie Greenberg
Illinois State Geological Survey, STEP
University of Illinois
USA

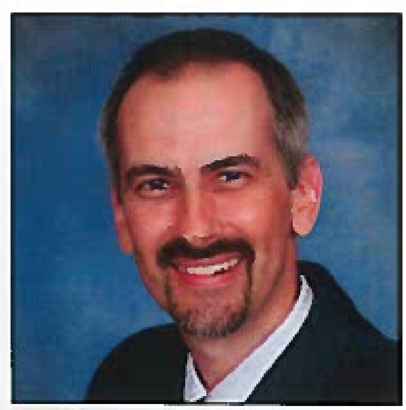
John Kaldi is the Chief Scientist for CO2CRC, and Professor and Chair of Geosequestration at University of Adelaide. John's expertise is in CO2 storage and petroleum geoscience. John's previous role was heading the Australian School of Petroleum (ASP) at University of Adelaide. Prior to academia, John spent 18 years in the Petroleum Industry (with Shell, Arco and Vico), in both technical and managerial roles. He has received numerous honours and awards from professional societies, including the American Association of Petroleum Geologists (AAPG)'s Special Commendation for Significant Lifetime Contributions to Petroleum Geology; Distinguished Service Award; Honorary Member Award; and Public Outreach Award. He has organised numerous workshops and conferences on Carbon Capture and Storage and has been a Distinguished Lecturer for AAPG, Petroleum Exploration Society of Australia (PESA) and Indonesian Petroleum Association (IPA) on several occasions. John is a member of the Society of Petroleum Engineers (SPE) committee on Geosequestration and is a proud member of the IEAGHG Summer School International Steering Committee.

John Kaldi
CO2CRC
Australia

I am the executive publisher for the Energy & Planetary Science portfolio of journals at Elsevier. I also manage the International Journal of Greenhouse Gas Control. I have a PhD in marine ecology from University College Cork, Ireland and I have been involved with energy related journals for the past 5 years

Dr. Clare Lehane
Elsevier
United Kingdom

Randy Locke is an Environmental Geochemist with the Illinois State Geological Survey in Champaign, Illinois. He is an Illinois Licensed Professional Geologist and the Coordinator of the Monitoring, Verification, and Accounting Program for the Midwest Geological Sequestration Consortium. He is a member of the National Ground Water Association and the Illinois Groundwater Association (IGA). He served the IGA for 12 years and was its Executive Committee Chair in 2004. His research has included extensive hydrogeological and geochemical investigations throughout Illinois including land use impact assessments, regional water resources assessments, wetland studies, and the development of field-based monitoring techniques.



Randy Locke
MGSC MVA Coordinator
Illinois State Geological Survey
USA

Monica Lupion
External Affairs Director, CIUDEN
Spain

Monica Lupion is the International Affairs Director of CIUDEN (2008-), a state-owned foundation currently operating a world-wide reference centre for Carbon Capture and Storage development and validation in NW Spain. She also holds a position as Associate Professor (2002-) in the Department of Chemical and Environmental Engineering at the University of Seville (Spain). From 2000 onwards, she has been involved in R&D on technological issues related to coal combustion and gasification processes, hydrogen and fuel cell technologies, under contract for a number of European utilities and/or the European Commission. Monica is a member of various international organizations related to energy and climate change mitigation such as the Technology Task Force and the Communication Group of the European Zero Emissions Platform (2009-), the European Energy Research Alliance (2009-), and EUROGIA+ Network (2010-) among others. She is author of more than 20 papers and contributions to peer-reviewed international conferences, and has participated as researcher in more than 15 national and international projects.

Dr. Franz May
Federal Institute for Geosciences and Natural Resources (BGR)
Germany

Dr. Franz May is a geologist and received his doctorate in geodynamics in 1994. From 1990–2000 he conducted research on relations between CO_2, magmatism and lithospheric transport processes since 2000 research on CO_2 storage at BGR & in European joint research projects on storage capacity, site selection and monitoring. Currently he is the head of unit geological CO_2 storage, technical interest: monitoring and site characterization.

Kevin McCauley
Director, Advanced Technology Development, Babcock & Wilcox
USA

Kevin McCauley is Director, Advanced Technology Development, Asia, and also serves as Manager, Strategic Planning, for the Babcock & Wilcox Power Generation Group, responsible for B&W's strategic planning and development activities within the Technology group, in Barberton, OH. Kevin has over 30 years of experience at B&W. Kevin holds a bachelor's degree in mechanical engineering from Clarkson University, a master's in business administration from Ashland University, an executive scholar certificate from Northwestern University, Kellogg School of Management, focusing on corporate strategic planning, and is a Registered Professional Engineer in the United States. Kevin serves on the DOE US-China Clean Energy Research Center program, EPRI CoalFleet for Tomorrow program, the Coal Utilization Research Council (CURC), the executive committee of the IEA Greenhouse Gas Programme, and is a member of the American Society of Mechanical Engineer's (ASME). Areas of interest are carbon capture technologies for coal-fired power generation, which includes post-combustion capture and oxycombustion capture.

Dr. Edward Mehnert is a Senior Geohydrologist with the Hydrogeology Section, Illinois State Geology Survey. He has worked at the ISGS since 1985. He holds degrees in Civil Engineering from Oklahoma State University (1982 B.S.), University of Notre Dame (1984 M.S.), and the University of Illinois at Urbana-Champaign (1998 Ph.D.).

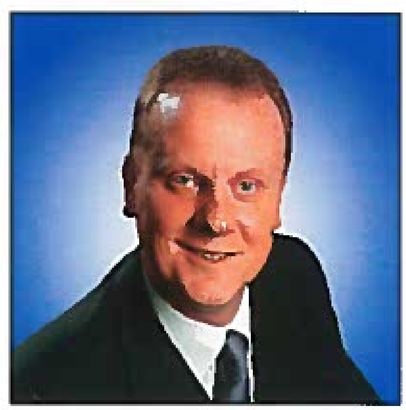
Dr. Mehnert's current research focuses on the use of analytic element modeling to estimate recharge and refine geologic modeling. In addition, he is involved with a research program to demonstrate the feasibility of geologic carbon sequestration into coal seams, oil reservoirs, and saline aquifers.

Dr. Ed Mehnert
Illinois State Geological Survey,
University of Illinois
USA

Warren Riemer is currently working for Kingsland Energy Corporation, an enhanced hydrocarbon recovery company, in Regina, Saskatchewan as Lead Geologist. Warren recently received his degree, Bachelors of Science, and completed an undergraduate thesis at the University of Regina. While at university he majored in geology, but also took some engineering courses to help broaden his knowledge. Warren is also pursing other options to possibly continue his education and further expand his knowledge of geology. Warren's background and areas of interests are in petroleum and structural geology, enhanced oil recovery, CO_2 storage, and reservoir characteristics.

Warren Riemer
University of Regina
Canada

Philip joined Alstom Power in June 2008 and is currently Director of Technology External Affairs, reporting to Alstom's Senior Vice-President of Technology. Prior to this, he spent over 25 years in the low-carbon energy sector both in the private and public sector. From 2001, he focused on technology transfer programmes addressing low-carbon energy technologies with North America for the UK Department of Trade and Industry and as an R&D Specialist for UK Trade and Investment. Philip's main focus of activity for Alstom is to develop stronger linkages with governments and research/design institutes/organizations and technology providers worldwide, creating business opportunities for Alstom's Power businesses. Philip currently represents the UK on the Technical Group of the Carbon Sequestration Leadership Forum (CSLF). He also chairs the UK's Advanced Power Generation Technology Forum (APGTF) and the Scientific Advisory Committee of the UK Research Councils' Energy Programme and sits on a number of management/governance or advisory boards.



Philip Sharman
Alstom Power
United Kingdom

Malgorzata Stein-Brzozowska

MSc. Eng., Institute of Combustion and Power Plant Technology (IFK) University of Stuttgart, Germany

Malgorzata (Gosia) Stein-Brzozowska , born 09/06/1981, Warsaw, Poland. Following studies in Environmental Protection and Management at Technical University of Gdansk (2000–2005), continued Master studies at University of Stuttgart in Process Engineering (2006–2008). She graduated complementary studies in Environmental Auditing (2005) and in European Studies (2008). After some experience with refuse derived fuels, in May 2008 she joined Institute of Combustion and Power Plant Technology, Univ. of Stuttgart as research engineer. Her main responsibilities include execution of industrial, national and international R&D projects concerning influence of combustion conditions on behaviour of boiler heat-exchanger-surfaces in oxy-fuel, super-critical and conventional power plants.

John Thompson

Clean Air Task Force

USA

John Thompson directs the Clean Air Task Force's Coal Transition Project. The project's primary purpose is to prevent climate change by fostering low-carbon coal solutions. The specific activities of the Coal Transition Project include: Endorsing environmentally sound commercial projects that advance gasification, post-combustion capture, enhanced oil recovery, and geologic sequestration; Transferring innovative, low-carbon coal technology between the US and China; Developing federal policy that speeds the transition of the US coal fleet to deep carbon dioxide reductions. John is a frequent presenter on coal technology and sequestration at conferences both in the United States and China. Last November, he led a delegation of 30 industry, government officials, and nonprofit leaders on a tour of China's advanced coal and sequestration sites. He has testified in numerous air permit and public service commission proceeding dealing with new power plants. John holds a B. S. degree in chemical engineering form the University of Illinois, Champaign-Urbana, as well as an M.B.A. from Olin School of Business at Washington University in Saint Louis.

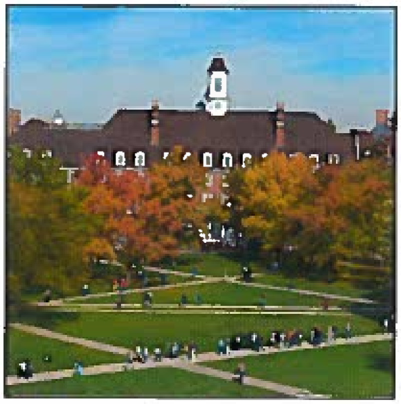
Dr. Klaas van Alphen

Global CCS Institute

Australia

Dr. Klaas van Alphen, Senior Advisor – Projects Knowledge Management In his role as Senior Advisor for the Global CCS Institute, Klaas is responsible for the assessment of applications for financial support of commercial scale CCS projects and management of key global industry/commercial relationships with CCS project developers. Klaas also leads the Institute's working group on "CCS Project Integration" in cooperation with the Technical Working Group of the CSLF and he recently joint the Executive Committee of the IEAGHG R&D programme. Before joining the Institute in 2009, Klaas has been involved in CCS research for over 5 years in the Dutch knowledge network on CCS (CATO) and focused on a variety of research topics ranging from public engagement issues to the development of techno-economic scenarios for CCS.

Students



Nate Adams
University of Illinois
USA

My undergraduate degree is in Civil Engineering from the University of Kentucky with a focus in water resources. In May I started my graduate work in the Environmental Hydrology and Hydraulic Engineering department at the University of Illinois. I am currently studying subsurface hydrology, specifically multiphase flow of supercritical carbon dioxide and brine. I will be modeling the injection of supercritical CO_2 into the Mt. Simon aquifer at the Illinois Basin - Decatur Project site in Decatur, IL.

Samer Gheyath Abdulrida
Chemical Engineer, Petroleum Research and Development Center
Iraq

I am a member of Iraqi group joint sharing research with OPEC countries in carbon management, as I have been appointed by the Iraqi Oil Ministry. My interest is to develop different solvents for capture CO_2. I have M.S.C. thesis on modification of CO_2 recovery. I am working as researcher engineer in petroleum research and development center in gas and refining department.

Viktor Andersson
PhD Student
Chalmers University of Technology
Sweden

My name is Viktor Andersson, and I am a PhD student at Chalmers University of Technology. I have a master's degree in Chemical Engineering, and also a master's degree in Sustainable Energy Systems. My PhD work is focused on process integration of post combustion CCS processes in the process industry. I will look at one refinery and also a cluster consisting of two refineries, one NGCC plant and one biomass gasification plant in order to see how waste heat can be utilized in order to lower the cost for CCS.

I am a Ph.D. fellow working on Thermodynamic modeling of Post-combustion CO_2 capture systems at Department of Chemical and Biochemical Engineering in Technical University of Demark. My current research area is experimental investigations of aqueous amines, DEEA and MAPA. It includes Freezing point depression of aqueous amines with and without CO_2 loadings, VLE and LLE measurements and thermodynamic modeling of these amines systems using Extended- UNIQUAC model. I have M.Sc. degree in Chemical Engineering. Based on my educational background, I have technical interests in the field of Process design and simulation, Separation processes, Thermodynamics and Experimentation, in short Chemical Process Engineering.

Muhammad Waseem Arshad
Technical University of Denmark
Denmark

I am PhD student at the University of Miami's Abess Center for Ecosystem Science and Policy. My background is in environmental and industrial engineering. My research is two-fold, I do reaction-transport and finite element modeling of injection sites and use these results to inform my analysis of a regulatory framework for CCS. I am particularly interested in the development of private industry standards as a basis for regulation.

Caitlin Augustin
University of Miami
USA

In October 2004 I started my studies in mechanical engineering at the Technische Universität München in Munich, Germany. Within this 5 year diploma course, my specialization was focused on applied power engineering on the one hand and more theoretical fluid mechanics and thermodynamics. In 2008 I gained some practical experience in the power industry during my internship at a power plant consultancy in southern France. Since June 2011 I am a PhD student at Stuttgart University. At the Institute of Combustion and Power Plant Technology I work on the oxy-fuel combustion technology applied in circulating fluidized beds.

Theodor Beisheim
IFK - University of Stuttgart
Germany

Sarah Bouquet
PhD Student, Mines Paris Tech
France

I am a PhD student (first year) at Mines ParisTech, France (Geosciences research centre). My work focuses on the geological storage of CO_2 and on modelling of this. The PhD subject is the study of interferences in between multiple CO_2 injection sites in deep saline aquifer at industrial scale and short to intermediate time scales. I was graduated last year for my master in petroleum geosciences and reservoir and for my geologist engineering diploma. During my studies, I worked on different CCS projects (Otway project in Australia, HARP in Alberta, Canada) or other studies related to CCS (mineral reactivity with CO_2).

Tory Boyd
MSc, University of Illinois
USA

I have my BS in Environmental Engineering from Clarkson University in Potsdam, NY. I am currently working towards my Masters in Environmental Engineering at the University of Illinois at Urbana-Champaign. My research is on pore-scale precipiation of carbonate minerals with applications to carbon sequestration. I use a small micro-fluidic device to stimulate subsurface conditions and inject mineral and carbonate solutions to form precipitates. I hope to relate these experiments to possible concerns at CO_2 injection sites such as decreased reservior porosity or caprock dissolution.

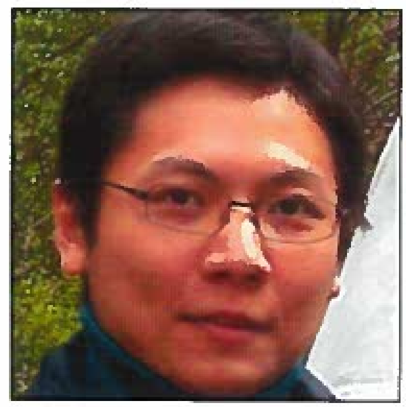
Anne Sjoerd Brouwer
MSc, Utrecht Unversity & ECN
The Netherlands

Anne Sjoerd Brouwer received his bachelor's degree in life sciences and master's degree in energy science from Utrecht University (UU) in The Netherlands. He has been working for the same university since July 2010: first as a junior researcher and since October 2010 as a PhD-student for a joint project of Utrecht University and Energy Research Centre of the Netherlands (ECN). The research focus of his 4-year project is on the interactions between CCS and other CO_2 emission reduction technologies within energy systems. Currently, he is studying the flexibility of power plants with CCS, and the effects of large scale implementation of both these power plants and wind power on the electricity system.

My dad is a diplomat so I have been given the opportunity to live in many countries including Mexico, Spain and Switzerland. Therefore, during my childhood I have moved to many countries and learnt 4 languages. I moved back to Thailand for my last years of high school and studied in the Science curriculum. I furthered my study in Thammasat University to study Chemical Engineering and received my bachelor degree. Right after graduation, I started my two-year master's degree at The Petroleum and Petrochemical Technology, Chulalongkorn University, majoring in Petrochemical Technology. I am currently starting second year working on my thesis.

Parvinee Chaemchaeng
MSc, The Petroleum and Petrochemical College, Chulalongkorn University
Thailand

I completed my Bachelors degree in Chemical Engineering at the University of Melbourne in 2007 and is now in the third year of my PhD degree in the area of membrane carbon capture under the supervision of A/Prof Sandra Kentish and Prof Greg Qiao. Gas separation membranes have potential in both pre and post-combustion capture from flue gases due to the small equipment footprint and low energy consumption. My PhD studies are focused on the influence of water vapor in the feed stream of a mixed gas membrane separation system.



George Chen
PhD Student, CO2CRC/ University of Melbourne
Australia

I am a Chemical Engineer that is currently working at CIUDEN's Technology Centre. My job role at the moment is to coordinate the construction and commissioning of the plant. My future career aspirations is to become an important part of the research team and to be able to lead new researchers into new and ambitious results in CCS, testing and optimizing the operation of the plant to accomplish a reasonable operating cost so CCS will attract more companies to this edge. As my background in water treatment, my interest (and curiosity) is on the membrane capture of CO_2 as I think that it may be a good and reliable unit for operation at post-combustion processes or where space limitations exist.

Tomas Coca Stefaniak
CIUDEN
Spain

Chemistry is my graduation, I did chemistry and industrial chemistry degree, both concluded on 2009/2. Then I joined the master's degree. The research group, which I entered, studies ways to recover methane gas from deep coal. Our group has a pilot site, where we study the steps in this process. My biggest interest is to increase my knowledge in this field, in cases involving the ECBM technique. And in a general manner, integrate myself more with the economic, legal and social issues around the world and general processes involving the various techniques of carbon storage.

Gláucia Costa
MSc., CEPAC/ PUCRS
Brazil

I studied geography and economics in Peking University, China. Currently, I am a graduate student at Civil and Environmental Engineering, Princeton University. My research interests are reactive transport in fracture networks, its impact on the performance of CO_2 storage site. Mostly, I will be focusing on how mineralogical heterogeneity and kinetics will affect the fracture geometry, and thus fluid flow in the fracture network.

Hang Deng
PhD Student, Princeton University
USA

Marc Duchesne is a PhD student within the Chemical and Biological Engineering Department at the University of Ottawa. He holds a BSc in Biochemistry with Honours and a BASc in Chemical Engineering. His research work is focused on slagging in entrained-flow gasifiers. This work is done in conjunction with the CanmetENERGY Fluidized Bed Combustion and Gasification Group (Natural Resources Canada). Mr. Duchesne's interests extend to various energy technologies, climate change policies and regulations, as well as the ecological, political and socio-economic impacts of climate change

Marc Duchesne
PhD Student, University of Ottowa & CanmetENERGY
Canada

I am currently a Project Manager with the Sequestration Division at the DOE's National Energy Technology Laboratory in Pittsburgh, PA. My focus is on projects involving the numerical simulation of geologic CO_2 storage. I have a BS in Environmental Science and a BSE in Interdisciplinary Engineering from Purdue University as well as MS and PhD degrees in Environmental Engineering from the University of Notre Dame. My graduate research focused on heterogeneous groundwater systems and the behavior and transport of liquids, gases, chemicals, and bacteria throughout these systems.

Andrea Dunn
US DOE – National Energy Technology Laboratory
USA

I'm from Colombia. I got a bachelor degree in Geology but I switched to civil engineering. Currently my research interests include numerical simulation of geochemical reactions and uncertainty quantification in CO_2 storage in geological formations.

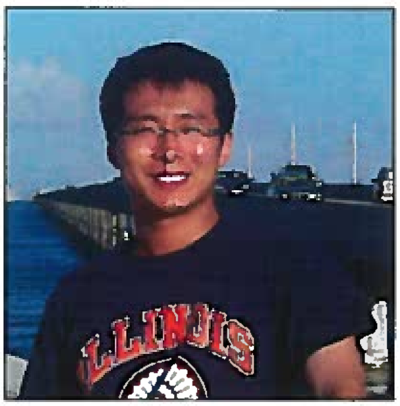
Oscar Garcia-Cabrejo
University of Illinois
USA

My name is Manuel Gomez with an MSc in Chemical Engineering and I am a future researcher at the experimental installation named "Technology Development Centre for CO_2 Capture for R&D purposes related to Carbon Capture and Storage (CCS) that is currently under commissioning phase in Spain. My area of interest is the oxy-combustion, one of the technical options to reduce green house gases. I am currently in charge of the construction of the compression and purification unit.

Manuel Gomez
Fundación Ciudad de la Energía
Spain

Master degree and BS in Chemical engineer from University of Guanajuato Mexico. I began my professional career in 2004 working on the fields of energy and environmental issues for Electrical Research Institute in Mexico. I have worked in the applications of energy concepts in the assessment of cost of steam and electricity in cogeneration system in oil refineries, development of models for diagnosis of the operation of combined cycle power plant and currently in modeling of CO_2 capture process post-combustion in coal power plant from Mexican Federal Commission of Electricity. I am interested in helping my country to reduce CO_2 emissions by introducing CCS.

Abigail González
Electrical Research Institute
Mexico



I am a Ph.D candidate in Dept of Civil & Environmental Engineering in University of Illinois. I worked on a joint project between our department and Dept of Agricultural & Biological Engineering. My research involves the 2nd generation biofuels production, with a focus on the hydrothermal pretreatment process of a specific energy crop, Miscanthus. Prior to University of Illinois, I got both my bachelor and master degree in Environmental Engineering in Tsinghua University, China. Personally, I am not only interested in biofuels or bioenergy, but other major sustainable energy technologies, energy economics, policies, etc.

Bin Guo
University of Illinois
USA

I currently work as an advisor at the Global CCS Institute and manage the activities that feed into the Institute's annual 'Global Status of CCS: 2011' report. Over the past year, I have been heavily involved in monitoring the progress and status of large scale integrated CCS projects. I am also working on innovative digital solutions where different groups working across the CCS chain can communicate and share knowledge. I previously worked in mine safety at the Australian Department of Resources, Energy and Tourism after completing their graduate program. I have a Bachelor in Resource Economics (Honours) from Sydney University.

Edlyn Gurney
Global CCS Institute
Australia

I graduated from the University of Texas at San Antonio in 2006 with a Bachelor of Science in Geology. I worked as an exploration geologist in the uranium mining industry for 2 years after college. From 2009–2010, I worked for two of the Illinois State Geological Survey's CO_2 Sequestration programs as an assistant project coordinator. I am currently pursuing a Master of Science in Geology at the University of Illinois at Urbana-Champaign. My areas of technical interest related to sequestration include post-injection monitoring, well construction, project development, and project management.

Jessica Hinton
MSc, University of Illinois
USA

I am a Ph.D candidate of Department of Thermal Engineering in Tsinghua University, Beijing, China. My research experiences are mainly about thermal power plant performance monitoring and operation optimization and now my academic interests are modelling and simulation and analysis of energy and water consumption for carbon capture system. Our research group are now preparing for building the simulator of carbon capture system for conventional coal-fired power plants. With this simulator, we can further research on the impacts of capture system on the original thermal power plants in the field of CCS power plant operation, energy consumption, water consumption, pollutants emission etc.

Xiaolong Jiang
Tsinghua University
China

I am a Ph.D. candidate in the Department of Civil and Environmental Engineering at Princeton University. My research involves analytical-numerical multi-scale modeling of multi-phase flow in subsurface environments. I am currently developing a model to investigate the potential for leakage of carbon dioxide through faults. Previous to arriving at Princeton, I was employed at HydroGeoLogic, Inc., an environmental engineering consulting firm based out of Reston, VA. I also received a B.A.Sc. and a M.A.Sc. at the University of Waterloo in Civil and Environmental Engineering, where my research focus was on contaminant transport in groundwater.

Mary Kang
PhD Student, Princeton University
USA

Kerry Kelly
Research Associate, University of Utah
USA

Kerry Kelly works with students and faculty on energy and transportation processes and the associated health, environmental, policy and performance issues. She is a registered Professional Engineer and a PhD student. Her work currently focuses on evaluating developing carbon-capture and sequestration technologies using a comprehensive life-cycle approach. Recent projects include: characterizing aerosol emissions from combustion processes, carbon capture, pollution prevention through process design, and collection of field data under challenging conditions. She has also worked for the University of Tennessee and the Fraunhofer Institute for Atmospheric Environmental Research in Garmisch-Partinkirchen, Germany.

Marlinde Knoope
PhD Student, University of Utrecht
The Netherlands

After my bachelor Science and Innovation Management, I studied the master Energy Science. Both studies consist of science (chemistry, physics, and energy analysis) but also economics and sustainability items are included. Since the beginning of this year, I am working as a PhD student at the University Utrecht. I investigate the technological and economic aspects of developing and scaling up a CO_2 infrastructure in the Netherlands. Consequently, my technical area of interest is CO_2 transport.

KGH Kodagoda
Petroleum and Petrochemical College
India

I started my career as a Chemical and Process Engineer and today directing to Petroleum Sector with work and studies in petroleum field. My main interest in the CCS is the applicability of the technologies, technology availability to transfer and their economic aspects especially for developing countries. Handling the public resistance to CCS projects is also one of my interests. Just storing a carbon source underground is a great loss but acceptable due to the lack of technological developments in utilizing carbon dioxide for chemical needs. Hence, my key interest in future research is chemical utilization of stored carbon dioxide.

Gavin Lai is research assistant/student in the University of Nottingham Malaysian Campus. He holds a bachelors degree in Mechanical Engineering and an MBA in Technology and Innovation Management. His current research topic relates to the diffusion of CCS in a developing nation setting.

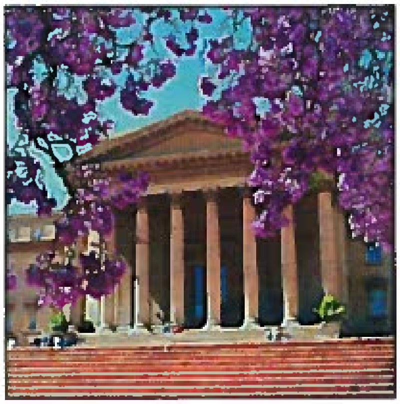
Gavin Lai
Research Assistant, University of Nottingham, Malaysian Campus
Malaysia

Last summer I started my PhD at ETH Zürich, where I study public acceptance and communication of CCS. I graduated from the University of Zürich in 2008 with a Master in psychology, English literature and English linguistics (with specializations in social and environmental psychology). Subsequently, I worked as an environmental officer for a town in Switzerland, spent 10 months in Vancouver, B.C., and am now back at university. Given my background, my academic interest in CCS lies in public perception and acceptance. As a politically interested citizen, I also wonder what part CCS can play in a sustainable energy future.

Selma L'Orange
PhD Student, ETH Zürich
Switzerland

Currently, our focus is to investigate the effects of multiphase flow—driven fracture on the tensile strength of caprock, a challenging problem in geomechanics related to geologic carbon sequestration. An understanding of fracturing physics provides engineers with the insight to help them maintain the caprock integrity critical to any CO_2 geologic sequestration project. Specific project research includes: 1. Testing of multiphase fluid-driven fracture on unsaturated caprock under plane-strain compression. Temperature and capillary forces will also be investigated from the experiments, where pore pressure will be controlled throughout the failure process. The next step we will concentrate on experimental studies with equipment made by ourselves. 2. Combining the poromechanics and fracture—damage mechanics, we addressed possible linear hydraulic-isothermal response of the rock mass linked to multiphase flow in poroelastic caprock.

Jianrong Lu
MSc, Institute of Rock and Soil Mechanics, Chinese Academy of Sciences
China



I am currently studying towards PhD in Engineering at the University of the Witwatersrand, Johannesburg in South Africa I hold a BSc degree in Chemistry and a Masters in Engineering at the same University I have a keen interest in the development of CCS in Africa as it will give Africa an opportunity to continue on its growth path using its most abundant resource, coal. A former great football (or soccer) player and played 1st team University football, up until my PhD work and wife (I just got married in December 2010) took every bit of free time I had!

Tshifhiwa Maphala
PhD Student, University of Witwatersrand
South Africa

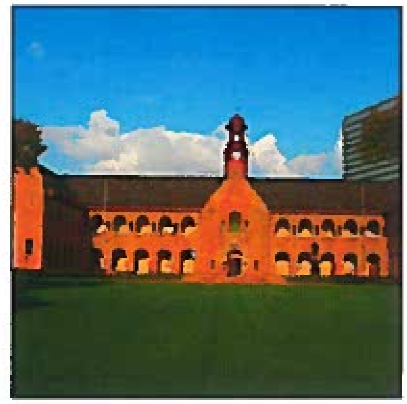
I have studied Marine Sciences and Environmental Sciences and last year, I did a Master in Global Change. At the present, I am doing my PhD thesis on geological storage of CO_2 funded by CIUDEN. I am working on stable isotopes of carbon with different purposes. First, I am measuring carbon isotopic compositions of the different regional water masses where CIUDEN is planning to storage CO_2. The purpose of these measurements is to set a baseline for possible diffusive leakages. A second part of my PhD thesis is the study of different natural analogues. We will study different aquatic ecosystems which are able to capture CO_2 and ecosystems which can be use in geological storage of CO_2.

Amanda Metcalf
PhD Student, CIUDEN
Spain

I have been studying about the ocean circulation (Japan Sea). Recently, the ocean model techniques have been developing however the technique of the ocean model is not sufficient because of the computational errors of the techniques. I have conducted the data analysis using the observation data which is obtained by the ferryboat and I have found the current variations which can not be shown by the model simulation. We have tried to understand the mechanism of those current variations using observation data and will develop the model for high resolution (Very fine grids).

Kioshi Mishiro
Kyushu University
Japan

Mr. Thembane Mlambo holds a BHon degree in Geology (4th Year University; 2009; Fort Hare University, South Africa) and three-year degrees in both Geology and Chemistry (2008; University of The Witwatersrand, South Africa). He is currently in his second year of his master degree (MSc) in Geology at the University of Pretoria, South Africa. Mr. Mambo's MSc project is entitled "Improving Geological Saline Reservoir Integrity through Applied Mineral Carbonation Engineering". Mr Mlambo has proposed to carry out a PhD study entitled "CO2 storage in saline formations combined with brine extraction, desalination and purification", where Active CO2 Reservoir Management (ACRM) will be use in South African Geological formations. Area of interest: Geologic sequestration, mineral carbonation, safety, economic.



Thembane Kelvin Mlambo
MSc, University Pretoria
South Africa

In 1999, GSCS Certificate in math and physics, then in 2000 A level certificate in math and physics, from 2001–2005 I did my BSc in applied physics in university of Uromia. Regarding my career I have worked in Oil Industrial Engineering and Construction Group (OIEC) in Tehran, Iran from Dec-06 to Jan-09 as a procurement project planner. Presently MSc student in Middle East Technical University (METU) as an petroleum and natural gas engineering and doing thesis work on well integrity in CCS applications. As an petroleum engineer, I have been thought that big reductions in carbon dioxide emissions are the application of technology of CO_2 capture and sequestration, it has been known that CO_2 when captured and stored and if injected into depleting oil reservoirs, can increase recovery through an enhanced oil recovery (EOR) process. This is being presented as opportunities for the oil industry to participate emission reductions wile increasing the recovery from oil fields and reducing global warming.

Kahila Mokhtari Jadid
MSc Student, Middle East Technical University
Turkey

I am an Electronics Engineer and I am currently pursuing my masters in the Engineering Systems and Management Program at the Masdar Institute. There is a need for technologies and processes that will enable the transition to a scenario where RETs are as competitive as hydrocarbons. This is where CCS comes in. One of my projects was to build possible CCS scenarios for the UAE. CCS is at present an expensive. I am interested in understanding the drivers and barriers to deploy CCS in developing and emerging economies. I want to explore the policy and regulatory frameworks that will be needed to support the CCS industry in these countries.

Lakshmi Natarajan
MSc, Masdar Institute of Science and Technology
United Arab Emirates

My name is Saeid Nikoosokhan. I am 26 years old. While getting my engineering degree in Civil Engineering in Tehran, I realized that one of the major issues of my country was related to air pollution and warming. This is at that time that I had the great opportunity to come to the Ecole des Ponts ParisTech (France) for my graduate studies. I have now been in France for almost two and a half year. I quickly realized that, at the worldwide scale, climate change was one of the key issues of our time, and I want to help solving this issue. This is why my PhD is on the CO2 storage in coal bed reservoirs as an option to mitigate climate change, and this is why I am highly motivated to follow this innovative summer school.

Saeid Nikoosokhan
PhD Student, Ecole des Ponts Paris Tech
France

Adebola Ogunlade is currently completing an LLM Degree in Petroleum Law & Policy at the Centre for Energy, Petroleum and Mineral Law & Policy (CEPMLP), University of Dundee, UK. He is Co-Editor-in-Chief of the CEPMLP Annual Review (CAR) 2009/2010. He currently works as Legal Counsel at Total E&P Nigeria Limited (A subsidiary of Total S.A.). Until recently, he was a Legal Officer at the Nigerian National Petroleum Corporation (NNPC), Abuja where he worked for over five (5) years. He is an Associate of the Chartered Institute of Arbitrators, UK; Graduate Member of the Energy Institute, UK and Student Member of the Institute of Chartered Secretaries and Administrators, London. He has special research interests in the legal, regulatory and fiscal frameworks that are imperative for the deployment of Carbon Capture and Storage Technology globally.

Adebola Ogunlade
CEPMLP, University of Dundee
Scotland

My name is Anamaria Padurean and I am a Romanian, 2nd year PhD student within the Chemistry and Chemical Engineering Faculty at the Babes-Bolyai University, in Cluj Napoca, Romania. My PhD thesis entitled "Innovative systems for carbon dioxide capture in energy conversion systems" aims to investigate three important carbon dioxide capture technologies for energy conversion systems: post- and pre- combustion capture by gas-liquid absorption and chemical looping combustion. For each technology the objective is to evaluate the optimal operating conditions using engineering software, the key performance indicators, technico-economical assessment and potential ways to increase the overall plant energy efficiency.

Anamaria Padurean
PhD Student, Babes-Bolyai University, in Cluj Napoca
Romania

I am a Ph.D. candidate at Department of Thermal Engineering, Tsinghua University. My previous research experiences involve life-cycle assessment and modelling of energy transformation technology, benefit & cost analysis on energy development roadmap, and scenario analysis on pollutants as well as GHG emissions of China's coal-fired power plants. With these experiences, I've got strong background of China's coal industry, which is the major carbon source in China. My present research focuses on the water and carbon footprint within the coal supply chain in China. Currently, I'm at the stage of digging in varied methodologies of carbon footprint analysis, and next I plan to apply appropriate analyzing methods on China's coal-dominant situation, for the purpose of finding out relatively accurate carbon dioxide emission of the coal supply chain in China, and giving applicable policy suggestions on mitigating GHG emission in China.

Lingying Pan
PhD Student, Tsinghua University
China

I graduated from the Faculty of Chemistry at the Silesian University of Technology. I obtained MSc in Chemical Engineering. At present, I am employed as a research assistant at the Institute of Chemical Engineering, Polish Academy of Sciences. I work in prof. Krzysztof Warmuzinski's research group on sorption and membrane methods of separation. We apply adsorption and membrane methods in flue gas cleaning and limiting emission of greenhouse gases. One of the major topics is connected with post-combustion capture of CO_2 from flue gas streams. My activity is also connected with utilisation of methane released in coal mining.

Anna Pawlaczyk
MSc, Silesian University of Technology
Poland

My background is in Physics, particularly in Fluid Mechanics at both micro and macro scales. My PhD thesis concerns transport phenomena of an electrically driven convection under various fluid parameters. My research activities include Microfluidics, Evaporation, Drop Impact, Wetting Transition, Superhydrophobic Surfaces, Electroconvection, and Convective Turbulence with experimental and numerical tools. Currently, I am interested in fluidynamical aspects of carbon capture and sequestration technology, for instance, transport phenomena of mulit-component fluids in porous media.

Peichun Tsai
Post-doctoral Researcher, Princeton University
USA

Carrie Petrik-Huff is a Graduate Student at the University of Massachusetts, Amherst in the Geosciences Department where she focuses on determining the ability of the Holyoke Basalt to sequester carbon dioxide through mineral precipitation at various temperatures and pressures. Prior to her graduate work, she earned a Bachelors degree from Bard College at Simon's Rock with a focus in Political Science and then went on to a second Bachelors degree in the geosciences at the University of Massachusetts, Amherst. Carrie enjoys exploring the intersections of policy and science and finding new and informative ways of communicating science both with the public and policy makers. When not working on her carbon sequestration research, Carrie can be found digging in her garden or attempting to unlock the mysteries of bread baking.

Carrie Petrik-Huff
University of Massachusetts
USA

Born in Buenos Aires (ARG), Age: 29 years old. Living in Israel, for the last 21 years. Recently Graduated at the Geology & Environmental Sciences Department, BGU, And Currently I am an M.Sc student at the same department, in the Field of Geochemistry. My area of technical interest is: CO_2-Water-Rock Interactions in Carbon Geological Storage. And my research focus on: Precipitation and dissolution Kinetics of secondary minerals phases at elevated Temperatures and Pressures - Experimental Approach. The research is carried out in cooperation with the Institute of Earth Sciences at the University of Iceland.

Peter Rendel
MSc, Ben-Gurion University of the Negev
Isreal

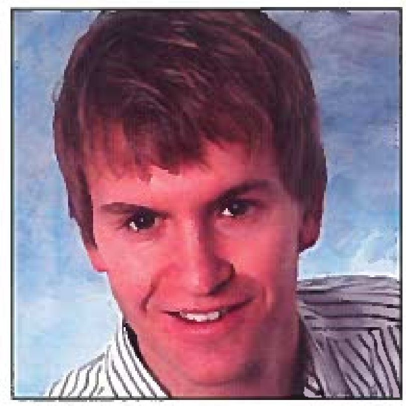
Chemical Engineer. Working since 2001 as a researcher and Project Leader at the Mechanical Systems Department of the Instituto de Investigaciones Eléctricas (IIE) in projects related to power plant, chemical process and fluid flow simulation; equipment assessment and diagnosis, process optimization, energy saving and cogeneration for CFE and PEMEX. He is interested in efficient technologies to produce power and to reduce pollutant and greenhouse gases; modeling, simulation, optimization and economics of CO_2 capture processes and integrated systems. Currently He is developing a technical and economical assessment of alternatives to integrate postcombustion carbon capture processes to a Mexican fossil power unit.

Hugo Rodriguez Martinez
Engineer, Instituto de Investigaciones Electricas
Mexico

Since joining the civil service in 2002, I have developed strategy and policies on rural delivery and waste, delivered business change projects on corporate performance reviewing and PPM and undertaken financial management of projects. In 2008, I joined the commercial team tasked with procuring the UK's first CCS demonstration, working collaboratively with specialists to design and deliver key stages of the procurement (including negotiation of FEED contracts). My focus now is on developing proposals to address barriers to UK CCS Demonstration 1 and working with regulators to ensure that the regulatory framework and processes for CCS are fit for purpose.

Shameem Shah
Department of Energy and Climate Change
United Kingdom

After graduating from a business oriented high school, I started a Bachelor in Mechanical Engineering at ETH Zurich in 2005. In 2008, I continued with a Master in Process Engineering with a broad focus on renewable and sustainable energy technologies. I did project work on carbon capture as well as on geothermal energy, including the Master Thesis on future development and deployment of geothermal energy written in Prof. Jeff Tester's group at Cornell University, NY. In December 2008 I started my PhD at ETH Zurich focusing on post-combustion CO_2 capture.



Daniel Sutter
PhD Student, ETH Zürich
Switzerland

I graduated at the University of Miskolc in 2006 with a master's degree in earth science (geophysics). I have been working closely in the theme of carbon dioxide geological storage in the ELGI for 4 years. This involes reservoir selection in Hungary, estimation of storage capacity in different geological objects. I have been Ph.D. student since 2009 and would like to focus my research topic on monitoring of carbon-dioxide storage sites. I have been learning the following earth science subjects and researcher seminars: EOR Methods, Petrophysics, Subsurface gas storage, Geophysical methods are adaptable for detection of CO_2 migration.

Ágnes Szamosfalvi
PhD Student, Eötvös Lóránd Geophysical Institute of Hungary
Hungary

Nuria Tavera-Valero
PhD Student, Norwegian University of Science and Technology
Norway

I studied Chemical Engineering at University of Granada (Spain). After having been an exchange student at NTNU, I started my PhD in August 2010. The main aim of my research is to study the influence of the amine degradation products on corrosion in order to determine the mechanisms and reduce the corrosion rates. In addition, as responsible for GC-MS, I collaborate on other research areas, such as oxidative and thermal degradation studies and the development of a method to reduce emissions of nitrosamines.

Amit Kumar Verma
The Energy and Resources Institute, New Delhi
India

I am presently working as Research Associate in the center for Research on energy Security Area of The Energy and Resources Institute (TERI), New Delhi, India. I have completed B. Tech. in Mining engineering in 2006 from Institute of technology, Banaras Hindu University, Varanasi, India and carrying out Ph D studies externally from Indian Institute of Technology Bombay in the department of Earth Sciences on geological disposal of carbon dioxide and high level nuclear wastes deep inside earth in collaboration with Bhabha Atomic Research Center, Bombay. I have more than 3 years of research experience and expertise in oil and gas reservoirs simulations, coal and metal mining, underground nuclear waste repositories, geological disposal of carbon dioxide, natural hazards and other areas related to rock science and engineering. My area of research is geological storage of CO_2 inside basaltic rocks for permanent storage. Also, enhanced coal bed methane, enhanced oil recovery and storage in saline aquifers is current area of research. I am interested to develop screening criteria for sequestration of CO_2 in Indian geological basins.

Dr. Tao Wang
Columbia University
USA

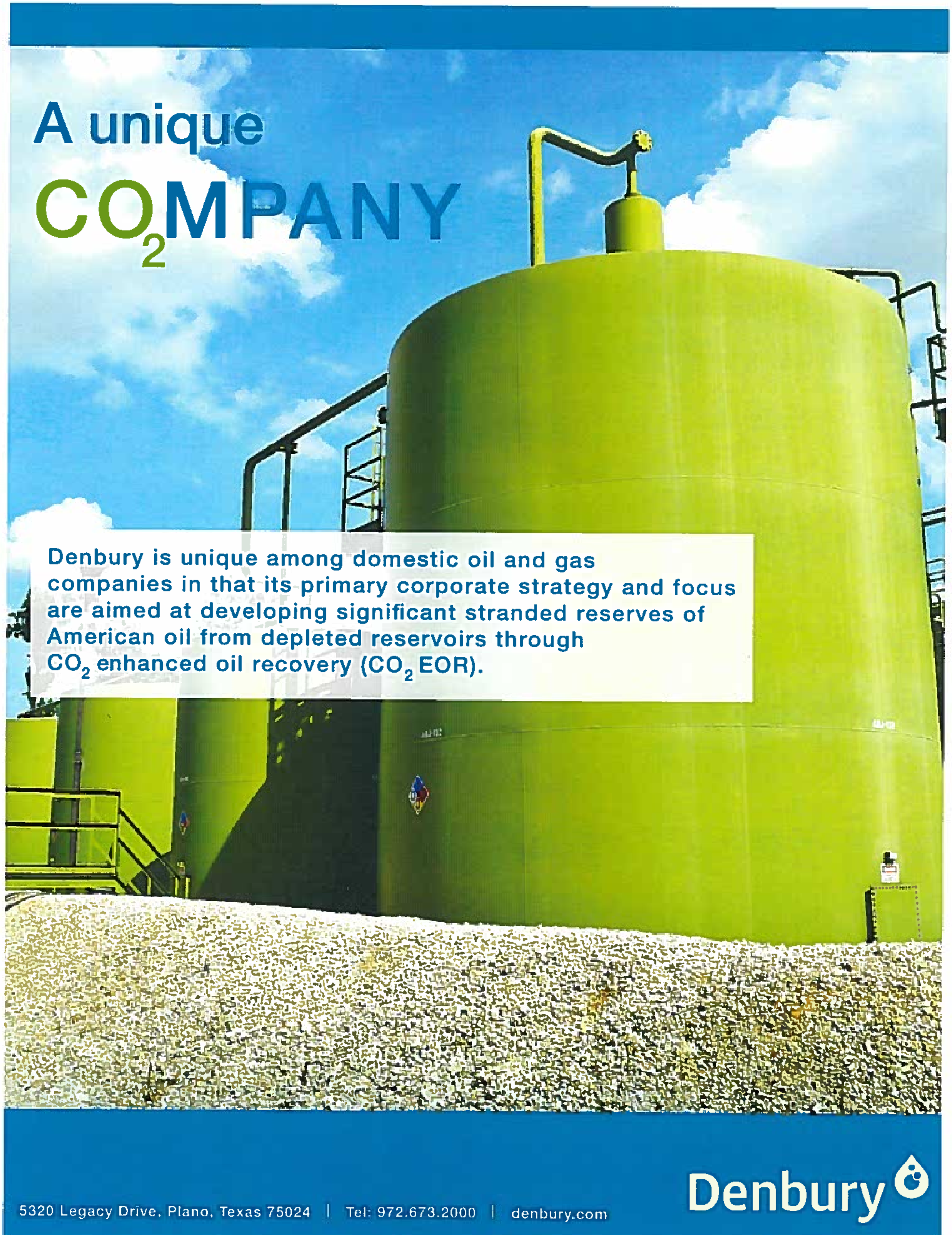
Dr. Tao Wang received his BS in Thermal Power Engineering from Zhejiang University in 1998 and continued at Zhejiang to earn his PhD in Power Engineering and Engineering Theromophysics in 2008. He continued as a postdoctoral fellow at State Key Laboratory of Clean Energy Utilization developing solar technologies and PV systems. Since 2009, Wang works at Columbia University as a postdoctoral fellow at the Earth Institute researching air capture technology. His technical interest includes carbon capture from air, solar energy and nano-material.

I have studied CO_2 capture by absorption for 2 years, mainly on mixed amine and finding new solvent that can be applied for liquid-liquid phase transition system. A fast screening experiment system was established and absorption and desorption performances of 10 amines have been investigated. I'm interested in the solvent selection and the methods of evaluating their performance in terms of overall performance.

Zhicheng Xu
Tsinghua University
China

I am currently a postdoctoral fellow at the Gulf Coast Carbon Center in the Bureau of Economic Geology, University of Texas, Austin. My degree is in geosciences with a background in sedimentology, petrophysical, and subsurface data analysis. Since joining GCCC (a leading research organization in various aspects of CCS) in November, 2010, I have been exposed to various projects that deal with both brine and EOR field monitoring, measurement, verification, and accounting for sequestration. My interest in CO_2 storage involves construction of static reservoir models using available logs, core, seismic, and past production data to predict storativity and evaluate risk.

Dr. Khandaker Zahid
BEG, University of Texas at Austin
USA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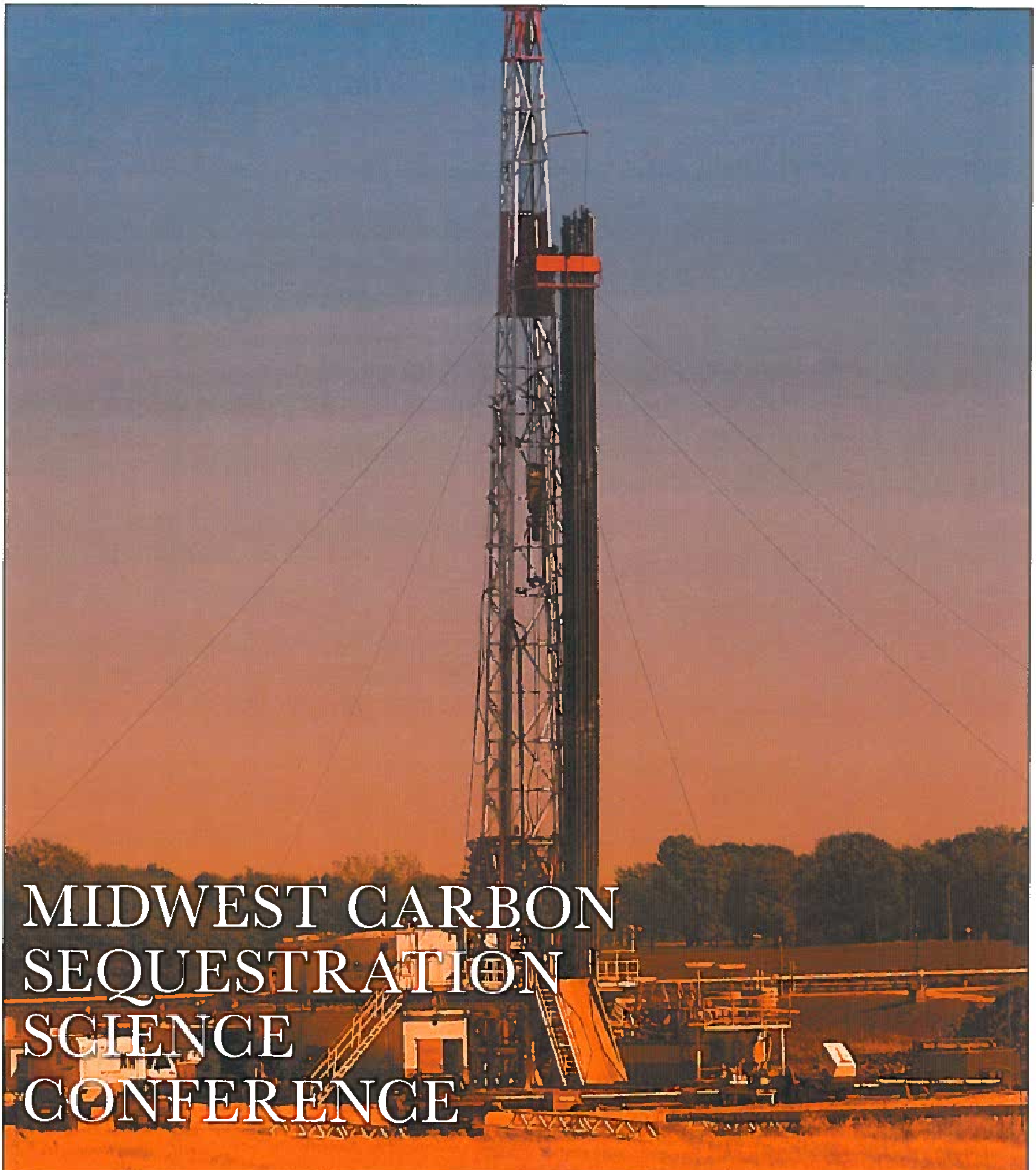
The International Institute for Carbon-Neutral Energy Research is the 6th and newest member of the World Premier International (WPI) Research Center Initiative launched in 2007 by Japan's Ministry of Education, Culture, Sports, Science, and Technology. I^{2}CNER is a joint partnership between Kyushu University and the University of Illinois. I^{2}CNER's objective is to foster and advance the fundamental science required to remove the barriers impeding society's movement towards an efficient, carbon-neutral fueled society.

For more information please visit http://i2cner.kyushu-u.ac.jp/en/

Addendum 2.
Printed programs from Midwest Carbon Sequestration Science Conference
(2011-2014)



MIDWEST CARBON SEQUESTRATION SCIENCE CONFERENCE

November 7-9, 2011

Champaign, Illinois USA

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Schlumberger
Carbon Services

STEP

MGSC

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PRAIRIE
RESEARCH INSTITUTE

Home of the Illinois State Scientific Surveys

ILLINOIS NATURAL HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS STATE ARCHAEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS STATE WATER SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS SUSTAINABLE TECHNOLOGY CENTER
PRAIRIE RESEARCH INSTITUTE

Welcome to the Midwest Carbon Sequestration Science Conference

On behalf of the Midwest Geological Sequestration Consortium (MGSC), Schlumberger Carbon Services, the Sequestration Training and Education Program (STEP), the Illinois State Geological Survey (ISGS) and the Prairie Research Institute at the University of Illinois, we want to welcome you to this conference, which celebrates our accomplishments at the Illinois Basin – Decatur Project (IBDP).

The past year marks several significant milestones for the MGSC and the IBDP in collaboration with the Archer Daniels Midland Company in Decatur, Illinois. The verification well was drilled in October–November 2010 and completed and instrumented in summer 2011. The compression/dehydration facility is being tested and commissioned as we go to print with this program. We are currently completing all the final requirements under our Underground Injection Control permit from the Illinois Environmental Protection Agency and we expect to begin carbon dioxide injection very soon.

These milestones could not have been reached without ongoing project funding from the U.S. Department of Energy, National Energy Technology Laboratory, and the support of our many project partners and researchers. Their contributions, large and small, lay the foundation for carbon capture and sequestration (CCS) research and its successful future deployment. It is deeply satisfying to know that the research being conducted on this project will serve as baseline information for development of CCS projects in the Illinois Basin, the entire Midwest, and beyond.

As part of the Prairie Research Institute at the University of Illinois we strive to provide objective, cutting-edge research and solutions to allow citizens and decision-makers to make choices that ensure sustainable economic development, enduring environmental quality, and cultural resource preservation for Illinois and beyond. Our technical program for this conference focuses not only on our accomplishments but also on knowledge sharing to provide you with research results, expertise, and data for independent scientific analysis and decision-making.

Welcome and enjoy the program.

Robert J. Finley

Robert J. Finley
Principal Investigator
Midwest Geological Sequestration Consortium

William Shilts

William W. Shilts
Executive Director, Prairie Research Institute


SEQUESTRATION TRAINING AND EDUCATION PROGRAM
STEP
TM
STEP is a program of the Advanced Energy Technolgy Initiative, University of Illinois.
sequestration.org/step
Pioneering change. From the ground up.
In a perfect world, all energy production would be carbon neutral, maintaining the delicate balance between the power we use and the planet we need to preserve. Until that world arrives, however, science is rapidly pursuing a wide range of interim solutions designed to create cleaner-burning fuels and reduce rising carbon dioxide emission levels.
At the Sequestration Training and Education Program, we're part of this vital initiative, transferring carbon capture and sequestration technology from the edge of science to the heart of a growing industry and equipping today's energy professionals with the steps they need to mitigate global environmental change.

Who We Are

About the Midwest Geological Sequestration Consortium

The Midwest Geological Sequestration Consortium (MGSC) is one of seven regional partnerships selected by the U.S. Department of Energy to determine the best approaches for capturing and storing carbon dioxide (CO_2) that might otherwise contribute to global climate change. The MGSC is led by the Illinois State Geological Survey (ISGS), in conjunction with the Indiana Geological Survey (IGS) and the Kentucky Geological Survey (KGS), and covers Illinois, southwestern Indiana and western Kentucky. This partnership was established to assess geological carbon sequestration options in the 60,000 square mile oval-shaped, geologic feature known as the Illinois Basin. Within the Basin are deep, noneconomic coal resources, numerous mature oil fields, and deep saline rock formations with potential to store CO_2. MGSC's objective is to determine the technical and economic feasibility of using these geologic formations for long-term storage.

About the Illinois State Geological Survey

Founded in 1905, the ISGS provides the citizens and institutions of Illinois with earth science research and information that are accurate, objective and relevant to the state's environmental quality, economic prosperity and public safety. ISGS is one of five scientific surveys within the Prairie Research Institute at the University of Illinois. Together, they form a unique group of scientific experts in the earth, environmental and biological sciences that is unmatched in the nation. These agencies carry out objective, high quality, multi-disciplinary scientific studies in service to all the people of Illinois.

About ADM

Every day, the 30,000 people of Archer Daniels Midland Company (NYSE: ADM) turn crops into renewable products that meet the demands of a growing world. At more than 265 processing plants, we convert corn, oilseeds, wheat and cocoa into products for food, animal feed, chemical and energy uses. We operate the world's premier crop origination and transportation network, connecting crops and markets in more than 75 countries. Our global headquarters is in Decatur, Illinois, and our net sales for the fiscal year ended June 30, 2011, were $81 billion. For more information about our company and our products, visit www.adm.com.

About Schlumberger Carbon Services

Schlumberger Carbon Services provides technologies and services for the long-term geological storage of CO_2. Our experience, gained by participation in many CCS projects worldwide, is backed up by a corporate history of over 80 years in the oil & gas industry. Our multidisciplinary teams bring the project management, communications, and technology delivery skills needed to integrate all the services for storage safety, reliability and regulatory compliance. We work to combine our storage knowledge together with that of other providers in the areas of capture and transport, to deliver safe and successful CCS projects. Visit www.slb.com/carbonservices.

About DOE National Energy Technology Laboratory

The National Energy Technology Laboratory (NETL), part of DOE's national laboratory system, is owned and operated by the U.S. Department of Energy (DOE). NETL supports DOE's mission to advance the national, economic, and energy security of the United States. NETL implements a broad spectrum of energy and environmental research and development (R&D) programs that will return benefits for generations to come while protecting our environment and enhancing our energy independence.

About STEP

Established through the pioneering efforts of the American Recovery and Reinvestment Act, the U.S. Department of Energy and the Midwest Geological Sequestration Consortium, the Sequestration Training and Education Program was created to share new climate mitigation technology as it is developed, dramatically reducing the time it takes for innovations in research to produce positive global change.

Through continuing education, hands-on training and innovative outreach programs, STEP provides career enhancement opportunities and leadership development for engineers, geologists, service providers, regulators, executives and others in wide range of energy related fields. For more information please visit www.sequestration.org/step

Schedule of Events

Monday, November 7, 2011

11:30 a.m.	Registration open
Noon – 1:00 p.m.	Lunch (Fighting Illini Room)
1:00 p.m. – 4:00 p.m.	Class VI Workshop (Golden Gopher Room), sponsored by STEP
6:00 p.m. – 8:00 p.m.	Welcome reception (Fighting Illini Room), sponsored by ISGS and Prairie Research Institute

Tuesday, November 8, 2011

7:00 – 8:00 a.m.	Breakfast (Alumni Ballroom)
8:00 a.m. – 5:00 p.m.	Technical Program (Badger Room)
9:55 a.m. – 10:15 a.m.	Morning Break
Noon – 1:00 p.m.	Lunch (Alumni Ballroom)
1:50 p.m. – 2:10 p.m.	Afternoon Break
3:10 p.m. – 3:30 p.m.	Afternoon Break
6:00 p.m. – 9:00 p.m.	Conference Dinner and Poster Viewing, sponsored by MGSC and Schlumberger Carbon Services at Colonnades Club at Memorial Stadium. Buses depart from the Fighting Illini Room at 5:50, 6:30 and 7:00 p.m. and return at 9:00 p.m. and 9:30 p.m.

Wednesday, November 9, 2011

7:00 a.m. – 8:00 a.m.	Breakfast (Fighting Illini Room)
8:00 a.m.	Field Trip departs from the Fighting Illini Room
Noon – 1:00 p.m.	Lunch (Fighting Illini Room)
1:00 p.m.	Viz Lab Tours depart from Fighting Illini Room (sign up at registration)

Schlumberger
Carbon Services

Permanent geological storage solutions for your carbon capture project

Schlumberger Carbon Services provides technologies and services for the long-term geological storage of carbon dioxide (CO_2). Experience and a detailed understanding of the varied challenges posed by CO_2 storage, gained by participation in more than 60 carbon capture and storage projects worldwide, is backed up by a corporate history of over 80 years in the oil & gas industry.

Teams with multidisciplinary skills in project management, communications, and technology delivery integrate all the services needed for storage safety, reliability and regulatory compliance. A worldwide Schlumberger corporate presence in over 140 countries, and Carbon Services offices in North America, Europe, and Australia, brings the capability to support safe and successful CO_2 storage projects anywhere in the world.

Global Expertise | **Innovative Technology** | Measurable Impact

www.slb.com/carbonservices

Class VI Workshop – open to all participants » 1:00 p.m. Golden Gopher Room

Monday, November 7

Workshop: Class VI for Project Developers. Sponsored by STEP

This short course has been developed to introduce and educate project developers, industry leaders, and regulators to the newly developed UIC Class VI regulations specific to permitting wells for geologic storage of carbon dioxide. This course will focus on the educational needs of the project developers with specific attention paid to gaining greater understanding of the new regulations, geologic and engineering technical challenges, and permit application development. In addition, a review of guidance documents will be provided. Other topics include the current state of knowledge about tools used for gaining geologic knowledge of the subsurface and creating models for area of review.

1:00 – 1:15	Welcome from Sallie Greenberg, STEP Director
1:15 – 2:00	Introduction to Underground Injection Control Program and Class VI
2:00 – 2:30	Anatomy of a Class VI Application
2:30 – 3:00	Class VI Application Data Requirements
3:00 – 3:15	Break
3:15 – 3:45	Plans and Guidance Documents
3:45 – 4:00	Panel Discussion

Conference Technical Program » 8:00 a.m.–5:00 p.m. Badger Room

Tuesday, November 8

Abstracts for all presentations are listed later in the program.

8:00 – 8:10 a.m.	Opening Remarks, Robert Finley, ISGS
8:10 – 8:25 a.m.	CCS: Think Global, Act Local, John Tombari, Schlumberger Carbon Services
8:25 – 8:45 a.m.	US Department of Energy Program Overview, John Litynski, US DOE
8:45 – 9:15 a.m.	IBDP Overview and Project Organization, Robert Finley, ISGS
9:15 – 9:35 a.m.	Managing CCS Projects Through Integrative Components, Sallie Greenberg, ISGS
9:35 – 9:55 a.m.	Project Integration and Risk Assessment: Parasitic, Entangled, or Symbiotic? Ken Hnottavange-Telleen, Schlumberger Carbon Services
9:55 – 10:15 a.m.	Break
10:15 – 10:45 a.m.	Illinois Basin - Decatur Project Subsurface Geoscience Program: An Anatomy of a Reservoir, Hannes Leetaru, ISGS
10:45 – 11:15 a.m.	Illinois Basin - Decatur Project Seismic Program: Success in the Face of Adversity, Marcia Cousëlan, Schlumberger Carbon Services

11:15 – 11:35 a.m.	Characterizing Brine Quality for the Illinois Basin-Decatur Project, Randall Locke, ISGS
11:35 – noon	Use of the Westbay System for Multilevel Reservoir Monitoring at the IBDP Carbon Capture and Storage Site, Bryan Robinson, Schlumberger Water Services
Noon – 1:00 p.m.	Lunch
1:00 – 1:30 p.m.	Development of Surface Facilities: An In-Depth View of Compression/ Dehydration and Dehydration at IBDP, Ray McKaskle, Trimeric Corporation
1:30 – 1:50 p.m.	Establishing Baseline Conditions of Shallow Groundwater Quality at the Illinois Basin-Decatur Project, Bracken Wimmer, ISGS
1:50 - 2:10 p.m.	Break
2:10 – 2:30 p.m.	Integrated Modeling of CO_2 in the CCS Process, Dwight Peters, Schlumberger Carbon Services
2:30 – 2:50 p.m.	Geologic and Reservoir Characterization and Modeling, Scott Frailey, ISGS
2:50 – 3:10 p.m.	CO_2 Injection in a Saline Formation: Pre-injection Reservoir Modeling and Uncertainty Study for Illinois Basin - Decatur Project, Ozgur Senel, Schlumberger Carbon Services
3:10 – 3:30 p.m.	Break
3:30 – 3:50 p.m.	Basin-Scale Modeling of CO_2 Sequestration in the Mount Simon Sandstone of the Illinois Basin—Status Report, Edward Mehnert, ISGS
3:50 – 4:10 p.m.	Geomechanics for the Illinois Basin - Decatur Project Mt. Simon Injection, Donald Lee, Schlumberger
4:10 – 4:30 p.m.	Modeling Atmospheric Dispersion of CO_2 for Pipeline Leakage Risk Assessment, Curtis Oldenburg, Lawrence Berkeley National Laboratory
4:30 - 4:50 p.m.	Future Directions: Industrial Sources, Robert Finley, ISGS

Conference Dinner and Poster Session » 6:00–9:00 p.m.

Cocktails, dinner and poster viewing will be held in the Colonnades Club at Memorial Stadium, home of the Fighting Illini Football Team. Buses will depart from the Fighting Illini Room at 5:50 p.m., 6:30 p.m. and 7:00 p.m. Cocktails and Poster Viewing will be from 6:00 – 7:30 with Dinner will be served at 7:30 p.m.

One of the most breathtaking stadiums in the country, Historic Memorial Stadium at the University of Illinois holds an esteemed position among the nation's elite sports facilities. Its regal colonnades and austere brick and limestone façades have dominated the central Illinois landscape for generations. Holabird & Roche designed the stadium as a memorial dedicated to the 189 University of Illinois students and alumni who died in World War I. Memorial colonnades were designed to run the length of the east and west façades. The colonnades were comprised of 200 individual columns. On 189 of these columns was inscribed the name of an Illini soldier who died in the war. In addition, carved stone panels were placed on the facility's exterior to commemorate the war and to honor athletic achievements.

The Colonnades Club, located on the third level of the stadium's west side, stretches end zone to end zone and offers an exceptional view of the entire stadium.

Buses will return to the Hilton Hotel at 9:00 and 9:30, alternatively it is a short walk back to the Hilton Garden Inn.

Poster Session

Petrological assessment of the Mt. Simon Sandstone and Eau Claire Formation by Brenda B. Bowen, Thomas Lovell, Ryan Neufelder, Raul Ochoa, Nick Fischietto, Nathan Wilkens, Brenton Chentinik, John Shufflebarger, John Rupp, Cristian Medina, Richard Lahann, and Jim Brophy

Geochemical and Mineralogical Investigations of Carbon Sequestration in the Illinois and Michigan Basins: Reaction Experiments by William Roy, Peter Berger, Shane Butler, Jared Freiburg, Lois Yoksoulian, Illinois State Geological Survey

Phylogeneic Diversity, Stratigraphic Distribution of Indigenous Microbes Revealed from a 2KM Well in Decatur, IL by Yiran Dong, Ted M. Flynn, Rob A. Sanford, Philip A. Miller, Nicolas Chia, Charu G. Kumar, Pan-Jun Kim, Isaac K. O. Cann, Roderick I. Mackie, Nathan D. Price, Mayandi Sivaguru, Michael Nolte, Bruce Fouke, Department of Geology, Department of Microbiology, University of Illinois Urbana-Champaign

Monitoring of surface deformation at the Illinois Basin - Decatur Project with SqueeSAR by Jessica Morgan, TRE Canada Inc.

Design and Evaluation of the Primary Casing Strings for Carbon Sequestration in the Illinois Basin – Decatur Project by Deepak Kumar Khatri, Robert Butsch, Jim Kirksey, Juan Carrasquilla, Jonathan Moreira, Schlumberger Carbon Services

Illinois Basin – Decatur Project Seismic Program: Acquisition to Inversion by Marcia Coueslan, Hannes E. Leetaru, George El-Kaseeh, Nikolas Preece, Lei Zhang, Schlumberger Carbon Services and Illinois State Geological Survey

Westbay at Illinois Basin – Decatur Project by Jim Kirksey and Scott Marsteller, Schlumberger Carbon Services

Illinois Basin - Decatur Project MVA Program by Midewest Carbon Sequestration Consortium, presented by Randy Locke, Illinois State Geological Survey

Field Trip Information

Wednesday, November 9, 2010

Archer Daniels Midland Company

The field trip is designed to provide participants the opportunity to see an active CCS injection site, ask questions of practitioners, investigate monitoring equipment first hand, and gain insights on issues that will impact future projects. Visits to the IBDP site will depart the hotel lobby door at 8:00 a.m. and will return to the Hilton Hotel at noon. Lunch will be available in the Fighting Illini Room at noon.

For safety reasons all visitors must have closed-toe shoes and long pants to participate in the field trip. Visitors to the IBDP are prohibited from taking any photographs or videos while on ADM property. Use of cell phones or tobacco are not allowed on the ADM property.

Visualization Lab Tours

Wednesday, November 9, 2011

Illinois State Geological Survey

We will be offering a tour of the new Earth Systems Visualization Laboratory at the Illinois State Geological Survey on Wednesday, November 9th.

Visiting the Laboratory will provide an opportunity for visualization of our new three-dimensional (3D) seismic reflection data of the IBDP area geology. We will demonstrate how gaining a better understanding of subsurface geology prior to inject of CO_2 allows researchers to confirm site quality, predict target CO_2 injection intervals, as well as evaluate the distribution of the subsurface CO_2 plume.

The Visualization Lab uses a 14 by 8-foot screen and specialized software to provide realistic 3D views of subsurface geophysical records.

There will be a sign up sheet at the registration table as well as at the Tuesday evening poster session. Please add your name if you are interested. Transportation to the Earth Systems Visualization Laboratory will be provided from the Hilton Garden Inn.

Demonstrations of the Visualization Lab are available to conference participants starting at 1:00 p.m. Tours will take about one hour and will depart from the Fighting Illini Room. You must sign up for the tours at the registration desk. Space is limited.

Abstracts

CCS: Think Global, Act Local

John Tombari, President, Schlumberger Carbon Services

"Think global, act local" is the appropriate way to apply carbon sequestration as a means to address climate change. Because of its scalability, Carbon Capture and Storage (CCS) is an essential tool that must be available in the portfolio of solutions this global problem necessitates. While we must think global, many of the hurdles to deployment will involve geologic, social, economic, and political challenges. These challenges and others will require local modification. At the national level, different countries will choose different solutions in the form of regulation, tax regimes, carbon trading, incentives, energy mix, and so on.

'Local' means different things to different people: 'local' is North America; 'local' is the Midwest Geological Sequestration Consortium; and 'local' is the Illinois Basin - Decatur Project. Our discussions today focus on this project, and although some of the detailed results are specific, the general practices are globally applicable, with care.

Much of the technology that will be proven in demonstration-scale projects around the world will be able to be transferred and applied elsewhere. For storage, however, local geologic conditions will limit our ability to share exploration, appraisal, construction, operation, and monitoring experience. A template approach is unlikely to be successful. One must be able to adapt local project insights and use them intelligently elsewhere.

Today's knowledge sharing event aims to help in that process, and is a local response to the global challenge of moving CCS from commercial-scale demonstrations to commercial rollout around the world.

US Department of Energy Program Overview

John Litynski, P.E., Carbon Sequestration Technology Manager, U.S. DOE National Energy Technology Laboratory, Strategic Center for Coal, Office of Coal Power R&D

Carbon, capture, utilization, and storage technologies are a promising option that can help reduce greenhouse gas emissions from industrial and power generation facilities while enhancing the energy security of the United States. The U.S. DOE National Energy Technology Laboratory's Strategic Center for Coal (SCC) is implementing the federal governments program to develop and deploy technologies for CCUS. The Strategic Center for Coal is responsible for managing the Core R&D program, which includes the external applied R&D projects with industry, universities, and other research organizations. These programs are focused on the development of advanced cost effective capture and storage technologies for all industry interested in mitigating CO_2 emissions from their facilities. Part of that effort includes the Regional Carbon Sequestrations Partnerships of which the Midwest Geologic Sequestration Consortium is an important part. The SCC is also responsible for managing $3.4 billion dollars of recovery act funds that are being used to support the design, construction, and operation of the first fleet of commercial CCS facilities in the United States. This presentation will summarize the DOE's efforts to implement these applied RD&D programs and the benefits which may be realized from these efforts.

Illinois Basin - Decatur Project Overview

Robert J. Finley, Director Advanced Energy Technolgy Initiative, Illinois State Geolgical Survey

The Illinois Basin-Decatur Project, the Phase III demonstration of the Midwest Geological Sequestration Consortium, is designed to inject 1 million metric tons of carbon dioxide over three years at the nominal rate of 1,000 tonnes per day. The CO_2 is derived from the ethanol production facilities at the Archer Daniels Midland (ADM) plant in Decatur, Illinois. The project was developed following regional evaluations (2003–05) indicating that East-Central Illinois held a reservoir-seal combination of Mount Simon Sandstone-Eau Claire Shale suitable for demonstrating geological sequestration in a saline reservoir.

Initial discussions with ADM in 2007 led to collection of 2D seismic along roads adjacent to an 0.25 mi^2 (800×800 m) tract that indicated no resolvable faulting and no adverse pre-Mount Simon topography. The project was funded under the U.S. Department of Energy's Regional Carbon Sequestration Partnership program in December 2008. Drilling of the injection well in 2009 confirmed suitability of the site and was followed by a 3D seismic survey, a geophysical monitoring well, and a pressure and fluid sampling (verification) well, all in 2010. Perforation and completion of the verification well and two rounds of initial fluid sampling were completed by September 2011. While these activities were taking place, a 1,100 tonne per day compression/dehydration facility and delivery pipeline were developed to deliver supercritical CO_2 to the wellhead at a nominal pressure of 1,400 psig (97 bars). Four years of effort are thus coming to fruition at a site with unique capabilities, some of them first-in-the-world with respect to subsurface monitoring.

Managing CCS Projects Through Integrative Components

Sallie E. Greenberg, Illinois State Geological Survey

Project integration is an essential process for meeting project goals, facilitating internal and external communication, and completing other key aspects of the Illinois Basin - Decatur Project (IBDP). Managing a project of this scope requires frequent discussion of technological and non-technological details which in turn leads to decision-making, implementation of operational activities, risk assessment and mitigation, and scientific research. The benefits of technical discussion and implementation in technical areas are obvious. However, non-technical areas of project management also require familiarity and use of technical information. In the IBDP, communication, education, and permitting activities all require integration of technical information from multiple project disciplines, project team members, and external sources. Communication and education efforts are better able to serve the project needs through a process that starts by understanding technological activities, then translating challenging information into more approachable forms, and providing knowledge sharing functions by which project details are made available to multiple stakeholders and audiences. Permitting activities directly integrate required technological details and key project components, focusing those details in reports, and communicating details to regulators and other stakeholders. The benefits of the integration process to the IBDP are both internal and external serving to facilitate project goals. The integration process, recent activities, and examples by which information integration has taken place will be discussed.

Project Integration and Risk Management: Parasitic, Entangled, or Symbiotic?

Ken Hnottavange-Telleen, Schlumberger Carbon Services

In Illinois Basin - Decatur Project (IBDP), activities carried out under the banner of risk assessment and risk management (RA/RM) have acted as an integrative force within the project. To thoroughly identify, evaluate, and mitigate risks, boundaries between disciplines, between organizations, and between conceptually isolated physical systems have been consciously crossed. The intended result is that the project experience little impact from scenarios that are wholly unanticipated – even from scenarios that may involve complex and multi-disciplinary chains of events. This outcome, if achieved, will fulfill the fundamental mission of RA/RM: to envision possible negative impacts from plausible scenarios, to minimize those potential impacts, and to maintain risk at acceptable levels.

High-quality RA must incorporate an approach that promotes thoroughness, and must satisfy design criteria that include explicit definitions of scope and project values (risk receptors), and discrete metrics for risk evaluation (the scaling of impact severity and likelihood). The outcome of RA must establish a structure for RM, which must then function to (1) Document progressive reduction of identified risks, and (2) Maintain continual openness to emergent risks. IBDP has fulfilled RA/RM design criteria using an approach integrating semi-quantitative and text data gathered through expert elicitation. The approach to RM applied for IBDP is explicitly cross-disciplinary and so it inherently supports the ongoing integration of project elements.

A focus on RA/RM has helped different components of IBDP to integrate, minimizing risk in the process. Method developments that have been applied in later-starting projects sponsored by the US Department of Energy's Regional Carbon Sequestration Partnerships Program – given a head start by IBDP – are now improving IBDP's techniques for managing risk information, advancing the practice of CCS as a whole.

Illinois Basin - Decatur Project Subsurface Geoscience Program: An Anatomy of a Reservoir

Hannes E. Leetaru[1], Alan Brown[2], Marcia L. Couëslan[2], David Morse[1], and Jared Freiburg[1]

[1]Illinois State Geological Survey,
[2]Schlumberger Carbon Services

Both the CCS #1 well and the Verification #1 well at the Illinois Basin - Decatur Project in Macon County, Illinois encountered over 1,500 feet of Cambrian Mt. Simon Sandstone. The Mt. Simon strata were composed almost entirely of sandstone of various reservoir qualities. The Mt. Simon Sandstone can be subdivided into three major stratigraphic units: a lower, middle, and upper sandstone. The best reservoir quality strata are found in alluvial fan and braided river deposits of the lower Mt. Simon Sandstone. These lower Mt. Simon rocks had average porosities of 22% and permeabilities of 200 mD. However, individual intervals had porosities as high as 28% and permeabilities of over one Darcy. Both seismic reflection data and well control suggest that the braided river deposits contain significant lateral and vertical reservoir heterogeneity that may complicate predicting the migration of any CO_2 plume.

The middle section of the Mt. Simon Sandstone has permeabilities of less than 1 mD and reservoir flow simulation suggests that the middle section is a baffle that impedes the flow of CO_2 into the upper Mt. Simon

Sandstone. The upper Mt. Simon Sandstone could also be a sequestration target, as it has average porosities of 12% and permeabilites of 133 mD. These upper Mt. Simon strata were deposited in a nearshore tidally-influenced environment.

The well data were processed for pore throat connectivity and facies relationships from the two wells and then were integrated with the results of the 3D seismic inversion data to predict the continuity of reservoir facies. The 3D seismic data show Precambrian paleotopography northwest of the two wells. There appears to be onlap of the sandstone facies on to this paleohigh that indicates slight thinning of the sandstone strata in the lower Mt. Simon interval. This thinning prediction was validated when the Verification #1 Well was drilled slightly updip from the CCS#1 well and had 84 feet less sand than the downdip CCS#1 well.

The inversion analysis provided better results in the lower Mt. Simon Sandstone because the sandstone body is thicker. The upper Mt. Simon has an average porous interval thickness of 10 feet, which is below the resolution of the seismic data whereas the lower Mt. Simon porous intervals have an average thickness of 35 feet.

Illinois Basin – Decatur Project Seismic Program: Success in the Face of Adversity

Marcia L. Couëslan, Hannes E. Leetaru, George El-Kaseeh, Nikolas Preece, and Lei Zhang

Designing and executing a successful seismic program for the Illinois Basin – Decatur Project (IBDP) has presented unique challenges to the acquisition, processing, and analysis teams involved in the project. Given the original lack of well data in the area, it was critical for the project to obtain high quality seismic data that could be used for site characterization and would aid in the detection of the lithology and porosity trends in the Mt. Simon Sandstone (storage) and Eau Claire Shale (caprock) formations.

The project site in Decatur is surrounded by industrial and cultural activities as well as an electrical substation that all result in significant levels of noise contamination in the data. Acquisition of high density, point receiver surface seismic data allowed the noise issues to be effectively attenuated over the course of data processing. This, in addition to the well logs acquired in the injector well, were the keys to obtaining excellent results from the inversion analysis predictions of lithology and porosity trends within the formations of interest. The final seismic image and the inversion results have been used to guide the geologic model and the three-dimensional (3D) mechanical earth model.

Over the course of injection, time-lapse 3D vertical seismic profiles (VSPs) will be used to monitor the carbon dioxide (CO_2) plume development. Fluid substitution modeling, which predicts the change in seismic response to CO_2, will be used in conjunction with the results from the reservoir simulations to schedule monitor surveys.

Characterizing Brine Quality for the Illinois Basin - Decatur Project

Randall A. Locke II, Ivan G. Krapac, Keith C. Hackley, Bracken T. Wimmer, and Abbas Iranmanesh, Illinois State Geological Survey

An extensive Monitoring, Verification, and Accounting (MVA) program has been initiated for the Illinois Basin - Decatur Project (IBDP) and is focused on the 0.25 mi^2 (0.65 km^2) project site. One of the project's unique monitoring strategies involves fluid sampling and pressure monitoring from 11 discrete zones in a 7,166 ft (2,180 m) deep verification well. Zones 1 through 9 are located within the Mt. Simon Sandstone, the deep saline reservoir. Zones 10 and 11 are located in the Ironton-Galesville Sandstone above the primary cap rock.

In May 2011 after the verification well was perforated, brine samples were collected from the well by swabbing. In June 2011, a multi-level Westbay* monitoring system was installed and fluid samples were collected by wireline in June and September. Significant efforts were made to minimize impacts to in-situ fluid quality as a result of well construction and completion activities. Procedures were developed to assess sample representativeness and nearly 90,000 gallons (2,150 barrels) of fluid was purged from the well to ensure that high-quality baseline fluid chemistry data were obtained.

Fluid sampling will continue through the injection and post-injection phases of the project and will provide valuable information for geochemical monitoring and modeling efforts. These data are also relevant to understanding the variability and evolution of saline fluids in the Mt. Simon Sandstone.

[redacted]

Use of the Westbay System for Multilevel Reservoir Monitoring at the IBDP Carbon Capture and Storage Site

Bryan Robinson, Schlumberger Water Services

The Westbay* multilevel groundwater characterization and monitoring system was installed to provide monitoring within the Mount Simon sandstone and in the formations overlying the CO_2 injection zone. Westbay is a customizable system that provides access to numerous zones within a single borehole. The system offers a unique advantage over other existing monitoring technologies, as it allows the continuous recording of reservoir pressure and temperature, the collection of reservoir samples at formation pressure, and hydraulic testing at a large number of different depth intervals.

In this project, a newly-developed version of the Westbay system was deployed, which is specifically designed for deep installations and for a CO_2-rich environment. At IBDP, Westbay was installed to a depth of 2,200 meters (7,218 ft) below ground level, and provides access to eleven groundwater monitoring and sampling intervals.

The system was deployed to monitor the effect of CO_2 injection, beginning with pre-injection baseline sampling and continuing through injection, closure, and post-closure of the site.

The Westbay System at the IBDP site provides a versatile and robust multilevel monitoring technology that will allow the collection of accurate and verifiable direct pressure measurements and formation fluid data. This information will be used to improve the understanding of CO_2 movement in the subsurface during and after injection and to support/confirm the project's computer modeling. The data obtained will be an integral part of proving the feasibility and viability of long-term CO_2 geological storage.

[redacted]

Development of Surface Facilities: An In-Depth View of Compression and Dehydration at IBDP

Ray McKaskle, Trimeric Corporation

Trimeric will review the process design and present startup results for the compression and dehydration facilities for the MGSC Phase III Sequestration Project. Equipment reviewed in the presentation will include the multistage centrifugal booster blower, reciprocating compressors, triethylene glycol dehydration unit, multistage centrifugal pump, and the injection pipeline. A block flow diagram, process flow diagram, overlay of operations on a CO_2 phase diagram, facility and equipment layout, and photos of the equipment will be presented. Data from initial startup operations will be presented and compared with design requirements. Lessons learned will be discussed and a view going forward for the next three years of injection operations will be presented.

Establishing Baseline Conditions of Shallow Groundwater Quality at the Illinois Basin - Decatur Project

Bracken T. Wimmer, Randall A. Locke II, and Abbas Iranmanesh, Illinois State Geological Survey

An extensive Monitoring, Verification, and Accounting (MVA) program has been initiated for the Illinois Basin - Decatur Project (IBDP) and is focused on the 0.25 mi^2 (0.65 km^2) project site. Seventeen wells have been installed as part of the project's shallow groundwater monitoring network. Well depths range from 295 feet (89.92 m) to 11.5 feet (3.51 m). The wells monitor three shallow sand and gravel aquifers and a thin Pennsylvanian-age sandstone that has been designated by the Illinois Environmental Protection Agency as the lowermost Underground Source of Drinking Water (USDW).

Monthly sampling began in June 2009 for the shallow sand and gravel wells, and quarterly sampling began in July 2010 for the USDW wells. During sampling, pH, temperature, electrical conductance, and other field parameters are recorded. Samples are analyzed for cations, anions, alkalinity, total dissolved solids, and other constituents. A minimum of one year (and for some locations two years) of baseline data will be available prior to carbon dioxide injection at the IBDP. These data are important to develop an understanding of pre-injection variations in the local geochemical and hydrological environments. That understanding, in turn, provides a basis to assess if carbon dioxide injection activities have any effect on shallow groundwater quality either from direct interaction with carbon dioxide or migrated brine.

Integrated Modeling of CO_2 in the CCS Process

Dwight Peters, Schlumberger Carbon Services

There are many models or simulations that are created for individual parts of a CCS project. All are used in planning and design of various aspects of the project, and all require certain assumptions to be made. Even if the models are highly accurate, they are only valid if the input assumptions for each model are not violated. Outputs from one model could easily conflict with a related simulation. This could lead to project results that are not within predictions, or worse, unknowingly into situations that could be potentially dangerous. Some high-risk situations can be identified only by integrating the results from multiple models in many realistic scenarios.

The Illinois Basin - Decatur Project has many models being run, all of which depend on the carbon dioxide (CO_2) being in an assumed, predictable phase. One model looks at the properties of the CO_2 from the output of the compressors, through the pipeline, down the well, and into the reservoir. It is a dynamic model, which means that over time we can vary input parameters, such as a number of CO_2 impurities from upset conditions in the plant, extreme weather conditions that will heat or cool the pipeline, or other situations. It is also being used to model the behavior during startup and shutdown. The outputs from this model can be input to the various steady-state models for constraining the range of input assumptions and thereby increasing the precision of their predictions. By using this model, we aim to anticipate all the important scenarios for the phase behavior of the CO_2.

Geologic and Reservoir Characterization and Modeling

Scott Frailey and James R. Damico, Illinois State Geological Survey

Reservoir modeling is well established in providing projections of well performance in managing and designing field projects. The foundation and basis of all reservoir models is a geologic model representative of the depositional system and the reservoir flow properties anticipated to influence the movement of fluids in the subsurface. Consequently, reservoir characterization is an essential part of geologic and reservoir model development.

For modeling purposes, reservoir characterization includes absolute horizontal and vertical permeability, effective porosity, net and gross thickness, and depth. For horizontal permeability, log porosity was correlated to core permeability using the cementation exponent from Archie's equation. Due to the relatively large thickness and selecting the injecting interval near the base of the Mt. Simon, vertical permeability is an important characteristic. Vertical permeability is scale dependent and defined stochastically based on the model cell vertical thicknesses.

The IBDP facies-based geologic model reflects the reservoir architecture and is developed using 3D seismic data and interwell flow-unit correlations. Outcrop studies from similar depositional environments will further enhance the geologic model. The geocellular model is defined by combining the geostatistical representation of the flow properties and the geologic depositional environment.

The reservoir model incorporates fluid properties and fluid-rock properties with the geocellular model. Additionally, a description of the wellbore and the outer boundary of the model complete the reservoir model. In the design phase of the IDBP project, model projections of CO_2 injection rates, plume size and injection pressure were made based on reasonable ranges of input parameters.

CO_2 Injection in a Saline Formation: Pre-Injection Reservoir Modeling and Uncertainty Study for Illinois Basin - Decatur Project

Ozgur Senel, Schlumberger Carbon Services and Nikita Chugunov, Schlumberger-Doll Research

The Illinois Basin - Decatur Project (IBDP), funded by the United States Department of Energy National Energy Technology Laboratory, plans to inject one million tonnes of carbon dioxide (CO_2) into the Mount Simon Formation over a three-year period, starting in late 2011. We discuss the results of the pre-injection reservoir modeling and uncertainty study for IBDP.

Reservoir simulation is the main (and in most cases the only) tool used to predict long-term fate of CO_2 injected underground. Key characteristics of the storage site such as capacity, injectivity and containment are often evaluated based on the modeling results. Predictions of the CO_2 plume profile and possible migration paths play important role in risk analysis and mitigation planning. In this study, a representative reservoir model consistent with all available geophysical and petrophysical data (3D seismic and well logs) was developed. Water injection/fall-off tests were used to history match and calibrate the petrophysical properties of the injection zone.

Given a series of geostatistical realizations, a detailed uncertainty and sensitivity analysis was performed to provide probabilistic evaluation of the storage site performance including containment of CO_2, injectivity, and dynamic mass partitioning (mobile, residually trapped, and dissolved). On the reservoir scale, we analyze uncertainty in CO_2 plume migration and pressure profiles, and its implications for Area of Review evolution during the life of the project. From a monitoring well perspective, we obtain probabilistic estimates of predicted CO_2 saturation and pressures, and link these estimates to the breakthrough time at the monitoring well and pressure/saturation measurements from the Westbay* multilevel groundwater characterization and monitoring systems under reservoir uncertainty.

[redacted]

Basin-Scale Modeling of CO_2 Sequestration in the Mount Simon Sandstone of the Illinois Basin—Status Report

Edward Mehnert, James Damico, Scott Frailey, Hannes Leetaru, Roland Okwen, Illinois State Geological Survey

Yu-Feng Lin, Jihua Wang, Illinois State Water Survey

Nathaniel Allen, Oscar Garcia-Cabrejo, Brynne Storsved, Albert Valocchi

Department of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign

The Mount Simon Sandstone is the basal sandstone reservoir In the Illinois Basin and has an estimated capacity to store 27 to 109 billion metric tons of CO_2. This storage capacity is sufficient to sequester 88 to 360 years of current CO_2 emissions from the basin's major stationary sources. Thus, geologic carbon sequestration offers a viable solution for removing carbon dioxide from the atmosphere with the goal of mitigating climate change.

To evaluate the feasibility of future, commercial-scale, geologic sequestration within the basin, a flow and transport model has been developed and is currently being refined as new geologic and hydrogeologic data become available. The goal of the numerical modeling effort is to evaluate the migration of injected CO_2 and assess the pressure changes in this open reservoir in response to future developments. Two key questions to be addressed by this effort are: Will the resulting pressure increases negatively affect the natural gas storage operations currently utilizing the Mount Simon? Will fresh water resources at the basin periphery be affected by future geologic sequestration?

A basin-scale model has been developed using TOUGH2-MP. TeraGrid/XSEDE computational resources have been used to run this large (1.2 million elements) model. We are currently revising the geologic model (e.g., porosity, permeability, geometry) based on data collected from wells in Macon County. We will discuss how an evolving geologic model affects the CO_2 plume and pressure distribution from commercial-level geologic sequestration within the basin. In addition, we will describe our approach to address the potential for affecting freshwater aquifers at the periphery of the basin.

Geomechanics for the Illinois Basin - Decatur Project Mt. Simon Injection

Donald Lee and Jose Adachi, Schlumberger NAM Geomechanics

Geomechanical analysis provides understanding of how rock properties change with associated changes in formation pore pressure, temperature, and stress. When a borehole is drilled and fluids are produced from or injected into the reservoir, geomechanics determines when and how the rock will react. This technology makes it useful as a risk analysis and planning tool for many applications. Key areas of interest to examine in carbon sequestration projects include caprock integrity with injection, fault reactivation, and rock property change with pressure cycling.

At the Illinois Basin - Decatur Project (IBDP) site, a 3D geomechanical model has been built for the Knox and the Mt. Simon formations. Construction and calibration of the mechanical earth model (MEM) uses available rock property data including seismic, seismic inversion, wireline log data, drilling data, core test results, and other information to provide an accurate description of rock properties. In addition multiple rock strength models, which are calibrated with laboratory core test results and observed wellbore conditions during drilling, are used. Once calibrated, the model results provide insight into potential future changes in the rock properties with pressure changes.

We will present an introduction to geomechanics, the Mt. Simon 3D MEM, and stress models using the base case reservoir simulation. The results of the finite element modeling show time lapse changes in the rock properties and associated stress path for the Mt. Simon injection scenario.

Modeling Atmospheric Dispersion of CO_2 for Pipeline Leakage Risk Assessment

Alberto Mazzoldi and Curtis M. Oldenburg, Lawrence Berkeley National Laboratory

In the Illinois Basin Decatur Project (IBDP), CO_2 will be transported from the capture facility to the injection well by an above-ground high-pressure pipeline of length 5,675 ft (1,730 m) within the built environment of the Archer Daniels Midland (ADM) ethanol plant. We have carried out modeling studies of the atmospheric dispersion of CO_2 that would occur under various pipeline failure scenarios. There are several aspects of CO_2 that make its transportation and leakage somewhat different from other substances, most notable is its non-flammability and propensity to change to solid (dry ice) upon strong decompression. Failure frequency of the various components of a pipeline transportation system is taken from prior work on general pipeline safety and leakage modeling. The temporal evolution of the released mass from the high pressure pipeline was simulated using a state-of-the-art approach (Picard's Pipe model) that considers thermodynamic effects. Atmospheric dispersion simulation results show that the built environment of the plant plays a significant role in the dispersion of the gas as CO_2 can impinge upon buildings and other infrastructure. In all cases simulated to date, the hazardous region of very high-concentration CO_2 is limited to a small area around the pipeline failure, suggesting the risk of harmful CO_2 exposure to plant personnel from pipeline leakage is low.

Midwest Geological Sequestration Consortium Partners

MGSC is a consortium of the geological surveys of Illinois, Indiana, and Kentucky joined by private corporations, professional business associations, the Interstate Oil and Gas Compact Commission, two Illinois state agencies, and university researchers to assess carbon capture, transportation, and storage processes, and their costs and viability, in the three-state Illinois Basin region. The MGSC Project Advisory Group (PAG) includes:

Ameren
American Air Liquide
American Water Works Association
Archer Daniels Midland Company
Aventine Renewable Energy
Baker Hughes, Inc.
Biorecro, LLC
Blue Source, LLC
BP Alternative Energy
Caterpillar, Inc.
Conoco Phillips
Continental Carbonic Products, Inc.
Drummond Company, Inc.
Duke Energy
Edison Mission Energy/Midwest Generation
Electric Power Research Institute
Environmental Defense
GE Energy
Halliburton/Pinnacle
IL Dept. of Commerce & Economic Opportunity
Illinois Clean Coal Institute
Illinois Corn Growers Assoc.
Illinois Dept. of Natural Resources
Illinois Dept. of Transportation
Illinois Oil and Gas Assoc.
Illinois State Geological Survey
Indiana Gasification
Indiana Geological Survey
Indiana Oil and Gas Association
Interstate Oil and Gas Compact Commission
Kentucky Geological Survey

Kentucky Oil & Gas Assoc.
LG & E Energy, LLC
LincolnLand Agri-Energy, LLC
Natural Gas and Pipeline Company of America, LLC
Natural Resources Defense Council
NiSource Gas Transmission and Storage Company
Peabody Energy
Peoples Gas
Petroleum Technology Research Centre
Power Holdings, LLC
Praxair, Inc.
Schlumberger Carbon Services
Spectra Energy Corporation
Tenaska Taylorville, LLC
The Cline Group
TOTAL E&P USA, Inc.
US Dept. of Energy
Vectren Corporation

MGSC Marks a Milestone

This year's Project Advisory Meeting and the Midwest Carbon Sequestration Science Conference mark a major accomplishment, the beginning of the 1 million metric ton demonstration project at Decatur, Illinois that we all have been working towards since our geologic assessments began with Department of Energy and State of Illinois funding in 2003. Many people and organizations have made tremendous contributions to get us to this point and I want to sincerely thank everyone for their individual and collective accomplishments.

Sometime in last few days the birth of the 7 billionth human occurred somewhere on this planet. Hopefully, it was a joyous and safe event for the baby and the parents. Included in the future of that child will be the question of what energy sources humankind will continue to use and what will be the consequences of that use.

Fossil fuels will remain one of the major energy sources for the coming decades just as it has contributed to humankind's wellbeing for many decades past. It is my hope that our research efforts will help bridge the gap to widespread use of energy without the negative outcomes foreseen in climate models and ecosystem studies. If we can safely, economically, and effectively perfect carbon capture and storage we will have made a major contribution to mitigating some of these outcomes as efforts continue to refine a diverse portfolio of energy options.

Robert J. Finley

Principal Investigator

Midwest Geological Sequestration Consortium

MGSC

2012 MIDWEST CARBON SEQUESTRATION SCIENCE CONFERENCE

September 17-19, 2012
Champaign, Illinois USA

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ILLINOIS STATE WATER SURVEY
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ILLINOIS SUSTAINABLE TECHNOLOGY CENTER
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Welcome to the Midwest Carbon Sequestration Science Conference

On behalf of the Midwest Geological Sequestration Consortium (MGSC), Schlumberger Carbon Services, the Sequestration Training and Education Program (STEP), the Illinois State Geological Survey (ISGS), and the Prairie Research Institute at the University of Illinois, we want to welcome you to this conference which celebrates our accomplishments at the Illinois Basin – Decatur Project (IBDP).

The past year marks several significant milestones for the MGSC and the IBDP, carried out in collaboration with the Archer Daniels Midland Company in Decatur, Illinois. Operational injection began on 17 November, 2011, and during the week of 20 August, 2011 we passed the milestone of 250,000 tonnes injected. We have completed two cased-hole logging runs and have seen carbon dioxide at our observation well. We have also completed the first post-injection, 3D vertical seismic profile monitoring survey, and our modeling and reservoir simulation has benefited from the extensive data collection program that remains underway.

These milestones could not have been reached without ongoing project funding from the U.S. Department of Energy, National Energy Technology Laboratory, and the support of our many project partners and researchers. Their contributions, large and small, lay the foundation for carbon capture and sequestration research and its successful future deployment. It is deeply satisfying to know that the research being conducted on this project will serve as baseline information for development of carbon capture and storage (CCS) projects in the Illinois Basin, in the entire Midwest, and in other regions around the world. Indeed, we particularly welcome our international visitors to this meeting.

As part of the Prairie Research Institute at the University of Illinois we strive to provide objective, cutting-edge research and solutions to allow citizens and decision-makers to make choices that ensure sustainable economic development, enduring environmental quality, and cultural resource preservation for Illinois and beyond. Our technical program for this conference focuses not only on our accomplishments but also on knowledge sharing to provide you with research results, expertise, and data for independent scientific analysis and decision-making.

Welcome and enjoy the program.

Robert J. Finley
Robert J. Finley
Principal Investigator
Midwest Geological Sequestration Consortium

William Shilts
William W. Shilts
Executive Director, Prairie Research Institute

Who We Are

About the Midwest Geological Sequestration Consortium

The Midwest Geological Sequestration Consortium (MGSC) is one of seven regional partnerships selected by the U.S. Department of Energy to determine the best approaches for capturing and storing carbon dioxide (CO_2) that might otherwise contribute to global climate change. The MGSC is led by the Illinois State Geological Survey (ISGS), in conjunction with the Indiana Geological Survey (IGS) and the Kentucky Geological Survey (KGS), and covers Illinois, southwestern Indiana and western Kentucky. This partnership was established to assess geological carbon sequestration options in the 60,000 square mile oval-shaped, geologic feature known as the Illinois Basin. Within the Basin are deep, noneconomic coal resources, numerous mature oil fields, and deep saline rock formations with potential to store CO_2. MGSC's objective is to determine the technical and economic feasibility of using these geologic formations for long-term storage.

About the Illinois State Geological Survey

Founded in 1905, the ISGS provides the citizens and institutions of Illinois with earth science research and information that are accurate, objective and relevant to the state's environmental quality, economic prosperity and public safety. ISGS is one of five scientific surveys within the Prairie Research Institute at the University of Illinois. Together, they form a unique group of scientific experts in the earth, environmental and biological sciences that is unmatched in the nation. These agencies carry out objective, high quality, multi-disciplinary scientific studies in service to all the people of Illinois.

About ADM

Every day, the 30,000 people of Archer Daniels Midland Company (NYSE: ADM) work to connect the harvest to the home, turning crops into renewable products that serve the vital needs of a growing world. At more than 265 processing plants and more than 330 sourcing facilities, we trade, transport, store and process corn, oilseeds, wheat and cocoa into products for food, animal feed, industrial and energy uses. We are committed to the responsible, sustainable development of agriculture throughout the world.

Headquartered in Decatur, Illinois, ADM connects crops and markets in more than 75 countries on six continents. Net sales for the fiscal year ended June 30, 2011, were $81 billion. For more information on our company and our products, visit www.adm.com.

About Schlumberger Carbon Services

Schlumberger Carbon Services provides technologies and services for the long-term geological storage of CO_2. Our experience, gained by participation in many CCS projects worldwide, is backed up by a corporate history of over 80 years in the oil & gas industry. Our multidisciplinary teams bring the project management, communications, and technology delivery skills needed to integrate all the services for storage safety, reliability and regulatory compliance. We work to combine our storage knowledge together with that of other providers in the areas of capture and transport, to deliver safe and successful CCS projects. For more information, please visit www.slb.com/carbonservices.

About DOE National Energy Technology Laboratory

The National Energy Technology Laboratory (NETL), part of DOE's national laboratory system, is owned and operated by the U.S. Department of Energy (DOE). NETL supports DOE's mission to advance the national, economic, and energy security of the United States. NETL implements a broad spectrum of energy and environmental research and development (R&D) programs that will return benefits for generations to come while protecting our environment and enhancing our energy independence.

About STEP

Established through the pioneering efforts of the American Recovery and Reinvestment Act, the U.S. Department of Energy, and the Midwest Geological Sequestration Consortium, the Sequestration Training and Education Program was created to share new climate mitigation technology as it is developed, dramatically reducing the time it takes for innovations in research to produce positive global change.

Through continuing education, hands-on training, and innovative outreach programs, STEP provides career enhancement opportunities and leadership development for engineers, teachers, geologists, service providers, regulators, executives, and others in wide range of energy related fields.

Schedule of Events

Monday, September 17, 2012

11:30 a.m.	Registration open
Noon – 1:00 p.m.	Lunch for workshop attendees
1:00 p.m. – 4:30 p.m.	Global Developments in Carbon Capture and Storage, sponsored by STEP
6:00 p.m. – 8:00 p.m.	Welcome reception, sponsored by ISGS and Prairie Research Institute

Tuesday, September 18, 2012

7:30 a.m.	Registration Opens
7:30 a.m. – 8:30 a.m.	Conference Breakfast
8:30 a.m. – 4:45 p.m.	Conference Technical Program
Noon – 1:00 p.m.	Conference Luncheon
6:00 p.m. – 7:00 p.m.	Poster Session and Cocktail Reception
7:00 p.m. – 9:00 p.m.	Sponsored by MGSC and Schlumberger Carbon Services, the poster viewing, reception and dinner will be at the Colonnades Club on the third floor of Memorial Stadium, home of the Fighting Illini Football Team. The Stadium is located on the northeast corner of Kirby and 1st Street and is a short walk from the conference center. Or if you prefer, shuttle service will be available from the North Foyer of the I Hotel Conference Center and the Front Lobby of the Hilton Garden Inn beginning at 5:50 p.m. Shuttles will run continuously from 5:50 – 6:50 p.m. and return from 8:30 p.m. to 9:15 p.m.

Wednesday, September 19, 2012

7:00 a.m. – 8:00 a.m.	Breakfast (Loyalty Room)
8:00 a.m.	Buses depart for Field Trip. Meet in South Foyer of the I Hotel Conference Center.
9:00 a.m. – 11:00 a.m.	IBDP site tour
Noon	Arrive back at the I Hotel in Champaign

The office of Continuing Education at the University of Illinois at Urbana-Champaign has granted attendees at the 2012 Midwest Carbon Sequestration Science Conference, 1.7 Continuing Education Units (CEU) for participation in this meeting. Please see Kathy Atchley at the registration desk to sign-up and receive a printed copy of your certificate.

Global CCS Workshop – Open to all participants » 1:00 p.m. Illinois Ballroom

Monday, September 17

Workshop: Global Developments in Carbon Capture and Storage, Sponsored by STEP
Abstracts for these presentations are listed later in the program.

Regulatory, social, and economic issues continue to impact the development of CCS technologies worldwide. This workshop will explore CCS developments from six countries on four continents. Attendees will hear firsthand accounts of ongoing and planned CCS projects as well as the unique issues and challenges faced in these respective counties. Participants will gain insight into global project development including site selection, operations, regulatory frameworks, community engagement, and monitoring. Presenters will discuss specific challenges and share lessons learned. A panel discussion will follow with a focus on leveraging these global experiences for future developments.

1:00 – 1:10 p.m.	Welcome from Sallie Greenberg, STEP Director
1:10 – 1: 35 p.m.	CCS in the UK, A.K. (Tony) Booer
1:35 - 2:00 p.m.	An Overview of CCS Activities in Germany, Martin Streibel
2:00 - 2:25 p.m.	The South African Centre for Carbon Capture and Storage, Brendan Beck
2:25 – 2:40 p.m.	Break
2:40 – 3:05 p.m.	CO_2 Transport, Storage and Monitoring R&D Progress in Republic of Korea, Cheol Huh
3:05 - 3:30 p.m.	Shaping an Understanding of China's CCS Roadmap: Energy Flow and Carbon Flow Analysis, Zheng Chang
3:30 – 3:55 p.m.	Carbon Storage Research and Demonstration in Australia, Richard Aldous
3:55 – 4:30 p.m.	Panel Discussion

Conference Technical Program » 8:30 a.m.–4:45 p.m.

Tuesday, September 18

Abstracts for these presentations are listed later in the program.

8:30 – 8:40 a.m.	Opening Remarks, Robert Finley, ISGS
8:40 – 9:00 a.m.	Long Term Success Will Come From the "S" in CCUS, John Tombari, Schlumberger Carbon Services
9:00 – 9:20 a.m.	US Department of Energy Program Overview, Bruce Brown, NETL
9:20 – 9:50 a.m.	Illinois Basin - Decatur Project Overview, Robert Finley, ISGS
9:50 – 10:20 a.m.	CO_2 Enhanced Oil Recovery in the Illinois Basin: Phase II Results, Scott Frailey, ISGS
10:20 – 10:40 a.m.	Break

10:40 – 11:00 a.m.	IBDP Monitoring, Verification, and Accounting – Near Surface and Surface, Randall A Locke II, ISGS
11:00 – 11:20 a.m.	Advance time-lapse InSAR for monitoring ground deformation at the IBDP, Giacomo Falorni, TRE Canada Inc.
11:20 – 11:40 a.m.	Deep Well Monitoring Activities at the IBDP Site, Jim Kirksey, Schlumberger Carbon Services
11:40 – noon	Responses, Uses, Interpretations, and Project Management Through an Integrated Data System, Ahsan Alvi, Schlumberger Carbon Services
Noon – 1:00 p.m.	Lunch
1:00 – 1:25 p.m.	Optimization of Surface Facilities: In Depth View of Compression and Dehydration at IBDP, Ray McKaskle, Trimeric Corporation
1:25 – 1:50 p.m.	Sedimentology and Petrology of a Carbon Capture Sequestration Reservoir and Seal, Jared Freiburg, ISGS
1:50 - 2:15 p.m.	Monitoring Injected CO_2 at the Illinois Basin - Decatur Project with Time-lapse 3D VSPs, Marcia Couselan, Schlumberger Carbon Services
2:15 – 2:40 p.m.	Microseismic Monitoring at Illinois Basin - Decatur Project: Systems Review and Current Status, Bob Will, Schlumberger Carbon Services
2:40 – 3:00 p.m.	Break
3:00 – 3:25 p.m.	Integrated Reservoir Modeling at IBDP, Ozgur Senel, Schlumberger Carbon Services
3:25 – 3:50 p.m.	Basin-scale Modeling of CO_2 Sequestration in the Illinois Basin - Progress Report, Ed Mehnert, ISGS
3:50 – 4:30 p.m.	Adapting IBDP Lessons to Project Development, Dwight Peters, Schlumberger Carbon Services
4:30 – 4:45 p.m.	Concluding remarks

Conference Dinner and Poster Session » 6:00–9:00 p.m.

Poster viewing, cocktails and dinner will be held in the Colonnades Club at Memorial Stadium, home of the Fighting Illini Football Team. The Stadium is located on the northeast corner of Kirby and 1st Street and is a short walk from the conference center. Walking maps and directions are available at the Conference Registration Desk. If you prefer, shuttle service will be available from the North Foyer of the I Hotel Conference Center and the Front Lobby of the Hilton Garden Inn beginning at 5:50 p.m. Shuttles will run continuously from 5:50 –6:50 p.m. and return from 8:30 p.m. to 9:15 p.m.

One of the most breathtaking stadiums in the country, Historic Memorial Stadium at the University of Illinois holds an esteemed position among the nation's elite sports facilities. Its regal colonnades and austere brick and limestone façades have dominated the central Illinois landscape for generations. Holabird & Roche designed the stadium as a memorial dedicated to the 189 University of Illinois students and alumni who died in World War I. Memorial colonnades were designed to run the length of the east and west façades. The colonnades were comprised of 200 individual columns. On 189 of these columns was inscribed the name of an Illini soldier who died in the war. In addition, carved stone panels were placed on the facility's exterior to commemorate the war and to honor athletic achievements.

The Colonnades Club, located on the third level of the stadium's west side, stretches end zone to end zone and offers an exceptional view of the entire stadium.

Poster Session

Illinois Basin- Decatur Project MVA Program by Midewest Carbon Sequestration Consortium, presented by Randall A Locke II, Illinois State Geological Survey

Soil Flux Monitoring for the Illinois Basin - Decatur Project by Curt S Blakley, Jacquelyn Hurry, and Randall A Locke II, Illinois State Geological Survey

Illinois Basin- Decatur Project: Groundwater Monitoring by Randall A Locke II, Abbas Iranmanesh, and Bracken Wimmer, Illinois State Geological Survey

Soil Gas Monitoring at the Illinois Basin – Decatur Project by David A.N. Ussiri and Randall A Locke II, Illinois State Geological Survey

Characterizing Compositional Variability in the Cambrian Illinois Basin: Provenance and Depositional Evolution by Thomas R. Lovell, Brenda B. Bowen, John Rupp, Rick Lehan, Cristian Medina, Brenton Chetnik, Alex Gonzalez, Purdue University

Identifying Diagnostics for Reservoir Structure and CO_2 Plume Migration from Multilevel Pressure Measurements by Christin Strandli and Sally M. Benson, Stanford University

Field Trip Information

Wednesday, November 19, 2012

Archer Daniels Midland Company

The field trip is designed to provide participants the opportunity to see an active CCS injection site, ask questions of practitioners, investigate monitoring equipment first hand, and gain insights on issues that will impact future projects. Visits to the IBDP site will depart the South Foyer of the I Hotel Conference Center at 8:00 a.m. and will return to the I Hotel at noon.

For safety reasons all visitors must have closed-toe shoes and long pants to participate in the field trip. Visitors to the IBDP are prohibited from taking any photographs or videos while on ADM property. Use of cell phones or tobacco are not allowed on the ADM property.

Global CCS Workshop Abstracts

CCS in the UK

A. K. Booer, Schlumberger Carbon Services, United Kingdom

The UK has played a significant role in shaping European and international legislation as a necessary precursor to allow offshore storage of CO_2 in geological formations beneath the North Sea. Storage resources include existing depleted oil and gas fields, with some limited opportunities for enhanced oil recovery, and also new capacity in saline formations. The requirement for offshore storage places specific constraints on site characterization, well construction and monitoring technologies.

Significant clusters of industry, including coal fired power stations, exist along the east coast of the UK, in relative close proximity to the North Sea, and afford the opportunity for aggregating significant quantities of CO_2 for storage, promising some economies of scale.

Despite a succession of CCS project opportunities, several tranches of funding from the European Union, up to one billion pounds funding promised from the UK government, and two competition rounds, no firm winner has emerged. But the results of two front-end engineering studies from the first competition have been published in some detail and contain valuable insights for future projects.

Competition number two is distinguished from its predecessor in being badged as a 'CCS Commercialisation Programme' and promises to be more than just a single project demonstration. Nevertheless, the UK and European programmes to develop commercial CCS technologies differ in several significant and instructive ways.

An Overview of CCS Activities in Germany

Martin Streibel, Centre for CO_2 Storage, GFZ - German Research Centre for Geosciences, Germany

Carbon Capture and Storage (CCS) could play a major role in reducing CO_2 emissions of current energy systems. In Germany two funding programs, COORETEC and GEOTECHNOLOGIEN, have been installed in order to support research in the field of power generation/CO_2 Capture and geological storage of CO_2. In the first part of the talk a brief summary of the topics and development of CCS research in Germany will be given. In addition the view will be widened to the European context.

In the second part major results of the first European on-shore pilot site Ketzin located near Berlin, Germany, will be presented. Starting in 2004, Ketzin is fully operational since the start of injection in June 2008. Up to August 2012 more than 61,000 tons of CO_2 have been injected and stored in a saline aquifer at a depth of approx. 650 m. Fundamental knowledge about the injection and geological storage of CO_2 in saline rock formations is obtained and show that: (i) the CO_2 storage at the pilot site Ketzin runs reliably and safely, (ii) a combination of geochemical and geophysical monitoring methods is capable of detecting very small quantities of CO_2, (iii) interactions between fluid and rocks have no essential consequences for the integrity of the rocks, and (iv) computational simulations are capable of describing the temporal and spatial distribution of the CO_2.

The South African Centre for Carbon Capture and Storage

Brendan Beck, Manager of the South African Centre for Carbon Capture and Storage, South Africa

South Africa is reliant on fossil fuels – approximately 90% of primary energy is derived from fossil fuels. Coal provides 92% of electricity production and, through coal to liquids technology, 30% of the petroleum used in South Africa. South Africa is targeting to peak its CO_2 emissions between 2020 and 2025, with a reduction in absolute terms from around 2035. South Africa will require a portfolio of technologies to meet its climate change goals. Within this portfolio, carbon capture and storage (CCS) is of particular importance as the only technology to mitigate CO_2 emissions from large-scale fossil fuel usage in fuel transformation, industry and power generation.

CCS is a new technology in South Africa, which is why the South African government, in collaboration with international governments and industry launched the South African Centre for CCS (SACCCS) in 2009. SACCCS has been mandated to further the understanding of CCS potential in South Africa. The SACCCS CCS Roadmap (Roadmap) provides the overarching direction for the SACCCS work plan and includes:

2004	Assessment of CCS potential in South Africa
2010	Production of a South Africa CO_2 storage atlas (Atlas)
2017	Performing a South African CO_2 test injection project (TI Project)
2020	Enabling a CCS demonstration plant in South Africa
2025+	Informing CCS commercial deployment

The first two steps in the Roadmap are now complete with an assessment of CO_2 sources, a preliminary assessment of South African geology for CCS and the production of the Atlas. South Africa has a significant number of large CO_2 point sources applicable to CCS, particularly in the electricity and coal/gas to liquids industries. The Atlas, produced in 2010 to better assess the geological storage opportunities in South Africa, identifies 150Gt of theoretical storage capacity in four geological basins around the country. Of that storage capacity, 98% is offshore.

The next step in the Roadmap is the TI Project. The TI Project is planned for 2017, subject to the results for further geological exploration. The TI Project is anticipated to store in the order of 10,000 – 50,000t CO_2 and aims to find out more about the geological storage opportunities in preparation for larger CCS deployment. Further investigation is now underway to assess whether the onshore portions of the Outeniqua basin and Durban/Zululand basin are appropriate to host the TI Project with plans being draft for the additional collection of data. Work is also ongoing to define the scope, business plan, and other considerations of the TI Project.

CO_2 Transport, Storage and Monitoring R&D Progress in Republic of Korea

Cheol Huh[1], Seong-Gil Kang[1], Myong-Ho Park[2], Young-Gyu Park[1]

[1]Korea Institute of Ocean Science and Technology, Republic of Korea
[2]Korea National Oil Corporation, Republic of Korea

The objective of this presentation is to review and introduce R&D strategy, progress and plan focused on marine geological storage in Republic of Korea. The present project focused on an investigation into potential CO_2 storage sites on the Korean continental shelves supported by Ministries of Land, Transport and Maritime Affairs (MLTM). This technology development plan is to meet Korean Government's CCS demonstration plan to explore and secure the CO_2 storage sites which have >1MtCO_2/year capacity in 2015 and to start CO_2 injection of >1 MtCO_2/year in 2017. We carried out the interpretation including fine-tuned stratigraphic/structural analysis and relatively accurate storage capacity estimates of the southwestern margin of the Ulleung Basin with the objectives of establishing a regional stratigraphic framework for possible CO_2 storage candidates and estimating their theoretical storage capacities prior to relatively more accurate and detailed analysis. In Korea, most of the largest CO_2 emission sources such as fossil power plant and industrial plants are located along the coastal area. To match CO_2 source and sink, onshore pipeline and offshore ship transport scenario was studied for demonstration phase. A conceptual design of large-scale transport network including onshore and offshore area was carried out. To verify no leakage and to predict the long-term behavior, 4-D time lapse seismic monitoring technique has been studied by considering the offshore conditions. Generally, waste and other material dumping into the ocean is prohibited by IMO London Protocol. But the revised IMO LP makes it possible to carry out CO_2 geologic storage sub-seabed. The Marine Environmental Protection Law of Korea was also revised based on the IMO LP. On the other hand, the detail legal and regulatory framework was established yet. To achieve this baseline, marine risk assessment and management was studied by considering the offshore geologic storage.

Shaping an Understanding of China's CCS Roadmap: Energy Flow and Carbon Flow Analysis

Zheng Chang, China

As of 2010, China's energy consumption has doubled in the past 10 years, from 1.04 billion tonnes of oil equivalent (toe) (2001) to 2.43 billion toe, accounting for 20% of the current world consumption. The natural connection between fossil fuel and CO_2 emission combined with a heavy reliance on coal cannot be ignored. China is now becoming the largest emitter of CO_2, accounting for 22% of current emissions. Coal will continue to dominate the energy structure for the coming decades. CCS would help to reconcile the potential threat of coal use and climate change. However, most CCS activities in China are rather recent, involving very limited actors. The main drivers are almost exclusively in expert circles with no mature policy. For China's CCS development, much effort should especially be put into public policy aspects. A clear and direct look at the energy use and CO_2 emissions using energy flow and carbon flow analysis method is needed. Compiling a CO_2 emission inventory would help to shape an understanding of China's CCS roadmap, making it easier to be accepted by the public.

Carbon Storage Research and Demonstration in Australia

Dr Richard Aldous, Chief Executive Officer, Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC), Australia

Carbon storage science continues to be supported by governments and industry in Australia. The new emissions trading scheme and stronger science on climate change is expected to continue this trend. Treasury modelling implies over 100 mtpa of CO_2 is required to be stored by 2050 for Australia to meet its emissions reduction targets.

Carbon storage activities in Australia include the following, all of which have research and development needs:

- Regional exploration and basin analysis to more accurately assess capacity and suitability of particular basins in the long term
- Exploration and characterisation of storage sites for moderate scale demonstration projects (Queensland and NSW)
- Exploration and characterisation for large scale demonstration projects (SW Hub and CarbonNet)
- Construction of the Gorgon Project (3.5 mtpa CO_2 injection starting in 2014)
- The implications of Australia's LNG growth on storage needs
- Research and demonstration to underpin the storage science/technology knowledge base; (eg seal integrity, capacity evaluation, fluid flow, geochemical and geo-mechanical modelling, etc.)
- Developing technology and approaches for continuous low cost MMV in the subsurface
- Atmospheric, marine and seismicity MMV continues be investigated to determine baseline monitoring requirements
- Hub and spoke business modelling to determine the appropriate role of government in large scale CCS projects
- Continued community engagement and monitoring around the Otway and emerging large-scale projects

The status of these activities and CO2CRC's role will be described together with the implications for research and the future. An overview of the next steps for storage research at the Otway will also be presented.

Technical Program Abstracts

Long Term Success Will Come From the "S" in CCUS

John Tombari, President, Schlumberger Carbon Services

Since last year's science conference we have seen accelerating focus on the "U" in CCUS. The "U" is largely CO_2-EOR and has become a means to help bridge the economic hurdle created by the capture of anthropogenic CO_2. We have seen that CO_2 off take agreements by oil and gas companies have become a critical component for the continuance of large scale integrated CCUS projects.

While the benefits of the "U" are necessary and undeniable, we must not forget how we got here and the importance of the "S" in CCUS. Keeping in mind the "S" for "Storage", means that regardless of the type of reservoir we choose to inject anthropogenic CO_2 into, we will be diligent in our efforts to ensure proper long term CO_2 containment for the benefit of climate change mitigation.

While not as politically main stream as it was just a few years ago, it is climate change that has drawn us all together to study and validate CCUS technology. Having CCUS technology as an available and accepted tool for dealing with climate change is still necessary if there is hope to keep atmospheric GHG concentrations at acceptable levels. Despite the prospects of increased oil production through CO_2-EOR, there are still three key questions we must properly answer to policy makers, financiers, the public, and others: Does CCUS technology work at scale? Is it safe? And how much will it cost?

The Illinois Basin–Decatur Project, and soon the Illinois Industrial Carbon Capture and Storage project, goes a long way to address these questions as well as to demonstrate the potential for geological formations, such as the Mount Simon, to store significant volumes of CO_2. These projects put great science, effort and focus on the "S" in CCUS. IBDP remains one of the few large scale integrated saline storage projects in the world and has an important role to play in bringing confidence to the overall technology. While the "U" provides short term continuity, it is the "S" and the efforts of projects like this one which will lead to the long term successes we have been seeking.

US Department of Energy Program Overview

Bruce Brown, Infrastructure Coordinator, U.S. DOE Carbon Storage Program, U.S. DOE National Energy Technology Laboratory

This presentation offers an overview of the Carbon Storage Program within the Office of Coal and Power Research and Development at DOE's National Energy Technology Laboratory. The presentation addresses FY2012 funding, CO_2 utilization, the technology areas within the Carbon Storage Program, as well as a brief update on the Phase III, large-scale geologic tests by the Regional Partnerships. Additional updates will be provided on knowledge sharing products such as the Best Practices Manuals, the Carbon Sequestration Atlas and web-based information.

Illinois Basin - Decatur Project Overview

Robert J. Finley, Director Advanced Energy Technolgy Initiative, Illinois State Geolgical Survey

The Midwest Geological Sequestration Consortium's (MGSC) Illinois Basin – Decatur Project (IBDP) is a collaboration of the MGSC, the Archer Daniels Midland Company (ADM), Schlumberger Carbon Services, and other subcontractors to inject 1 million metric tons of anthropogenic carbon dioxide (CO_2) into a saline reservoir, the Mount Simon Sandstone, at Decatur, IL. MGSC is one of the US Department of Energy's Regional Carbon Sequestration Partnerships. The IBDP derives its CO_2 from ADM's ethanol fermentation facility at Decatur and consists of a compression/dehydration facility, a 1.9 km pipeline, one injection well, one observation/verification well, and a geophysical test well developed on the ADM-owned site. The project holds a UIC Class I Nonhazardous permit from the Illinois EPA and has applied for a UIC Class VI permit in December 2011 to be issued by the US EPA, Region 5. The objectives of the project are to validate the capacity, injectivity, and containment of the Mount Simon which represents the primary carbon storage resource in the Illinois Basin and the Midwest Region. Operational injection started on 17 November 2011 and as of late-August 2012, more than 256,000 tonnes have been injected.

During the injection process, which is expected to last until fall of 2014, extensive data collection is occurring. A full subsurface and surface Monitoring, Verification, and Accounting (MVA) program is in place, and periodic data collection such as fluid sampling, geophysical measurements, and cased-hole logging is underway. Core and log data from the original drilling operations are being integrated with a 3D seismic volume to interpret original depositional systems and support reservoir simulation. Since injection began, two rounds of reservoir fluid samples have been collected in the verification well and pressure measurements from that well have helped define the distribution of the developing CO_2 plume.

The Mount Simon reservoir has been performing as expected and the CO_2 is being readily injected at a wellhead injection pressure of about 9.3 MPa (1,350 psi) and a temperature of 35°C (95°F). CO_2 had reached the verification well in March 2012, which was sooner than expected. Logging showed about a 2 m (6 ft) thick interval with CO_2 in a zone equivalent to the upper injection perforations. The lower zone in the verification well showed CO_2 in July 2012. The CO_2 distribution is interpreted to be spreading in a thin zone which is impacting its detection on the repeat 3D Vertical Seismic Profile (VSP). Clusters of microseismic events have been detected northwest of the verification well with very low magnitudes, typically between minus 2.0 and minus 3.8. The automated data collection system is functioning as planned and provides valuable real-time monitoring and data archiving. The compression/dehydration system has been functioning as planned with no major deviations. Insulation was added to the above-ground pipeline after early operational experience showed that weather-induced temperature changes could result in pressure variations at the injection well. Overall, capacity, injectivity, and containment have met pre-injection expectations, and project activities remain focused on MVA, understanding CO_2 distribution, and improvements in equipment and ongoing operations.

CO_2 Enhanced Oil Recovery in the Illinois Basin: Phase II Results

Scott Frailey, Senior Reservoir Engineer, Illinois State Geological Survey

Geological carbon dioxide (CO_2) sequestration in Illinois Basin oil reservoirs was assessed by completing two small-scale CO_2 injection tests. The purpose of these Phase II tests was to gauge the large-scale CO_2 storage potential that might be realized from enhanced oil recovery (EOR) of mature oil fields via miscible and immiscible CO_2 flooding. In order to project the EOR potential of a larger-scale project, the pilots were designed to measure and record data that could be used to calibrate a reservoir simulation model of the fields to make EOR estimates of full-field, long-term CO_2 sequestration.

Truck delivered CO_2 was injected at each site over about one year, with interruptions at each site due to winter road restrictions and poor weather. An increase in oil production associated with CO_2 was measured at both sites after a few months of CO_2 injection.

The miscible (liquid) CO_2 flood pilot (EOR II) was conducted at Mumford Hills Field in Posey County, Indiana; 6,950 tons were injected. Projections based on these models indicated that full-field CO_2 injection for 20 years could have 12% oil recovery or 170,000 stb with CO_2 storage of nearly 300,000 tons.

The immiscible CO_2 flood pilot (EOR III) was conducted at the Sugar Creek Field in Hopkins County, Kentucky; 7,230 tons were injected. Projections based on these models indicated that full-field CO_2 injection for 20 years could have 5.5% incremental oil recovery or 174,000 stb with CO_2 storage of nearly 10,000 tons. At lower reservoir pressure, less CO_2 can be stored.

IBDP Monitoring, Verification, and Accounting – Near Surface and Surface

Randall A Locke II, Illinois State Geological Survey

An extensive Monitoring, Verification, and Accounting (MVA) program has been undertaken for the Illinois Basin Decatur Project (IBDP) and is focused on the 0.65 km^2 (0.25 mi^2) project site. Near-surface and subsurface monitoring are integral efforts to reach MVA and project goals of 1) establishing pre-injection conditions to evaluate potential impacts from CO_2 injection, 2) demonstrating that project activities are protective of human health and the environment, and 3) quantifying and tracking CO_2 stored in the Mount Simon reservoir. The IBDP MVA Program is a combined effort of the Illinois State Geological Survey, Archer Daniels Midland Company, Schlumberger Carbon Services, Schlumberger Water Services, Lawrence Berkley National Laboratory, University of Illinois, TRE-Canada and the Carbon Capture Project, Physical Sciences Incorporated, and the Illinois Department of Transportation. Up to 24 months of pre-injection data have been collected.

Near-surface monitoring efforts include near-infrared color aerial imagery acquisition, surface deformation monitoring, net CO_2 flux monitoring, soil CO_2 flux monitoring, soil gas sampling, high-resolution electrical earth resistivity surveys, and shallow groundwater sampling. Subsurface monitoring efforts include 2D seismic surveying; 3D seismic and vertical seismic surveying; passive seismic monitoring; injection zone temperature, pressure, and fluid monitoring; above caprock temperature, pressure, and fluid monitoring; and open and cased hole logging. Research monitoring was initiated in 2009 and will conclude in 2017 after the three-year injection and three-year post-injection periods. Injection is currently active under a Class I – non-hazardous underground injection control (UIC) permit issued by the Illinois Environmental Protection Agency. A Class VI UIC permit application has been submitted to the U.S. Environmental Protection Agency for the IBDP and is currently under review.

Advance time-lapse InSAR for monitoring ground deformation at the IBDP

Giacomo Falorni[1], Jessica Morgan[1], Jean-Simon Michaud[1], Marco Bianchi[2]

[1]TRE Canada Inc., Vancouver, BC
[2]Tele-Rilevamento Europa T.R.E., Milan, Italy

The CO_2 Capture Project Consortium (CCPC) is a partnership of several of the world's leading energy companies with a mandate to research and develop technologies for the capture and geological storage of carbon dioxide (CO_2). Working in partnership with the Midwest Geological Sequestration Consortium, which oversees the Illinois Basin - Decatur Project (IBDP), the CCPC is supporting the use of InSAR as part of the MVA toolkit for this site. The main objective of InSAR monitoring over Decatur is the detection of any ground deformation produced in response to CO_2 injection as well as to demonstrate the use of InSAR as a monitoring tool in North American sites.

TRE Canada (TRE) is applying its proprietary SqueeSAR™ algorithm to identify a high density of measurement points to assess deformation. To complement the "natural" measurement points a series of artificial reflectors (ARs) were installed between the injection well and a nearby observation well. Radar satellite imagery is being collected by the Cosmo-SkyMed constellation of satellites and the data is being processed at three-month intervals. To date 45 images have been collected at 8-day intervals and the most recent processing was carried out at the end of June 2012. Starting from July, the acquisition frequency has decreased to a new image every 16 days.

Results to date show little or no uplift in the area of the injector and at the artificial reflector locations. Pockets of uplift have been detected in the surrounding areas but appear to be related to local surface conditions rather than to injection activities.

Deep Well Monitoring Activities at the IBDP Site

Jim Kirksey, Project Manager, Schlumberger Carbon Services

The Illinois Basin–Decatur Project (IBDP) employs several Monitoring, Verification, and Accounting (MVA) activities at the injection site – both surface and subsurface. The subsurface monitoring program is split into shallow and deep monitoring regions. The shallow monitoring focuses primarily on groundwater and soil gas. The deep monitoring program uses the Geophone, Verification, and Injection wells to monitor and verify that the injection and subsequent movement of the injected CO_2 is contained within the target formation.

Once injected deep into the subsurface, CO_2 can be tracked using various MVA techniques, which are used to verify and monitor three main areas: (1) storage performance – in terms of capacity (of the injection formation), injectivity, and containment; (2) risk management – providing information needed for protecting valuable resources such as groundwater by understanding movement of CO_2; and (3) numerical model performance – so that computer-based projections of reservoir responses to injection can progressively improve in accuracy as the project proceeds.

These deep MVA activities include utilizing RST* reservoir saturation tool measurements along with temperature logging in both the Injection and Verification wells. Downhole injection pressure and temperature are continuously monitored at the Injection well. Micro-seismic activity is monitored inside the Injection well and at the dedicated Geophone well. The Westbay* multilevel groundwater characterization and monitoring system in the Verification well is used for pressure and temperature monitoring and periodic sampling of reservoir fluids. Reservoir pressures are monitored in nine zones of the Mount Simon and two zones above the Eau Claire caprock seal in the Verification well.

[redacted]

Responses, Uses, Interpretations, and Project Management Through an Integrated Data System

Ahsan Alvi, Assistant Project Manager, Schlumberger Carbon Services

RTAC* real-time acquisition and control software is a user-friendly interface that allows for real-time monitoring of downhole and surface instrumentation for the Illinois Basin – Decatur Project (IBDP). A diverse team from around the globe took part in the development of the specifically enhanced system to serve the IBDP fit-for-purpose use.

The motivation factor behind developing RTAC was to incorporate the large volume of data that is continuously collected from the 140 process sensors between the compressors, pipeline, and wellbore completions. The subsurface data that the RTAC system collects from the Injection, Geophone, and Verification Wells are the downhole pressure and temperature, Distributed Temperature Sensor (DTS), Westbay* multilevel groundwater characterization and monitoring system pressure and temperature information, as well as geophone data. The RTAC system collects flow rate, wellhead pressures and temperatures, and ambient conditions from a weather station.

The RTAC system provided an integrated solution for managing a complex, interdependent system and enabling data monitoring which enhanced operational safety, optimized injection parameters, improved project communications and data management, as well as system performance analysis.

[redacted]

Optimization of Surface Facilities: In Depth View of Compression and Dehydration at IBDP

Ray McKaskle, Trimeric Corporation

Trimeric will briefly review the design, installation, and operation of the IBDP compression and dehydration equipment including the multistage centrifugal booster blower, reciprocating compressors, triethylene glycol dehydration unit, multistage centrifugal pump, and the injection pipeline and will then present operational data to date and compare these data with the equipment performance metrics for this project. Lessons learned will be reviewed and steps taken to date to optimize equipment performance and future possible options to further improve operations will be presented. Relationships between surface operating conditions and bottomhole injection conditions such as the influence of surface injection temperature on CO_2 density at the wellhead and on bottomhole pressure will be discussed.

Sedimentology and Petrology of a Carbon Capture Sequestration Reservoir and Seal

Jared T. Freiburg, David G. Morse, and Hannes E. Leetaru, Illinois State Geological Survey

Specific intervals of the Mt. Simon Sandstone and the Eau Claire Formation were cored during the drilling of the Verification #1 well for the Illinois Basin – Decatur Project (IBDP). Approximately 182 meters (600 feet) of 4-inch core were recovered from the Mt. Simon Sandstone and Eau Claire Formation. Using core and geophysical logs, depositional facies and diagenetic heterogeneities have been determined and characterized to correlate and describe geologic controls on reservoir and seal properties.

At Decatur, the Mt. Simon Sandstone reservoir is over 487 meters (1,600 feet) thick and can be divided into three major sections; the upper, middle, and lower. Each section is comprised of distinct depositional facies including tidal flat, tidal channel, eolian, and fluvial (braided river), respectively. Facies of the upper and lower sections offer ideal reservoir conditions with porosity as high as 27% and permeability up to 500 millidarcies. However, within these sections some intervals may have high porosity but rather low permeability as a result of grain size or authigenic minerals that occlude pore throats thus supporting the necessity for sedimentologic and diagenetic characterization. All sections present some intervals of potential intraformational seals or baffles comprised of diagenetic cements such as authigenic quartz. The primary reservoir seal is the overlying Eau Claire Formation. It is approximately 152 meters (500 feet) thick and is predominantly a marine influenced depositional facies with numerous intertidal mudflats. The basal 91 meters (300 feet) is comprised of tight siltstone and impermeable silty mudstone dominantly composed of quartz, feldspar, and illite. Together, the Mt. Simon Sandstone and the Eau Claire Formation provide an excellent reservoir and seal for carbon capture sequestration.

Monitoring Injected CO_2 at the Illinois Basin - Decatur Project with Time-lapse 3D VSPs

Marcia L. Couëslan, Schlumberger Carbon Services

Time-lapse three-dimensional (3D) vertical seismic profiles (VSPs) are an important component of the monitoring, verification, and accounting (MVA) plan for the Illinois Basin–Decatur Project (IBDP). The VSPs will be used to provide information on CO_2 plume development, demonstrate containment of the CO_2 in the storage formation, and provide data to verify and update models and simulations over the life of the project. VSPs are more economical to acquire and process than surface seismic data and cause less disruption to local landowners as they have smaller acquisition footprints.

In 2009, a dedicated geophysical well was drilled to the northwest of CCS#1, and a 31-level downhole geophone array was cemented in place. The permanent geophone array brings two advantages to the project:

1. Acquisition of multiple 3D VSP surveys becomes more economical

2. A permanent array eliminates the repeatability errors related to the receivers

Three 3D VSP surveys have been acquired at the site to date: two baseline surveys and one monitoring survey acquired after ~70,000 tonnes of CO_2 had been injected. The baseline surveys were acquired under substantially different ground conditions, and the normalized root mean square (NRMS) repeatability metric shows that the data has poor repeatability. The Baseline 2 and Monitoring Survey 1 data are much more repeatable. While the final difference displays do not provide conclusive results regarding CO_2 movement in the Mt. Simon formation, the NRMS depth slice displays some higher NRMS values that may be suggestive of CO_2 movement. Future surveys are expected to produce more conclusive results as the volume of injected CO_2 increases.

Microseismic Monitoring at Illinois Basin - Decatur Project: Systems Review and Current Status

Bob Will, Principal Reservoir Engineer, Schlumberger Carbon Services

The growing need to address domestic energy and environmental challenges has resulted in an increase in underground injection activities (fluid injection, carbon sequestration). Awareness of the potential for related induced seismicity if these operations are not carefully managed has heightened. Therefore a prudent operational plan includes contingencies for monitoring of microseismic activity and the recording of concurrent operational data which are needed to evaluate potential causal relationships.

The Illinois Basin–Decatur Project's (IBDP's) microseismic monitoring has been one of the key features of this project since inception and has included the deployment of measurement and analysis technology throughout the data acquisition, data processing, and data flow analysis. Data acquisition includes real-time multi-borehole seismic monitoring, real-time integration with operational data (pressure, temperature, flow rates, etc.), data transmittal to a secure web-based portal, and automated activity email alerts. Data processing utilizes methods which combine classical seismology with signal processing algorithms and computing resources. Data analysis integrates available 3D seismic data, 3D numerical fluid flow, and coupled geomechanical simulations. Concurrent operational data such as flow rates, pressures, and temperatures are also used to investigate potential causal relationships and understand prevention and mitigation techniques.

As a result, the IBDP represents a unique field laboratory providing many-fold opportunities for advancing the state of knowledge regarding prediction, monitoring, and management of potential induced seismicity that may be associated with CO_2 sequestration operations. We provide a review of the IBDP system and processes and a snapshot of current status.

Integrated Reservoir Modeling at IBDP

Ozgur Senel and Robert J. Butsch, Schlumberger Carbon Services

Reservoir simulation is the main tool used to predict long-term movement of carbon dioxide (CO_2) injected deep underground. By using calibrated reservoir models – with field data when available – improved estimates of injectivity, pressure perturbation, CO_2 plume shape, and development can be obtained.

Since 2007, throughout the course of Illinois Basin – Decatur Project (IBDP), reservoir modeling and numerical simulations have been used extensively to design wellbore, completions and well tests; to analyze and understand the well test results and monitoring data; to optimize injectivity; to predict CO_2 plume development and pressure perturbation over time; as well as to quantify uncertainties.

The reservoir model has evolved greatly as more data became available. In early 2012, all of the available petrophysical, geological, and geophysical data were incorporated to build an updated reservoir model representing the Mount Simon and Eau Claire formations. The model was then calibrated with the monitoring data collected during the first four months of CO_2 injection. The petrophysical, geological, and dynamic components of this model, the model calibration, and reservoir simulations will be described.

Basin-scale Modeling of CO_2 Sequestration in the Illinois Basin - Progress Report

Edward Mehnert, James Damico, Scott Frailey, Hannes Leetaru, Yu-Feng Lin, Roland Okwen, Illinois State Geological Survey

Nathaniel Adams, Brynne Storsved, Albert Valocchi, Department of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign

To mitigate climate change, carbon dioxide (CO_2) emissions to the atmosphere must be reduced. Geologic carbon sequestration can be used to permanently store CO_2 in the subsurface. The Mt. Simon Sandstone is the basal sandstone reservoir in the Illinois Basin and has an estimated CO_2 storage resource of 11 to 151 billion metric tons. This storage resource is sufficient to sequester 41 to 569 years of current CO_2 emissions from the basin's stationary sources.

To evaluate the feasibility of future, commercial-scale, multi-site, geologic sequestration within the basin, a flow and transport model has been developed and is currently being revised as new geologic and hydrogeologic data become available. Key issues to be addressed by this numerical modeling effort are the fate of the injected CO_2, the fate of the native brine, the integrity of the injection formation and its caprock, and effects on other industries or stakeholders.

Input data for the TOUGH2-MP simulator include a geologic model with three layers -- Precambrian granite, Mt. Simon Sandstone, and Eau Claire (bottom to top). TOUGH2-MP modeling results demonstrate the significant effect that the geologic parameters can have on the predicted pressure changes in the injection zone and adjacent confining layers and the distribution of aqueous and free-phase CO_2. In addition, the modeling results demonstrate that pressure fronts from the injection wells will experience well interference, but the CO_2 plumes will remain close to the injection wells. Finally, we will describe our progress for addressing the potential for affecting freshwater aquifers at the periphery of the basin.

Adapting IBDP Lessons to Project Development

Dwight Peters, Schlumberger Carbon Services

Throughout the DOE Carbon Storage Program, the focus has been on developing a technology portfolio of safe, cost-effective, commercial-scale CO_2 capture, storage, and mitigation technologies that will be available for commercial deployment beginning in 2020. The Regional Carbon Sequestration Partnerships, as demonstrated by the Illinois Basin–Decatur Project, have been the earliest to accomplish large-scale injection demonstrations. As evidenced by the content of the technical talks at this MGSC Science Conference, we have certainly added a lot to the technology portfolio.

But what does it all mean to a commercial entity that will someday have to apply these learnings to mitigate emissions from a large point source? What have we accomplished for the commercial setting? What can we do through the rest of this project to help them get more confidence? We will ask a small panel of knowledgeable industry leaders to give us feedback.

Midwest Geological Sequestration Consortium Partners

MGSC is a consortium of the geological surveys of Illinois, Indiana, and Kentucky joined by private corporations, professional business associations, the Interstate Oil and Gas Compact Commission, two Illinois state agencies, and university researchers to assess carbon capture, transportation, and storage processes, and their costs and viability, in the three-state Illinois Basin region. The MGSC Project Advisory Group (PAG) includes:

Ameren
American Air Liquide
American Water Works Association
Archer Daniels Midland Company
Aventine Renewable Energy
Baker Hughes, Inc.
Biorecro, LLC
Blue Source, LLC
BP Alternative Energy
Caterpillar, Inc.
Conoco Phillips Company
Continental Carbonic Products, Inc.
Drummond Company, Inc.
Duke Energy Corporation, Inc.
Edison Mission Energy/Midwest Generation
Electric Power Research Institute
Environmental Defense
GE Energy
Halliburton/Pinnacle
IL Dept. of Commerce & Economic Opportunity
Illinois Clean Coal Institute
Illinois Corn Growers Assoc.
Illinois Dept. of Natural Resources
Illinois Dept. of Transportation
Illinois Oil and Gas Assoc.
Illinois State Geological Survey
Indiana Gasification
Indiana Geological Survey
Indiana Oil and Gas Association

Interstate Oil and Gas Compact Commission
Kentucky Geological Survey
Kentucky Oil & Gas Association
Korea Institute of Ocean Science and Technology (KIOST)
LG & E Energy, LLC
LincolnLand Agri-Energy, LLC
Natural Gas and Pipeline Company of America, LLC
Natural Resources Defense Council
NiSource Gas Transmission and Storage Company
Peabody Energy
Peoples Gas
Petroleum Technology Research Centre
Power Holdings, LLC
Praxair, Inc.
Schlumberger Carbon Services
Spectra Energy Corporation
Tenaska Taylorville, LLC
The Cline Group
TOTAL E&P USA, Inc.
US Dept. of Energy
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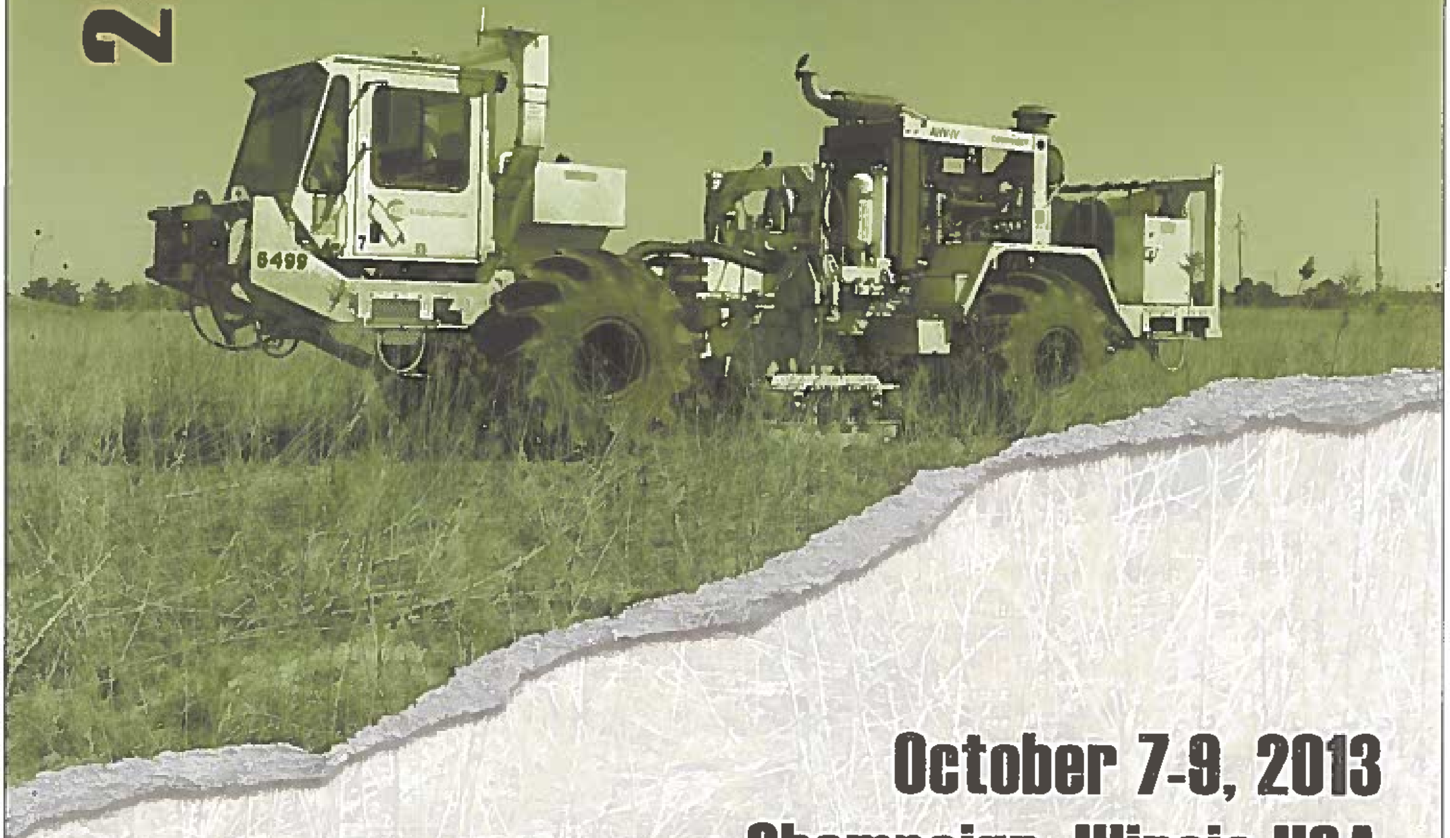
2013

MIDWEST GEOLOGICAL SEQUESTRATION

SCIENCE CONFERENCE



October 7-9, 2013
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SEQUESTRATION TRAINING AND EDUCATION PROGRAM
STEP

MGSC

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Welcome to the Midwest Geological Sequestration Science Conference

Welcome to the Midwest Geological Sequestration Science Conference

On behalf of the Midwest Geological Sequestration Consortium (MGSC), Schlumberger Carbon Services, the Sequestration Training and Education Program (STEP), the Illinois State Geological Survey (ISGS) and the Prairie Research Institute at the University of Illinois, we want to welcome you to this conference which celebrates our accomplishments at the Illinois Basin – Decatur Project (IBDP).

The past year marks several significant achievements for the MGSC and the IBDP, carried out in collaboration with Schlumberger Carbon Services and the Archer Daniels Midland Company in Decatur, Illinois. Operational injection began on November 17, 2011, and on September 23, 2013 we passed the milestone of 600,000 tonnes injected. We foresee the completion of our planned 1 million tonne injection by November 30, 2014. We have completed multiple cased-hole logging runs and have verified carbon dioxide remaining in the lowermost Mount Simon reservoir. We have also completed the second post-injection, 3D vertical seismic profile monitoring survey on which we now have an indication of the plume position, and our modeling and reservoir simulation has benefited from the extensive data collection program that remains underway. We are beginning to formulate plans for post-injection assessments interfaced with conversion to a UIC Class VI permit.

These milestones could not have been reached without ongoing project funding from the U.S. Department of Energy, National Energy Technology Laboratory, and the support of our many project partners and researchers. Their contributions, large and small, are creating the foundation for carbon capture and storage (CCS) technology and its successful future deployment. It is deeply satisfying to know that the research being conducted on this project will serve as baseline information for development of CCS projects in the Illinois Basin, in the entire Midwest, and in other regions around the world. Indeed, we particularly welcome our international visitors to this meeting.

As part of the Prairie Research Institute at the University of Illinois, we strive to provide objective, cutting-edge research and solutions to allow citizens and decision-makers to make choices that ensure sustainable economic development, enduring environmental quality, and cultural resource preservation for Illinois and beyond. Our technical program for this conference focuses not only on our accomplishments but also on knowledge sharing to provide you with research results, expertise, and data for independent scientific analysis and decision-making.

Welcome and enjoy the program.

Robert J. Finley
Principal Investigator
Midwest Geological Sequestration Consortium

William W. Shilts
Founding Executive Director
Prairie Research Institute

Sequestration Training and Education Program

Pioneering change. From the ground up.

Around the world, research is being conducted on new energy solutions that will help decrease our reliance on carbon-based fuels. Science is taking the next logical step, pursuing a wide range of interim solutions designed to create cleaner-burning fuels and reduce the global impact of greenhouse gases released into the environment.

At the Sequestration Training and Education Program (STEP), we are part of this vital initiative, transferring Carbon Capture and Sequestration (CCS) technology from the edge of science to the heart of a growing industry and equipping today's energy professionals with the steps they need to mitigate global environmental change.

STEP is a program of the Advanced Energy Technology Initiative, within the Prairie Research Institute – University of Illinois.

This material is based upon work supported by the U.S. Department of Energy under Award Number DE-FE0002462 and the Illinois Department of Commerce and Economic Opportunity #09-484002.

Who We Are

About the Midwest Geological Sequestration Consortium

The Midwest Geological Sequestration Consortium (MGSC) is one of seven regional partnerships selected by the U.S. Department of Energy to determine the best approaches for capturing and storing carbon dioxide (CO_2) that might otherwise contribute to global climate change. The MGSC is led by the Illinois State Geological Survey (ISGS), in conjunction with the Indiana Geological Survey (IGS) and the Kentucky Geological Survey (KGS), and covers Illinois, southwestern Indiana and western Kentucky. This partnership was established to assess geological carbon sequestration options in the 60,000 square mile oval-shaped, geologic feature known as the Illinois Basin. Within the Basin are deep, noneconomic coal resources, numerous mature oil fields, and deep saline rock formations with potential to store CO_2. MGSC's objective is to determine the technical and economic feasibility of using these geologic formations for long-term storage.

About the Illinois State Geological Survey

Founded in 1905, the ISGS provides the citizens and institutions of Illinois with earth science research and information that are accurate, objective and relevant to the state's environmental quality, economic prosperity and public safety. ISGS is one of five scientific surveys within the Prairie Research Institute at the University of Illinois. Together, they form a unique group of scientific experts in the earth, environmental and biological sciences that is unmatched in the nation. These agencies carry out objective, high quality, multi-disciplinary scientific studies in service to all the people of Illinois.

About ADM

Every day, the 30,000 people of Archer Daniels Midland Company (NYSE: ADM) work to connect the harvest to the home, turning crops into renewable products that serve the vital needs of a growing world. At more than 265 processing plants and more than 330 sourcing facilities, we trade, transport, store and process corn, oilseeds, wheat and cocoa into products for food, animal feed, industrial and energy uses. We are committed to the responsible, sustainable development of agriculture throughout the world.

Headquartered in Decatur, Illinois, ADM connects crops and markets in more than 140 countries on six continents. For more information on our company and our products, visit www.adm.com.

About Schlumberger Carbon Services

Schlumberger Carbon Services provides technologies and services for the long-term geological storage of CO_2. Our experience, gained by participation in many CCS projects worldwide, is backed up by a corporate history of over 80 years in the oil & gas industry. Our multidisciplinary teams bring the project management, communications, and technology delivery skills needed to integrate all the services for storage safety, reliability and regulatory compliance. We work to combine our storage knowledge together with that of other providers in the areas of capture and transport, to deliver safe and successful CCS projects. For more information, please visit www.slb.com/carbonservices.

About DOE National Energy Technology Laboratory

The National Energy Technology Laboratory (NETL), part of DOE's national laboratory system, is owned and operated by the U.S. Department of Energy (DOE). NETL supports DOE's mission to advance the national, economic, and energy security of the United States. NETL implements a broad spectrum of energy and environmental research and development (R&D) programs that will return benefits for generations to come while protecting our environment and enhancing our energy independence.

About STEP

Established through the pioneering efforts of the American Recovery and Reinvestment Act, the U.S. Department of Energy, and the Midwest Geological Sequestration Consortium, the Sequestration Training and Education Program was created to share new climate mitigation technology as it is developed, dramatically reducing the time it takes for innovations in research to produce positive global change.

Through continuing education, hands-on training, and innovative outreach programs, STEP provides career enhancement opportunities and leadership development for engineers, teachers, geologists, service providers, regulators, executives, and others in wide range of energy related fields.

Schedule of Events

Monday, October 7, 2013

11:30 a.m.	Registration open
Noon – 1:00 p.m.	Lunch for STEP workshop attendees
1:00 p.m. – 4:00 p.m.	Workshop sponsored by STEP
6:00 p.m. – 8:00 p.m.	Welcome reception, sponsored by ISGS and Prairie Research Institute

Tuesday,October 8, 2013

7:30 a.m.	Registration Opens
7:30 a.m. – 8:30 a.m.	Conference Breakfast
8:30 a.m. – 5:00 p.m.	Conference Technical Program
Noon – 1:00 p.m.	Conference Luncheon
6:00 p.m. – 7:00 p.m.	Poster Session and Cocktail Reception at Memorial Stadium
7:00 p.m. – 9:00 p.m.	Conference dinner sponsored by MGSC and Schlumberger Carbon Services, the poster viewing, reception and dinner will be at the Colonnades Club on the third floor of Memorial Stadium, home of the Fighting Illini Football Team. The Stadium is located on the northeast corner of Kirby and 1st Street and is a short walk from the conference center. Or if you prefer, shuttle service will be available from the North Foyer of the I Hotel Conference Center and the Front Lobby of the Hilton Garden Inn beginning at 5:50 p.m. Shuttles will run continuously from 5:50 – 6:50 p.m. and return from 8:30 – 9:15 p.m.

Wednesday, October 9, 2013

7:00 a.m. – 8:00 a.m.	Breakfast (Knowledge Room)
8:00 a.m.	Buses depart for Field Trip. Meet in North Foyer of the I Hotel Conference Center.
9:00 a.m. – 11:00 a.m.	IBDP site tour
Noon	Arrive back at the I Hotel in Champaign

The office of Continuing Education at the University of Illinois at Urbana-Champaign has granted attendees at the 2013 Midwest Carbon Sequestration Science Conference 1.7 Continuing Education Units (CEU) for participation in this meeting. Please see Kathy Atchley at the registration desk to sign-up and receive a printed copy of your certificate.

Agenda

Conference Workshop » 1:00–4:00 p.m. Illinois Ballroom

Monday, October 7

Financial Assurance 101 – Open to all participants

1:00 – 1:10 p.m.	Opening remarks from Sallie Greenberg, STEP Director
1:10 – 2: 45 p.m.	Financial Assurance 101, Chiara Trabucchi, Industrial Economics Inc.
2:45 – 3:00 p.m.	Break
3:00 - 4:00 p.m.	Panel Discussion (Mr. Larry Bengal, Mr. Dwight Peters, and Ms. Chiara Trabucchi)

Conference Technical Program » 8:30 a.m.–5:00 p.m. Illinois Ballroom

Tuesday, October 8

Abstracts for these presentations are listed later in the program.

7:30 – 8:30 a.m.	Continental Breakfast

Introductory Comments and Review

8:30 – 8:40 a.m.	Opening Remarks, Robert Finley
8:40 – 9:00 a.m.	US Department of Energy Program Overview, Darin Damiani
9:00 – 9:25 a.m.	Project Progress and the Year in Review, Rob Finley

Reservoir and Basin Framework

9:25 – 9:50 a.m.	Reservoir and Seal Sedimentologic Insights, Jared Freiburg
9:50 – 10:15 a.m.	Illinois Basin Basement and Structure, John McBride
10:15 – 10:45 a.m.	Break
10:45 – 11:10 a.m.	Review of Illinois and Indiana Seismicity, Bob Bauer
11:10 – 11:35 a.m.	3D Seismic at Decatur Revisited, Dianna Shelander
11:35 – noon	Discussion: Expanding Site Characterization (Rob Finley)
Noon – 1:00 p.m.	Lunch

Integrated Insights

1:00 – 1:30 p.m.	History of Microseismic Events at IBDP, Valerie Smith
1:30 – 2:00 p.m.	Geomechanical and Flow Modeling at IBDP, Bob Will
2:00 - 2:25 p.m.	Plume Monitoring through VSPs, Marcia Cousëlan
2:25 – 2:45 p.m.	Discussion: Assessing the Response to Plume and Pressure (Michael Carney)
2:45 – 3:00 p.m.	Break

Increased Storage Scale

3:00 – 3:25 p.m.	A Second Project Takes Shape, Scott McDonald
3:25 – 3:45 p.m.	Reservoir Engineering Update, Bob Will
3:45 – 4:10 p.m.	Basin-Scale Modeling of Large Injected Volumes, Ed Mehnert
4:10 – 4:40 p.m.	Discussion: Moving Upward from Demonstration-Scale (Dwight Peters)
4:40 – 5:00 p.m.	Fieldtrip Information and Closing Remarks

Conference Dinner and Poster Session » 6:00–9:00 p.m. Memorial Stadium

Poster viewing, cocktails and dinner will be held in the Colonnades Club at Memorial Stadium, home of the Fighting Illini Football Team. The Stadium is located on the northeast corner of Kirby and 1st Street and is a short walk from the conference center. Walking maps and directions are available at the Conference Registration Desk. If you prefer, shuttle service will be available from the North Foyer of the I Hotel Conference Center and the Front Lobby of the Hilton Garden Inn beginning at 5:50 p.m. Shuttles will run continuously from 5:50 – 6:50 p.m. and return from 8:30 – 9:15 p.m.

One of the most breathtaking stadiums in the country, Historic Memorial Stadium at the University of Illinois holds an esteemed position among the nation's elite sports facilities. Its regal colonnades and austere brick and limestone façades have dominated the central Illinois landscape for generations. Holabird & Roche designed the stadium as a memorial dedicated to the 189 University of Illinois students and alumni who died in World War I. Memorial colonnades were designed to run the length of the east and west façades. The colonnades were comprised of 200 individual columns. On 189 of these columns was inscribed the name of an Illini soldier who died in the war. In addition, carved stone panels were placed on the facility's exterior to commemorate the war and to honor athletic achievements.

The Colonnades Club, located on the third level of the stadium's west side, stretches end zone to end zone and offers an exceptional view of the entire stadium.

Poster Session

Illinois Basin - Decatur Project MVA Program
by Randall A Locke II
Illinois State Geological Survey

Statistical Evaluation of Groundwater Compliance Data from the Illinois Basin - Decatur Project
by Abbas Iranmanesh, Randall A Lock II, Bracken T Wimmer, and Carl H Carman,
Illinois State Geological Survey

Developing a Conceptual Model of Shallow Groundwater Hydrology and Geochemistry at the Illinois Basin - Decatur Project
by Bracken T Wimmer, Randall A Locke II, Abbas Iranmanesh, and Ivan Krapac
Illinois State Geological Survey

The Roll of Depositional Setting and Diagenesis on Reservoir and Seal Quality of the Mt. Simon Sandstone and Eau Claire Formation: The Illinois Basin - Decatur Project
by Jared Freiburg,
Illinois State Geological Survey

Improving Whole Core Permeability Data from the Mt. Simon Reservoir at the Illinois Basin - Decatur Project
by Martin Palkovic, Scott Frailey, and Peter Berger
Illinois State Geological Survey

Design and Evaluation of the Primary Casing Strings for Carbon Sequestration in the Illinois Basin - Decatur Project
by Jim Kirksey
Schlumberger Carbon Services

Illinois Basin - Decatur Project: Surface Facilities Operations Review
by Ray McKaskle,
Trimeric Corporation

Data Management System for the Illinois Basin - Decatur Project
by Ahsan Alvi,
Schlumberger Carbon Services

Analysis of the Multilevel Pressure Transient Data at the Illinois Basin - Decatur Project
by Christin Strandli and Sally M. Benson
Stanford University

Field Trip Information

Wednesday, October 9, 2013

Archer Daniels Midland Company

The field trip is designed to provide participants the opportunity to see an active CCS injection site, ask questions of practitioners, investigate monitoring equipment first hand, and gain insights on issues that will impact future projects. Visits to the IBDP site will depart the North Foyer of the I Hotel Conference Center at 8:00 a.m. and will return to the I Hotel at noon.

For safety reasons all visitors must have closed-toe shoes and long pants to participate in the field trip. Visitors to the IBDP are prohibited from taking any photographs or videos while on ADM property. Use of cell phones or tobacco are not allowed on the ADM property.

Financial Assurance 101 Workshop

Financial Assurance 101

Chiara Trabucchi, Industrial Economics Incorporated

This STEP-sponsored workshop provides an overview of financial assurance with specific focus on the regulations underpinning the UIC Class VI well operator. Ms. Chiara Trabucchi from Industrial Economics, Inc. will lead the workshop. The elements of this workshop include: financial assurance terms and concepts; discussion of the current financial assurance framework for Class VI wells, with focus on the mix of regulatory requirements under 40 CFR 146.85 and recommendations proffered by EPA's July 2011 FR guidance document; overview of the six financial instruments allowed under 40 CFR 146.85; and discussion of financial assurance requirements by geological sequestration phases.

The workshop will conclude with a panel discussion featuring financial, technical, and industry perspectives on issues related to pre-operational, operational, and post-operational liabilities in the geologic storage of carbon dioxide. Mr. Larry Bengal, Director of the Arkansas Oil and Gas Commission, will lead off the panel discussion with a brief presentation on work being conducted by the Interstate Oil and Gas Compact Commission's (IOGCC) Carbon Geologic Task Force on liability related to CCS. Co-panelists, Ms. Chiara Trabucchi and Mr. Dwight Peters will join in discussing and answering audience questions.

Technical Program Abstracts

US Department of Energy Program Overview

Darin Damiani, NETL

This presentation offers an overview of the Carbon Storage Program within the Office of Coal and Power Research and Development at DOE's National Energy Technology Laboratory. The presentation addresses the technology areas within the Carbon Storage Program, FY2013 funding, and a brief update on the Regional Partnership Development Phase Projects. Additional updates will be provided on the Carbon Sequestration Atlas and web-based information.

Progress on the Illinois Basin – Decatur Project in the Past Twelve Months

Robert J. Finley, Project Director, Illinois State Geological Survey

The Illinois Basin – Decatur Project (IBDP), one of the U.S. Department of Energy's Regional Carbon Sequestration Partnerships, made steady progress in 2012–13 toward its goal of injecting one million metric tons of dense-phase carbon dioxide (CO_2) into a saline reservoir, the Mount Simon Sandstone, at Decatur, Illinois. In operation since 17 November 2011 with our partners, the Archer Daniels Midland Company and Schlumberger Carbon Services, we have injected more than 600,000 tonnes as of mid-September 2013. We expect injection operations to be completed around 30 November 2014.

We are increasing our understanding of the reservoir which we are injecting into and the response of the geologic framework to the injection process. The lowermost Mount Simon, in which we have 55 ft of perforations open, consists of bedload-rich fluvial (braided stream) and subordinate stream-margin aeolian deposits and has excellent reservoir quality with an average 20% porosity and 185 md permeability. Pore space was preserved by grain coatings which precluded the precipitation of quartz cements. Diagenetic heterogeneity has produced a layered reservoir which has resulted in limited vertical CO_2 migration as shown by cased-hole well logs and by pressure readings in our verification well.

We continue to carry out an active program of Measurement, Verification, and Accounting (MVA) that is demonstrating that the Mount Simon reservoir – Eau Claire Shale seal system is providing the injectivity, capacity, and containment that we expected when we selected the Decatur site. We have seen no evidence of CO_2 pressure increases more than a few hundred feet above the injection zone and fluid sampling and pressure readings at two levels above the Eau Claire Shale confirm no migration through the seal. Certainly, surface measurements confirm no leakage. At the same time we are placing an increased emphasis on understanding the physical framework of the Mount Simon reservoir and have undertaken a re-evaluation of our pre-injection 3D surface geophysical survey to remove the effects of intrabed multiples in an effort better resolve reservoir structure. We have also carried out a new seismic inversion for porosity using the 3D volume to better extrapolate reservoir properties away from our project wellbores. We are also now using data from the neighboring Illinois Industrial CCS Sources project and their verification well, drilled in September–October 2012, which has provided a better vertical velocity model for time-depth conversion. Our second 3D Vertical Seismic Profile (VSP) was acquired in March–April 2013 and processed data confirm differences with a baseline survey interpreted as the presence of the CO_2 plume, generally north to northwest of the injection well, as expected.

Microseismic events continue to be detected using the Passive Seismic Sensing System (PS3) system in our injection well and recently we have located an average of 89 events per month (June–August 2013). Sixteen clusters of events have been identified around the IBDP site, primarily north of the CCS1 injector, and mean moment magnitude has been -0.98 for the same three-month period. The rate of event occurrence has been dropping over the last 12 months. We continue to focus on understanding these events and the geomechanics of the site through advanced data analyses.

The Role of Depositional Setting and Diagenesis on Reservoir and Seal Quality of the Mt. Simon Sandstone and Eau Claire Formation: Illinois Basin - Decatur Project.

Jared T. Freiburg, Illinois State Geological Survey

The Mt. Simon Sandstone is the primary reservoir for the Illinois Basin - Decatur Project (IBDP). It is overlain by the Eau Claire Formation comprised of impermeable shale, siltstone, sandstone, and dolomite acting as the primary reservoir seal. The Mt. Simon is approximately 1,600 feet thick at the IBDP (Fig. 1). Approximately 800 feet of core was selectively cut through the Mt. Simon, representing all major depositional and diagenetic facies identified using geophysical logs (Fig. 2). Using core descriptions, petrographic analyses, and geophysical logs, three major divisions referred to as the Lower, Middle, and Upper are identified in the Mt. Simon (Fig. 3). Two repeating fluvial to eolian depositional sequences (Middle and Lower; Figs. 6 and 7) are described. Additionally, the depositional sequences reflecting the beginning of the Sauk Sequence marine transgression (Eau Claire and Upper; Figs. 4 and 5) are described. A formation referred to as the Pre-Mt. Simon Sandstone was also identified that overlies the Precambrian basement and unconformably underlies the Mt. Simon and (Fig. 8). The IBDP reservoir and injection intervals are located in the Lower Mt. Simon Sandstone fluvial deposits where primary porosities are preserved reaching to 30% and permeability nearing 500 millidarcy units (Fig. 7C). The overlying Middle Mt. Simon represents depositional environments similar to the Upper Mt. Simon; however, reservoir conditions are poor with porosities averaging 9% with little to no permeability (Fig. 6A). Poor reservoir conditions in the Middle Mt. Simon are the result of diagenesis such as quartz cementation and extensive compaction. The excellent reservoir conditions in the Lower Mt. Simon and the lack of diagenetic porosity destruction is largely controlled by the clay rims on detrital quartz grains inhibiting diagenetic quartz cements (Fig. 7C). The abundance of authigenic clay rims in the Lower Mt. Simon are largely the result of feldspar alteration and dissolution and may be related to an unconformity separating the Middle and Lower Mt. Simon units.

Illinois Basin Basement and Structure

John H. McBride, Brigham Young University

Little is known of the deeply buried Precambrian basement of the Illinois Basin, despite the fact that it is one of the world's most intensively studied intracratonic basins. Geologic cross sections of the Midwest typically show the Precambrian as a uniform mass, a *terra incognita*, that simply disappears off the bottom of the diagram. Due to the deep burial of the Precambrian in Illinois, knowledge of these rocks is limited to approximately 40 drill holes, which have brought up only small fragments of rock and a few precious cores. Precambrian basement rocks in Illinois, as in other parts of the Midwest, consist primarily of granite plutons, granodiorite, and rhyolite and have been assigned to the "Eastern Granite-Rhyolite Province" (EGRP), part of a vast igneous belt stretching from northern Mexico to eastern Québec. This province is thought to only represent a thin veneer (a "few kilometers thick") or possibly even isolated igneous intrusions. The southern part of the Illinois Basin is an exceptional area where the coincidence of deep drill hole, seismic reflection, and potential field data provide a unique "window" into the basement beneath the basin. Geochemical modeling suggests that the center of Illinois is crossed by a major crustal boundary, which has been interpreted to mark an ancient Precambrian-age active continental margin. For this reason, crustal tectonic and magmatic activity would therefore be expected to have been more intense over the southern half of the state. This could account for the complexity in basement structure that is observed in this part of the basin, where we know the most about its Paleozoic structure and underlying basement.

The state of knowledge of the Precambrian rocks of Illinois depends heavily on geophysical remote sensing, guided wherever possible by actual rock samples. A first-order result from industry seismic profiles is that the reflectivity of Precambrian upper crust is richly coherent and widespread. Long regional profiles reveal vertically stacked, broad basinal "seismic stratigraphic" sequences (Centralia sequence) beneath the Paleozoic strata. The internal structure of the sequences is marked by dipping and offset reflectors, and by extensive apparent angular unconformities, all of which give the impression of a sedimentary (or volcani-clastic) succession. The regional structure of the sequences is well-developed (mappable over distances of more than 124 miles (~200 km), with discrete boundaries along which the sequences pinch out. These sequences could either rest over or be part of the EGRP. It has been suggested that the basement reflectivity represents extensive remnants of Proterozoic continental rifting or part of a large collapsed caldera system. Three-dimensional mapping of the sequences can be represented by a contour map that reveals a broad, bowl-shaped package that reach an estimated maximum depth of roughly 6 miles (~10 km) and a thickness of about 3.7 miles (~6 km). Normal faults progressively disrupt the sequences with depth along their outer margins. The overall distribution of the sequences mimics that of the overlying Cambrian Mt. Simon Sandstone unit (the target carbon storage interval).

During the past several years, the Illinois State Geological Survey has used deep and conventional industry seismic data in order to reveal the detailed structure of folds and fault zones within the Paleozoic section as previously known from drill hole data and to detect major zones of faulting within the deep basement. In general, these studies indicate that most of the major Paleozoic folds and monoclines are cored by high-angle reverse faults in a Laramide-style of deformation. In some cases, these faults have propagated up from the Precambrian basement; in other cases, faulting appears to be confined to the basement and/or of limited vertical extent. Good examples of such folded structures include the La Salle anticlinal belt and Du Quoin monocline. Measurements, geological observations, and earthquake data indicate a contemporary maximum horizontal compressive stress that trends just north of east in southern Illinois and Indiana, as shown by available data for the Illinois Basin and by the World Stress Map Project. The general north-south strike of many of the faults and folds in the basin is consistent with this orientation, although these structures originated in a stress field many millions of years old (e.g., late Paleozoic). Some structures in the basin may have a component of strike-slip displacement. The best example of this is the Cottage Grove fault system, a 113-km long right-lateral wrench zone that cuts across the southern Illinois basin and that has previously been proposed to mark a major Proterozoic terrane boundary. This structure shows en echelon, pull-apart, and other subsidiary structures typical of a strike-slip fault system.

Small 3D seismic surveys (e.g., at the ADM site and Stewardson Dome) provide detailed views of basement and lower Paleozoic structure. These surveys locally indicate a greater degree of structural complexity for the interval around the Mt. Simon Sandstone. For example, the Stewardson Dome survey shows definite faults that can be mapped within shallow basement, but which cannot confidently be continued higher into the lower Paleozoic section (and *vice versa*). One of the lessons learned from 3D surveys in the basin is that generalizations about vertical continuity of deformation structures between basement and Paleozoic strata from 2D seismic profiles may require refinement.

Review of Illinois and Indiana Seismicity

Robert A. Bauer, Illinois State Geological Survey

Seismicity in the Illinois and Indiana are known through historical accounts dating back to 1795, seismograph stations starting in the 1950s, and prehistoric events through the dating of surface deformations (liquefaction features) caused by earthquake shaking. All show the greatest concentration of earthquake events in the southern parts of these states and the next concentration in the northern parts with the lowest concentration of events just north of the middle of both states. Seismographs show the earthquakes originating deep in the Precambrian, crystalline basement rocks and not associated with the mapped faults in the sedimentary (Paleozoic) bedrock overlying the crystalline basement.

Historical accounts can detect down to about the low magnitude 2s while the U.S. Geological Survey's national network of seismographs can detect to about 2 in the central to northern part of the states and down in the 1s and lower in the extreme southern parts where there is a higher density of stations. Earthquake induced liquefaction features can be produced in areas that experience magnitudes starting in the 5s to 6s in areas which have liquefiable sediments in/near the epicenter areas (high shaking areas).

Microseismic events, magnitude 2 and lower, have been detected during a study that deployed portable seismographs for 211 days in lower Wabash River valley in Illinois and Indiana. Over 500 events were detected ranging from magnitude 0.6 to 1.8 at depths of 1 to 3 km. The authors lean toward the cause being water reinjection into oil formations which are mostly 0.6 km deep.

3D Seismic at Decatur Revisited

Dianna Shelander, Schlumberger

Additional seismic coverage over the IBDP area was acquired and merged with a previously existing acquisition in 2011. As a result of the larger area, analyses of the seismic data were revisited; analyses included careful well tie analyses and reconstruction of the velocity model used to convert data from the time domain to the depth domain. Seismic attributes were examined for correlation with microseismic events observed below the injection zone. The curvature attribute, which can indicate natural fractures, exhibited anomalous features along microseismic swarms.

Important findings were revealed from analyses between synthetic well log ties and seismic data. The phase of VSP data and original data were reverse polarity. Furthermore interbed multiple energy was determined to obscure the character of the target reservoirs, the Knox dolomite and the Mt. Simon sandstone. Even with the high-resolution acquisition and processing techniques used, the data were not immune to contamination of interbed multiples. The interbed multiples were attenuated using a custom, post stack method prior to a post stack inversion.

The multiple attenuated seismic volume was filtered to zero phase and inverted to an Acoustic Impedance (AI) volume. AI, essentially the combination of rock velocity and density, can be transformed to important characteristics, e.g. lithology and porosity, needed for reservoir modeling. From well control two transforms, one for Knox dolomites and one for Mt. Simon sandstones, were defined and used to estimate porosity from the seismic AI. The resulting porosity volumes then provide input to reservoir models for control between well locations.

IBDP Pre-injection Microseismicity

Valerie Smith, Schlumberger Carbon Services

The Illinois Basin – Decatur Project (IBDP), located in Decatur, Illinois, is a large-scale carbon dioxide (CO_2) injection and storage project. Over a three-year period one million metric tons of CO_2 will be injected into the Mt. Simon Formation, a deep saline reservoir in the Illinois Basin. This study examines the microseismic data gathered for the 18-month period preceding CO_2 injection. Microseismic events are detected through permanent geophone arrays installed in two wells. A CO_2 injection well (CCS1) drilled to the depth of 7,236 feet is outfitted with a 4-component geophone array. Adjacent to CCS1, a 3,502 feet deep geophysical monitoring well (GM1) contains an OYO, 3-component geophone array.

During the 18-month pre-injection period, a total of 7,894 microseismic events were detected. 99% of these events were determined to be associated with well drilling or other well related operations. Eight local microseismic events were identified that appear unrelated to well activity. These events are believed to be representative of the background level of microseismic activity.

Regional seismicity was also examined by changing triggering parameters and producing a second dataset. Under this configuration the system detected twelve regional seismic events and approximately 1,100 distant events that are believed associated with quarry or mine related blasting operations.

Geomechanical and Flow Modeling at the Illinois Basin - Decatur Project

Bob Will, Schlumberger Carbon Services

One of the key objectives of the modeling program at IBDP is development of the capability to perform inter-consistent reservoir engineering and geomechanical forecasting, which will be used to support various aspects of the project including permitting, caprock integrity studies, MVA planning, and understanding mechanisms for potential induced seismicity. The workflow used to achieve such forecasting capability is a tightly integrated sequence of data analysis and interpretation steps that begins with geologic modeling and culminates in the formation of a calibrated, coupled flow-geomechanical dynamic simulation model. This presentation will outline the integrated workflow and discuss some of the key steps processes used in development of the geologic model, the calibrated flow model, and the coupled flow-geomechanical earth model (MEM).

In this presentation we will show;

- The use of seismic inversion products to constrain the 3D interpolation of hydrodynamic and geomechanical properties in the model
- The calibration of the flow model using multi-level pressure monitoring data and repeat CO_2 saturation measurements made possible through specialized geophysical logging
- An initial application of pressure predictions from the flow simulator for preliminary investigations of microseismic observations
- The development of a MEM through integration of borehole geophysical measurements and core.
- The development of a preliminary 3D MEM.

The proposed implementation of features extracted from microseismic observations to characterize failure planes in the geomechanical modeling process will also be discussed.

Monitoring Injected CO_2 at the Illinois Basin - Decatur Project: Second Time-lapse 3D VSP Survey

Marcia L. Couëslan, Schlumberger Carbon Services

Time-lapse three-dimensional (3D) vertical seismic profiles (VSPs) are an important component of the monitoring, verification, and accounting (MVA) plan for the Illinois Basin - Decatur Project. The VSPs will be used to provide information on carbon dioxide (CO_2) plume development, demonstrate containment of the CO_2, and provide data to verify and update reservoir simulations.

Four 3D VSP surveys have been acquired at the site to date: two baseline surveys and two monitor surveys. All the surveys have been recorded into a permanent geophone array in Geophysical Monitoring Well #1 (GM1). Monitor surveys 1 and 2 (M1 and M2) were acquired in February 2012 and April 2013 after ~70,000 and 433,000 tonnes of CO_2 had been injected, respectively. The number of repeated shot points between the monitor surveys and the Baseline 2 (B2) survey has decreased over time due to new infrastructure and permit issues.

The original time-lapse processing flow was re-visited and optimized for the B2 and M2 surveys with an overall improvement to data repeatability. The primary repeatability metric used to quality control the processing was the normalized root mean square (NRMS) metric. Comparisons of the NRMS metrics through the Eau Claire and Upper Mt. Simon Formations show that the B2, M1, and M2 data is highly repeatable. However, through the injection interval, the data around GM1 is much less repeatable, and there has been a clear increase in

NRMS values in the time between M1 and M2. This is indicative of CO_2 plume development over time and is supported by other MVA data.

A Second Project Takes Shape: Illinois Industrial Carbon Capture and Storage Project

Scott McDonald, Archer Daniels Midland Company

The Illinois Basin is hosting several major carbon capture and sequestration projects. This basin, which underlies most of the state of Illinois, parts of Kentucky, and Indiana, ranks among one of North America's the best sites for potential storage of anthropogenic carbon dioxide (CO_2) emissions. Within this basin, the Mount Simon Sandstone, a major regional saline reservoir, is the target for sequestration because it has good permeability and porosity with overlying strata of impermeable shale. Because the regional thickness of this reservoir increases towards the center of the basin, the optimum location for maximum storage of CO_2 is in north central Illinois. Because of the excellent regional geology and access to industrial scale quantities of CO_2, two projects are being conducted at the Archer Daniels Midland Company's (ADM) agricultural processing and biofuel production facility located in Decatur, Illinois. Both projects will demonstrate the ability to inject and store industrial scale quantities CO_2 emissions into the Mount Simon; safely, permanently, and economically for hundreds of years.

Illinois Basin - Decatur Project (IBDP), (Status - in Operation). This project is led by Illinois State Geological Survey (ISGS), under the Midwest Geological Sequestration Consortium (MGSC) Regional Carbon Sequestration Program, and is a large-volume, saline reservoir sequestration test that will inject approximately 333,000 metric tons of CO_2 per year for three years.

Illinois Industrial Carbon Capture and Storage Project (IL-ICCS), (Status - under Construction). This project is led by ADM and will expand the sites CO_2 injection and storage capability to that of a commercial-scale operation. The project is scheduled for startup in 2014 and will inject up to 1.0 million metric tons per year over an operational period of approximately 2.5 years. ADM will integrate the IBDP compression and dehydration facilities with the new facilities constructed under the IL-ICCS project upon completion of IBDP injection operations in fall 2014. A significant benefit of these two complimentary projects is the unique opportunity to better understand the interaction between the CO_2 plumes and pressure fronts emanating from two injection wells in the same sandstone formation.

IL-ICCS project has the following objectives:

- Demonstrate an integrated system for collecting CO_2 from an ethanol production plant and geologically sequestering in a saline sandstone reservoir:
- Conduct required geologic site surveys, site characterization and modeling.
- Design, construct, and operate a new CO_2 collection, compression, and dehydration facility capable of delivering up to 2,000 metric tons of CO_2 per day to the injection site.

- Integration of the new facility with an existing 1,000 metric tons per day CO_2 compression and dehydration facility to achieve a total CO_2 injection capacity of 3,000 metric tons per day or one million tons annually.
- Design, construct, and operate a storage site capable of accepting up to 3,000 metric tons of CO_2 per day.
- Implementation of deep subsurface and near-surface MVA plans for the stored CO_2.
- Develop and conduct an integrated communication, outreach, training, and education initiative.

The IL-ICCS project has leverage the knowledge and experience gained during the IBDP project. Site selection, reservoir modeling, MVA development, risk assessment, community outreach, engineering design, and facility construction are many of the areas in which the project team benefitted from the experience and lessoned learned during the IBDP project. Because of this experience, the IL-ICCS project has an accelerated design and construction schedule and plans for operation within 24-30 months.

Reservoir Engineering Update

Bob Will, Schlumberger Carbon Services

Activity on the reservoir engineering model has proceeded on a number of fronts including model calibration update, support of Area of Review (AoR) calculations and the Environmental Protection Agency (EPA) permit review, investigating potential correlations between observed microseismicity during day-to-day injection operational activities, and evaluation of the CCS2 well completions scenarios.

To further improve calibration, the reservoir simulation model has been history matched against injection pressure measurements in the injection well and at 10 multi-level monitoring ports in the verification well located approximately 900 ft from the injector. Model calibration is verified against periodic CO_2 saturation estimates achieved using the wireline RST* reservoir saturation tool measurements in the injector and verification well.

Support was provided to Cadmus, the environmental consultancy, who has been employed by the EPA to perform an independent evaluation of the injection permit application. This involved detailed communications between Schlumberger and Cadmus engineers to translate the extensive simulation model input file structures from the ECLIPSE* reservoir simulation software format to that used by Cadmus. More recently the Illinois State Geological Survey has received request for clarifications on the injection permit, some of which will involve additional uses of the simulation model to assess triggers for possible intermediate AoR re-evaluation prior to the end of the 5-year period.

At the operational level the calibrated simulation model has been used in conjunction with data from the RTAC* real-time acquisition and control software system to investigate potential correlations between microseismic observations and injection start-up/ shut-in activity. Finally, the calibrated model has been used to investigate potential interactions between CCS1 and CCS2 for different CCS2 completion scenarios.

Basin-scale Modeling of CO_2 Sequestration in the Illinois Basin—Status Report

Edward Mehnert, Illinois State Geological Survey

To mitigate climate change, carbon dioxide (CO_2) emissions to the atmosphere must be reduced. Geologic carbon sequestration can be used to permanently store CO_2 in the subsurface. The Mt. Simon Sandstone is the basal sandstone reservoir in the Illinois Basin and has an estimated CO_2 storage resource of 11 to 150 billion metric tons. This storage resource is sufficient to sequester 38 to 515 years of current CO_2 emissions from the basin's stationary sources.

To evaluate the feasibility of future, commercial-scale, multi-site, geologic sequestration within the basin, a flow and transport model has been developed and is currently being revised as new geologic and hydrogeologic data become available. Key issues to be addressed by this numerical modeling effort are the fate of the injected CO_2, the fate of the native brine, the integrity of the injection formation and its caprock, and effects on other industries or stakeholders. Input data for the TOUGH2-MP simulator include a geologic model with three layers - Precambrian granite, Mt. Simon Sandstone, and Eau Claire (bottom to top).

TOUGH2-MP modeling results demonstrate the significant effect that the geologic parameters can have on the predicted pressure changes in the injection zone and adjacent confining layers and the distribution of aqueous and free-phase CO_2. In addition, the modeling results demonstrate that pressure fronts from adjacent injection wells will intersect and that the pressure fronts will extend many miles from the injection wells. However, the CO_2 plumes will remain close to the injection wells and will not migrate vertically to the caprock for the scenarios studied. We have developed our third geologic model and are assembling TOUGH2-MP input files for this geologic model. Finally, we will describe our progress for linking two flow models that address the potential for affecting freshwater aquifers at the periphery of the basin.

Midwest Geological Sequestration Consortium Partners

MGSC is a consortium of the geological surveys of Illinois, Indiana, and Kentucky joined by private corporations, professional business associations, the Interstate Oil and Gas Compact Commission, two Illinois state agencies, and university researchers to assess carbon capture, transportation, and storage processes, and their costs and viability, in the three-state Illinois Basin region. The MGSC Project Advisory Group (PAG) includes:

Ameren
American Air Liquide
American Water Works Association
Archer Daniels Midland Company
Aventine Renewable Energy
Baker Hughes, Inc.
Biorecro, LLC
Blue Source, LLC
BP America
Caterpillar, Inc.
Conoco Phillips Company
Continental Carbonic Products, Inc.
Drummond Company, Inc.
Duke Energy Corporation, Inc.
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Electric Power Research Institute
Environmental Defense
GE Energy
Halliburton/Pinnacle
IL Dept. of Commerce & Economic Opportunity
Illinois Clean Coal Institute
Illinois Corn Growers Assoc.
Illinois Dept. of Natural Resources
Illinois Dept. of Transportation
Illinois Oil and Gas Assoc.
Illinois State Geological Survey
Indiana Gasification
Indiana Geological Survey
Indiana Oil and Gas Association
Interstate Oil and Gas Compact Commission
Kentucky Geological Survey

Kentucky Oil & Gas Association
Korea Institute of Ocean Science and Technology (KIOST)
LG & E Energy, LLC
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Peoples Gas
Petroleum Technology Research Centre
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Schlumberger Carbon Services
Spectra Energy Corporation
The Cline Group
TOTAL E&P USA, Inc.
US Dept. of Energy
Vectren Corporation

MGSC

2013 Midwest Carbon Sequestration Science Conference

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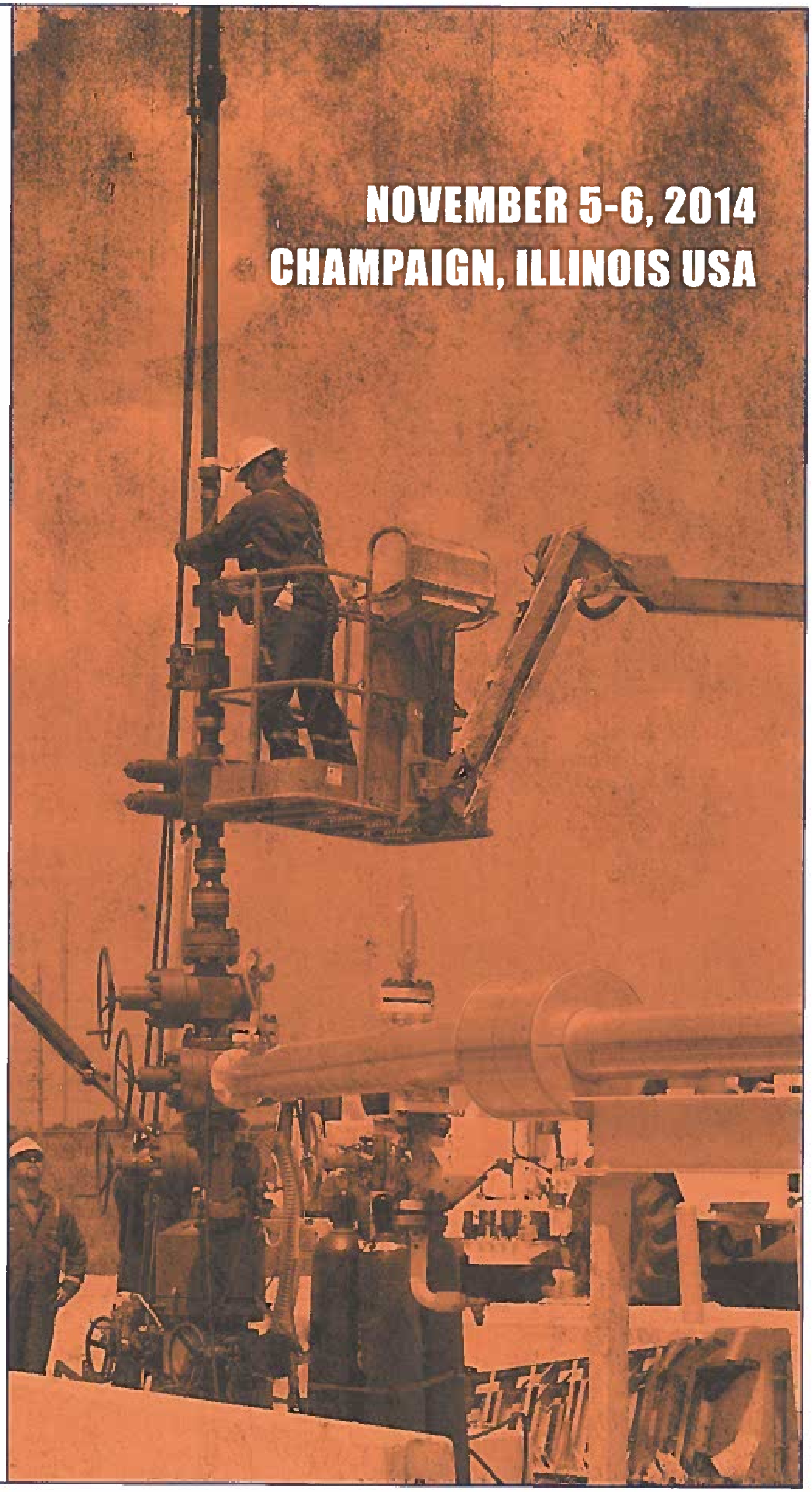
2014 MIDWEST CARBON SEQUESTRATION SCIENCE CONFERENCE

NOVEMBER 5-6, 2014
CHAMPAIGN, ILLINOIS USA



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STEP

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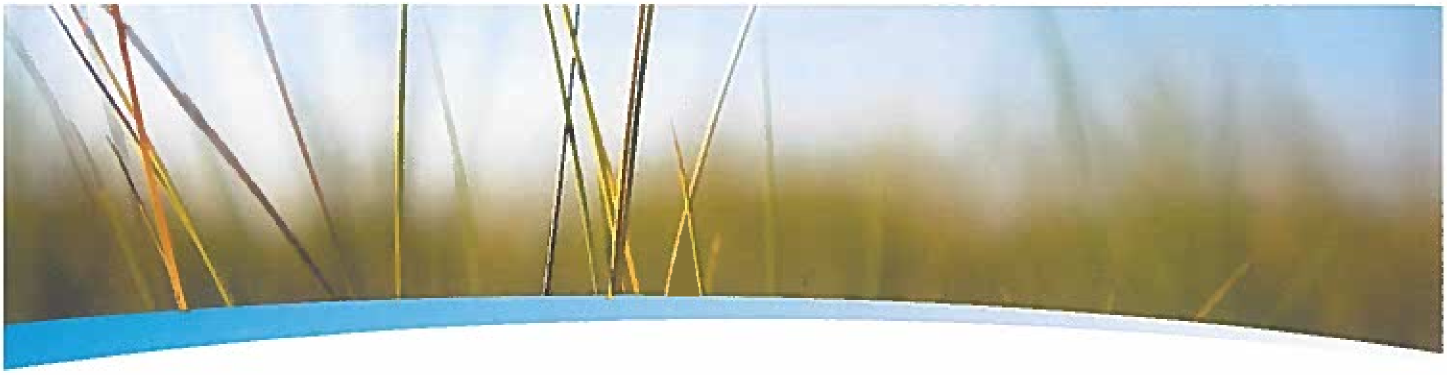

Sequestration Training and Education Program

Pioneering change. From the ground up.

Around the world, research is being conducted on new energy solutions that will help decrease our reliance on carbon-based fuels. Science is taking the next logical step, pursuing a wide range of interim solutions designed to create cleaner-burning fuels and reduce the global impact of greenhouse gases released into the environment.

At the Sequestration Training and Education Program (STEP), we are part of this vital initiative, transferring Carbon Capture and Sequestration (CCS) technology from the edge of science to the heart of a growing industry and equipping today's energy professionals with the steps they need to mitigate global environmental change.

STEP is a program of the Advanced Energy Technology Initiative, within the Prairie Research Institute – University of Illinois.

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Welcome to Champaign!

On behalf of the Illinois State Geological Survey (ISGS) and the Prairie Research Institute at the University of Illinois I would like to welcome you to Champaign, Illinois and the 2014 Midwest Carbon Sequestration Science Conference. We are delighted that you could join us to celebrate the accomplishments of the Midwest Geological Sequestration Consortium (MGSC) and the Illinois Basin - Decatur Project (IBDP).

Please allow me to share with you a brief history of the ISGS. The Survey is part of the Prairie Research Institute at the University of Illinois at Urbana-Champaign, which is a cultural and educational center. Champaign-Urbana is ranked as one of the top ten "high-tech" cities in the U.S. The ISGS is a premier state Geological Survey serving the needs of Illinois with earth science information relevant to the State's environmental quality, economic vitality, and public safety. Some 200 scientists and technical support staff conduct basic and applied research in geology, compile geologic maps, and gather and manage the state's geological data to provide information to industry, governmental agencies, and the public about the geology and mineral resources of Illinois. Our staff is actively involved in joint research projects supported through public and private grants. Additionally, our staff is involved with cultivating the next generation of scientists by supervising graduate studies, and teaching courses through joint appointments with the University.

Since 1905, ISGS research and service activities have contributed to Illinois' economic prosperity. Our research programs are carefully designed to address real-world problems while advancing basic geologic knowledge and developing cutting-edge research techniques. The ISGS has developed a program of research and development related to global energy issues including the IBDP, research in coal, oil and natural gas, and energy and environmental engineering.

We are proud of our past and excited about the many contributions we are making for the future of Illinois and are committed to innovative and ongoing investigations of energy resources and issues.

Best regards,

Richard C. Berg

Richard C. Berg

Interim Director, Illinois State Geolgical Survey

Welcome to the Midwest Carbon Sequestration Science Conference

The Midwest Geological Sequestration Consortium (MGSC), Schlumberger Carbon Services, the Sequestration Training and Education Program (STEP), and the Illinois State Geological Survey (ISGS) are delighted to welcome you to this conference which celebrates our accomplishments at the Illinois Basin – Decatur Project (IBDP).

The past year marks the approaching completion for the MGSC of injection at the IBDP, carried out in collaboration with Schlumberger Carbon Services and the Archer Daniels Midland Company, our partners in providing the site and the source of the carbon dioxide at Decatur, Illinois. Operational injection began on November 17, 2011, and will be completed in November 2014. As of October 27, 2014 we have Injected 968,300 metric tons. We have completed multiple cased-hole logging runs and have verified carbon dioxide remaining in the lowermost Mount Simon reservoir. Further, multiple levels of pressure monitoring in the Mt. Simon have shown that, even in this late stage of the demonstration, upward pressure increase due to injection is only ~25 psi (1.7 bar) at 351 ft (107 m) above the injection interval. We have also completed three post-injection, 3D vertical seismic profile (VSP) monitoring surveys on which we now have indications of the plume position, and a final 3D VSP will be run after injection ends. A substantial set of microseismic data has been obtained and is undergoing continuing interpretation. Events average around -1.0 on a monthly basis and around 80 events are located each month. A few events have reached around +1.0, the largest events that are in the data set; none of the microseismic events suggest any threat to the reservoir or the Eau Claire seal. We are now entering a post-injection monitoring phase that will be carried out under a new US EPA Class VI permit for our IBDP injection well. In addition to the ongoing monitoring, we will be focusing on knowledge sharing and publications to convey the experiences and outcomes of the IBDP project for the benefit of sequestration science globally.

The completion of this phase of our one million tonne demonstration could not have been reached without ongoing project funding from the U.S. Department of Energy, National Energy Technology Laboratory, and the support of our many project partners and researchers. Their contributions, large and small, are creating the foundation for carbon capture and storage (CCS) technology and its successful future deployment. It is deeply satisfying to know that the research being conducted on this project will serve as baseline information for development of CCS projects in the Illinois Basin, in the entire Midwest, and in other regions around the world.

As part of the Prairie Research Institute at the University of Illinois, we strive to provide objective, cutting-edge research and solutions to allow citizens and decision-makers to make choices that ensure sustainable economic development, enduring environmental quality, and cultural resource preservation for Illinois and beyond. Our technical program for this conference focuses not only on our accomplishments but also on knowledge sharing to provide you with research results, expertise, and data for independent scientific analysis and decision-making.

Welcome and enjoy the program.

Robert J. Finley
Principal Investigator
Midwest Geological Sequestration Consortium

Who We Are

About the Midwest Geological Sequestration Consortium

The Midwest Geological Sequestration Consortium (MGSC) is one of seven regional partnerships selected by the U.S. Department of Energy to determine the best approaches for capturing and storing carbon dioxide (CO_2) that might otherwise contribute to global climate change. The MGSC is led by the Illinois State Geological Survey (ISGS), in conjunction with the Indiana Geological Survey (IGS) and the Kentucky Geological Survey (KGS), and covers Illinois, southwestern Indiana and western Kentucky. This partnership was established to assess geological carbon sequestration options in the 60,000 square mile oval-shaped, geologic feature known as the Illinois Basin. Within the Basin are deep, noneconomic coal resources, numerous mature oil fields, and deep saline rock formations with potential to store CO_2. MGSC's objective is to determine the technical and economic feasibility of using these geologic formations for long-term storage.

About the Illinois State Geological Survey

Founded in 1905, the ISGS provides the citizens and institutions of Illinois with earth science research and information that are accurate, objective and relevant to the state's environmental quality, economic prosperity and public safety. ISGS is one of five scientific surveys within the Prairie Research Institute at the University of Illinois. Together, they form a unique group of scientific experts in the earth, environmental and biological sciences that is unmatched in the nation. These agencies carry out objective, high quality, multi-disciplinary scientific studies in service to all the people of Illinois.

About ADM

For more than a century, the people of Archer Daniels Midland Company (NYSE: ADM) have transformed crops into products that serve the vital needs of a growing world. Today, we're one of the world's largest agricultural processors and food ingredient providers, with more than 33,000 employees serving customers in more than 140 countries. With a global value chain that includes more than 470 crop procurement locations, 285 ingredient manufacturing facilities, 40 innovation centers and the world's premier crop transportation network, we connect the harvest to the home, making products for food, animal feed, chemical and energy uses.

Founded in 1902 and incorporated in 1923, ADM is headquartered in Chicago, Illinois, and operates processing and manufacturing facilities across the United States and worldwide. For more information on our company and our products, visit www.adm.com.

About Schlumberger Carbon Services

Schlumberger Carbon Services provides technologies and services for the long-term geological storage of CO_2. Our experience, gained by participation in many CCS projects worldwide, is backed up by a corporate history of over 80 years in the oil & gas industry. Our multidisciplinary teams bring the project management, communications, and technology delivery skills needed to integrate all the services for storage safety, reliability and regulatory compliance. We work to combine our storage knowledge together with that of other providers in the areas of capture and transport, to deliver safe and successful CCS projects. For more information, please visit www.slb.com/carbonservices.

About DOE National Energy Technology Laboratory

The National Energy Technology Laboratory (NETL), part of DOE's national laboratory system, is owned and operated by the U.S. Department of Energy (DOE). NETL supports DOE's mission to advance the national, economic, and energy security of the United States. NETL implements a broad spectrum of energy and environmental research and development (R&D) programs that will return benefits for generations to come while protecting our environment and enhancing our energy independence.

About STEP

Established through the pioneering efforts of the American Recovery and Reinvestment Act, the U.S. Department of Energy, and the Midwest Geological Sequestration Consortium, the Sequestration Training and Education Program was created to share new climate mitigation technology as it is developed, dramatically reducing the time it takes for innovations in research to produce positive global change.

Through continuing education, hands-on training, and innovative outreach programs, STEP provides career enhancement opportunities and leadership development for engineers, teachers, geologists, service providers, regulators, executives, and others in wide range of energy related fields.

Schedule of Events

MGSC Project Field Trip » 1:00–5:00 p.m.

Wednesday, November 5

1:00 – 5:00 p.m. Field trip to visit the Illinois Basin – Decatur Project injection site (departs from the I Hotel and Conference Center)

The field trip is designed to provide participants the opportunity to see an active CCS injection site, ask questions of practitioners, investigate monitoring equipment first hand, and gain insights on issues that will impact future projects. Visits to the IBDP site will depart the North Foyer of the I Hotel Conference Center.

For safety reasons all visitors must have closed-toe shoes and long pants to participate in the field trip. Personal protective equipment will be distributed to visitors on-site. Visitors to the IBDP are prohibited from taking any photographs or videos while on ADM property. Use of cell phones or tobacco are not allowed on the ADM property.

6:00 – 9:00 p.m. Conference Dinner (at the I Hotel & Conference Center)

This event will begin with a cocktail reception, hosted by the Illinois State Geological Survey at the Prairie Research Center, from 6:00 – 7:00 p.m. Cocktails will be followed by the Conference Dinner hosted by Schlumberger Carbon Services.

Technical Program » 8:00 a.m.–4:00 p.m.

Thursday, November 6

8:00 – 9:00 a.m.	*Conference Breakfast*
9:00 – 9:20 a.m.	DOE Overview, Darin Damiani
9:20 – 10:10 a.m.	Impacts of Three Years of CO_2 Injections, Robert Finley
10:10 – 10:30 a.m.	*Morning Coffee Break*
10:30 – 10:55 a.m.	Permitting at IBDP, Sallie Greenberg
10:55 – 11:20 a.m.	Ground Water: Pre-injection and Injection Results, Abbas Iranmanesh
11:20 – 11:45 a.m.	Results From the IBDP Geophysics Program, Bob Will
11:45 – 1:00 p.m.	*Lunch & Poster Viewing*
1:00 – 1:30 p.m.	Understanding the Mt. Simon Reservoir Constraints, Hannes Leetaru, Jared Freiburg
1:30 – 2:00 p.m.	Micro-seismic Monitoring at IBDP, Bob Bauer
2:00 – 2:50 p.m.	Setting the Stage for Future: What Comes Next, Robert Finley
2:50 – 3:10 p.m.	*Afternoon Break*
3:10 – 4:00 p.m.	Facilitated Discussion and/or Presentation by Schlumberger, Dwight Peters

Poster Session

Screening Methodology for Regional-scale CO_2 EOR and Storage Using Economic Criteria, Charles C. Monson, Christopher P. Korose, and Scott M. Frailey, Illinois State Geological Survey

Strategies for Advancing CO_2 EOR in the Illinois Basin, James Damico, Charles Monson, Scott Frailey, Yaghoob Lasemi, Nathan Webb, Nathan Grigsby, Fang Yang, and Peter Berger, Illinois State Geological Survey

Integration of Near-surface Monitoring Information Using ArcGIS at the Illinois Basin - Decatur Project, USA, Christopher P. Korose, Randall A. Locke, Curt S. Blakley, Carl H. Carman, Illinois State Geological Survey

Tunable Diode Laser Absorption Spectrometers for CO_2 Wellhead and Pipeline Leakage Monitoring: Experiences from Prototype Testing at the Illinois Basin - Decatur Project, USA, Joseph Zimmerman, Randall Locke, Curt Blakley, Michael Frish, Matthew Laderer, Richard Wainner, Illinois State Geological Survey

Basin-scale Modeling for CO_2 Sequestration in the Basal Sandstone Reservoir of the Illinois Basin - Improving the Geologic Model, Edward Mehnert, James Damico, Scott Frailey, Hannes Leetaru, Roland Okwen, B. Storsvedb, and A. Valocchi, Illinois State Geological Survey

Multivariate Statistical Evaluation of Groundwater Compliance Data from the Illinois Basin - Decatur Project, Abbas Iranmanesh, Randall A. Locke, Bracken T. Wimmer, Illinois State Geological Survey

Update on Soil CO_2 Flux Monitoring at the Illinois Basin - Decatur Project, USA, Carl Carman, Randall Locke, Curt Blakley, Illinois State Geological Survey

The Application of an Integrated Earth Model in Reservoir Management of a CO_2 Plume, Hannes Leetaru, Valerie Smith, Robert Will, Jared Freiburg, and Alan Brown, Illinois State Geological Survey

Produced Water from CO_2-EOR in the Illinois Basin, Seyed A. Dastgheib, Chad Knutson, Yaning Yang, Illinois State Geological Survey

The Evolution and Effect of the Velocity Model on Various Aspects of Surface Seismic Data Analysis, Dianna Shelander, Valerie Smith, Hannes Leetaru, Robert Will, & Marcia Couëslan, Schlumberger Carbon Services.

Integrating Mechanical Earth Models, Surface Seismic, and Microseismic Field Observations at the Illinois Basin - Decatur Project, Donald W. Lee, Farid Mohamed, Robert Will, Robert Bauer, Dianna Shelander, Schlumberger Carbon Services.

Seismic Monitoring at the Decatur, IL, CO_2 Sequestration Demonstration Site, J. Ole Kaven, Stephen H. Hickman, Arthur F. McGarr, Steven Walter, William L. Ellsworth, US Geological Survey.

Midwest Geological Sequestration Consortium Partners

MGSC is a consortium of the geological surveys of Illinois, Indiana, and Kentucky joined by private corporations, professional business associations, the Interstate Oil and Gas Compact Commission, two Illinois state agencies, and university researchers to assess carbon capture, transportation, and storage processes, and their costs and viability, in the three-state Illinois Basin region. The MGSC Project Advisory Group (PAG) includes:

Ameren
American Air Liquide
American Water Works Association
Archer Daniels Midland Company
Aventine Renewable Energy
Baker Hughes, Inc.
Biorecro, LLC
Blue Source, LLC
BP America
Caterpillar, Inc.
Conoco Phillips Company
Continental Carbonic Products, Inc.
Drummond Company, Inc.
Duke Energy Corporation, Inc.
Edison Mission Energy/Midwest Generation
Electric Power Research Institute
Environmental Defense
GE Energy
Halliburton/Pinnacle
IL Dept. of Commerce & Economic Opportunity
Illinois Clean Coal Institute
Illinois Corn Growers Assoc.
Illinois Dept. of Natural Resources
Illinois Dept. of Transportation
Illinois Oil and Gas Assoc.
Illinois State Geological Survey
Indiana Gasification
Indiana Geological Survey
Indiana Oil and Gas Association
Interstate Oil and Gas Compact Commission
Kentucky Geological Survey

Kentucky Oil & Gas Association
Korea Institute of Ocean Science and Technology (KIOST)
LG & E Energy, LLC
LincolnLand Agri-Energy, LLC
Natural Gas and Pipeline Company of America, LLC
Natural Resources Defense Council
NiSource Gas Transmission and Storage Company
Peabody Energy
Peoples Gas
Petroleum Technology Research Centre
Power Holdings, LLC
Praxair, Inc.
Schlumberger Carbon Services
Spectra Energy Corporation
The Cline Group
TOTAL E&P USA, Inc.
US Dept. of Energy
Vectren Corporation

Notes

Notes

Addendum 3.
Samples of STEP branded materials

Pioneering change. From the ground up.

sequestration.org/step

This material is based upon work supported by the U.S. Department of Energy under Award Number DE-FE0002462 and the Illinois Department of Commerce and Economic Opportunity #09-484002.

STEP™

STEP is a program of the **Advanced Energy Technology Initiative**, University of Illinois.

Course Testimonials

"This was an awesome opportunity to help me become more aware of environmental issues, new technologies and hands-on lab ideas. All of these will benefit my students in the long run. The faculty was amazing as well!"

CSI: Climate Status Investigation attendee.

"This is by far the best continuing education opportunity I have been to. Instructors were personable and knowledgeable. Information was clear and well thought out".

CSI: Climate Status Investigation attendee.

"This summer school was fantastic. It presented a good overview of the whole CCS issue and provided a very enriching experience. As a technical person, it was really interesting to see the complexity of CCS."

IEAGHG International CCS Summer School Programme attendee.

Our mission.

Our mission is to create a knowledgeable and inspired workforce with broad understanding of energy issues and an in-depth knowledge of technical concepts associated with CCS through timely quality and value-driven educational programs and products.

For more information about STEP educational programs visit www.sequestration.org/step.

To join our mailing list contact katchley@illinois.edu or call 217-244-9527.

This material is based upon work supported by the U.S. Department of Energy under Award Number DE-FE0002402 and the Illinois Department of Commerce and Economic Opportunity #09-484002.

STEP is a program of the Advanced Energy Technology Initiative, within the Prairie Research Institute — University of Illinois.

Sequestration Training and Education Program

Pioneering change. From the ground up.

Around the world, research is being conducted on new energy solutions that will help decrease our reliance on carbon-based fuels. Science is taking the next logical step, pursuing a wide range of interim solutions designed to create cleaner-burning fuels and reduce the global impact of greenhouse gases released into the environment.

At the Sequestration Training and Education Program (STEP), we are part of this vital initiative, transferring Carbon Capture and Sequestration (CCS) technology from the edge of science to the heart of a growing industry and equipping today's energy professionals with the steps they need to mitigate global environmental change.

Building on our strengths.

STEP is uniquely positioned as a leader within the field of CCS education and training. Working with the Illinois State Geological Survey, Advanced Energy Technology Initiative at the University of Illinois and the Midwest Geological Sequestration Consortium (MGSC), STEP builds programs based on more than ten years of active CCS research. Our partnership and collaboration with private companies, government, research organizations, and regional geologic surveys provides the foundation for creating specialized knowledge sharing and capacity building programs. STEP is a bridge between scientific research and education developed to expand and share valuable insights learned in the Illinois Basin with the world. Join STEP in training the energy workforce of tomorrow.

Where research meets the real world.

STEP educational programs are built on the solid foundation of research being conducted through the ISGS and MGSC. This unique research collaboration allows us to create knowledge sharing and capacity building programs that draw on CCS experts to develop conferences, short courses, brown bag lectures and workshops to meet diverse education, knowledge sharing, and capacity building training needs. Past training activities have included programs for all levels of attendees interested in CCS. Some of the topics include:

- CCS project development and engineering
- CCS project planning and management
- CCS communication, regulatory and legal frameworks
- Climate change and impact to environment

Always moving forward.

To prepare students for the future, we track the latest trends in the energy field, energy technology, and climate policy, translating those developments into our courses, curricula, conferences, and workshops. STEP places a strong emphasis on developing practical experience through courses based on real projects with real issues. This translates into a wide range of educational products, including webinars, conferences, workshops and customized short courses.

The application of innovation.

Ultimately, our goal is to educate and train a skilled workforce to participate in the new energy economy in general and CCS specifically. STEP programs are designed to inspire and equip future generations to solve complex, integrated energy and climate problems on both a global and local scale. Our programs include hands-on learning experiences and knowledge sharing opportunities to understand the technical, political and societal concepts associated with CCS.

STEP.

MGSC

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

PRAIRIE RESEARCH INSTITUTE

SEQUESTRATION TRAINING AND EDUCATION PROGRAM

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STEP is a program of the Advanced Energy Technology Initiative, University of Illinois.

This material is based upon work supported by the U.S. Department of Energy under Award Number DE-FE0002462 and the Illinois Department of Commerce and Economic Opportunity #09-484002.

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SEQUESTRATION TRAINING AND EDUCATION PROGRAM

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STEP is a program of the Advanced Energy Technology Initiative, University of Illinois.

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Addendum 4.
Subcontract report from Ana Houseal (August 2014)

Dear Dr. Greenberg, Wednesday, August 20, 2014

It is my pleasure to let you know that the subcontracted portion of this project, namely the work contracted through the Science and Mathematics Teaching Center at the University of Wyoming through the ***Illinois State Geologic Survey (ISGS)– Sequestration Training Education Program (STEP), US Department of Energy Phase III, and The Science and Mathematics Teaching Center (SMTC) at the University of Wyoming (UW) - Energy Curriculum Development Project*** was completed August 15, 2014.

Attached, please find a final report noting a description of the work and table of accomplishments. While several pieces of the project are on-going, specifically accompanying research projects and article write ups, none of these will be requiring further funding. Two conference presentations resulted from this project, however, peer-reviewed journal articles have not yet been realized. In addition, having students participate in conference presentations of the work was also not realized, thus resulting in left-over funds that will revert back to the ISGS.

On July 31, 2014, there was a positive balance of $6,318.79. As of August 15, 2014, $1005.90 had been spent on Ana Houseal's July conference travel, and $483.36 in salary for Shaleas Harrison. Indirect encumbrances totaled $1853.21. The encumbrance amount will be adjusted with the final invoices and a final number should be available at the end of August. This final amount will revert back to the ISGS when all of the travel and payments have been processed.

Thank you for the opportunity to work on the STEP project with you. Please let me know if you have any questions or need anymore information from me.

Sincerely,

Ana Houseal

Ana Houseal, Ph.D.
Outreach Science Educator
Science and Mathematics Teaching Center
University of Wyoming
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Wyoming Hall 449
Laramie, WY 82071
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Cc: Farrell J. Rapp, Coordinator Sponsored Programs, University of Wyoming

Illinois State Geologic Survey (ISGS)– Sequestration Training Education Program (STEP), US Department of Energy Phase III, and The Science and Mathematics Teaching Center (SMTC) at the University of Wyoming (UW)

Energy Curriculum Development Project

Principal Investigator: Ana Houseal, PhD
Science Outreach Educator
Science and Mathematics Teaching Center
University of Wyoming
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Department 3992
Laramie, WY 82071
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July 1, 2012- August 30, 2014

Description:
Three graduate students at the University of Wyoming (UW) were selected to develop curriculum related to energy-based science, specifically in two areas: Balanced Energy Portfolios and Carbon Capture and Storage (CCS). The participating students worked with Ana Houseal at UW and Sallie Greenberg at Illinois State Geologic Survey (ISGS) to create units with supplemental science-based kits to be used to teach some key energy ideas within the context of the complex social issues and critical decision making skills needed by all citizens. In addition, professional development materials were developed to go with the curriculum, which will be further refined towards conducting 2-day workshops in the next phase of the project.

The graduate students worked to develop curriculum suitable for Middle Level students (Grades 5-8). Curriculum materials were initially piloted in a 9th grade earth science class in Laramie, Wyoming during the 2013 spring semester. In June 2013, teachers who were working on Master's Degrees in science education through the Science and Mathematics Teaching Center (SMTC) participated in a pilot of the professional development. After the completion of the development of the initial two units in Wyoming, during the 2013-2014 school year, the team in Wyoming worked with Rebecca Adwell and Kathy Atchley at ISGS to integrate a third unit specifically focused on CCS on by Rebecca into the Wyoming curriculum. Shaleas Harrison, a newly graduated Master's student familiar with middle level earth science and the new science standards helped with the finalization of the Wyoming units and some initial integration of the IL work.

There were three parallel aspects to this project:

- Curriculum and professional development
- Graduate student Plan B (non-thesis) projects based on some aspect of the process
- Evaluation of the products and the professional development

Completed Timeline:

Time line	**Task**	**Date completed**
Summer 2012:	Recruit graduate students	September 2013
Fall 2012:	Work with graduate students to develop first unit and begin Plan B projects	Ongoing work throughout the FA12 and SP13 school year
Spring 2013:	Develop second and third units.	Second unit completed SP13
	Pilot both units in April/May 2013 and revise units as needed, prepare for final versions	Both units piloted in Heath Brown's 9th grade Earth Science courses (n=4; for a total of approximately 96 students)
	Develop PD workshops for June classes	PD was developed to coincide with needs of MSNS (Master's degree program) for SU13 students
	Continue work on Plan B projects	On-going work on Plan B conducted by John Reinertsen, based on "Trace it to the Source" Assessment
	Begin evaluation of units and PD	Unit evaluation and revisions began FA13 – completed SU14
Summer 2013:	PD for teachers (June)	Completed June 2013
	Plan B defenses for students	Plan B project was completed by John Reinertsen - FA13
	Evaluation of PD	No formal evaluation completed – however data are available from the workshop.

At the end of the Summer 2013 work, a decision was made to continue the project into the 2013-2014 school year. During this time several items were accomplished:

- The two units developed at UW were revised for clarity and alignment with the Next Generation Science Standards (NGSS). Resources were double-checked and background information was developed as needed. This work was mostly done by Shaleas Harrison. The third unit developed in IL was worked on there with an attempt to match both the level and clarity of the other two units.
- Proposal was submitted accepted and presented at the Geological Society of America conference in Denver, Colorado.
    - **Houseal, A. K.**, Greenberg, S. A., Ramsey-Walters, S., Brown, H., & Reinertsen, J. (2013, October). *Developing balanced energy curriculum for middle level students.* Paper presented at the 125th annual meeting of the Geologic Society of America (GSA). Denver, CO.
- The IRB was renewed for John Reinertsen's work to be evaluated further and turned into an article. In July 2014, an additional graduate student was hired for 30-60 hours to specifically work on this piece of the project. This work is ongoing by Ana Houseal into FA14.
- Proposal was submitted, accepted and presented at the International Workshop on Public Education, Training, and Community Outreach for CCUS. Decatur, IL.
    - **Houseal, A. K.,** Greenberg, S.A., Atchley, K., & Adwell, R. (2014, July). *Developing balanced energy curriculum for middle level students.* Paper presented at the International Workshop on Public Education, Training, and Community Outreach for CCUS. Decatur, IL.
    - Sample activities were presented in workshop format to practicing teachers at the same workshop.
- Alignment to Next Generation Science Standards was completed and materials lists for kit development were completed in August 2014.

The subcontracted portion of this project was completed August 15, 2014.

Addendum 5.

Subcontract report from Western Kentucky University (June 2015)

STEP Subcontract to Western Kentucky University - Final Report June 2015

Dr. Fred Siewers, Department of Geography and Geology

The Sequestration Technological Education Program (STEP) issued a subcontract to Dr. Fred Siewers, a geologist at Western Kentucky University, to assist with the development of capacity building workshops focused on carbon capture and storage. This subcontract was for the period July 1, 2013 to September 30, 2014. The contract was later extended until June 30, 2015.

Siewers worked with the Project PI, Sallie Greenberg, and Phil Jaguki, Schlumberger Carbon Services via phone conferences and face-to-face meetings over the course of the subcontract period. Also included in these meetings was staff from the Illinois State Geological Survey and others from Schlumberger Carbon Services. Most of the group's work focused on a workshop for individuals and organizations interested in the details of carbon capture and storage (CCS) and the steps necessary to adequately identify, characterize and monitor a CCS site. Siewers also developed University course that focused, in part, on CCS entitled "Energy, Climate and Carbon." Details about that course are presented here.

Geol. 315 - Energy, Climate and Carbon - Western Kentucky University (F'14)

Purpose of the Course: Energy, Climate and Carbon examines our current reliance upon carbon-based sources of energy, the affect of fossil-fuel emissions on climate, and current efforts to limit fossil-fuel emissions and global climate change. The course is particularly focused on carbon-capture technologies and geological carbon sequestration. Laboratory work will focus on real-world issues pertaining to site selection, permitting, and monitoring of carbon stored in subsurface settings.

Learning Outcomes: After the completion of Geol. 315, students will be able to discuss:

- our current and changing energy landscape
- the carbon cycle and the flow of carbon through the Earth System
- climate forcings and the causes of global warming
- how CO_2 is sequestered in geological settings
- renewable energy and nuclear power
- the probable consequences of a warming world

Assessement

Exams (2)	25%
Exercises (7)	40%
Semester Paper & Presentation	20%
Final	15%
	100%

Text Resources

Archer, David, 2011, *Global Warming: Understanding the Forecast*, 2nd Edition. John Wiley and Sons, Inc., p. 203.

Cook, Peter J., 2012, *Clean Energy, Climate and Carbon.* CRC Press/Balkema, Leiden, The Netherlands. p. 215

Lynas, Mark, 2008, *Six degrees: Our Future on a Hotter Planet.* National Geographic Society, Washington DC. p. 335

Lecture Topics

- The Carbon Cycle
- Energy Consumption
- Greenhouse Gases and Climate Forcings
- Global Warming Events in Earth History
- Societal Impacts of Global Warming
- International Climate Change Treaties
- Sources of Anthropogenic CO2
- CCS and Geological Sequestration
- DOE Regional Sequestration Partnerships
- Fluid Injection, Hydraulic Fracturing, and Subsurface Monitoring
- The 2014 IPCC 5th Assessment
- Terrestrial Sequestration
- Nuclear Energy and Renewables

Supplementary Videos and Documentaries:

- Switch!
- Beyond the Light Switch
- PCOR 5-video Educational Series
- Gasland and Fracknation
- EERC CO2 Goes Canadian (Weyburn CO2-EOR Project)
- AMNH Science Bulletin: Storing CO2 to Protect the Climate (Sleipner Project)
- Google Tech Talk: Carbon Dioxide Capture and Sequestration: Hype or Hope? (Sally Benson, Stanford, University)
- Pandora's Promise

Exercises: (provided at the end of this document)

- Exercise 1: Your Carbon Footprint
- Exercise 2: The Geologic Carbon Cycle
- Exercise 3: Fossil Fuels and Energy
- Exercise 4: Societal Impacts of Rising GHG Emissions
- Exercise 5: Greenhouse Gases and Climate Forcings
- Exercise 6: CCS Throughout North America (Regional Partnerships)
- Exercise 7: Introduction to Geophysical Well Logs

Outside Speakers:
Ms. Christian Ryan - WKU Sustainability Coordinator
KY State Representative Jim DeCesare on Kentucky Green Building Initiatives

Who Participated? 11 undergraduates, 4 graduate students. Most undergraduate and graduate students were geology majors; one undergraduate student is pursuing a BIS in Interdisciplinary studies; one graduate student is pursuing an MA in Social Responsibility and Sustainable Communities.

Course structure *Energy, Climate and Carbon* met Tuesday and Thursdays from 11:10 am to 12:30 pm for 15 weeks. The course also had a 2 hour lab which met on Thursdays from 12:45-2:45. Lab times were used to work on exercises, watch documentaries and for student presentations.

The lecture-lab structure of the course allowed for extensive exploration of a range of topics related to energy, climate and carbon.

Comments on the exercises The exercises, in many ways, were the most experimental part of the course. They were designed to foster individual or group exploration of lecture topics. For the most part, they were successful.

Three of the exercises (Ex. 2, 3, 5) were based on exercises found in David Archer's book *Global Warming: Understanding the Forecast*. The exercises used online computer models housed at the University of Chicago to simulate changes in atmosphere greenhouse gas (GHG) concentrations, the timing of Peak Oil, radiative forcing by various GHGs, and future changes in to the global economy in a warming world. In future classes, they exercises will be modified to more closely address lecture topics.

The ***most successful exercise***s were Exercise 1 - Your Carbon Footprint and Exercise 6 - CCS Throughout North America (the Regional Partnerships Exercise). Students really enjoyed calculating their carbon footprint and finding out what they would have to do to shrink their footprint to a more sustainable size. The Regional Partnerships Exercise was popular because the exercise allowed students to take "ownership" of a particular Carbon Sequestration Region and develop a presentation explaining all the activities and initiatives happening in that region.

The ***least successful exercise*** was the well-log exercise (Exercise 7). There simply was not enough time to give it adequate treatment. It needs substantive revision.

Comments on the Documentaries The PCOR Documentaries are all excellent and are recommended as is the AMNH Science Bulletin providing an overview of the Sleipner Project. Sally Benson's Google Tech talk was really nice to show at the end of the semester when students had already been introduced to CCS. *Switch* and *Beyond the Light Switch* are both good, although only one needs to be shown to give an overview of our current energy situation and our likely future energy needs. *Gasland* and *Fracknation* are interesting/humorous, opposing perspectives on hydraulic fracturing; however, they are ultimately more political than necessary and, as a consequence, will be dropped from future offerings of the course. *Pandora's Promise* is a very interesting overview of nuclear power and is recommended.

Student Term Paper and Presentation Topics

- Geothermal Energy: Fueling a Low Energy Future
- Frack To The Future
- In-situ mineral carbonation and hydration: The Ultimate alternative for carbon sequestration
- Carbon Capture and Storage in Washington and Oregon:
  Why basalt is best
- Climate Change: Not Only Effecting Humans
- Taking the Steam out of Fossil Fuels by Reducing Demand
- Fossil fuel Subsides: Their impact on the future climate and why we must move them to more sustainable sources
- Agricultural Greenhouse Gas Emissions
- Rare Earth Elements and Renewable Energy
- Ocean-Atmosphere Processes and Response to Climate Change
- Sea Level Rise: The most dangerous consequence
- The 2 Degree Celsius Mark: Not an Effective Measuring Stick for Climate Change
- Carbon Emissions in Kentucky: The Promise of Carbon Sequestration
- Nuclear Energy: An Overlooked Opportunity
- The Promise of a Coal-Fueled Future

Future offerings:

Another offering of *Energy, Climate and Carbon* is already planned for Spring '16. It will not have a laboratory component. Even without the lab, it is not anticipated that the content of the course will change much.

Additional Files (provided separately in STEP DropBox folder):

- Lecture PowerPoints
- Exam Materials
- Student Regional Partnership Presentations
- Course evaluation for Geol. 315 (Energy, Climate and Carbon)

(Geol. 315 Exercises provided below)

Geol. 315: Exercise 1 – Your Carbon Footprint

The goal of today's exercise is to gain a sense of your personal carbon footprint. As defined, a carbon footprint is the sum of all emissions of CO_2 which were induced by your activities in a given time frame (usually one year).

There are a number of online carbon footprint calculators. A useful one is from the World Wildlife Foundation's (WWF) office out of the United Kingdom: http://footprint.wwf.org.uk. We will be using this calculator plus a Greenhouse Gas Equivalencies Calculator from the EPA for this exercise.

Step 1
Go to the *WWF Footprint Calculator* page. Determine how your living habits make up your carbon footprint by answering the WWF's online 5-minute carbon footprint questionnaire. The questionnaire will ask you about your food choices, your current living situation, your travel activities, and other "stuff" that impacts your overall carbon footprint.

Note: this is a British quiz! Results will be in tonnes of carbon, which is equivalent to a metric ton - that, in turn is equal to 1000 kilograms or approximately 2,204.6 pounds. You will encounter a fair number of other British expressions. Currency figures will be in pounds (£); £1.00 currently = $1.66. When in doubt with any other terms, use Google to get equivalent US values or use any one of the many online conversion calculators.

Your results: the WWF Footprint calculator will give you the following:

- the number of planets required to accommodate the world's population if everyone shared your carbon footprint
- Your carbon footprint relative to the UK Average of 3.1 planets
- Your carbon footprint in carbon tonnes (metric tons). This is your annual emissions value.

Write down these results.

Step 2
Go to *EPA Greenhouse Gas Equivalencies Calculator* - http://www.epa.gov/cleanenergy/energy-resources/calculator.html. Using your carbon emissions value in metric tons, calculate a carbon or carbon equivalent value. The Equivalencies Calculator will give you a wide range of values. Take note (write down) the following:

- Your equivalency results in both *tons* and *pounds* of CO_2

Under Annual Greenhouse gas emissions, write down:

- the number of passenger vehicles needed to achieve an emissions value equivalent to yours
- the number of miles/year that would have to be driven by an average passenger vehicle to release a value equivalent to your greenhouse gas value.

Under the number of CO_2 emissions, note:

- the number of gallons of gasoline consumed to reach an emissions value equivalent to yours
- the number of pounds of coal burned to reach an emissions value equivalent to yours

Under carbon sequestered by, note

- the number of tree seedlings that would need to be grown for 10 years to sequester your carbon value
- the number of acres of U.S. forests needed to sequester your carbon value

Provide a written reflection of your results from the WWF Carbon Footprint calculator and the Greenhouse Gas Equivalencies Calculator. Did any of your results surprise you? In discussions with others in the class, how did your results compare with your class colleagues? Were they larger? Smaller? Why?

Step 3:
Go back to the WWF Carbon Footprint Calculator, and retake the questionnaire. ***Reduce your carbon footprint by 25%.*** Reflect (in writing) on how you achieved your 25% reduction. Is a 25% carbon emission reduction something that you might be capable of? Discuss.

To turn in - *typed* answers to:
- Steps 1 (your WWF footprint calculator results)
- Step 2 (your greenhouse gas equivalency results plus your written reflection)
- Step 3 (your 25% carbon footprint reduction reflection)

Turn in your complete work via our course site on Blackboard

Total Points: 20
Due Date: Tuesday, Sept. 2, 2014 by midnight

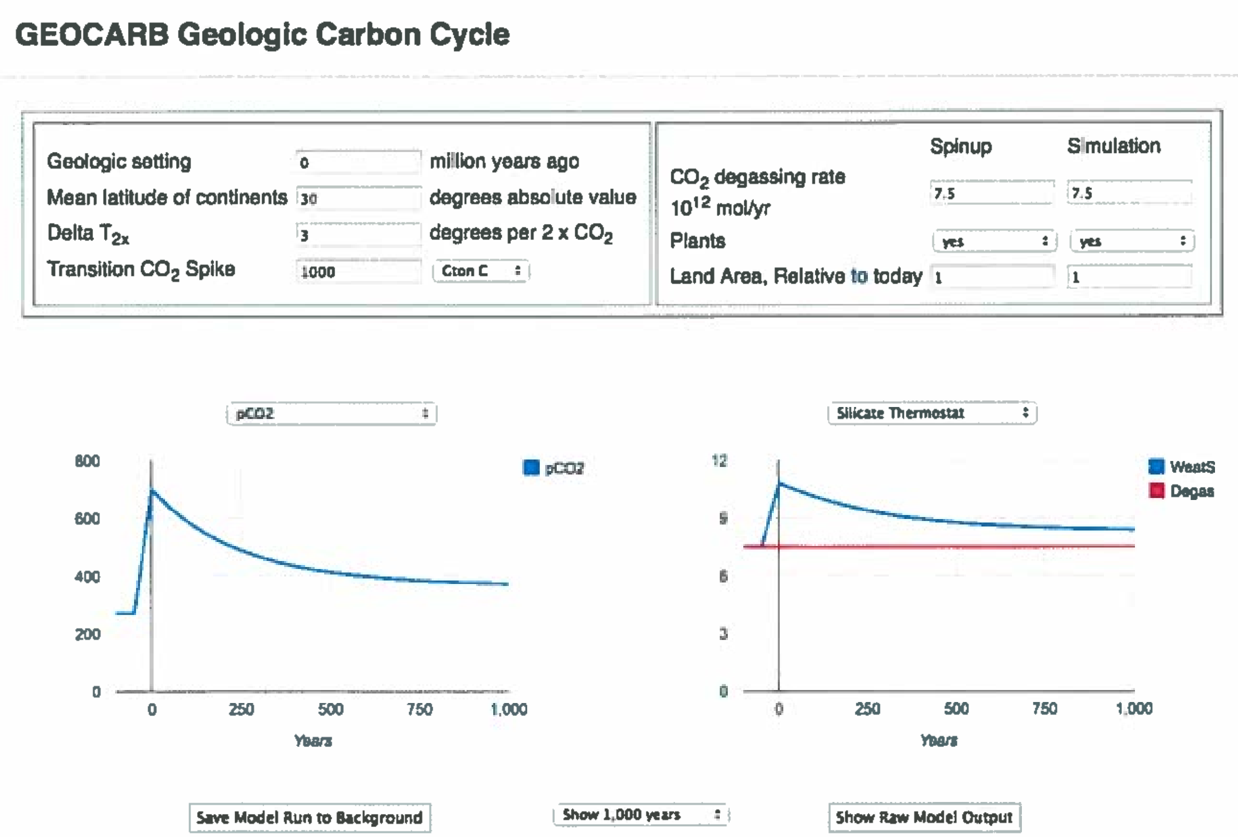
Geol. 315: Exercise 2 - Exploring the Geological Carbon Cycle

Our focus today is on the geological carbon cycle and the responsiveness of this long-term cycle to changes in weathering, CO_2 degassing, solar intensity and plant cover. We will explore these relationships using a computer model housed at the University of Chicago and made available via our textbook "Global Warming: Understanding the Forecast." We will use the model GEOCARB for this exercise (see http://forecast.uchicago.edu/models.html).

The GEOCARB model is based on geochemical model developed by Robert Berner at Yale (see the course readings for all the details). In this model, CO_2 is released to the atmosphere as volcanic degassing and is consumed by chemical weathering of rocks on land. The interaction between degassing and weathering generates a stabilizing negative feedback called the silicate weathering CO_2 feedback. The weathering CO_2 feedback stabilizes atmospheric CO_2, and as a consequence Earth's climate, on time scales of hundreds of thousands of years.

Procedure (from Archer, p. 102)

Go to http://climatemodels.uchicago.edu/geocarb/geocarb.doc.html and click on "Run this Model." The initial settings should be as follows:



The model does an initial spin-up phase to make sure that the initial condition is in equilibrium where all the various budgets balance. You will see only the last few years of this phase in the model output. Then there is a transition to a new set of conditions, say an increase in CO_2 degassing flux from volcanoes. We can watch the transition from one equilibrium state to another.

At the moment of the transition from spin-up phase to transient phase, you can inject a slug of new CO_2 into the system, say by fossil carbon combustion and release to the atmosphere. For the problems below, we'll set the fossil fuel carbon spike to 0.

Questions:

1. **Weathering as a function of CO_2.** In steady state, the rate of weathering must balance the rate of CO_2 degassing from the Earth, from volcanoes and deep-sea vents. Run a simulation with a higher CO_2 degassing rate at the transition time.

   a) Does an increase in CO2 degassing drive atmospheric CO_2 up or down? How long does this take?

   b) How can you see that the model balances weathering against CO_2 degassing?

   c) Repeat this run with a range of degassing rates, and make a table of the equilibrium CO_2 concentration as a function of the CO_2 degassing rate. The CO_2 degassing rate is supposed to balance the CO_2 consumption rate by silicate weathering.

   d) Make a plot of weathering as a function of atmospheric pCO_2 using your model runs.

2. **Effect of solar intensity on steady state CO_2 concentration.** The rate of weathering is a function of CO_2 and sunlight, a positive function of both variables. By this I mean that an increase in CO_2 will drive an increase in weathering, as will an increase in sunlight. The sun used to be less intense than it is now. Turn back the clock 500 million years to when the sun was cooler than today. What do you get for the steady-state CO_2, and how does this compare with what you get for today's solar intensity? Explain why.

3. **Plants.** Plants pump CO_2 down into the soil gas, possibly accelerating weathering. They also stabilize soils, perhaps decreasing weathering. Run a simulation with a transition from no plants to a world with plants, with no carbon spike on the transition, to see which way the CO_2 effect of plants will go.

   a) What happens to the rate of chemical weathering immediately after the plants are introduced? Does it go up or down? What does it do after some time has passed?

   b) What happens to atmospheric CO_2 and why?

   c) When the CO_2 concentration changes, where does the carbon go?

To turn in - *typed* answers to:

- All the questions above, including a table and plot from 1c and d.

Turn in your complete work via our course site on Blackboard

Total Points: 20
Due Date: Tuesday, Sept. 9, 2014 by midnight

Geol. 315: Exercise 3 – Fossil Fuels and Energy

We have two goals with this exercise. Our first goal is to get a sense of the factors that influence ***Hubbert's Peak*** (Peak Oil), that time when the rate of oil extraction is at a maximum and when the amount of remaining oil is about half used up. Our other goal is to get a sense of the factors that control CO_2 emissions and how those factors might influence carbon emissions in the future. We will explore those emission scenarios using a computer model known as the ***Kaya Identity***. Like our last exercise, we will be running on-line computer models associated with our text *Global Warming: Understanding the Forecast.*

Questions: (modified from Archer, pp. 116-117)

1. Hubbert's Peak

Point your web browser to http://climatemodels.uchicago.edu/hubbert/hubbert.doc.html. Read the overview and how to sections, and check out the video introduction. After you have done this, click on "Run this Model"

a) You will see two different data sets to plot against, along with the three parameters (knobs) that control the shape of the Hubbert curve. Nothing fancy here: We are just matching the curve to the data by eye. First start out with the U.S. oil production. The page comes up with some values for the curve that look pretty good, but you should try varying the numbers in the box to see how tightly those values are constrained. What combination of values allows you to best fit the curve?

b) Now switch to global oil production with the pull-down menu. What combination of values allows you to best fit the curve? When do you forecast the peak of oil extraction?

2. The Kaya Identity

Point your web browser to http://climatemodels.uchicago.edu/kaya/kaya.doc.html. Read the overview and how to sections, and check out the video introduction. After you have done this, click on "Run this Model"

a) For a population of 11 billion people, create graphs (blue line) for gross domestic product per capita, energy intensity, and carbon efficiency that best fit the historical data (red dots). Note each parameter will have a small range of values that will allow you to fit the historical data. Make a table of the lowest and highest values that best fit each parameter. Your table should have lowest and highest values for GDP/capita, energy intensity, and carbon efficiency.

b) How much carbon is humankind predicted to emit by the end of the century based on your best-fit parameters? To determine this, plug in the low parameter values that you found in part "a" and read the carbon emission value for the year 2100 on the right hand plot. Do the same for the high parameter values, again reading the carbon emission value for 2100 on the right hand plot. Add columns to your table showing the carbon emission rates at year 2100 for the high and low parameter values. Tweak your input values within the best-fit ranges that you determined to come up with the highest and lowest plausible carbon emission for 2100. Write down these values.

c) For the plot on the right, toggle the output from carbon emissions to ISAM pCO2. ISAM (Integrated Science Assessment Model) is a research-level climate model that is far more sophisticated than the Kaya Identity. Using the parameters that gave you your highest and lowest carbon emission values, what is the expected range in atmospheric pCO_2 (blue line) for 2100. Note that this is a "business as usual" range - meaning, this is the range that humanity can expect if nothing is done to curb CO_2 emissions.

d) Toggle the right plot again to bring up "carbon free energy needed." This plot gives a sense of the amount of carbon-free energy needed to stabilize the atmosphere at particular levels of atmosphere CO_2. How much carbon-free energy (in TeraWatts) would allow atmosphere CO_2 to stabilize at 450 ppm. What rate of improvement in carbon efficiency would be required to limit atmospheric CO_2 to at most 450 ppm? (*hint*: tweak your carbon efficiency until the 450 line equals 0 terawatts in 2100).

Note: for some useful conversions to give you a feel for how much a terawatt is or any other any energy unit, go here: http://www.climatecentral.org/blogs/helpful-energy-comparisons-anyone

3. **Describe in a paragraph or two what you learned doing this exercise.** For example when how much is Peak Oil dependent upon predictions of total reservoir size? What do the Kaya Identity and ISAM models tell you about future atmosphere CO_2 levels? What does business as usual mean with respect to global warming.

To turn in - *typed* answers to:

- All the questions above, including a table from 2a and b.

Turn in your complete work via our course site on Blackboard

Total Points: 20
Due Date: Tuesday, Sept. 16, 2014 by midnight

Geol. 315: Exercise 4 – Climate Change: Societal Impacts 1

This week's assignment doesn't deal computer models of the Earth System (that's next week!). Instead, we are going to look some of the social issues surrounding climate change. This will be the first of several explorations we will conduct over the course of the semester.

First, we are going to watch the first episode of the Showtime Series *Years of Living Dangerously* (http://www.sho.com/sho/years-of-living-dangerously/home). We will watch this in class. Pay close attention and take notes of those things that you find particularly interesting.

Second, on your own time, watch the documentary *Climate Change: Faith and Fact*, shown this past week on the PBS show *Moyers and Company* (http://billmoyers.com/episode/full-show-climate-change-faith-and-fact/). This documentary features a conversation with Dr. Katharine Hayhoe, a climate scientist and evangelical Christian. She was also featured in the Showtime Series. Pay close attention to this too and take notes of those things that you find particularly interesting.

To turn in – a summary of both the *Years of Living Dangerously* show and the Bill Moyers conversation with Katherine Hayhoe. After you write your summary, *reflect on what you have learned.* This reflection can focus on the intersection of Faith and Science, the role of deforestation (in places like Indonesia) on CO_2 emissions, how climate change influences local economies and plays a significant role in political upheaval, or any other topic you want to reflectively write about. I expect your typed summary will be at least 3-4 pages.

Total Points: 20
Due Date: Tuesday, Sept. 23, 2014 by midnight

Turn in your complete work via our course site on Blackboard

Coming soon!
- The People's Climate March, Sunday, Sept. 21 (http://peoplesclimate.org/march/)
- UN Climate Summit, Tuesday, Sept. 23 (http://www.un.org/climatechange/summit/)

Tune in to the media surrounding these events. We will be discussing these events in class on Sept. 25.

Geol. 315 - Exercise 5: Climate Forcing And The Relative Influence Of Greenhouse Gases

Today's exercise utilizes two computer models from David Archer's *Global Warming: Understanding the Forecast*. One model - the MODTRAN model - will give you an appreciation for the concept of radiative forcing and how that forcing has changed since pre-industrial times. The other model - the SLUGULATOR model - simulates the radiative impacts of "slugs" (spikes) of greenhouse gases - specifically CO_2 and CH_4 - released to the atmosphere over various time scales. This model will give you a sense of the relative role that CO_2 and CH_4 plays in global warming.

Part I - MODTRAN model - http://climatemodels.uchicago.edu/modtran/modtran.doc.html. Point your web browser to the MODTRAN site. Read the "Overview" and "How-to" sections, and check out the video introduction. After you have done this, click on "Run this Model" and answer the following questions.

a) What does the MODTRAN model illustrate?

b) Why does the intensity of infrared light become depressed for the wavelength band for CO_2?

c) When CO_2 is 400 ppm and CH_4 is 1.7 ppb (current conditions), what is the upward infrared heat flux?

d) What was the upward infrared heat flux during pre-industrial times? See the *Carbon Dioxide Information Analysis Center* (http://cdiac.ornl.gov/pns/current_ghg.html) for the appropriate CO_2 and CH_4 concentrations (don't worry about ozone or water vapor).

e) How much more infrared radiation does the atmosphere now absorb relative to pre-industrial times?

Part II - SLUGULATOR Model - http://climatemodels.uchicago.edu/slugulator/. Point your web browser to the SLUGULATOR site. Read the "Overview" and "How-to" sections, and check out the video introduction. After you have done this, click on "Run this Model" and answer the following questions.

f) When the CO_2 and CH_4 values are set to 0, what are the concentrations of CO_2 and CH_4 in the atmosphere?

g) How many gigatons of CO_2 must be emitted to have a radiative forcing comparable to 1 gigaton of CH_4

h) How long does it take for equilibrium conditions to return after a slug of 10 gigatons of both CO_2 and CH_4 are added?

i) Describe the behavior of Slugs of CH_4 and CO_2 in the atmosphere. Which causes the most immediate warming? How long does each gas remain in the atmosphere until equilibrium levels are reached. Provide an example.

j) According to Bill McKibben, scientists say that we can pour another 565 gigatons of carbon into the atmosphere without having catastrophic warming. How much will the atmosphere warm over 100 years with this amount of additional CO_2 (keeping CH_4 emissions at 1 gigaton).

k) According to the *Carbon Tracker Initiative* - http://www.carbontracker.org - the amount of carbon already contained in proven coal and oil and gas reserves amounts to 2,795 gigatons. If all of this carbon is burned, how much will global temperatures increase over a 100 year period of time? (again, keep CH_4 emissions at 1 gigaton).

NOTE: for some sobering commentary on these numbers see *Global Warming's Terrifying New Math* - http://www.rollingstone.com/politics/news/global-warmings-terrifying-new-math-20120719).

To turn in - *typed* answers to all the questions above. As we have done before, *turn in your complete work via our course site on Blackboard*

Total Points: 20
Due Date: Wednesday, October 1, 2014 by midnight

Geol. 315 - Exercise 6: Carbon Capture and Storage throughout North America

This week's activities will begin our focus on carbon capture and storage (CCS) and geological carbon sequestration. Since I am away at the International Conference on Greenhouse Gas Technologies (GHGT-12), I am going to introduce these topics via some individual and group assignments. These assignments will involve the *United States 2012 Carbon Utilization and Storage Atlas, Fourth Edition* (Atlas IV). Two copies of the Atlas are on the back table of EST 326; the Atlas can also be found online here.

Part I: Individual Work:
Familiarize yourself with the *Introduction* and *National Perspectives* of the Atlas (pp. 1-30). Then based on these sections, individually answer the following questions. Answers to these questions are to be assembled in MS Word and uploaded to Exercise 6 area on Blackboard.

a) In general terms, what are the natural and anthropogenic (i.e. human derived) sources of CO_2 in the atmosphere? How much CO_2 is being emitted to the atmosphere, globally, by the energy sector?

b) Why preform carbon storage? What technology options exist to stabilize greenhouse gas concentrations in the atmosphere?

c) What kinds of facilities or plants release CO_2 to the atmosphere? The North American Carbon Storage Atlas (NCSA) Viewer will be of use here.

d) What kinds of rocks have the potential to store CO_2? Differentiate between those reservoirs that have a high potential to store CO_2 and those with a low potential to store CO_2.

e) Briefly describe how the following might be used to store CO_2
- Oil and gas reservoirs
- Unmineable coal
- Saline Formations
- Basalt Formations
- Organic-Rich Shale Basins

Part II: Group Work (explore, compile, share)
This part of the assignment involves breaking up into groups of (mostly) two and exploring one of the seven DOE Regional Carbon Sequestration Partnerships. The exploration groups you will be working in are as follows:

Midwest Geological Sequestration Consortium
- Steven Devine
- Ryan Hart

Southwest Regional Partnership on Carbon Sequestration
- Beth McGrew
- Ben Rafferty

West Coast Regional Carbon Sequestration Partnership
- Jacob Hughes
- Chelsey Kipper

The Plains CO_2 Reduction Partnership
- Jacob Lord
- Michelle Foley

Midwest Regional Carbon Sequestration Partnership
- Evan Crowe
- Brook Curry

Big Sky Carbon Sequestration Partnership
- Brian Way
- Tiffany Quiles
- Sarah Zibart

Southeast Regional Carbon Sequestration Partnership

- Trentin Corbin
- Kyle Hogancamp

Each group will compile the following information:
- the overall location of your Regional Partnership
- the sources and emissions of CO_2 in the partnership area
- the reservoirs under consideration for CO_2 injection
- any large scale storage projects either being considered or underway
- any monitoring, verification and accounting protocols that have been put into place

On ***Tuesday, October 14***, you all will share your group findings with the class via a ***10 minute PowerPoint presentation***. Your group's presentation need not be overly complex - in fact, it can probably be accomplished with 4 to 6 slides. All I am looking for is for you to convey your group's finding to the rest of the class so that everyone learns from each other.

Due Dates:

Part I: October 9 Individual answers submitted as a Word file to Blackboard by 11:59 pm.
Part II: October 14 Group PowerPoint presentation uploaded to Blackboard by the beginning of class.

Assessment:

Part I - 10 points
Part II - 10 points. Your group will be assessed on your ability to convey information both verbally and visually and your ability to answer questions from your class colleagues.

Questions? Let me know.

Geol. 315 - Exercise 7: Introduction to Geophysical Well Logs.

This week's activity will introduce you to geophysical well logs, one of the most important tools used to study subsurface geology and, for our purposes, carbon capture and storage. Since we have variable backgrounds in geology in this course, I have decided to pull exercises from two introductory outside sources: Gastaldo, Savrda and Lewis' *Deciphering Earth History, 4th edition* (2006) and a well log exercise used for years in a sedimentary rocks course (Geo. 416M) at the University of Texas at Austin. These exercises are presented in parts I and II of this lab activity.

Note: because our readings do not focus on well logs, I have included readings here to guide you along.

Part I (from Gastaldo et al, 2006)

In studies of subsurface geology including those involving the search for oil and gas, it would be ideal if geologists could drill many wells and take a continuous core of rock from each. Examination of the cores would establish the vertical sequence of rock types below each drill site and provide the basis to correlate lithostratigraphic units across the area of study. However, because recovery of continuous core is very expensive, geologists often have to rely on other ways of evaluating the nature of subsurface rock sequences. When geologists drill a bore hole, they can examine the small pieces of rock that are washed upward from the drill bit by circulating drilling muds (special muds pumped into a well to lubricate the drill bit). Although rock chips do not provide as much information as a continuous rock core, these bits of rock, which are called well cuttings, provide general information about the sequence of rocks in the subsurface. More information can be obtained from bore holes by using geophysical tools. Geophysicists have developed a variety of instruments that can be used in open bore holes to measure various physical properties that can tell us the rock types that have been penetrated. The properties most commonly measured are electrical resistivity, self potential, natural gamma radiation, and sonic velocity

Electrical resistivity puts an electrical charge into a subsurface rock and measures how resistive the rock is to the current. That is, this technique is used to determine how much or how little a current can be passed through a rock. Resistivity generally increases with the amount of fluid in a rock and, hence, reflects the *porosity* (the amount of pore space) of the rock. *Rocks that have low porosities (e.g., most shales) have low resistivity, whereas porous rocks (e.g., most sandstones and limestones) possess high resistivity.*

Self-potential is another measure that uses electricity. When the core is being drilled and the drilling muds (think lubricant) react with the fluids in the rock, self-potential measures the difference in voltage as ions in the fluids move toward or away from the bore hole. Although related to the chemistry of pore fluids, self-potential is controlled by rock permeability (a measure of the interconnection between the pore spaces). *Self-potential is generally more positive for shales and dense limestones and more negative for more permeable sandstones, within which pore space is filled with salt water or oil.*

Natural gamma radiation is the natural radioactivity emitted by rocks. Most of the gamma radiation in sedimentary rocks is produced during the decay of potassium-40 (^{40}K), which is more common in rocks with abundant potassium-bearing minerals (e.g., clays, feldspars, micas). Gamma radiation also comes from the decay of uranium, which, in sediments, is typically associated with organic matter or phosphate. Hence, gamma radiation primarily reflects rock composition. *Gamma radiation is low for quartz sands without much silt or clay (quartz arenites) and most limestones, moderate to high for feldpathic or lithic sandstones and most mudrocks, and very high in organic-rich shales and coals.*

Sonic velocity, or the speed that sound waves travel through subsurface materials, is controlled by rock density and porosity and can be related to lithology. As examples, *seismic velocities are generally very low in coals, moderate to high in sandstones and shales, and very high in limestones and dolostones.* Sonic velocity also can be used to link rock types to subsurface reflectors in seismic profiles.

Geophysical instruments are lowered to the bottom of a borehole and, as they are slowly raised, they continuously monitor one or more of the rock properties described above. This procedure generates a chart with readings of rock properties plotted versus depth (Figure 7.2). These **instrumental well logs** record electrical resistivity, self-potential, natural gamma radiation, and sonic velocities referred to as **resistivity logs, SP logs, gamma-ray logs,** and **sonic logs**, respectively. Several of these properties are plotted side-by-side on a well-log record. For example, in the well logs shown in Figure 7.2, self-potential is recorded on the left, and resistivity is plotted on the right

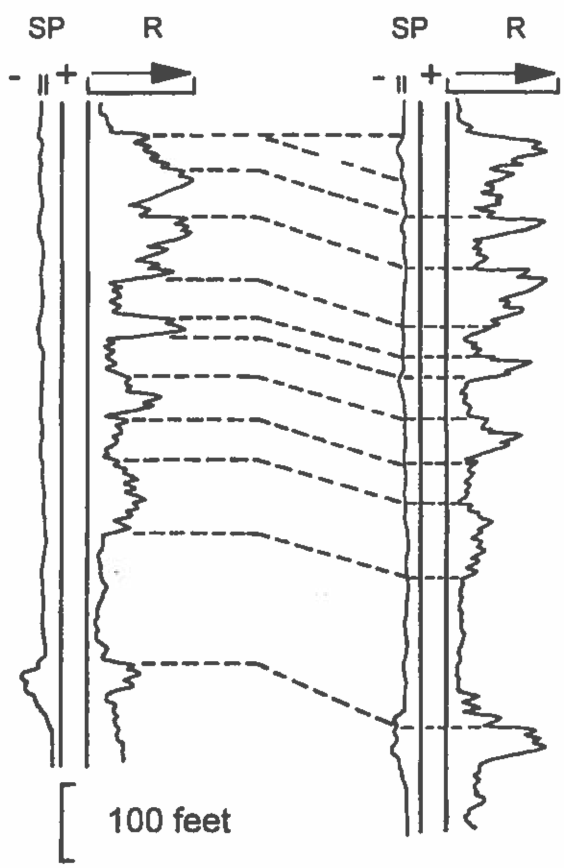
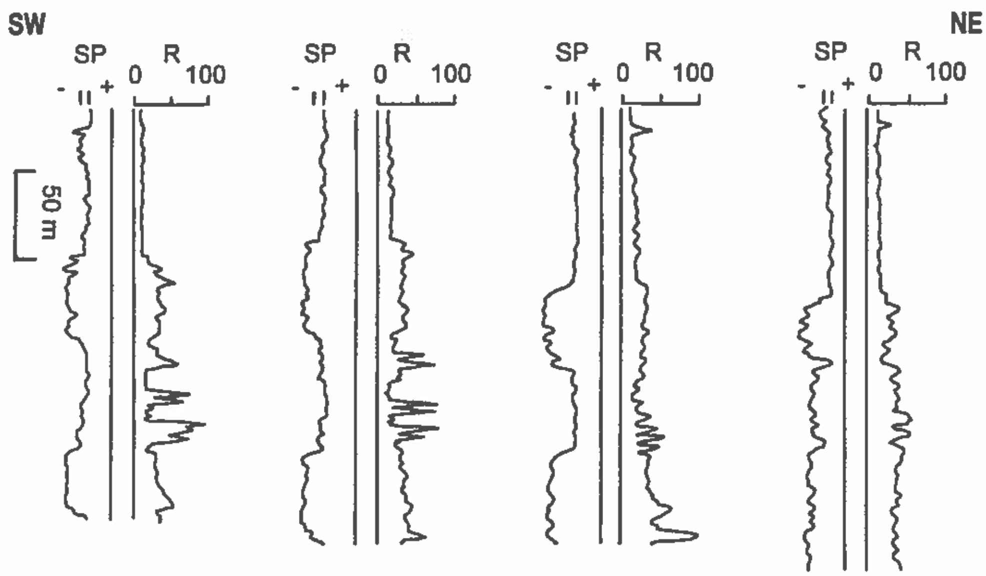


Figure 7.2 — Hypothetical examples of instrumental well logs recording self-potential and electrical resistivity with depth in two boreholes. Wells can be correlated (dashed lines) on the basis of well-log signatures.

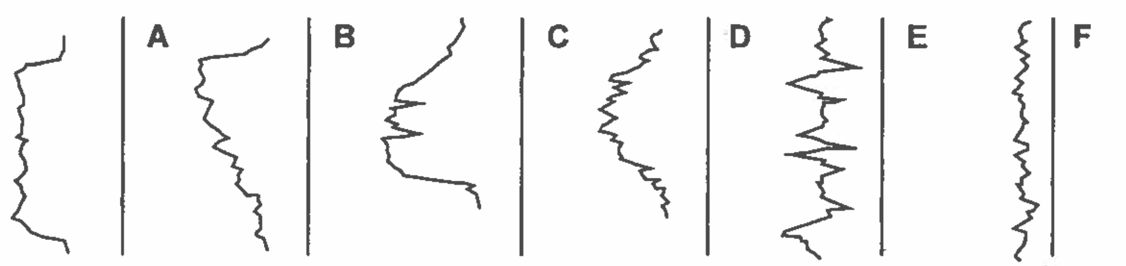
Geophysical properties are indirectly linked to lithology and lithofacies. Hence, well logs can be used to interpret vertical sequences of rocks and to correlate stratigraphic packages between drilling sites (Figyre 7.2). This can be done without seeing the rocks and without the expense of core recovery during drilling. However, because well logs provide valuable information about porosity and other rock features, geologists also generate geophysical logs for drilling sites that have been cored.

Questions:

1. The well logs below are electric logs recording spontaneous potential (SP) and resistivity (R). The stratigraphic interval in these well logs is characterized by four units. Two of these units are dominated by sandstones that represent shallow marine and/ or barrier-island facies. A third unit is characterized by shales deposited on a marine shelf. The fourth unit is characterized by interbedded mudrocks and sandstones that record deposition in a coastal lagoon behind a barrier island.



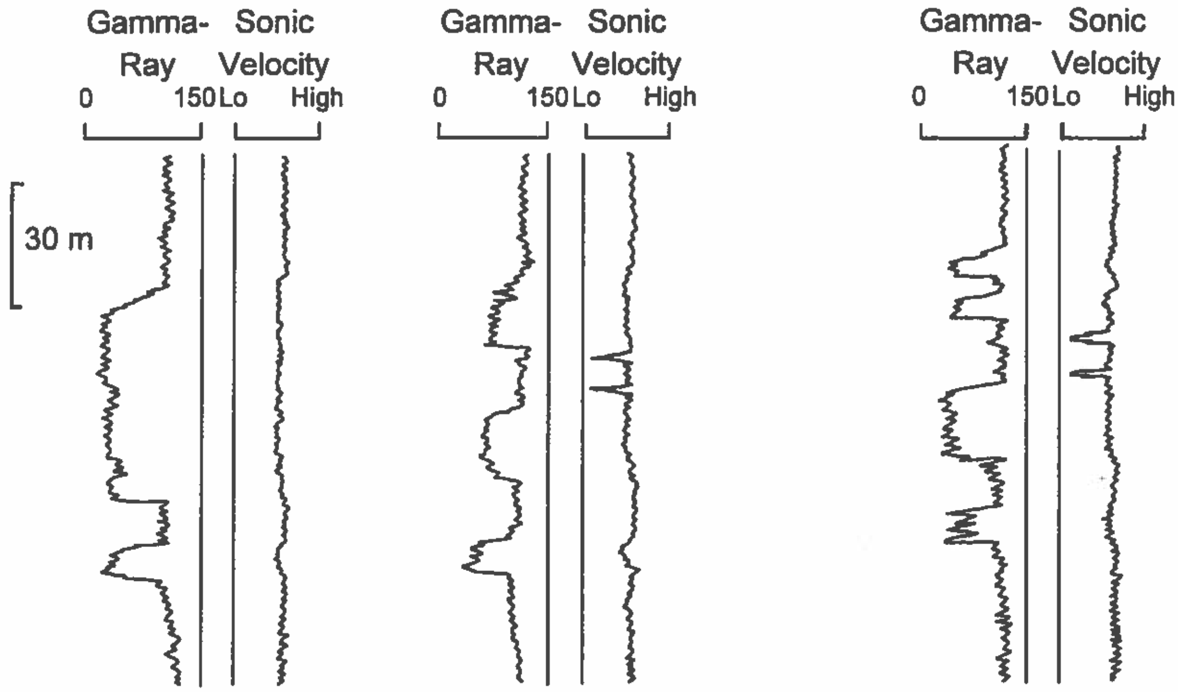
A. Using the well-log signatures above and the following SP interpretive diagrams, identify the units described above.



Blocky indicating thick deposit of gravel or sand or limestone, reef	Funnel-shaped indicating coarser deposits at top; river bar, barrier island, marine sand sheet, carbonate shoal	Bell shaped indicating abrupt bottom and finer deposits at top; point bar, tidal bar, deep sea channel	Symmerical indicating fine-to-coarse-to-fine deposit; sandy shelf bar	Irregular mixed sand and shale deposits; river floodplain, carbonate slope, turbidite	Irregular, low amplitude indicating fine shaly deposits; offshore shelf

2. Well logs for three different cores are shown below. These record natural gamma radiation (gamma-ray log) and sonic velocity (sonic log). The stratigraphic package represented in

these well logs contains three general lithofacies: (1) shallow marine sandstone; (2) marine shale; and (3) coastal-plain mudrock/ coal.



A. Gamma-ray traces are very similar in their patterns to S-P curves. Using the well-log signatures and the information provided above, determine the vertical distribution of the three lithofacies in each of the cores.

B. Using neat solid lines, correlate lithologic boundaries between the three wells. Then, sketch standard lithologic symbols (e.g., stippled pattern for sandstones) across the diagram to show the distribution of lithofacies across the area.

Part II (from Geo. 416M, UT Austin)

We will be studying electric logs and learning how they can be used to evaluate the lithologic and textural characteristics of sedimentary rocks. An electric log of a well is a record of the ***self potential*** (SP) and the ***apparent resistivity*** of the rock. These two properties are measured in the uncased part of the well, commonly with drilling mud present in the hole. The equipment used to make the measurements consists of: 1) a system of electrodes (sondes) that is lowered into the hole; 2) a multi-conductor cable spooled on a power driven winch that raises and lowers the electrodes; 3) a measuring device that records the depth of the electrodes; and 4) electrical measuring instruments. Also, a plotting mechanism is needed that records measured values of SP and resistivity on film. The standard scales used are 1 inch = 100 feet and 1 inch = 50 feet.

Although electric logs are extremely valuable to the analysis of lithologies of subsurface rock units, they cannot be used with absolute certainty without reference to well cuttings and cores. The reason for this is that different lithologies can produce similar electric log curves.

Self Potential (some important notes)

A. The natural electrical potential of the rock.

B. Measured in millivolts.

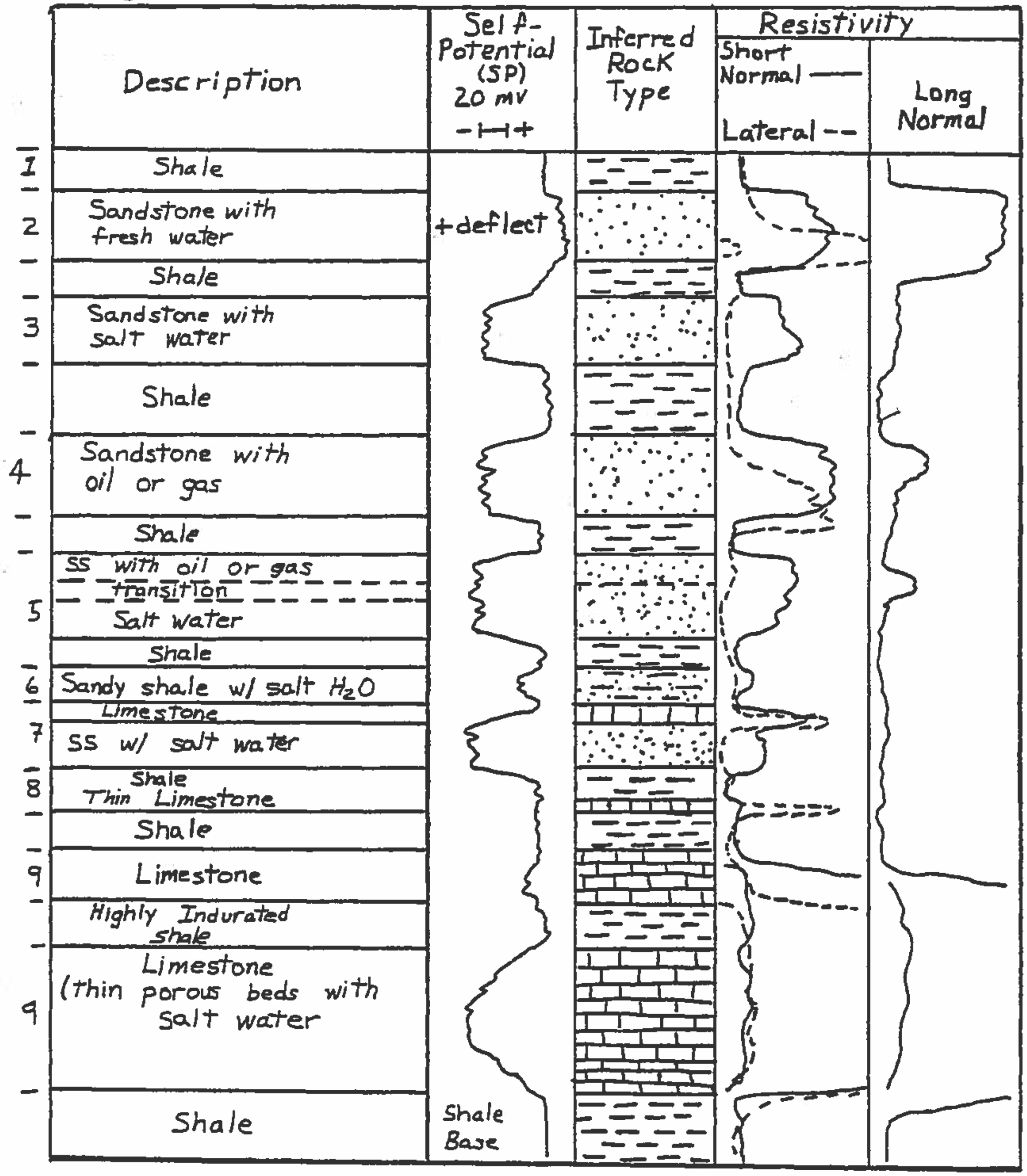
C. Equals the difference in electrical potential between the electrode in the column of drilling mud and a surface electrode.
D. Used to distinguish permeable from impermeable beds, as well as to locate boundaries of beds with contrasting permeabilities.
E. The zero line is the flat line for shale. This represents the zero line because impermeable shales do not respond to the electrochemical and electrofiltration effects induced in the more permeable units.
F. Positive and negative deflections from the shale base line result from the contrast in salinity of the drilling fluid and the formation water. If the concentration of ions in the formation is less than the concentration of ions in the drilling fluid, the ions in the drilling fluid will migrate into the formation water in order to reduce the charge imbalance between the two. This gives a positive deflection. A negative deflection is caused by the reverse situation. A negative deflection is the more normal case since most formation waters are saline and the salinity of most drilling muds is near that of fresh water.
G. The amount of (-) deflection has important textural implications for sections composed of shale and sandstone. Shales will produce the shale base line and sands will cause a (-) deflection proportional to how "clean" they are, or inversely proportional to their grain size. A clean sand will gl.ve a "sand line" on the (-) side of the SP curve.
H. A second type of textural information is given by the slope of the line between sandy and muddy units. The flatter the line, the more abrupt the lithologic contact between the two units.

Resistivity Curves (some important notes)
A. Resistivity curves measure the resistance to flow of an artificially induced electrical current in the formation.
B. Differences in resistivity are due to textural characteristics of the rock, especially porosity, and the nature of the pore fluids that the rock contains. Dense rocks are usually resistant to current flow because they have no pore space and therefore no pore fluid. Examples are granite, quartzite, chert, gypsum, and coal. Porous sandstone with oil, gas, or fresh water in its pore will always show high resistivity because these fluids are not good electrolytes.
C. Increases in resistivity are recorded by deflections to the right on the curve. Differences in the magnitude of the deflection for the three curves are a result of their effective penetration, which is related to electrode spacing in the well. The spacings most commonly used are 16 inches (short normal), 64 inches (long normal), and 19 feet (lateral curve).
D. The depth of the electrical investigation into the rock is equal to the distance between the current electrode and the measuring electrode.

As a result, the top and bottom of beds down to 16 inches can be measured for short normal curves. This means the device is also measuring 16 inches into the rock, except for soft permeable rock where the drilling fluid can leak more than 16 inches into the rock. So, long normal and lateral electrodes are used in these cases. They can measure deeper into the formation but do not resolve boundaries between thin units as well. In general, the short normal curve should be used to look at the boundary relationships and the long normal and lateral are used to determine the lithology of the units.

Figures 1 and 2 illustrate characteristic responses of E-logs with different lithologies and conditions.

Fig. 1



E-log curves and their expression of common lithologies, fluids and gas.
Note: Dolomite, anhydrite, quartzite and coal have curves similar to limestone

SEE ACCOMPANYING DESCRIPTION

Interpretation of Units (see Figure 1)

1. Shale: All curves give low readings. The almost straight SP curve for the shale is referred to as the shale base. The shale base may drift gently with depth and may shift abruptly between marine and continental sediments, but it remains relatively constant in the shale beds of the same origin.

2. **Sandstone containing fresh water:** All the resistivity curves give a high reading with the lateral curve giving the highest reading, because it indicates the true salinity of the formation fluid. Positive deflection of the SP curve denotes a permeable formation containing fresh water. Note reciprocal pattern of the short normal resistivity and SP curves here.

3. **Sandstone bearing salt water:** Low deflection of the lateral and long normal curves, because these are measuring the low resistivity of the salt water in the formation. High short normal resistivity due to inversions of a porous, permeable unit by the drilling fluid (fresh water). High negative deflection on the SP curve indicates a permeable unit bearing salt water.

4. **Sandstone containing gas or oil:** Presence of oil denoted by the large deflection of all resistivity curves to the right. Short normal measures the high resistivity of the drilling fluid and the lateral resistivity curve ~easures the high resistivity of the oil. Note the high negative deflection of the SP curve and a gradual recession of the long normal downwards.

5. **Sandstone having oil and salt water:** Note the large deflection of the short and long normal curves at the top (high resistivity of the oil in the pores) and their gradual recession toward the bottom. Note the left deflection of the lateral curve in the lower part. Because of the 19' spacing of the electrodes recording the lateral curve, the high resistivity of this thin bed of oil saturated sandstone is not recorded by the lateral curve as it is with the thicker zone of oil saturation shown above.

6. **Sandy shale containing salt water:** Sandier portions shown by the negative deflection of the SP and the slight separation of the short normal and lateral resistivity curves.

7. **Limestone overlying sandstone that bears salt water:** Limestone lithology shown by the strong resistivity deflections to the right for short normal and lateral curves (denotes low porosity and thus high resistivity of the rock type), as well as by the rounded slope of the SP curve. The small reverse deflection (to the left) of the long normal curve is characteristic of a thin, highly resistive bed. The salt water sandstone is indicated by the negative deflection of the SP, as well as the contrast in deflection for the short normal and lateral resistivity curves.

8. **Thin limestone:** Note the small reverse deflections (to the left), the short and long normal curved, the pronounced deflection of the lateral curve and the lack of deflection of the SP curve. The reverse deflection of the lateral curve for a depth of 19' under the limestone is due to the 19' electrode spacing and the shielding effect of the limestone.

9. **Limestone:** Pronounced deflection of all resistivity curves (low porosity and permeability). Low deflection of the SP. Note the higher deflection of the SP for lower limestone unit; this results from the presence of a porous zone in the limestone.

Scale of the sample log: 1" = about 100'

Fig. 2

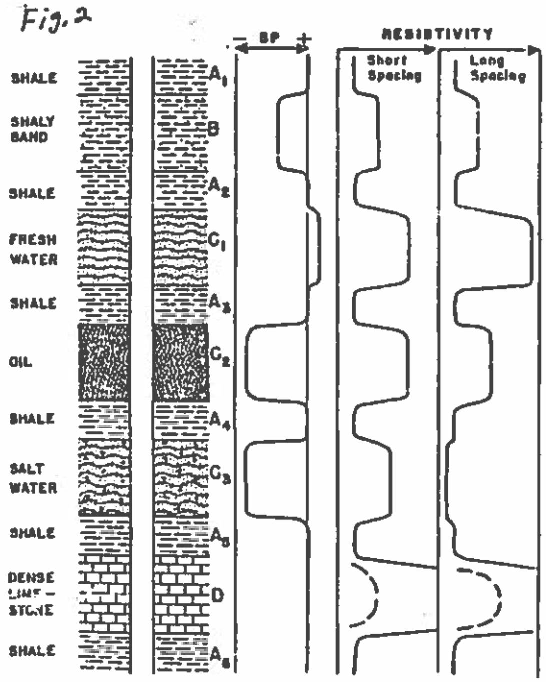


Fig. 3-11. Idealized S.P. and resistivity curves for various combinations of rock types and contained fluids. [Courtesy Schlumberger Well Surveying Corporation.]

Units A_1, A_2, A_3, . . . , are interpreted as shales for the following reasons:

1. The S.P. curve does not depart from the shale line, indicating a non-permeable medium.
2. The units have a low resistivity, indicating high porosities.
3. Both short and long spacing resistivity curves have the same value, indicating that the strata are impervious to drilling mud.

Unit B is interpreted as a shaly sandstone for the following reasons:

1. The S.P. has a moderate departure from the shale line.
2. Both resistivity curves show a value only slightly higher than the shale, indicating strata of moderate porosity.

Unit C_1 is interpreted as a fresh-water bearing sandstone for the following reasons:

1. The S.P. curve has a positive departure from the shale line.
2. Both resistivity curves are high because the fresh water, which saturates the sand, is poorly conductive.

Unit C_2 is interpreted as a sandstone saturated with oil for the following reasons:

1. The S.P. has a strong negative deflection.
2. The short spacing resistivity is fairly high because the part of the sand measured by that spacing contains residual oil and the invading drilling fluid.
3. The long spacing resistivity is high because the sand beyond the invaded section is principally saturated with oil, which is a poor conductor.

Unit C_3 is interpreted as salt water bearing sandstone for the following reasons:

1. The S.P. has a strong negative departure from the shale line.
2. The short spacing resistivity is fairly high because the portion of sand measured is filled with nonconductive mud filtrate, which has displaced much of the conductive salt water.
3. The long spacing resistivity is very low because this curve reaches beyond the invaded section and into the sand saturated with conductive salt water.

Unit D is interpreted as an impermeable limestone for the following reasons:

1. The S.P. has no departure, indicating a nonpermeable formation.
2. Both resistivity curves are very high; in fact the primary curves are off scale, and the reduced scales are recorded. This indicates a very dense formation containing little water.

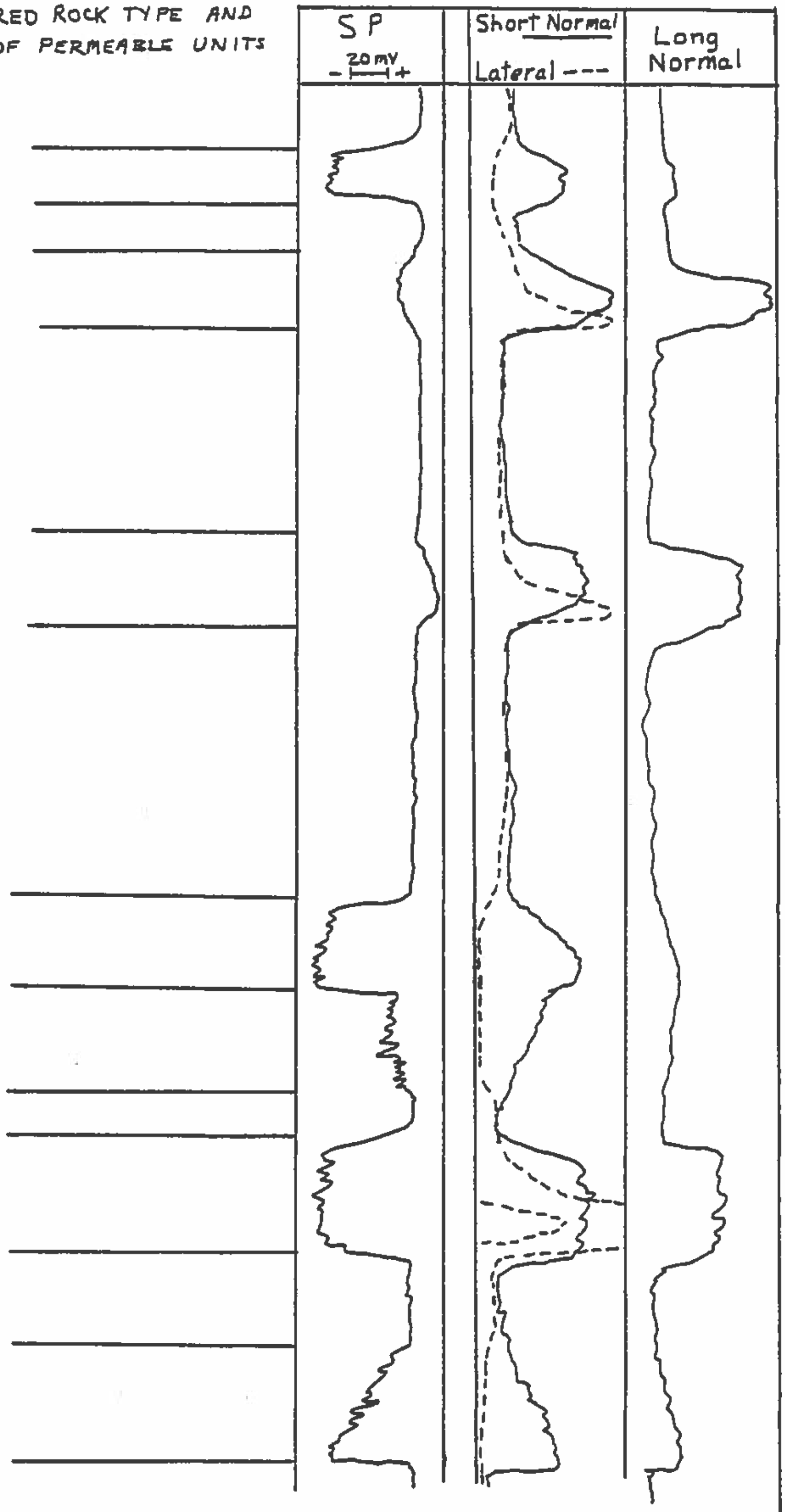
Questions:

For sheets 1 and 2 interpret the inferred rock type and fluid of the permeable units based on the E-logs (see following pages)

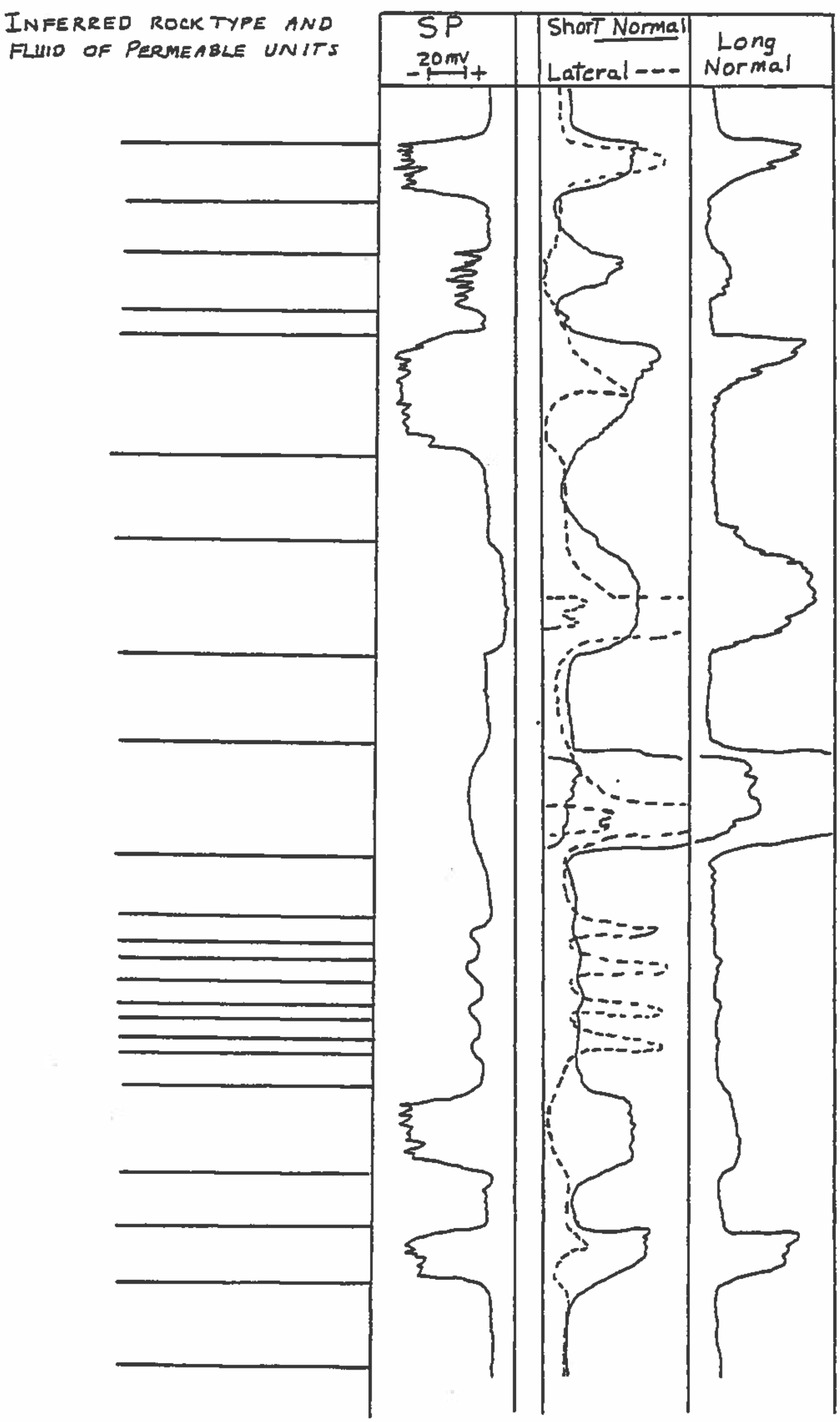
Due Date: Thursday, October 23
Total Points: 20

SHEET 1

INFERRED ROCK TYPE AND FLUID OF PERMEABLE UNITS



SHEET 2


INFERRED ROCK TYPE AND
FLUID OF PERMEABLE UNITS
SP
20mV
- +
Short Normal
Lateral ---
Long
Normal

Western Kentucky University
Fall 2014 Full Term Course Evaluations

Course: GEOL315001 : ENERGY, CLIMATE AND CARBON

Instructor: Fredrick Siewers *

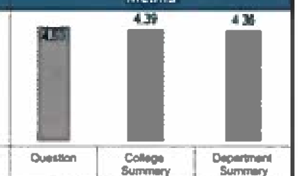
1 - What is your expected grade in this course?

Response Option	Weight	Frequency	Percentage
A	(1)	5	83.33%
B	(2)	0	0%
C	(3)	1	16.67%
D	(4)	0	0%
F	(5)	0	0%

Return Rate
6/11 (54.55%)

2 - My instructor displays a clear understanding of course topics.

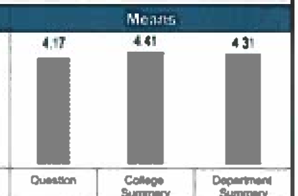
Response Option	Weight	Frequency	Percentage
Strongly Agree	(5)	3	50%
Agree	(4)	3	50%
Neutral	(3)	0	0%
Disagree	(2)	0	0%
Strongly Disagree	(1)	0	0%



Return Rate	Mean	STD	Median	College Summary	Mean	STD	Median	Department Summary	Mean	STD	Median
6/11 (54.55%)	4.50	0.55	4.50	12,015	4.39	0.89	5.00	1,180	4.36	0.93	5.00

3 - My instructor is well-prepared for class.

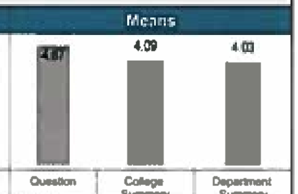
Response Option	Weight	Frequency	Percentage
Strongly Agree	(5)	2	33.33%
Agree	(4)	3	50%
Neutral	(3)	1	16.67%
Disagree	(2)	0	0%
Strongly Disagree	(1)	0	0%



Return Rate	Mean	STD	Median	College Summary	Mean	STD	Median	Department Summary	Mean	STD	Median
6/11 (54.55%)	4.17	0.75	4.00	12,015	4.41	0.82	5.00	1,180	4.31	0.90	5.00

4 - Performance measures (exams, assignments, etc.) are well constructed.

Response Option	Weight	Frequency	Percentage
Strongly Agree	(5)	4	66.67%
Agree	(4)	2	33.33%
Neutral	(3)	0	0%
Disagree	(2)	0	0%
Strongly Disagree	(1)	0	0%



Return Rate	Mean	STD	Median	College Summary	Mean	STD	Median	Department Summary	Mean	STD	Median
6/11 (54.55%)	4.67	0.52	5.00	12,015	4.09	1.07	4.00	1,180	4.03	1.11	4.00

Western Kentucky University
Fall 2014 Full Term Course Evaluations

Course: GEOL315001 : ENERGY, CLIMATE AND CARBON

Instructor: Fredrick Siewers *

5 - My instructor provides helpful feedback.

Response Option	Weight	Frequency	Percentage
Strongly Agree	(5)	2	33.33%
Agree	(4)	4	66.67%
Neutral	(3)	0	0%
Disagree	(2)	0	0%
Strongly Disagree	(1)	0	0%

Means: Question 4.33; College Summary 4.02; Department Summary 3.99

Return Rate	Mean	STD	Median	College Summary	Mean	STD	Median	Department Summary	Mean	STD	Median
6/11 (54.55%)	4.33	0.52	4.00	12,015	4.02	1.11	4.00	1,180	3.99	1.11	4.00

6 - Overall, my instructor is effective.

Response Option	Weight	Frequency	Percentage
Strongly Agree	(5)	3	50%
Agree	(4)	3	50%
Neutral	(3)	0	0%
Disagree	(2)	0	0%
Strongly Disagree	(1)	0	0%

Means: Question 4.50; College Summary 4.09; Department Summary 4.02

Return Rate	Mean	STD	Median	College Summary	Mean	STD	Median	Department Summary	Mean	STD	Median
6/11 (54.55%)	4.50	0.55	4.50	12,015	4.09	1.07	4.00	1,180	4.02	1.08	4.00

7 - I have learned a lot in this course.

Response Option	Weight	Frequency	Percentage
Strongly Agree	(5)	5	83.33%
Agree	(4)	1	16.67%
Neutral	(3)	0	0%
Disagree	(2)	0	0%
Strongly Disagree	(1)	0	0%

Means: Question 4.83; College Summary 4.05; Department Summary 3.96

Return Rate	Mean	STD	Median	College Summary	Mean	STD	Median	Department Summary	Mean	STD	Median
6/11 (54.55%)	4.83	0.41	5.00	12,015	4.05	1.08	4.00	1,180	3.96	1.11	4.00

8 - My instructor treats me fairly with regard to race, age, sex, religion, national origin, disability, and sexual orientation.

Response Option	Weight	Frequency	Percentage
Strongly Agree	(5)	6	100%
Agree	(4)	0	0%
Neutral	(3)	0	0%
Disagree	(2)	0	0%
Strongly Disagree	(1)	0	0%

Means: Question 5.00; College Summary 4.64; Department Summary 4.62

Return Rate	Mean	STD	Median	College Summary	Mean	STD	Median	Department Summary	Mean	STD	Median
6/11 (54.55%)	5.00	0.00	5.00	12,015	4.64	0.66	5.00	1,180	4.62	0.68	5.00

Course: GEOL315001 : ENERGY, CLIMATE AND CARBON

Instructor: Fredrick Siewers *

9 - My instructor displays enthusiasm when teaching.

Response Option	Weight	Frequency	Percentage
Strongly Agree	(5)	6	100%
Agree	(4)	0	0%
Neutral	(3)	0	0%
Disagree	(2)	0	0%
Strongly Disagree	(1)	0	0%

Return Rate	Mean	STD	Median	College Summary	Mean	STD	Median	Department Summary	Mean	STD	Median
6/11 (54.55%)	5.00	0.00	5.00	1,180	4.29	0.99	5.00	1,180	4.29	0.99	5.00

10 - This course stretched and broadened my views greatly.

Response Option	Weight	Frequency	Percentage
Strongly Agree	(5)	5	83.33%
Agree	(4)	1	16.67%
Neutral	(3)	0	0%
Disagree	(2)	0	0%
Strongly Disagree	(1)	0	0%

Return Rate	Mean	STD	Median	College Summary	Mean	STD	Median	Department Summary	Mean	STD	Median
6/11 (54.55%)	4.83	0.41	5.00	1,180	3.85	1.10	4.00	1,180	3.85	1.10	4.00

11 - I can apply information/skills learned in this course.

Response Option	Weight	Frequency	Percentage
Strongly Agree	(5)	2	33.33%
Agree	(4)	4	66.67%
Neutral	(3)	0	0%
Disagree	(2)	0	0%
Strongly Disagree	(1)	0	0%

Return Rate	Mean	STD	Median	College Summary	Mean	STD	Median	Department Summary	Mean	STD	Median
6/11 (54.55%)	4.33	0.52	4.00	1,180	3.92	1.09	4.00	1,180	3.92	1.09	4.00

12 - I know how I stand relative to others in the class on exams.

Response Option	Weight	Frequency	Percentage
Strongly Agree	(5)	2	33.33%
Agree	(4)	3	50%
Neutral	(3)	1	16.67%
Disagree	(2)	0	0%
Strongly Disagree	(1)	0	0%

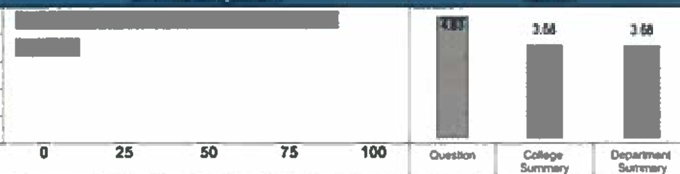
Return Rate	Mean	STD	Median	College Summary	Mean	STD	Median	Department Summary	Mean	STD	Median
6/11 (54.55%)	4.17	0.75	4.00	1,180	3.86	1.10	4.00	1,180	3.86	1.10	4.00

Course: GEOL315001 : ENERGY, CLIMATE AND CARBON

Instructor: Fredrick Siewers *

13 - I would enjoy taking another course from this instructor.

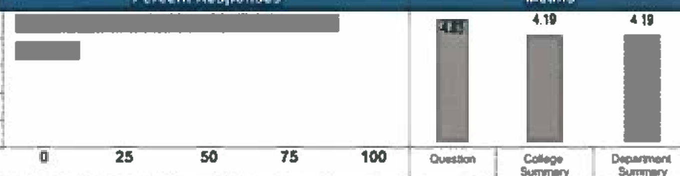
Response Option	Weight	Frequency	Percentage
Strongly Agree	(5)	5	83.33%
Agree	(4)	1	16.67%
Neutral	(3)	0	0%
Disagree	(2)	0	0%
Strongly Disagree	(1)	0	0%



Return Rate	Mean	STD	Median	College Summary	Mean	STD	Median	Department Summary	Mean	STD	Median
6/11 (54.55%)	4.83	0.41	5.00	1,180	3.68	1.31	4.00	1,180	3.68	1.31	4.00

14 - I understand what is expected of me in this course.

Response Option	Weight	Frequency	Percentage
Strongly Agree	(5)	5	83.33%
Agree	(4)	1	16.67%
Neutral	(3)	0	0%
Disagree	(2)	0	0%
Strongly Disagree	(1)	0	0%



Return Rate	Mean	STD	Median	College Summary	Mean	STD	Median	Department Summary	Mean	STD	Median
6/11 (54.55%)	4.83	0.41	5.00	1,180	4.19	0.90	4.00	1,180	4.19	0.90	4.00

15 - Please provide additional feedback:

Return Rate	2/11 (18.18%)

- This is the first time this course is being offered and I believe this is a very interesting topic that should be taught in future semesters.

- I hope this class is offered again. It has been interesting learning of different viewpoints about the issues our world is currently facing. It has been very informative.

Addendum 6.

PowerPoint Presentation from final DOE Project Overview (July 2015)

STEP

CCS Knowledge Sharing and Capacity Building through US DOE Regional Training Centers: The STEP Experience

Sallie E. Greenberg

STEP Director, Associate Director – Advanced Energy Technology Initiative

20 July 2015

ILLINOIS ENERGY NETL

Pioneering Change From the Ground Up

STEP

STEP is supported by the U.S. Department of Energy under Award Number DE-FE0002462 and the Illinois Department of Commerce and Economic Opportunity #09-484002.

ILLINOIS ENERGY NETL

Pioneering Change From the Ground Up

Project Objectives

- Create regional CCS technology training center
- Disseminate CCS technology and information gained through MGSC and other projects
- Provide education and training opportunities
- Work with academic institutions, State and Regional job development programs
- Partner with professional organizations and regional experts
- Leverage existing opportunities and stand-alone training

sequestration.org/step

Scope of Work

- Operation:
  - Initial three year grant period 2009 – 2012
  - No-Cost Extension 2012 – 2015
- Project management and planning
  - Business and financial development
- Creation of sponsorship program
- Development of short courses on CCS technology
- Event implementation and training
- Communication and information dissemination

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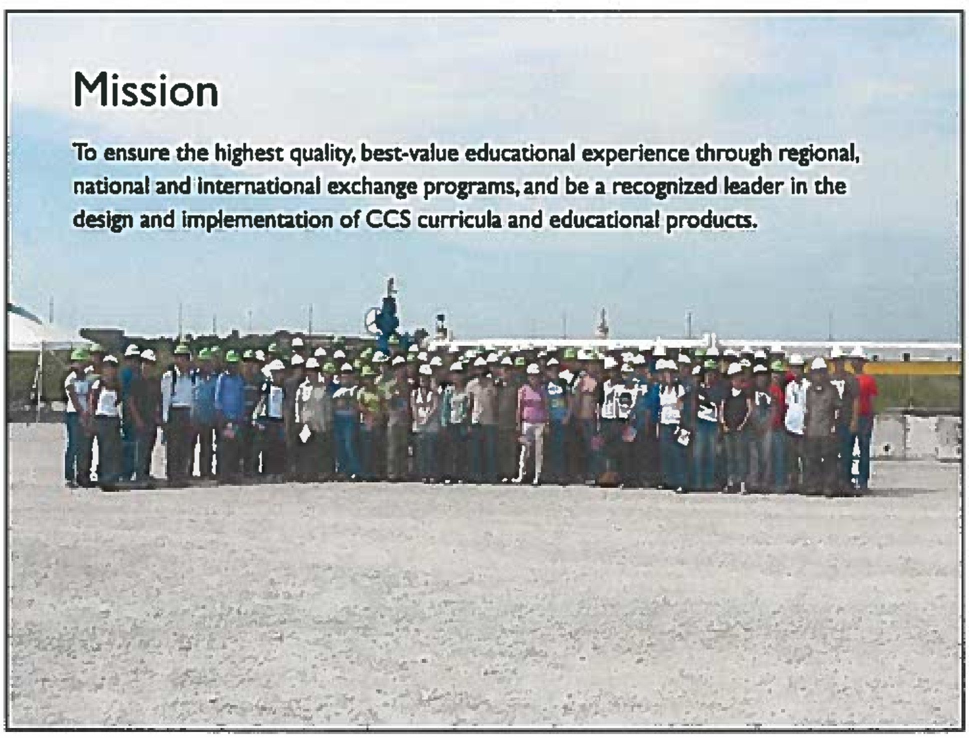
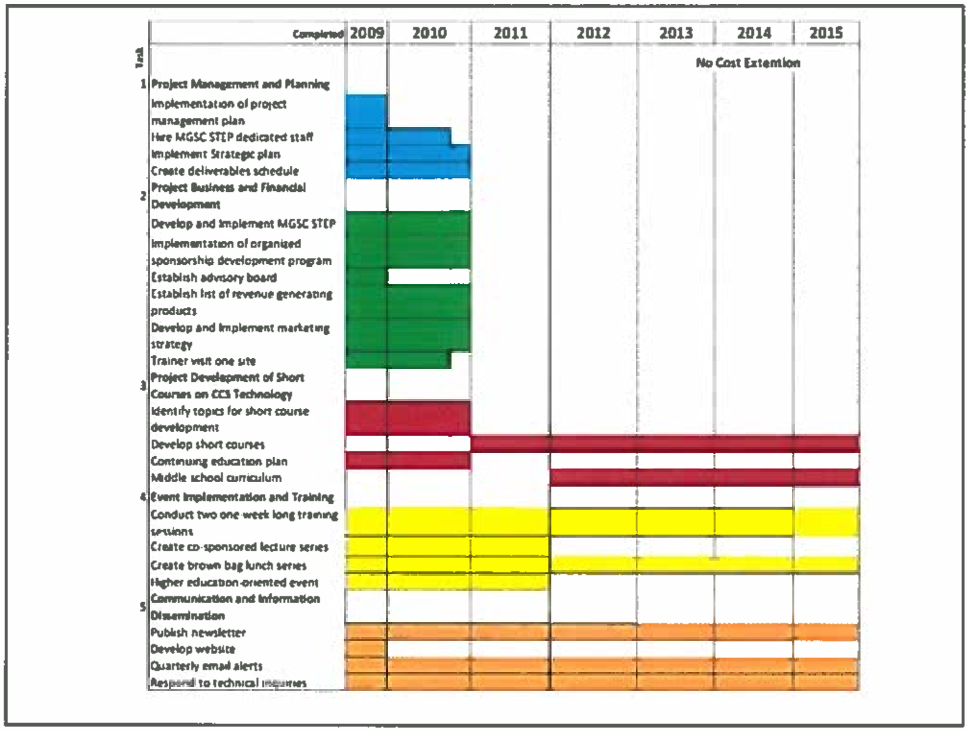
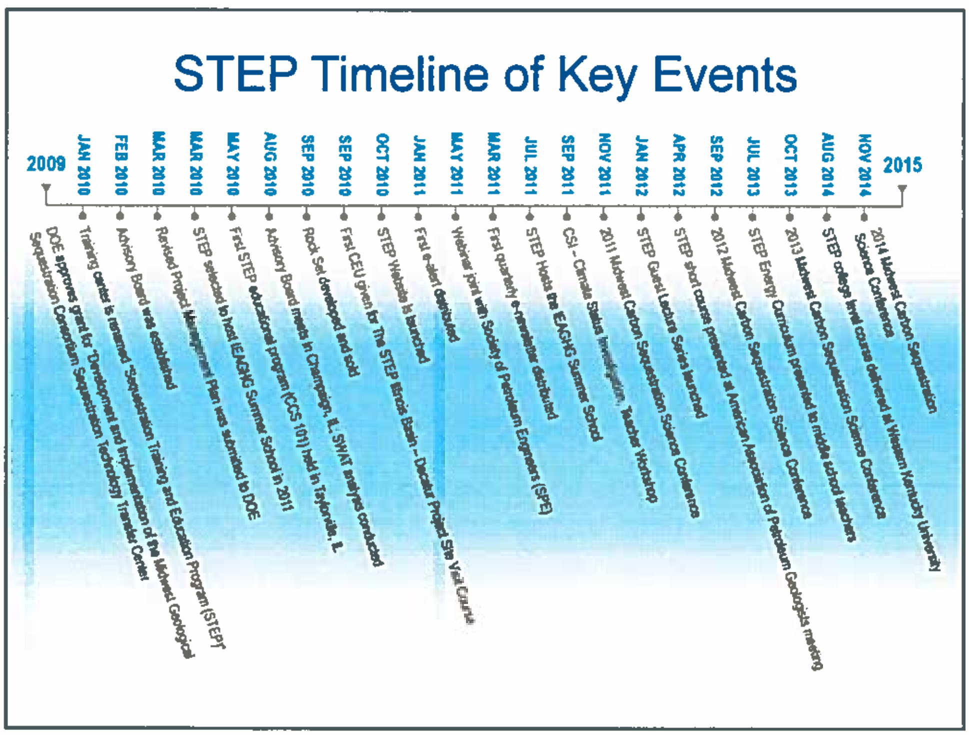
The STEP Vision

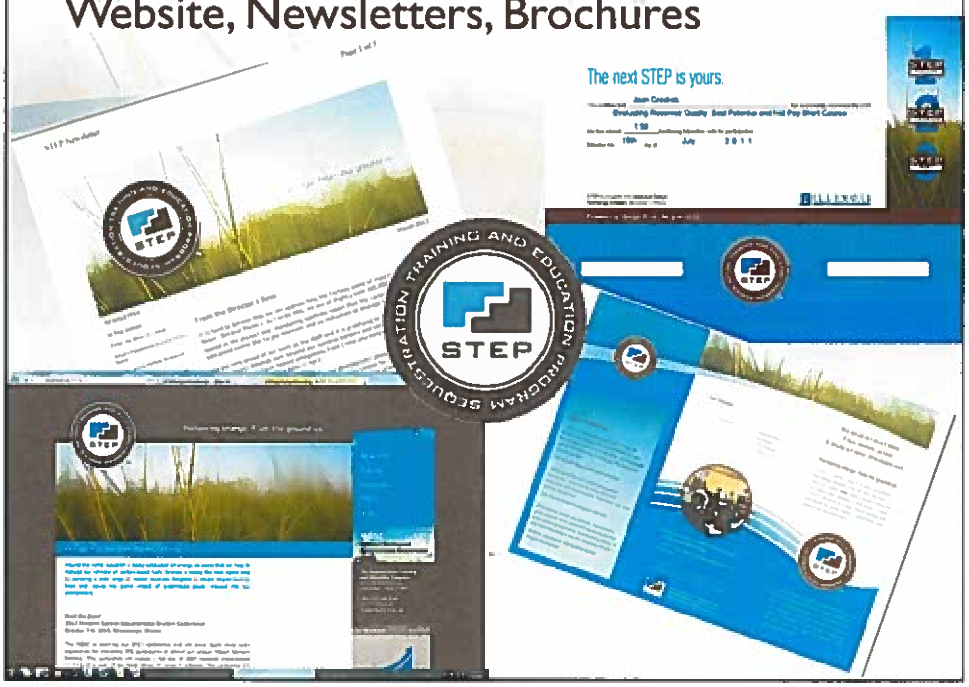

Mission
To ensure the highest quality, best-value educational experience through regional, national and international exchange programs, and be a recognized leader in the design and implementation of CCS curricula and educational products.


Task
Completed
2009
2010
2011
2012
2013
2014
2015
No Cost Extention
1 Project Management and Planning
Implementation of project management plan
Hire MGSC STEP dedicated staff
Implement Strategic plan
Create deliverables schedule
2 Project Business and Financial Development
Develop and implement MGSC STEP
Implementation of organized sponsorship development program
Establish advisory board
Establish list of revenue generating products
Develop and implement marketing strategy
Trainer visit one site
3 Project Development of Short Courses on CCS Technology
Identify topics for short course development
Develop short courses
Continuing education plan
Middle school curriculum
4 Event Implementation and Training
Conduct two one-week long training sessions
Create co-sponsored lecture series
Create brown bag lunch series
Higher education-oriented event
5 Communication and Information Dissemination
Publish newsletter
Develop website
Quarterly email alerts
Respond to technical inquiries


STEP Timeline of Key Events
2009
DOE approves grant for "Development and Implementation of the Midwest Geological Sequestration Consortium Sequestration Technology Transfer Center
JAN 2010
Training center is renamed "Sequestration Training and Education Program (STEP)"
FEB 2010
Advisory Board was established
MAR 2010
Revised Project Management Plan was submitted to DOE
MAR 2010
STEP selected to host IEAGHG Summer School in 2011
MAY 2010
First STEP educational program (CCS 101) held in Taylorville, IL
AUG 2010
Advisory Board meets in Champaign, IL, SWAT analyses conducted
SEP 2010
Rock Set developed and sold
SEP 2010
First CEU given for The STEP Illinois Basin – Decatur Project Site Visit Course
OCT 2010
STEP Website is launched
JAN 2011
First e-alert distributed
MAY 2011
Webinar joint with Society of Petroleum Engineers (SPE)
MAR 2011
First quarterly e-newsletter distributed
JUL 2011
STEP Hosts the IEAGHG Summer School
SEP 2011
CSI – Climate Status Investigation, Teacher Workshop
NOV 2011
2011 Midwest Carbon Sequestration Science Conference
JAN 2012
STEP Guest Lecture Series launched
APR 2012
STEP short course presented at American Association of Petroleum Geologists meeting
SEP 2012
2012 Midwest Carbon Sequestration Science Conference
JUL 2013
STEP Energy Curriculum presented to middle school teachers
OCT 2013
2013 Midwest Carbon Sequestration Science Conference
AUG 2014
STEP college level course delivered at Western Kentucky University
NOV 2014
2014 Midwest Carbon Sequestration Science Conference
2015

Significant Achievements

Website, Newsletters, Brochures



Professional Programs

- STEP/MGSC Development of a Saline Reservoir Carbon Sequestration Demonstration Project Workshop
- STEP Illinois Basin – Decatur Project Site Visit Workshop
- STEP Communications, Projects, Planning & Management for CCS Projects
- Evaluating Reservoir Quality, Seal Potential and Net Pay (sponsored)
- STEP Guest Lecturer Series
- STEP Principles of Geologic Carbon Sequestration
- 2011 to 2014 Midwest Carbon Sequestration Science Conference
  - STEP/USEPA UIC Class VI Workshop
  - STEP Global Developments in CCS Workshop
  - STEP Financial Assurance for UIC Class VI Workshop (contracted)

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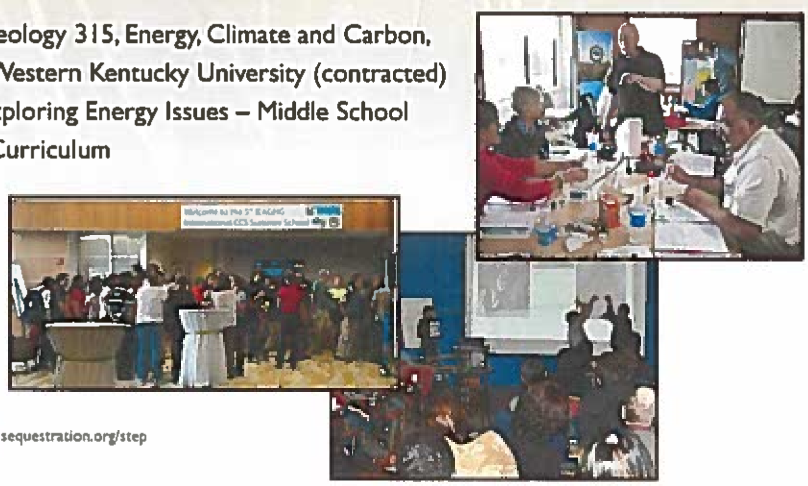
Educational Programs

- 2011 IEAGHG International CCS Summer School Programme (hosted)
- CSI: Climate Status Investigation (sponsored)
- Geology 315, Energy, Climate and Carbon, Western Kentucky University (contracted)
- Exploring Energy Issues – Middle School Curriculum



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Summary of Formal Education Contact

Continuing Education Credits Issued:
- **10,920 hours (1,092 CEU's - 619 people)**

Professional Development Hours (PHD) and/or Continuting Professional Development Units Issued:
- **475 hours (200 people)**

General course work contact (non-CEU, non-PDH, non-CPDU)
- **2,044 hours (508 people)**

Total – 13,439 hours to 1,327 people

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Global Participants
Attending STEP-IBDP Events

STEP Technical Presentations

- Over 140 technical presentations in 12 states and 13 countries reaching over 25,000 people.
  - Academic Institutions
  - Scientific Conferences
  - Public Meetings
  - Research Institutions
  - Governmental Agencies

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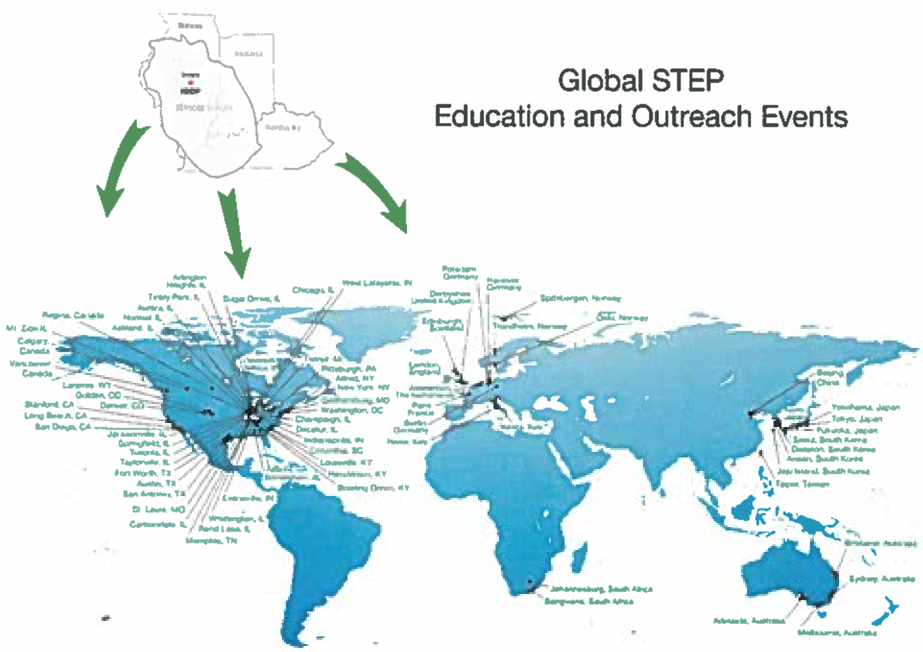
Global STEP
Education and Outreach Events



*All International STEP Activities Were Paid From Non-Contract Funds

Technical Presentations

- The STEP Illinois Basin - Decatur Project Site Visit Course, Decatur, IL, 12-Jun-2015, 4-Jun-2015, 27-Apr-2015, 12-Feb-2015, 2-Nov-2014, 2-Oct-2014, 9-Oct-2013, 17-May-2013, 22-Apr-2013, 22-Feb-2013, 24-Jan-2013, 19-Sep-2012, 5-Jun-2012, 27-Apr-2012, 8-Mar-2012, 12-Jan-2012, 13-Nov-2011, 11-Nov-2011, 9-Nov-2011, 23-Jul-2011, 18-May-2011, 1-Mar-2011, 9-Nov-10, 27-Oct-2010, 22-Oct-2010, 14-Sep-2010
- STEP DEVELOPED: Guest Lecture, Champaign, IL, 4-Jun-2015, 5-Mar-2015, 11-Jul-2014, 11-Apr-2014, 25-Jul-2012, 17-Feb-2012, 13-Jan-2012
- CO2GEONET, Venice, Italy, 13-May-2015
- Indiana Geological Survey/Indiana University, Bloomington, IN, 15-Apr-2015
- 2015 Naturally Illinois Expo, Champaign, IL, 17-Apr-2015
- SECARB Stakeholder Briefing, Atlanta, GA, 12-Mar-2015
- National Science Teachers Association Meeting, Chicago, IL, 12-Mar-2015
- Prairie Council Boy Scouts Merit Badge Seminar , Champaign, IL, 7-Mar-2015
- KIOST, Seoul, Korea, 23-Feb-2015
- Fourth Annual Americas Forum: Call to action on CCUS policy and deployment, Washington, DC, 5-Feb-2015
- STEP DEVELOPED: 2014 Midwest Carbon Sequestration Science Conference, Champaign, IL, 5-Nov-2014
- Chicago Park District Fall Adventure Day, Chicago, IL, 11-Oct-2014
- GHGT 12 Conference, Austin, Texas, 5-Oct-2014

Technical Presentations

- South African Centre for Carbon Capture and Storage (SACCS) Workshop, Bongwana, South Africa, 9-Sep-2014
- STEP DEVELOPED: GEOL 315, Energy, Climate and Carbon, WKY, Bolling Green, KY, Fall 2014
- CCS in Action, Today, Tomorrow and Beyond Conference, Sydney Australia, 31-Aug-2014
- DOE Carbon Storage R&D Project Review Meeting, Pittsburgh, PA, 12-Aug-2014
- International Workshop on Public Education, Training, and Community Outreach for Carbon Capture, Utilization, and Storage, Decatur, IL, 30-Jul-2014
- Workshop on Pre-feasibility Study of Large Scale CCUS Demonstration Project, Beijing, China, 8-Jul-2014
- Stanford Center for Carbon Storage Annual Meeting, Stanford, CA, 22-May-2014
- CSIRO, Brisbane, Australia, 5-May-2014
- University of Melbourne, School of Earth Sciences, Melbourne, Australia, 2-May-2014
- University of Adelaide, Geology Department, Adelaide, Australia 29-Apr-2014
- 3rd International Low Rank Coal Industry Symposium, Melbourne, Australia, 28-Apr-2014
- Energy Council of Illinois Chamber of Commerce, Springfield, IL, 24-Mar-2014
- Illinois Community Environmental Council, Decatur, IL, 6-Mar-2014
- Prairie Council Boy Scouts Merit Badge Seminar, Champaign, IL, 1-Mar-2014

Technical Presentations

- 4th Korea CCS International Congress, Jeju Island, Korea, 24-Feb-2014
- IEAGHG Social Research Network Meeting, Calgary, AB, Canada, 14-Jan-2014
- Mid-term Meeting of the Korean Institute of Ocean Science and Technology, Seoul, Korea, 19-Nov-2013
- Geological Society of America Annual Meeting, Denver, CO, 27-Oct-2013
- SUCCESS Centre Workshop, University of Oslo, Oslo, Norway,24-Oct-2013
- Illinois Science Teachers Association Meeting & Expo, Tinley Park, IL,24-Oct-2013
- STEP DEVELOPED: 2013 Midwest Carbon Sequestration Science Conference, Champaign, IL, 8-Oct-2013
- STEP DEVELOPED: Financial Assurance Workshop, Champaign, IL, 7-Oct-2013
- Department of Thermal Engineering, Tsinghua University, Beijing, China, 26-Sep-2013
- DOE Carbon Storage R&D Project Review Meeting, Pittsburgh, PA, 21-Aug-2013
- Enhanced Oil Recovery Institute (EORI) Laramie, Wyoming, 2-Jul-2013
- STEP DEVELOPED: Teacher Professional Development Workshop, Laramie, Wyoming, 1-Jul-2013
- RECS Program, Birmingham, Alabama, 25-Jun-2013
- IEA International CCS Regulatory Meeting, Paris, France, 18-Jun-2013
- 2013 DCEO Coal Education Conference, Whittington, IL, 18-Jun-2013

Technical Presentations

- IEAGHG Modeling and Risk Networking, Trondheim, Norway, 10-Jun-2013
- US Canada Clean Energy Dialogue, Champaign, IL, 23-Apr-2013
- CO2GeoNet Open Forum, Venice, Italy, 9-Apr-2013
- Robeson School Science Night, Champaign, IL, 27-Mar-2013
- Junior Professional CCS Legal and Regulatory Tutorial Group, WEBINAR, 10-Mar-2013
- 2013 Naturally Illinois Expo, Champaign, IL, 8-Mar-2013
- AAPG GeoScience Technology Workshop, Fort Worth, TX, 5-Feb-2013
- Western Kentucky University, Geology Department Seminar, Bowling Green, KY, 15-Feb-2013
- Research Institute of Innovative Technology for the Earth (RITE) Tokyo, Japan, 22-Jan-2013
- 2012 Taiwan Symposium on CO2 CCUS, Taipei, Taiwan, 25-Nov-2012
- GHGT - 11 Conference, Kyoto, Japan, 18-Nov-2012
- Illinois Science Teachers Association Meeting & Expo, Springfield, IL 1-Nov-2012
- Prairie Research Institute Lighting Mini-Symposium, Champaign, IL, 20-Sep-2012
- STEP DEVELOPED: 2012 Midwest Carbon Sequestration Science Conference, Champaign, IL, 18-Sep-2012
- STEP DEVELOPED: Global Developments in CCS, Champaign, IL, 17-Sep-2012

Technical Presentations

- DOE: Developing the Technologies and Building the Infrastructure of CCUS, Pittsburgh, PA, 21-Aug-2012
- 2012 DCEO Coal Education Conference, Whittington, IL, 19-Jun-2012
- STEP CO-SPONSORED: Principles of Geologic Carbon Sequestration, AAPG Short Course, Long Beach, CA, 21-Apr-2012
- National Association for Research in Science Teaching Meeting, Indianapolis, Indiana, 27-Mar-2012
- 2nd Korea CCS Conference, Jeju, Republic of Korea, 15-Mar-2012
- Naturally Illinois Expo, Champaign, IL, 9-Mar-2012
- AAAS Annual Meeting, Vancouver, BC, Canada, 20-Feb-2012
- Decatur Science Day, Decatur, IL, 14-Feb-2012
- Jonan High School, Fukuoka, Japan, 1-Feb-2012
- Korean Ocean Research & Development Institute, Daejeon, Republic of Korea, 27-Jan-2012
- Korean Ocean Research & Development Institute, Daejeon, Republic of Korea, 26-Jan-2012
- Illinois Legislator Briefing, Washington, DC, 18-Jan-2012
- DOE Carbon Storage Program Infrastructure Annual Review Meeting, Pittsburgh, PA, 15-Nov-2011
- STEP DEVELOPED: Class VI Workshop, Champaign, IL, 7-Nov-2011

Technical Presentations

- STEP DEVELOPED: 2011 Midwest Carbon Sequestration Science Conference, Champaign, IL, 7-Nov-2011
- 2nd South African CCS Week, Johannesburg, South Africa, 24-Oct-2011
- STEP SPONSORED: CSI Climate Status Investigation (Keystone), Decatur, IL, 29-Sep-2011
- STEP DEVELOPED: EPA Wireline Training, Chicago, IL, 1-Aug-2011
- STEP SPONSORED: 2011 IEAGHG Summer School, Champaign, IL 17-Jul-2011
- STEP DEVELOPED: Evaluating Reservoir Quality, Seal Potential and Net Pay Short Course, Champaign, IL, 14-Jul-2011
- 2011 DCEO Coal Education Conference, Whittington, IL, 6-Jun-2011
- FutureGen Public Scoping Meeting, Jacksonville, IL, 9-Jun-2011
- FutureGen Public Scoping Meeting, Tuscola, IL, 8-Jun-2011
- FutureGen Public Scoping Meeting, Taylorville, IL, 7-Jun-2011
- STEP CO-SPONSORED WEBINAR - Society of Petroleum Engineers, Webinar, 16-May-2011
- Cass-Morgan County Farm Bureau Meeting, Ashland, IL, 26-Apr-2011
- MacMurray College, Jacksonville, IL, 19-Apr-2011

Technical Presentations

- University of Illinois, Geology 380 Class Champaign, IL, 18-Apr-2011
- FutureGen Public Meeting, Jacksonville, IL, 30-Mar-2011
- STEP CO-SPONSORED WORKSHOP: Effective Communication, Project Planning and Management Strategies for CCS Projects, Washington, DC, 17-Mar-2011
- Naturally Illinois Expo, Champaign, IL, 12-Mar-2011
- Carbon-Neutral Energy Research (I2CNER), Fukuoka, Japan, 1-Feb-2011
- STEP SPONSORED EVENT: Introduction to Geology - Junior Geologists, Mt. Zion, IL, 25-Jan-2011
- FutureGen Public Meeting, Vandalia, IL, 14-Jan-2011
- FutureGen Public Meeting, Tuscola, IL, 13-Jan-2011
- FutureGen Public Meeting, Alexander, IL, 12-Jan-2011
- FutureGen Public Meeting, Jacksonville, IL, 6-Dec-2010
- Council of Energy Research & Education Leaders (CEREL) Conference, Golden, CO, 4-Nov-2010
- FutureGen Public Meeting, Springfield, IL, 28-Oct-2010
- DOE-NETL Regional Carbon Sequestration Partnerships Annual Review Meeting, Pittsburgh, PA, 5-Oct-2010
- GHGT-10 Conference, Amsterdam, The Netherlands, 19-Sep-2010

Technical Presentations

- 2010 MGSC PAG Meeting, Champaign, IL, 14-Sep-2010
- 2010 IEAGHG Summer School, Svalbard, Norway, 22-Aug-2010
- UK CCSC Academic Research Strategy Meeting, Edinburgh, Scotland, 4-Jul-2010
- 2010 DCEO Coal Education Conference, Rend Lake, IL, 17-Jun-2010
- Taylorville Energy Center, Taylorville, IL 27-May-2010
- Illinois Academy of Sciences Annual Meeting, Decatur, IL, 10-Apr-2010
- Waubonsee Community College Sugar Grove, IL, 8-Apr-2010
- University of Illinois, Geology Class, Champaign, IL, 5-Apr-2010
- Purdue University, Geology Class, West Layfatte, IN, 30-Mar-2010
- University of Illinois, Geology Class, Champaign, IL, 22-Feb-2010

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Academic Presentations – Over 500 Students

- Waubonsee Community College, April 2010, Aurora, IL
- University of Illinois, Champaign, IL, April 2010, April 2011, November 2012
- New Mexico Tech & University of Utah, November 2010
- Kyushu University, Fukuoka, Japan, February 2011
- Jonan High School, Fukuoka, Japan, February 2012
- Western Kentucky University, February, 2013, Fall Semester 2014
- University of Wyoming, July 2013
- Tsinghua University, Beijing, China, September 2013
- Seoul National University, Seoul, South Korea, November 2013
- University of Oslo, Oslo, Norway, October 2013
- University of Adelaide, April 2014
- University of Melbourne, May 2014
- Indiana University, April 2015

Successfully Achieved Project Objectives

- Development of a Branded, Recognized, CCS Education Provider
- Hosted IEAGHG Summer School
- Illinois Basin – Decatur Project Site Visit Workshop (over 600 visitors)
- Developed Fee-based Short Courses, Workshops, Conferences
- Issued 1,091 Continuing Education Units
- 140 Technical Presentations reaching over 25,000 People
- Sponsorship Program - $97,500 to Supplement Program Development
- Global Knowledge Sharing and Capacity Building
- 18 quarterly Newsletters and 25 E-alerts Distributed
- Teacher Training Workshop
- Energy Curriculum for Middle School Learners
- College Level Course Development
- International Guest Lecture Series

STEPping Beyond 2015

- Sustainability
- Leveraging STEP Achievements for MGSC Outreach Activities
- Build on STEP brand and continue to look for new opportunities
- International partnerships

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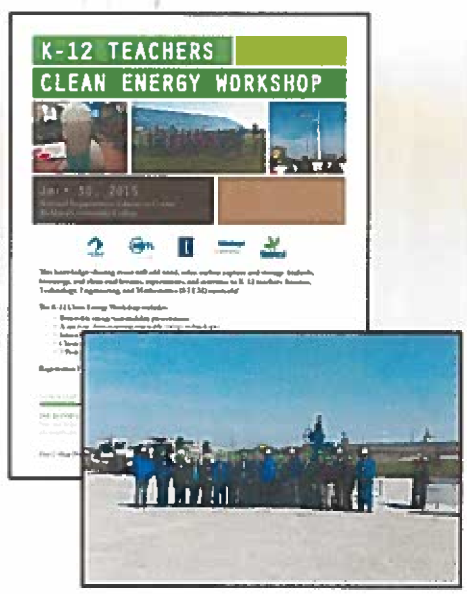
Upcoming Activities

- July 2015:
  - 2nd Annual K-12 Teachers Clean Energy Workshop, National Sequestration Education Center,
- August 2015:
  - EPRI IBDP Site Visit
  - Korean Delegation IBDP Site Visit
- October 2015:
  - Illinois Science Teachers Association (ISTA) Meeting & Expo



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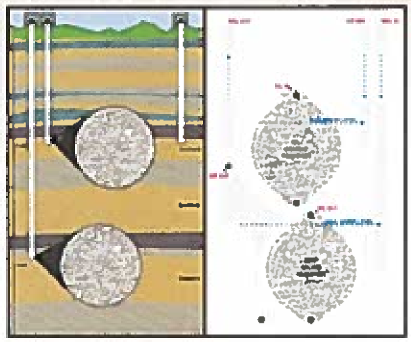
New Products Under Development

- Sequestration model redesign
- Project videos for educational activities
- Policy maker informational materials (English and Chinese)



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Project Management Workshop

- Project Development
- Permitting
- Monitoring
- MVA
- Public Engagement

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STEP up to the challenge: Exploring Energy Issues.

- A supplemental Curriculum for Middle School Learners.
- Aligned with Next Generation Science Standards
- 20 Activity Sets
- Teacher Workshop
- Supplies Kit with materials to conduct activities

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Continued Capacity Building

- STEP Illinois Basin – Decatur Project Site Visit Course
- STEP Guest Lecture Series
- Midwest Carbon Sequestration Science Conference

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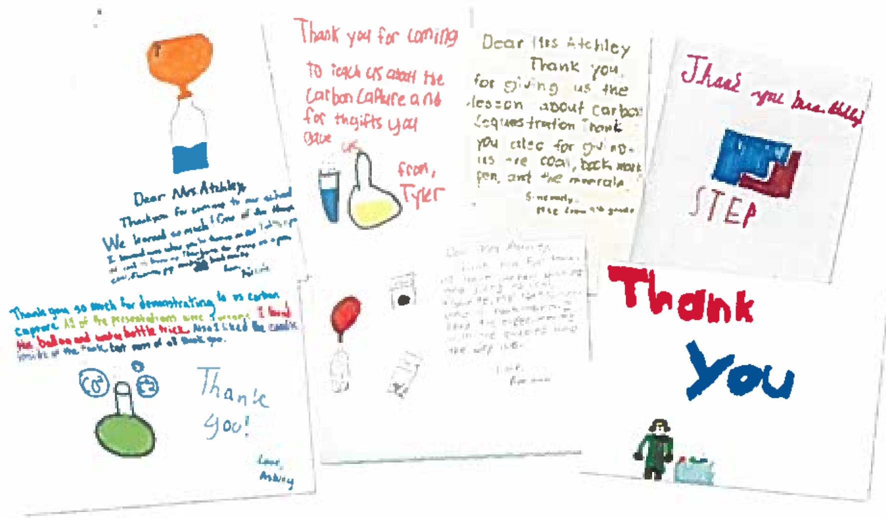
Thank you for making STEP possible



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Questions?

Pioneering Change · From the Ground Up