

WYOMING CARBON CAPTURE AND STORAGE INSTITUTE
Final Scientific/Technical Report

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Teresa Nealon
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University of Wyoming
1000 E. University Avenue
Dept. 3011
Laramie, WY 82071

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ABSTRACT

This report outlines the accomplishments of the Wyoming Carbon Capture and Storage (CCS) Technology Institute (WCTI), including creating a website and online course catalog, sponsoring technology transfer workshops, reaching out to interested parties via news briefs and engaging in marketing activities, i.e., advertising and participating in tradeshow.

We conclude that the success of WCTI was hampered by the lack of a market. Because there were no supporting financial incentives to store carbon, the private sector had no reason to incur the extra expense of training their staff to implement carbon storage.

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EXECUTIVE SUMMARY

The Wyoming CCS Technology Institute (WCTI) project accomplished the following activities during the grant period, November 2009 – June 2014.

- 1) Created a website
The WCTI website provided information about WCTI's online courses and workshops. The website provided an online mechanism through which users could purchase the courses. We also provided R&D information, news links, general information on CCS and specific information on CCS in WY as well as a free online presentation giving a comparison of WY's CO₂-EOR and CCS activities to other large scale North American EOR and CCS projects. Website information has been transferred to UWYO's Carbon Management Institute. The contact is Shanna Dahl 307-766-6810 sdahl2@uwyo.edu.
- 2) Completed all six core courses
 - An Introduction to the CCS Industry
 - CCS Legal and Regulatory Frameworks
 - CCS Public Outreach and Education
 - CCS Site Exploration: Best Practices
 - Underground Injection Control (UIC) and the new Class VI Well
 - Class VI Well Construction, Operation, Monitoring and TestingThe seventh course "Development of CCS Project Plans" was not completed due to time constraints. Most requested copyright releases were given. At least two attempts were made to secure each copyright release.

Although we had interest internationally, we did not have any students for our online courses.

All courses have been given to UWYO's Carbon Management Institute. The contact is Shanna Dahl 307-766-6810 sdahl2@uwyo.edu.
- 3) WCTI-sponsored Technology Transfer Workshops
The WCTI has conducted 200 hours of training and awarded 10 CEUs and 104 PDHs. Nine workshops were slated on the topics of Introduction to CCS, Legal, Public Outreach and Site Characterization. Two workshops were actually held while the remaining 7 were cancelled due to lack of enrollment.
- 4) WCTI Participation at Tradeshows
WCTI had booth space at the following tradeshows. WCTI staff answered questions and handed out course information and materials.
GSA 2010 October 31-November 3, 2010

SPE 2011	October 30-November 2, 2011
Carbon Management Technology Conference	February 7-9, 2012
AAPG 2012	April 22-25, 2012
11th Annual Carbon Capture, Utilization & Sequestration Conference	April 30-May 3, 2012
SPE 2012	October 8-10, 2012

- 5) Advertising
WCTI advertised our online courses and workshops in the following journals and conference catalogs.

Conference	Dates	Location
6th Annual European CCS Conference	February 27-28, 2012	London
CCS Conference Abu Dhabi	March 12-14, 2012	Abu Dhabi
2012 AAPG	April 22-25, 2012	Long Beach
4th Annual CCS Summit Dusseldorf	May 9-10, 2012	Dusseldorf

Journal

Journal of Petroleum Technology	1/4 page ad	Dec 2011 - Jan 2012
Carbon Capture Journal	online	Dec 2011 - Feb 2012

- 6) News Briefs (emails)
A total of 9 emails providing information about online WCTI courses or researcher interviews were created and sent between March 2012 and December 2013. Each email was sent to approx. 1100 recipients, opened by an average of 180 people with 20 of those 180 people clicking on a link to WCTI's website.

We conclude that the success of WCTI was hampered by the lack of a market. Because there were no supporting financial incentives to store carbon, the private sector had no reason to incur the extra expense of training their staff to implement carbon storage.

ACCOMPLISHMENTS

Our mission was to create an Institute that would facilitate the transfer of the technical knowledge required for commercial CCS site development, operations and monitoring via online education and training as well as in-person workshops. We accomplished all of our DOE objectives of creating a core course catalog as well as offering and holding several technology transfer workshops. Appendix A provides milestone status for our grant. We focused on creating a sustainable business from our courses and workshops, charging students \$1000+ and \$750+, respectively. Appendix B provides the cost history for this grant.

Website

A primary accomplishment was to develop a website. The WCTI website provided information about WCTI's online courses and workshops. The website provided an online mechanism through which users could purchase the courses. We also provided R&D information, news links, upcoming events, general information on CCS and specific information on CCS in WY as well as a free online presentation giving a comparison of WY's CO₂-EOR and CCS activities to other large scale North American EOR and CCS projects. Website information has been transferred to UWYO's Carbon Management Institute. The contact is Shanna Dahl 307-766-6810 sdahl2@uwyo.edu.

Core Courses

Our courses focused on the applied engineering and science of geological CCS for site developers, geologists, engineers, information specialists and regulators and were developed by experts in the field. The core course catalog included the following courses and their developers:

- An Introduction to the CCS Industry (Dr. James Myers)
- CCS Legal and Regulatory Frameworks (Kipp Coddington)
- CCS Public Outreach and Education (Lindsay Tollefson)
- CCS Site Exploration: Best Practices (Dr. Geoffrey Thyne and GeoMechanics Technologies)
- Underground Injection Control (UIC) and the new Class VI Well (EPA)
- Class VI Well Construction, Operation, Monitoring and Testing (EPA and DOE)

The syllabi for all courses are given in Appendix C.

The courses were online, asynchronous delivered via the web. Each course had the online presentation to review as well as a combination of formative and summative assessments which were completed online and submitted to the WCTI for evaluation. These assessments allowed the students to show their mastery of the material via short answer, true-false, multiple choice and fill-in-the-blank questions. Students were allowed to take an assessment two times in order to get a passing grade. Some courses had additional assignments and activities to complete for evaluation, too. All activities and assessments had to be completed within three months of beginning the course. Students could earn continuing education units (CEUs) to maintain professional standing or obtain a certification from the WCTI. There were several levels of certification. Completion of three of the online courses resulted in Level 1 certification. Higher levels of certification were obtained for each additional group of three online courses completed.

The WCTI staff had also planned to develop a seventh core course “Development of CCS Project Plans” using an EPA guidance document as the source of course content. This plan was scrapped due to insufficient time to complete course development, peer review, recording, website uploading and final QC.

Every course contained copyrighted graphics and tables from outside sources. WCTI staff made at least two copyright release requests for each copyrighted item. Most copyright release requests were granted from outside sources.

All courses have been given to UWYO’s Carbon Management Institute. The contact is Shanna Dahl 307-766-6810 sdahl2@uwyo.edu.

Technology Transfer Workshops and Presentations

The WCTI created and offered eight technology transfer workshops during regional, national and international professional meetings. They were:

- 1) Petrophysical Characterization of the Madison Formation for Carbon Sequestration Modeling: An Example from Southwestern Wyoming – through the Petroleum Technology Transfer Council (PTTC)
- 2) Moving CCS from Research to Commercial Deployment: Pending Regulations, Public Perceptions and Public Outreach – through PTTC
- 3) CCS Legal and Regulatory Frameworks – through the Society for Petroleum Engineers (SPE) for Houston
- 4) Public Outreach and Education: Preparing CCS Professionals for Engaging with Stakeholders – through SPE for Houston
- 5) CCS Legal and Regulatory Frameworks – through SPE for Denver
- 6) Public Outreach and Education: Preparing CCS Professionals for Engaging with Stakeholders – through SPE for Denver
- 7) Introduction to CCS – through the Carbon Management Conference
- 8) Site Characterization – through the Carbon Management Conference

Note that only the first two workshops were actually held. The remaining six were cancelled due to lack of enrollment. For workshops 3 – 6, SPE had said their membership had expressed interest in these workshops and we were charging the SPE workshop fee of \$750. Additionally, the content experts who developed the online courses in these areas were slated to be the workshop presenters.

Actual dates and workshop presenters can be found in the milestone status in Appendix A.

The WCTI also made several presentations as follows:

- ‘The Emerging CCS Industry: An Overview’ offered at the 2011 Geological Society of America Annual Meeting in Minneapolis, MN and the 2011 Rocky Mountain American Association of Petroleum Geologists Meeting in Cheyenne, WY.
- ‘CCS Overview’ offered at the June 2012 meeting of the Cheyenne Chapter of SPE

For all of these events, the WCTI conducted 200 hours of training and awarded 10 CEUs and 104 PDHs.

Marketing and Advertising

In an effort to boost participation in both our online courses and our in-person workshops, the WCTI engaged in marketing, advertising and other outreach activities.

The WCTI had booth space at the following tradeshow. WCTI staff answered questions and handed out course information and materials.

GSA 2010	October 31-November 3, 2010
SPE 2011	October 30-November 2, 2011
Carbon Management Technology Conference	February 7-9, 2012
AAPG 2012	April 22-25, 2012
11th Annual Carbon Capture, Utilization & Sequestration Conference	April 30-May 3, 2012
SPE 2012	October 8-10, 2012

WCTI advertised our online courses and workshops in the following journals and conference catalogs.

Conference	Dates	Location
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CCS Conference Abu Dhabi	March 12-14, 2012	Abu Dhabi
2012 AAPG	April 22-25, 2012	Long Beach
4th Annual CCS Summit Dusseldorf	May 9-10, 2012	Dusseldorf
Journal		
Journal of Petroleum Technology	1/4 page ad	Dec 2011 - Jan 2012
Carbon Capture Journal	online	Dec 2011 - Feb 2012

The WCTI also sent out news briefs (emails) to all of the contacts we had made at the tradeshow and conferences. A total of 9 emails providing information about online WCTI courses or researcher interviews were created and sent between March 2012 and December 2013. Each email was sent to approx. 1100 recipients, opened by an average of 180 people with 20 of those 180 people clicking on a link to WCTI's website.

This report outlines the major accomplishments and issues for the Wyoming CCS Technology Institute from November 2009 to June 2014 by fiscal year quarters.

FY10

3rd Quarter FY10

Work in 3rd Quarter FY10 of the Wyoming CCS Technology Institute (WCTI) project focused on accomplishing the following five tasks: 1) hiring a temporary Project Manager (PM) while the permanent PM position is being filled; 2) working with various university units to locate space for the WCTI and its staff on campus; 3) defining responsibilities and skills associated with the course developer position, completing the Human Resources hiring paperwork for this position and obtaining its approval by the university administration; 4) continuing to introduce the WCTI to various university groups, and 5) starting development of two online overview courses.

- 1) The primary focus of the Project Director in the second quarter of this project was to advertise the permanent PM position, interview candidate(s), and hire the top candidate. The PM job opportunity, advertised May 3 – June 3, 2010, identified the following responsibilities: 1) coordinate and manage the administrative, financial, academic, and personnel activities of the Institute; 2) develop project goals and objectives and revise as necessary; 3) develop and implement a comprehensive plan for delivery and assessment of project objectives and goals; 4) represent Wyoming, University, Department and Institute at grant functions, meetings and events; 5) collaborate with other project professionals; and 6) manage staff by developing position duties, advertise, interview, hire, train and supervise support staff for the Institute. Five candidates formally applied for the PM position by the closing date of the advertisement. After applying a rubric developed by the Project Director to the candidates' applications, the Project Director identified a top candidate who had double the rubric points as the second candidate. This candidate was interviewed on June 15, 2010, and the Project Director started the University paperwork to permit a formal offer of employment to this candidate. Knowing that the permanent PM would probably not be hired before July 2010, the Project Director extended a temporary offer of employment to an individual with project management and DOE experience. This temporary PM started work on May 12, 2010 on a part-time basis and will be finished when the permanent PM is hired.
- 2) The primary focus of the temporary PM was acquiring space for the Institute on the UW campus. The PM met with the University's space 'czar' to discuss and tour all potential sites for the Institute. Six sites on and off campus were viewed but discarded for various reasons. With the assistance of the space 'czar', the PM was able to identify several

potential spaces in the Geology and Earth Sciences Building. The PM met with the Head of the Geology and Geophysics Dept. to discuss getting space in the Geology and Earth Sciences Building. After some negotiation, the Dept. Head provided two interior offices for three staff members and an office for the PM on the third floor of the Earth Sciences Building. These offices were cleaned out, painted and furnished with Steelcase modular office furniture. Phone and data lines are being installed or upgraded in the interior staff offices. Computers, printers and a portable projector have been ordered for staff.

- 3) The temporary PM wrote a position description for the course developer and collaborated with Human Resources to find an appropriate UW job classification. Because of the UW job classification system, WCTI's course developer is now called an Instructional Technology Education Specialist (ITES). The essential duties of this position are: 1) work collaboratively with faculty and subject experts to provide instructional design consultation to support successful and effective delivery of short courses and technology transfer workshops; 2) develop and execute a protocol to extensively test and refine each course before it is offered for credit; 3) review the comprehensive exam for each course to ensure that it measures a knowledge level consistent among other courses, and 4) provide training on using and integrating instructional and media technologies into learning environments. The salary for the ITES is \$45,000. The position will be advertised from June 15, 2010 until July 7, 2010. Applicants will be evaluated against a rubric developed by the PM from the position description and interview(s) will begin in mid-July.
- 4) Presentations describing the WCTI, its mission and organizational structure were given to: 1) the GIS department (WYGISC); 2) the Outreach School; and 3) the Marketing department. The presentations outlined the structural organization and long-term goals of the WCTI, introduced the project milestone timelines, and presented the preliminary Course Catalog and Workshop Directory. The results of these presentations are: 1) WYGISC will draft a suite of overview and professional classes for an information specialist strand for the Course Catalog by July 2010; 2) further meetings are needed with the Outreach School to investigate possibilities for collaborating with their education and website specialists, using their classrooms and equipment, and modifying their electronic commerce practices to fit the Institute's needs; and 3) a graphic designer in the Marketing department will design a logo for the Institute by end of July 2010.
- 5) The Project Director added a new online overview class to the course catalog entitled, "CCS Site Characterization: Public Outreach and Education". He has started development of this new course as well as "An Introduction to the CCS Industry" class.

4th Quarter FY10

Work in 4th Quarter FY10 of the Wyoming CCS Technology Institute (WCTI) project focused on accomplishing the following five tasks: 1) hiring a permanent Project Manager (PM), a Marketing Specialist, 2 Course Developers (ITES) and a Technology Expert; 2) working with University Vice President to locate space for the Technology Expert; 3) completing two online overview course's syllabi, and 4) developing our initial marketing efforts and the Institute's Marketing Plan.

1) Staff Hiring

The temporary PM, Teresa Nealon, was hired as the permanent PM effective July 1, 2010. The primary focus of the PM has been to hire the WCTI's remaining staff. The ITES position was posted from June 16 through July 29 with responsibilities including: 1) working collaboratively with faculty and subject experts to provide pedagogical and instructional design consultation for adult students to support successful and effective delivery of interactive, web-based training courses and technology transfer workshops; 2) developing and executing a protocol to extensively test and refine each course before it is offered for credit; 3) reviewing the comprehensive exam for each course to ensure that it measures a knowledge level consistent among other courses, and 4) developing work flow procedures and quality control standards to ensure a consistent appearance, style and quality characteristic of a recognizable and reputable brand. There were five applicants who met the minimum HR criteria of an M.S. and 2 years experience. Phone interviews were conducted with all applicants and three applicants were brought in for interviews. The top candidate selected declined, the second candidate's offer was rescinded during negotiations, and the third candidate accepted the offer on September 27, 2010. Jim Verley will start on Monday, October 11.

The Marketing Coordinator position was posted from July 22 through August 25 with responsibilities including: 1) Coordinating marketing and promotional materials for the WCTI, including print publications, advertising, and Web site maintenance and design; 2) designing and producing graphics for marketing publications, advertising, and Web sites, and 3) ensuring that the design of all marketing and promotional materials maintains a consistency with the integrated marketing theme of the Institute and UWYO, as appropriate. Sixteen candidates formally applied by the closing date. One retrenched UW employee was interviewed first but was not chosen due to lack of marketing campaign experience. The remaining 15 candidates were scored with a rubric developed by the PM and 4 were chosen for interviews. One candidate had already accepted a position elsewhere, and 2 candidates withdrew their applications. The final candidate was interviewed; an offer was extended to her and she accepted on September 17. Kerri Smith started at WCTI on September 27.

The Technology Expert position was posted on September 13 with responsibilities including: 1) designing, developing and managing the WCTI's controlled-access website; 2) implementing and maintaining interfaces to all related WCTI systems; 3) designing, developing and managing the infrastructure for delivering the Institute's print and electronic publications, and 4) managing the WCTI's use of the online course delivery system (WyoSakai). As of October 1, there have been no applicants. We will

be extending the time to receive applications through October 18, opening up the job ad in higheredjobs.com, the Chronicle of Higher Education and, if necessary, the Denver Post.

Because Jim Verley has such an extensive background in course assessments and editing and the bottleneck for course development lies with the course developer, the PD and PM decided to hire an additional course developer in place of the two part-time positions – assessment expert and editor. The PM has drafted the Human Resources hiring paperwork for this position and is working to obtain its approval by the University administration.

2) Office Space for the Technology Expert

Although in early summer the Geology Dept. Head provided the WCTI with sufficient office space for staff, it was taken back later in the summer because ‘WCTI hadn’t hired anyone, we only had one job posted, and we didn’t need all that space’. We are currently short one office for the Technology Expert. The PD and PM are working to resolve this issue with University administrators.

3) Course Syllabi

The PD completed two syllabi for Overview Short Course 1 (An Introduction to the CCS Industry) and 5 (CCS Site Characterization: Public Outreach and Education). These were sent to the DOE PM on September 29, thereby meeting our DOE milestone.

4) Initial Marketing Efforts

The Institute has contracted with Greg Oaklief at Oaklief Creative to help develop our logos and Marketing Plan. The WCTI logo will be finalized in October. The WCTI will have a booth at the GSA meeting in Denver in early November. The PM and Marketing Specialist will be manning the booth with regularly scheduled appearances by our technical CCS experts from UWYO.

FY11

1st Quarter FY11

Work in 1st Quarter FY11 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following five tasks: 1) exhibited at the GSA exposition in late October/early November in Denver, CO; 2) held 2 technology transfer workshops in November 2010 in Golden, CO; 3) completed the first draft of the Marketing Plan and publication guide and templates; 4) advertised for 2 positions (a technology expert and a course developer), and 5) continued ongoing course development.

1) Booth at GSA exposition

WCTI exhibited at the 2010 GSA Annual Meeting & Exposition October 31 – November 3, 2010 in Denver, CO. The Marketing Coordinator and Project Manager staffed the booth to explain the Institute and its mission. We had a handout with contact information, our course catalog and announcements for two November 2010 workshops that we were sponsoring. Although GSA attendees are not our primary market, the Director decided it was a good ‘trial run’ for the Institute. We had a few promising leads that resulted from our attendance.

2) Sponsored 2 technology transfer workshops

Workshop entitled ‘Petrophysical Characterization of the Madison Formation for Carbon Sequestration Modeling: An Example from Southwestern Wyoming’ was held at the Colorado School of Mines on November 18, 2010 with 10 attendees. The workshop was taught by Drs. Geoffrey Thyne and Mark Tomasso of the Enhanced Oil Recovery Institute, University of Wyoming. Workshop entitled "Moving CCS from Research to Commercial Deployment: Pending Regulations, Public Perceptions and Public Outreach" was held at the Colorado School of Mines on November 19, 2010 with 6 attendees. The workshop was taught by Dr. James Myers of the WCTI and the Department of Geology and Geophysics, University of Wyoming. Both workshops received positive reviews from attendees.

3) Completed the first draft of the Marketing Plan and the publication guidelines and templates

The Marketing Plan and the publication guidelines and templates were sent to the DOE Program Manager on December 27, 2010.

4) Advertised for two staff positions

The technology expert position was posted mid-September through the end of December 2010 with responsibilities including: 1) designing, developing and managing the WCTI’s controlled-access website; 2) implementing and maintaining interfaces to all related WCTI systems; 3) designing, developing and managing the infrastructure for delivering the Institute’s print and electronic publications, and 4) managing the WCTI’s use of the online course delivery system (WyoSakai). We posted the ad in higheredjobs.com, the Chronicle of Higher Education and the Denver Post. We had three applicants by year

end. We are assessing their qualifications and our decision to move forward with this hire.

The course developer position was posted mid-October to mid-November 2010 with responsibilities including: 1) working collaboratively with faculty and subject experts to provide pedagogical and instructional design consultation for adult students to support successful and effective delivery of interactive, web-based training courses and technology transfer workshops; 2) developing and executing a protocol to extensively test and refine each course before it is offered for credit; 3) reviewing the comprehensive exam for each course to ensure that it measures a knowledge level consistent among other courses, and 4) developing work flow procedures and quality control standards to ensure a consistent appearance, style and quality characteristic of a recognizable and reputable brand. We had two qualified applicants. We are assessing their qualifications and our decision to move forward with this hire.

5) Continued ongoing course development

Overview Short Course 1 (An Introduction to the CCS Industry) was almost completed by year end. The outline for Course 1 was developed and the content fleshed out. The template for course delivery on the Web has been built by the course developer. Text and audio for the course are under development.

2nd Quarter FY11

Work in 2nd Quarter FY11 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following three tasks: 1) hired three outside content experts to develop the 2nd, 3rd and 4th core short courses, 2) outlined clear plan for website, CMS and eCommerce module development and 3) continued 1st short course development.

1) Hired three outside content experts

Per our proposal, WCTI never planned to hire content experts to be on staff. Instead, we planned to tap into the University of Wyoming professors to develop these courses. Unfortunately, none of the professors had the availability or the ability to develop the courses in the short timeframe we required. Therefore, WCTI hired three outside content experts to develop the 2nd, 3rd and 4th core short courses. These experts were chosen from a short proposal including a Statement of Interest, Statement of Qualifications, Price and Delivery Date. They all maximized CCS knowledge and experience in their fields, and minimized price and course development lead time. Individual proposals are available upon request. Lindsey Tollefson of Leverich Solutions was hired to develop “Public Outreach and Education: Preparing CCS Professionals for Dealing with Stakeholders”, Kipp Coddington of Mowrey Meezan Coddington Cloud was hired to develop “CCS Regulatory and Legal Frameworks”, and Terralog Technologies USA, Inc., was hired to develop “CCS Site Characterization: Best Practices”. The first two thirds of Lindsey’s and Kipp’s courses have been developed. Final course completion for these courses is slated for the end of April after internal and external peer reviews. Terralog was put under contract on March 30; their course is not slated for completion until June.

- 2) Outlined clear plan for website, CMS and eCommerce module development
Per our proposal, Drupal is the website software package picked for this grant because of its functionality and excellent support. After much negotiation with the University, WCTI can create its own domain (www.WyomingCarbonStorage.com), use the Adobe eLearning suite as its Course Management System (CMS), but must use CashNet, the open source eCommerce platform used by the University. (As an entity of the University, we were expected to adhere to University protocols which included using the University's website. The current UW website does not have the capability to allow WCTI to provide different levels of subscription giving users access to specific website features and documents as required by our DOE contract. Therefore, we negotiated to use Drupal which provides necessary functionality 'out of the box'.) WCTI's Kerri Smith, the Marketing Coordinator, has demonstrated talent and skill in website development. (As a result, we are changing her position to include web development along with her marketing duties.) We have had to contract with Redfin Solutions to develop the bridge between CashNet and Drupal because the University does not use Drupal and its staff is not required to have knowledge or experience with this software. We are on schedule to be online by May 2011.
- 3) Continued 1st short course development
Time commitment of producing this course has been greater than originally thought. First drafts are mostly complete, but the final editing stages have been time consuming. As with all courses, the editing stages have revealed that the original implementation plan did not anticipate the need for more background material to prepare students for subsequent courses. Consequently, course has grown in scope and breadth which has made achieving original timelines difficult. Please refer to pages 6-7 for a comparison between the original and final course configurations. Now that first drafts of all sections have been finished, it is hoped the final editing stages will proceed at a faster pace. This class is on schedule for completion by mid-April 2011.

3rd Quarter FY11

Work in 3rd Quarter FY11 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following six tasks: 1) conducted a CCS Industry Overview workshop in conjunction with AAPG RMS on June 30th, 2) continued with ongoing website, CMS and eCommerce module development, 3) finalized peer review of online Public Outreach course, 4) hired an outside content expert to finish 1st core short course, 5) continued development of 3rd and 4th core short courses, and 6) reorganized the Institute, laying off our ITES and hiring a Program Technologist.

- 1) Conducted workshop
Workshop entitled 'The Emerging CCS Industry: An Overview' was held after the AAPG RMS meeting in Cheyenne, WY on June 30, 2011 with 2 attendees. The workshop was taught by Dr. James Myers of the WCTI and the Department of Geology and Geophysics, University of Wyoming. The workshop received positive reviews from attendees.

- 2) Continued with ongoing website, CMS and eCommerce module development
Per our original proposal, Drupal is the website software package picked for this project because of its functionality, flexibility and excellent support. After much negotiation with the University, WCTI was allowed to create and host its own domain (www.WyomingCarbonStorage.com), but has been required to use CashNet, the eCommerce platform used by the University. (As an entity of the University, we were expected to adhere to University protocols which included using the University's website. The current UW website system does not have the capability to allow WCTI to provide different levels of subscription giving users access to specific website features and documents as required by our DOE contract. Therefore, we negotiated to use Drupal which provides necessary functionality 'out of the box'.) WCTI's Kerri Smith, the Marketing Coordinator, has demonstrated talent and skill in website development. (As a result, we are changing her position to include web development along with her marketing duties.) Redfin Solutions developed the bridge between CashNet and Drupal (the University does not use Drupal and its staff is not required to have knowledge or experience with this software), and we have successfully tested it. Website content has been reviewed and is currently being revised. We will be online in the 4th quarter FY11.
- 3) Finalized peer review of online Public Outreach course
Audio for the course has been recorded and uploaded to the website along with transcripts and presentations. Peer reviews of the course were conducted by Bob Kane, formerly at DOE HQ, for content and Christi Boggs, instructional designer at the University, for pedagogy. Comments have been incorporated and the course is undergoing final editing and quality review. This course will be posted in the 4th Quarter FY11.
- 4) Hired an outside content expert to finish 1st core short course
Time commitment of producing this course has been greater than originally thought. Therefore, WCTI hired an outside content expert, Steve Carpenter of Advanced Resources International, to finish the 1st core short course. This expert was chosen based on a short proposal - including a Statement of Interest, Statement of Qualifications, Price and Delivery Date - he submitted in response to our call for content experts. He maximized CCS knowledge and experience in the field, and minimized price and course development lead time. His proposal is available upon request. Once we receive the course, audio will be recorded and uploaded to the website with transcripts and presentations. A peer review will be conducted and final edits and quality checks made. Our goal is to have this class posted in early October 2011.
- 5) Continued development of 3rd and 4th core short courses
Kipp Coddington of Mowrey Meezan Coddington Cloud has completed the "CCS Regulatory and Legal Frameworks" course. The course is currently under internal review and audio is being recorded. Terralog Technologies USA, Inc., continues to develop "CCS Site Characterization: Best Practices". They have submitted 3 of 8 modules. The transcripts for this course are being developed by Dr. Geoffrey Thyne of the Enhanced Oil Recovery Institute, University of Wyoming.

- 6) Reorganized the Institute, laying off our ITES and hiring a Program Technologist
Our original Institute model as outlined in our proposal was to tap into the University of Wyoming professors to develop these courses. Unfortunately, none of the professors had the availability or the ability to develop the courses in the short timeframe we required. Consequently, WCTI had to subcontract with content experts. Thus, the needs of the WCTI staff changed from a pedagogical focus to a more technical focus. We needed someone who could work with material developed by the content experts, answer student questions and grade student assessments. We also needed a technical person to develop technical content for the website and make technical presentations to perspective students. As a result, we laid off our Instructional Technology Education Specialist (ITES) and hired a Program Technologist, Erin Stoesz, who has a masters in Geology, teaching experience at the college level and industry experience with CCS.

4th Quarter FY11

Work in 4th Quarter FY11 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following six major tasks: 1) opened the new WCTI website to the public on August 10, 2011, 2) posted the 2nd core online course in the WCTI curriculum “CCS Public Outreach and Education” to the website on August 10, 2011, 3) made a presentation in China entitled “A Comparison of Wyoming’s CO₂-EOR and CCS Activities to other Large-Scale North American EOR and CCS Projects” on August 24, 2011, 4) continued to make in-house revisions of the 1st, 3rd and 4th core online courses, 5) developed short course “The Emerging CCS Industry: An Overview” for delivery at GSA National Meeting in Minneapolis in October, and 6) cancelled two short courses offered through SPE due to lack of enrollment.

- 1) Opened the new WCTI website to the public
The new WCTI website (www.WyomingCarbonStorage.com) opened to the public on August 10, 2011 with increased functionality, links and information. The website was created with Drupal software, our eCommerce platform CashNet, and the CMS. Thus, we are now ready to have students pay for classes as they are made available on the website.
- 2) Posted the 2nd online core short course in the WCTI curriculum
The 2nd core online course in the WCTI curriculum “CCS Public Outreach and Education” was posted to the website on August 10, 2011. It consists of eight modules, each with accompanying audio and text, required reading assignments and assessments. Additionally, there is a final summative assessment.
- 3) Made a presentation in China
WCTI Director, Jimm Myers, made a presentation in Beijing, China entitled “A Comparison of Wyoming’s CO₂-EOR and CCS Activities to other Large-Scale North American EOR and CCS Projects” on August 24, 2011. This talk was given at the 2nd Annual Global Carbon Capture Utilization & Storage Summit (GCCUSS). There were approximately 150 attendees. The talk was well received with follow up questions and comments from the audience.

- 4) Continued to make in-house revisions of the 1st, 3rd and 4th core online courses
During the peer review of the 1st core online short course, the WCTI Manager determined that a rework of the course was necessary. She will perform this rework herself and then send out for internal peer review, before the external peer review occurs toward the end of October. The WCTI has conducted an extensive internal peer review of the 3rd core online short course, sent a request for revisions to Kipp and are currently awaiting his revision of that course. Once we receive it, we can begin external peer review. Finally, the WCTI will begin 4th core online course reorganization in late October and begin the internal peer review after that is completed.
- 5) Developed short course for GSA National Meeting
WCTI Director and Program Technologist developed an 8 hour short course entitled “The Emerging CCS Industry: An Overview” for delivery at GSA’s National Meeting in Minneapolis on October 9, 2011. Dr. Myers will present the introduction and legal sections, and Erin Stoesz will present site characterization and public outreach. There are currently 7 people signed up for the course.
- 6) Cancelled two short courses offered through SPE due to lack of enrollment
The WCTI was contracted by the Society of Petroleum Engineers to deliver two one-day-long workshops at the SPE Institute in Houston. “CCS Legal and Regulatory Frameworks” was slated for September 7, 2011, and to be taught by Kipp Coddington. “Public Outreach and Education: Preparing CCS Professionals for Engaging with Stakeholders” was slated for September 8, 2011 and to be taught by Lindsey Tollefson. Essentially, these courses were to be based on our online courses which were developed by these two content experts. Unfortunately, Lindsey’s class had no registrants; Kipp had one. The classes were cancelled due to lack of enrollment.

FY12

1st Quarter FY12

Work in 1st Quarter FY12 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following six major tasks: 1) offered short course at GSA National Meeting in Minneapolis on October 9, 2011, 2) exhibited at the Society of Petroleum Engineer's Annual Technical Conference and Exhibition in Denver October 30 – November 2, 2011, 3) cancelled two short courses offered at SPE ACTE due to lack of enrollment, 4) presented and exhibited at the Annual DOE Carbon Storage Program Infrastructure Meeting in Pittsburgh November 15-17, 2011, 5) attended the CO2 Conference in Houston December 5-6, 2011, and 6) continued to make in-house revisions of the 1st, 3rd and 4th core online courses.

- 1) Offered short course at GSA National Meeting in Minneapolis on October 9, 2011
WCTI Director and Program Technologist developed and taught an 8 hour short course entitled "The Emerging CCS Industry: An Overview" at GSA's National Meeting in Minneapolis on October 9, 2011. Dr. Myers presented the introduction and legal sections, and Erin Stoesz presented site characterization and public outreach. There were 10 attendees at the course.
- 2) Exhibited at the Society of Petroleum Engineer's Annual Technical Conference and Exhibition in Denver October 30 – November 2, 2011
WCTI exhibited at the Society of Petroleum Engineer's Annual Technical Conference and Exhibition (SPE's ATCE) in Denver October 30 – November 2, 2011. The Marketing Coordinator and Manager staffed the booth to explain the Institute and its mission. We had several pieces of marketing literature on hand to giveaway. We had a few promising leads that resulted from our attendance.
- 3) Cancelled two short courses offered at SPE ACTE due to lack of enrollment
The WCTI was contracted by the Society of Petroleum Engineers to deliver two one-day-long workshops at the SPE ATCE in Denver. "CCS Legal and Regulatory Frameworks" was slated for October 30, 2011, and to be taught by Kipp Coddington. "Public Outreach and Education: Preparing CCS Professionals for Engaging with Stakeholders" was slated for November 3, 2011 and to be taught by Lindsey Tollefson. Essentially, these courses were to be based on our online courses which were developed by these two content experts. Unfortunately, Lindsey's class had no registrants; Kipp had four, although he decided that was an insufficient number for him to hold the class. The classes were cancelled due to lack of enrollment.
- 4) Presented and exhibited at the Annual DOE Carbon Storage Program Infrastructure Meeting in Pittsburgh November 15-17, 2011
The WCTI Manager presented a status update on the work done to date by the WCTI at the Annual DOE Carbon Storage Program Infrastructure Meeting in Pittsburgh on November 15, 2011. The WCTI Manager also staffed an Institute booth and answered questions during the evening reception on November 15 and 16 with all marketing materials available for handout.

- 5) Attended the CO2 Conference in Houston December 5-6, 2011
The WCTI Manager attended the CO2 Conference in Houston December 5-6, 2011 in order to keep abreast of the oil and gas company perspective on CCS as well as find content experts for new classes. Darrick Eugene, General Counsel of the Texas CCS Association, is a potential content expert for legal, UIC and permitting courses.
- 6) Continued to make in-house revisions of the 1st, 3rd and 4th core online courses
The 1st core short course was recorded, and peer reviewed. The WCTI web master is finalizing the upload of the course, reading assignments and assessments. The WCTI has conducted an extensive internal peer review of the 3rd core online short course and sent a request for revisions to Kipp. Since Kipp was too busy to complete the course, the WCTI has hired Darrick Eugene to address all outstanding work for the course, including addressing peer reviewer comments and developing assessments. Finally, the WCTI is still reworking the 4th online short course.

2nd Quarter FY12

Work in 2nd Quarter FY12 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following seven major tasks: 1) posted the 1st core online course (3rd overall) in the WCTI curriculum “An Introduction to the CCS Industry” to the website on January 10, 2012, 2) posted the 2nd core online course (4th overall) in the WCTI curriculum “CCS Legal and Regulatory Frameworks” to the website on January 20, 2012, 3) exhibited at the Carbon Management Conference in Orlando, FL February 7-9, 2012, 4) ran ads in Journal of Petroleum Technology in January issue (print), Carbon Capture Journal in January/February issue (print and online), and on Carbon Management Conference website advertising two day-long workshops to be held in Orlando, FL in conjunction with the conference, 5) cancelled two workshops offered in conjunction with the Carbon Management Conference due to lack of enrollment, 6) attended an 8-hour consultative sales training course, and 7) continued to make in-house revisions of the 4th and 5th core online courses.

- 1) Posted the 1st core online course (3rd overall) in the WCTI curriculum “An Introduction to the CCS Industry” to the website on January 10, 2012
It consists of seven modules, each with accompanying audio and text, required reading assignments and assessments. Additionally, there is a final summative assessment.
- 2) Posted the 2nd core online course (4th overall) in the WCTI curriculum “CCS Legal and Regulatory Frameworks” to the website on January 20, 2012
It consists of four modules, each with accompanying audio and text, required reading assignments, exercises and assessments. There is no final summative assessment, but the exercises involve synthesizing material across several modules.
- 3) Exhibited at the Carbon Management Conference in Orlando, FL February 7-9, 2012
The WCTI Director and Marketing Manager staffed an Institute booth and answered questions during this conference with all marketing materials available for handout.

- 4) Ran ads in Journal of Petroleum Technology in January issue (print), Carbon Capture Journal in January/February issue (print and online), and on Carbon Management Conference website advertising two day-long workshops to be held in Orlando, FL in conjunction with the conference
“Introduction to CCS” was slated for February 6, 2012, and to be taught by Erin Stoesz and Geoffrey Thyne. “Site Characterization” was slated for February 10, 2012 and to be taught by Erin Campbell-Stone and Ranie Lynds. We charged \$750/workshop.
- 5) Cancelled two workshops offered in conjunction with the Carbon Management Conference due to lack of enrollment
There were no registrants for either workshop.
- 6) Attended an 8-hour consultative sales training course
In an effort to help us gain some knowledge and skills regarding consultative sales which treats sales as a process and not an event, Teresa, Kerri and Erin attended a day-long sales training course offered by the Vice President of the Wyoming Technology Business Center. We plan to use these techniques at several upcoming tradeshow not only to try to obtain students, but also to assess what the market needs are so we can make any necessary business plan corrections.
- 7) Continued to make in-house revisions of the 4th and 5th core online courses
The WCTI is still reworking the 4th online short course (Site Characterization) using a technical expert from UW/Enhanced Oil Recovery Institute who is reorganizing the information and writing the text for the audio portion of the course. The Manager obtained approval from the EPA to use their online course as the basis for the WCTI 5th core online course (UIC). The Manager reworked the course and contracted again with Darrick Eugene to create assessments, exercises, glossary, FAQ, etc. for this course. Both courses are slated to be online in early summer 2012.

3rd Quarter FY12

Work in 3rd Quarter FY12 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following two major tasks: 1) exhibited at the Carbon Capture Utilization and Storage Conference in Pittsburgh, PA April 30 – May 3, 2012, and 2) continued to make in-house revisions of the 4th and 5th core online courses.

- 1) Exhibited at the Carbon Capture Utilization and Storage Conference in Pittsburgh, PA April 30 – May 3, 2012
The WCTI Director and Marketing Manager staffed an Institute booth and answered questions during this conference with all marketing materials available for handout.
- 2) Continued to make in-house revisions of the 4th and 5th core online courses
The WCTI is still reworking the 4th online short course (Site Characterization) using a technical expert from UW/Enhanced Oil Recovery Institute who is reorganizing the information and writing the text for the audio portion of the course. The Manager

obtained approval from the EPA to use their online course as the basis for the WCTI 5th core online course (UIC). The Manager reworked the course, contracted with Darrick Eugene to create assessments, exercises, glossary, FAQ, etc. for this course, and contracted with Bob Van Voorhees for an extensive peer review. Both courses are slated to be online in summer 2012.

4th Quarter FY12

Work in 4th Quarter FY12 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following four major tasks: 1) posted the 5th core online course (4th overall) in the WCTI curriculum “Underground Injection Control (UIC) and the new Class VI Well” to the website on August 6, 2012; 2) exhibited at the DOE Carbon Storage R&D Project Review Meeting in Pittsburgh, PA August 21-23, 2012; 3) posted the 4th core online course (5th overall) in the WCTI curriculum “CCS Site Exploration: Best Practices” to the website on September 28, 2012; and 4) started to investigate developing a CCS workshop and field trip for regulators to be held in WY, spring 2013.

- 1) Posted the 5th core online course (4th overall) in the WCTI curriculum “Underground Injection Control (UIC) and the new Class VI Well” to the website on August 6, 2012. It consists of 15 modules, each with accompanying audio and text, required reading assignments and assessments. Additionally, there is a final summative assessment.
- 2) Exhibited at the *DOE Carbon Storage R&D Project Review Meeting in Pittsburgh, PA* August 21-23, 2012. The Program Technologist attended the meeting and staffed an Institute table where she answered attendees’ questions and brought all marketing materials for handout.
- 3) Posted the 4th core online course (5th overall) in the WCTI curriculum “CCS Site Exploration: Best Practices” to the website on September 28, 2012. It consists of eight modules, each with accompanying audio and text, required reading assignments and assessments.
- 4) Started to investigate developing a CCS workshop and field trip for regulators to be held in WY, spring 2013.

The WCTI Director was contacted by Dave Hill of the Railroad Commission of Texas inquiring about whether we would be interested in holding a one-day workshop on CCUS for regulators with an optional field trip. Dave’s thinking is that air quality regulators will want to understand the basic ins and outs of the process and why it’s a good idea, relevant regs, economics, etc. This audience will be seeing CCUS in the next couple of years as power plants apply for permits. The Director asked Steve Melzer and Geoff Thyne, two experts in CCUS, to draft an agenda and inquire with WY oil companies about the possibility for a field trip.

FY13

1st Quarter FY13

Work in 1st Quarter FY13 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following four major tasks: 1) exhibited at the Society of Petroleum Engineers' Annual Technical Conference and Exposition in San Antonio, TX October 8-10, 2012; 2) could not find interested attendees or instructors for a CCS workshop and field trip for regulators to be held in WY, spring 2013; 3) started development of the last course in the WCTI catalog "Class VI Well Construction, Operation, Monitoring and Testing"; and 4) started discussion with Dr. Kaszuba at UWYO about including some WCTI modules in his Spring 2013 Geochemical Modeling class.

- 1) Exhibited at the *Society of Petroleum Engineers' Annual Technical Conference and Exposition in San Antonio, TX* October 8-10, 2012
The Marketing Coordinator and the Program Technologist attended the meeting and staffed an Institute booth where they attempted to sign students up for our online courses and brought all marketing materials for handout.
- 2) Could not find interested attendees or instructors for a CCS workshop and field trip for regulators to be held in WY, spring 2013
The WCTI Director was contacted by Dave Hill of the Railroad Commission of Texas inquiring about whether we would be interested in holding a one-day workshop on CCUS for regulators with an optional field trip. The Director checked with a contact at EPA Region 8 to gauge interest from regulators in taking such a course. The response was not now due to workloads and no permits including CCS technologies. Furthermore, Steve Melzer and Geoff Thyne, two experts in CCUS, were not interested in developing and teaching the course for \$10,000.
- 3) Started development of the last course in the WCTI catalog "Class VI Well Construction, Operation, Monitoring and Testing"
The Director and the Program Technologist have started course development of the well construction (from EPA guidance documents) and monitoring and testing (from DOE Best Practices documents) respectively. The Director is trying to find an expert to develop the operation modules of the course from one of the DOE RCSP projects.
- 4) Started discussion with Dr. Kaszuba at UWYO about including some WCTI modules in his Spring 2013 Geochemical Modeling class
The Director and the Program Technologist started discussion with Dr. Kaszuba at UWYO's Geology Dept. about including some WCTI modules in his geochemical modeling class. Our goal is to get feedback from students about the organization, depth, breadth and quality of the material presented by the WCTI.

2nd Quarter FY13

Work in 2nd Quarter FY13 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following four major tasks: 1) continued development of the last course in the WCTI catalog “Class VI Well Construction, Operation, Monitoring and Testing”; 2) continued to request copyright releases for appropriate graphics and photos in completed classes; 3) provided 4 WCTI modules for inclusion in Dr. Kaszuba’s UWYO Spring 2013 Geochemical Modeling class; and 4) executed a contract with Kipp Coddington to update the legal and regulatory course – WCTI 102.

- 1) Continued development of the last course in the WCTI catalog “Class VI Well Construction, Operation, Monitoring and Testing”
The Director and the Program Technologist have drafted the course modules for well construction (from EPA guidance documents) and monitoring and testing (from DOE Best Practices documents) respectively. Course is under review internally. Next steps include final outside peer review and audio recording.
- 2) Continued to request copyright releases for appropriate graphics and photos in completed classes
- 3) Provided 4 WCTI modules for inclusion in Dr. Kaszuba’s UWYO Spring 2013 Geochemical Modeling class
The WCTI collaborated with Dr. Kaszuba at UWYO to incorporate 4 modules (1 from our Introduction to CCS course and 3 from our CCS Site Exploration course) into his Spring 2013 Geochemical Modeling class. The goal is to use the WCTI modules to provide background information that will help students better understand a paper about the Weyburn CCS project, and from which they will be using data to do a geochemical modeling exercise.
- 4) Executed a contract with Kipp Coddington to update the legal and regulatory course – WCTI 102
As the legal and regulatory realm of CCS and CCUS has been very volatile, the WCTI wanted to update WCTI 102 to reflect the latest developments in the field.

3rd Quarter FY13

Work in 3rd Quarter FY13 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following two major tasks: 1) continued development of the last course in the WCTI catalog “Class VI Well Construction, Operation, Monitoring and Testing”; and 2) continued to request copyright releases for appropriate graphics and photos in completed classes.

- 1) Continued development of the last course in the WCTI catalog “Class VI Well Construction, Operation, Monitoring and Testing”

The course was reviewed externally* by Bob Kane and a few minor edits were made to course content. Course is currently being audio recorded and uploaded to the website.

*Review was made with the following requests:

- i. review and comment on the appropriateness of the syllabus, slides and assessments for excellence in providing practical content and skills to students in construction, operation, monitoring and testing
 - ii. identify areas of weakness or omissions in the topical area(s) with specific and detailed suggestions about practical and creative ways to address such deficiencies
 - iii. identify specific opportunities to synthesize cutting-edge research from academia, industry field results and the latest regulatory information from various government agencies within course/workshop topical area(s).
- 2) Continued to request copyright releases for appropriate graphics and photos in completed classes

4th Quarter FY13

Work in 4th Quarter FY13 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following four major tasks: 1) received revisions to WCTI 102 “CCS Legal and Regulatory Frameworks” course and made updates; 2) exhibited at the DOE Carbon Storage R&D Project Review Meeting in Pittsburgh, PA August 20-22, 2013; 3) **continued** development of the last course in the WCTI catalog WCTI 106 “Class VI Well Construction, Operation, Monitoring and Testing”; and 4) continued to request copyright releases for appropriate graphics and photos in completed classes.

- 1) Received revisions to WCTI 102 “CCS Legal and Regulatory Frameworks” course and made updates

As the legal and regulatory realm of CCS and CCUS has been very volatile, the WCTI wanted to update WCTI 102 to reflect the latest developments in the field. Kipp Coddington completed revisions of the original course this quarter. Edits have been made to the course and the revised slides have been recorded.

- 2) Exhibited at the DOE Carbon Storage R&D Project Review Meeting in Pittsburgh, PA August 20-22, 2013

The Marketing Coordinator attended the meeting and staffed an Institute table where she answered attendees’ questions and brought all marketing materials for handout.

- 3) Continued development of the last course in the WCTI catalog WCTI 106 “Class VI Well Construction, Operation, Monitoring and Testing”

The quality of the first recording of this course was not up to quality standards, so the Director re-recorded it. New audio recordings are currently being reviewed and uploaded to the website.

- 4) Continued to request copyright releases for appropriate graphics and photos in completed classes

FY 14

1st Quarter FY14

Work in 1st Quarter FY14 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following five major tasks: 1) posted the 6th core online course in the WCTI curriculum - WCTI 106 “Class VI Well Construction, Operation, Monitoring and Testing” - to the website on October 24, 2013; 2) started development of the final WCTI course, WCTI 107 “Development of CCS Project Plans”; 3) started uploading revisions to the website for the WCTI 102 “CCS Legal and Regulatory Frameworks” course ; 4) conducted an interview with subject expert, Dr. Ye Zhang - Associate Professor of Geology & Geophysics; and 5) continued to request copyright releases for appropriate graphics and photos in completed classes.

- 1) Posted the 6th core online course in the WCTI curriculum - WCTI 106 “Class VI Well Construction, Operation, Monitoring and Testing” - to the website on October 24, 2013

It consists of nine modules, each with accompanying audio and text, suggested reading assignments and assessments.

- 2) Started development of the final WCTI course, WCTI 107 “Development of CCS Project Plans”

Since WCTI staff has time to develop another class, we have decided to create WCTI 107 “Development of CCS Project Plans” using an EPA guidance document as the source of course content. The course will have 7 modules covering the AOR and Corrective Action Plan, Testing and Monitoring Plan, Injection Well Plugging Plan, PISC and Site Closure Plan and Emergency and Remedical Response Plan. We will develop audio and text, suggested reading assignments and assessments for the modules, and we plan to have the course uploaded by June 30, 2014.

- 3) Started uploading revisions to the website for WCTI 102 “CCS Legal and Regulatory Frameworks” course

The process of uploading 27 revised audio and slides for this course was started in this quarter. Unfortunately, due to the holidays, this action item will not be completed until January.

- 4) Conducted an interview with subject expert, Dr. Ye Zhang - Associate Professor of Geology & Geophysics

The Program Technologist interviewed Dr. Ye Zhang, Associate Professor of Geology & Geophysics about how her research contributes to the development of accurate and efficient models for CO₂ storage and CO₂-EOR. This interview will be uploaded to the website in early January.

- 5) Continued to request copyright releases for appropriate graphics and photos in completed classes

2nd Quarter FY14

Work in 2nd Quarter FY14 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following three major tasks: 1) continued development of the final WCTI course, WCTI 107 “Development of CCS Project Plans”; 2) continued uploading revisions to the website for the WCTI 102 “CCS Legal and Regulatory Frameworks” course; and 3) continued to request copyright releases for appropriate graphics and photos in completed classes.

- 1) Continued development of the final WCTI course, WCTI 107 “Development of CCS Project Plans”

The WCTI 107 “Development of CCS Project Plans” course using an EPA guidance document as the source of course content is ongoing. The course will have 7 modules covering the AOR and Corrective Action Plan, Testing and Monitoring Plan, Injection Well Plugging Plan, PISC and Site Closure Plan and Emergency and Remedial Response Plan. We will develop audio and text, suggested reading assignments and assessments for the modules, and we plan to have the course uploaded by June 30, 2014.

- 2) Continued uploading revisions to the website for WCTI 102 “CCS Legal and Regulatory Frameworks” course

All revisions have been uploaded except for the completely rerecorded module 4. We are experiencing unexplained technical difficulties which are causing the audio to play too fast. We will continue to work to remedy the issue.

- 3) Continued to request copyright releases for appropriate graphics and photos in completed classes

3rd Quarter FY14

Work in 3rd Quarter FY14 of the Wyoming CCS Technology Institute (WCTI) project accomplished the following four major tasks: 1) scrapped development of the final WCTI course, WCTI 107 “Development of CCS Project Plans”; 2) completed uploading revisions to the website for the WCTI 102 “CCS Legal and Regulatory Frameworks” course; and 3) completed requests for copyright releases for appropriate graphics and photos in completed classes, and 4) completed shutdown of WCTI.

- 1) Scrapped development of the final WCTI course, WCTI 107 “Development of CCS Project Plans”

The WCTI 107 “Development of CCS Project Plans” course using an EPA guidance document as the source of course content was scrapped due to insufficient time to complete course development, peer review, recording, website uploading and final QC.

- 2) Completed uploading revisions to the website for WCTI 102 “CCS Legal and Regulatory Frameworks” course
- 3) Completed requests for copyright releases for appropriate graphics and photos in completed classes

Most copyright releases were obtained. We made at least two requests for each copyright release.

- 4) Completed shutdown of WCTI

The Institute and its website was shutdown on June 30, 2014. Website content, courses and copyright releases/requests were given to the Carbon Management Institute at the University of Wyoming. The contact is Shanna Dahl 307-766-6810 sdahl2@uwyo.edu.

CONCLUSIONS

The WCTI accomplished all of our DOE milestones and provided a work product of high-quality. Our mission was to create a sustainable business where we trained the workforce in deploying CCS technologies. Our niche was to provide the online courses which were guided presentations with assessments that could be taken anywhere in the world at any time. We charged rates for our online courses and in-person workshops which were in line with industry standards.

However, we noted that other DOE regional training centers were charging nominal fees (to cover a lunch) or free in-person workshops. This could have severely impacted the market’s desire to pay our workshop fees. Regarding online course offerings, the only other training center (PTTC) that eventually offered online courses to take for certification was also woefully under-utilized. One of their students, in fact, was a WCTI staffer who was taking the course in order to assess other market offerings. In our opinion, that course entailed an onerous amount of journal reading and very long essays. The staffer did not enjoy it, found the work to be cumbersome, and access to reading materials frustrating. Our courses were packaged to appeal to a student – WE provided the students information in a concise, piecemeal fashion with opportunities to easily demonstrate mastery of the material. Upon course completion, the course materials provided a succinct summary of CCS concepts for further reference and review.

We conclude that the success of WCTI was hampered by the lack of a market. Because there were no supporting financial incentives to store carbon, the private sector had no reason to incur the extra expense of training their staff to implement carbon storage.

Appendix A

Milestone Status

Type	Milestone	Original Planned Completion Date	Revised Planned Completion Date	Actual Completion Date	Validation/Notes
Project	Finalize the WCTI Management Plan with the WCSSC	12/17/09	11/30/09	01/29/10	Message sent to NETL COR
HQ	HQ Milestone: Project Kick-off Meeting	03/31/10	03/31/10	11/18/09	A presentation describing this project was delivered at the official kick-off meeting on November 18, 2009, in Pittsburgh, PA. held during the Annual Regional Partnership Meeting (special session on Regional Sequestration Technology Training Centers)
Project	Hire the WCTI manager	12/31/09	05/31/10	05/12/10	A temporary Project Manager was hired on 5/12/10 to fulfill the duties; the permanent PM was hired in July 2010.

HQ	HQ Milestone: Educational program instituted by identifying potential participants and completing a training schedule	06/30/10	06/30/10	06/11/10	A revised schedule and plan for implementing the WCTI was sent to the NETL Project Manager on 6/11/10.
Project	Design, build, test and deploy the WCTI website	06/30/10	07/30/10	07/30/10	www.WyomingCarbonStorage.com
HQ	HQ Milestone: Semi- Annual Progress Report	09/30/10	09/30/10	07/15/10	The Quarterly Report for the period ending 6/30/10 was submitted to the FITS@NETL.DOE.GOV on 7/15/10.
HQ	HQ Milestone: Complete training curriculum developed for first set of classes	09/30/10	09/30/10	09/29/10	Two syllabi for Overview Short Course 1 (An Introduction to the CCS Industry) and 5 (CCS Site Characterization: Public Outreach and Education) were sent to the DOE PM on 9/29/10.

Project	Complete first technology transfer workshop	05/31/10	11/29/10	11/18/10	Workshop entitled 'Petrophysical Characterization of the Madison Formation for Carbon Sequestration Modeling: An Example from Southwestern Wyoming' was held at the Colorado School of Mines with 10 attendees. The workshop was taught by Drs. Geoffrey Thyne and Mark Tomasso of the Enhanced Oil Recovery Institute, University of Wyoming.
Project	Complete second technology transfer workshop	11/30/10	05/30/11	11/19/10	Workshop entitled 'Moving CCS from Research to Commercial Deployment: Pending Regulations, Public Perceptions and Public Outreach' was held at the Colorado School of Mines with 6 attendees. The workshop was taught by Dr. James Myers of the Wyoming CCS Technology Institute and the Department of Geology and Geophysics, University of Wyoming.
Project	Develop the WCTI publication guidelines and templates	06/30/10	12/17/10	12/27/10	The publication guidelines and templates were sent to the DOE Program Manager on 12/27/10.
Project	Develop and review marketing strategy	07/30/10	12/31/10	12/27/10	The marketing strategy was sent to the DOE Program Manager on 12/27/10.

Project	HQ Milestone: Updated Tech Training Plan Completed and Submitted	12/31/10	12/31/10	12/27/10	The updated plan was sent to the DOE Program Manager on 12/27/10.
HQ	HQ Milestone: Trainers visit one field site	12/31/10	12/31/10	NA	DROPPED per W. Aljoe (email 12/13/10)
HQ	HQ Milestone: Complete first classes for regional sequestration technology training	12/31/10		11/18/10	Workshop entitled 'Petrophysical Characterization of the Madison Formation for Carbon Sequestration Modeling: An Example from Southwestern Wyoming' was held at the Colorado School of Mines on 11/18/10 with 10 attendees. The workshop was taught by Drs. Geoffrey Thyne and Mark Tomasso of the Enhanced Oil Recovery Institute, University of Wyoming. Workshop entitled "Moving CCS from Research to Commercial Deployment: Pending Regulations, Public Perceptions and Public Outreach' was held at the Colorado School of Mines on 11/19/10 with 6 attendees. The workshop was taught by Dr. James Myers of the WCTI and the Department of Geology and Geophysics, University of Wyoming.

Project	Complete first core short course	07/30/10	1/31/2012	01/10/12	Posted the 1st core online course (3 rd overall) in the WCTI curriculum “An Introduction to the CCS Industry” to the website on January 10, 2012
Project	Recruit the WCTI educational staff	03/31/10	12/31/2012	03/31/14	Completed
Project	Complete second core short course	07/30/10	09/30/11	08/10/11	The on-line course 'CCS Outreach,' developed by content expert Lindsey Tollefson of Montana State University, was made available for review and purchase on August 10, 2011.
Project	Complete third core short course	12/01/10	02/29/12	01/20/12	Posted the 2nd core online course (4 th overall) in the WCTI curriculum “CCS Legal and Regulatory Frameworks” to the website on January 20, 2012
Project	Hire the WCTI administrative staff	02/28/10	06/30/11	06/08/11	A Program Technologist started June 8. This person will draft website content, grade student submissions and assist with marketing as needed.
Project	Create online short course delivery platform	07/30/10	09/30/11	08/10/11	Completed
Project	Deploy Internet collaboration technologies	08/31/10	09/30/11	08/10/11	The WCTI website was opened to the public on August 10, 2011 (www.WyomingCarbonStorage.com). Collaboration technologies will be added to other courses as they go live.

HQ	HQ Milestone: Yearly Review Meeting	03/31/11	03/31/11	10/06/10	Project Results were presented at the DOE Regional Carbon Sequestration Partnerships Annual Meeting on October 6, 2010.
Project	Complete fourth overview short course	12/01/10	06/30/12	09/28/12	Posted the 4th core online course (5 th overall) in the WCTI curriculum “CCS Site Exploration: Best Practices” to the website on September 28, 2012
Project	Complete fifth overview short course	06/30/12		08/06/12	Posted the 5th core online course (4 th overall) in the WCTI curriculum “Underground Injection Control and the new Class VI Well” to the website on August 6, 2012
Project	Complete sixth overview short course	06/30/13	11/15/13	10/24/13	Posted the 6th core online course in the WCTI curriculum - WCTI 106 “Class VI Well Construction, Operation, Monitoring and Testing” - to the website on October 24, 2013
HQ	HQ Milestone: Issue a minimum of 250 Professional Development Units (PDUs) or Continuing Education Units (CEUs) across all training centers	06/30/11	06/30/11	12/31/2011	The WCTI has conducted 200 hours of training and awarded 10 CEUs and 104 PDHs.
HQ	HQ Milestone: Semi-Annual Progress Report (i.e. Quarterly report ending June 30, 2011)	09/30/11	09/30/11	7/19/2011	The Quarterly Report for the period ending 6/30/11 was submitted to the FITS@NETL.DOE.GOV on 7/19/11.

HQ	HQ Milestone: Complete at least 2 classes on CCS	12/31/11		10/09/11	The short course “The Emerging CCS Industry: An Overview” was delivered at the AAPG RMS Meeting in Cheyenne on June 30, 2011 to 2 participants and at the GSA National Meeting in Minneapolis on October 9, 2011 to 10 participants.
HQ	HQ Milestone: Issue an additional 100 Professional Development Units (PDUs) or Continuing Education Units (CEUs).	03/31/12		03/31/12	The WCTI has conducted 200 hours of training and awarded 10 CEUs and 104 PDHs.
HQ	HQ Milestone: Semi-annual progress reports (i.e. Quarterly Report ending March 31, 2012).	06/30/12		04/11/12	The Quarterly Report for the period ending 3/31/12 was submitted to the FITS@NETL.DOE.GOV on 4/11/12.
HQ	HQ Milestone: Yearly Review Meeting of all recipients; opportunities for information exchange and collaboration.	09/30/12		11/15/11	Project Results were presented at the DOE Regional Carbon Sequestration Partnerships Annual Meeting on November 15, 2011.
Project	Complete CCS Well DB Building short course	06/30/11	09/30/11	NA	Course is no longer slated for development.
Project	Complete CS Storage short course	06/30/11	09/30/11	NA	Course is no longer slated for development.

Project	Complete technology transfer workshop	03/17/13		NA	The WCTI has been contracted by SPE to deliver a one-day long workshop at the 2013 Health, Safety, Security, and Environmental Conference in Galveston, TX. Darrick Eugene and Melita Elmore will be instructing WCTI's GHC and CCS Regulatory and Legal Framework on Sunday 17 March, 2013. Workshop was cancelled due to lack of enrollment.
Project	Complete third (and fourth) technology transfer workshop	05/31/11	11/25/11	NA	The WCTI was contracted by the Society of Petroleum Engineers to deliver two one-day-long workshops at the SPE Institute in Houston. "CCS Legal and Regulatory Frameworks" was slated for September 7, 2011, and to be taught by Kipp Coddington. "Public Outreach and Education: Preparing CCS Professionals for Engaging with Stakeholders" was slated for September 8, 2011 and to be taught by Lindsey Tollefson. Essentially, these courses were to be based on our online courses which were developed by these two content experts. Unfortunately, Lindsey's class had no registrants; Kipp had one. The classes were cancelled due to lack of enrollment.
Project	Complete CCS Well DB Geochemical short course	10/31/11	01/31/12	NA	Course is no longer slated for development.

Project	Complete CS Baseline short course	10/31/11	01/31/12	NA	Course is no longer slated for development.
Project	Complete CCS Well DB Geophysical short course	02/23/12	05/31/12	NA	Course is no longer slated for development.
Project	Complete CS geophysical short course	02/23/12	05/31/12	NA	Course is no longer slated for development.
Project	Complete fifth and sixth technology transfer workshop	11/30/11	05/31/12	NA	The WCTI was contracted by the Society of Petroleum Engineers to deliver two one-day-long workshops at the SPE ATCE in Denver. "CCS Legal and Regulatory Frameworks" was slated for October 30, 2011, and to be taught by Kipp Coddington. "Public Outreach and Education: Preparing CCS Professionals for Engaging with Stakeholders" was slated for November 3, 2011 and to be taught by Lindsey Tollefson. Essentially, these courses were to be based on our online courses which were developed by these two content experts. Unfortunately, Lindsey's class had no registrants; Kipp had four, although he decided that was an insufficient number for him to hold the class. The classes were cancelled due to lack of enrollment.
Project	Complete CS NEPA short course	06/19/12	09/28/12	NA	Course is no longer slated for development.

Project	Complete Well DB evaluating professional short course	06/19/12	09/28/12	NA	Course is no longer slated for development.
Project	Complete seventh and eighth technology transfer workshop	05/31/12	11/15/12	NA	Cancelled two workshops ("Introduction to CCS" was slated for February 6, 2012, and to be taught by Erin Stoesz and Geoffrey Thyne; "Site Characterization" was slated for February 10, 2012 and to be taught by Erin Campbell-Stone and Ranie Lynds) offered in conjunction with the Carbon Management Conference due to lack of enrollment.
Project	Implement marketing strategy	11/15/12	06/30/14	06/30/14	
Project	Complete seventh online course	06/30/14		Not completed	WCTI staff was unable to finalize WCTI 107 "Development of CCS Project Plans" using an EPA guidance document as the source of course content due to time constraints.
HQ	Semi-annual progress reports (i.e. Quarterly Report ending March 31, 2013).	06/30/13		04/10/13	The Quarterly Report for the period ending 3/31/13 was submitted to the FITS@NETL.DOE.GOV on 4/10/13.
HQ	Yearly Review Meeting of active projects; opportunities for information exchange and collaboration.	09/30/13		8/20 - 22/13	The Marketing Coordinator attended the meeting and staffed an Institute table where she answered attendees' questions and brought all marketing materials for handout.

HQ	Final progress report	09/30/14	07/14		The Final Report for the period ending 6/30/14 was submitted to http://www.osti.gov/eliink-2413 .
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Appendix B

Cost Plan/Status

Baseline Reporting Quarter	YEAR 1 Start: 11/16/09 End: 9/30/10				YEAR 2 Start: 10/1/10 End: 9/30/11			
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
<u>Baseline Cost Plan</u>								
Federal Share	\$0	\$6,441	\$1,264	\$45,491	\$122,474	\$83,407	\$86,473	\$12,094
Non-Federal Share	\$0	\$0	\$39,886	\$15,926	\$12,006	\$26,978	\$50,613	\$95,979
Total Planned (Fed + Non-Fed)	\$0	\$6,441	\$41,150	\$61,417	\$134,478	\$110,384	\$137,084	\$108,072
Cumulative Baseline Cost	\$0	\$6,441	\$47,591	\$109,008	\$243,486	\$353,870	\$490,955	\$599,026
<u>Actual Incurred Costs</u>								
Federal Share	\$0	\$6,441	\$1,264	\$45,491	\$122,474	\$83,407	\$86,473	\$12,094
Non-Federal Share	\$0	\$0	\$39,886	\$15,926	\$12,006	\$26,978	\$50,613	\$95,979
Total Incurred Costs - Qtrly (Fed + Non-Fed)	\$0	\$6,441	\$41,150	\$61,417	\$134,479	\$110,385	\$137,085	\$108,073
Cumulative Incurred Costs	\$0	\$6,441	\$47,591	\$109,008	\$243,487	\$353,872	\$490,958	\$599,030

<u>Variance</u>								
Federal Share	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Non-Federal Share	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total Variance - Qtrly (Fed + Non-Fed)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Cumulative Variance	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

NOTE: Plan was changed on 12/31/13 to match actuals for past quarters in order to properly plan remaining funds.

Baseline Reporting Quarter	YEAR 3 Start: 10/1/11 End: 9/30/12				YEAR 4 Start: 10/1/12 End: 9/30/13			
	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
<u>Baseline Cost Plan</u>								
Federal Share	\$10,062	\$51,743	\$113,930	\$119,967	\$126,083	\$97,471	\$62,643	\$32,853
Non-Federal Share	\$133,628	\$84,668	\$49,297	\$0	\$0	\$0	\$23,239	\$65,919
Total Planned (Fed + Non-Fed)	\$143,689	\$136,410	\$163,226	\$119,966	\$126,082	\$97,470	\$85,881	\$98,771
Cumulative Baseline Cost	\$742,715	\$879,125	\$1,042,351	\$1,162,317	\$1,288,399	\$1,385,869	\$1,471,750	\$1,570,521
<u>Actual Incurred Costs</u>								
Federal Share	\$10,062	\$51,743	\$113,930	\$119,967	\$126,083	\$97,471	\$62,643	\$32,853
Non-Federal Share	\$133,628	\$84,668	\$49,297	\$0	\$0	\$0	\$23,239	\$65,919
Total Incurred Costs - Qtrly (Fed + Non-Fed)	\$143,690	\$136,411	\$163,227	\$119,967	\$126,083	\$97,471	\$85,881	\$98,772
Cumulative Incurred Costs	\$742,720	\$879,131	\$1,042,358	\$1,162,325	\$1,288,408	\$1,385,879	\$1,471,761	\$1,570,533

<u>Variance</u>								
Federal Share	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Non-Federal Share	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total Variance - Qtrly (Fed + Non-Fed)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Cumulative Variance	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

Baseline Reporting Quarter	YEAR 5 Start: 10/1/13 End: 6/30/14			
	Q17	Q18	Q19	Q20
<u>Baseline Cost Plan</u>				
Federal Share	\$11,440	\$11,076	\$0	\$0
Non-Federal Share	\$95,758	\$94,302	\$105,000	\$7,677
Total Planned (Fed + Non-Fed)	\$107,197	\$105,378	\$105,000	\$7,677
Cumulative Baseline Cost	\$1,677,718	\$1,783,096	\$1,888,096	\$1,895,773
<u>Actual Incurred Costs</u>				
Federal Share	\$11,440	\$882	\$8,625	
Non-Federal Share	\$95,758	\$96,750	\$103,090	
Total Incurred Costs - Qtrly (Fed + Non-Fed)	\$107,198	\$97,632	\$111,715	
Cumulative Incurred Costs	\$1,677,731	\$1,775,363	\$1,887,078	

<u>Variance</u>				
Federal Share	\$0	\$10,194	-\$8,625	
Non-Federal Share	\$0	-\$2,448	\$1,910	
Total Variance - Qtrly (Fed + Non-Fed)	\$0	\$7,746	-\$6,715	
Cumulative Variance	\$0	\$7,746	\$1,031	

Appendix C

Syllabus for 'An Introduction to the CCS Industry'

Course Number: WCTI 101

Title: *An Introduction to the CCS Industry*

Delivery: Online

Presentation Mode: Asynchronous

Estimated Online Hours: 5

UW CEUs: 0.5

Completion Deadline: 3 months

Cost: \$1000

Introduction: Carbon capture and storage (CCS) has been proposed as a means of reducing anthropogenic, atmospheric carbon dioxide emissions while permitting the continued use of fossil fuels (the supplier of nearly 87% of the world's primary energy). CCS involves capturing carbon dioxide at a stationary source, compressing it to a supercritical fluid, transporting it to a storage site and injecting it into suitable underground geologic formations. From source to sink, CCS encompasses a variety of engineering and Earth science concepts and principles. At the same time, it involves activities, e.g., underground injection, regulated at state and federal levels that require careful risk assessment. Although all the technologies required for CCS have been routinely used in other industries for decades, they must be combined in ways not done previously and scaled up significantly. At the same time, CCS commercialization at scales likely to impact atmospheric carbon emissions will require public acceptance of the associated risks, benefits and costs. Not surprisingly, the increased interest in CCS has led to a recent explosion in academic and industry research into all aspects of CCS.

Course Objectives: This course is intended to provide individuals new to CCS with the general background knowledge necessary to understand CCS goals, technical requirements and potential obstacles. In particular, the course will provide the foundation necessary for individuals to pursue CCS certification through the WCTI. It will provide individuals who wish to pursue a career in the evolving CCS industry with the background knowledge to make informed choices about where their career opportunities might lie in this expanding industry. To this end, the course brings together the results from the latest academic, industry and government research to provide a comprehensive survey of carbon capture and storage.

Learning Goals: The specific learning goals of this course are to:

- Explore the importance of energy for modern societies and the role fossil fuels play in supplying this energy;
- Examine the relationship between anthropogenic carbon emissions, the carbon cycle and climate;
- Explore the physical and chemical properties of carbon dioxide;

- Examine the various stages of CCS;
- Investigate the legal and regulatory frameworks being created for CCS;
- Examine how public perception can mean the difference between project success and failure and the importance of public outreach; and
- Prepare individuals for other WCTI courses by providing them with the requisite background and technical CCS knowledge.

Course Organization: This is an online, asynchronous course delivered via the Web. The course should take approximately 5 hours of online time to complete. In addition, all course activities and assignments must be completed within three (3) months after beginning the course. The final grade for the class is pass/fail and 0.5 University of Wyoming Continuing Education Units (CEUs) will be awarded for a passing grade. Organizationally, the course consists of reading assignments (both online and in PDF format), individual exercises to be completed at the conclusion of each module, activities designed to reinforce important concepts and principles through active learning, and various learning assessments (see next section). To support learning, the course has a comprehensive, searchable glossary, online instructor support and an extensive supplemental reading list. In addition, educational technology support is provided by on-line technical support from WCTI's information technology staff.

Assessment: To receive course credit, the student must demonstrate a basic level of mastery of CCS knowledge, principles and concepts. This mastery will be assessed through a combination of formative and summative assessments. Formative assessments will be conducted after completion of specific learning modules. These will be completed online and submitted electronically to the WCTI for evaluation. Assessments will be evaluated within two (2) business days of submittal and returned to the student electronically. The student may continue to the next learning module while assessments are being evaluated.

Upon completion of the course, the student must pass a comprehensive, summative assessment that evaluates the student's overall grasp of the course material. As with the formative assessment, this final assessment will be completed and submitted online. Upon successful completion of WCTI 101, an individual will earn 0.5 UW CEUs. For purposes of attaining WCTI certification, these CEUs will remain valid for four (4) years after their initial award.

Follow-up Courses: Successful completion of this course does not qualify the recipient to take any of the face-to-face courses in the various professional specializations. An individual may enroll in face-to-face courses only after all six (6) online core courses have been completed successfully.

An Introduction to the CCS Industry

Course Syllabus: 7 Modules

1. Energy Basics and Use

- 1.1 The Premise
- 1.2 The Basics of Energy Sources
- 1.3 Current Global and U.S. Energy Use
- 1.4 Looking into the Energy Future
 - 1.4.1 Future Demand
 - 1.4.2 The Role of Fossil Fuels
 - 1.4.3 What Replaces Fossil Fuels?
- 1.5 Summary
- 1.6 Assessment

Module 1 Reading & Assignments:

Reading	Pages	Sources
The Increasing Role of Unconventional Reservoirs in the Future of the Oil and Gas Business	All	http://www.spe.org/jpt/print/archives/2003/11/JPT2003_11_management.pdf
Science on Sustainability	Pgs 1-29	http://www.sos2006.jp/english/rsbs_summary_e/ScienceOnSustainability2006.pdf
International Energy Outlook 2010	Pgs. 1-8	http://www.eia.gov/forecasts/archive/ieo10/pdf/0484(2010).pdf
Additional Resources & Optional Exercises		
Unit Conversion Charts		
Complete Module 1 Assessment		

2. Climate Science and Climate Change

- 2.1 Climate Science and the Carbon Cycle
- 2.2 Greenhouse Gases (GHG) and GHG Effect
- 2.3 Climate Change, Atmospheric CO₂ Levels & Emissions
- 2.4 Wedge Theory
- 2.5 Summary
- 2.6 Exercise & Assessment

Module 2 Reading & Assignments:

Reading	Pages	Sources
IEA CO ₂ Emissions from Fuel Combustion Highlights 2011	pgs. 7-15	http://www.iea.org/co2highlights/co2highlights.pdf
International Energy Outlook 2010	Pgs. 123-134	http://www.eia.gov/forecasts/archive/ieo10/pdf/0484(2010).pdf

Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies	All	http://www.sciencemag.org/content/305/5686/968.full.pdf
Complete Module 2 Exercise		
Additional Resources & Optional Exercises		
GHG Equivalency Calculator Exercise		
Stabilization Wedge Game		http://cmi.princeton.edu/wedges/pdfs/teachers_guide.pdf
Complete Module 2 Assessment		

3. CCS Overview

- 3.1 CO₂ Chemistry and Physics
- 3.2 Carbon Sources
- 3.3 Carbon Capture
- 3.4 Carbon Transport
- 3.5 Carbon Storage
 - 3.5.1 Geological
 - 3.5.2 Terrestrial
 - 3.5.3 Oceanic
- 3.6 Summary
- 3.7 Assessment

Module 3 Reading & Assignments:

Reading	Pages	Sources
IPCC Special Report on Carbon Dioxide Capture and Storage: Technical Summary	Pgs. 17-50	http://www.ipcc.ch/pdf/special-reports/srccs/srccs_wholereport.pdf
CO ₂ Sequestration in Deep Sedimentary Formations	all	http://elements.geoscienceworld.org/content/4/5/325.full.pdf+html
Complete Module 3 Assessment		

4. CCS Nuts and Bolts

- 4.1 Project Definition and Management
- 4.2 Site Screening
- 4.3 Site Selection
- 4.4 Initial Characterization
- 4.5 Risk Analysis
- 4.6 Operations
- 4.7 Measurement, Verification and Accounting
- 4.8 Summary
- 4.9 Exercise & Assessment

Module 4 Reading & Assignments:

Reading	Pages	Sources
DOE Best Practice Manual for Site Screening, Site Selection and Initial Characterization	pgs. 7-42	http://www.netl.doe.gov/technologies/carbon_seq/refshelf/BPM-SiteScreening.pdf
DOE Best Practice Manual for Monitoring, Verification and Accounting	pgs. 14-18 24-30	http://www.netl.doe.gov/technologies/carbon_seq/refshelf/MVA_Document.pdf
DOE Best Practice Manual for Risk Analysis and Simulation	pgs. 6-15	http://www.netl.doe.gov/technologies/carbon_seq/refshelf/BPM_RiskAnalysisSimulation.pdf
The critical role of monitoring, verification and accounting for geologic carbon dioxide storage projects	all	http://www.netl.doe.gov/technologies/carbon_seq/refshelf/project%20portfolio/2011/SelectedPubs/MVA%20Paper%20-%20Environmental%20Geosciences_2011.pdf
Impact of Knowledge and Misconceptions on Benefit and Risk Perception of CCS	all	http://pubs.acs.org/doi/pdfplus/10.1021/es1005412
Complete Module 4 Exercise		
Complete Module 4 Assessment		

5. People and Paper

5.1 Public Outreach

5.2 Legal and Regulatory Frameworks

5.2.1 Key International GHG Agreements

5.2.2 U.S. GHG Agreement

5.2.3 U.S. Regulations of CCS

5.3 Permitting

5.3.1 Underground Injection Control

5.4 Summary

5.5 Exercise & Assessment

Module 5 Reading & Assignments:

Reading	Pages	Sources
DOE Best Practice Manual for Public Outreach and Education for Carbon Storage Projects	pgs. 15-31	http://www.netl.doe.gov/technologies/carbon_seq/refshelf/BPM_PublicOutreach.pdf
State and Regional Control of Geological Carbon Sequestration	all	http://repository.icse.utah.edu/dspace/bitstream/123456789/11095/1/reitze_state_sequestration_pt1_eli_4_1_2011.pdf
WRI CCS Guidelines and Emerging Geologic Sequestration Regulations: A Comparative Assessment	all	doi:10.1016/j.egypro.2009.01.230
Additional Resource		

Financial Incentives for CCS		http://www.pewclimate.org/sites/default/modules/usmap/pdf.php?file=8380
Complete Module 5 Exercises		
Complete Module 5 Assessment		

6. CCS Projects

6.1 International Projects

6.2 DOE Regional Carbon Sequestration Partnerships

6.3 Other U.S. Projects

6.4 Summary

6.5 Assessment

Module 6 Reading & Assignments:

Reading	Pages	Sources
Lessons Learned from 14 years of CCS Operations: Sleipner, In Salah and Snøhvit	all	doi:10.1016/j.egypro.2011.02.541
Geological storage of CO ₂ in saline aquifers – A review of the experience from existing storage operations	all	doi:10.1016/j.ijggc.2009.12.011
Life Cycle Inventory of CO ₂ in an Enhanced Oil Recovery System	all	http://pubs.acs.org/doi/pdfplus/10.1021/es902006h
Reducing Carbon Dioxide Emissions with Enhanced Oil Recovery Projects: A Life Cycle Assessment Approach	all	http://pubs.acs.org/doi/pdfplus/10.1021/ef000258a
Additional Resources & Optional Exercises		
The Hawaii Carbon Dioxide Ocean Sequestration Field Experiment: A Case Study in Public Perceptions and Institutional Effectiveness	A helpful resource for the assessment	http://sequestration.mit.edu/pdf/defaultthesis.pdf
Complete Module 6 Assessment		

7. Course Summary

7.1 Summary

7.2 Exercise

7.3 Summative Assessment

Module 7 Reading & Assignments:

Reading	Pages	Sources
Scaling up carbon dioxide capture and storage: From megatons to gigatons	all	doi:10.1016/j.eneco.2010.11.004
Global learning on carbon capture and storage: A call for strong international	all	doi:10.1016/j.enpol.2009.01.020

cooperation on CCS demonstration		
Complete Module 7 Exercises		
Complete the Summative Assessment		

Syllabus for 'CCS Legal and Regulatory Frameworks'

Course Number: WCTI 102

Title: *CCS Legal and Regulatory Frameworks*

Delivery: Online

Presentation Mode: Asynchronous

Estimated Online Hours: 4

UW CEUs: 0.4

Completion Deadline: 3 months

Cost: \$1000

Introduction: As with any industrial activity, the evolving carbon capture and storage industry will require various frameworks within which to operate. These frameworks consist of the legal statutes that outline issues such as subsurface ownership, precedence of competing estates, and liability and mechanisms for enforced cooperation, such as unitization as found in the oil and gas industry. The regulatory structure that defines the day-to-day operating procedures of an industry is built upon this legal framework.

Because the subsurface injection of carbon dioxide has been used for enhanced oil recovery (EOR) for over four decades, a legal and regulatory framework has been developed within the United States for this activity. However, the scale, extent and scope of EOR carbon dioxide injection will pale in comparison to a commercial carbon sequestration industry. Thus, the legal and regulatory frameworks for EOR-related CO₂ injection cannot adequately govern carbon capture and storage (CCS). To create the necessary CCS legal and regulatory frameworks, various legislative bodies and governmental agencies are designing, debating and passing laws and regulations directly intended for a commercial CCS industry. These efforts are occurring both at the national and state level and are taking various directions. All future CCS projects will be directly impacted by the decisions made during these legal and regulatory efforts.

Course Objectives: This course is a broad overview of the evolving legal and regulatory frameworks that will govern the emerging CCS industry. It documents activities at both the international and national levels that are driving requirements to reduce anthropogenic emissions of carbon dioxide. Within the U.S., the course covers the different legal approaches that the U.S. federal government and the states are using to regulate all aspects of CCS, including CO₂ capture, transportation, injection, storage and stewardship.

Learning Goals: The specific learning goals of this course are to:

- Examine the carbon cycle and the greenhouse effect;
- Review evolving attempts to regulate anthropogenic emissions of CO₂, both internationally and nationally;
- Explore other U.S. regulations pertaining to greenhouse gases; and
- Document U.S. legislative efforts relevant to carbon capture and storage, both on a national and state level through:
 - Examination of important issues, and

- Review of state legislative actions.

Course Organization: This is an online, asynchronous course delivered via the Web. The course should take approximately 4 hours of online time to complete. In addition, all course activities and assignments must be completed within three (3) months after beginning the course. The final grade for the class is pass/fail and 0.4 University of Wyoming Continuing Education Units (CEUs) will be awarded for a passing grade. Organizationally, the course consists of reading assignments (both online and in PDF format), activities designed to reinforce important concepts and principles through active learning, and various learning assessments (see next section). To support learning, the course has a comprehensive, searchable glossary, online instructor support and an extensive supplemental reading list. In addition, educational technology support is provided by online technical support from WCTI's information technology staff.

Assessment: To receive course credit, the student must demonstrate a basic level of mastery of the legal and regulatory frameworks that are evolving to regulate the CCS industry. This mastery will be assessed through a combination of formative and summative assessments. Formative assessments will be conducted after completion of specific learning modules. These will be completed online and submitted electronically to the WCTI for evaluation. Assessments will be evaluated within two (2) days of submittal and returned to the student electronically. The student may continue to the next learning module while assessments are being evaluated.

Upon completion of the course, the student must pass a comprehensive, summative assessment that evaluates the student's overall grasp of the course material. As with the formative assessment, this final assessment will be completed and submitted online. Upon successful completion of the course, a student will earn 0.4 UW CEUs. For purposes of attaining WCTI certification, these CEUs will remain valid for four (4) years after their initial award.

CCS Legal and Regulatory Frameworks

Course Outline: 4 Modules

Module 1: Introduction to Carbon Capture and Storage

- 1.1 Why Policymakers Care about CCS
 - 1.1.1 Climate Change
 - 1.1.2 GHGs and the Carbon Cycle
- 1.2 Fossil Fuel Usage and Climate Change
- 1.3 Wedge Theory and the CCS Wedge
- 1.4 What is CO₂-EOR?
- 1.5 Assessment

Module 2: GHGs Legal and Regulatory Frameworks

- 2.1 Some Comments on Legalese
- 2.2 International Agreements
 - 2.2.1 United Nations Framework Convention on Climate Change (UNFCCC)
 - 2.2.2 Kyoto Protocol to the UNFCCC
 - 2.2.3 Copenhagen Accord
 - 2.2.4 Cancun Agreement
 - 2.2.5 Durban Conference
- 2.3 Key Foreign Jurisdictions
- 2.4 Hot Topics in the International Climate Negotiations
- 2.5 Assessment

Module 3: U.S. GHGs Legal and Regulatory Frameworks

- 3.1 U.S. National Frameworks
- 3.2 U.S. Regional Frameworks
- 3.3 U.S. State Frameworks
- 3.4 Voluntary Carbon Markets
- 3.5 Assessment

Module 4: CCS Legal and Regulatory Frameworks

- 4.1 Stages of a CCS Project
- 4.2 CCS Regulatory Frameworks
 - 4.2.1 United States
 - 4.2.2 International
- 4.3 Assessment

Syllabus for 'CCS Public Outreach and Education'

Course Number: WCTI 103

Title: *Public Outreach and Education: Preparing CCS Professionals for Engaging with Stakeholders*

Delivery: Online

Presentation Mode: Asynchronous

Estimated Online Hours: 4

UW CEUs: 0.4

Completion Deadline: 1 month

Cost: \$1000

Introduction:

As the United States and other nations focus on ways to adapt to a carbon constrained future, CCS is emerging as a technology to help reduce CO₂ emissions from fossil fuel combustion. In 2003, the U.S. Department of Energy began its Regional Carbon Sequestration Program to identify and demonstrate the best approaches to carbon storage. Many leaders in the CCS field have noted that after solving major technical and economic obstacles, the commercial deployment of CCS may encounter public opposition challenges or delays.

Through the experiences of the U.S. DOE program and others around the globe, the importance of conducting effective public outreach in coordination with CCS projects has been recognized as a key project component. Similar to the development of other new technologies and extraction of hydrocarbon fuels, CCS projects may involve or interact with a wide variety of stakeholders, businesses, government agencies and the public. Implementing effective outreach strategies in CCS projects will promote improved community relationships and build trust with land owners, regulatory agencies, politicians, and community members. Conducting outreach will also help reduce permitting delays and lawsuits often associated with 'Not In My Back Yard' (NIMBY) opposition. As CCS moves from the research and demonstration stages to a global-scale, commercial operation, there is a distinct possibility that the NIMBY outlook may expand to a NUMBY (Not Under My Back Yard) attitude.

This course is focused on assisting professionals in the CCS industry learn the necessary skills to conduct effective public outreach for their CCS projects. It will draw upon the lessons learned from projects in the US and around the world to teach students how to use interdisciplinary approaches to confidently engage stakeholders and conduct public outreach. On local, regional, national and global scales, significant public outreach and education will be necessary if CCS is to play a significant role in mitigating future anthropogenic emissions of carbon to the atmosphere.

Course Objectives: The primary objective of this course is to help CCS project team members understand and apply effective public education and outreach strategies in selecting, permitting and operating a carbon sequestration site. Through lessons learned from other industries and CCS pilot projects, the course will demonstrate the importance of these types of activities and

illustrate how lack of attention to them during project development can create serious problems. This course will provide project members with technical and scientific backgrounds, with specific guidelines and best practices for dealing with a variety of different stakeholders in a number of different settings. The course brings together the results from the latest CCS research published on public perceptions, outreach and education best practices.

Learning Goals: The specific learning goals of this course are to:

- Explore the benefits and importance of conducting effective public outreach for CCS activities through historical case studies;
- Examine case studies and public attitudes toward CCS activities;
- Understand how to integrate an effective outreach strategy into project management;
- Learn how to conduct community research for your specific CCS site;
- Understand how to design an effective outreach strategy and communications plan for CCS projects;
- Understand the proposed permitting process for CCS infrastructure development and the role the public will play in this process;
- Review effective communication skills and message development for CCS projects;
- Describe a toolbox of outreach and education strategies and resources for CCS projects;

Course Organization: This is an online, asynchronous course delivered via the Web. The course should take approximately 8 hours of online time to complete. In addition, all course activities and assignments must be completed within one (1) month after beginning the course. Organizationally, the course consists of reading assignments (both online and in PDF format), individual exercises to be completed at the conclusion of each unit, activities designed to reinforce important concepts and principles through active learning and various learning assessments (see next section). To support learning, the course has an extensive FAQ section addressing common content knowledge misconceptions, a comprehensive, searchable glossary, online instructor support and an extensive supplemental reading list. In addition, educational technology support is provided by a comprehensive technical FAQ as well as online technical support from WCTI's information technology staff.

Assessment: To receive course credit toward WCTI certification, the student must demonstrate a basic level of mastery of CCS knowledge, principles and concepts. This mastery will be assessed through a combination of formative and summative assessment instruments. Formative assessments will be conducted after completion of specific learning units. These will be completed online and submitted electronically to WCTI for evaluation. Assessments will be evaluated within two (2) days of submittal and returned to the student electronically. Upon successful completion of an assessment, the student will be allowed to proceed to the next learning unit. In the event of an unsatisfactory performance on an assessment, the student shall have the opportunity to retake the assessment within one (1) week. Upon completion of the course, the student must pass a comprehensive, summative assessment that evaluates the student's overall grasp of the course material. As with the formative assessment, this final assessment will be completed and submitted online. Upon successful completion of WCTI-105, an individual will earn 0.8 UW CEUs toward WCTI certification. These CEUs will remain valid for four (4) years after their initial award.

Follow-up Courses: Successful completion of this course does not qualify the recipient to take any of the face-to-face courses in the various professional specializations. An individual may enroll in face-to-face courses only after all six (6) online core courses have been completed successfully.

Public Outreach and Education: Preparing CCS Professionals for Dealing with Stakeholders

Course Syllabus: 8 Modules

1. Introduction

- a. An overview of what this course is all about
- b. Public outreach for CCS projects – What is it? Why is it important and necessary?
 - i. Ways to prepare for outreach
 - ii. DOE Best Practices
 - iii. Why bother with public outreach?
- c. Public Perception of CCS: A Global Review

Module 1 Reading & Assignments:

<i>Reading</i>	<i>Pages</i>	<i>Sources</i>
DOE Best Practices for Public Outreach and Education for Carbon Storage Projects	11-30	http://www.netl.doe.gov/technologies/carbon_seq/refshelf/BPM_PublicOutreach.pdf
World Resources Institute CCS and Community Engagement Guidelines	7-12, 18-28	http://www.wri.org/publication/ccs-and-community-engagement
Research and Writing		
Find one news story in the media that reflects <i>either</i> positive or negative public views on a project in your region (related to CCS or energy development) – write a brief paragraph how you think public outreach influenced this project		
Complete Module 1 Assessment		

2. Outreach in CCS Case Studies from around the World

- a. Examples of projects and public outreach strategies
 - i. From other energy project and related industries
 - ii. CCS – International
 - iii. CCS – National
 - iv. Media influence on projects

Module 2 Reading & Assignments:

<i>Reading</i>	<i>Pages</i>	<i>Sources</i>
CRS Report for Congress: Community Acceptance of Carbon Capture and Sequestration Infrastructure: Siting	1-20	http://openocrs.com/document/RL34601/

Challenges by Paul W. Parfomak		
World Resources Institute CCS and Community Engagement Guidelines	37-52	http://www.wri.org/publication/ccs-and-community-engagement
NYTimes Article: A Town's Lonely Struggle Shows CO2 Fears Here to Stay	All	http://www.nytimes.com/gwire/2010/05/11/11greenwire-a-towns-lonely-struggle-shows-co2-fears-here-to-218.html
Module 2 Assessment		

3. How It's Done: Public Outreach and Education Methods and Tools

- a. Resources to help you
 - i. DOE Best Practices Manual
 - ii. WRI Guidelines
 - iii. CSIRO Publications
 - iv. Journal Articles and Books
 - v. Websites
 - vi. People in the Field
 - vii. Conferences
- b. Planning and integration with overall CCS project
- c. Getting buy-in from project managers/bosses
- d. Forming your outreach/communications team

Module 3 Reading & Assignments:

<i>Reading</i>	<i>Pages</i>	<i>Sources</i>
DOE Best Practices for Public Outreach and Education for Carbon Storage Projects	38-41	http://www.netl.doe.gov/technologies/carbon_seq/refshelf/BPM_PublicOutreach.pdf
World Resources Institute CCS and Community Engagement Guidelines	53-78	http://www.wri.org/publication/ccs-and-community-engagement
Communication, project planning and management for carbon capture and storage projects: An international comparison	4-7	http://www.globalccsinstitute.com/resources/publications/communication-project-planning-and-management-carbon-capture-and-storage-proj
Research and Assignment		
Use the template provided to fill in examples of outreach activities that could be coordinated with a CCS project		Module3Template.pdf
Complete Module 3 Assessment		

4. Community Research – Social Site Characterization

- a. An Overview
- b. Key Questions to Consider
- c. Methods

d. Common Concerns and Questions

Module 4 Reading & Assignments:

<i>Reading</i>	<i>Pages</i>	<i>Sources</i>
DOE Best Practices for Public Outreach and Education for Carbon Storage Projects	42-43	http://www.netl.doe.gov/technologies/carbon_seq/refshelf/BPM_PublicOutreach.pdf
Communication, Project Planning and Management for Carbon Capture and Storage Projects: An International Comparison by Ashworth et al.	8-10	http://www.globalccsinstitute.com/resources/publications/communication-project-planning-and-management-carbon-capture-and-storage-project-planning-and-management.pdf
Afraid to Start Because the Outcome is Uncertain?: Social Site Characterization as a Tool for Informing Public Engagement Efforts by Wade and Greenberg	All	www.sciencedirect.com
FutureGen Case Study by Hund and Greenberg	7-25	http://www.csiro.au/resources/FutureGen-case-study.html
Complete Module 4 Assessment		

5. Development of an Outreach Strategy and Communications Plan

- a. Introduction to Outreach Strategy Development
- b. Outreach Strategy Components
- c. Background Information on Communications
- d. Communications Plan Development

Module 5 Reading & Assignments:

<i>Reading</i>	<i>Pages</i>	<i>Sources</i>
DOE Best Practices for Public Outreach and Education for Carbon Storage Projects	38-41, 44-47	http://www.netl.doe.gov/technologies/carbon_seq/refshelf/BPM_PublicOutreach.pdf
Involving the Community E-book by Guy Bessette	7-14	http://www.idrc.ca/openbooks/066-7/
CO2CRC Otway Project Case Study by Ashworth, Rodriguez & Miller	7-20	http://www.csiro.au/resources/Otway-case-study.html
Review the two Strategic Communications Plan Templates from www.SPINproject.org and WK Kellogg Foundation	all	Download SPIN's Strategic Communications Plan Generator here http://www.spinproject.org/article.php?id=113 and the Kellogg Foundation Plan here http://ww2.wkkf.org/default.aspx?tabid=1172&NID=&ItemID=5000009&L

		anguageID=0
Handout on Pretesting materials by Escalada	1-8	http://devcompagne.com/wp-content/uploads/2010/12/Pretesting-and-evaluation.pdf
Complete Module 5 Assessment		

6. Working Within and Beyond the Regulatory Environment

- a. History of public participation in environmental policy
- b. Overview of regulatory topics
- c. Regulatory frameworks
 - i. Federal
 - ii. State
- d. Public participation
- e. Working with public and private organizations

Module 6 Reading & Assignments:

<i>Reading</i>	<i>Pages</i>	<i>Sources</i>
EPA Basic Information on Wells and Classes of Wells Webpage	All	<ol style="list-style-type: none"> 1. http://water.epa.gov/type/groundwater/uic/basicinformation.cfm 2. http://water.epa.gov/type/groundwater/uic/wells.cfm
EPA Class IV overview Webpage	All	http://water.epa.gov/type/groundwater/uic/wells_sequestration.cfm
EPA Guidelines – Public Considerations Guidelines – .pdf document	1-3	http://water.epa.gov/type/groundwater/uic/class6/gsguidedoc.cfm see link at bottom of page under Guidance Document
See regulatory presentation by John Talbott presented at AAPG Rocky Mountain Section 58th Annual Rocky Mountain Rendezvous, Durango, Colorado, June 13-16, 2010	All slides	http://www.searchanddiscovery.net/abstracts/pdf/2010/rms/abstracts/ndx_talbott.pdf
Spectrum on Public Participation from IAP2	All	http://www.iap2.org/displaycommon.cfm?an=5 see last link on bottom of page
World Resources Institute CCS and Community Engagement Guidelines	13-14, 80-81	http://www.wri.org/publication/ccs-and-community-engagement
Complete Module 6 Assessment		

7. Communications – Getting the Message out Effectively

- a. Communication: Some General Principles & Tips
- b. Crafting messages
- c. Risk Communication
- d. Interacting with the media

Module 7 Reading & Assignments:

Reading	Pages	Sources
Public Participation Tool Box from IAP2		http://www.iap2.org/associations/4748/files/06Dec_Toolbox.pdf
A Primer on Perceptions of Risk, Risk Communication and Building Trust by Peter S. Adler and Jeremy L. Kranowitz	1-41	http://www.netl.doe.gov/technologies/carbon_seq/refshelf/reg-issues/TKC%20Risk%20Paper.fin.pdf
Ezine article: Media Training - The Five Biggest Mistakes Scientists Make and How to Avoid Them by Brad Phillips		http://ezinearticles.com/?Media-Training-Tips---The-Five-Biggest-Mistakes-Scientists-Make---And-How-You-Can-Avoid-Them&id=4196161
Complete Module 7 Assessment		

8. Additional Outreach and Education Tools

- a. Crisis Communications
- b. Social Media
- c. Overview of types of outreach events
- d. Facilitation Skills
- e. Take home points for effective outreach and education

Module 8 Reading & Assignments:

Reading	Pages	Sources
DOE Best Practices for Public Outreach and Education for Carbon Storage Projects	47-59	http://www.netl.doe.gov/technologies/carbon_seq/refshelf/BPM_PublicOutreach.pdf
Read Facilitation 101 by Edward S. Ruete	all	http://www.iaf-world.org/i4a/pages/Index.cfm?pageid=3292
Check out Media Interview Tips Webpage by MediaMastersTraining.com		http://www.mediamasterstraining.com/mediatips.html
Watch Social Media Revolution 2 YouTube video by SocialNomics09		http://www.youtube.com/watch?v=1FZ0z5Fm-Ng
Complete Module 8 Assessment		

Syllabus for 'CCS Site Exploration: Best Practices'

Course Number: WCTI 104

Title: *CCS Site Exploration: Best Practices*

Delivery: Online

Presentation Mode: Asynchronous

Estimated Online Hours: 11.1

UW CEUs: 1.1

Completion Deadline: 3 months

Cost: \$2000

Course Objectives: This course reviews the best practice guidelines published by DOE for characterizing a geological carbon storage site. The course will use this background to discuss the information necessary to move a storage site through the review and permitting stages to operation.

Learning Goals: The specific learning goals of this course are to:

- Provide a general overview of geologic storage;
- Identify key physical, geologic and chemical characteristics of the injection zone, confining system and carbon dioxide stream;
- Examine the roles of geologic, geomechanical, and CO₂ injection and migration modeling in site characterization; and
- Assess the potential impacts on ground and surface waters, atmosphere, and human health and safety.

Course Organization: This is an online, asynchronous course delivered via the Web. The course should take approximately 11.1 hours of online time to complete. In addition, all course activities and assignments must be completed within three (3) months after beginning the course. The final grade for the class is pass/fail and 1.1 University of Wyoming Continuing Education Units (CEUs) will be awarded for a passing grade. Organizationally, the course consists of suggested reading assignments (both online and in PDF format), and various learning assessments (see next section). There are approximately 3-5 pages of supplemental reading per online hour of coursework. To support learning, the course has a comprehensive, searchable glossary, online instructor support and an extensive supplemental reading list. In addition, educational technology support is provided by online technical support from WCTI's information technology staff.

Assessment: To receive course credit, the student must demonstrate a basic level of mastery of the best practices for geologically characterizing a potential carbon storage site. This mastery will be assessed through formative assessment instruments. Formative assessments will be conducted after completion of specific learning modules. These will be completed online and submitted electronically to WCTI for evaluation. Assessments will be evaluated within two (2) days of submittal and returned to the student electronically. The student may continue to the next learning unit while assessments are being evaluated. In the event of an unsatisfactory

performance on an assessment, the student shall have the opportunity to retake the assessment within one (1) week. There are 8 formative assessments to be completed throughout the course. Each formative assessment will cover an average of 1 hour of online coursework, and will consist of 10-15 questions with topics that are spread evenly among the major concepts learned since the last assessment. Assessments consist of fill-in the blank, matching and multiple choice questions and short answer questions.

Upon successful completion of the course, a student will earn 1.1 University of Wyoming CEUs. For purposes of attaining WCTI certification, these CEUs will remain valid for four (4) years after their initial award.

CCS Site Exploration: Best Practices

Course Outline: 8 Modules

Module 1: Introduction

- 1.1 Review of Climate Change
- 1.2 Why CCS?
- 1.3 U.S. Regulations of CCS
- 1.4 Potential CO₂ Storage Sites
- 1.5 Summary
- 1.6 Exercise & Assessment

Module 2: Site Exploration Overview

- 2.1 Site Exploration
 - 2.1.1 Project Definition and Management
 - 2.1.2 Site Screening
 - 2.1.3 Site Selection
 - 2.1.4 Initial Site Characterization
- 2.2 Site Characterization
- 2.3 Implementation
- 2.4 Summary
- 2.5 Exercise & Assessment

Module 3: Site Screening – Part 1

- 3.1 Site Screening Overview
- 3.2 GS Rule Requirements for Regional & Site Geology
- 3.3 Subsurface Data Analysis
 - 3.3.1 Geologic Characteristics of Reservoirs
 - 3.3.2 Adequate Depth
- 3.4 Summary
- 3.5 Exercise & Assessment

Module 4: Site Screening – Part 2

- 4.1 Site Screening Overview
- 4.2 Subsurface Data Analysis
 - 4.2.1 Confining Zone – Well Review
 - 4.2.2 Confining Zone – Sealing Capacity
 - 4.2.3 Confining Zone – Potential Leakage Paths
 - 4.2.4 Prospective Storage Resources
- 4.3 Regional Proximity Analysis
 - 4.3.1 Groundwater
 - 4.3.2 Protected & Sensitive Areas
 - 4.3.3 Population Centers & Existing Development
- 4.4 Social Context Analysis
- 4.5 Summary
- 4.6 Exercise & Assessment

Module 5: Site Selection – Part 1

- 5.1 Site Selection Overview
- 5.2 Subsurface Data Analysis
 - 5.2.1 Well Log Review & Interpretation
 - 5.2.2 Injection Zone
 - 5.2.3 Confining Zone & Leaking Faults
 - 5.2.4 Confining Zone & Caprock Integrity
 - 5.2.5 Confining Zone & Well Integrity
 - 5.2.6 Existing Seismic
- 5.3 Summary
- 5.4 Exercise & Assessment

Module 6: Site Selection – Part 2

- 6.1 Site Selection – Subsurface Data Analysis
 - 6.1.1 Trapping Mechanisms
 - 6.1.1.1 Structural & Stratigraphic Trapping
 - 6.1.1.2 Residual Trapping
 - 6.1.1.3 Solubility Trapping
 - 6.1.1.4 Precipitation & Mineral Trapping
 - 6.1.2 Potential Injectivity
- 6.2 Site Selection -- Model Development
 - 6.2.1 Data Requirements & Cost
 - 6.2.2 Modeling Parameters
 - 6.2.3 Geomechanical Model Development
- 6.3 Site Selection – Subsurface Data Analysis Continued
 - 6.3.1 Storage Capacity Demonstration
- 6.4 Site Selection – Site Suitability Analysis
 - 6.4.1 Infrastructure
 - 6.4.2 Surface Access Issues
 - 6.4.3 AoR Requirements
 - 6.4.4 Pore Space Ownership

- 6.5 Summary
- 6.6 Exercise & Assessment

Module 7: Initial Characterization – Subsurface Data Analysis

- 7.1 Baseline Geological Data
- 7.2 Baseline Hydrogeological Data
- 7.3 Baseline Geochemical Data
- 7.4 Baseline Geomechanical Data
- 7.5 Flux Baselines
- 7.6 Summary
- 7.7 Exercise & Assessment

Module 8: Initial Characterization and Onward

- 8.1 Model Refinement
 - 8.1.1 CO₂ Injection & Migration Model
- 8.2 Additional Characterization – Well Testing
- 8.3 Additional Characterization – Seismic Acquisition
- 8.4 Summary
- 8.5 Exercise & Assessment

Syllabus for 'Underground Injection Control (UIC) and the new Class VI Well'

Course Number: WCTI 105

Title: *Underground Injection Control (UIC) and the new Class VI Well*

Delivery: Online

Presentation Mode: Asynchronous

Estimated Online Hours: 11.3

UW CEUs: 1.1

Completion Deadline: 3 months

Cost: \$2000

Introduction: In the United States, underground sources of drinking water (USDWs) are protected by the Safe Drinking Water Act (SDWA) and its various amendments. As part of this law, the U.S. Environmental Protection Agency (EPA) created the Underground Injection Control or UIC program. The UIC program is designed to regulate what is injected into the subsurface so that the quality of USDWs is protected. Originally, the program defined five classes of injection wells (I-V) associated with a variety of activities. Injections of hazardous liquid wastes, solvents for solution mining and municipal waste water disposal are regulated under the UIC program. In addition, disposal of produced and waste waters associated with hydrocarbon, i.e., oil and gas, production are also covered. Under the program, states are given the opportunity to regulate the UIC program within their own borders (primacy), provided their regulations are as stringent as the federal rules.

As carbon capture and storage (CCS) gained support as a potential means of reducing anthropogenic emissions of carbon dioxide, it became apparent that GCS injection wells would not fit readily into any of the existing UIC injection classes. In particular, the volume of material that would be injected in the operational lifetime of a sequestration well would be several magnitudes greater than for other types of liquids injected into the subsurface. At the same time, the wells would operate for much longer time periods (on the order of decades) and the injected carbon dioxide would have to remain safely sequestered for thousands of years. Despite not fitting into existing regulatory classes, the potential adverse impact of injected CO₂ on USDWs clearly requires careful regulation. To cover carbon sequestration activities, EPA, with input from a variety of stakeholders, has created a new UIC well class, Class VI, for geological carbon sequestration. This new well class was formally approved and promulgated in late 2010. Any sequestration operation in the U.S. now has to go through an extensive UIC Class VI permitting and review process. The Class VI category sets out an extensive array of requirements for a carbon sequestration well.

Course Objectives: This course is intended to introduce CCS professionals to the primary regulatory framework under which carbon dioxide injection will be carried out, i.e., the Underground Injection Control (UIC) program. Accordingly, it has the following two primary purposes:

- 1) provide a general review of the UIC program and its Class I-V wells; and, most importantly,
- 2) introduce the new Class VI well category and its requirements.

This course will introduce all CCS professionals to the basics of the UIC permitting process and examine the requirements and procedures for UIC permitting. It will thereby facilitate communication between project team members during the permit application process and understanding about the types of information necessary for a successful application.

Learning Goals: The specific learning goals of this course are to:

- Summarize the main provisions of the SDWA and, in particular, USDWs;
- Introduce the UIC program and its objectives;
- Recap the requirements of Class I-V wells;
- Review in detail the new Class VI well requirements; and
- Examine the requirements and procedures for UIC permitting.

Course Organization: This is an online, asynchronous course delivered via the Web. The course should take approximately 11.3 hours of online time to complete. In addition, all course activities and assignments must be completed within three (3) months after beginning the course. The final grade for the class is pass/fail and 1.1 University of Wyoming Continuing Education Units (CEUs) will be awarded for a passing grade. Organizationally, the course consists of reading assignments and various learning assessments (see next section). To support learning, the course has a comprehensive, searchable glossary, online instructor support and an extensive supplemental reading list. In addition, educational technology support is provided by online technical support from WCTI's information technology staff.

Assessment: To receive course credit, the student must demonstrate a basic level of mastery of CCS knowledge, principles and concepts. This mastery will be assessed through a combination of formative and summative assessments. Formative assessments will be conducted after completion of specific learning modules. These will be completed online and submitted electronically to WCTI for evaluation. Assessments will be evaluated within two (2) days of submittal and returned to the student electronically. The student may continue to the next learning module while assessments are being evaluated.

Upon completion of the course, the student must pass a comprehensive, summative assessment that evaluates the student's overall grasp of the course material. As with the formative assessment, this final assessment will be completed and submitted online. Upon successful completion of the course, an individual will earn 1.1 UW CEUs. For purposes of attaining WCTI certification, these CEUs will remain valid for four (4) years after their initial award.

Underground Injection Control and the new Class VI Well

Course Outline: 15 Modules

Module 1: Introduction

- 1.1 Review of climate change
- 1.2 Why CCS?
- 1.3 The Safe Drinking Water Act (SDWA)
 - 1.3.1 Underground Injection Control (UIC) Program
 - 1.3.1.1 Well Classes
- 1.4 The Clean Air Act's GHG Reporting Program's Subpart RR
- 1.5 EPA's general permitting procedures
- 1.6 Required Public Involvement
- 1.7 Summary
- 1.8 Assessment

Module 2: The GS Rule and Permit Overview

- 2.1 The GS Rule
 - 2.1.1 Elements
 - 2.1.2 Adaptive approach for updating
- 2.2 Class VI permits
 - 2.2.1 Facts
 - 2.2.2 Overview of required information
 - 2.2.3 Formal reviews
 - 2.2.3.1 With permit application
 - 2.2.3.2 Prior to well operation
 - 2.2.3.3 Periodically throughout operational phase
- 2.3 Summary

Module 3: Site Characterization

- 3.1 Purpose
- 3.2 Activities and data uses
- 3.3 Proof of site suitability
- 3.4 Permit requirements
 - 3.4.1 Injection and confining zone
 - 3.4.1.1 Stratigraphy
 - 3.4.1.2 Structure
 - 3.4.1.3 Mineralogy
 - 3.4.2 Porosity, permeability and injectivity
 - 3.4.3 Geochemical characterization
 - 3.4.4 Geomechanical characterization
 - 3.4.5 Geophysical characterization
 - 3.4.6 Storage capacity demonstration
 - 3.4.7 Confining zone integrity demonstration
 - 3.4.8 Additional information
- 3.5 Summary

3.6 Assessment for Modules 2 and 3

Module 4: Area of Review and Corrective Action

- 4.1 Purpose
- 4.2 AoR and corrective action Class VI well differences
- 4.3 Overview
- 4.4 AoR delineation procedures
 - 4.4.1 AoR re-evaluation
 - 4.4.2 UIC Program Director review
- 4.5 Corrective action procedures
 - 4.5.1 Phased
 - 4.5.2 Report on corrective action status
- 4.6 Plan updates
- 4.7 Summary
- 4.8 Assessment

Module 5: Financial Responsibility

- 5.1 History of financial responsibility requirements
 - 5.1.1 Comparison of well classes
- 5.2 Purpose
- 5.3 Components
 - 5.3.1 Cost estimate
 - 5.3.2 Independent third-party instruments OR self-insurance
 - 5.3.2.1 Required coverage conditions and specifications
 - 5.3.2.2 Recommendations for different GS activities
- 5.4 UIC Program Director review
- 5.5 Summary
- 5.6 Assessment

Module 6: Injection Well Construction and Pre-Injection Activities

- 6.1 Well construction
 - 6.1.1 Purpose
 - 6.1.2 Required elements
 - 6.1.3 UIC Program Director review
- 6.2 Re-injection activities
 - 6.2.1 Purpose
 - 6.2.2 Required elements
 - 6.2.3 UIC Program Director review
- 6.3 Additional tests prior to injection well operation
- 6.4 Summary

Module 7: Injection Well Operation and Mechanical Integrity

- 7.1 Injection well operation
 - 7.1.1 Purpose
 - 7.1.2 Required elements
 - 7.1.3 UIC Program Director review

- 7.2 Mechanical integrity
 - 7.2.1 Purpose
 - 7.2.2 Required elements
 - 7.2.3 UIC Program Director review
- 7.3 Summary
- 7.4 Assessment for Modules 6-7

Module 8: Testing and Monitoring

- 8.1 Purpose
- 8.2 Testing and monitoring plan
 - 8.2.1 Updates
 - 8.2.2 Results
- 8.3 Record retention
- 8.4 UIC Program Director review
- 8.5 Summary

Module 9: Reporting and Recordkeeping

- 9.1 Purpose
- 9.2 Required reports
- 9.3 Electronic reporting system
- 9.4 Recordkeeping
- 9.5 Summary

Module 10: Injection Well Plugging

- 10.1 Purpose
- 10.2 Injection well plugging plan
- 10.3 Notice of intent to plug
- 10.4 Plugging report
- 10.5 UIC Program Director review
- 10.6 Summary
- 10.7 Assessment for Modules 6-10

Module 11: Post-Injection Site Care (PISC) and Site Closure

- 11.1 Purpose
- 11.2 PISC and site closure plan
- 11.3 PISC period timeframe
- 11.4 Non-endangerment demonstration
- 11.5 Notice of intent for site closure
- 11.6 Site closure report
- 11.7 Site closure record retention
- 11.8 UIC Program Director review
- 11.9 Summary

Module 12: Emergency and Remedial Response (E&RR)

- 12.1 Purpose
- 12.2 E&RR plan
- 12.3 UIC Program Director review
- 12.4 Emergency response
- 12.5 Injection resumption
- 12.6 Summary
- 12.7 Assessment for Modules 11-12

Module 13: Class VI Injection Depth Waivers

- 13.1 Purpose
- 13.2 Supplemental report
- 13.3 UIC Program Director review
- 13.4 Public notification requirements
- 13.5 Documentation for Regional Administrator review
- 13.6 Special operating requirements for Class VI Well with waiver
- 13.7 Summary

Module 14: Re-Permitting Existing Injection Wells as Class VI Wells

- 14.1 Purpose
- 14.2 Well re-permitting not required
- 14.3 Well re-permitting from
 - 14.3.1 Class II
 - 14.3.2 Class V
- 14.4 Well re-permitting flowchart
- 14.5 Summary
- 14.6 Assessment for Modules 13-14

Module 15: Course Summary

- 15.1 Summary
- 15.2 Final assessment

Syllabus for 'Class VI Well Construction, Operation, Monitoring and Testing'

Course Number: WCTI 106

Title: *Well Construction, Operation, Monitoring and Testing*

Delivery: Online

Presentation Mode: Asynchronous

Estimated Online Hours: 5

UW CEUs: .5

Completion Deadline: 3 months

Cost: \$1000

Course Objectives: This course is intended to introduce CCS professionals to the construction and operating requirements of Class VI wells. Additionally, it introduces a variety of techniques for monitoring the injected CO₂ plume in the subsurface and for detecting any potential CO₂ leaks from the well or reservoir.

Learning Goals: The specific learning goals of this course are the following:

Describe the construction and operating requirements for Class VI injection wells;

Provide suggested options for meeting the Class VI Rule requirements for well materials, design and construction; and

Describe monitoring and testing techniques used to make CO₂ storage safe and effective

Course Organization: This is an online, asynchronous course delivered via the Web. The course should take approximately 5 hours of online time to complete. In addition, all course activities and assignments must be completed within three (3) months after beginning the course. The final grade for the class is pass/fail and .5 University of Wyoming Continuing Education Units (CEUs) will be awarded for a passing grade. Organizationally, the course consists of suggested reading assignments (both online and in PDF format), and learning assessments (see next section). To support learning, the course has a comprehensive, searchable glossary, online instructor support and an extensive supplemental reading list. In addition, educational technology support is provided by online technical support from WCTI's information technology staff.

Assessment: To receive course credit, the student must demonstrate a basic level of mastery of the best practices for well construction, operation, monitoring and testing at a carbon storage site. This mastery will be assessed through formative assessments. Formative assessments will be conducted after completion of specific learning modules. These will be completed online and submitted electronically to WCTI for evaluation. Assessments will be evaluated within two (2) days of submittal and returned to the student electronically. The student may continue to the next learning module while assessments are being evaluated. A passing grade for each assessment is 75%. In the event of an unsatisfactory performance on an assessment, the student shall have the opportunity to retake the assessment within one (1) week. There are 8 formative assessments to be completed throughout the course. Each formative assessment will consist of approximately 10 questions with topics that are spread evenly among the major concepts learned since the last assessment. Assessments consist of fill-in the blank, matching, multiple choice and short answer questions.

Upon successful completion of the course, a student will earn .5 University of Wyoming CEUs. For purposes of attaining WCTI certification, these CEUs will remain valid for four (4) years after their initial award.

Well Construction, Operation, Monitoring and Testing

Course Outline: 9 Modules

Module 1: Introduction

- 1.1 Review of Climate Change
- 1.2 CCS: Why?, What? and Where?
- 1.3 Site Exploration
- 1.4 U.S. Regulations of CCS
- 1.5 UIC Class VI Permits
- 1.6 Assessment

Module 2: Construction Requirements

- 2.1 Class II vs. Class VI
- 2.2 Mechanical Integrity
 - 2.2.1 Internal
 - 2.2.2 External
- 2.3 Class VI Injection Well Components
 - 2.3.1 Casing
 - 2.3.2 Liners
 - 2.3.3 Tubing
 - 2.3.4 Cement
 - 2.3.5 Packer
 - 2.3.6 Annulus
 - 2.3.7 Landing Nipples
- 2.4 Design Considerations
- 2.5 Permit Application
- 2.6 Assessment

Module 3: Stresses and Corrosion

- 3.1 Stresses
 - 3.1.1 Internal
 - 3.1.2 External
 - 3.1.3 Axial
 - 3.1.4 Safety Factor
- 3.2 Corrosion
- 3.3 Well Permit Application
- 3.4 Assessment

Module 4: Cementing

- 4.1 Cementing the Casing
- 4.2 Drilling Mud and Cementing
- 4.3 Cementing Horizontal Wells
- 4.4 Different Stage Options for Cementing
- 4.5 Reverse Circulation Cementing
- 4.6 Cement Top-off

- 4.7 Cement Compatibility
- 4.8 Cement Alteration
- 4.9 Increasing Cement Resistance
- 4.10 Cement Bond and Variable Density Logs
- 4.11 Assessment

Module 5: Operational Requirements and Permits

- 5.1 Required Equipment
- 5.2 Operations
- 5.3 Permit Application
- 5.4 Assessment

Module 6: Monitoring Techniques

- 6.1 Monitoring Techniques
- 6.2 Atmospheric Monitoring
- 6.3 Near-Surface Monitoring
- 6.4 Subsurface Monitoring
- 6.5 Assessment

Module 7: Applicability of Management Tools

- 7.0 Monitoring Tool Applicability
 - 7.0.1 Applicability for UIC Class VI Rule
 - 7.0.2 Applicability for GHG Reporting Rule
 - 7.0.3 Applicability for Reservoir Management
 - 7.0.4 Technology Field Readiness
 - 7.0.5 CO₂ Leak Detection or Quantification
- 7.1 Monitoring Plan Design
- 7.2 Risk Identification
- 7.3 Assessment

Module 8: Examples of Monitoring Techniques

- 8.1 Introduction
- 8.2 InSalah
- 8.3 Zero Emission Research and Technology Center (ZERT)
- 8.4 CO₂CRC Otway
- 8.5 Assessment

Module 9: Conclusions