

TITLE PAGE

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ABSTRACT:

This report details the activities of the Carbon Capture and Storage Training Northwest (CCSTNW) program 2009 to 2013. The CCSTNW created, implemented, and provided Carbon Capture and Storage (CCS) training over the period of the program. With the assistance of an expert advisory board, CCSTNW created curriculum and conducted three short courses, more than three lectures, two symposiums, and a final conference. The program was conducted in five phases; 1) organization, gap analysis, and form advisory board; 2) develop list serves, website, and tech alerts; 3) training needs survey; 4) conduct lectures, courses, symposiums, and a conference; 5) evaluation surveys and course evaluations. This program was conducted jointly by Environmental Outreach and Stewardship Alliance (dba. Northwest Environmental Training Center – NWETC) and Pacific Northwest National Laboratories (PNNL).

TABLE OF CONTENTS:

Page	Section	
1	Title	
2	Disclaimer	
3	Abstract	
3	Table of Contents	
4-5	Executive Summary	
6	Report Details	
6-26	Program Activities	
26-32	Program Milestones Log	
33	Results and Discussions	
33-34	Conclusion	
35-44	Appendix 1	

EXECUTIVE SUMMARY:

This report details the activities of the Carbon Capture and Storage Training Northwest (CCSTNW) program 2009 to 2013. The CCSTNW created, implemented, and provided Carbon Capture and Storage (CCS) training over the period of the program. With the assistance of an expert advisory board, CCSTNW created curriculum and conducted three short courses, more than three lectures, two symposiums, and a final conference. The program was conducted in five phases; 1) organization, gap analysis, and form advisory board; 2) develop list serves, website, and tech alerts; 3) training needs survey; 4) conduct lectures, courses, symposiums, and a conference; 5) evaluation surveys and course evaluations. This program was conducted jointly by Environmental Outreach and Stewardship Alliance (dba. Northwest Environmental Training Center – NWETC) and Pacific Northwest National Laboratories (PNNL).

During phase 1 the CCSTNW program was set up and structures created then utilized the advisory board to further clarify activities and directions. A project management plan was organized as well as a preliminary marketing plan and training gap analysis. At this point the CCSTNW outreach process was underway determining the viability and best practices necessary to conduct a successful program.

Phase 2 provided the opportunity to develop the CCSTNW web site, list serves, and newsletters. The web page was modeled after the NWETC's web page that has provided information and training registration over the last fourteen years. Along with information and class registration, the web site also allowed for the posting of relevant videos and course videos to be viewable online. The newsletter and CCSTNW blogs were also present on the site. The list serve process benefitted from utilizing, when appropriate, the extensive NWETC database.

Next, phase 3 conducted a training needs survey with several potential audiences. The feedback from this process tended to mirror society as a whole with a relative lack of interest in CCS. One might connect this potential lack of interest with unsuccessful greenhouse gas legislation and consequent political shifts that occurred. That being said, there were small pockets of interest across professional associations, engineers, as well as local and state politicians. This feedback also led to the shape and form that the training would eventually take.

Phase 4 makes up the bulk of the CCSTNW program and deliverables. The initial lecture was delivered as a part of the STOMP class conducted in Utah. Then next lectures were to the USGS Oregon Water Science Center, WSPE Washington chapter in Renton, Wa., and to CCS Project Developers Wa. D.C.. The first short course partnered with the University of Utah and provided an introductory course on its state of the art Subsurface Transport over Multiple Phases (STOMP) simulator. The course was held October 26-27 at the University of Utah. STOMP is a suite of computer codes used in tackling subsurface multifluid flow and reactive

transport problems. This course combined lectures by PNNL coding staff with dynamic computer laboratory activities to give students a broad understanding of the simulator and its applications. The next courses were the 1st and 2nd annual “Fundamentals of Carbon Capture and Storage” held over 2 days at PNNL offices in Richland, WA. These courses included a comprehensive look at CCS as well as laboratory and related facility tours of the PNNL campus and included various CCS experts as instructors. The first symposium was delivered in partnership with the University of Washington’s Department of Professional and Continuing Education. This provided a state of CCS presentation followed by panel and a Q & A period. The second symposium was conducted in Portland, Ore. at the World Trade Center partnering with local universities and NGO’s. This event provided a brief background of CCS and then moved on to the ongoing research and policy issues followed by Q and A. The final major deliverable of the project was a two day conference delivered in partnership with Whitman University Geology Department. The conference utilized the Subsurface Transport over Multiple Phases (Stomp) modeling tool with university students.

The final phase 5 looked at course and program evaluations and please note that these were reviewed after events and on a ongoing basis throughout phase 4 of the project. This provided program and process improvements that were applied to each consequent deliverable. The project concluded with web presentation of the entire project to NETL staff. The remainder of this report includes the following sections; report details including program activities and milestone log, results and discussions, and a conclusion.

REPORT DETAILS:

Program Activities

Date: June 30, 2010

EOS Alliance continued to work closely with its key partners to update numerous process driven documents. During Q2 EOS and its partners met both in-person and with scheduled conference calls, to update:

- Project management plan
- Project marketing plan and
- Partner agreements

The partnership gathered and extended invitations to national and regional experts to participate on the CCSTNW initial Advisory Board. Ten Advisory Board members responded to the invitation and the first Advisory Board meeting was held June 24, 2010 (minutes included in appendix 1 of this report).

During the second quarter, a systematic approach was developed launching a discovery process for brand integrity through the symbolic naming / logo to firmly solidify the CCST future. Since project objectives are to develop regional sequestration technology training to facilitate the transfer of knowledge and technologies required for site development, operations, and monitoring of commercial CCS projects, it is critical for the project to provide a clearly unique, but identifiable, name and graphic to drive traffic to its website. This website will be the primary public portal for gaining current CCS information and to register for CCS training in the Pacific Northwest. The site will be database driven for content and client data management and will include an e-commerce section for training events and registration, Tech Updates and monthly CCS newsletters.

Requests for Proposals were written for both the branding and naming project for website development. The first RFP for website development was released to 20 organizations in March. Nine organizations responded. Extensive interviews were conducted with five of the RFP award candidates. A comprehensive rating system was applied to each, further defining a direct match to the specific criteria required within the RFP. The award was presented to EfelleMedia, located in Seattle, WA.

EfelleMedia met 95% of the requirements. Extensive interviews were conducted with their references, receiving positive alignment with the projects goals, declaring them as highly communicative, process based, delivering on time, within budget and holding a high degree of creativity for matching design to audience preference.

RFP number two was released simultaneous to nine public relations agencies. It was designed to solicit bids for the creation and design of branding, naming and logo for the website and project. This process was considered critical to establish a solid and unified vision for all CCST programs with its partners, vendors, and future students.

Award for this RFP was made on April 10, 2010 to RiverBed, also a Seattle, WA company. Its bid matched 100% all the requirement of the RFP. The one-on-one interviews showed their company to hold a well-aligned understanding of the unique qualities required for success within training programs and non-profit entities. It also provided a concise outline and timeline for the discovery process, which met a difficult schedule for outcomes in cooperation with the website development team.

In summary the following deliverables were achieved.

By the end of Q2: EOS has

- Established an Advisory Board with up to 10 members. Set first in person meeting on June 24, 2010;
- Updated the Project Management Plan to meet Department of Energy (DOE) and EOS needs;
- Made contact with other carbon capture and storage (CCS) groups via a conference to introduce CCST Northwest;
- Established an outline and table of contents for performing a gap analysis to determine what training content and format will be most useful to our audience;
- Worked with Washington Society of Professional Engineers (WSPE) to develop a viable marketing plan;
- Executed two RFP for the development of a brand, name, graphic logo and website development;
- Hired a Project Director for project oversight and management;
- Educational Program instituted – CCS 101 video course was shot and completed;
- Website development continued.

Date: Sept. 30, 2010

During Q3: EOS has done the following:

- Worked with Washington Society of Professional Engineers (WSPE) to develop a viable marketing plan

- Hired New Program Director for project oversight and management, Bill Huhta.
- New P.I. took over CCS program – James Workman and also took over as Executive Director of EOS Alliance.
- Educational Program instituted – CCS 101 video course was shot and completed and uploaded to the CCS website.
- Website development required significant project hours during Q3 and went live Oct. 1, 2010.
- Registered to Attend Future Energy Washington Conference, Nov. 8-10 at the Convention Center to further promote the outreach of our grant and eventual completion of our milestones.
- Registered to Attend Northwest Environmental Energy conference , Nov. 6-7 at the Portland Red Lion. Due to the location, this conference will attract a wider regional audience. Our goal will be to further promote the outreach of our grant and eventual completion of our milestones.
- PI report was submitted.
- Met with Willis Turner to further our Q4 and Q1 2011 – Marketing plans
- Met with NEBC – Robert Grott, Exec. Dir. Of Northwest Environmental Business Council to discuss future class offerings and development of CCS classes.
- Framework for future classes being developed for Q1 and 2 of 2011.
- Planned a STOMP class via PNNL Labs to be offered at the end of Oct. 2010. – course description pasted below.
- Held phone and in person meetings with PNNL – Gretchen Hund to continue program development, class content organization, and continued collaborating on all areas of CCS.
- Prepared for October meeting in Pittsburg. Prepared tabling items and PowerPoint presentation collaboratively with PNNL – Gretchen Hund and Charlotte Sullivan.

Any items not captured will be noted in the Q4 report.

PNNL is offering an introductory course on its STOMP simulator

Pacific Northwest National Laboratory (PNNL), in conjunction with the University of Utah, is providing an introductory course on its state of the art STOMP simulator. The course will be held October 26-27 at the University of Utah. STOMP is a suite of computer codes used in tackling subsurface multifluid flow and reactive transport problems. This course combines lectures by PNNL coding staff with dynamic computer laboratory activities to give students a broad understanding of the simulator and its applications.

The simulator itself is a package of 'operational modes' designed for tackling a wide variety of complex conservation equations. This tool's versatility is illustrated by the breadth of applications that it has for both field and laboratory investigations. It has been used in analyzing the following: geologic nuclear waste repositories; radionuclide transport; unsaturated zone hydrology; reactive barriers; nuclear waste tank thermal histories; surface barriers; freeze walls; soil desiccation; soil vapor extraction; volatile organic migration and fate; dense nonaqueous phase migration and natural attenuation; geologic sequestration of greenhouse gases; coupled reactive transport; oil shale production; and natural gas hydrate production.

This 2-day course is being offered for a fee of \$200 (discounted student rate: \$50), which includes lunch and all course materials. Students interested in obtaining a STOMP software license can do so at the STOMP website: <http://stomp.pnl.gov/licensing.stm>

To register for the course, visit the following link: <https://www.regonline.com/builder/site/Default.aspx?EventID=901754>

Date: Dec. 31, 2010

Current Quarter Activities

Brief summaries and activities to report for this quarter are noted below with corresponding HQ Milestones and Program Milestones respectively.

1) **10/4 HQ-5 Milestone Complete first classes for regional training. Mcgrail 101 Lecture series online.**

10/26-27 HQ-5 Milestone STOMP class offered at University of Utah.

Pacific Northwest National Laboratory (PNNL), in conjunction with the University of Utah, is providing an introductory course on its state of the art STOMP simulator. The course will be held October 26-27 at the University of Utah. STOMP is a suite of computer codes used in tackling subsurface multifluid flow and reactive transport problems. This course combines lectures by PNNL coding staff with dynamic computer laboratory activities to give students a broad understanding of the simulator and its applications. The simulator itself is a package of 'operational modes' designed for tackling a wide variety of complex conservation equations. This tool's versatility is illustrated by the breadth of applications that it has for both field and laboratory investigations. It has been used in analyzing the following: geologic nuclear waste repositories; radionuclide transport; unsaturated zone hydrology; reactive barriers; nuclear waste tank thermal histories; surface barriers; freeze walls; soil desiccation; soil vapor extraction; volatile organic migration and fate; dense nonaqueous phase migration and natural attenuation; geologic sequestration of greenhouse gases; coupled reactive transport; oil shale production; and natural gas hydrate production.

This 2-day course is being offered for a fee of \$200 (discounted student rate: \$50), which includes lunch and all course materials. Students interested in obtaining a STOMP software license can do so at the STOMP website: <http://stomp.pnl.gov/licensing.stm>

2) **11/1 HQ-6 Milestone** Trainers visit one field site . Charlotte Sullivan is a trainer and has visited the field location several times.

3) **11/8-10 PM 4.25 Networking** Attended Future Energy conference in Seattle, to further understand the direction and focus of Washington State's energy and carbon capture reduction initiatives.

4) **11/18 PM 4.29 Website Updates** Further developed the content within the Carbon Tech Alliance web site. Posted new article on CCS web site regarding Alberta's legislation to continue the development and deployment of CCS within this region in Canada. Posted new CCS technical and educational update links to website.

5) **12/ 6-7 PM 4.25 Networking** Attended the NW Environmental Conference and Trade show in Portland, OR to promote CCS and further educate the attendee's our involvement in CCS as well as the overall direction outlined by DOE.

6) **12/ 7 PM 4.26 Additional Lectures Delivered** Held Seminar at USGS Oregon Water Science Center

Title: The Big Sky Wallula CO2 Basalt Pilot

Charlotte Sullivan PNNL

USGS Oregon Water Science Center

Fall 2010 Seminar Series

Audience: 25 professional scientists and college students

Message Conveyed: Most of the attendees had no background on CCS. The following topics were covered:

- Review and Importance of CCS in addressing rise in atmospheric CO2
- Role of the DOE in CCS
- Role of State and Federal Regulation in CCS
- Washington State Department of Ecology and forward-looking CCS Requirements
- Types of CCS subsurface targets
- CCS Potential in the Pacific Northwest
- Columbia River Flood Basalt aquifers and seals
- The Wallula Pilot Project: significance, drivers, objectives, hurdles and project significance

- Geophysical, Geologic and Hydrologic characterization
- Results and Path Forward
- Importance of community support

7) **12/ 8 PM 4.25 Networking** Met with the Mayor of Issaquah and other city leaders to share our involvement within CCS and what we're doing with D.O.E.

8) **12/21 PM 4.10 2nd Course Developed** Met with PNNL, Gretchen Hund to further discuss and plan the execution of the 2nd set of CCS educational courses.

i) We see the target audience being decision makers – legislative staff in Olympia, political types, community leaders all interested in getting smart on CCS. A thought is that we would have a different person for each of these to mix it up and we would fill in the remainder of the time with a lab tour and visit to Wallula. Seven segments (90 minutes each):

- a. What is CCS, why is it important?
- b. How do you select an appropriate site?
- c. How are CCS projects permitted?
- d. How do you characterize a potential site?
- e. What are the risks involved and how do you manage them during operation and long-term (monitoring, verification, and accounting)?
- f. Why is public perception important and how so you assess stakeholder acceptance?
- g. What is the status of CCS being implemented regionally, nationally, and globally?

9) **12/22 PM 2.4 Design Tech Alerts** Continued the outreach of CCS within the social media space on our Twitter and Facebook sites.

Date: Mar. 31, 2011

Current Quarter Activities

Brief summaries and activities to report for this quarter are noted below with corresponding HQ Milestones and Program Milestones respectively.

- 1) **1/20- 3/31 4.31 Administrative Support** – Weekly conference call instituted and lead to significant progress in all areas of the program, increased accountability with the partners and complete .
- 2) **1/20- 3/31 1.7 Advisory Board Meets** – planned both video conference with Advisory Board as well as the in person meeting.
- 3) **2/8 PM 4.29 Website Updates** Continued relevant development of the site making it ready for current and future class offerings. Updated FAQ's and reorganized pages.
- 4) **2/15 1.5 Preliminary Marketing Plan** – updated and reviewed marketing plan.
- 5) **3/17 4.22 3rd Lecture Delivered** - Hund – CCS Project Developers – Public Perceptions. Wa. D.C.
- 6) **3/24 4.24 Certification Program** – developed professional development hours for CCS course in Richland WA.
- 7) **1/10- 3/31 2.1 Listserve Development** – formed EOS database to target appropriate CCS targets. Developed CCS postcard with WSP and PNNL, 23,000 to be mailed in hard copy to State of Washington Engineers.
- 8) **2/1- 3/31 PM 4.25 Networking** - developed and commenced social media campaigns with twitter, facebook, and YouTube. Logged in and accessed NETL Sharepoint site and formed list of documents to share on the site.
- 9) **2/1- 3/31 PM 4.30 Newsletter Developed** with partners – format, content, style, etc.
- 10) **2/13- 3/31 PM 4.10 2nd Course Developed** Met with PNNL, Gretchen Hund to further discuss and plan the execution of the 2nd set of CCS educational courses. All class logistics were planned and set up.

- i) We see the target audience being decision makers – legislative staff in Olympia, political types, community leaders all interested in getting smart on CCS. A thought is that we would have a different person for each of these to mix it up and we would fill in the remainder of the time with a lab tour and visit to Wallula. Seven segments (90 minutes each):
- a. What is CCS, why is it important?
 - b. How do you select an appropriate site?
 - c. How are CCS projects permitted?
 - d. How do you characterize a potential site?
 - e. What are the risks involved and how do you manage them during operation and long-term (monitoring, verification, and accounting)?
 - f. Why is public perception important and how so you assess stakeholder acceptance?
 - g. What is the status of CCS being implemented regionally, nationally, and globally?

11) **3/31** **PM 2.4 Design Tech Alerts** - Continued the outreach of CCS within the social media space on our Twitter and Facebook sites.

12) **3/31** **HQ-7 Milestone** Yearly Review Meeting. Developed Yr. 2 HQ Milestones.

Date: Jun. 30, 2011

Current Quarter Activities

Brief summaries and activities to report for this quarter are noted below with corresponding HQ Milestones and Program Milestones respectively.

- 1) **4/1- 6/30 PM 4.31 Administrative Support** – Weekly conference call instituted and lead to significant progress in all areas of the program, increased accountability with the partners.
- 2) **4/1- 6/30 PM 5.4 Advisory Board Meets** – virtual and phone conference meetings throughout quarter.
- 3) **4/1- 6/30 PM 4.29 Website Updates** Added video and consulted with company to increase future capability and function of web site.
- 4) **5/16 PM 4.30 Newsletters** – Delivered newsletter to listserve and Board.
- 5) **4/1- 6/30 PM 4.24 Certification Program** – developed and delivered professional development hours for CCS course in Richland WA.
- 6) **4/1- 6/30 PM 4.25 Networking** - continued development of social media campaigns with twitter, Facebook, and YouTube. Logged in and accessed NETL Sharepoint site and formed list of documents to share on the site.
- 7) **6/14 - 6/15 PM 4.14 2nd Course Delivered** Collaborated with PNNL to deliver 2 day course that contained the following.
 - h. What is CCS, why is it important?
 - i. How do you select an appropriate site?
 - j. How are CCS projects permitted?
 - k. How do you characterize a potential site?
 - l. What are the risks involved and how do you manage them during operation and long-term (monitoring, verification, and accounting)?
 - m. Why is public perception important and how so you assess stakeholder acceptance?
 - n. What is the status of CCS being implemented regionally, nationally, and globally?

- o. Managing Liability related to CCS.

Location: Richland, WA at Battelle, PNNL Campus.

Attendees: Governmental Agencies, Legislative Representatives, PNNL Staff, Private and Consulting organizations.

Class Structure – Included various presentations and teaching by instructors, extensive lab tours, hands-on activity in lab with basalt and the injection process.

Instructor Expertise – Dr. Pete McGrail – PNNL, Tom Anderson - PNNL, John Stormon - Wa. Dept. of Ecology, Wayne Rowe – Schlumberger, Dr. Lee Gresham – Carnegie Mellon Univ., Dr. Charlotte Sullivan – PNNL, Gretchen Hund - PNNL

Video Development – captured complete course footage for potential online offerings. Also captured footage for video promotion and marketing purposes.

Feedback – Class was an overwhelming success with attendees as reflected by the evaluations.

- 8) **6/27 PM 4.11 Symposium 1 Description** – Met with potential Symposium 1 Host and discussed preliminary program.
- 9) **4/1- 6/30 PM 2.4 Design Tech Alerts** - Continued the outreach of CCS within the social media space on our Twitter and Facebook sites.

Date: Sept 30, 2011

Current Quarter Activities

Brief summaries and activities to report for this quarter are noted below with corresponding HQ Milestones and Program Milestones respectively.

- 1) **7/1- 9/30 PM 4.31 Administrative Support** – Weekly conference call instituted and lead to significant progress in all areas of the program, increased accountability with the partners.
- 2) **7/1- 9/30 PM 5.4 Advisory Board Meets** – virtual and phone conference meetings throughout quarter.
- 3) **7/1- 9/30 PM 4.29 Website Updates** Added video and consulted with company to increase future capability and function of web site.
- 4) **7/1- 9/30 PM 4.30 Newsletters** – Delivered newsletter to listserve and Board.
- 5) **7/1- 9/30 PM 4.25 Networking** - continued development of social media campaigns with twitter, Facebook, and YouTube. Logged in and accessed NETL Sharepoint site and formed list of documents to share on the site.
- 6) **7/1- 9/30 PM 4.14 2nd Short Course Delivered** – Course Videos - Produced and edited course summary and individual lectures in video format. Posted on Website.
- 7) **7/1- 9/30 PM 4.11 Symposium 1 Description** – Met with potential Symposium 1 Host and discussed preliminary program. Decided on Nov. 30 as date.
- 8) **7/1- 9/30 PM 2.4 Design Tech Alerts** - Continued the outreach of CCS within the social media space on our Twitter and Facebook sites.

Date: Dec 31, 2011

Current Quarter Activities

Brief summaries and activities to report for this quarter are noted below with corresponding HQ Milestones and Program Milestones respectively.

- 1) **10/1- 12/31** **PM 4.31 Administrative Support** – Weekly conference call instituted and lead to significant progress in all areas of the program, increased accountability with the partners.

- 2) **10/1- 12/31** **PM 4.29 Website Updates** Added video and consulted with company to increase future capability and function of web site.

- 3) **10/1- 12/31** **PM 4.30 Newsletters** – Delivered newsletter to listserve and Board.

- 4) **10/1- 12/31** **PM 4.25 Networking** - continued development of social media campaigns with twitter, Facebook, and YouTube. Logged in and accessed NETL Sharepoint site and formed list of documents to share on the site. Monthly conference call with all seven national training centers

- 5) **10/1- 12/31** **PM 4.13 Symposium 1 Delivered** –November 30th, Carbon Tech Alliance hosted its fall symposium on Carbon Capture and Storage (CCS) in conjunction with the University of Washington’s Department of Professional and Continuing Education. The speakers included Pete McGrail, Ph.D., Laboratory Fellow, Pacific Northwest National Laboratory and Malcolm Wilson, Ph.D., Executive Director, Petroleum Technology Research Centre.

- 6) **10/1- 12/31** **PM 2.4 Design Tech Alerts** - Continued the outreach of CCS within the social media space on our Twitter and Facebook sites.

Date: Mar. 31, 2012

Current Quarter Activities

Brief summaries and activities to report for this quarter are noted below with corresponding HQ Milestones and Program Milestones respectively.

- 1) **1/1- 3/31 PM 4.31 Administrative Support** – Weekly conference call instituted and lead to significant progress in all areas of the program, increased accountability with the partners.
- 2) **1/1- 3/31 PM 4.29 Website Updates** Added video and consulted with company to increase future capability and function of web site, new site is being tested and should go live next quarter.
- 3) **1/1- 3/31 PM 4.30 Newsletters** – Delivered newsletter to listserve and Board. Completed and disseminated fourth quarterly newsletter on March 29th. The newsletter, CCS Exchange, was sent to 32,322 individuals from six states, British Columbia, Alberta, and Saskatchewan representing a variety of state, federal, and municipal entities, consulting firms and private parties.
- 4) **1/1- 3/31 PM 4.25 Networking** - continued development of social media campaigns with twitter, Facebook, and YouTube. Logged in and accessed NETL Sharepoint site and formed list of documents to share on the site. Monthly conference call with all seven national training centers. Attended Globe 2012 conference with permission of program coordinator. Over 10,000 attendees from over 80 countries to attend and international conference on green energy and business. We tabled as a part of the USA pavilion next to the US consulate booth. Enjoyed enthusiastic world-wide audience with the largest opportunity to date to share our CCS project.
- 5) **1/1- 3/31 PM 4.17 Symposium 2 Description** – Currently preparing for a spring symposium in Portland, OR. The event will take place on May 21st at the World Trade Center. The speakers include Casie Davidson, Senior Research Scientist, Pacific Northwest

National Laboratory, and Lucinda Low Swartz, Esq., Environmental Consultant. The two-hour event will start with a brief overview of CCS, followed by ongoing research that incorporates similar techniques used for CCS. The speakers will also address some of the policy aspects including facility siting considerations and federal regulatory requirements, potential career opportunities in the field and educational background that are in the most demand. Recruitment efforts are directed towards several of the environmental NGOs in Portland and the local universities.

- 6) **1/1- 3/31 PM 4.21 3rd Short Course Delivered** - Also preparing for the second annual 'Fundamentals of Carbon Capture and Storage' course. This event will take place in Richland, WA at the Pacific Northwest National Laboratory on July 31st and August 1st. Currently recruiting speakers and organizing site tours.
- 7) **1/1- 3/31 PM 2.4 Design Tech Alerts** - Continued the outreach of CCS within the social media space on our Twitter and Facebook sites.

Date: Jun. 30, 2012

Current Quarter Activities

Brief summaries and activities to report for this quarter are noted below with corresponding HQ Milestones and Program Milestones respectively.

- 1) **4/1- 6/30 PM 4.31 Administrative Support** – Weekly conference call instituted and lead to significant progress in all areas of the program, increased accountability with the partners.
- 2) **4/1- 6/30 PM 4.29 Website Updates** Added video and consulted with company to increase future capability and function of web site, new site is being tested and should go live next quarter.

- 3) **4/1- 6/30 PM 4.30 Newsletters** – Delivered newsletter to listserve and Board. Completed and disseminated fourth quarterly newsletter on March 29th. The newsletter, CCS Exchange, was sent to 32,322 individuals from six states, British Columbia, Alberta, and Saskatchewan representing a variety of state, federal, and municipal entities, consulting firms and private parties.
- 4) **4/1- 6/30 PM 4.25 Networking** - continued development of social media campaigns with twitter, Facebook, and YouTube. Logged in and accessed NETL Sharepoint site and formed list of documents to share on the site. Monthly conference call with all seven national training centers.
- 5) **4/1- 6/30 PM 4.17 Symposium 2 Description** – Conducted the spring symposium in Portland, OR. The event took place on May 21st at the World Trade Center. The speakers included Casie Davidson, Senior Research Scientist, Pacific Northwest National Laboratory, and Lucinda Low Swartz, Esq., Environmental Consultant. The two-hour event started with a brief overview of CCS, followed by ongoing research that incorporates similar techniques used for CCS. The speakers addressed some of the policy aspects including facility siting considerations and federal regulatory requirements, potential career opportunities in the field and educational background that are in the most demand. Recruitment efforts were directed towards several of the environmental NGOs in Portland and the local universities.
- 6) **4/1- 6/30 PM 4.21 3rd Short Course Delivered** - Also preparing for the second annual ‘Fundamentals of Carbon Capture and Storage’ course. This event will take place in Richland, WA at the Pacific Northwest National Laboratory on July 31st and August 1st. Currently recruiting speakers and organizing site tours.

4/1- 6/30 PM 2.4 Design Tech Alerts - Continued the outreach of CCS within the social media space on our Twitter and Facebook sites.

Date: Sept. 30, 2012

Current Quarter Activities

Brief summaries and activities to report for this quarter are noted below with corresponding HQ Milestones and Program Milestones respectively.

- 1) **7/1 – 9/30 PM 4.31 Administrative Support** – Weekly conference call instituted and lead to significant progress in all areas of the program, increased accountability with the partners.
- 2) **7/1 – 9/30 PM 4.29 Website Updates** Added video and consulted with company to increase future capability and function of web site. New site went live in August, a little bumpy with normal transition issues, but improvements are numerous.
- 3) **7/1 – 9/30 PM 4.30 Newsletters** – Delivered newsletter to listserve and Board. Completed and disseminated fifth quarterly newsletter. The newsletter, CCS Exchange, was sent to 32,322 individuals from six states, British Columbia, Alberta, and Saskatchewan representing a variety of state, federal, and municipal entities, consulting firms and private parties.
- 4) **7/1 – 9/30 PM 4.25 Networking** - continued development of social media campaigns with twitter, Facebook, and YouTube. Logged in and accessed NETL Sharepoint site and formed list of documents to share on the site. Monthly conference call with all seven national training centers.
- 5) **7/1 – 9/30 PM 4.21 3rd Short Course Delivered** - Delivered ‘Fundamentals of Carbon Capture and Storage’ course. This event took place in Richland, WA at the Pacific Northwest National Laboratory on July 31st and August 1st. Had fantastic line-up of speakers and solid program over 2 days.
- 6) **7/1 – 9/30 PM 2.4 Design Tech Alerts** - Continued the outreach of CCS within the social media space on our Twitter and Facebook sites.

Date: Dec 31, 2012

Current Quarter Activities

Brief summaries and activities to report for this quarter are noted below with corresponding HQ Milestones and Program Milestones respectively.

1) **10/1-12/31 PM 4.31 Administrative Support** – Weekly conference call instituted and lead to significant progress in all areas of the program, increased accountability with the partners.

2) **10/1-12/31 PM 4.29 Website Updates** Added video and consulted with company to increase future capability and function of web site. New site went live in August, a little bumpy with normal transition issues, but improvements are numerous.

3) **10/1-12/31 PM 4.30 Newsletters** – Delivered newsletter to listserv and Board. Completed and disseminated fifth quarterly newsletter. The newsletter, CCS Exchange, was sent to 32,322 individuals from six states, British Columbia, Alberta, and Saskatchewan representing a variety of state, federal, and municipal entities, consulting firms and private parties.

4) **10/1-12/31 PM 4.25 Networking** - continued development of social media campaigns with twitter, Facebook, and YouTube. Logged in and accessed NETL Sharepoint site and formed list of documents to share on the site. Monthly conference call with all seven national training centers.

5) **10/1-12/31 PM 2.4 Design Tech Alerts** - Continued the outreach of CCS within the social media space on our Twitter and Facebook sites.

Date: Mar. 31, 2013

Current Quarter Activities

Brief summaries and activities to report for this quarter are noted below with corresponding HQ Milestones and Program Milestones respectively.

- 1) **1/1- 3/31** **PM 4.31 Administrative Support** – Weekly conference call instituted and lead to significant progress in all areas of the program, increased accountability with the partners.
- 2) **1/1- 3/31** **PM 4.29 Website Updates** Added video and consulted with company to increase future capability and function of web site. New site went live in August, a little bumpy with normal transition issues, but improvements are numerous.
- 3) **1/1- 3/31** **PM 4.30 Newsletters** – Delivered newsletter to listserv and Board. Completed and disseminated fifth quarterly newsletter. The newsletter, CCS Exchange, was sent to 32,322 individuals from six states, British Columbia, Alberta, and Saskatchewan representing a variety of state, federal, and municipal entities, consulting firms and private parties.
- 4) **1/1- 3/31** **PM 4.25 Networking** - continued development of social media campaigns with twitter, Facebook, and YouTube. Logged in and accessed NETL Sharepoint site and formed list of documents to share on the site. Monthly conference call with all seven national training centers.
- 5) **1/1- 3/31** **PM 2.4 Design Tech Alerts** - Continued the outreach of CCS within the social media space on our Twitter and Facebook sites.
- 6) **1/1- 3/31** **PM 4.23 Conference Delivered** – Conference was delivered in conjunction with the Geology Department at Whitman College as our final deliverable. We have hosted several symposia, lecturers, and two multi-day courses on carbon capture and storage (CCS) that have all focused on the basic components of conducting a CCS project. This conference gave us the opportunity to conduct a more in-depth program into a particular topic.

Conference Description

The conference used a subsurface modeling tool, Subsurface Transport over Multiple Phases (STOMP) that can be used for a variety of applications including geologic sequestration of greenhouse gasses. Professors at Whitman were quite interested in the course, given that it is used for modeling CO₂ migration subsurface but also has broader applicability.

The conference was offered on two consecutive Fridays from noon to 5:00 p.m. and was open to all the students in the Geology Department at Whitman College. The Geology Department provided computers and laboratory space and receive a royalty-free academic-use license for their in-kind services. The content was taught by Dr. Mark White and Signe White from Pacific Northwest National Laboratory who are experts on the tool and on CCS.

The students were introduced to STOMP through a combination of lectures and computer practicums. They were guided through a series of problems designed to demonstrate the simulator's features and capabilities. The students learned to prepare input files for flow and reactive transport problems and interpret simulation results by working with sample problems that vary in complexity and structure. The students worked through a set of problems, which could come from the following list:

- Radial Flow of Supercritical CO₂ from an Injection Well
- CO₂ Injection into a 2-Dimensional Layered Brine Formation
- Contrasting Pressure- and Flow-Controlled CO₂ Injection Wells
- Non-Isothermal Effects on CO₂ Plume Evolution and Leakage through an Abandoned Well
- Estimation of the CO₂ Storage Capacity of a Brine Aquifer
- Trapping in a Glauconitic Sandstone Aquifer
- Caprock Hydromechanical Changes Associated with CO₂ Injection into a Brine Formation

Date: June 30, 2013

Current Quarter Activities

Brief summaries and activities to report for this quarter are noted below with corresponding HQ Milestones and Program Milestones respectively.

- 1) **4/1 – 6/30** **PM 4.31 Administrative Support** – Weekly conference call instituted and lead to significant progress in all areas of the program, increased accountability with the partners.
- 2) **4/1 – 6/30** **PM 4.29 Website Updates** Added video and consulted with company to increase future capability and function of web site. New site went live in August, a little bumpy with normal transition issues, but improvements are numerous.
- 3) **4/1 – 6/30** **PM 4.30 Newsletters** – Delivered newsletter to listserve and Board. Completed and disseminated fifth quarterly newsletter. The newsletter, CCS Exchange, was sent to 32,322 individuals from six states, British Columbia, Alberta, and Saskatchewan representing a variety of state, federal, and municipal entities, consulting firms and private parties.
- 4) **4/1 – 6/30** **PM 4.25 Networking** - continued development of social media campaigns with twitter, Facebook, and YouTube. Logged in and accessed NETL Sharepoint site and formed list of documents to share on the site. Monthly conference call with all seven national training centers.
- 5) **4/1 – 6/30** **PM 2.4 Design Tech Alerts** - Continued the outreach of CCS within the social media space on our Twitter and Facebook sites.

Date: Sept. 30, 2013

Current Quarter Activities

Brief summaries and activities to report for this quarter are noted below with corresponding HQ Milestones and Program Milestones respectively.

1) 7/1 – 9/30 **All grant activities completed and final paperwork in process of being completed and finalized.**

Program Milestones Log:

HQ Milestones	Planned Completion Date	Actual Completion Date	Validation
HQ -1 Milestone: Project Kick-off Meeting	03/31/10	11/18/09	All project participated in the official kick-off meeting on November 18, 2009, Pittsburgh Hilton. Projects presented during the Regional Sequestration Technology Training Session held during the Annual Regional Partnership Meeting, Pittsburgh Hilton.
HQ-2 Milestone: Educational Program Instituted by identifying potential participants and completing a training schedule	06/30/10	06/30/10	Letter from Recipient dated 06/30/2010. Milestone was met- abstracts for 14 courses were created and candidates have been identified.
HQ-3 Milestone: Complete training curriculum developed for first set of classes	09/30/10	10/04/10	Pete McGrail 101 Lecture Series completed and available Aug. 1. Uploaded and available on new website http://carbontechalliance.org/ .
HQ-4 Milestone: Semi-Annual Progress Report (i.e. Quarterly report ending June 30, 2010)	09/30/10	09/30/10	Submitted to DOE and Dawn Deel (PM).

HQ-5 Milestone: Complete first classes for regional sequestration technology training	12/31/10	10/4 and 10/26-27, 2010	McGrail 101 Lecture series online and Subsurface Transport Over Multiple Phases (STOMP) class offered at University of Utah.
HQ-6 Milestone: Trainers visit one field site	12/31/10	11/01/10	Charlotte Sullivan is a trainer and also has visited the field location several times.
HQ-7 Milestone: Yearly Review Meeting	03/31/11	6/31/11	Completed.
HQ Milestone: Issue a minimum of 250 Professional Development Units (PDUs) or Continuing Education Units (CEUs)	06/30/11	Various Dates	Note: This milestone was met collectively by all projects. No one project was held accountable to the milestone.

HQ Milestone: Semi-Annual Progress Report (i.e. Quarterly report ending June 30, 2011)	09/30/11	07/15/11	Quarterly report served as the semi-annual progress report.
HQ Milestone: Complete at least 2 classes on CCS	12/31/11	06/14/11	1) STOMP – Subsurface Transport Over Multiple Phases – Univ. of Utah 10/27/10 2) Fundamentals of Carbon Capture & Storage, June 14-15 Richland, WA
HQ Milestone: Issue an additional 100 Professional Development Units (PDUs) or Continuing Education Units (CEUs).	03/31/12		Note: This milestone will be met collectively by all projects. No one project will be held accountable to the milestone.
HQ Milestone: Semi-annual progress reports (i.e. Quarterly Report ending March 31, 2012).	06/30/12	7/30/13	Completed
HQ Milestone: Yearly Review Meeting of all recipients; opportunities for information exchange and collaboration.	9/30/2012	7/30/13	Completed

Milestones Year 2

Milestones	Planned Completion Date	Actual Completion Date	Validation
1 Milestone: Conduct Advisory Board Meeting (s).	12/31/2011	Ongoing	Held quarterly providing project updates and seeking direction and guidance. Held in March, June, and upcoming in August.
2 Milestone: Deliver Quarterly Newsletter	6/30/2011	5/16/2011	Completed and uploaded to SharePoint site for NETL training centers.
3 Milestone: Complete 2nd Multi-day Course	6/30/2011	6/14/2011	Fundamentals of Carbon Capture & Storage June 14-15, 2011. Battelle – PNNL Richland, WA.
4. Host a CCS Symposium locally with a significant partner.	11/31/11	11/30/2011	On November 30th, Carbon Tech Alliance hosted its fall symposium on Carbon Capture and Storage (CCS) in conjunction with the University of Washington's Department of Professional and Continuing Education. The speakers included Pete McGrail, Ph.D., Laboratory Fellow, Pacific Northwest National Laboratory and Malcolm Wilson, Ph.D., Executive Director, Petroleum Technology Research Centre.

Program Milestone Log (PM)				
<i>Title</i>	<i>Completion Due Date</i>	<i>Description</i>	<i>Actual Completion</i>	<i>Progress</i>

			<i>Date</i>	
PHASE 1	11/15/09 - 6/30/10			
1.1 Project Kickoff Meeting	11/15/09	Meeting in Pittsburgh, PA	11-15-09	Done
1.2 Project Management Plan	12/11/09	Update Project Management Plan	2-18-10	Done
1.3 Gather Advisory Board	1/15/10	Make first contact and commitments	6-24-10	Done
1.4 CCS Outreach Begins	3/2/10	Begin coordination with CCS groups	3-2-10	Done
1.5 Preliminary Marketing Plan	6/30/10	Develop marketing plan with WSPE	6-24-10	Done
1.6 Preliminary Training Gap Analysis	6/30/10	Perform gap analysis	6-24-10	Done
1.7 Advisory Board meets	6/30/10	First in-person meeting	6-24-10	Done
1.8 Administrative Support	6/30/10	Related admin work complete	8-12-10	Done
PHASE 2	3/1/10 - 5/7/10			

2.1 Develop List Serves	3/26/10	Assemble contact/client lists	10/1/10	Done
2.2 Design Website	4/30/10	Draft CCST Northwest website	10-4-10	Done
2.3 Design Newsletters	4/30/10	Draft CCST Northwest newsletter	4-15-11	Done
2.4 Design Tech Alerts	5/7/10	Draft CCST Northwest tech alerts	05/16/11	Done
2.5 Administrative Support	5/7/10	Related admin work complete	06/1/11	Done
PHASE 3	3/26/10 -- 6/30/10			
3.1 Training Needs Survey	6/30/10	Complete survey to guide courses	3/20/11	Done
3.2 Administrative Support	6/30/10	Related admin work complete	3/31/11	Done
PHASE 4	5/1/10 - 11/15/12			
4.1 1st Lecture Description	4/30/10	Description Posted on Website	6-30-10	Done
4.2 1st Lecture Marketed	5/7/10	Lecture opened to public	6-30-10	Done
4.3 1st Course Descriptions drafted for Advisory Board Review	6/30/10	Training descriptions developed	6-24-10	Done
4.4 1st Lecture Developed	6/30/10	Lecture ready to teach	6-24-10	Done
4.5 1st Course Marketed	8/9/10	Short course opened to public	10-26-10	Done
4.6 1st Course Developed	10/15/10	Short course ready to teach	10-26-10	Done
4.7 1st Course Credits	12/28/10	Credits developed and ready	10/26/10	Done
4.8 1st Lecture Delivered	12/28/10	Lecture delivered to public	10-26-10	Done
4.9 1st Course Delivered	12/28/10	Course delivered to public	10-26-10	Done
4.10 2nd Course Developed	3/31/11	Course Developed	06/10/11	Done

4.11 Symposium 1 Description	12/31/11	Description finalized	10/5/11	Done
4.12 Symposium 1 Marketed	12/31/11	Event Marketed	11/10/31	Done
4.13 <u>Symposium 1 Delivered</u>	<u>12/31/11</u>	<u>Host cosponsored CCS symposium</u>	<u>11/30/12</u>	Done
4.14 2nd Short Course Delivered	12/31/11	Fundamentals of Carbon Capture and Storage. Richland, WA	06/15/11	Done
4.15 2nd Lecture Delivered	12/31/11	Sullivan - USGS Oregon Water Science Center	12/7/10	Done
4.16 Conference Description	6/15/12	Description posted on website	9/30/13	Done
4.17 Symposium 2 Description	3/31/12	Description posted on website	3/1/12	Done
4.18 Symposium 2 Marketed	6/30/12	Symposium 2 registration begins	3/15/12	Done
4.19 Conference Marketed	9/31/12	Conference registration begins	9/30/13	Done
4.20 <u>Symposium 2 Delivered</u>	<u>11/15/12</u>	<u>Host cosponsored CCS symposium</u>	5/21/12	Done
4.21 3rd Short Course Delivered	11/15/12	2nd annual Fundamentals of Carbon Capture and Storage Course	7/31/12	Done
4.22 3rd Lecture Delivered	11/15/12	Hund – Wa. D.C. Lecture	2/10/11	Done
4.23 Conference Delivered	11/15/12	Host co-sponsored CCS conference	3/8/13	Done
4.24 Certification Program	11/15/12	Develop CCS certification(s) (if feasible)	9/30/13	Done
4.25 Networking	11/15/12	Attend conferences, network	9/30/13	Done
4.26 Additional Lectures Delivered	11/15/12	Hund – WSPE WA Chpt. Renton WA.	4/12/11	Done

4.27 Additional Courses Delivered	11/15/12	Ongoing 2-3 day topic-specific courses	9/30/13	Done
4.28 Email Tech Alerts	11/15/12	Ongoing quarterly tech alerts	9/30/13	Done
4.29 Website Updates	11/15/12	Ongoing updates of content	9/30/13	Done
4.30 Newsletters	11/15/12	Ongoing quarterly newsletters	9/30/13	Done
4.31 Administrative Support	11/15/12	Weekly Conference Calls and Program Communications	9/30/13	Done
PHASE 5	11/12/10 - 11/15/12			
5.1 <u>Evaluation Survey 1</u>	11/12/10	First round of program surveys - via Advisory Board	06/24/10	Done
5.2 <u>Evaluation Survey 2</u>	11/11/11	Second round of program surveys – Program Evaluation	06/25/11	Done
5.3 <u>Evaluation Survey 3</u>	6/30/12	Third round of program surveys	9/30/13	<u>Done</u>
5.4 Advisory Board Meets	11/15/12	Meets quarterly, once/yr in person	9/30/13	Done
5.5 Course Evaluations	11/15/12	Fundamentals of Carbon Capture and Storage. Richland, WA	06/15/11	Done
5.6 Course Improvements	11/15/12	Ongoing improvements to courses	9/30/13	Done
5.7 Administrative Support	11/15/12	Related admin work complete	9/30/13	Done

Results and discussions:

The CCSTNW program brought a comprehensive set of offerings to the Northwest region of the U.S. that likely would not have taken place if it were not for the grant funding. When discussing the results of the 2009-2013 program it must be done within the context of the significant effort to pass greenhouse gas legislation. The result of the greenhouse gas initiatives failing directly impacted the outreach and impact of the main grant subject area. Attendance and response to all aspects of the program were relatively lower than expected. The three courses were in 25-40 attendee range, the symposiums were 13 and 40 respectively, and the lectures ranged 15-40 in attendance. Web traffic and interest were also relatively quiet as compared to NWETC's environmental training site.

The program did result in developing a comprehensive fundamentals of CCS curriculum and course. The participants valued the expert instructors and liked the PNNL Laboratories that facilitated the hands-on portions of the program. The STOMP programs also resulted in significant engagement by the university student attendees. The program overall offered introductory levels of CCS education combined with more sophisticated concepts utilizing higher level laboratory tools. The symposiums offered a representation of interest groups across the spectrum of pro-CCS to anti-CCS and was evident during Q & A periods. Overall, participants found the program informative and interesting, but didn't know what the next steps were.

This became one of the program challenges, "What is next?" and "How will this help me get a job?" The current CCS job opportunity prospects seem to be very limited at best due to the current set of CCS needs and context of the political climate. CCS is an area that is in need of significant stimulus for it to become a viable career track. The concepts and scientific approaches and basis for CCS are solid from an academic standpoint, but the life of the program demonstrated that political and public sentiment often swayed more viewpoints. Consequently, interest in the content and components of the program diminished as the program neared its completion.

The program accomplished its purpose to develop curriculum and training programs for CCS education. The implied goal of developing a self-sustaining training program that could make financial and job placement sense was less promising. Given the lack of interest and unwillingness for participants to self-fund their potential CCS training is a clear indicator of the state of CCS training.

Conclusion:

CCS remains a scientifically viable solution to carbon emissions, but seems to lack the political and societal will to move forward with significant self-sustaining training programs. The program illustrated that high quality experts, instructors, and curriculum can do an effective job of training pre-service and post-service professionals. Going forward both the content and context of the Carbon

Sequestration training needs to be significantly utilized to justify training programs. Time will tell, but perhaps CCS technologies and techniques will be more prevalent in the coming years and if that is the case then training programs can financially justify their existence. Until then, it looks like more of a subsidized model will need to be used. Or alternatively, some of the current energy sectors will utilize similar or related strategies so that funding may be provided by private industry in economically viable sectors. The concept of the grant was to clearly build a program in anticipation of needed employee's in the CCS sector, but the current CCS industry needs are limited. Hopefully the impact is one of timing and in the future these training programs will fulfill their original intended purpose.

APPENDIX 1



Carbon Tech Alliance

MINUTES

Northwest Carbon Capture and Storage Training
Advisory Board Meeting
June 24, 2010
Pacific Northwest National Laboratory
1100 Dexter Ave. Suite 400
Seattle, WA 98109

Present

Mary Ausburn, AICP
SEPA Project Manager
Department of Ecology

Stefan Bachu, PhD, PEng
Distinguished Scientist, CO2 Storage
Alberta Innovates – Technology Futures

John Biggane, RG, LG, LEG, LHg
Senior Principal/Geo Engineers, Inc.

Will Einstein
Manager of Emerging Technology and Climate
Change
Puget Sound Energy

Gretchen E. Hund
Senior Staff Scientist
Pacific Northwest National Laboratory

Wayne Lei, PhD, Chairman
Director of Research and Development
Portland General Electric

Gretchen Stewart
Project Director – DOE Carbon Capture and
Storage
EOS Alliance

E. Charlotte Sullivan, PhD
Senior Research Scientist
Applied Geology and Geochemistry
Energy and Environment Directorate
Pacific Northwest National Laboratory

Lucinda Low Swartz, Esq.
Lucinda Low Swartz Environmental
Consulting

David Szatmary, PhD
Vice Provost
University of Washington Educational
Outreach

Willis Turner, CAE, CSE
Executive Director
Washington Society of Professional Engineers

David Weatherby
Senior PM/Senior Geologist
URS Corporation

Malcolm Wilson, PhD
Director – Office of Energy and Environment
University of Regina

John Wolff, PhD
Professor & Director of GeoAnalytical Lab
School of Earth & Environmental Sciences
Washington State University

James Workman
Executive Director
EOS Alliance

Introduction

Gretchen Hund from the Pacific Northwest National Laboratory (PNNL) welcomed the participants, followed by James Workman and Gretchen Stewart from EOS. Willis Turner, Executive Director of the Washington Society of Professional Engineers (WSPE) was also introduced as a partner of the team. All participants introduced themselves.

Overview

Gretchen Hund provided an overview of the goals and objectives of the CCS Training Center. The goal is to develop regional sequestration technology training to facilitate transfer of knowledge and technologies required for site development, operations, and monitoring of commercial CCS projects. The primary objectives are:

- 2) To provide meaningful and timely training that will stimulate the CCS industry
- 3) To have a sustainable program before the end of the third year

Training will focus on applied engineering and science of CCS for site developers, geologists, engineers, and technicians (but the team is interested in hearing from participants as to the audience(s) that should be of focus). By the end of the third year, the team wants to have an in-operation revenue-generating training curriculum. Gretchen Hund described why CCS is important and provided some context on the other CCS initiatives that the US Department of Energy (DOE) is funding. DOE's National Energy Technology Laboratory has established seven regional partnerships for CCS pilot projects:

- 2 [Big Sky Regional Carbon Sequestration Partnership \(Big Sky\)](#)
 - 3 [Plains CO₂ Reduction Partnership \(PCOR\)](#)
 - 4 [Midwest Geological Sequestration Consortium \(MGSC\)](#)
 - 5 [Midwest Regional Carbon Sequestration Partnership \(MRCSP\)](#)
 - 6 [Southeast Regional Carbon Sequestration Partnership \(SECARB\)](#)
 - 7 [Southwest Regional Partnership on Carbon Sequestration \(SWP\)](#)
 - 8 [West Coast Regional Carbon Sequestration Partnership \(WESTCARB\)](#)
- http://www.netl.doe.gov/technologies/carbon_seq/partnerships/partnerships.html

DOE funded seven entities for developing regional training programs

- Board of Trustees, Univ. of Illinois (Champaign, IL)
- **Environmental Outreach and Stewardship (EOS) Alliance (Seattle, WA)**

- NM Institute of Mining & Technology (Socorro, NM)
- Petroleum Technology Transfer Council (Tulsa, OK)
- Southern States Energy Board (Norcross, GA)
- The University of Texas at Austin (Austin, TX)
- University of Wyoming (Laramie, WY)

Gretchen Hund reiterated that the NW Center has three partners: EOS as the lead, and PNNL and the WSPE. DOE's plan is to have all of the seven training centers augment what is going on through the partnerships with an aim to accelerate adoption of CCS technology and have a trained workforce ready to go.

Gretchen Hund emphasized that CCS is not really a market at this point, at least for non-enhanced oil recovery operations. The stimulus funds (*\$995,000; duration: 36 months*) from DOE are to help jump-start the market by training work force members. The NW Center is designed to have EOS as the lead to implement the program, with PNNL providing much of the content and WSPE developing the marketing plan and determining the feasibility of developing a professional certification program based on prerequisites and competency testing. WSPE will also provide professional development hours certificates for students who attend the lectures.

Currently the team has 12-14 draft topics identified with potential lecturers, and a few longer courses scoped. However, the purpose of this meeting is to hear from attendees as to their suggestions.

Offerings that are to be part of the Center include:

- p. Lectures – up to 14 topics
- q. Short courses – overview of several topics and deep-dive into a particular topic
- r. Carbon TechAlliance Website
- s. CCS Exchange – a quarterly newsletters
- t. Tech Alerts – when newsworthy
- u. Symposia – one in 2011 and one in 2012
- v. Conference – one is 2012

Gretchen Hund mentioned that the current plan is to offer the short courses in Richland, WA, where PNNL's main office is, and offer a tour of CCS laboratories and a field trip to PNNL's pilot CCS site in Wallula, where there is a characterized borehole intended for CO₂ injection. The aim is to have hands-on learning. The current plan is to also work with the WSPE to develop Professional Development Hours. There is interest by UW to look at the possibility of offering some type of certification with the courses and possible relationships with other universities proximal to CCS training centers.

Milestones established in the proposal to DOE include:

- First lecture and first course delivered -- 12/28/10
- Second lecture and second course delivered – 12/31/11
- First Symposium delivered – 12/31/11
- Second Symposium delivered – 11/15/12
- Third lecture and third course delivered – 11/15/12
- Conference delivered – 11/15/12
- Additional lectures (1-10) and courses (1-4) – 11/15/12
- Evaluation survey 11/12/10, 11/11/11, 6/30/12
- Advisory Board meets quarterly, once/yr in person

Other activities include:

- Develop certification program
- Attend and participate in networking events
- Have lectures available on-line
- Keep website content updated and relevant
- Publish Newsletter quarterly and Tech Alerts as needed

After this overview, Gretchen Hund described the function and expectations of the Advisory Board. Its members are to serve as an objective sounding board to provide advice as to forward direction for the Center, with a major focus on content of the lecturers and courses to be offered. Furthermore, the Board is expected to help link the Center with contacts that could advance the mission of the Center. Finally, the Board is encouraged to help promote and champion the development of the Center to their networks.

Audience Discussion

There was quite a bit of discussion about the audiences for the Center. The following is a list of the options discussed:

- *Current Environmental Service Providers/Industry* – they could be interested in getting further accreditation for a new field. This could include a wide range of engineers and geologists who are applying their skills to problems for clients (broad consultants or architectural and engineering firm employees) or industries that might be interested in sequestering their own CO₂ (e.g., utilities). One way to reach out to this audience would be through the professional organizations with which they are affiliated. The list discussed included:
 - Geological Society of America
 - American Geophysical Union (San Francisco meeting)
 - Society of Petroleum Engineers (Regional Rocky Mountain chapter)
 - American Chemical Society
- *Individuals who want to be educated* about the general topics of CCS. They see a need to become more informed but don't want to become experts in the field like the above audience. This could include:
 - *Government officials*
 - Includes legislators, regulatory agencies, planners, staffers
 - Politicians will need a short, condensed course. Staffers will most likely take course in lieu of public official.
 - Officials and/or staffers from anywhere in the Pacific Northwest could be included.
 - *General Public and the Media*
 - Focus on funding, oversight, regulation, pros/cons e.g. safety, environment
 - Fight the perception that CCS is a way to sustain “dirty technology” as opposed to a viable green tech. The message might be that CCS is an acceptable and safe method to address climate change. This would tie in to the marketing approach.
 - Avoid being too granular. Online website/free self-test course may be sufficient.

- *Industry* – producers of CO₂ (e.g., utilities). Some may be interested in more than just being educated, but initially this is likely the target.
- *Academia* – this is a possible arena – to target graduate students who want to add this capability to their degree. This could be through an extension program (such as at the Univ. of WA). Certain PhDs and MBAs might be interested. The Board mentioned the importance of coordinating with faculty – the possibility of building in a course (101). Undergraduates might also be interested (Whitman and WSU). Finally, the Board discussed external education through a certification program. They would likely be interested in the more in-depth 3-day course.

Board members saw a need to collaborate with the Geological Society of America (GSA) and the American Geophysical Union (AGU). The Board discussed ways to partner in marketing with such organizations. The Center could consider sharing its curriculum with these organizations.

One Board member offered a different approach for categorizing audiences. He suggested:

- a) *Scientists/engineers* – in-depth 3 day program where the Center would establish as many partnerships as makes sense to reach out to scientists and engineers. One group mentioned was the National Institute for Certification in Engineering Technologies. This may be an interesting group to partner with. Do market research on *what this community really wants* – identify topics for which they want cert/credentials. Companies may want more technical education. This could include well drillers, engineers, and geoscientists.
- b) *Project managers/ environmental regulators/ lawyers* – this audience would be interested in the legal liability/risk analysis type issues. It was felt that this piece may not yet be ripe, but should be fleshed out a bit.
- c) *Business community* – this audience is interested in the value proposition for doing CCS. Where does it make sense with energy legislation, other incentives for capturing CO₂? Environmental MBAs might be interested in this. Planners (American Institute of Certified Planners (AICP)) might also be interested and they have Continuing Education requirements.

Another suggestion for targeting topics to focus on was to look at CCS by its components: Capture, Transport, and Storage (including site characterization, well drilling, reservoir engineering, injection, and monitoring). A case study could be developed and offered as part of the curriculum. Weyburn was one case study suggested. The Electric Power Research Institute (EPRI) was highlighted as being an important entity to possibly partner with, particularly on the capture front. Chemical engineers will be particularly interested in capture. They will be interested

in an overview of the whole operation and understanding the benefits and hurdles to get over and will want to be educated on what is occurring outside of the plant gate. Likewise on the pipeline front, Kinder Morgan may be a good company to partner with.

Marketing

Willis Turner gave a presentation on the draft marketing plan thus far developed. The main points of his presentation included:

- 2 Serving and leading the carbon capture and storage industry by facilitating knowledge exchange and establishing educational forums
- 3 Goals – dates, self-evaluation, student evaluation, financial goals, non-financial goals & awareness,
- 4 Define territory of the Pacific Northwest. Alaska? California? However consider the potential for global scale e.g. India.
- 5 Continuous feedback loop
- 6 Size and stability of market
- 7 Competitor analysis
- 8 Build on a basic messaging platform. What points are the differentiators
- 9 Price ranges
- 10 Northwest Environmental Business Council (NEBC) hosts 2 forums: energy forum occurs monthly roughly 70 people attend, also brownfields forum. What about a CCS forum? Would be smart to determine NEBC's interest in hosting a forum where a 101 lecture was given on CCS for members to receive Professional Development Hours
- 11 Sponsorship revenue from third parties
- 12 Regional Trade associations e.g. Western Energy. Will target utility audience
- 13 Could provide scholarships for graduate students
- 14 Internship similar to Regional Air and Waste Engineers linking senior engineers with students
- 15 Distinguishing need from demand, or yet instill a need

The discussion centered on what could occur in Year 1. It was felt that there needed to be:

- 101 free class (the great equalizer)
- NEBC forums and listserves to promote the program
- Professional development (anyone not in a degree track),
- Start communication with faculty to determine the interest in building in a single course for under/grads,
- Engage government staffers through forums;
- Reach out to Pacific NorthWest Economic Region (PNWER) as a possible partner – (a public-private partnership chartered by the states of Alaska, Idaho, Montana, Oregon, and Washington; the western Canadian provinces of Alberta, British Columbia, and Saskatchewan and the

territories of Yukon and Northwest Territories, with a mission to encourage global economic competitiveness and preserve our world-class natural environment.)

- Use a variety of communication tools to reach out to potential interested parties -- Email, business updates, regulatory updates, tech alerts, newsletter

Gap Analysis

Gretchen Stewart gave a brief talk on the gap analysis that EOS had conducted. Some findings included:

2. Classes that fill at EOS are ones that result from regulation. Companies will budget for training.
3. MIT only institution with comprehensive CCS course. Added after the meeting by Stefan Bachu: Sally Benson at Stanford University is also offering CCS courses.
4. Challenge is that the team is training a workforce for a market that doesn't yet exist. Without government aid, this is tough.
5. Training window. Need to think in the time horizon of the grant – 3 years. Newness of the whole concept.
6. Sustainability, not just environmentally; trainees are interested in jobs (a market) that have longevity.
7. Eastern WA and parts of ID, and OR sit on flood basalts. Different from other US CCS programs that will apply to other parts of the world.

Some interesting statistics shared with the Board included that the Bureau of Labor Statistics in 2008 indicated that approximately 1390 individuals were employed as civil engineers, environmental engineers or as geologists. There are 25 educational institutions in the Pacific Northwest with engineering- and geology-related curriculum.

Brand/Logo/website

Gretchen Stewart also described the work EOS had conducted to develop a brand and logo and to create a website. She showed a demo of a Home page of the website for the Board. She said the aim was to have a website with an “education” feel. September 1, 2010 was given as the tentative roll-out date for website. She said that the name they developed for the Center is the Carbon Tech Alliance and she shared the logo with the Board.

UW Extension Program Possible Link

David Szatmary, Vice Provost of Educational Outreach at the University of Washington, briefly spoke about his connection with a hub of other universities that might be interested in teaming in some way to offer classes. In this hub are three other CCS training centers funded by DOE -- Georgia

Tech in Atlanta, University of Texas in Austin, and Northwestern University in Chicago. He reported that he had mentioned the possibility to his counterparts at these universities and that they were interested in looking into a possible partnership further.

The Board concurred that such a partnership could go a long ways towards launching the Centers. Of particular interest was the support that the UW could provide in helping to provide some type of certification for the courses.

CCS Courses

The remainder of the Board meeting was focused on discussing the appropriate courses for the Center to develop. After briefly describing the 14 possible topics that PNNL had developed for the proposal and the audiences that should be targeted, the Board recommended that the team focus on a 101 course that dives deeper than the 90-minute lecture prepared and delivered by Dr. Pete McGrail at a recent WSPE meeting.

One suggestion was to design a multi-hour course that has most of the hours of standardized knowledge and then the remaining hours of specialized knowledge to allow a mix and match for target audiences. The training survey would help hone in on what would be of most interest for the deep-dive portion of the course, but the suggestion was made to have the standardized portion include covering:

1. Site Characterization
2. Project Development and Assessment – project management, risk analysis, liability, financing
3. Site Selection and Environmental Review
4. Permitting
5. Stakeholder Acceptance
6. Overview of How CCS Works

The remainder of a course could drill deeper into a technical topic if that is of interest to a particular audience. Topics could include:

1. Capture of CO₂ – NW context
2. Transportation – pipeline design
3. Storage – geo-storage resource assessment, reservoir engineering, well drilling, injection, monitoring, geochemical and/or geomechanical impacts.

The Board recommended starting with developing the standardized portion of the course. A course evaluation would be part of the offering so that the course could be improved for future students.

The Board adjourned at 5 PM.