

PUBLIC SITE UPDATES

Plains CO₂ Reduction (PCOR) Partnership Phase III Task 2 – Deliverable D13

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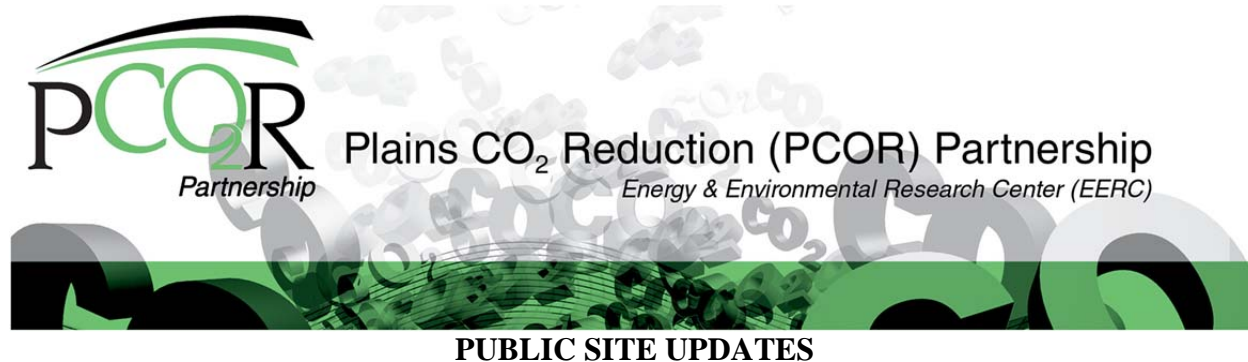
The Plains CO₂ Reduction Partnership Web team would like to acknowledge Tera Buckley for her efforts on behalf of this update to the public Web site. Before her departure from the EERC in May 2012, Ms. Buckley was the Web site task lead. In that position, she was responsible for the design of the product as well as ensuring its progress and delivery. As part of this effort, she introduced concepts to improve tracking capability and content presentation. Her creativity, organizational skills, and enthusiasm are greatly appreciated.

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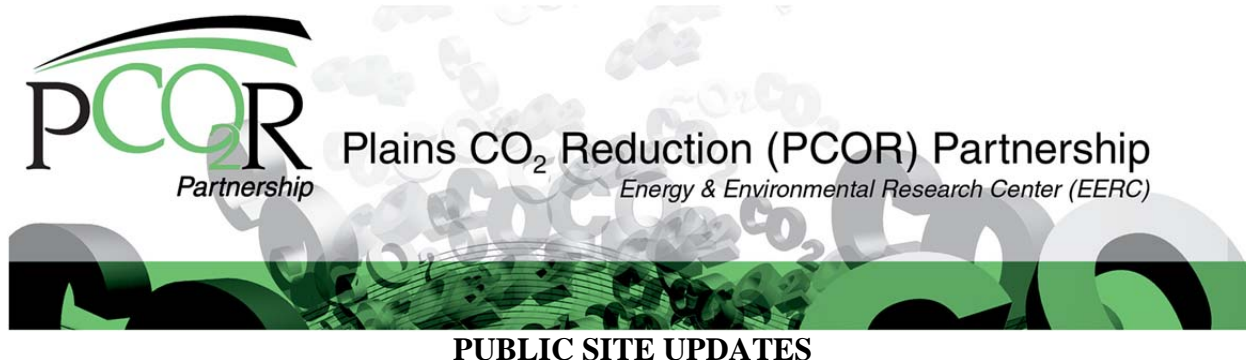
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PUBLIC SITE UPDATES

EXECUTIVE SUMMARY

This report summarizes the proposed 2012 contractual update to the Plains CO₂ Reduction (PCOR) Partnership public Web site for the period from January 15, 2010, to July 31, 2012. The proposed update includes revisions to the Home Page and Educator Page and an expansion of the CO₂ Sequestration Projects section from one page to nine pages in order to include information on each of the Phase III projects and the Phase II verification test projects, as well as information on other carbon capture, utilization, and storage projects in the PCOR Partnership region. In addition to a summary of the revisions and additions that comprise the D13 update for 2012, this report provides images and links to the proposed pages as well as existing pages where appropriate. The PCOR Partnership public Web site has been online since the summer of 2005, and the next contractual update is due in July of 2014.



PUBLIC SITE UPDATES

INTRODUCTION

The U.S. Department of Energy Office of Fossil Energy National Energy Technology Laboratory's Regional Carbon Sequestration Partnership (RCSP) Program requires that each regional partnership have a public Web site to inform and educate the general public regarding sequestration in general and regional RCSP activities. The Plains CO₂ Reduction (PCOR) Partnership's public Web site has been live since the summer of 2005, and the PCOR Partnership Outreach Team is continuously striving to keep the public Web site up to date and to provide content in an interesting format to the general public. During Budget Period 4, updates will happen every 2 years with minor elements being updated on a more regular basis. The most recent Web update was provided in January of 2010.

The PCOR Partnership is led by the Energy & Environmental Research Center (EERC) at the University of North Dakota. The public Web site subtask is managed by Dan Daly, EERC Research Manager. Major contributors providing content to the public Web site include PCOR Partnership public Web site team members Tera Buckley (formerly of the EERC), Dan Daly (Task Leader), Katherine Anagnost, and Charlene Crocker. The Web site update was supported by the Programming, Communications, and Graphics groups at the EERC as well as other PCOR Partnership personnel.

SITE IMPROVEMENTS

The updates proposed to the PCOR Partnership public Web site for the period from January 15, 2010, to July 31, 2012, includes updates to the Home Page and Educator Page, replacing the *PCOR Partnership Atlas*, 3rd Edition, with the 4th Edition and an expansion of the CO₂ Sequestration Projects section from one page to nine pages in order to include information on the Phase III projects as well as other carbon capture, utilization, and storage (CCUS) projects in the PCOR Partnership region. Except where noted, the proposed Web pages will go live pending approval of the new pages described below.

HOME PAGE

Changes to the home page (Figure 1) include the addition of the PCOR Partnership annual meeting button and Bell Creek fact sheet link added to the left column. The home page has also been updated to include the image of the newly published *PCOR Partnership Atlas*, 4th Edition and the new CO₂ projects map that links to the CO₂ Sequestration Projects page. With the exception of the new map image, all changes have already been implemented on the existing public Web site home page.



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CO₂ and Storage in the Region

Matching CO₂ sources with potential CO₂ storage sites in the region

About the Partnership

Carbon Sequestration, Climate Change and CO₂

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Carbon dioxide (CO₂) sequestration, the long-term storage of CO₂ either in geologic zones deep underground or at the earth's surface in plants and soils, is emerging as a major strategy to help address climate change concerns. But to be successful, CO₂ sequestration projects need to take regional characteristics into account.

The Plains CO₂ Reduction (PCOR) Partnership is a collaboration of over 80 U.S. and Canadian stakeholders that is laying the groundwork for practical and environmentally sound CO₂ sequestration projects in the heartland of North America.

The PCOR Partnership is led by the Energy & Environmental Research Center at the University of North Dakota and is **one of seven regional partnerships** under the U.S. Department of Energy (DOE) **National Energy Technology Laboratory's (NETL's) Regional Carbon Sequestration Partnership (RCSP) Program**. NETL and RCSP are part of DOE's Office of Fossil Energy.

PCOR Partnership Features:

DOE Techlines

DOE-Sponsored Field Test Finds Potential for Permanent Storage of CO₂ in Lignite Seams

DOE Regional Partnership Successfully Demonstrates Terrestrial CO₂ Storage Practices in Great Plains Region of U.S. and Canada

Topical Report

Factors Affecting the Potential for CO₂ Leakage from Geologic Sinks (PDF)

PCOR Partnership Regional Atlas



[Download atlas \(PDF\)](#)

[View Content](#)

CO₂ Storage News

Geologists Testing Aquifer Rocks as Containers to ...
Jul 10, 2012
Geologists Testing Aquifer Rocks as Containers to Permanently Trap Carbon ...Lab Manager MagazineEach institution is looking at ...

Google

[A carbon \(sequestration\) graveyard beneath Jersey? - The Star-L...](#)

[Geologists Testing Aquifer Rocks as Containers to Permanently T...](#)

[Using Grasslands for Carbon Sequestration: a Viable Weapon ag...](#)

[CO₂ Solutions Completes Investigatory Phase of Collaboration w...](#)

[The Quest to Capture Carbon is on - energybiz](#)

[Carbon Sequestration's Got an Earthquake Problem, Too - CleanT...](#)

CO₂ Projects in the PCOR Partnership Region



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Figure 1. Updated home page.
 Test link: <http://stage.undeerc.org/PCOR/default.aspx>
 Existing link: www.undeerc.org/PCOR

THE ATLAS, 4TH EDITION

The PCOR Partnership Regional Atlas page (accessed via the home page [test link] and the News and Publications menu selection [not part of the test site]) has been updated with content from each of the seven chapters and the reference section of the 4th edition (published June 2012). Figure 2 shows the content listing. Each topic listed is a hyperlink to the corresponding page in the Atlas. In addition, the PDF of the entire atlas can be downloaded from both the home page and the Atlas page. These pages became available on the public Web site in June 2012.

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Final Report (2003-2005)
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Links

PCOR Partnership Regional Atlas
The PCOR Partnership Regional Atlas was developed for project sponsors and private individuals to provide global and regional context for CO₂ issues and permanent CO₂ storage opportunities in the PCOR Partnership region.
Download the Atlas now! **PCOR Partnership Regional Atlas, 4th Edition (2012)** (45MB PDF)
Please [click here](#) to obtain a free copy of the atlas.
Browse the Atlas

Chapter 1: The Challenge

- Greenhouse Effect
- Greenhouse Gases
- Global Carbon Cycle
- Climate Change Patterns
- Major Stationary CO₂ Sources
- Anthropogenic CO₂
- Growing Economy = Growing CO₂ Emissions
- Household Carbon Footprints
- World CO₂ Emissions
- North American Sources
- North American CO₂ Profile
- Potential Impacts of Climate Change
- Finding a CO₂ Solution

Chapter 2: Carbon Management

- Terrestrial Carbon Storage
- Mechanisms for Terrestrial Storage
- Carbon Capture and Storage
- CO₂ Capture
- CO₂ Separation and Compression
- CO₂ Transportation Infrastructure
- Pipelines
- Long-Term Geologic Storage
- Geologic Storage Criteria
- Supercritical CO₂
- Trapping CO₂ in Rocks
- Enhanced Oil Recovery
- CO₂ Gets the Oil Out
- Oil Fields of the United States and Canada
- CO₂ in Oil Fields
- North American Sedimentary Basins
- CO₂ in Saline Formations
- Putting TDS Levels into Perspective
- Salinity
- Coal Regions of the United States and Canada
- CO₂ in Unminable Coal

Chapter 3: The PCOR Partnership

- DOE's Regional Carbon Sequestration Partnerships
- PCOR Partnership Region
- PCOR Partnership Activities
- Project Phases
- Regional Vision
- PCOR Partnership Partners

Chapter 4: Regional Characterization

- Distribution of Major Stationary CO₂ Sources
- CO₂ Sources
- Classification of Major Stationary CO₂ Sources
- CO₂ Sources by Type
- Major Regional Sedimentary Basins
- CO₂ Storage Opportunities
- Enhanced Oil Recovery Potential
- CO₂ Storage in Oil and Gas Fields
- Major Coal Basins
- CO₂ Storage in Unminable Coal
- Evaluated Suitable Saline Formations
- CO₂ Storage in Saline Formations

Chapter 5: Field-Based Activities

- Demonstrating CCS
- CCS in Action
- Prairie Pothole Region
- Terrestrial Sequestration
- Zama Field Validation Test
- CO₂-Rich Gas in a Pinnacle Reef Structure
- Lignite Field Validation Test
- CO₂ in an Unminable Lignite Seam
- Northwest McGregor Field Validation Test
- CO₂ in a Deep Oil Reservoir
- Commercial-Scale Demonstrations
- Philosophy of Approach
- Monitoring, Verification, and Accounting
- MVA Techniques
- Fort Nelson Demonstration Project
- Geologic Storage of Sour CO₂
- Bell Creek Demonstration Project
- CO₂ Injection for Enhanced Oil Recovery
- Bell Creek - Layers of Security
- Bell Creek - Monitoring
- Demonstrating CCS Throughout the Region
- CO₂ Capture at Great Plains Synfuels Plant
- Weyburn-Midale CO₂ Monitoring and Storage Project
- CO₂ Capture at Boundary Dam
- The Aquistore Project

Chapter 6: CCS Deployment

- The Evolution of CCS Regulations
- PCOR Partnership Regulation Activities
- U.S. Presidential Interagency Task Force on CCS
- Current EPA Regulations
- Regulatory Activities in the Region
- Carbon Markets
- Carbon Offsets

Chapter 7: The Path Forward

- CCS Efforts Outside North America
- Challenges to CCS Deployment
- CCS: State of the Science
- CCS Acceptance
- Keeping the Lights On
- Public Awareness
- Documentary Series
- Ramping up CCS Development

Notes and References

- CCS Units and Conversion Factors
- Further Sources of Information
- Nomenclature
- Photo and Image Credits
- References

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Figure 2. PCOR Partnership Regional Atlas, 4th Edition, Web page.


Test link: <http://stage.undeerc.org/PCOR/newsandpubs/atlas.aspx>;Existing link: www.undeerc.org/PCOR/newsandpubs/atlas.aspx

EDUCATOR PAGE

The Educators page (Figure 3) has been updated to include the following new sections:

- See Us at These Upcoming Education Events for Teachers
- Recent Educational Events for Teachers

Information on the Prairie Energy and Carbon Teacher Training Institute (PECTTI), a recent collaboration between the PCOR Partnership and Prairie Public Broadcasting (www.prairiepublic.org), has been added, including an external link to the lesson plans developed by teachers attending the workshop (www.prairiepublic.org/education/teachers/media-resources/eerc-2011-lesson-plans). The page has also been enhanced with photos of the recent PECTTI. This page will go live once it is approved by program management.



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Educators

The PCOR Partnership is committed to providing classroom resources that address the role of practical and environmentally safe ways to reduce anthropogenic CO₂ emissions and the level of CO₂ in the atmosphere.

Carbon management is a great topic to study because it integrates so many subjects: energy, environment, geography, politics, chemistry, biology, economics, and more. It requires students to use analytical tools to exercise their abilities to research, think, and understand complex issues.



Dan Daly, PCOR Partnership Outreach Manager, presents during the Prairie Energy & Carbon Teacher Training Institute.

See Us at These Upcoming Educational Events for Teachers


North Dakota Petroleum Council Teacher Education Seminar June 2013 Bismarck State College Bismarck, North Dakota	Lignite Energy Council Education Seminar June 2013 Bismarck State College Bismarck, North Dakota
--	--

Recent Educational Events for Teachers

Missouri Minerals Education Foundation Teacher Workshop July 15-20, 2012 Mineral Area College Park Hills, Missouri	Lignite Energy Council Education Seminar June 18-21, 2012 Bismarck State College Bismarck, North Dakota
North Dakota Petroleum Council Teacher Education Seminar June 11-14, 2012 Bismarck State College Bismarck, North Dakota	The Changing Face of North Dakota North Dakota Geographic Alliance June 4-8, 2012 Dickinson State University Dickinson, North Dakota

Recommended Curriculum Sources

- In collaboration with **Prairie Public Broadcasting**, the PCOR Partnership hosted the Prairie Energy & Carbon Teacher Training Institute on November 18-19, 2011, at the Energy & Environmental Research Center in Grand Forks, North Dakota. Check out the **lesson plans** developed during the institute.



Teachers tour the EERC during the Prairie Energy & Carbon Teacher Training Institute.

- The Keystone Center** developed middle and high school **climate lesson plans**. Each year, several curriculum training workshops are held across the United States. In July 2009, a 2-day training session was held in Omaha, Nebraska, in conjunction with the PCOR Partnership.
- The Northeast Sustainable Energy Association** has K-12 climate lesson plans that cover many options for reducing CO₂ emissions.
- The Institute for Global Environmental Strategies** developed extensive classroom resources for educators to provide students in grade levels 1-12 with an understanding of and activities focused on the potential consequences of climate variability and change.
- The Teachers' Guide to High-Quality Educational Materials on Climate Change and Global Warming** points K-12 educators to the best online resources for teaching about climate change: several that offer first-rate background materials and include detailed lesson plans and experiments.

[Educator Links >](#)


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Figure 3. Updated Educators page.

Test link: <http://stage.undeerc.org/pcor/educators/>Existing link: www.undeerc.org/PCOR/educators/default.aspx

CO₂ SEQUESTRATION PROJECTS

Formerly one page, this section has been expanded to include information on major CCUS projects in the PCOR Partnership region, including separate pages for the four Phase II field validation tests and the two Phase III demonstrations. The landing page for this section, presented in Figure 4, is a map of the region with each project labeled. Clicking on the project label opens a new window containing a brief description of the project and a link to a separate page. Figure 5 shows all of the project windows, which open separately on top of the existing window.

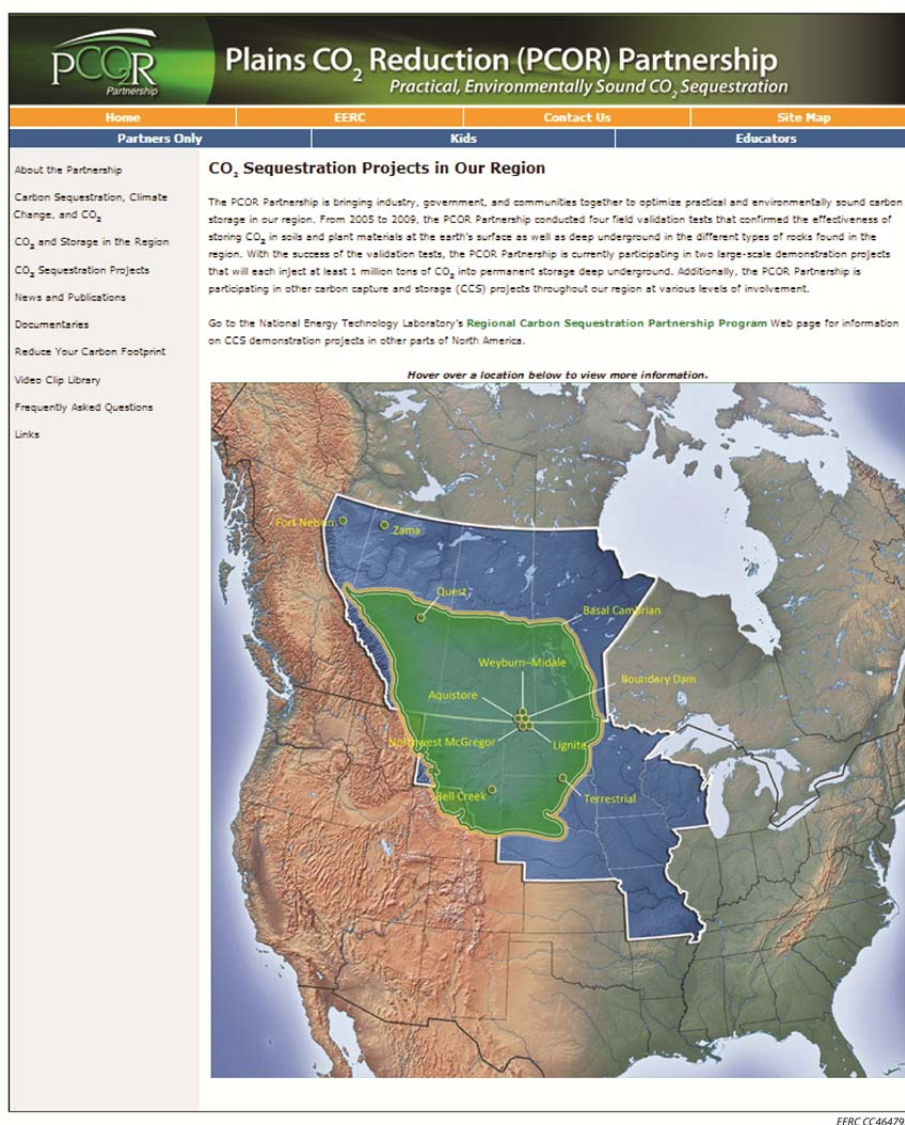


Figure 4. Updated CO₂ Sequestration Projects landing page.

Test link: <http://stage.undeerc.org/pcor/co2seqprojects/#>

Existing link: www.undeerc.org/PCOR/co2seqprojects/default.aspx

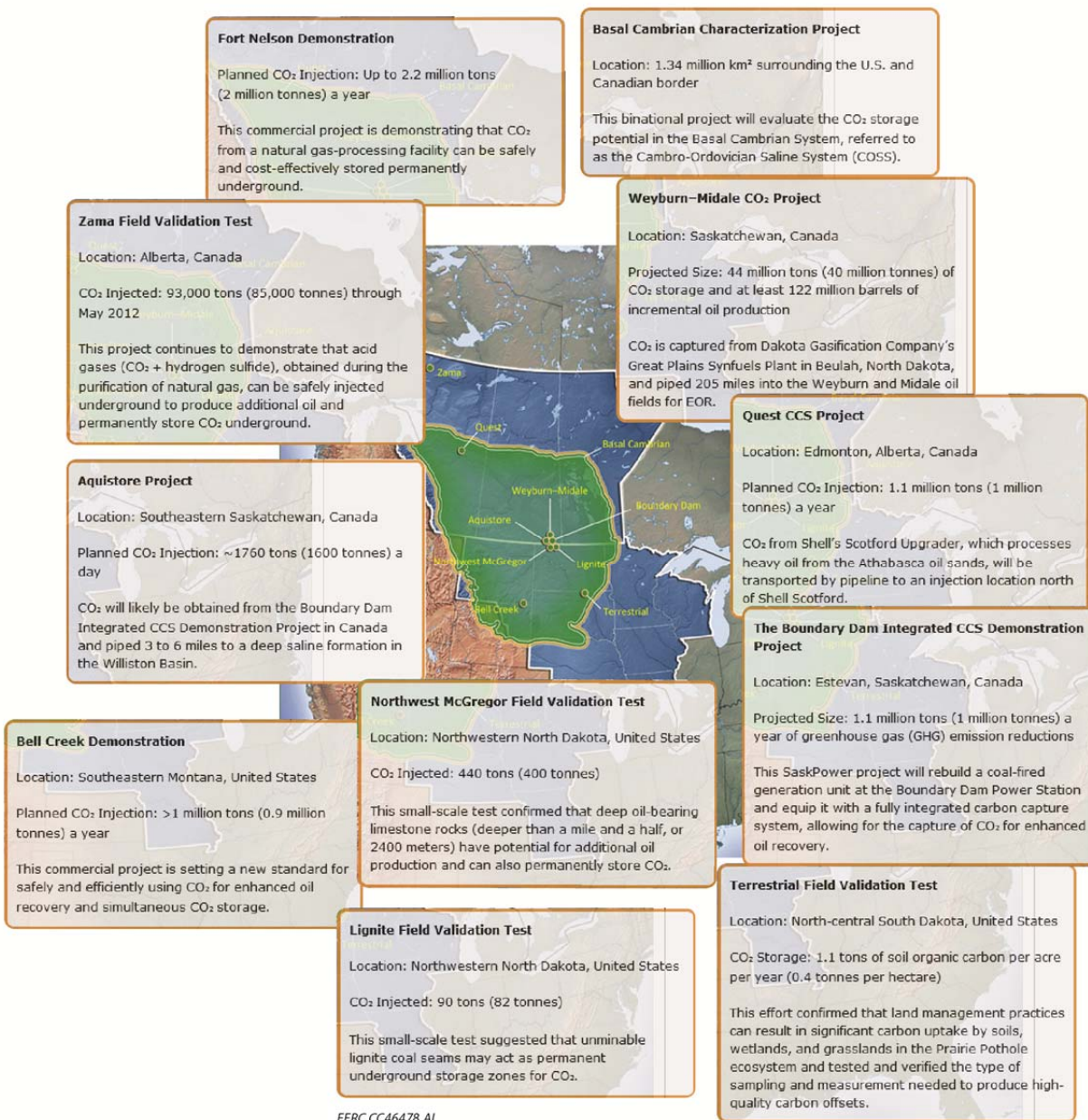



Figure 5. Project information boxes that pop up when hot spots (project titles) are selected on the landing page (Figure 4).

Test link: <http://stage.undeerc.org/pcor/co2seqprojects/#>

Existing link: www.undeerc.org/PCOR/co2seqprojects/default.aspx

Each project has its own Web page. The four PCOR Partnership Phase II field validation “Learn More” links go to the existing PCOR Partnership fact sheets for each of these activities (images not included). The Basal Cambrian “Learn More” link goes to the Geologic Characterization of the Basal Cambrian System page presented in Figure 6, which provides a description of this Phase III activity.



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Geologic Characterization of the Basal Cambrian System

The oldest layer of sedimentary rock in the northern Great Plains region is dated to the Cambrian and Ordovician period of geologic time—600 million years ago. This Cambrian-age rock layer is more than 1000 ft thick and reaches a depth of 14,000 feet in the center of the Williston Basin (4400 meters) and is the oldest and deepest rock layer that can be used for the geologic storage of anthropogenic CO₂. Because the pores of the sedimentary rock contain very salty water (up to 10 times as salty as ocean water), the zone of rock is referred to as the Cambro-Ordovician Saline System (COSS).

Because much of the COSS rock layers are deep underground in the region, they are rarely penetrated by drilling for hydrocarbons. As a result, less is known about the rocks of the COSS or the chemistry of the fluids they contain in their pores relative to shallow layers of rock. The Basal Cambrian Geological Characterization Project will remedy this by studying the geology of the COSS and suitability of the COSS rock formations and fluids for geologic storage of CO₂. The project will feature a close collaboration between Canadian and U.S. scientists and result in a detailed picture of the COSS across the entire region.



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Project Goals

In the 1.34-million-km² area underlain by the COSS, there are 43 large CO₂ sources that each emit more than 0.75 Mt CO₂/year. Assuming that all of these emissions from each of these sources will be stored in the COSS, the main questions to be addressed by this project are:

- What areas of the COSS are suitable for CO₂ storage?
- How many years of CO₂ emissions can be stored in the COSS?
- How will geologic CO₂ storage likely affect the rocks and fluids of the COSS?
- How will the CO₂ behave once injected into the rocks and fluids of the COSS?

Project Phases

The project started on October 1, 2010, and is structured in three 1-year phases.

- Phase I focused on delineating and characterizing separately the Canadian and U.S. portions of the COSS.
- Phase II brought together the data from Phase I into a single 2-D model. Data on depth, thickness, and porosity were collected to compute the CO₂ storage resource of this saline system.
- Phase II will develop a massive 3-D geologic model encompassing the entire study area.

Binational Effort

This binational collaborative effort is led on the U.S. side by the Energy & Environmental Research Center (EERC) through the Plains CO₂ Reduction (PCOR) Partnership and on the Canadian side by Alberta Innovates – Technology Futures (AITF). Other partners include:

- U.S. Department of Energy
- Lawrence Berkeley National Laboratory
- Princeton University
- Saskatchewan Industry and Resources
- Manitoba Water Stewardship
- Manitoba Innovation – Energy and Mines
- CanmetENERGY
- Natural Resources Canada
- TOTAL E&P Ltd.
- University of Regina Petroleum Technology Research Centre


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Figure 6. New Phase III Basal Cambrian activity page, accessible from the CO₂ Sequestration Projects landing page.

Test link: <http://stage.undeerc.org/pcor/co2seqprojects/BasalCambrian.aspx>

No equivalent link exists.

The Bell Creek “Learn More” link goes to the Bell Creek Integrated EOR and CO₂ Storage Project page presented in Figure 7. This page outlines the dual nature of the project—the Denbury Onshore LLC (Denbury), enhanced oil recovery (EOR) project and the collaborative effort with the PCOR Partnership to demonstrate CCUS under the RCSP. This page includes options to download the Bell Creek test site fact sheet (Deliverable D15), the Bell Creek test site poster (Deliverable D25), and the Bell Creek PowerPoint presentation (Deliverable D18). Links on the page offer the visitor the opportunity to learn more about both projects by clicking on the “Learn More” hyperlink for each project. The visitor can also learn more about utilization of CO₂ for EOR by clicking on the “Learn About EOR” link, which goes to the existing CO₂ Flooding page (www.undeerc.org/PCOR/sequestration/flooding.aspx).



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The Bell Creek Integrated EOR and CO₂ Storage Project



This project will produce ~35 million barrels of incremental oil at Bell Creek using CO₂ enhanced oil recovery (EOR) and put millions of tons of CO₂ in permanent storage.


An Integrated EOR and CO ₂ Storage Project	
Denbury's Commercial CO ₂ EOR Project	Bell Creek CO ₂ Storage Demonstration Project
Denbury Onshore LLC (Denbury) is implementing a commercial project that will inject at least 1 million tons (0.9 million tonnes) of CO ₂ per year into its Bell Creek oil field to rejuvenate oil production and permanently store anthropogenic CO ₂ deep underground. Learn More >>	The PCOR Partnership is adding value to Denbury's project through additional characterization, monitoring, and modeling. This collaborative effort will result in a new standard for safe and practical long-term geologic storage of anthropogenic CO ₂ . Learn More >>

Project Location: The Bell Creek Oil Field

Since its 1967 discovery in the Powder River Basin of southeastern Montana, the Bell Creek oil field has produced approximately 133 million barrels (MMbbl) of oil. Most of that oil was produced by injecting water into the oil-bearing zone to push oil to production wells. By 2010, about 38% of the oil was produced and production was dwindling.


In 2010, Denbury acquired the Bell Creek Field with the intention of rejuvenating the once robust field by switching from water injection to CO₂ injection. Bell Creek is an optimal site for CO₂ EOR because experience has shown successful primary and secondary oil recovery using water. Even more oil recovery is expected using CO₂, yielding an additional 35 million barrels of incremental oil. The rock layers in the field are also ideally suited for carbon storage following the oil recovery process.

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Downloads



Fact Sheet
March 2012



Poster
September 2011

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Figure 7. New Phase III Bell Creek Integrated EOR and CO₂ Storage Project page, accessible from the CO₂ Sequestration Projects landing page.

Test link: <http://stage.undeerc.org/pcor/co2seqprojects/BellCreek.aspx>

No equivalent link exists.

The “Learn More” link for Denbury’s Commercial CO₂ EOR Project goes to the page Denbury’s Commercial Project (Figure 8), which provides a general description of the four main steps involved the Bell Creek EOR project. This page also includes external hyperlinks to Denbury’s Web site (www.denbury.com) and to their Greencore Pipeline Web site (www.greencorepipeline.com)

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Denbury's Commercial Project

Denbury's project combines the proven techniques of enhanced oil recovery (EOR) with the characterization and monitoring needed for effective production of additional oil.


1. Obtaining CO₂

The CO₂ EOR project at Bell Creek will require a consistent supply of more than 1 million tons of CO₂ each year for several years. The CO₂ will be provided from the ConocoPhillips Lost Cabin natural gas-processing facility in Fremont County, Wyoming. Natural gas must be in a pure form for transport and use; therefore, the plant removes about 50 million ft³ (1.42 m³) of CO₂ from the raw natural gas produced each day. In the past, the Lost Cabin plant would release the CO₂ into the atmosphere (the current practice at many other gas-processing facilities), but now the CO₂ will be held for use at the Bell Creek Field. [Learn more about Denbury's CO₂ EOR efforts.](#)



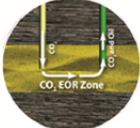
2. Transporting CO₂

In order to transport CO₂ to the field, Denbury will build and operate the **Greencore Pipeline**. Denbury began constructing the 232-mile CO₂ pipeline in August 2011. The first segment of the pipeline starts at the Lost Cabin natural gas plant and runs northeast through Wyoming. In December 2012, Denbury plans to complete the pipeline into southeastern Montana, where it will initially terminate at Bell Creek Field.




3. CO₂ EOR Injection/Separation

At the Bell Creek oil field, CO₂ will be injected ~4500 feet (1.37 km) underground into a mature oil reservoir starting in early 2013 to help produce more oil through the EOR process. A separation facility will purify the oil by removing the portion of CO₂ that is dissolved in the produced oil from EOR operations. Compressors will maintain the pressures needed for CO₂ injection. EOR will be conducted in phases moving from area to area in the oil field. All wells will be inspected and refurbished prior to CO₂ EOR operations.



4. CO₂ Monitoring and Verification

The CO₂ will be monitored and accounted for from the Lost Cabin plant to its arrival at the Bell Creek Field. At the field, monitoring of CO₂ input at the wells and CO₂ recovery at the primary oil purification facility (on-site facility that separates CO₂ dissolved in the oil from EOR operations) will provide accountability during operations. Over a number of years, essentially all of the injected CO₂ used in the EOR process will be trapped in the underground injection zone.



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Figure 8. New page describing Denbury's commercial CO₂ EOR project at Bell Creek (linked from Figure 7).

Test link: <http://stage.undeerc.org/pcor/co2seqprojects/Denbury.aspx>

No equivalent link exists.

The “Learn More” link for Bell Creek CO₂ Storage Demonstration Projects goes to the PCOR Partnership Phase III demonstration collaboration with Denbury presented in Figure 9. This page summarizes the Phase III activities at Bell Creek. This page also has the link to an interactive version of the Integrated Approach concept diagram (presented in Figure 10a) whereby the visitor can learn more about some of the components of the diagram by hovering over each circle (see Figure 10b).

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Bell Creek CO₂ Storage Demonstration Project

The PCOR Partnership is collaborating with Denbury to use the Bell Creek commercial enhanced oil recovery (EOR) operation to learn more about the science of CO₂ behavior in the subsurface. This knowledge will assist future projects to move seamlessly from CO₂ EOR projects to long-term CO₂ storage projects.

Collaborative Effort

The PCOR Partnership teamed with Denbury to provide further information on the geology of the site as well as additional monitoring of injected CO₂. This information will be used to develop a more detailed picture of the site geology and behavior of CO₂, oil, and water in the subsurface. Based on field experience, this improved understanding will be the basis of a comprehensive approach to monitor injected CO₂, account for the CO₂ during and after the EOR operation, and verify that the CO₂ remains in place in the injection zone once EOR operations are complete. The result is improved safety, EOR efficiency, and having the systems in place for CO₂ storage operations.

Integrated Approach

The nature of the geology at a location, both at the surface and deep underground, is the key to successful CO₂ EOR and CO₂ storage. The PCOR Partnership is developing an approach that takes knowledge of the geology and uses it to build an interactive computer model. This allows us to:

- Develop plans to properly track CO₂ in the subsurface.
- Respond to the potential for CO₂ migration.
- Account for the CO₂ injected.
- Verify the CO₂ volume and position in the subsurface.

This approach helps meet the safety expectations of local landowners and communities, while reassuring CO₂ owners that the commodity will remain securely stored in the formation.

A New Standard for CO₂ EOR

By implementing our integrated approach at Bell Creek, the demonstration project will result in a new standard for safe and practical geologic CO₂ EOR-to-CO₂ storage operations.

The real-world results generated by the Bell Creek project will provide stakeholders, including policy makers, regulators, industry, financiers, and the public, with the knowledge necessary to make informed decisions regarding the effectiveness of carbon capture and storage (CCS) as a carbon management strategy.

With this knowledge, stakeholders will have the data necessary to expand the implementation of safe, practical, well-documented CCS projects.




Learn how we are implementing this approach at Bell Creek.



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Figure 9. New page describing the PCOR Partnership collaboration with Denbury at Bell Creek.

Test link: <http://stage.undeerc.org/pcor/co2seqprojects/BellCreekDemonstration.aspx>

No equivalent link exists.

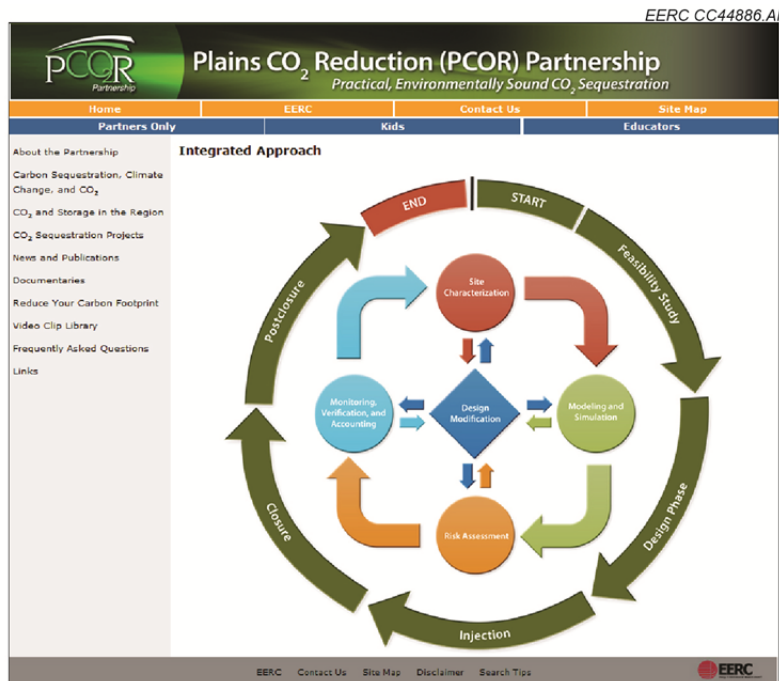


Figure 10a. PCOR Partnership Integrated Approach interactive diagram.

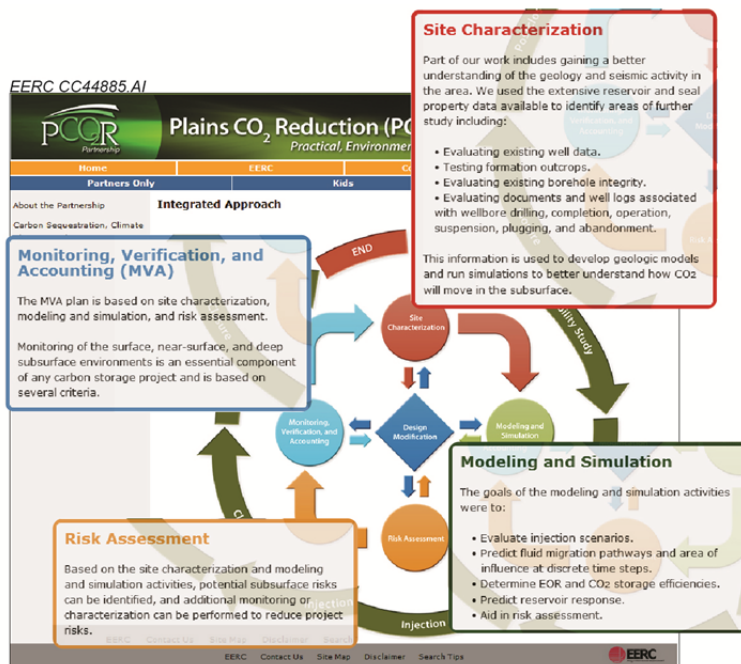


Figure 10b. Boxes appear individually as the visitor hovers the cursor over each circular component.

Test link: <http://stage.undeerc.org/pcor/co2seqprojects/IntegratedApproach.aspx>
 No equivalent link exists.

The Fort Nelson “Learn More” link goes to the Fort Nelson CCS Feasibility Project page presented in Figure 11. This page describes the PCOR Partnership Phase III demonstration collaboration with Spectra Energy near Fort Nelson, British Columbia. The page includes external links to the Carbon Sequestration Leadership Forum (www.cslforum.org/index.html?cid=nav_index) and to Spectra Energy’s Fort Nelson Web page (www.spectraenergy.com/Sustainability/Environment/Carbon-CaptureStorage/).



Figure 11. New Fort Nelson Phase III demonstration, accessible from the CO₂ Sequestration Projects landing page.

Test link: <http://stage.undeerc.org/pcor/co2seqprojects/FortNelson.aspx>

No equivalent link exists.

The Aquistore “Learn More” link goes to the new Aquistore Project page presented in Figure 12. The page provides a brief description of the project and external links to the project’s Web site (www.ptrc.ca/aquistore_overview.php) and to the related SaskPower project Web site (www.saskpower.com/sustainable_growth/projects/carbon_capture_storage.shtml).



Figure 12. New Aquistore Project page, accessible from the CO₂ Sequestration Projects landing page.

Test link: <http://stage.undeerc.org/pcor/co2seqprojects/Aquistore.aspx>

No equivalent link exists.

The Boundary Dam “Learn More” link goes to the new SaskPower Boundary Dam project page presented in Figure 13. The page provides a brief description of the project and an external link to the project’s Web site (www.saskpower.com/sustainable_growth/projects/carbon_capture_storage.shtml).

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SaskPower Boundary Dam Integrated Carbon Capture and Storage Demonstration Project

SaskPower is leading the development of the world's first and largest integrated carbon capture and storage (CCS) project at the Boundary Dam Power Station in Estevan, Saskatchewan, Canada. **The Boundary Dam Integrated Carbon Capture and Storage Demonstration Project** is a \$1.24 billion government-industry partnership between the Government of Canada, the Government of Saskatchewan, SaskPower, and private industry. The Boundary Dam Integrated Carbon Capture and Storage Demonstration Project will reduce carbon emissions by approximately one million tonnes per year. The captured CO₂ will be used for enhanced oil recovery or will be stored in a deep saline formation through the Petroleum Technology Research Centre's **Aquistore Project**.

This leading-edge project, which is expected to become operational in 2014, will determine the technical, economic, and environmental performance of CCS technology.

Project Benefits

- A pathway toward economically and environmentally sustainable power generation.
- One million tonnes/year of greenhouse gas emission reductions from an existing power station.
- A domestic, integrated, commercial-scale carbon capture utilization and storage project – the first and largest of its kind in the world.
- A means to keep coal in the electricity supply mix, thus utilizing an existing supply of reliable, low-cost fuel.
- The reuse of existing fuel supplies and structures within the footprint of an operating industrial site.
- A demonstration project for the development of sound regulation and policies.

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Figure 13. New SaskPower Boundary Dam project, accessible from the CO₂ Sequestration Projects landing page.

Test link: <http://stage.undeerc.org/pcor/co2seqprojects/SaskPower.aspx>

No equivalent link exists.

The Quest “Learn More” link goes to the new Quest CCS Project page presented in Figure 14. The page provides a brief description of the project and an external link to the project’s Web site (www.shell.ca/home/content/can-en/aboutshell/our_business/business_in_canada/upstream/oil_sands/quest/).

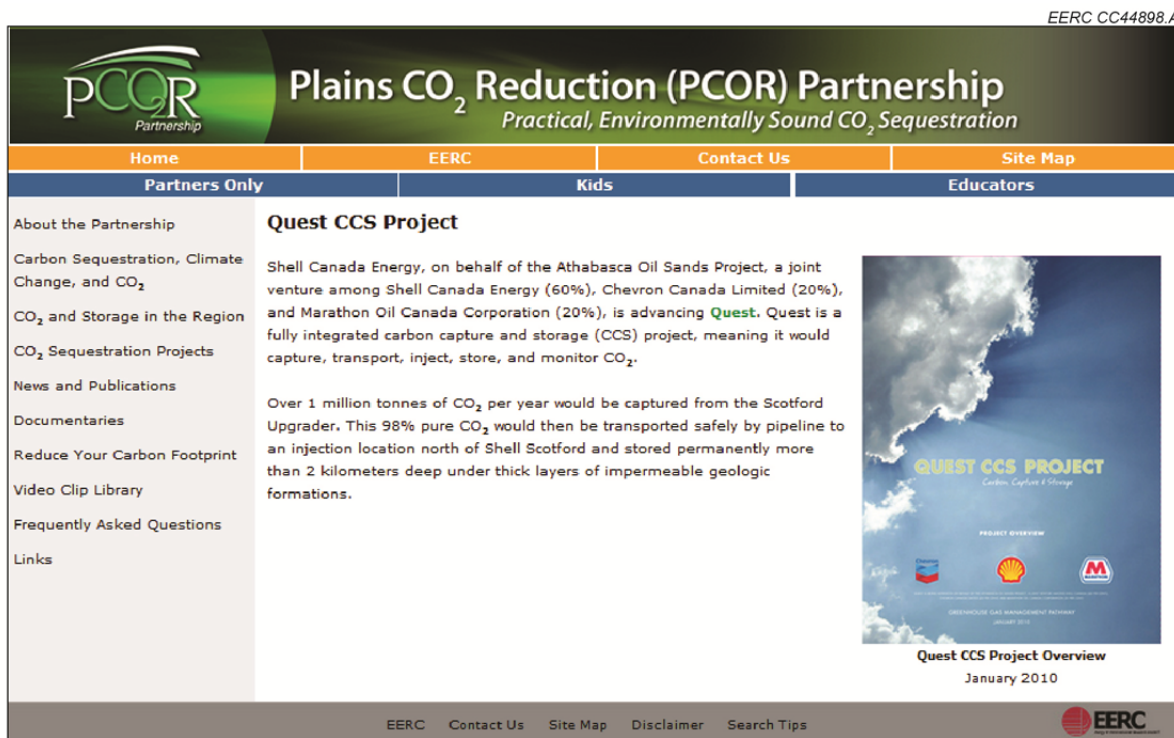


Figure 14. New Quest CCS Project page, accessible from the CO₂ Sequestration Projects landing page.

Test link: <http://stage.undeerc.org/pcor/co2seqprojects/Quest.aspx>

No equivalent link exists.

The Weyburn–Midale “Learn More” link goes to the new Weyburn–Midale CO₂ Project page presented in Figure 15. The page provides a brief description of the project and external links to the commercial companies’ project Web sites (Cenovus: www.cenovus.com/operations/oil/weyburn.html and Apache Canada: www.apachecorp.com/Operations/Canada/Saskatchewan/index.aspx), to Dakota Gasification Company’s CO₂ Capture and Storage Web page (www.dakotagas.com/CO2_Capture_and_Storage/index.html) and to the IEA GHG Weyburn–Midale CO₂ Monitoring and Storage Project Web site (www.ptrc.ca/weyburn_overview.php).

These pages will go live once they are approved by program management.

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Weyburn–Midale CO₂ Project

Assessing CO₂ behavior in an ongoing commercial CO₂ EOR project

The **Weyburn** and **Midale** oil fields in the southern portion of the Canadian province of Saskatchewan are the sites of major commercial enhanced oil recovery (EOR) operations using CO₂. The industrial CO₂ used for the oil field operations travels 205 miles (330 km) by pipeline from the **Great Plains Synfuels Plant** in Beulah, North Dakota, to the Weyburn and Midale oil fields. The EOR operations will eventually produce an additional 122 million barrels of oil and permanently store 44 million tons of CO₂ deep underground in the oil-producing rocks.

The behavior of the CO₂ accumulating in the underground oil-producing zones during the commercial EOR operation has been the focus of the **IEAGHG Weyburn–Midale CO₂ Monitoring and Storage Project**, an 11-year, \$85 million scientific assessment completed in 2011. The assessment program was managed by the Petroleum Technology Research Centre (PTRC) in Regina, Saskatchewan, and was funded by numerous government and industry sources, including the International Greenhouse Gas Research and Development Programme, Natural Resources Canada, and the U.S. Department of Energy. A final report on the project, *Best Practices for Validating of CO₂ Geological Storage - Observations and Guidance from the IEAGHG Weyburn-Midale CO₂ Monitoring and Storage Project*, will be released in the Fall of 2012.

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Figure 15. New Weyburn–Midale CO₂ Project page, accessible from the CO₂ Sequestration Projects landing page.

Test link: <http://stage.undererc.org/pcor/co2seqprojects/Weyburn.aspx>

No equivalent link exists.

FUTURE WORK

The next Web update is due in July of 2014. At this time, an update of the Web site design itself is anticipated, including implementing a more user-friendly YouTube-type video player, greater interactivity, updated information on active projects, and more materials targeting K–12 education (for teachers and students). These changes will be made as part of the effort to provide products that will serve the needs of key audiences, increase overall traffic to the site, and improve our ability to track and assess Web site use.