



# Big Sky Carbon Sequestration Partnership – Phase I

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# **Big Sky Carbon Sequestration Partnership**

## **9<sup>th</sup> Quarterly Report**

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## ABSTRACT

The Big Sky Carbon Sequestration Partnership, led by Montana State University, is comprised of research institutions, public entities and private sectors organizations, and the Confederated Salish and Kootenai Tribes and the Nez Perce Tribe. Efforts under this Partnership in Phase I are organized into four areas:

- Evaluation of sources and carbon sequestration sinks that will be used to determine the location of pilot demonstrations in Phase II;
- Development of GIS-based reporting framework that links with national networks;
- Design of an integrated suite of monitoring, measuring, and verification technologies, market-based opportunities for carbon management, and an economic/risk assessment framework; (referred to below as the Advanced Concepts component of the Phase I efforts) and
- Initiation of a comprehensive education and outreach program.

As a result of the Phase I activities, the groundwork is in place to provide an assessment of storage capabilities for CO<sub>2</sub> utilizing the resources found in the Partnership region (both geological and terrestrial sinks), that complements the ongoing DOE research agenda in Carbon Sequestration.

The geology of the Big Sky Carbon Sequestration Partnership Region is favorable for the potential sequestration of enormous volume of CO<sub>2</sub>. The United States Geological Survey (USGS 1995) identified 10 geologic provinces and 111 plays in the region. These provinces and plays include both sedimentary rock types characteristic of oil, gas, and coal productions as well as large areas of mafic volcanic rocks. Of the 10 provinces and 111 plays, 1 province and 4 plays are located within Idaho. The remaining 9 provinces and 107 plays are dominated by sedimentary rocks and located in the states of Montana and Wyoming. The potential sequestration capacity of the 9 sedimentary provinces within the region ranges from 25,000 to almost 900,000 million metric tons of CO<sub>2</sub>. Overall every sedimentary formation investigated has significant potential to sequester large amounts of CO<sub>2</sub>. Simulations conducted to evaluate mineral trapping potential of mafic volcanic rock formations located in the Idaho province suggest that supercritical CO<sub>2</sub> is converted to solid carbonate mineral within a few hundred years and permanently entombs the carbon. Although MMV for this rock type may be challenging, a carefully chosen combination of geophysical and geochemical techniques should allow assessment of the fate of CO<sub>2</sub> in deep basalt hosted aquifers.

Terrestrial carbon sequestration relies on land management practices and technologies to remove atmospheric CO<sub>2</sub> where it is stored in trees, plants, and soil. This indirect sequestration can be implemented today and is on the front line of voluntary, market-based approaches to reduce CO<sub>2</sub> emissions. Initial estimates of terrestrial sinks indicate a vast potential for increasing and maintaining soil Carbon (C) on rangelands, and forested, agricultural, and reclaimed lands. Rangelands can store up to an additional 0.05 mt C/ha/yr, while the croplands are on average four times that amount. Estimates of technical potential for soil sequestration within the region in cropland are in the range of 2.0 M mt C/yr over 20 year time horizon. This is equivalent to approximately 7.0 M mt CO<sub>2</sub>e/yr. The forestry sinks are well documented, and the potential in the Big Sky region ranges from 9-15 M mt CO<sub>2</sub> equivalent per year. Value-added benefits

include enhanced yields, reduced erosion, and increased wildlife habitat. Thus the terrestrial sinks provide a viable, environmentally beneficial, and relatively low cost sink that is available to sequester C in the current time frame.

The Partnership recognizes the critical importance of measurement, monitoring, and verification technologies to support not only carbon trading but all policies and programs that DOE and other agencies may want to pursue in support of GHG mitigation. The efforts in developing and implementing MMV technologies for geological and terrestrial sequestration reflect this concern. Research in Phase I has identified and validated best management practices for soil C in the Partnership region, and outlined a risk/cost effectiveness framework to make comparative assessments of each viable sink, taking into account economic costs, offsetting benefits, scale of sequestration opportunities, spatial and time dimensions, environmental risks, and long-term viability. This is the basis for the integrative analysis that will be undertaken in Phase II to work with industry, state and local governments and with the pilot demonstration projects to quantify the economic costs and risks associated with all opportunities for carbon storage in the Big Sky region. Scientifically sound MMV is critical for public acceptance of these technologies.

Key deliverables for Phase I include:

- **Geological efforts:** Three deliverables including two major reports on *Technology Needs and Action Plan on the Evaluation of Geological Sinks and Pilot Project Deployment* (Deliverables 2/3), and *Report on the Feasibility of Mineralization Trapping in the Snake River Plain Basin* (Deliverable 14);
- **Terrestrial efforts:** Seven key deliverables including an *Evaluation of Terrestrial Sinks* and a Report of the *Best Production Practices for Soil C Sequestration* (Deliverables 8 and 15) and the supporting documentation for terrestrial sinks.
- **GIS efforts:** the development of the on-line carbon atlas and an accompanying special report on the overall GIS activities for the Partnership which includes the documentation for the carbon atlas plus efforts on development of a data warehouse infrastructure to support Phase II activities, and linkages to other national cyberinfrastructure and outreach efforts.
- **Advanced Concepts efforts:** Seven key deliverables focusing on designing carbon market protocols, assessment of MMV technologies, assessment of geological and terrestrial sink potential as a screening tool for determining Phase II demonstration pilots, and risk assessment and decision-support methodologies. In addition the Partnership has developed a second special report on the policy implications of future economic growth in the Big Sky region.
- **Education Outreach efforts:** The Partnership developed a comprehensive plan which serves as a guide for implementing the outreach activities under Phase I, a well designed web site ([www.bigskyco2.org](http://www.bigskyco2.org)) which has been integrated with the Carbon Atlas, and has been involved in numerous regional and national outreach efforts designed to lay the foundation for regional support of the Phase II demonstration tests.

In conclusion, in Phase I the Partnership has identified, assessed and catalogued C sources and promising geologic and terrestrial sequestration sites, developed market-based carbon trading protocols to facilitate an efficient means to sequester carbon and improve verification that is transferable to other regional, national, and international settings, designed the foundations for an

economic and risk assessment decision support framework to optimize the region's C sequestration portfolio, examining means of cost effectively implementing promising MMV technologies, and developed an education and outreach program, which addresses stakeholders needs as well as develops a program for capacity building in the region incorporating the tribal colleges and at the universities involved in our Partnership.

The Phase I work clearly identified the geological similarities among Montana, Idaho, Wyoming, Washington, and Oregon. There are similar land use patterns and cropland practices among these states and South Dakota, and the Canadian provinces. At the conclusion of Phase I, we have expanded the Partnership to include the states/provinces with similar and contiguous geological and terrestrial sinks. This expansion is also justified by the common economic interests of these States, including many regional energy companies operating across States and Provincial lines. Additionally, the Partnership is working with leading research institutions in DOE's Carbon Sequestration Leadership Forum member countries including Norway, India and China who will bring unique expertise and funding commitments to leverage DOE's Big Sky Partnership investment.

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## INTRODUCTION

The Big Sky Partnership, led by Montana State University, Bozeman, MT, seeks to identify and catalogue CO<sub>2</sub> sources and promising geologic and terrestrial storage sites, develop a risk assessment and decision support framework to optimize the area’s carbon-storage portfolio, enhance market-based carbon-storage methods, identify and measure advanced greenhouse gas-measurement technologies to improve verification, support voluntary trading and stimulate economic development, call upon community leaders to define carbon-sequestration strategies, and create forums that involve the public. Idaho, Montana, Wyoming, and South Dakota are currently served by this Partnership that is comprised of 23 organizations and the Confederated Salish and Kootenai Tribes and the Nez Perce Tribe. Additional collaboration was obtained in the latter half of the Phase I efforts which expanded the Partnership to include the neighboring states of Washington and Oregon, and the neighboring provinces in Canada. We have also brought in several new industrial partners including Puget Sound Energy, Energy Northwest, Sempra Generation, Portland General Electric, and rural Cooperatives in the region. Montana Tech-Montana Bureau of Mines and Geology and the Idaho Carbon Sequestration Advisory Committee/Idaho Soil Conservation Commission, and Battelle Pacific Northwest Division are new members of the Partnership. Inland Northwest Research Alliance (INRA) and Western Governors’ Association (WGA) have provided support for our Partnership since the onset and are members of the Partnership.

<b>Original Partners include</b>	
Montana State University	Nez Perce Tribe
South Dakota School of Mines & Technology	Idaho National Laboratory
Texas A & M University	Los Alamos National Laboratory
University of Idaho	Montana Governor’s Carbon Sequestration
The Sampson Group	Working Group
EnTech Strategies, LLC	National Carbon Offset Coalition
Boise State University	The Confederated Salish & Kootenai Tribes
<b>New Partners include</b>	
Idaho Carbon Sequestration Advisory Committee/ Idaho Soil Conservation Commission	National Tribal Environmental Council Univ. of Wyoming Ruckelshaus Institute for Environment and Natural Resources
Inland Northwest Research Alliance	Montana Natural Resource Information System - Montana State Library
Montana Tech-Montana Bureau of Mines and Geology	Montana Dept. of Admin., Montana GIS Services Bureau, Information Technology Services
Western Governors’ Association	Unifield Engineering
Wyoming Carbon Sequestration Advisory Committee	Jackson Hole Center for Global Affairs
Montana Department of Environmental Quality Wyoming Department of Environmental Quality	Battelle Pacific Northwest Division Energy Northwest
Univ. of Wyoming Geographic Information Science Center	Puget Sound Energy
Univ. of Wyoming Enhanced Oil Recovery Institute	Sempra Generation Portland General Electric Columbia University-Lamont Doherty Earth Observatory
Idaho State University University of Nebraska-Lincoln Intertribal Timber Council	

## **EXECUTIVE SUMMARY**

The final report is being assembled and no additional research was performed during the reporting period.

## **EXPERIMENTAL**

Nothing to report

## **RESULTS AND DISCUSSION**

Nothing to report

## **CONCLUSIONS**

Nothing to report

## **REFERENCES**

None to report

## **APPENDICES**

All Reports and Deliverables will be attached to the Final Report.