

Carbon Sequestration Role in State and Local Actions

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Introduction

This report is written with the intent of summarizing existing carbon sequestration activities at the state level, to inform decision makers, planners, and others who may be interested in the progress of carbon sequestration development in the United States. Beginning with the reasons why states have chosen to initiate carbon sequestration activities, the history of regulation to address greenhouse gas emissions, this report then discusses state and regional activities, and ends with an overview of selected federal programs for carbon sequestration. As the report will describe, there are many carbon sequestration programs throughout the United States today. These programs are diverse, yet there are many similarities in accounting methods and strategy. The authors anticipate that readers of this report will find the summary of existing work useful, and may use it as the foundation for discussion, planning, and collaboration.

Background and State Context

The uncertainty surrounding a national approach to address GHG emissions has led many states to respond to the challenge of reducing CO₂ emissions in a variety of ways, including:

Avoiding CO₂ restrictions by passing regulation that prevents any legislation that would regulate GHG emissions¹;

Supporting independent, voluntary CO₂ emissions reduction by providing guidance in undertaking emissions mitigating projects, and measuring and reporting results in state inventories; and

Regulating CO₂ emissions, by means that include:

- placing caps on point sources
- restricting transportation CO₂ emissions
- reducing net emissions
- joining regional partnerships to reduce emissions.

States that have opted to support mitigation efforts or to regulate CO₂ emissions do so for several reasons. These states may be seeking to gain experience in controlling CO₂ emissions, or prepare for what they consider will be likely future policy and regulation. They may also be anticipating economic gain from participating in the developing GHG market.

Several states have implemented actions to reduce CO₂ emissions, whether through mitigating emissions at the source or by capturing and storing emitted CO₂. There is no typical CO₂ reduction program. State policies run the gamut of focusing on a single economic sector, such as capping CO₂ emissions from power plants, to multifaceted approaches that seek to reduce emissions from several sectors, such as reducing the state's net CO₂ emissions. In some cases, states have developed programs and policies to explicitly reduce CO₂ emissions, and have specified the means by which to reduce them. In other cases, states mandate emissions

¹ Twenty-seven states (EPA Global Warming: Actions: State: Legislative Initiatives, <http://yosemite.epa.gov/OAR/globalwarming.nsf/content/ActionsStateLegislativeinitiatives.html>) proposed or passed legislation recommending that the U.S. government not ratify Kyoto on the grounds that it is too economically damaging to implement. Of these, nine passed rules preventing the state legislature from passing greenhouse gas emissions restrictions in the absence of federal greenhouse gas emissions regulations. Alabama (HB 465), Kentucky (HB 723 (BR 2259)), and Utah (SJR 9) passed these rules in 1998; Wyoming (HB0171), Idaho (SCR 132), West Virginia (amendment to WV Code, Chapter 22), and Oklahoma (SJR 6) in 1999; and Iowa (HB 246) and Illinois (Public Act 90-797) in 2000. Although these states have chosen to avoid restrictions to GHG emissions, they continue to support voluntary reduction programs, and several have worked to develop mitigation plans and strategies.

reductions or energy improvements without specifying compliance methods. Although many states have chosen to develop programs solely to reduce CO₂ emissions, many others have simply expanded existing energy efficiency, transportation, land management, agricultural, electricity generation and energy management programs to include guidelines for CO₂ emissions reduction. Given the plethora of ways that CO₂ emissions may be reduced—whether by fuel switching, energy efficiency improvements, or capturing and storing CO₂ emissions—it is no wonder that there are a variety of state regulations and programs to mitigate CO₂ releases. In this report, we focus on the state and local actions underway to sequester CO₂ emissions.

Though there is neither national legislation for carbon sequestration activity, nor national market for greenhouse gas (GHG) reductions, several states have developed regulations to encourage carbon sequestration projects, and regional alliances have been developed to coordinate efforts and resources to reduce GHG emissions. In the absence of a national directive to address GHG emissions, state opinions regarding the best approach to manage GHG emissions are subject to fluctuate with resource availability and political climate. For example, some states that have established registries later repealed them; other states sought to create registries and advisory boards but could not afford to maintain them, and some states that previously sought to restrict regulation of GHGs have created carbon sequestration advisory boards.

States are developing programs to reduce GHG emissions for many reasons, and carbon sequestration is one of many tools to aid them in meeting their goals. State and regional activities to encourage carbon sequestration and the development of GHG emissions markets are complementary. Carbon sequestration is a viable option to reduce GHG emissions, and is a valuable asset among technologies used to comply with GHG emissions caps. The creation of GHG emissions markets encourages the development of means to reduce GHG emissions, such as energy efficiency practices, renewable energy resources, and carbon sequestration.

As of June 11, 2004, 40 states and Puerto Rico have voluntarily prepared greenhouse gas inventories, and 28 states have climate change action plans.² In doing so, they have taken steps to quantify and reduce their GHG emissions. Quantification of GHG emissions entails the creation of a GHG inventory, which can serve as the starting point for more involved reduction activities, by identifying areas where emissions reductions may be achieved, creating registries for emissions reductions, and modeling energy and economic activity. Several states have followed this course and have begun the process of passing and implementing regulations that encourage the use and development of carbon sequestration.

To date, projects and guidance for terrestrial sequestration comprise the majority of state level carbon sequestration activity. Geologic sequestration guidance will follow, as more geologic sequestration demonstration projects are undertaken, and the potential impacts of increased application of this technology are better understood. Technical support for geologic sequestration is being developed at the federal level to better understand how carbon sequestration can fit into current regulatory frameworks. As this technical knowledge increases, the guidance and application of geologic sequestration will increase.

² EPA State and Local Office.

Carbon Sequestration in State Legislation

While many states have recognized the need to quantify and understand their GHG emissions only a few have realized the potential to employ carbon sequestration as a means to meet their emissions reduction goals. Implementation of this technology varies by state. Some states have chosen to endorse terrestrial sequestration projects through creation of a third party to manage sequestration activity and other states have simply established a committee to evaluate the potential for sequestration or to develop best management practices to enable current and future participation in carbon markets. The breadth in state carbon sequestration legislation is shown in Figure 1. Registries developed independently by states are shown in Figure 1; regional registry efforts and the specific role of carbon sequestration in registries will be discussed in following sections.

Box 1. States have developed several tools to support the development of carbon sequestration projects. Predominant state programs include sequestration advisory boards and greenhouse gas registries.

7 States have established Carbon Sequestration Advisory Boards to discuss general sequestration issues. These Carbon Sequestration Advisory Boards can also provide guidelines for calculating the costs and offsets of projects, as well as serve to aggregate project emissions throughout the state for sale in a GHG credit market.

4 States have passed legislation to develop GHG Registries. Registries are a voluntary reporting program through which companies can keep an official record of their annual GHG emissions.

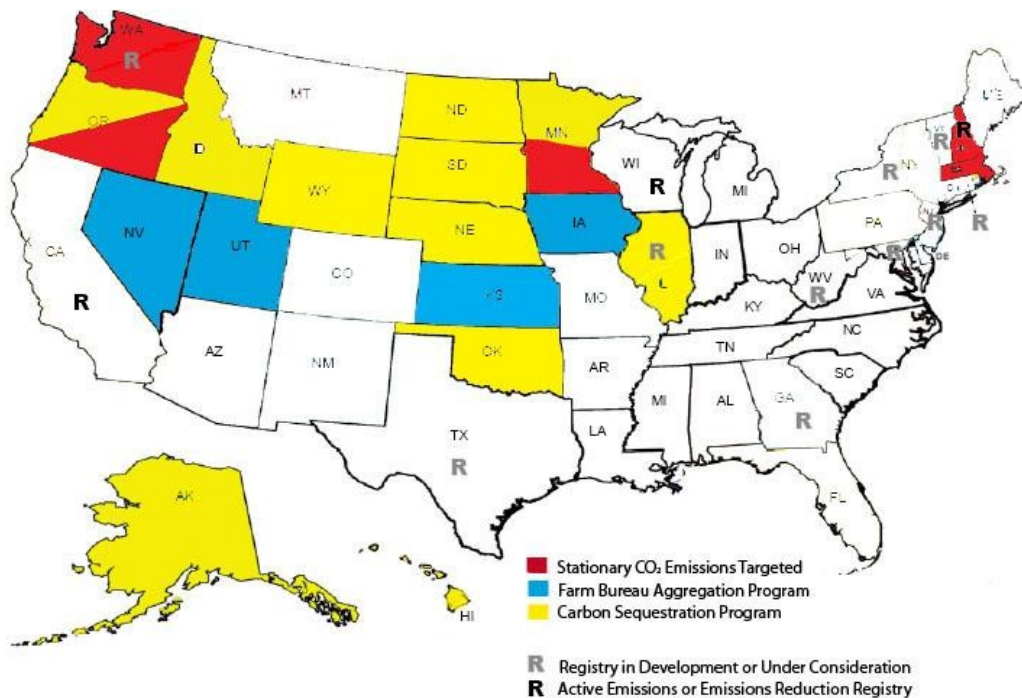


Figure 1. Carbon Sequestration Legislation by State

Oregon was the first state to establish a regulation of GHG emissions from power production. In 1997, Oregon passed House Bill 3283, creating the Oregon Climate Trust, requiring new power plants to offset their CO₂ emissions by approximately 17 percent of the most efficient gas fired power plant in the nation. Emitters may finance the Oregon Climate Trust to undertake mitigation projects to offset emissions. Many of these offset projects include fuel efficiency improvements, as well as forestry sequestration projects. In April 2004, Washington passed House Bill 3141, which requires new power plants rated 25 MW or greater to offset 20 percent of their CO₂ emissions over 30 years of plant operations. Similar to Oregon law, Washington power plant operators may opt to pay a state-approved third party at the rate of \$1.60/tCO₂ for offset projects. The Oregon offset rate was \$0.57/tCO₂ at the inception of House Bill 3283, subject to a 50 percent increase or decrease by the Oregon Energy Facility Siting Council in any two-year period after 2000. Although Massachusetts and New Hampshire also have CO₂ emissions restrictions for power plants in their multipollutant emissions legislation, they do not explicitly define mechanisms for power plant operators to reduce emissions. Massachusetts 310 CM4 7.29, passed in April, 2001, restricts CO₂ emissions to 1,800 lbs/MWh by 2006 or 2008 with an overall goal of reducing total plant emissions by 10 percent. New Hampshire HB 284, passed January, 2002, requires a return to 1990 emissions levels by 2006.

Several states have passed legislation to support carbon sequestration. Most of these regulations concern terrestrial sequestration. Hawaii is an exception in that it also supports oceanic sequestration. Other states, such as Minnesota and Oregon, seek to promote the health of their forests while sequestering carbon. Several midwestern states have developed carbon sequestration advisory committees to recommend policies or programs to enhance the ability of agriculture and forest landowners to participate in carbon trading systems. These states, Nebraska, Wyoming, South Dakota, North Dakota, Oklahoma, Illinois, Oklahoma, and Idaho,

have all recognized the potential to capitalize on their farm and forest land to sequester carbon. These legislative actions are summarized in Table 1. The reader may note that although Hawaii passed a law supporting carbon sequestration, it later opposed oceanic sequestration experiments off the Kona coast, and that Illinois created a Carbon Sequestration Advisory Board despite its initial opposition to control GHGs under Illinois Public Act 90-797 in 2000. This change in opinion towards GHG control and sequestration is not unique; as will be discussed further in this paper, other states have changed regulatory course over time as well. It may also be expected that as speculation over national regulation continues, changes in regulatory direction at the state level will also continue.

Table 1. State Carbon Sequestration Legislation

State	Bill	Passed	Remarks
Minnesota	Division of Lands and Forestry Statute Section 88.82	1999	Establishes the Minnesota ReLeaf Program in the Department of Natural Resources to encourage, promote, and fund planting, maintenance, and improvement of trees in the state to reduce CO ₂ levels, promote energy conservation, and achieve other environmental benefits. Depending on available funding, matching grants up to \$25,000 per project may be available as reimbursement for up to 50 percent of project costs. At least 50 percent of project costs must be paid through non-state-funded cash or in-kind contributions.
Nebraska	LB 957	2000	Created Carbon Sequestration Advisory Committee to determine best management practices for terrestrial sequestration, to develop inventory, and support a pilot sequestration program.
Wyoming	HB 0047	2001	Created Carbon Sequestration Advisory Committee to recommend policies or programs to enhance the ability of Wyoming agriculture and forest landowners to participate in carbon trading systems. Created Carbon Sequestration Advisory Committee to document and quantify reductions related to agricultural practices and to create the Carbon Sequestration Assessment Cash Fund.
South Dakota	SB 126	2000	Created the Carbon Sequestration Advisory Committee to evaluate the potential for South Dakota landowners to participate in carbon trading systems. The C-Lock program is funded by governor's grant, administered by the South Dakota School of Mines to assist landowners in understanding, identifying, certifying and marketing carbon credits. http://hpcnet.org/clock . Accessed June 24, 2004.
South Dakota	HB 1150	2000	Establishes \$250,000 fund for carbon sequestration research for agricultural lands through July 31, 2001.
Idaho	SB 1379A	2002	Creates Carbon Sequestration Advisory Committee; expands the duty of Idaho Soil Conservation Commission to determine potential for sequestration to address climate change issues and benefit the state, evaluate best management practices, measurement and verification protocols for terrestrial sequestration.
North Dakota	SCR 4043	2001	Directs legislative council to study feasibility and desirability of promoting carbon sequestration programs in state.
Oklahoma	HB 1192	2001	Establishes Carbon Sequestration Advisory Committee to determine potential for Oklahoma farmers and landowners to participate in carbon trading systems.
Illinois	HB 842	2001	Creates a Carbon Sequestration Advisory Committee within the Department of Agriculture to investigate the potential for carbon sequestration in Illinois, focusing on air quality and the preservation of agricultural resources. Repealed June 1, 2002.
Hawaii	HB 1893	2000	Encourages GHG emission reductions and carbon sequestration through agriculture and forestry.

State	Bill	Passed	Remarks
	SB 1253	2000	Establishes a fee-based pollution fund to develop carbon offset forestry projects. This fund is intended to aid in the management and accounting of carbon sinks and carbon offset forestry projects.
	SCR 158	2001	Resolution supporting efforts of the U.S., Japanese, Norwegian, Canadian, and Australian governments to conduct scientifically sound and environmentally safe studies of carbon sequestration in the deep ocean. Resources and cooperation of the State of Hawaii will be made available to contribute to this effort in conformance with the laws of Hawaii.
	HR 64	2001	Opposes an experiment to sequester CO ₂ in Kona waters. The exclusion applies only to a defined area of ocean at Keahole Point, about 2 miles wide and 2.6 miles out to sea.
Oregon	HB 2200	2001	Directs the Department of Forestry to link the Forest Resource Trust, state forestlands, and bring together representatives of other non-federal landowner's programs by developing a shared carbon accounting system. It anticipates that markets will emerge for forestry carbon offsets and builds on the success of the Forest Resource Trust.
Alaska	HB 196	2003	Recognizes the potential for improved agricultural, forest and soil management practices to reduce CO ₂ emissions. Creates a Carbon Sequestration Advisory Committee to be appointed by the governor to recommend policies or programs to enhance state participation in carbon trading, identify sequestration research needs, review sequestration programs and policies of other states, and evaluate potential GHG restriction regimes.
Minnesota	Statutes 2003 216B.1694	2003	Defines an "innovative energy project" for utilities, as one that uses technology to control NO _x , SO ₂ , and Hg more effectively than conventional technology. Among the criteria defined for a project to be considered innovative is "good faith effort to secure funding from the United States Department of Energy and the United States Department of Agriculture to conduct a demonstration project at the facility for either geologic or terrestrial carbon sequestration projects to achieve reductions in facility emissions or carbon dioxide."
Georgia	SB 356	2004	Directs the Georgia Forestry Commission to create a registry of GHG reductions achieved through carbon sequestration activities.

Sequestration in Registries and Inventories

While 40 states and Puerto Rico have prepared voluntary greenhouse gas emissions inventories, or plan to reduce their emissions, only a few states have established greenhouse gas emissions registries. These states have varied approaches to representing carbon sequestration within these registries. Wisconsin and California passed legislation in 2000, New Hampshire in 2001, and Georgia in 2004, requiring voluntary emission reduction registries (Table 2). The major difference between the registries is that the Wisconsin, New Hampshire, and Georgia programs are registries of emissions reductions, while the California program is a registry of emissions and emissions reductions. According to Georgia SB 356, the Georgia Carbon Sequestration Registry must be in place within one year; that is, the Georgia Carbon Sequestration Registry guidance and program will be created by July 1, 2005. Because the Georgia Carbon Sequestration Registry is still in development, the bulk of this discussion about state registries will focus on those of Wisconsin, California, and New Hampshire as well as the Regional Greenhouse Gas Registry (RGGR) under development between Maine, New Hampshire, Vermont,

Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania and Delaware, with Maryland as observer to the process³.

The states that have working registries have each developed their own approaches toward the common goal of creating a repository for reporting emissions and emissions reductions. New Hampshire directs reporters to several resources to quantify emissions reductions, while California and Wisconsin provide specific guidance in reporting emissions offset from forestry projects; Wisconsin also provides an example of prairie sequestration. The RGGR is still under development, and will build upon existing protocols and initiatives. To date, none of these registries provide explicit guidance for reporting offsets from other means of sequestration. Although participation in voluntary registries does not guarantee credit for offset actions under future regulatory regimes, it does provide a record of action that may be grandfathered. For example, the state of California pledges to stand by the emissions reported in its registry, in the event of a future greenhouse gas emissions crediting program.

³ Personal correspondence with Kelly Levin, NESCAUM, October 12, 2004.

Table 2. State Voluntary Emission and Emission Reduction Registries

	Wisconsin	California	New Hampshire	Georgia^a	RGGR
Legislation	Act 195, signed May 17, 2000, effective June 1, 2000	SB 1771, signed by governor on September 30, 2000	Chapter Env-A 3800, adopted February 23, 2001	SB 356, effective July 1, 2004	None – Action Item # 9 in NEG/ECP Climate Action Plan spurred the creation of RGGR
Maintainer	Wisconsin Department of Natural Resources	California Climate Registry, a non-profit agency	New Hampshire Department of Environmental Services	Georgia Forestry Commission and Georgia Superior Court Clerks Cooperative Authority	Northeast States for Coordinated Air Use Management
Boundaries	Voluntary greenhouse gas emissions reductions undertaken in Wisconsin	Greenhouse gas emissions from California, nationwide, or international activity	Any business in New Hampshire reducing greenhouse gas emissions in or out of state	Greenhouse gas emissions offsets must be undertaken in Georgia	Undecided.
Third party verification	Recommended	Required after first two years of reporting; must be performed by a certified verifier	Not required; reported emissions verified by NH Department of Environmental Services personnel ^b .	Required; must be performed by certified verifier	Most likely will be required for voluntary reporters and offsets, should they be included in RGGI.
Baseline	Average annual or rate of emissions or rate of emissions for two years immediately preceding the year of action taken to voluntarily reduce emissions. If this is not a representative baseline, uses alternative baselines based on typical years, averages, and industry standards may be permitted	Any year after 1990	It is recommended that base year and baseline emissions should be set according to the WRI GHG Protocol	Any year for which the reporter has verified carbon sequestration data	Undecided
De Minimus	None	5 percent of greenhouse gas emissions	1 ton CO ₂ equivalent	None	Undecided.
Protocols	Recommend following 1605(b) guidelines, and using EPA AP-42 factors to calculate emissions; accepted estimation methods are flexible. Examples to calculate offsets from forestry and agricultural sequestration project provided	World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD); no carbon sequestration guidelines	Any guidance issued by NH DES, applicable guidance from EPA or DOE, other proposed methods later approved in accordance with Env-A 800. Emissions may be measured by stack testing in accordance with Env-A 800, and continuous emissions monitoring ^c	Under development; to date, Price Waterhouse Coopers and several Georgia universities are contributing to the development of reporting guidelines.	Under development among participating states.

^aInformation about the developing Georgia Carbon Sequestration Registry obtained through personal correspondence with John Wells of the Georgia Forestry Commission on August 13, 2004. Information here is subject to change as the Georgia Carbon Sequestration Registry is developed.

^bPersonal correspondence with Joseph Fontaine, NH DES, August 17, 2004.

^cNew Hampshire Code of Administrative Rules Env-A 3800.

^dPersonal correspondence with Kelly Levin, NESCAUM, October 12, 2004.

The California Climate Registry (hereon referred to as “The Registry”) is a registry of greenhouse gas emissions and emissions reductions presented its proposed forestry project reporting protocol to the public on June 24, 2004. As comments are received on this protocol, the Registry will revise and finalize the reporting protocol. Currently, the protocol requires Registry participants to report forest carbon stocks and biological emissions, as well as their entity’s GHG emissions from other sources. Biological emissions and carbon stock must be estimated from above and below ground living biomass, soil, dead biomass of diameter greater than 6 inch and 10 feet lengths, and for large dead biomass of diameter greater than 16 inch and 6 feet length. The Registry provides equations to estimate carbon stocks based on diameter at breast height (DBH), and published carbon factors. The de minimus requires reporting CO₂ for the first 3 years, and all applicable GHGs (notably CH₄ and N₂O) thereafter. To date, only forestry emissions from California projects must be certified; certification is required for the first year of reporting, and every four years thereafter. Forestry projects require a “biological baseline,” which is defined as a projection of the reporter’s forest carbon stocks over 100 years, based on its management practices and goals. This baseline may be adjusted as necessary, if factors affecting sequestration levels result in a ± 10 percent change in annual reportable carbon stocks.

Participants in the Wisconsin registry report emissions reductions and carbon sequestration, defined as the “establishment or enhancement of a carbon reserve.”⁴ The Wisconsin Department of Natural Resources advises that “quantification protocols do not yet exist for many carbon sequestration activities. When quantification protocols are not available, activities may be registered without quantifying the amount of carbon sequestered. However, the registration must include a detailed description of the project with the location, number of acres reforested or restored to prairie, number of trees planted or similar actions.”⁵ At this time, terrestrial sequestration projects are the predominant focus of examples to calculate offset from sequestration projects. The Wisconsin registry handbook provides an example of prairie sequestration, as well as a reference to the *Urban Forestry Carbon Sequestration Workbook*, developed by the Energy Information Administration (EIA) for forestry projects.

The New Hampshire Env-A 3800 rule recognizes carbon sequestration as a means to reduce GHG emissions, but does not yet provide explicit guidance for reporting emissions reductions achieved through sequestration activity. At this time, the sequestration emissions methodology presented in the WRI GHG Protocol is recommended to participants who wish to report emissions reductions from sequestration. The NH DES is revising its requirements and protocols for reporting, and plans to adjust its registry conditions to match the forthcoming *Voluntary Guidelines for Reporting Greenhouse Gases*⁶ from the EIA.

⁴ State of Wisconsin, Chapter NR 437. “Voluntary Emission Reduction Registry.”

⁵ Wisconsin Department of Natural Resources, “The Wisconsin Voluntary Emission Reduction Registry: How to Make It Work for you” 2000.

⁶ Personal correspondence with Joseph Fontaine, NH DES, August 17, 2004.

In October 2003, the Northeast States for Coordinated Air Use Management (NESCAUM) launched RGGR for the Northeast. RGGR is a key piece of the infrastructure necessary for the northeastern states to move ahead in meeting their climate change commitments under the New England Governors-Eastern Canadian Premiers Climate Change Action Plan to reduce northeast greenhouse gas emissions, adopted in August 2001, and individual targets set by New York and New Jersey. Beyond the NESCAUM states, RGGR participants also include Delaware and Pennsylvania, with several other states outside of the Northeast observing the process. The registry will use quantification and reporting protocols based on the GHG Protocol, a multi-stakeholder collaboration led by the World Resources Institute and the World Business Council for Sustainable Development. The GHG Protocol corporate standards have been used by the California Climate Action Registry, the World Economic Forum Registry, and many other climate initiatives. Adopting these standards will promote consistency and harmonization within the United States and beyond. In addition, NESCAUM is coordinating work on RGGR with the California Climate Action Registry and will work to design RGGR so that it is as compatible as possible with the California Registry while still meeting the individual needs of the northeastern states.

Other states with forthcoming registries are Illinois, Maine, Michigan, Massachusetts, New Jersey, New York, Rhode Island and Vermont. States currently considering registries are Maryland, Pennsylvania, Texas, Washington, and West Virginia.⁷ New Jersey and Maine both require “large emitters” to register their GHG emissions. Maine defines large emitters as any facility emitting more NO_x and SO₂ than allowed by its reporting threshold. Maine’s de minimus reporting requirement for GHG emissions from large emitters is 1 ton CO₂ equivalent.⁸ New Jersey had established a GHG registry in 2000, under its Open Market Emissions Trading Rule, but later halted this program in 2002 and officially repealed the Open Market Emissions Trading Rule on February 25, 2004.⁹ Currently, there are no de minimus reporting requirements for GHG emissions in New Jersey, but large emitters must report GHG emissions. New Jersey defines large emitters as facilities that have the potential to emit more than 5 tons of lead per year, more than 25 tons of NO_x or VOCs per year, and in excess of 100 tons of CO, NH₃, PM₁₀, PM_{2.5}, SO₂, and/or TSP per year.¹⁰

A Unified Effort: The Overlap Between Carbon Sequestration and Regional GHG Emissions Reduction Efforts

A sampling of regional carbon sequestration projects underway in the U.S. are summarized in Table 3. Many of these projects are the result of a collaboration between private entities, government, and nongovernmental grassroots organizations. Projects

⁷ EPA State and Local Office, personal correspondence with Niko Dietsch, August 16, 2004.

⁸ Personal correspondence with Tammy Gould and Mike Karagiannes, Maine Department of Environmental Protection, August 10, 2004.

⁹ New Jersey Department of Environmental Protection. Open Market Emissions Trading, Adopted Repeals: (N.J.A.C. 7:27-18.2A, 18.11, and 30), Filed March 5, 2004, as R.2004d. Online database: <http://www.nj.gov/dep/aqm/OMETrepealadopt.pdf>. Accessed August 23, 2004.

¹⁰ Personal correspondence with Marty Rosen, New Jersey Department of Environmental Protection, August 17, 2004.

<p>include no till practices and crop management to enhance terrestrial sequestration, as well as tree planting programs. There is strength in numbers; the cumulative effort of establishing a trust fund, such as the UtiliTree and PowerTree programs¹¹, enables a multitude of carbon sequestration projects to be undertaken. Aggregating carbon offset practices from farming results in market power for farmers, as the Iowa Farm Bureau is doing in participation in the Chicago Climate Exchange, results in market power for farmers. Carbon sequestration efforts may unite entities at many levels. Projects bring together the private sector, government, and environmental groups. Many</p>	<p>Box 2. Co-Benefits of Sequestration</p> <p>Geologic CO₂ injected into depleting oil and gas reservoirs or unmineable coal seams enhances resource recovery. Depleted reservoirs typically use primary oil recovery and secondary recovery via a water flood to produce 35-40% of the original oil in place (OOIP). Supercritical CO₂ is a strong hydrocarbon solvent recovers an additional 10-15% of the OOIP. CO₂ enhanced-gas and enhanced coalbed methane recovery are not yet routinely conducted in a commercial setting but field tests to date have been promising.</p> <p>Terrestrial In many cases, terrestrial sequestration offers an opportunity to improve the productivity and overall quality of the land. The potential ancillary benefits are many and vary according to the specifics of the chosen site. Examples include reduced run-off, improved soil quality, wildlife habitat created or improved, and conversion of under-productive lands to healthy ecosystems.</p>
<p>initiatives cross state lines, whether through agreements undertaken by multiple states to reduce greenhouse gas emissions, or by collaborative sequestration projects undertaken across state borders. This section of the report will examine the overlap between public and private sector sequestration efforts, regional initiatives, as well as government resources in support of carbon sequestration.</p>	

Many collaborative sequestration projects, as described in Table 3, have secondary benefits, such as the Lower Mississippi Valley Bottomland Hardwood Forest Restoration Project, which restores wetlands for migratory birds and provides an indigenous animal shelter while sequestering carbon.¹² In fact, several of the programs and projects currently underway to sequester carbon throughout the country began with other intended goals. For example, reforestation projects in Washington began over 10 years ago, with the aim of conserving soil and preserving forests. As interest in sequestration developed, these reforestation programs expanded to include sequestration projects. The interest in sequestration lends itself toward participation in the developing carbon market, as offsets are created and more entities enter trades.

The National Energy Technology Laboratory (NETL) is also engaged in a variety of carbon sequestration projects around the country. These projects are discussed at the end of this document and highlighted in Table 6.

¹¹ A leading private partnership includes UtiliTree and PowerTree, which is organized by the Edison Electric Institute. UtiliTree began in 1994 as a solicitation to utilities to voluntarily reduce their greenhouse gas emissions by sponsoring remediation work. As a consortium of 41 utilities, it has provided more than \$2.5 million to fund carbon sequestration projects. These projects are frequently collaborative undertakings with nonprofit conservation groups, community groups, universities, and government agencies. The monitoring and verification varies by project, but it is expected that participating utilities will be able to use the emissions reductions in future greenhouse gas credit or trading programs.

¹² Personal correspondence with John Kinsman of the Edison Electric Institute, July 8, 2004.

Table 3. Sampling of Carbon Sequestration Projects Underway around the U.S.^a

Project	Location	Size and Lifetime	Expected Carbon Sequestered	Participants	Remarks
Reforestation in Eastern Washington			250,000 tons	Tenaska Inc. PacifiCorp Trexler and Associates UtiliTree	
Pacific Forest Stewardship			240,000 tons	UtiliTree Pacific Forest Trust Oregon State University	The Pacific Forest Trust is a nonprofit conservation organization that works to protect and grow forests on private land by developing partnerships with landowners, forest managers, government agencies, local communities, and private investors. The Pacific Forest Trusts' Stewardship Forestry program works to manage private and commercial forests in an environmentally benign manner.
Mississippi River Valley Bottomland Hardwood Forest Restoration Project	Alluvial plan stretching from Illinois to Louisiana.	32 hectares 70 years	50,000 tons	The Conservation Fund UtiliTree Environmental Synergy Inc. AEP Dynegy Chevron Texaco Prima Klima Future Forests Winrock Intl.	Project is being managed by Environmental Synergy Inc. Tree planting is implemented in cooperation with state and federal agencies. Monitoring and verification of sequestration is managed by Winrock Int'l. Locations of reforestation under the program include Upper Ouachita, Overflow, and Bayou Cocodrie National Wildlife Refuges. The Overflow National Wildlife Refuge in Arkansas will be a 160 hectare project, with a 70 year lifetime that will sequester 240,000 tons of carbon. The Upper Ouachita River Valley project will reforest 400 hectares in the Upper Ouachita National Wildlife Refuge of Louisiana over 70 years and is expected to sequester 240,000 tons ^b – 600,000 tons ^c of carbon. The 160 hectares of land in the Bayou Cocodrie National Wildlife Refuge in Louisiana will sequester 240,000 tons of carbon over 70 years.
Forest Resource Trust Carbon Offset Project			45,000 tons	PacifiCorp Forest Resource Trust Trexler and Associates	The Forest Resource Trust was originally established by the 1993 Oregon Legislature with goals of conserving soil, restoring fish and wildlife habitat, increasing future timber availability, creating job opportunities and recreation.
Klamath Climate Cogeneration Plant Project			66,000 tons	PacifiCorp Trexler and Associates	
Western Oregon Carbon Sequestration Project		120 hectares 65 years	200,000 tons	UtiliTree Trexler and Associates Oregon Woods Inc.	
Tensas National Wildlife Refuge		70 years	881,000 tons	Chevron Texaco	
Salt Lake City			5,000 tons	PaciCorp	

Project	Location	Size and Lifetime	Expected Carbon Sequestered	Participants	Remarks
Urban Tree				Tree Utah Trexler and Associates	
Midwest Forest Restoration	Nature Conservancy reserves and State land in Indiana and Ohio	4856 hectares 40 years	150,000 tons	The Nature Conservancy Cinergy Corporation	The project aims to restore 1,000 acres of native forest in Ohio and Indiana. Currently, the project will plant 27,000 oak and walnut trees at Ohio Brush Creek, and reforest parcels around old-growth hemlocks at the Big Walnut Nature Preserve in Indiana.
Iowa Farm Bureau Carbon Credit Aggregation	Iowa	Goal of 100,000 acres 4 years ^d		Iowa Farm Bureau Federation Chicago Climate Exchange	Iowa Farm Bureau Federation manages the program, aggregating carbon credits from enrolled farmers. The Iowa Farm Bureau Federation monitors land, and pays farmers for the credits that are consequently sold on the Chicago Climate Exchange.
National Carbon Offset Coalition, formerly known as the Montana Carbon Offset Coalition	Montana	Varies			The National Carbon Offset Coalition is in development, and has received a grant from the State of Montana. The Coalition is working to become an aggregator of carbon offset from projects undertaken in Montana. To date, it has plans for 35 projects; it assembles its portfolio of offset projects based on initial proposals by potential project managers. Based on buyer interest, a project plan is made to create the carbon offsets. The Coalition hopes to accrue enough carbon offset and reserves to participate in the Chicago Climate Exchange ^e .
Kansas Farm Bureau Federation					
Western Oregon Carbon Sequestration Project	Oregon	300 acres 65 years	200,000 tons	UtiliTree	Project will plant trees on over 300 acres of unforested, non-industrial timberland in western Oregon.
Obion Creek Wildlife Management Area	Kentucky	900 acres 70 years	292,000 tons	Cinergy Kentucky Dept. of Fish and Wildlife Resources Environmental Synergy, Inc. The Conservation Fund	Cinergy is funding The Conservation Fund to undertake reforestation in the Obion Creek.

aInformation from this table includes World Resources Institute carbon sequestration project descriptions, and personal correspondence with project managers.

bEdison Electric Institute

c World Resources Institute

d Iowa Farm Bureau Spokesman Online, October 20, 2003

ePersonal correspondence with Neil Sampson, The Sampson Group, advisor to the National Carbon Offset Coalition, August 16, 2004.

State Support for Carbon Sequestration

Due to the fledgling status of the carbon market, states have taken several approaches to reduce uncertainty and provide guidance in developing carbon offset programs and projects. Guidance includes investigating the potential for entities in the state to participate in carbon sequestration and offset credit trading; developing GHG emissions reporting and reduction registries; and working to develop regional trading systems.

States with highly agricultural economies are recognizing the potential financial gains for farmers through participation in carbon markets.¹³ It is estimated that changes in soil management practices on farms may result in 154 million tons¹⁴ of sequestered carbon. Participation in aggregation programs, such as those sponsored by the Iowa and Kansas Farm Bureau Federations, may be profitable for farmers. The Iowa Farm Bureau markets aggregate offsets from participating farmers on the Chicago Climate Exchange. Other states have established advisory committees (shown in Table 1) to evaluate the potential benefits of participating in carbon markets, given the speculative nature of the current market and international politics of carbon credits.

In addition to the existing Wisconsin and California registries, regional activity is underway that will support future markets. The California registry is expected to expand to include Oregon and Washington, as well as serve as an outline for registry activities necessary for a forthcoming cap-and-trade system in the northeast. The combination of regional activities, and bicoastal cooperation will culminate in a larger, coordinated effort to reduce greenhouse gas emissions.

Regional alliances have developed between states to coordinate greenhouse gas reduction efforts. Such coordination includes the West Coast Governor's Global Warming Initiative, Regional Greenhouse Gas Initiative (RGGI), and the New England Governors and Eastern Canadian Premiers action to reduce regional GHG emissions. As a result of these alliances, the states are working toward regional goals in parallel with developing state level policies to reduce GHG emissions.

¹³ Bob Stallman, President of the American Farm Bureau Federation in a statement to the Senate Subcommittee on Clean Air, Climate Change, and Nuclear Safety, regarding agricultural sequestration of carbon. July 8, 2003.

¹⁴ USDA Global Change Fact Sheet, "Soil Carbon Sequestration: Frequently Asked Questions."

Table 4. Comparison of Regional Alliances

	Western Governor's Global Warming Initiative	New England Governors and Eastern Canadian Premiers	Regional Greenhouse Gas Initiative
Participants	California Oregon Washington	Connecticut Maine Massachusetts New Hampshire Rhode Island Vermont New Brunswick Newfoundland Nova Scotia Prince Edward Island Quebec	Connecticut Delaware Maine Massachusetts New Jersey New Hampshire New York Rhode Island Vermont
Observers	None	None	District of Columbia Eastern Canadian Provinces Maryland New Brunswick Pennsylvania
Goals	Increase fleet of fuel efficient, including hybrid, vehicles Reduce diesel emissions through creation of emission-free truck stops along I-5 Encourage the use of renewables in electricity generation Increase appliance efficiency standards Develop protocols for GHG reporting	Reduce regional GHG emissions to 1990 levels by 2010 Reduce regional GHG emissions to 10 percent below 1990 levels by 2020	Develop and implement a multistate emission trading market for GHGs
Actions	Participating states develop proposals and plans to address each of the five goals within their state and on a regional level. Proposals due September 6, 2004.	Participating states and provinces develop registries and inventories of GHG emissions, and means to reduce GHG emissions.	Develop regional model of energy use and emissions, as well as socioeconomic impacts of various cap-and-trade programs. Model rule for emissions trading program will be based on this regional energy-economic model, and will be completed by April 2005.

The first of these regional initiatives, the New England Governors and Eastern Canadian Premiers, was established in July 2000. The states and provinces involved agreed to reduce their emissions by the goals stated in resolution 25-9. Since then, the RGGI was initiated by New York Governor George Pataki in 2003.

The RGGI complements the New England Governors and Eastern Canadian Premiers resolution. Other NESCAUM activity that complements the New England and Eastern Canadian Premiers Climate Plan is an initiative to develop an economic-energy model of New England¹⁵, which will serve as the platform to develop a cap-and-trade program for greenhouse gas credits in the participating states and provinces.

The West Coast Governors’ Initiative was started in September 2003 by the governors of Washington, Oregon, and California. Each state created a plan to reduce emissions and increase energy efficiency, identifying areas where emissions reductions could be achieved within a year. Representatives of each state participate in working groups to address the designated goals of increasing the fleet of fuel efficient vehicles, reducing emissions on highway I-5, encouraging renewable resources in electricity production, increasing efficiency standards, and developing consistent GHG reporting protocols. Initial proposals to address these issues will be submitted in September 2004.

There are few marked differences between the west coast and east coast alliances; most notably are the treatment of power sector reduction requirements, goals, and approach. The power sector emissions reductions required by RGGI are based on available capacity, whereas the West Coast Governors’ Initiative power sector emissions reductions are load based. Thus far, the RGGI is focused solely on developing a cap-and-trade program for CO₂ reductions in the power sector, but will further develop protocols that will allow offsets to be considered, as well as GHG credit trading from sources outside the power sector. The West Coast Governors’ Initiative is using a multifaceted approach to reduce GHG emissions in the region.

Federal Support for Carbon Sequestration: DOE Initiatives

In direct support of President Bush’s Global Climate Change Initiative, the Department of Energy (DOE) sought to address the regional variance in sources and sinks by engaging local government agencies and nongovernmental organizations, research organizations, and private sector participants. Overall, these partnerships seek to promote the development of a framework and infrastructure necessary for the validation and deployment of carbon sequestration technologies. These seven partnerships, called Regional Carbon Sequestration Partnerships, include leaders from more than 140 organizations in 33 states, three American Indian nations, and two Canadian provinces.¹⁶ The states and members of these partnerships are summarized in Table 5. At this time, there is no partnership representing the northeast. However, the absence of a partnership in that region does not preclude the participation of organizations in those states from joining any of the existing sequestration partnerships.

Table 5. Regional Carbon Sequestration Partnerships¹⁷

Partnership Name	States	Partners (lead in bold)
Midwest Regional Carbon Sequestration Partnership	IA, KY, MI, MD, OH, PA, WV	Battelle Memorial Institute , BP, Nordic, Arch Coal Inc., American Electric Power, Cinergy, CONSOL, First Energy, Wisconsin Energy Corporation, Indiana Geological Survey, Kentucky Geological Survey, Ohio Coal Development Office, Ohio Division of Geological Survey, Ohio Environmental Office, Pennsylvania Geological Survey, West Virginia Geological and Economic Survey, Ohio State University, Pennsylvania State University, Purdue, West Virginia University, National Regulatory Research Institute, The Keystone Center, Michigan

¹⁵ The Northeast States for Combined Air Use Management (NESCAUM) is working with the EPA Office of Research and Development to develop a MARKAL model of New England. The model will represent and project energy use and electricity production, economic activity, transportation, and resultant emissions. The results will serve as the basis for examining the economic impacts of greenhouse gas emissions reduction policy in the northeast, and will be expanded to include New York and New Jersey in the future.

¹⁶ Department of Energy press release, “Energy Secretary Abraham Creates Regional Partnerships to Develop Carbon-Sequestration Options.” September 2, 2003.

¹⁷ DOE National Energy Technology Laboratory. “Carbon Sequestration Project Portfolio FY 2004.” July 20, 2004.

Partnership Name	States	Partners (lead in bold)
		State University, University of Maryland, Western Michigan University, Maryland Geological Survey, AES Warrior Run, Inc., Maryland Energy Administration, DTE Energy, Alliance Resources Partners, Constellation Energy
An Assessment of Geological Carbon Sequestration Options in the Illinois Basin	IL, IN, KY	The Board of Trustees of the University of Illinois, Illinois State Geological Survey
Southeast Regional Carbon Sequestration Partnership	AL, AR, FL, GA, LA, MS, NC, SC, TN, TX, VA	Southern States Energy Board , Electric Power Research Institute, Mississippi State university Diagnostic Instrumentation Analysis Laboratory, Massachusetts Institute of Technology, Tennessee Valley Authority Public Power Institute, Winrock International, Augusta Systems Inc., Applied Geo Technologies, Geologic Survey of Alabama, Susan Rice and Associates, Advanced Resources International, The Phillips Group, RMS Research
Southwest Regional Partnership for Carbon Sequestration	AZ, CO, KS, NE, NM, OK, TX, UT, WY	New Mexico Institute of Mining and Technology , Western Governors Association, Advanced Resources International, Bureau of Economic Geology University of Texas at Austin, Burlington Resources Center for Energy and Economic Development, Chevron Texaco ERTC, Chevron Texaco Permian Business Unit, ConocoPhillips, Intermountain Power Agency, Interstate Oil and Gas Compact Commission, Kansas Geological Survey, Kinder Morgan CO ₂ , Marathon Oil Company, McNeill Technologies, Navajo Nation, Nevada Bureau of Mines & Geology, Oklahoma Gas and Electric, Oxy Permian Ltd, PacifiCorp, Public Service Co. of New Mexico, Tucson Electric Power Company, WERC, Wyoming State Geological Survey, Yates Petroleum Corporation
West Coast Regional Carbon Sequestration Partnership	AK, AZ, CA, NV, OR, WA	State of California, California Energy Commission , Advanced Resources International, Aera, Automated Geographic Reference Center, BP, California Dept. of Forestry and Fire Protection, California Dept. of Oil, Gas and Geothermal Resources, California Geologic Survey, California Polytechnic Institute, California State University at Bakersfield, Chevron Texaco, Clean Energy Systems, ConocoPhillips, Electricity Innovation Institute, EPA-California, KinderMorgan, Lawrence Berkeley National Labs, Lawrence Livermore National Labs, Massachusetts Institute of Technology, M. Theo Kearney Foundation of Soil Science, Nevada Bureau of Mines and Geology, Nexant Inc., Occidental Petroleum, Oregon Department of Forestry, Pacific Forest Trust, Salt River Project, San Francisco Dept. of the Environment, Science Strategies, SFA Pacific, Shell, Sierra Pacific Resources, Stanford Global Climate Change Program, Terralog Technologies, TransAlta, Washington State DNR, Western Governors Association, Western States Petroleum Association, Winrock International, Oklahoma Gas and Electric, Oxy Permian Ltd., PacifiCorp, Public Service Co. of New Mexico, Tucson Electric Power Company, WERC, Wyoming State Geological Survey, Yates Petroleum Corporation
Big Sky Regional Carbon Sequestration Partnership	ID, MT, SD	Montana State University , Boise State University, Confederated Salish and Kootenai Tribes, Environmental Financial Products, EnTech Strategies LLC, Idaho National Engineering and Environmental Laboratory, Los Alamos National Laboratory, Montana Governors' Carbon Sequestration Working Group, National Carbon Offset Coalition, Nez Perce Tribe, South Dakota School of Mines and Technology, Texas A&M University, The Sampson Group, University of Idaho
Plains CO ₂ Reduction Partnership	IA, MO, MN, ND, NE, MT, SD, WI, WY	University North Dakota – Energy & Environmental Research Center , Amerada Hess Corporation, Basin Electric Power Cooperative, Bechtel Corporation, Center for Energy &

Partnership Name	States	Partners (lead in bold)
		Economic Development, Chicago Climate Exchange, Dakota Gasification Company, Eagle Operating Inc., Environment Canada, Fischer Oil and Gas Inc., Great River Energy, Interstate Oil and Gas Compact Commission, Minnesota Pollution Control Agency, Montana-Dakota Utilities Co., Montana Department of Environmental Quality

There are two phases of Regional Carbon Sequestration Partnership development: planning and development and field testing of technologies and infrastructure concepts and implementation of outreach plans. The costs during Phase I are approximately \$1.5 million per project, with 40 percent cost share from Regional Carbon Sequestration Partnership participants. This phase is intended to develop the partnership, identify potential projects, and characterize the regional sources and sinks during an 18 to 24 month time period. Project planning and understanding of the region achieved during this time period serve as the basis for technology and application of infrastructure ideas in *Phase II*.

In Phase 1 each Regional Sequestration Partnership:

- Identifies and characterizes CO₂ sources
- Evaluates existing infrastructure needs, to support CO₂ separation, capture, transport, and sequestration
- Develops Regional Project Implementation Plans
 - Identify most promising technologies and approaches to sequester carbon directly or indirectly, and/or capture carbon in the region
 - Develop public education and outreach plan(s)
 - Develop regulatory compliance action plan(s)
 - Assess monitoring, measurement and verification protocol requirements

The primary purpose of Phase II efforts will be to:

- Establish wide-scale deployment opportunities.
- Establish and implement monitoring, mitigation, and verification protocols.
- Establish and implement accounting, regulatory, and liability action plans.
- Implement outreach mechanisms.
- Perform proof-of-concept field tests for technology & infrastructure concepts.

Hundreds of opportunities for deploying sequestration technologies throughout the country have been developed during Phase I. These opportunities will be tested in Phase II, and outreach activities and MM&V protocols will be implemented. Phase II will likely include new field projects, analogous to several that are emerging from the core program and summarized in Table 6. Options selected for field testing in Phase II are expected to vary according to the unique regional source-sink characteristics. Capture facilities and technologies, prospective geologic sinks, and terrestrial sequestration on a landscape scale will likely be validated through Phase II activities.

Data collected by the partnerships that characterizing sources and sinks are being integrated into a national database, the National Carbon Sequestration Database and Geographic Information System (NATCARB).¹⁸ NATCARB is an online resource available to the public, that provides a comprehensive picture of national sequestration infrastructure.

In addition to building a cohesive partnership and assembling source-sink data, the Partnerships were also tasked with evaluating the regulatory framework for sequestration projects in Phase I. The Interstate Oil and Gas Commission (IOGCC) has engaged the seven partnerships to evaluate the specific regulatory needs in each

¹⁸NATCARB online database: www.natcarb.org/, Accessed August 25, 2004.

region. Draft regulatory guidelines for sequestration projects are expected to be released in Fall 2004. The U.S. EPA is directly involved as a member of two of the partnerships, and more active involvement from EPA is expected as the partnerships move towards Phase II. DOE is also working with EPA at the Federal level on a formal regulatory barriers analysis.

National Energy Technology Laboratory (NETL) Sponsored Carbon Sequestration Projects

The Regional Sequestration Partnerships are only one example of research being conducted through DOE's Carbon Sequestration Program, which includes a robust portfolio of research projects and outreach efforts. Projects relevant to this report are likely to have a local impact; a sampling of these projects is listed in Table 6. Omitted from this discussion, but worth noting is the development of technology for capturing CO₂ from the flue gas stream at a power plant, and the development of technologies and frameworks for monitoring, mitigation and verification (MM&V).

Table 6. DOE Carbon Sequestration Program¹⁹ Projects/Activities

Effort	Description	Location/URL
Sequestration Field Tests	Drilling into Mt. Simon reservoir (saline formation)	New Haven, WV http://www.netl.doe.gov/publications/factsheets/project/Proj227.pdf
	3,000 ton injection into saline formation	Frio, TX http://www.netl.doe.gov/publications/factsheets/project/Proj210.pdf
	Commercial-scale demonstration of coal-bed sequestration	New Haven, WV http://www.netl.doe.gov/publications/factsheets/project/Proj228.pdf
	Terrestrial sequestration demonstrations	Mined lands in KY and VA http://www.netl.doe.gov/publications/factsheets/project/Proj235.pdf http://www.netl.doe.gov/publications/factsheets/project/Proj236.pdf
Environmental Impact Statement	Evaluating the impacts of the entire DOE sequestration program	Opportunities for public input in writing and at public hearings throughout the country http://www.netl.doe.gov/coalpower/sequestration/eis/index.html
Carbon Offsets Opportunity Program	Web-based system designed to match parties interested in funding sequestration projects with landowners/project operators	Launched in WV in July 2004, will be used by several regional partnerships and launched nationally in 2005 www.offsetopportunity.com
Educational Curriculum	Interdisciplinary curriculum for middle school, covers climate change and available mitigation options (including sequestration)	Tested in schools in WI and OH in 2003; introduced at regional science teacher meetings in VA and OR in 2004; teacher training planned for October 2005 with teachers from across the country; additional national deployments in 2005 are expected.

Federal Support for Carbon Sequestration: EPA Initiatives

In addition to DOE guidance, regional partnerships have many resources available to them via the EPA regional offices. To date, representatives from state regulatory agencies and two EPA regional offices are among the participants in several of the regional partnerships. The EPA regional offices can provide expertise in understanding underground injection control (UIC) regulations, and historical injectate behavior data that helps planners understand the potential impacts of storing CO₂ underground. The EPA Office of Atmospheric

¹⁹ For a complete listing of projects, visit www.netl.doe.gov/sequestration

Programs (OAP), and Office of Ground Water and Drinking Water (OGWDW) are jointly convening an EPA Geologic Sequestration Workgroup to address issues related to carbon capture and sequestration.²⁰ EPA programs can facilitate carbon sequestration efforts by providing expertise, data, and a regulatory framework that systematically addresses the range of environmental concerns that might arise when carbon sequestration projects are developed. The EPA Underground Injection Control program addresses hazardous and radioactive waste disposal, as well as regulation of CO₂ injected for enhanced oil recovery, and can provide valuable lessons and useful data to support carbon sequestration efforts.

EPA OAP and OGWDW are convening a workgroup to help guide EPA participation in the Administration's carbon sequestration initiative. The working group's major goals will be to:

- Improve internal EPA coordination of carbon sequestration activities
- Monitor domestic and international technology and policy development
- Identify research needs to address the range of environmental concerns
- Develop and conduct risk assessment
- Identify policy measures that could support carbon sequestration while mitigating negative impacts to the environment
- Collaboratively develop an EPA position on carbon sequestration
- Communicate a consistent message to industry and the public
- Participate in ongoing lab and field research and DOE's Regional Sequestration Partnerships

Future Developments for Carbon Sequestration Programs

State and local approaches to addressing greenhouse gas emissions are marked by their variety, and many states have changed their strategies over time. However, many states have recognized the potential for carbon sequestration to reduce greenhouse gas emissions. Several states are evaluating and encouraging terrestrial carbon sequestration, while one state has debated oceanic sequestration. Federal support for carbon sequestration includes the development of terrestrial, oceanic, and geologic sequestration projects. Over time, project experience and guidance from states and federal agencies will result in better understanding of the financial costs and benefits of carbon sequestration projects, achievable greenhouse gas reductions, risks to human health and environment, as well as reporting and measurement protocols.

States have several tools at their disposal to develop carbon sequestration programs. States are experts of their respective domains. Though there are a variety of opinions about the roles that state agencies may play, and this is not a conclusive description, here are a few examples of how states can support carbon sequestration projects. Institutional resources vary by state; states can use their agencies and offices to disseminate information about carbon sequestration projects and risks to the general public, as well as aid the responsible development of carbon sequestration. Here are a few preliminary ideas for building upon existing knowledge and expertise:

State geological surveys may have information about state topography, fractures, potential reservoirs for storage, quality of rock and soil, that could support terrestrial and geologic sequestration.

State environmental agencies can provide regulatory guidance to validate emissions offset, and ensure that quality of environment and health are maintained as projects are developed.

²⁰ John Beale, Deputy Assistant Administrator for Air and Radiation and Mike Shapiro, Deputy Assistant Administrator for Water. Memorandum to EPA UIC Programs (Regions 1-10), ORD, OSWER, ORIA, OIA.

State agricultural and forestry boards can aid the development of terrestrial sequestration.

State commerce agencies can help manage credit trades, coordinate market activity, and consolidate offsets for trades.

Overall, states have a variety of expertise readily available to them. In collaboration with regional partnerships – whether it is the DOE regional partnership program, the NEG/ECP, or another alliance – states can find information and a network to support the development of sequestration.

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