

## Carbon Capture and Storage

This IPRO report examines states' efforts to regulate and incentivize carbon capture and storage.

### Carbon Dioxide and Climate Change

Greenhouse gases (GHG) in the atmosphere increase the Earth's temperature by trapping the Sun's heat.<sup>1</sup> Many recent scientific tests have shown that the concentration of GHG is increasing to dangerous levels.<sup>2</sup> The increasing concentration in the atmosphere has corresponded with a rise in average global temperatures. Many scientists believe temperatures will continue to increase as GHG concentrations in the atmosphere continue to rise, which will alter environments all around the world and may lead to more frequent and severe natural disasters, such as floods, drought, tidal waves and hurricanes.<sup>3</sup>

Burning fossil fuels leads to significant emissions of carbon dioxide (CO<sub>2</sub>), which is the most common GHG found in the atmosphere.<sup>4</sup> Among fossil fuels, the combustion of coal adds the most CO<sub>2</sub> to the air.<sup>5</sup> Burning one pound of coal, which is primarily carbon, releases about 3.7 pounds of CO<sub>2</sub> into the atmosphere due to the bonding of carbon and oxygen.<sup>6</sup> Since coal is one of the biggest causes of GHG emissions, scientists are focusing on ways to limit the emissions' impact on the environment.

### The Carbon Capture and Storage Process

Scientists are developing ways to capture and store CO<sub>2</sub> produced by industry. There are currently four commercial CCS projects worldwide, none of which are in the United States. Numerous other projects are under development.<sup>7</sup>

There are three steps to carbon capture and storage: separating the CO<sub>2</sub> at the site of operation, transporting it to the storage site, and storing it.

There are three ways to capture carbon:

- The post-combustion method involves trapping the CO<sub>2</sub> after the fossil fuel is burned, which leads to an 80-90 percent reduction of CO<sub>2</sub> released into the air.
- The pre-combustion method involves separating the CO<sub>2</sub> before the fossil fuel is burned and is cheaper than the post-combustion method.<sup>8</sup>

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<sup>1</sup> "EIA - Greenhouse Gases, Climate Change, and Energy." *Energy Information Administration - EIA - Official Energy Statistics from the U.S. Government*. Web. 18 Oct. 2009. <<http://www.eia.doe.gov/bookshelf/brochures/greenhouse/Chapter1.htm>>.

<sup>2</sup> *Ibid.*

<sup>3</sup> *Ibid.*

<sup>4</sup> *Ibid.*

<sup>5</sup> "Carbon Dioxide Emission Factors for Coal." *Energy Information Administration - EIA - Official Energy Statistics from the U.S. Government*. Web. 15 Oct. 2009. <[http://www.eia.doe.gov/cneaf/coal/quarterly/co2\\_article/co2.html](http://www.eia.doe.gov/cneaf/coal/quarterly/co2_article/co2.html)>.

<sup>6</sup> *Ibid.*

<sup>7</sup> "Federal Register Environmental Documents." Environmental Protection Agency. Web. 28 Oct 2009. <<http://www.epa.gov/EPA-WATER/2009/August/Day-31/w20920.htm>>.

<sup>8</sup> "Federal Register Environmental Documents." Environmental Protection Agency. Web. 28 Oct 2009. <<http://www.epa.gov/EPA-WATER/2009/August/Day-31/w20920.htm>>.

- The oxy-fuel combustion method involves burning fossil fuel in oxygen and separating the CO<sub>2</sub> through a cooling process. While it is more expensive than the pre-combustion and post-combustion methods, it is more effective at removing CO<sub>2</sub> than the other methods.<sup>9</sup>

After the CO<sub>2</sub> is captured, it is transferred by truck or pipe to a site to be injected into the ground or ocean. For ground storage, porous rocks such as basalt are used to store the CO<sub>2</sub>. There are two methods to storing the CO<sub>2</sub> in the ocean: storing it at depths of about 1,800 meters, where it will dissolve and storing at depths of 3,000 meters, where it will not move and will stay concentrated.<sup>10</sup>

## Drawbacks and Resistance to CCS

CCS takes a significant amount of energy to carry out and can use up to 40 percent of a power plant's capacity, which makes it very expensive. The transportation of CO<sub>2</sub> also uses energy.

CCS poses several risks to the environment. Storing CO<sub>2</sub> in the ocean can make the ocean more acidic and limit its natural ability to remove CO<sub>2</sub> from the air. On land, CO<sub>2</sub> may leak from underground CCS sites, harming nearby plants and animals.<sup>11</sup> There is some evidence that high exposure to CO<sub>2</sub> for short periods and low exposure for long periods may cause cancer or other health problems.<sup>12</sup>

Value of property near CCS sites is at risk because potential buyers may fear health risks associated with CCS.<sup>13</sup>

The future efficacy of CCS is hotly debated. Some environmentalists assert the technology will not limit emissions in time to mitigate effects of global warming. They advocate cutting emissions, rather than relying on CCS.<sup>14</sup>

## Federal Action on CCS

The federal government has taken action on CCS, principally through the Department of Energy (DOE), which sees CCS technology as one component of a broader effort to stave off global warming. The DOE set up the Monitoring, Verification and Accounting Focus Area to demonstrate the ability of storage sites to successfully contain CO<sub>2</sub>.<sup>15</sup> The DOE formed seven\* regional CCS partnerships that determine the most effective ways to capture and store carbon in their areas. The regional groups are voluntary government/industry partnerships and are "tasked with determining

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<sup>9</sup> Howstuffworks "How Carbon Capture Works" *Howstuffworks "Science"* Web. 19 Oct. 2009. <<http://science.howstuffworks.com/carbon-capture.htm/printable>>.

<sup>10</sup> "Carbon Capture and Ocean Storage." *Earth Ocean and Space*. Web. 28 Oct. 2009. <<http://www.earthoceanspace.com/pages/technology/carbon-capture-and-ocean-storage.php>>.

<sup>11</sup> Ibid.

<sup>12</sup> Regulation of Carbon Capture and Regulation. Publication. International Risk Governance Council, Feb. 2009. Web. 11 Oct. 2009. <[http://www.irgc.org/IMG/pdf/Policy\\_Brief\\_CCS.pdf](http://www.irgc.org/IMG/pdf/Policy_Brief_CCS.pdf)>.

<sup>13</sup> Ibid.

<sup>14</sup> "The Myth of Clean Coal." *Yale Environment* 360. Web. 20 Oct. 2009. <<http://e360.yale.edu/content/feature.msp?id=2014>>.

<sup>15</sup> "Carbon Sequestration." National Energy Technology Laboratory." Web. 20 Oct. 2009. <[http://www.netl.doe.gov/technologies/carbon\\_seq/index.html](http://www.netl.doe.gov/technologies/carbon_seq/index.html)>.

\* These include: the Big Sky Regional Carbon Sequestration Partnership, the Plains CO<sub>2</sub> Reduction Partnership, the Midwest Geological Sequestration Consortium, the Midwest Regional Carbon Sequestration Partnership, the Southeast Regional Carbon Sequestration Partnership, the Southwest Regional Partnership on Carbon Sequestration, and the West Coast Regional Carbon Sequestration Partnership.

the most suitable technologies, regulations, and infrastructure needs for carbon capture, storage, and sequestration in different areas of the country.”<sup>16</sup>

The Environmental Protection Agency (EPA) has also been active on CCS, primarily in developing regulations for injection.<sup>17</sup>

In addition, federal lawmakers allocated \$1.52 billion for carbon capture and storage from fossil fuel plants in the American Recovery and Reinvestment Act.<sup>18</sup>

### **State Action on the Regulation of CCS**

IPRO researchers identified 10\* states that have designated agencies to regulate CCS.<sup>19</sup> Four of these states—Montana, Oklahoma, Texas, and Wyoming—have already established regulations for the storage and injection phases of CCS.

### **State Incentives for CCS**

While some states have tried to incentivize CCS, only North Dakota and Kansas have enacted laws that set up such programs. Akin to other tax incentive programs, CCS incentive programs provide tax advantages for CCS activities. Kansas’ incentive methods include property tax exemptions for the capture and injection sites<sup>20</sup> and income tax exemptions for the company.<sup>21</sup>

### **Iowa Action on CCS**

Iowa does not have any laws regulating CCS, but legislators have considered two bills in recent years concerning the technology. A bill that would have set up a voluntary registry for projects was not passed. The failed legislation would have given the Department of Agriculture and Land Stewardship to administer the registry. Another bill that did not pass would have placed a five-year moratorium on the construction of coal-powered plants that did not permanently sequester 90 percent of carbon emissions.<sup>22</sup>

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<sup>16</sup> “NETL: Regional Carbon Sequestration Partnerships.” DOE - National Energy Technology Laboratory: Home Page. Web. 11 Oct. 2009. <[http://www.netl.doe.gov/technologies/carbon\\_seq/partnerships/partnerships.html](http://www.netl.doe.gov/technologies/carbon_seq/partnerships/partnerships.html)>.

<sup>17</sup> “Federal Register Environmental Documents.” Environmental Protection Agency. Web. 28 Oct 2009. <<http://www.epa.gov/EPA-WATER/2009/August/Day-31/w20920.htm>>.

<sup>18</sup> “Department of Energy Awards \$71 Million to Accelerate Innovative Carbon Capture Project.” U.S. Department of Energy, Sept. 2009. Web. 28 Oct. 2009. <[http://fossil.energy.gov/news/techlines/2009/09064-APS\\_to\\_Scale\\_Up\\_CCS\\_Project.html](http://fossil.energy.gov/news/techlines/2009/09064-APS_to_Scale_Up_CCS_Project.html)>.

\* Montana, North Dakota, Kansas, Illinois, Oklahoma, Washington, Utah, Texas, West Virginia.

<sup>19</sup> Ibid.

<sup>20</sup> “Statutes.” Kansas State Legislature. Web. 20 Oct. 2009. <<http://www.kslegislature.org/legsrv-statutes/getStatuteFile.do?number=/79-233.html>>.

<sup>21</sup> “Carbon Capture and Storage: State Law Update - Press Room - Hogan & Hartson.” Home - Hogan & Hartson. Web. 11 Oct. 2009. <<http://www.hhlaw.com/pressroom/newspubs/PubDetail.aspx?publication=4783>>.

<sup>22</sup> “Iowa General Assembly.” Web. 20 Oct. 2009. <<http://www.legis.state.ia.us/index.html>>.