

# **The Role of Environmental Advocacy Groups in the Advancement of Carbon Capture and Storage (CCS)**

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## **Abstract**

As the idea of carbon capture and storage (CCS) has evolved in the past fifteen years from a relatively obscure concept to an increasingly recognized potential approach that could be an important contributor to stabilizing atmospheric carbon dioxide (CO<sub>2</sub>) concentrations, environmental advocacy groups have had limited, but growing, involvement and engagement in the advancement of CCS technologies and public discussions related to carbon storage. Given the critical role that environmental advocacy groups play in shaping public perceptions of different potential approaches to solving environmental problems and given the recognition that public perception of CCS will influence its advancement, this paper reviews the perspectives and positions of several prominent environmental advocacy groups related to CCS. While several organizations have taken strong positions in favor of biological carbon storage and in opposition to carbon storage involving injecting CO<sub>2</sub> directly into the oceans, most environmental groups have been cautiously hesitant in their public stance and assessment of the more advanced concept of injecting captured CO<sub>2</sub> into underground or geologic storage. By reviewing the positions and activities related to CCS of several prominent environmental advocacy groups in the United States, this paper identifies factors contributing to this hesitancy to support CCS including concerns among environmentalists that CCS may detract from efforts and funds to support increased use of other existing energy technology alternatives as well as apprehension about ill-defined risks and impacts associated with storing CO<sub>2</sub> underground.

## **Introduction**

Throughout the 1990s and the first half of this decade, the most prominent environmental advocacy groups in the United States have been actively raising awareness on the issue of human-induced climate change and how society can make changes to reduce the risks of climate change. Strategies for taking action on climate change have focused largely on reducing emissions of carbon dioxide (CO<sub>2</sub>) into the atmosphere by advocating for improved energy efficiency of appliances and vehicles, shifting to low-carbon intensity fuels, educating the public on ways to conserve the use of energy, and promoting renewable sources of energy.

In addition to these climate change mitigation approaches, an additional approach, involving technologies for carbon capture and storage (CCS), has evolved during the past 15 years from a relatively obscure idea to an increasingly recognized, important potential contributor to efforts to stabilize atmospheric CO<sub>2</sub> concentrations. CCS technologies are increasingly considered necessary contributors to achieving the magnitude of emissions reductions required to stabilize atmospheric CO<sub>2</sub> concentrations at a level that reduces dangerous human interference with the earth's climate system.

Environmental advocacy groups have had limited, but growing, interest and involvement in CCS technologies during the rapid development of this concept. This paper reviews the perspectives on CCS of several prominent environmental advocacy groups in the United States. Following an initial description of the chronology of the development of CCS, an explanation of the different carbon storage options, including biological "sequestration", ocean storage, and geologic storage, and an introduction to studies assessing the public perception of CCS, a discussion of environmental groups' perspectives on the potential role of CCS is presented.

## **Development of Carbon Capture and Storage**

During the past 15 years, several different approaches to capturing and storing carbon dioxide have emerged and been studied as potential climate change mitigation options. The most prominent approaches can be grouped among three categories: (1) biological storage (often known as biological carbon sequestration), (2) ocean storage, and (3) geologic storage. Biological carbon storage, which involves enhancing the natural photosynthetic process whereby atmospheric CO<sub>2</sub> is taken up by growing plants and converted to organic carbon, is the approach that has received the most attention. Given the potential in many areas of the world for plant growth to offset CO<sub>2</sub> emissions, this approach was a focus

of discussions during the Kyoto Protocol negotiations. Given the co-benefits associated with efforts to enhance biological carbon storage and the minimal negative environmental impacts, biological carbon storage has been widely accepted and supported within the environmental community.

An additional approach to carbon storage involves storing CO<sub>2</sub> captured from power plants in the oceans. Theoretically this approach is appealing because the oceans have the capacity to store most of the CO<sub>2</sub> that is currently being emitted into the atmosphere, however concerns about the ecological impacts of accelerating the ocean's uptake of CO<sub>2</sub> by injecting it into the oceans have limited research and advancement of this approach. Several environmental advocacy groups have initiated campaigns in opposition to ocean storage.

Geologic storage of carbon, involving the injection of captured CO<sub>2</sub> into underground geologic reservoirs is the approach that has emerged in the past five years with the greatest potential to stabilize atmospheric CO<sub>2</sub> emissions. Currently, the acronym CCS generally refers to an engineered system where CO<sub>2</sub> gas from a power plant (or other large CO<sub>2</sub> source) is captured and subsequently stored in an underground geologic reservoir. Among the various different carbon storage approaches, geologic storage has emerged as the method with the greatest potential for large-scale CO<sub>2</sub> emission reductions in the near term [Anderson and Newell, 2004; IEA, 2004; IPCC, 2005].

Among these different approaches biological carbon storage involves the least technology and is the most easily understood by the public. The idea of planting trees as a way to mitigate climate change has been proposed by many [Ehrlich and Ehrlich, 1991; Gore, 1992], and this idea resonates well with those concerned about the environment in part due to the other associated environmental benefits of facilitating forest growth. Although the ideas of oceanic and geologic carbon storage are not widely understood or accepted by the public, exploration of these ideas within the scientific community began in the 1970s with a paper introducing the idea of capturing CO<sub>2</sub> from power plants and disposing of it somewhere other than the atmosphere [Marchetti, 1977]. In this early proposal, the ideas of injecting CO<sub>2</sub> into underground reservoirs and into the deep ocean to bypass the slow kinetics of ocean-atmosphere equilibration were both suggested.

As the magnitude and urgency of the CO<sub>2</sub> problem are increasingly recognized, advancement of geologic carbon storage has increasingly become the focus of research and demonstration projects [IEA, 2004]. An engineered system of deliberate geologic carbon storage includes four basic steps with different technologies required for each step: (1) capture the CO<sub>2</sub> from a power plant or other concentrated stream, (2) transport the CO<sub>2</sub> gas from the capture location to an appropriate storage location, (3) inject the CO<sub>2</sub> gas into an underground reservoir, and (4) monitor the injected CO<sub>2</sub> to verify its storage [Socolow, 2005]. Technologies to achieve each of these steps are commercially available; the current challenge to advance the concept is to integrate these technologies in large-scale demonstration projects [Stephens and Zwaan, 2005]. Given the emerging prominence of CCS involving geologic storage, particularly with the legitimacy associated with this option following the recently released Intergovernmental Panel on Climate Change's (IPCC's) special report on Carbon Capture and Storage [IPCC, 2005], this paper focuses on the perspectives of environmental advocacy groups related to CCS involving geologic carbon storage, however there is also some discussion of perspectives related to oceanic and biological carbon storage.

### **Public Perception of Carbon Capture and Storage**

It is increasingly acknowledged that the level of public acceptance of the concept of CCS will influence the advancement and deployment of CCS technologies yet it is clear that the public's perception of CCS is limited. Studies at the Tyndall Centre in the United Kingdom on public perception using focus groups [Gough *et al.*, 2002] coupled with surveys [Shackley *et al.*, 2004] indicate that with adequate information about the climate change context the public may look favorably on CCS. A study conducted in the United States, however, using one-on-one interviews and a survey suggests that the U.S. public may be more skeptical and less accepting than the U.K. public [Palmgren *et al.*, 2004]. The conclusions of this U.S. study urge careful consideration in considering the way in which the public

becomes informed about the technology and suggests that the way in which the public debate gets framed will be critical in determining the public's perception [Palmgren *et al.*, 2004]. Environmental advocacy groups play a critical role in shaping public debate about how best to address environmental problems, so how these groups portray CCS will influence public perception.

### **Environmental Advocacy Groups**

This section reviews the perspectives of several prominent environmental advocacy groups in the United States related to CCS and its development. The information presented here is based on analysis of written materials made public by environmental groups, including position papers and their websites, as well as information obtained from both written and oral responses to a questionnaire that was sent to the organizations. We have chosen to review several of the major environmental advocacy groups with influence in the United States. The four groups that we focused on are Natural Resources Defense Council (NRDC), Greenpeace, World Wildlife Fund (WWF), and the Union of Concerned Scientists (UCS). This is not a comprehensive review, as other national and international groups not included in this review have opinions and positions on CCS, and several smaller regional and local groups not included have also been involved in the advancement of CCS.

### **Natural Resources Defense Council**

The environmental advocacy group that has been the most influential and involved in the recent development of CCS is Natural Resources Defense Council (NRDC). David Hawkins, the director of NRDC's climate center and a prominent leader within the U.S. environmental community, has been an active participant of the community of academics, scientists, engineers, and government representatives who have been working on advancing CCS technologies and developing the policy framework for CCS implementation. Throughout the past decade, Hawkins has been publicly commenting on the potential and viability of CCS technology while voicing concerns about the CCS approach from the environmental community and the public [Hawkins, 2001; Hawkins, 2003b]. NRDC's involvement during the development of CCS has been extremely influential as this engagement has forced scientists and engineers to consider the environmental community's concerns at an early stage. This involvement has also made NRDC the leading organization within the environmental community on the issue of CCS. NRDC has been very clear that support for CCS must not have a negative impact on the adoption of other efficiency and renewable energy technologies and that the technology must not be used as a rationale to delay adoption of policies to achieve near term reductions in carbon emissions. By effectively communicating these concerns to industry, government, and academic representatives, NRDC has articulated the environmental community's concerns and called attention to the potential barriers to CCS implementation associated with public acceptance and support from the environmental community.

NRDC believes that the perception that coal use and climate protection are irreconcilable has contributed to the policy impasse on climate change, so they view the development and use of CCS technologies involving storing CO<sub>2</sub> in geologic reservoirs as a way to reconcile the inevitable continued use of coal with an enhancement of our ability to avoid a dangerous build-up of CO<sub>2</sub> in the atmosphere [Hawkins, 2003a]. NRDC has been advocating for CCS to be incorporated into the design of the next generation of coal-fired power plants [Hawkins, 2005; NRDC, 2005]. Given that more than 100 new coal fired power plants have been proposed to be built in the United States in the next 10-15 years and that the largest power plants will spout nearly 6 million tons of CO<sub>2</sub> into the atmosphere every year. And given the increase in coal utilization in developing countries particularly in China and India, NRDC has made it clear that they believe CCS will play a critical role in reducing projected CO<sub>2</sub> emissions in the future. Recognizing the absence of current incentives to develop or install CCS technology, NRDC advocates for a policy framework involving a combination of publicly funded financial incentives and a schedule of market-based limits on CO<sub>2</sub> emissions.

## **Greenpeace**

While Greenpeace has not taken an official position on CCS involving geologic storage, this group has strongly opposed the idea of ocean storage of carbon and they have developed a strong campaign against ocean storage. Greenpeace's early involvement included joining with some local environmental groups in Hawaii in a successful 1999 effort to halt an international ocean storage demonstration project [Figueiredo *et al.*, 2002].

In 2002 Greenpeace released its first official briefing on the issue in which they criticized ocean dumping of CO<sub>2</sub> as an unsustainable and distracting effort that draws attention away from adopting and researching cleaner alternative technologies. Greenpeace is concerned about various impacts associated with injecting CO<sub>2</sub> into the oceans including accelerated acidification and ecological harm to organisms in the vicinity of injection sites. In addition Greenpeace argues that injecting CO<sub>2</sub> into the water column would be contrary to the London Convention (1972) and, in the North East Atlantic region, to the OSPAR Convention (1992).

Although Greenpeace has not adopted an official position on geologic carbon storage, a Greenpeace spokesperson that we contacted said the group has maintained a skeptical view on geologic carbon storage, but they have been actively keeping up-to-date about the technological advancements of CCS, particularly related to geologic storage [Coequyt, 2006]. Two of the group's leading scientists were involved in and contributed to the IPCC Special report on Carbon Capture and Storage [IPCC, 2005].

The group's skepticism about geologic storage derives from concerns of leakage risks posed to human health, the environment, and the climate. Accepting that such an approach might become necessary to avoid dangerous levels of CO<sub>2</sub> in the atmosphere, they believe that more research needs to be done before CCS could be implemented safely at a large scale. They also are opposed to researching CCS at the expense of efforts to promote renewable energy technologies and other cheaper, more efficient, safer, and faster ways to reduce CO<sub>2</sub> emissions [Greenpeace, 2006].

Greenpeace has also recently spoken out about the likelihood of strong opposition to CCS by a mistrusting public unless CCS is developed in conjunction with other efforts to increase efficiency and increase renewable energy [Goerne, 2005].

## **World Wildlife Fund**

World Wildlife Fund (WWF) has been apprehensive about the idea of CCS, particularly the risks and uncertainties associated with ocean storage. WWF is concerned also with the high cost associated with CCS; they report that depending on locations, technologies and fuels used, CCS could increase costs of power generation by 40 – 80% compared to burning fuels without capture [WWF, 2005a].

The major concerns that need to be addressed before CCS is pursued further according to WWF include issues of assessing leakage and storage permanence, as well as potential direct or indirect impacts on biodiversity. WWF emphasizes the need to conduct more research related to CCS and the protection of biodiversity, geological suitability, security and permanence of carbon stored in geological strata, and they also advocate for the inclusion of stakeholder processes to allow for widespread involvement, review and comment on all demonstration projects [WWF, 2005a].

Regarding the inclusion of CCS into the international climate regime WWF believes that credits from CCS should not count toward meeting Kyoto Protocol targets in the first commitment period, because CCS was not considered when the first commitment period targets were set. If CCS is to be allowed to count in future commitment periods, the theoretically possible large reduction potential of CCS must be taken into account in target-setting. There must be internationally agreed upon procedures for independent verification and monitoring of storage and related activities before CCS technologies are allowed to count toward greenhouse gas reduction targets. The group favours the potential inclusion of CCS as an "add on" in the portfolio of robust energy efficiency, renewable energies and sustainable land use policies. The group released its latest position on the issue after the release of IPCC special report on CCS. They have urged governments to continue to work on resolving key concerns associated

with CCS but also urge commitments to make deeper cuts in CO<sub>2</sub> emissions based upon implement strong laws on energy efficiency and renewable energy [WWF, 2005b]. While WWF accepts that although CCS may play an important role in reducing atmospheric CO<sub>2</sub> in the future, the shorter term focus should remain on energy efficiency and renewable energy [WWF, 2005c].

### **Union of Concerned Scientists**

The Union of Concerned Scientists released their first public position on CCS in July 2001 [UCS, 2001]. In this document they expressed that geologic carbon storage can be viewed as one potentially viable option and a potentially important contributor to the much larger portfolio of carbon management and climate mitigation options, but that CCS should not be seen as a sole method or "silver bullet" to reducing emissions, nor should it be researched and developed at the expense of other environmentally sound, technologically feasible, and economically affordable solutions to climate change. UCS also identifies several risks posed by this technology to humans and the environment including risks due to leakage of CO<sub>2</sub>, risks of induced seismic activity due to underground movement of displaced fluids, risks from continued (and possibly increased) reliance on fossil fuels and risks due to extensive expansion of pipeline facilities necessary for the transfer of CO<sub>2</sub> to storage sites. They urge the government and policy makers to support research in the unexplored environmental consequences of the technology [UCS, 2006].

According to a UCS spokesperson that we contacted, the group's position or perspective on CCS has not changed much since the release of their initial comments in 2001 [Lawler, 2006]. The group is not opposed to the possibility of including CCS as a potential carbon mitigation strategy but they have not taken any official position in favor of or in opposition to this set of technologies. They believe that the technologies and policies that reduce the production of CO<sub>2</sub> gas, such as improving energy efficiency in power generation, transportation and buildings, developing renewable energy, and protecting threatened forests are the safest approaches to reducing CO<sub>2</sub> emissions, so these approaches should be given the highest priority.

Internally, UCS has focused more of its attention to biological carbon storage, than on either oceanic or geologic storage. The group highlights the large potential for enhancing carbon storage in the biosphere with sustainable forest management practices [UCS, 2004], and UCS points out that the additional environmental benefits associated with enhancing biological carbon storage are not present in the more technological engineered systems of CCS with geologic storage [UCS, 2006].

### **Conclusions**

This preliminary review of environmental advocacy groups' perspectives and positions on CCS demonstrates a consistent cautious hesitancy within the environmental community in the United States. While NRDC is the only environmental group that has taken a strong public position supporting the development and demonstration of CCS technologies, all of the groups have reservations and concerns about the environmental as well as political implications of CCS.

With the exception of NRDC, the environmental advocacy groups are cautiously hesitant about taking a public stance in favor of or in opposition to geological carbon storage. The lack of clear positions on CCS involving geologic storage reflects a balance between a cautious skepticism of this "end-of-pipe" approach with the practical acceptance that such carbon management technologies may be necessary to stabilize atmospheric CO<sub>2</sub> concentrations. The environmental community remains apprehensive about the idea of storing CO<sub>2</sub> underground, although there is a general increase in the acceptance that such carbon management technologies may have to play a role in climate change mitigation measures. Enhancing the storage of carbon in the biosphere, so called biological sequestration, is generally supported by each of the groups, and ocean storage of carbon has been consistently opposed by these groups.

The extensive involvement and leadership role of NRDC during the development of CCS are critical factors that have undoubtedly been influential in minimizing strong opposition to CCS within the

environmental community. Non-governmental organizations are increasingly interconnected and networked among each other [Fisher, 1997], and as these environmental groups delicately prioritize how they should spend their limited resources they rely on each other and learn from each other particularly in confronting a highly complex and technical issue like the development of CCS. The entire environmental community has benefited and learned from NRDC's extensive engagement on this issue.

The most important and consistent message that all of the environmental groups are trying to convey with regard to CCS is that CCS is not a "silver bullet", i.e. this potential technological approach to reducing CO<sub>2</sub> in the atmosphere is not capable of "solving" the problem, so interest in this approach must be an addition to rather than a substitute to interest and investment in other approaches including increased energy efficiency and renewable energy.

The recent release of the IPCC special report on CCS, and the associated main-stream attention that the concept of CCS has received may have some influence on the environmental community's perception of the potential role of CCS technologies. Our communication with representatives from these groups suggests that some refinements to the positions and perspectives of these groups on CCS are currently being developed.

Environmental advocacy groups have great potential to influence the public perception of CCS. During the rapid advancement of the idea of CCS in the past 15 years, environmental advocacy groups have facilitated minimal public engagement on the development of CCS, and they have not developed a strong and consistent public message related to geologic carbon storage. This lack of a strong position either in favor of or in opposition to geologic storage has likely contributed to the limited public awareness about this climate change mitigation approach.

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