

Research and Development Needs for The Sequestration of Carbon Dioxide as Part of a Carbon Management Strategy

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EXECUTIVE SUMMARY

The Secretary of Energy authorized this report by The National Coal Council (NCC). The report focuses on carbon dioxide sequestration opportunities and offers recommendations on needed research and development to bring cost-effective competitive sequestration technologies to the market. Scientists, policymakers and the public in general must recognize and deal with the continuing importance of coal, as well as other fossil fuels, as a major source of energy, especially electricity, even in a world constrained by concerns about human-induced climate change.

It is imperative that carbon dioxide sequestration and generation efficiency becomes high priorities if the goal is to manage carbon in the atmosphere while providing low-cost, reliable energy to drive the national as well as global economy. The NCC proposes a three-part management strategy to accomplish this task:

- Maximize the efficient use of fossil fuels in order to minimize CO₂ emissions;
- Shift to low-carbon and zero emissions technologies; and
- Capture and sequester CO₂ emissions and that which is present in the atmosphere already.

In order to successfully implement this strategy, research is needed to verify the feasibility of the numerous carbon dioxide sequestration options available. Leadership, in the form of a partnership between industry and government, is needed in order to demonstrate these sequestration technologies on a large enough scale. Costs must be reduced so that these technologies can be effectively implemented.

Conclusions

Most independent experts in the field project that the demand for electricity will continue to increase in the United States and will increase even more worldwide. Therefore, The National Coal Council concludes that the United States will need to do the following and, to the extent possible, encourage other nations to do the same.

Actively promote the efficient use of energy and encourage research to improve the efficiency of end use technologies. This will minimize the amount of increased energy required with a minimal reduction in wealth.

Encourage the use of more efficient energy conversion technologies that minimize the impact on environment. This includes such technologies as those based on non-hydro renewable resources. Improvement in many of these technologies, based on further R&D, will be needed to make them economically useful.

Place a high priority on improving all coal conversion technologies to make them more efficient and to reduce environmental impacts. (Details of this strategy are covered more fully later in this report.) Even with development and deployment of other technologies and with improved efficiency in end use, there will be required in the U.S. the continued conversion of coal to electricity at reliable, cost-effective levels. It is generally recognized that in the rest of the world coal use will increase substantially, and improved conversion rates will protect the environment globally.

Develop technologies and applications to sequester CO₂. If CO₂ is to be managed effectively to achieve the total ambient levels now thought desirable - even with successful applications of energy efficiency technologies, increased use of renewable fuels and application of improved coal conversion technologies - further actions will have to be taken to sequester CO₂.

Fund substantial research and development on CO₂ management technologies. CO₂ removal and sequestration is possible in some no-generation technologies but is now neither physically reliable nor economically feasible for electric generation combustion technologies. Therefore, given the current status of such technologies, there will be required a significant R&D effort. This subject comprises much of the bulk of this report.

Recommendations

The National Coal Council strongly recommends that the United States government, with the Department of Energy as the lead agency, implement an aggressive carbon management program than that which is currently underway. The major components should be research and development of cost-effective carbon dioxide sequestration technologies and efficient, super-clean, multi-use electric generation technologies. Specific recommendations are listed below:

Carbon Dioxide Separation and Capture: The Department should evaluate, improve and develop advanced chemical absorption solvents and physical adsorbents; develop improved membrane separation devices; conduct research to shorten the processing time and examine the handling demands of the silicate carbonation processes; develop additional technologies for transportation and storage of the produce upon successful completion of CO₂ separation and capture.

Geological CO₂ Sequestration: The Department should identify potential CO₂ storage options in saline reservoirs, rock caverns, unminable coal seams and salt domes. These sites should be characterized for their economic viability, and from the points of view of environmental protection.

Ocean CO₂ Sequestration: The Department should evaluate potential biological and chemical impacts on the oceans of CO₂ injection; develop the scientific ability to monitor biological, chemical and meteorological responses to ocean fertilization over long time periods and large distances in conjunction with other research organizations, including other Federal agencies, increase its research into iron fertilization in the ocean.

Terrestrial CO₂ Sequestration: The Department should refine the monitoring and verification methods for sequestering CO₂ in soil, vegetation, agricultural lands, pastures, tundra, forests and wetlands. Also, the long-term issues of the use of large tracts of land for carbon storage need resolution.

Advanced Concepts in CO₂ Management: The Department should increase research and development on the decarbonization of coal to produce hydrogen rich streams for electricity production and pure CO₂ for industrial use; conduct research based on biomimetic processes (i.e., processes that mimic the physics and chemistry of living systems) to fix CO₂.

Improved Generation Technologies: The Department should continue and if possible accelerate its work on achieving the success of super-clean, high efficiency, multi-use electric generation technologies, and more specifically, Vision 21; increase research into zero emissions technologies for coal.

Coproduction: The Department should accelerate research into the production of chemicals and clean transportation fuels from coal.