

# GREENHOUSE GAS CONTROL TECHNOLOGIES

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## UNCERTAINTIES IN CO<sub>2</sub> CAPTURE AND SEQUESTRATION COSTS

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### ABSTRACT

The cost of CO<sub>2</sub> avoidance depends on a wide variety of factors and assumptions whose impacts have not been fully considered in past assessments of carbon capture and sequestration technologies. As part of the USDOE's Carbon Sequestration Program, we have developed an integrated modeling framework to evaluate the performance and costs of alternative CO<sub>2</sub> capture and sequestration technologies for fossil-fueled power plants, in the context of multi-pollutant control requirements. This model (called the IECM-CS) allows for explicit characterization of the uncertainty or variability in any or all model input parameters. This paper reviews the major sources of uncertainty or variability in CO<sub>2</sub> cost estimates, then uses the IECM-CS to analyze uncertainties in CO<sub>2</sub> mitigation costs for currently available (amine-based) CO<sub>2</sub> capture technologies applicable to coal-fired power plants.

### INTRODUCTION

Development of improved technology to capture and sequester the CO<sub>2</sub> emitted by power plants using fossil fuels — especially coal — is the subject of major research efforts worldwide. The attraction of this option is that it would allow abundant world resources of fossil fuels to be used for power generation and other applications without contributing significantly to atmospheric emissions of greenhouse gases. The two key barriers to carbon capture and sequestration (CCS), however, are the high cost of current CO<sub>2</sub> capture technologies, and uncertainties regarding the technical, economic and political feasibility of CO<sub>2</sub> storage options.

Assuming geological storage of CO<sub>2</sub> indeed proves to be viable, how much would it likely cost to capture and store the CO<sub>2</sub> from a new coal-fired power plant? Various studies have addressed this question [1-7], but each study typically employs different assumptions that produce different results. Herzog (1999) and others have summarized recent cost studies and sought to adjust their results to a more consistent basis [8, 9]. Nonetheless there still remains substantial confusion and lack of understanding in both the technical and policy communities about the magnitude of CCS costs and the factors that affect it.

### FACTORS AFFECTING CCS COST

In this paper we attempt to peel back some of the cobwebs that continue to obfuscate answers to what many believe is the simple question of how much it costs to capture and sequester CO<sub>2</sub> emissions from power plants. We use the term "uncertainties" very loosely in this paper to describe the many different factors that contribute to differences in reported cost results for CCS systems. We begin with a brief review of the key determinants of CO<sub>2</sub> control cost.

**Defining the System Boundary:** The first requirement is to clearly define the "system" whose CO<sub>2</sub> emissions and cost are being characterized. The most common assumption in economic studies is a single power plant that captures CO<sub>2</sub> and transports it to an off-site storage area such as a geologic formation. The CO<sub>2</sub> emissions not captured are released at the power plant stack along with other pollutants. Other system boundaries that are sometimes used (or implied) in reporting CO<sub>2</sub> abatement costs may include CO<sub>2</sub> emissions over the complete fuel cycle that includes the extraction, refining and transportation of coal or other fuels used for power generation, as well as any emissions from byproduct use or disposal. Emissions of other greenhouse gases (expressed as equivalent CO<sub>2</sub>) also

