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A Framework for viewing theoretical, technological, economic and market potential of carbon dioxide capture and storage

JJ Dooley

October 2004

Prepared for the U.S. Department of Energy
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ABSTRACT: This short paper presents a framework for thinking about the differences represented by commonly used terms such as theoretical, technological, economic and market potential for carbon dioxide capture and storage (CCS).

KEY WORDS: carbon dioxide capture and storage.

Theoretical, technological, economic and market potential of CCS

Throughout the technical literature on carbon dioxide capture and storage (CCS), a number of different terms and metrics are used to quantify the potential of individual aspects carbon capture and storage systems as well as fully integrated systems. The range encompassed by these various measures of "potential" is quite large, spanning the highly specific (e.g., what is the likely storage potential of deep saline formations in a given country) to very broad measures (e.g., how many gigatons of emissions mitigation are likely to result from the deployment of CCS systems over the course of the coming century). The following four part taxonomy is meant to distinguish between and help interpret the potential of CCS systems when taking into account the range of economic, technical and other factors that determine what might actually be employed in the field, and the theoretical potential that exists in the absence of these factors. In many cases, these potentials can be very different.

(1) Theoretical Potential for Capture – For example, what are current and projected anthropogenic emissions of CO_2.

(2) Technical Potential for Capture – For example, what fraction of the CO_2 accounted for by the Theoretical Potential for Capture is from large fossil (and perhaps biomass)-fired power plants (and other large CO_2 point sources) in which we believe CO_2 capture systems exist or will likely exist.

(3) Economic Potential for Capture – For example, what fraction of the CO_2 emissions (or how many units) accounted for by the Technical Potential can be captured (including compression), transported and stored at a reasonable cost.

(1) Theoretical Storage Potential -- For example, how much pore space is contained within a class of geologic reservoirs.

(2) Technological Storage Potential - For example, how much of the Theoretical Storage Potential satisfies a set of technical criteria such as sufficient permeability, presence of structural traps.

(3) Economic Storage Potential -- For example, how much of the Technological Storage Potential is considered to be affordable when considerations such as proximity to a CO_2 point source or the potential for offsetting revenue from CO_2 driven advanced hydrocarbon recovery are taken into account.

(4) Market Potential: given the set of opportunities described by the Economic Potential for Capture and the Economic Storage Potential what is the likely deployment of CCS given a particular set of assumptions about critical factors such as: market conditions (e.g., future population projections, the vintage of the existing capital stock, rates of economic growth), policy (e.g., the assumed stringency and the structure of future greenhouse gas emission reduction policies), and competing and complementary technologies (e.g., the assumed cost and performance of other energy and emission reduction options such as renewable energy, nuclear power).