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Investigation of Economic Incentives for CO_2 Sequestration

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Abstract

We have completed an exploratory economic analysis based upon systematic compositional simulations of CO_2 EOR to establish how much and what type of economic incentive might be needed to encourage oil companies in the U.S. to store CO_2 in oil reservoirs. The economic analysis took into account factors such as capture and transportation costs. In order to quantify the effect of flood performance, various simulations were performed by employing different reservoir types, well spacing, and injection schemes. Experimental design and method of response surfaces along with Monte Carlo simulations were utilized to perform this study in a systematic, efficient and accurate manner. Combinations of reservoir parameters and economic factors were studied to achieve comprehensive understanding of the financial performance of coupled CO_2 sequestration and EOR projects. Possible CO_2 credits were also quantified in a probability based distribution functions considering various uncertain economic and geologic characteristics in different projects.

Introduction

CO_2 concentration in the atmosphere has drastically increased from 280 ppm during pre-industrial age to its current level of 380 ppm (Bryant, 1997). It is proven that this is mainly due to the dramatic increase in the fossil fuel consumption. This has caused climate change concerns among environmentalists and it is gaining more publicity as international agencies and governmental sectors in different countries seriously considering CO_2 reduction policies implemented. It should be mentioned that there is no direct proven evidence showing the relation between climate change and the CO_2 emissions.However, due to the greenhouse effect of CO_2, it is mainly suspected that a higher CO_2 concentration in the atmosphere has caused these climate changes.

Geological CO_2 storage as the only effective option to mitigate atmospheric CO_2 emissions has been considered since the 1990's and has been implemented in large scale for the first time in Norway. Based on the data published by Moritis (2002) over 35 million tones of CO_2 have been injected into the oil reservoirs for the purpose of EOR, and currently few aquifer CO_2 storage projects are underway. Weyburn CO_2 sequestration and EOR project is the only on-going commercial coupled EOR and sequestration project which has shown great success in terms of both objectives of the project (Malik and Islam, 2000). Carbon dioxide is transported from a North Dakota coal-gasification plant through pipelines and is injected into the to Weyburn oil field.

One of the main aspects of all current EOR projects in the United States is the use of inexpensive CO_2 from natural resources. These sources have high CO_2 purity and there are no additional costs for capture and compression of their stream. There are also limited amounts of anthropogenic CO_2 available from fertilizer, petrochemical, and coal-gasification plants which are much more expansive than natural sources of CO_2. Due to the recent high oil prices and assuming it will continue in similar fashion in the future, CO_2 flooding projects are expected to rapidly grow in numbers and volume in the next decade. Therefore, there will be serious need for additional CO_2 sources. From another perspective, carbon emission regulations have already been set in place in some European countries as well as Japan under Kyoto protocol. If the regulations are fully implemented in the industrialized countries such as United States, it can serve as double-purpose for both providing huge additional CO_2 sources for EOR processes and vast potential for geological storage of anthropogenic CO_2 emissions. Among all CO_2 emission sources, stationary sources such as power stations and petroleum industry facilities are main contributors.

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