Carbon Dioxide Transport for Geological Sequestration – The Issues and Decision Parameters for T&T

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Abstract

Owing to the increasing emphasis on Carbon Dioxide (CO₂) sequestration coupled with the acceptance that geological sequestration is perhaps one of the most promising carbon management strategy, the need to transport CO₂ from sources to sinks in a cost effective and safe manner is gaining widespread attention. This is justified as CO₂ transport is often one of the more underestimated component of any geological sequestration capture, transportation and storage chain. A few studies were done in evaluating CCS economics for T&T, however these did not place any great emphasis on CO₂ transportation cost estimation through widespread informed estimates and proper transportation modes and infrastructure options. This paper attempts to address this gap for T&T.

The transported CO₂ is normally processed in liquid or supercritical phase. The supercritical phase is used with pipelines in continuous flux and the liquid one for batch transportation (e.g. train, truck, ship). CO₂ can also be transported in a solid state; this process requires much more energy compared to the other options and is inferior from a cost and energy viewpoint. Transport of CO₂ is already a reality, occurring daily in many parts of the world. However, the scale of transportation infrastructure and investment required to enable large-scale deployment of CCS should not be underestimated. Hence, one of the objectives of this paper is to compare different ways of CO₂ transport from the selected source to the targeted fields for T&T. In doing this, some level of source-sink matching would be incorporated. Among all the options for CO₂ transportation, the most economic method of transport depends on the locations of capture and storage, distance from source to sink, and the quantities of CO₂ to be transported. However, if large amounts of CO₂ are to be transported, as may be in the case of T&T, pipelines and ships can well be the only viable transportation alternatives for CCS purposes. However, for T&T, the threshold volumes beyond which batch transportation is no longer feasible when compared with pipelines is still not known. This is expected to be another major output of this study.

The method of study utilizes a comprehensive literature review on CO₂ transportation. The sources of data for this review were not limited to T&T alone. However, where appropriate and possible, local data were incorporated to account for certain indigenous parameters (such as relatively cheaper electricity rates) that would influence the transportation cost. Once the data was acquired and contextualized for T&T, a financial operational model was built in excel to compute costs for different modes. It is well appreciated that each mode has variations and in order to account for this, the model was built to incorporate sensitivity analyses to emulate these variations. Since no transport simulations were done in this study, the robustness of data was imperative for the results to be meaningful.
Of particular interest for T&T, this study illustrates an estimate of the costs for transporting up to 6 Mt/yr of CO$_2$ by different modes and internal variations. It is expected that this information can be critical in evaluating overall CCS economics for T&T.

Keywords: Carbon Management, Economic Implications, CO$_2$ Transport