Unconventional EOR: Value of Information

Project Description

Existing literature on the value of information (VOI) for oil and gas relates mostly to seismic data and the drilling of appraisal wells, with limited publications on carbon capture and storage (CCS). GCCC sponsored a thesis that developed a decision analysis framework to quantify VOI in CCS projects that face uncertainties about permeability values in a reservoir.

The main objective of the study was to perform a VOI analysis in a specific CCS setting by defining prior scenarios with different probabilities and outcomes on the basis of the current knowledge of a reservoir, contractual requirements, and regulatory constraints.

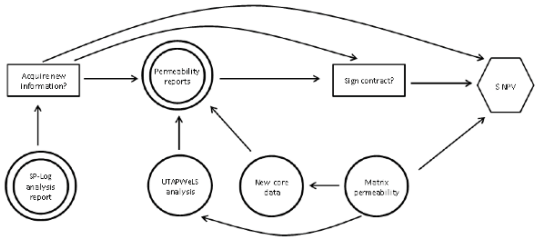


Diagram for the decision faced by a company to sign a contract

Method

VOI represents the maximum amount that a decision maker should be willing to pay for information-gathering activities. A geostatistical analysis implemented with the Stanford Geostatistical Modeling Software (SGeMS®) was used to assess reservoir permeability and pressure elevation, the latter being one of the main uncertainties in the estimation of carbon storage capacity.

The accuracy of the information-gathering activities was explored in detail and applied to the prior probabilities (Bayesian inference). By defining a 100% accuracy scenario, the maximum value that the operator should be willing to pay for any information-gathering activity was quantified.

Finally, a model guides the operator in deciding whether to sign or reject a contract to inject a predefined amount of CO_2 during a fixed amount of time and if more information should be gathered before making such a decision. If information gathering cannot predict results with 100% confidence—an unlikely scenario because of inherent discrete or continuous uncertainties such as porosity in an oil reservoir—then this VOI is referred to as value of imperfect information (VOII)

Problem Statement of Model

The operator of a mature and depleted oil field is considering signing a contract with a source of anthropogenic CO_2. The main uncertainty is the storage capacity of the reservoir, which is dependent on permeability and elevated pressure. This uncertainty translates into the risk of carbon credit prices, reservoir conditions, CO_2 migration out of the lease zone, noncompliance with contractual requirements on CO_2 storage capacity, leakage of CO_2 into underground sources of drinking water (USDW), and resulting penalty fees. Reservoir modeling suggests that the formation may be unable to store the contractual amount of CO_2 and/or the CO_2 plume will migrate outside of the lease area, which would result in penalty fees for the operator.

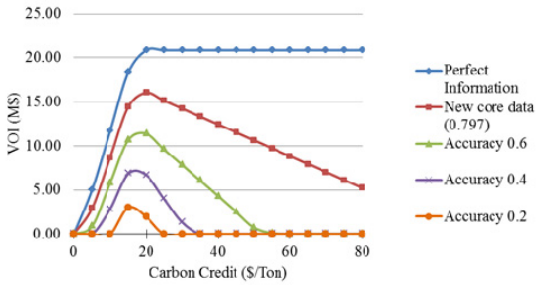
Three information-gathering activities are available to the operator. These include analyzing the data using the numerical based University of Texas at Austin's petrophysical and well-log simulator (UTAPWeLS®), drilling new wells, and acquiring new data by logging or coring existing wells.

Logging was found to be the only feasible process. The optimal number of tests to be performed should balance with the cost of sampling. The cost of each test is estimated at $200,000/well for coring or mini-drill-stem tests (mini-DSTs).

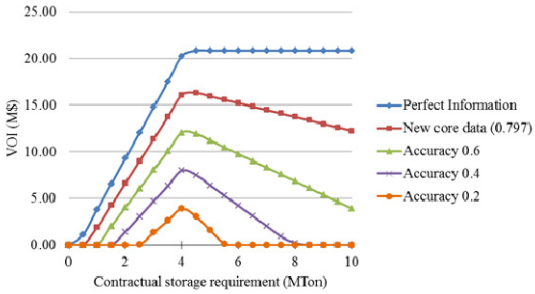
Unconventional EOR: Value of Information

Key Findings

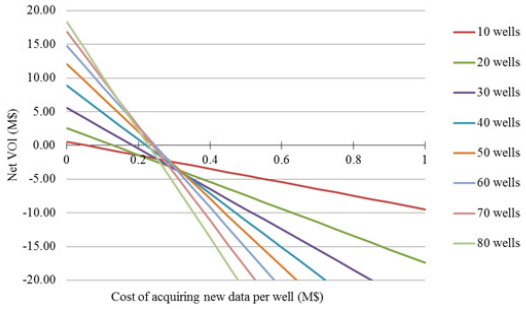
- VOI sensitivity analysis of carbon credit prices, contractual storage capacity, acquisition costs, and reservoir modeling accuracy showed that Bayesian inferential analysis can be used to optimize the number of wells to be tested in order to maximize VOI.
- The accuracy of the information-gathering activity depends on the number of wells logged or cored, 66 wells are optimal and correspond to a net VOI of $2.8 million.
- If the operator has limited availability of wells for logging operations or a limited budget, the number of locations tested can be optimized by maximizing the net VOI of newly acquired permeability data. If the operator has no means of or interest in acquiring new data, the project can still be profitable by increasing the length of the contract from three to four years for the same amount of injected CO_2 and penalty fees, or by considering EOR.



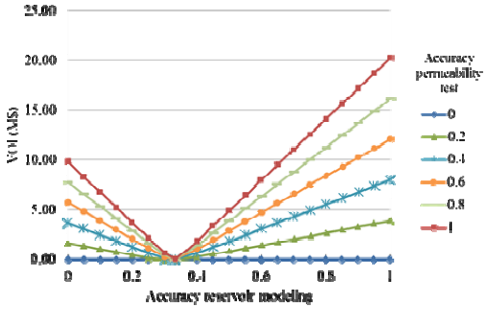
VOI sensitivity to carbon credit prices



VOI sensitivity to contractual storage capacity



VOI sensitivity to acquisition costs for a limited number of wells and/or constrained budget



VOI sensitivity to reservoir modeling accuracy

Citation

Puerta Ortega, C. A., 2012, A value of information analysis of permeability data in a carbon, capture and storage project: The University of Texas at Austin, Master's thesis, https://repositories.lib.utexas.edu/handle/2152/ETD-UT-2012-05-5100.

Contact

Vanessa Nuñez Lopez
vanessa.nunez@beg.utexas.edu, (U.S.) 512-471-5825
www.gulfcoastcarbon.org