Applications of Optimization to Shale Oil and Gas Monetization

by

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Abstract

This thesis addresses the challenges brought forth by the shale oil and gas revolution through the application of formal optimization techniques. Two frameworks, each addressing the monetization of shale oil and gas resources at different ends of the scale spectrum, are developed. Importantly, these frameworks accounted for both the dynamic and stochastic aspects of the problem at hand.

The first framework involves the development of a strategy to allocate small-scale mobile plants to monetize associated or stranded gas. The framework is applied to a case study in the Bakken shale play where large quantities of associated gas are flared. Optimal strategies involving the continuous redeployment of plants are analyzed in detail. The value of the stochastic solution with regards to uncertainty in resource availability is determined and it indicates that mobile plants possess a high degree of flexibility to handle uncertainty.

The second framework is a comprehensive supply chain optimization model to determine optimal shale oil and gas infrastructure investments in the United States. Assuming two different scenario sets over a time horizon of twenty-five years, the features of the optimal infrastructure investments and associated operating decisions are determined. The importance of incorporating uncertainty into the framework is demonstrated and the relationship between the stability of the stochastic solution and the variance of the distribution of future parameters is analyzed.

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