

Economic implications of drilling sequence in shale gas development, example from Horn River Basin, Canada

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Introduction

Unconventional shale gas resource development involves extensive capital investment along with considerable accompanying risk for commercial production. Economic appraisal, bringing together multidisciplinary project information and providing likely strategic outcomes for various development scenarios, forms the core of effective decision making for field development. Conventional economic appraisal uses either the average size or size distribution of well Estimated Ultimate Recoveries (EURs) as an economic measure, but commonly does not consider the potential impact of the order of drilling (similar to a “discovery sequence” in conventional exploration) on the economic outcome of a shale gas development project. This study examines the impact of drilling order, as it pertains to the rank of well or “leg” EUR’s on project economic performance.

Method

Any given well or “leg” drilling order, each with its own unique EUR, is essentially a result of a sampling scheme with a probability that is proportional to the unique EUR of each well. This permits one to adapt the “discovery process” model approach (Andreatta and Kaufman, 1996; Chen et al. 2013), commonly used in conventional petroleum exploration, to generate drilling sequence scenarios, each of which represents a possible development strategy. The resulting production forecasts are then evaluated using a discounted cash flow model to examine the economic implications of different drilling sequences or strategies. The net present value (NPV), internal rate of return (IRR), payback time (PBT) and break-even price are all used as various economic criteria evaluating disparate drilling strategies.

Results

To illustrate our analysis, we use the monthly historical production rate from Horn River Basin hydraulically fractured wells. We infer well EURs using common decline models to construct a statistical sample that represents variation in natural gas productivity in the basin.

Under the assumptions of a natural gas wellhead price of \$4/mcf and 10% discount rate, our study shows that drilling sequence as a function of well EUR can have significant impact on the economic outcome of shale gas play development. A random drilling strategy may lead to a negative NPV; whereas a strategy that seeks to prioritize drilling by targeting the larger EUR wells early in the drilling sequence, results in a positive NPV with various PBTs and IRRs. This implies that early identification of sweet spots combined with an appropriate development strategy to maximize production through the prioritization of drilling targets is crucial to economic success.

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References

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