PRODUCTION ESTIMATES OF UNDEVELOPED GAS WELLS: THE BOWLAND SHALE REGION

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Overview

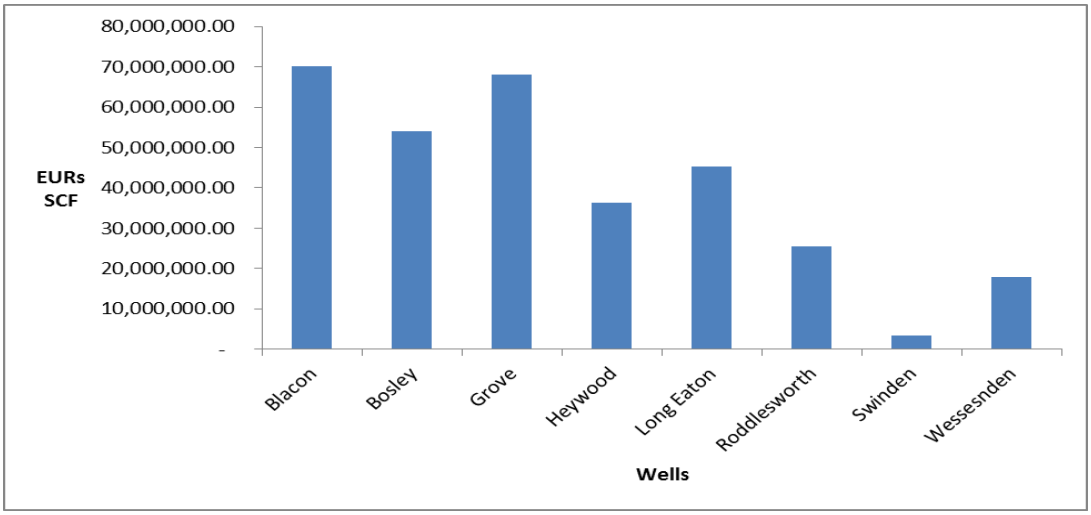
The objective of this paper is to propose an alternative approach which estimates production from undeveloped unconventional gas resources. This study estimates the recoverable reserves on a per well basis, accounting for reservoir heterogeneity, below ground uncertainty while developing an approach for undeveloped unconventional gas production estimation. The case study is the Bowland shale located in central Britain with an estimated gas in place range of 822-1329-2281 trillion cubic feet (Low, Base and High Scenarios). The outline of this study is as follows; we begin with an assessment of the reserve estimates of the United Kingdom and present production technology applied. The third part of the study reviews production estimate methodologies. Consequently an alternative approach is proposed adaptable to undeveloped unconventional gas wells, below ground parameter impact are analysed all on a per well basis. The results are then discussed with a focus on benefits and drawbacks of the approach. Finally conclusions and recommendations are offered based on the methodology and results provided by the study.

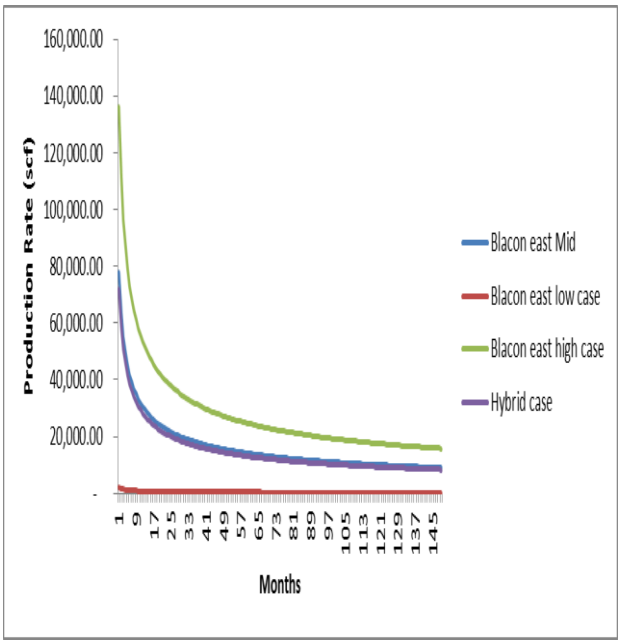
Methods

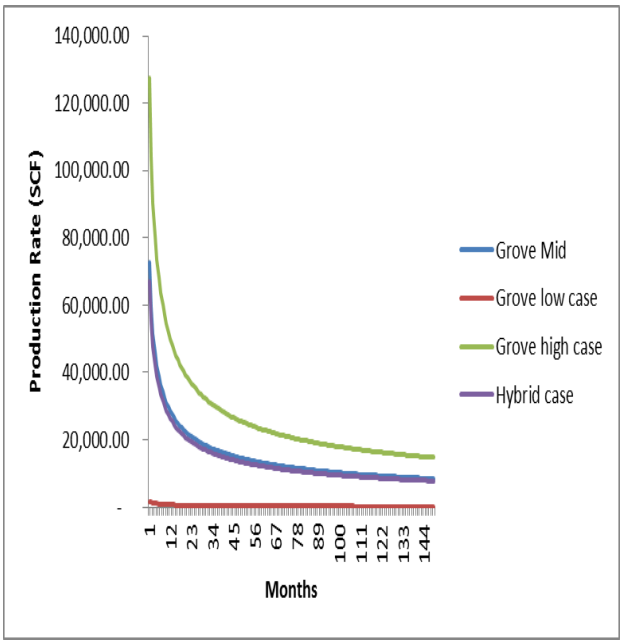
The paper proposes an analytical model extended with a developed multi-parameter estimation model. The impact of parameters that drive the analytical model is analysed via a sensitivity study, which reveals the relative importance of the variables to production estimation. Data ranges are available for two parameters while a developed depth dependent correlation matrix estimates the outstanding parameters. The results of the correlation matrix are then applied to the analytical model with low, mid and high scenarios (P90-P50-P10) established by parameter ranges. Furthermore a hybrid case is developed which applies both a stochastic and deterministic correlation approach to parameter estimation.

Results

The developed multi-parameter estimation model delivers results on a per well basis for prospective undeveloped unconventional gas wells. Results from the parameter model are validated with data from developed unconventional reservoirs; outputs fall within the accepted values. This approach addresses below-ground uncertainty prevalent in undeveloped wells as well as reservoir heterogeneity. Below are the estimated 10year recovery and production proiles based on developed scenarios of wells located in the Bowland shale of the United Kingdom.







Conclusions

The result from the sensitivity analysis suggests the formation volume factor has the most impact on production estimates and then rock exposure, pressure and viscosity while permeability, porosity and compressibility have the least and similar impacts. As stated permeability and porosity which are applied as scenarios due to data unavailability in this study have the least impact on the recoverable reserves. We find that the reservoir conditions and characteristics are significant to production estimation model.

Most importantly the result establishes a conceptual framework and develops four scenarios; a hybrid, low, base and high case which could guide further economic analysis of undeveloped unconventional gas regions. Production estimates are presented for prospective wells in the Bowland play guided by the developed scenarios on a per well basis.

This study, for the first time, incorporates multi-parameter estimation in an innovative way to an analytical method previously used for developed unconventional gas regions with high success rates to undeveloped unconventional gas regions. The developed hybrid approach to production forecast could be applied in decision making regarding further economic analysis and indeed acreage acquisition strategy.

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