Shale Play Development Scenarios

Alboran is the right advisory partner if you require a better understanding of the risks and opportunities in the emergent global market for shale gas and liquids. Our asset appraisals are based on detailed analyses of the geology, petrophysics and rock mechanics of your particular shale asset and we can m odel the economic field development options.

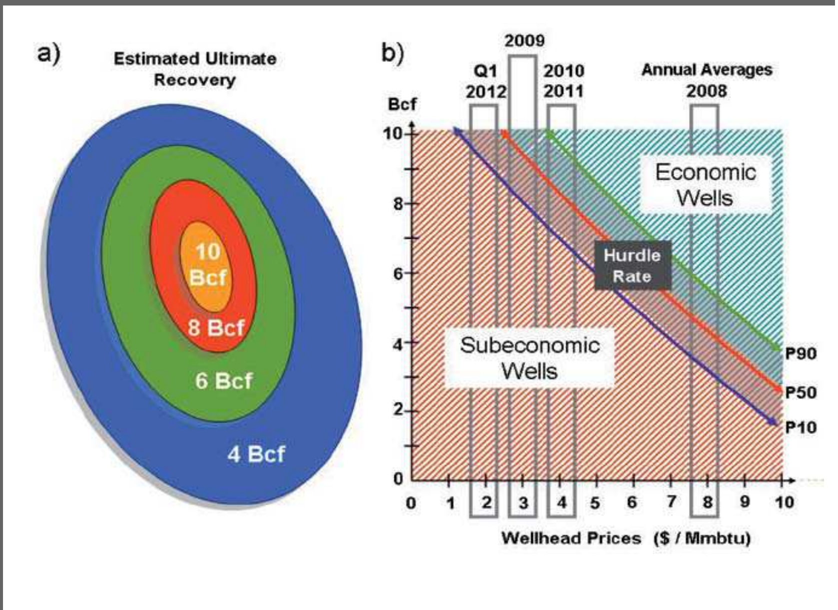
Alboran uses the latest tools and methods, is process owner of *DCF Shale Scenario Builder* TM, and holds provisional patents to drilling technology innovation *Smart Fracking Technology* TM. Alboran has evaluated numerous shale plays and related studies have been published by us in the peer-reviewed domain. Alboran experts also can provide in-company training for evaluating and developing shale resources.

Our clients are comprised of:

* ***Companies*** searching for sweet spots and better drilling strategies for rapid resource maturation.

* ***Investors*** in need of detailed assessments and validation of the value at risk in shale projects.

* ***Communities*** that require help in understanding the value and pitfalls related to shale development projects.

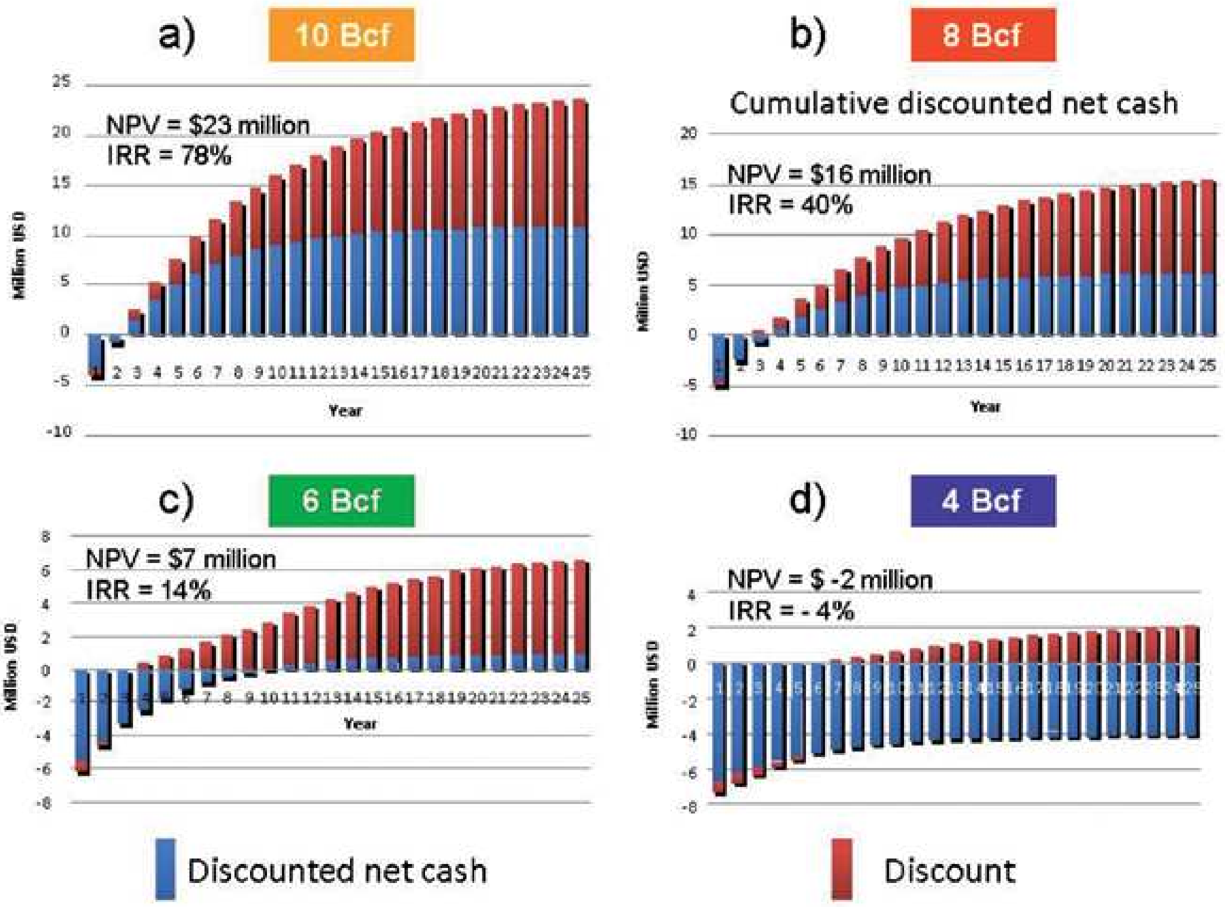


Lasting testimony of our well-established track-record is provided by the following peer-reviewed case studies.

1. Assessing the economic margins of sweet spots in shale gas plays

***First Break*, 2012, Vol. 30, Issue 12 (December), pages 99-106.**

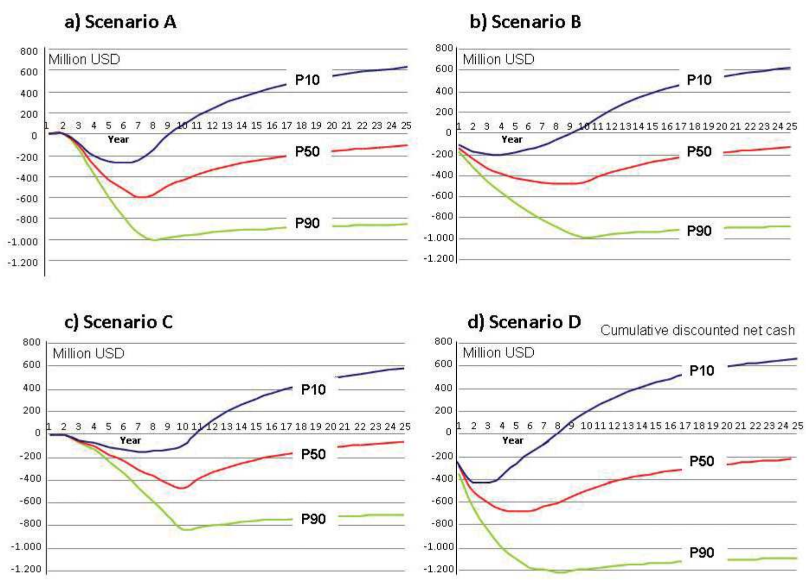
Sweet spot sensitivity to gas price volatility is illustrated for the Haynesville shale play. Shale plays previously assumed economic with rising gas prices may instead become sub-economic when gas-prices decline. A renewed effort to quantify the risks and uncertainties of shale project economics is crucial for the success of emergent shale gas plays. Investors' continued willingness to support new and existing shale -gas projects will hinge on their perception of the sector's ability to deliver the expected returns. The three key questions



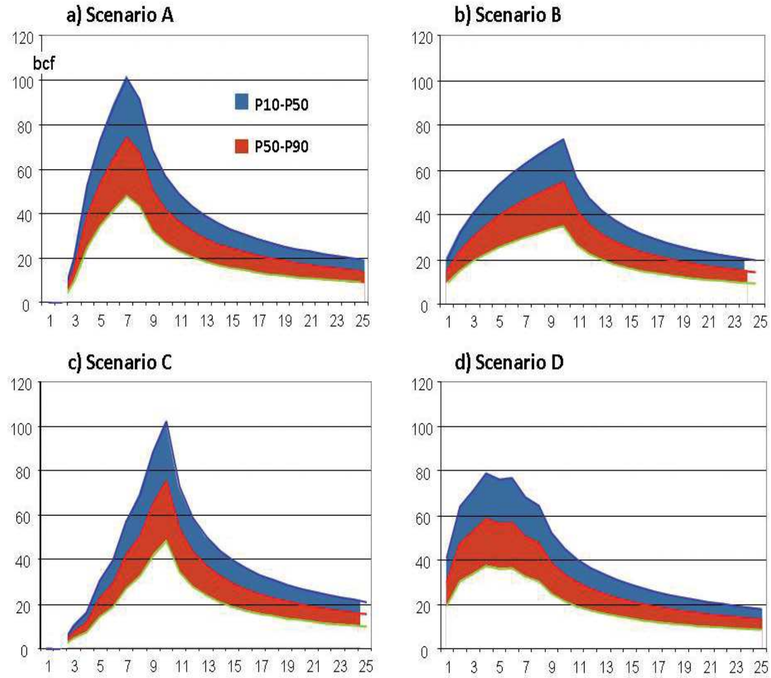
commonly asked are: 1. How much gas is in place? 2. Can the gas be safely extracted? 3. What portion of the gas can be extracted with a profit?

2. Global shale gas development risk: conditional on profits beating the time-value of money

***First Break*, 2013, Vol. 31, Issue 1 (January), pages 39-48.**



Sensitivity analyses of well roll-out rate scenarios in emergent shale plays show which field development strategies deliver the highest return on investment at the lowest cost of capital. Shale gas well performance may vary greatly due to geological heterogeneity in petrophyscial parameters such as fraccability and maturity of the organic content conversion to hydrocarbons. The uncertainty range in EUR estimates for individual wells must be factored into estimates of aggregated field performance to account for the spatial variation in well productivity. Our solution is to adopt a DCA proxy well with an assigned spatially averaged well productivity. The spatial spread in well output is captured by assigning P10–P50–P90 probabilities to productivity of the proxy well based on spatial averages for the best area, average area, and below average area.



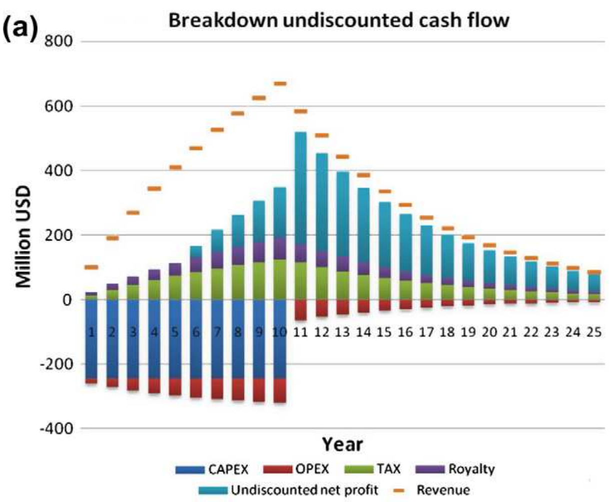
Operators try to find sweet spots but shale gas well productivities still have a large spread. This spread in well productivity must be taken into account when field NPV and project IRR are calculated, using conservative gas price assumptions. Uncertainty on the productivity of the aggregated wells in a shale play and the additional effects of external uncertainties, such as gas price volatility and delays in well roll-out rates must be taken into account without bias in the cash flow analysis. New shale gas projects should only be approved if the NPV is positive, and when the project profitability (IRR) is competitive and well above the corporate hurdle rate of 15%.

3. Economic appraisal of shale gas plays in Continental Europe

***Applied Energy*, 2013, Vol. 106, pages 100-115.**

This study evaluates the economic feasibility of five emergent shale gas plays on the European Continent. Each play is assessed using a uniform field development plan with 100 wells drilled at a rate of 10 wells/year in the first decade. The gas production from the realized wells is monitored over a 25 year life cycle. Discounted cash flow models are used to establish for each shale field the estimated ultimate recovery (EUR) that must be realized, using current technology cost, to achieve a profit. Our analyses of internal rates of return (IRR) and net present values (NPVs) indicate that the Polish and Austrian shale plays are the more robust, and appear profitable when the strict P90 assessment criterion is applied. In contrast, the Posidonia (Germany), Alum (Sweden) and a Turkish shale play assessed all have negative discounted cumulative cash flows for P90 wells, which puts these plays below the hurdle rate. The IRR for P90 wells is about 5% for all three plays, which suggests that a 10% improvement of the IRR by sweet spot targeting may lift these shale plays above the hurdle rate. Well productivity estimates will become better constrained over time as geological uncertainty is reduced and as technology improves during the progressive development of the shale gas fields.

(a)



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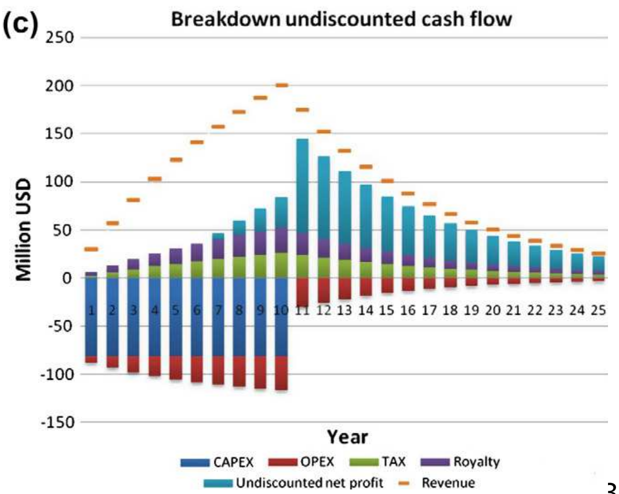
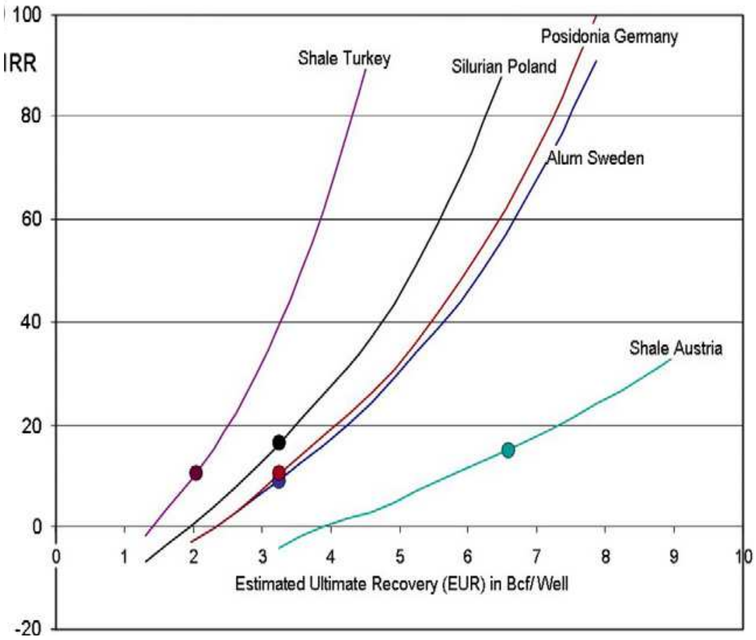


This study makes a first attempt to evaluate the economics of five potential shale gas plays in Europe (Austria, Germany, Poland, Sweden and Turkey). Well productivity type curves are established for each play based on an earlier review of estimated ultimate recovery (EUR) for the plays [4]. Decline curve analysis provides the well productivity model that fits the prior published EUR data. Subsequently, the net present value (NPV) and internal rate of return (IRR) of each shale play are calculated by applying discounted cash flow analysis, using representative inputs for gas price, production cost, taxes, depreciation and discount rate. The sensitivity of IRR and NPV to variations in EUR is modeled for each play, which thus provides the minimum EUR for which wells are economic – a directive for 'sweet spot targets'. A stochastic approach that accounts for the spatial spread of well productivities is included, using production volume probabilities P10–P50–P90. The spread in NPV and IRR related to the well productivity uncertainty range provides an indication for the risk taken when only few wells are drilled and provides a screening criterion for selecting the best field development opportunities.



We are delighted to provide additional information on our services.

Please contact us by Phone or Email:

Phone: **+31 655 873136**
Email: info@alboran.com