

### **Assembling Probabilistic Performance Parameters of Shale-Gas Wells**

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U. S. Geological Survey (USGS) assessments of continuous oil and gas accumulations within the National Oil and Gas Assessment project have been ongoing for a decade. During this time, specific well-performance parameters that are applicable to the assessment process have been established. These include two input parameters, estimated by the assessing geologists, that are directly related to oil and gas productivity: (1) a triangular distribution of cell size, which represents an individual well's drainage area; (2) a shifted, truncated lognormal distribution of the estimated ultimate recovery (EUR) of an individual well.

Using the IHS Energy well information database, each well within a particular formation requires a unique decline curve to be fit to the most recent production data available at the time of the assessment, and the distribution of the resulting EUR's is presented to the assessors as a part of the assessment work flow. These data are then used to estimate future cell size and EUR in the undrilled part of the area being assessed. This well-by-well examination, although labor and time intensive, provides detailed information on initial production by well, decline shapes, decline rates, and time-sequential production changes for a large number of continuous accumulations in the United States.

As large numbers of datasets become available, it is possible to start quantifying the information in a probabilistic manner. For example, the cell size and EUR distribution can be used to calculate the implicit volume-per-area density function for each assessment unit. The peak monthly production in a well's life becomes a single data point in a distribution of monthly peak production, as does decline rate.

The concept can then be expanded into raw production data, including trends through time. This allows the creation of probabilistic decline type curves, which can be converted into distributions of EUR's using correlations between distributions, or bootstrapping methods. Recognition of the variation among probabilistic decline type curves from different accumulations offers significant improvement for more empirically based assessments.