

Oil and Gas Resource Estimates for Permian Wolfberry Trend Reservoirs in Eastern Reagan County, West Texas

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Wolfberry Trend producing reservoirs are located within the Midland Basin Province of west Texas and are comprised of Permian (Leonardian and Wolfcampian) turbidite and debris-flow sediments within the Spraberry, Dean, and Wolfcamp Formations. Regionally, the current production is 132,000 BOPD plus 335 MMCFD gas and the trend has produced in excess of 1.59 BBO & 3.49 TCF gas from an area that covers approximately 2,600 square miles. Prior published field estimates for in-place oil and gas volumes have focused only on a portion of the column represented by conventional (non-shale) lithologies and have indicated 10 to >30 BBOIP with recovery factors ranging from 8-15%.

The estimation of hydrocarbon resources for Wolfberry Trend reservoirs requires assessment of oil and gas volumes from low-permeability sandstones, carbonates, and organic-rich shales. This study area is located in the eastern Reagan County portion of the Wolfberry trend where the productive column is 2,800 feet thick and produces oil and liquids-rich gas from multiple stratigraphic intervals. Core data and log analysis have identified the presence of organic-rich shale beds within the productive column. Characterization of the shales indicates the TOC ranges from 0.25-9.4% (3.3% average) and the kerogen is Type II/III (oil/gas prone) with vitrinite thermal maturities of 0.65-0.75 %Ro. Shale gas content values range from 53-165 SCF/Ton and some shale intervals have oil saturations as high as 49%. Integration of log analysis, core-derived rock properties, and shale gas desorption data for the conventional and unconventional Wolfberry reservoir intervals indicate that hydrocarbon in-place volumes average 132.5 MMBO per square mile. Historical 40-acre infill drilling recoveries of approximately 100 MBOE per well suggests that only 1-3% of the in-place resource has been developed.

In an effort to improve recovery, Broad Oak Energy has implemented multi-stage frac designs targeting the entire column of conventional and unconventional zones. The average well EUR forecast indicates an improvement of 30% compared to the average historical completion and initial potential rates of approximately 75 BOEPD are nearly double the area's historical average. Continued stimulation technology improvements, infill drilling, and horizontal drilling will be important methods to further increase recovery efficiency.