

# BAKKEN BILLIONS



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Success stories in the horizontal Bakken continue to mount. Production has spread from the play's genesis in Richland County, Montana, into McKenzie, Golden Valley and Billings counties, North Dakota. The horizontal Bakken play, discovered in 2000, now holds the potential to significantly contribute to the nation's oil reserves, according to a recent report by the U.S. Energy Information Administration. The report, by the EIA's office of oil and gas, reserves and production division, is the first in a series about technology-based oil and gas plays.

The Bakken is very much a technology story. Horizontal drilling and completion techniques, especially horizontal wellbore stimulations, have wedged open this play.

Elm Coulee Field, in Richland County, ranks as the largest discovery to date. In 2005, Elm Coulee produced 15 million barrels of oil from the middle member of the Bakken formation, nearly half of Montana's total daily crude production.

And it appears that considerably more oil can be produced. Headington Oil Co., a main operator in the field, has estimated it contains in-place resources of 5 million barrels per square mile. At an assumed recovery of 10%, Elm Coulee could produce an astonishing 500 million barrels.

Meanwhile, the U.S. Geological Survey estimates potential oil in place in the overall Bakken play is between 271- and 502 billion barrels of oil, according to a recent study. That's a gigantic leap from estimates the USGS made in 1995, when it calculated that only 151 million barrels were technically recoverable from the Bakken.

"If the potential bears out, this could (depending on recovery factors) increase the estimate of technically recoverable crude oil resources in the United States by billions of barrels," the EIA reports. At present, the USGS estimate for all technically recoverable oil resources in the country, not including the Bakken, is 175 billion barrels.

The Bakken was deposited during the Upper Devonian and Lower Mississippian periods. An upper shale that is 23 feet thick and a 50-foot lower shale sandwich a middle member composed of interbedded limestones, dolomites, siltstones and sandstones. Current drilling targets this middle member,

some 85 feet thick.

The Bakken formation is prolific because it is tightly sealed by overlying and underlying carbonates. As hydrocarbons were generated in the Bakken shales during geologic time, internal fluid pressures fractured the rocks. The bounds of the thermally mature portion of the Bakken are drawn at depths of 8,500 feet or greater, which corresponds to temperatures of 100° Celsius or above. Inside that area, the Bakken is overpressured, often oil-wet, and rife with natural fractures that make it capable of producing at high rates.

Of course, oil has been produced from the Bakken for decades. But earlier operators were often frustrated. Vertical wells attempted to intersect natural fracture systems. But Bakken shales are highly reactive to water, and older-style drilling and completion fluids caused swelling that reduced or eliminated permeabilities. Furthermore, the Bakken contains iron pyrite, which reacts with hydrochloric acid to form a precipitate that also damaged formations. And, because the Bakken is overpressured, normal sand proppants were crushed at the pressures required for stimulations.

Today, producers drill long horizontal laterals and routinely fracture-stimulate, and achieve excellent results. Wellbores are aligned so that induced fractures are oriented longitudinally. The stimulations use crush-resistant proppants and are produced through uncemented perforated liners.

Indeed, so much oil is being discovered and produced from the play that the Williston Basin's pipeline system—which also moves Canadian oil—is full. Producers have suffered discounts because of competition for pipeline space, and some have announced production shut-ins and drilling postponement. Consequently, midstream companies are stepping into the area.

Perhaps the most remarkable aspect of the Bakken is its provenance in a vintage petroleum basin. This play was realized because of the stick-to-it attitude of independent companies that pioneered it.

"Success came from analysis of geologic data on a decades-old producing area, identification of untapped resources, and application of the new drilling and completion technology necessary to exploit them," the EIA reports.