

Tight Oil: A Primer

by

Edward O'Brien, Economist

What is it?

Tight oil is conventional oil which is found within reservoirs with low permeability. The oil contained within these structures typically will not flow without assistance. With the advancement of horizontal drilling technology over the past ten years, coupled with the improvements to hydraulic fracturing technology, tight oil has become more accessible in recent years, making it economically feasible to extract. Extracting tight oil involves a multi-stage hydraulic fracturing process, expanding the space between the pores in the rocks (permeability) so that the trapped liquid hydrocarbons are allowed to flow. Although progress has been made with extracting this tight oil, the question of Estimated Ultimate Recovery (EUR) from tight oil still remains. Estimated ultimate recovery (EUR) is an approximation of the quantity of oil or gas that is potentially recoverable or has already been recovered from a reserve or well. For tight oil, the EUR is generally accepted as between 10 and 30 percent.

Tight oil is where oil is trapped within tiny pores inside rock formations. In order for the oil to be extracted, there needs to be a way to free that oil from that rock. One way which this is happening is through hydraulic fracturing. Hydraulic fracturing is a technique in which typically water is mixed with sand and chemicals, and the mixture is injected at high pressure into a well to create fractures. When hydraulic fracturing happens, a pathway for the oil to flow throughout the rock is created, and thus, the oil has the ability to flow. Tight oil usually has low to medium viscosity (the ability for a liquid to flow), and when freed, is able to be harvested easier than oil with a high viscosity. To expand the impact of the hydraulic fracturing, horizontal drilling is used. Horizontal drilling employs drilling a well from the surface to a subsurface location just above the target reservoir, then changing the well from the vertical well used to drill down to a level into the ground to a horizontal level, expanding the area in which the well can reach. The combination of horizontal drilling and hydraulic fracturing allows drillers to extract the oil more efficiently than only traditional vertical drilling.

These technological developments have allowed oil resources, which were once thought to be unrecoverable, are now recoverable, increasing growth in United States oil production. The United States Energy Information Administration's (EIA) forecast in 2010 predicted 5.8 million barrels of oil produced daily domestically in 2013; however, since the further development in tight oil, especially in North Dakota and Texas, the most recent EIA forecast shows 7.3 million barrels a day were produced in May, 2013, the most since 1988. It is forecasted that the United States will see additional gains of 3.9 million barrels of production a day through 2018, pushing the total production capacity to 11.2 million barrels a day, or 67% of the projected demand in 2018 being domestically produced. The EIA has also stated that the United States could be the world's global leader in production by 2020, based on technological developments that allow the exploitation of the tight oil.

Where is it?

The major tight oil plays within the United States are the Bakken in North Dakota and Eagle Ford in Texas. The Bakken play (which includes the Three Forks formation) has an EUR of 11 billion barrels of oil locked up in the tight oil throughout North Dakota, Lower Saskatchewan and Eastern

Montana, according to Lynn Helms, director of the North Dakota Department of Mineral Resources, the high estimate provided by the EIA. Eagle Ford, located in southern Texas, has an estimate between 7 to 10 billion barrels of EUR, according to the USGS. In addition to those two major plays, other tight oil plays within the United States include Niobrara (Colorado), Avalon (Texas/New Mexico), Wolfcamp (Texas/New Mexico), Barnett (Texas), Monterey (California), and in Louisiana, the Tuscaloosa Marine Shale. Tight oil is deeper than conventional oil plays, usually between 2,000 feet and 20,000 feet, depending on where the structures are located. As one would imagine, the deeper the tight oil, the more expensive it is to produce from those plays.

How much is there?

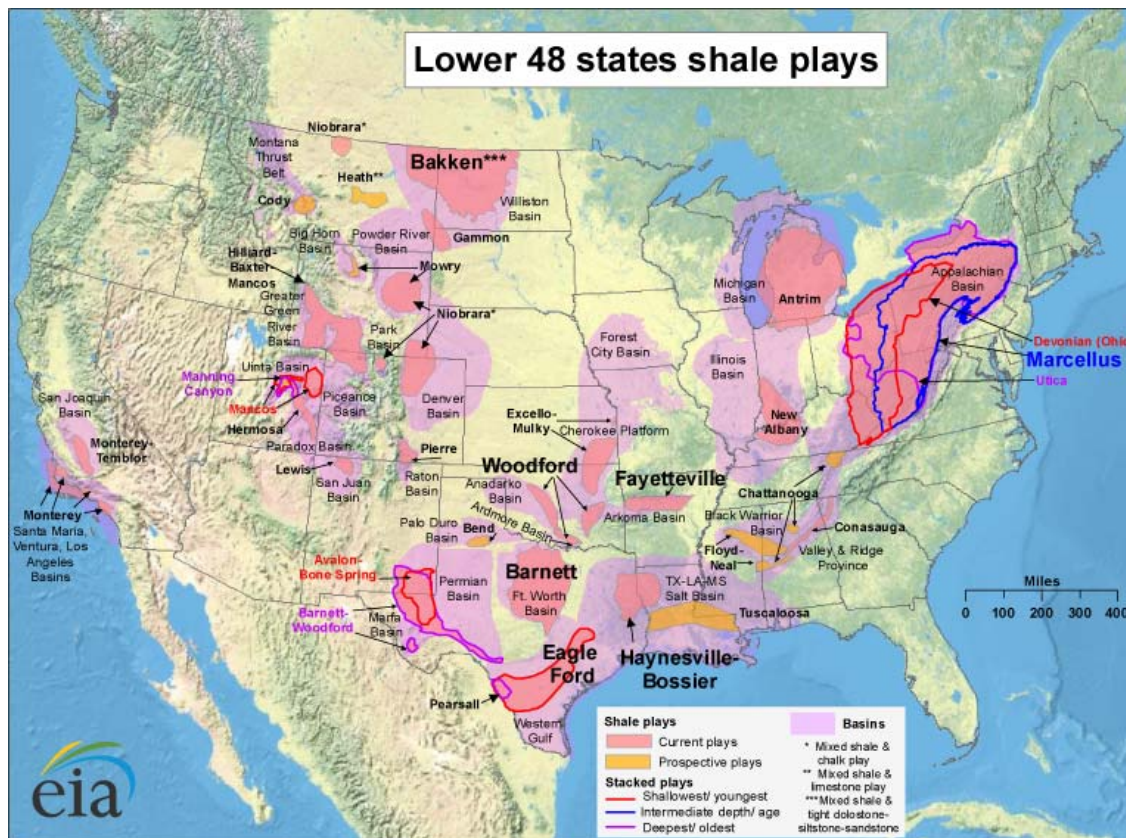
The EIA “Technically Recoverable Shale Oil Resources” data lists the United States as having 48 billion barrels of recoverable shale oil reserves, as of July 2013, although estimates differ on how

Table 1.

United States Tight Oil Supply Prices		
Play	State	Cost
Monterey	CA	\$36
Eagle Ford	TX	\$49
Bakken	ND	\$50
Wolfcamp	TX	\$55
Granite Wash	OK	\$57
Wolfcamp	NM	\$58
Granite Wash	TX	\$64
Avalon & Bone Spring	TX	\$65
Niobrara	CO	\$66
Avalon & Bone Spring	NM	\$69
Tuscaloosa	MS	\$69
AB-Bakken	MT	\$70
Three Forks/Sanish	ND	\$76
Elm Coulee	MT	\$85
Tuscaloosa	LA	\$92

Source: Rodgers Oil & Gas Consulting

Figure 1.



Source: Energy Information Administration based on data from various published studies. Updated: May 9, 2011

much oil is contained within the tight oil formations. In that same report, the EIA increased the global from the 2011 of 32 billion barrels of EUR shale oil to 345 billion barrels, a 1078% increase. With the development of new technology, tight oil (including shale oil) has become more exploitable, increasing not just the global reserves, but also the reserves in North America and the United States. BP stated in its annual statistical review that U.S. oil output rose by 13.9% to 8.905 million b/d in 2012 from 7.868 million b/d in 2011. This represented 9.6% of the world's total. The growth of oil output in the U.S. was the fastest in the world, according the BP statistical review.

Focusing on the United States, Bakken and Eagle Ford account for 82% of the oil produced from horizontal wells in the United States in 2011. U.S. tight oil production increased from an average 0.2 million barrels per day in 2000 to an average of 1.9 million barrels per day in 2012, or an 850% increase for that period. With an estimated 100 billion barrels of oil in the Bakken, with an EUR of between 10% and 30%, it is not out of the question that Ms. Helms was accurate in forecasting 11 billion barrels of recoverable oil from that region, which could ultimately be an extremely conservative estimate. As for Eagle Ford, there is a conservative estimate of 7 billion barrels of recoverable oil, out of an estimated 25 billion barrels of oil in the shale formation. One reason for the Eagle Ford play having a higher percentage of recoverable oil is a greater permeability than other shale oil fields. Other major fields include the Permian Basin, which has an estimated 100 billion barrels in oil shale, of which 15 billion barrels are technically recoverable. In Louisiana, there is an estimated 7 billion barrels of oil in the Tuscaloosa Marine Shale, with an estimated EUR of 700 million barrels. Under south Louisiana, from Slidell to Lake Charles, the Tuscaloosa Marine Shale is amassed from 12,000 to 16,000 feet down, the depth contributing to economic limit of \$92 per barrel, or the cost of extracting the shale oil from the ground.

Technology used to sever the oil shale from the ground is expanding. According to Edward Morse, global head of commodities research for Citigroup, from a April 27, 2013 New York Times article, "The most optimistic of people believe that we've only seen the beginning of a burst of technological innovation, and if you look back from 2020 to fracking techniques in 2013, by 2020 you'll think these are sort of feudal times". Taking the developments in technology into account, one can theorize that the amount of EUR should increase in the future, adding addition EUR to the total amount of shale oil which can be recovered. If today's estimate of 48 billion barrels represents just 10% of oil shale under the United States, with more development of technology, it is not unreasonable for that number to increase in upcoming years. One improvement which could be made is to somehow discover a method to slow the decline in production from oil shale wells, which is between 40% and 65% after the first year.

Looking Forward

With the resurgence of drilling in the oil patch, United States oil production has increased since 2008, to a level which exceeds production last seen in the 1980s. This increase of production, due to the exploitation of tight oil in the United States (mainly the Bakken and Eagle Ford shale) is projected to continue for the foreseeable future. With a conservative estimate of 11.2 million barrels per day produced in the United States in 2018 (projected by the EIA), tight oil has allowed the United States to expand oil production to a point which rivals many OPEC nations. The United States is currently importing oil at the lowest rate in more than 20 years. This trend is expected to continue for at least the next 15 years. In addition to the proven tight oil, new estimations on various tight oil deposits are being made. With improvements being made in technology, it is not out of the

realm of possibility for the current 10%-30% recovery to increase to 20%-40%, increasing the total EUR.

Figure 2.

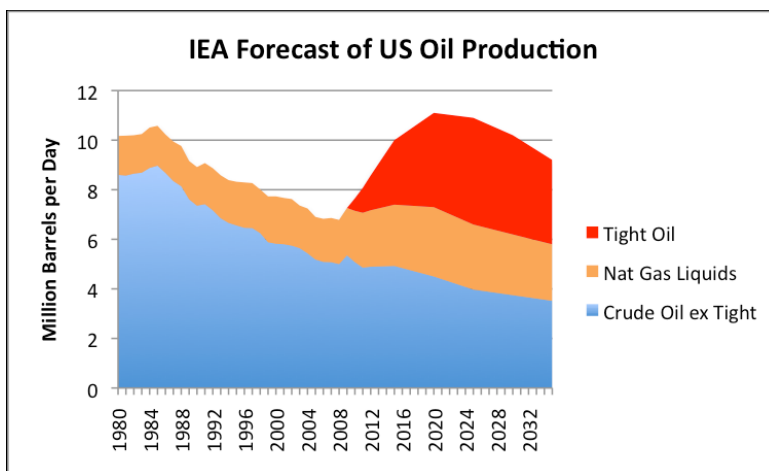
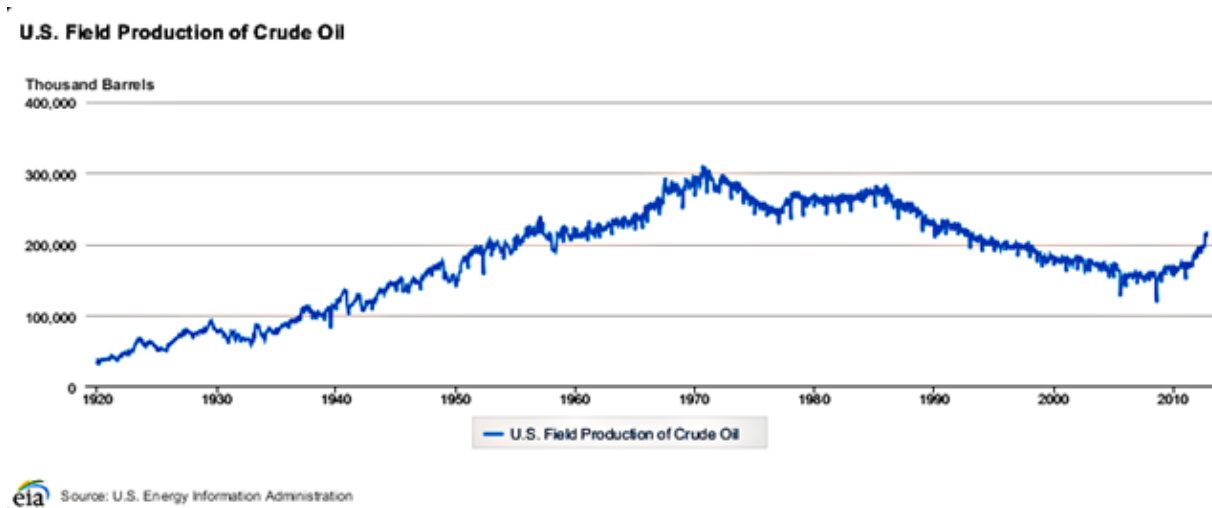


Figure 3.



Source: U.S. Energy Information Administration