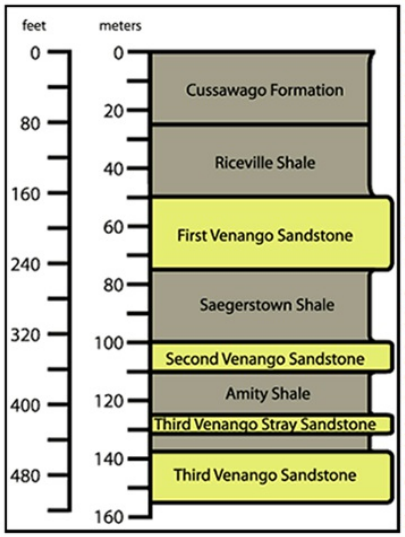
The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Tech Talk - The Appalachian Basin, simple lessons from the beginning

Posted by Heading Out on May 1, 2011 - 12:57pm

There are a number of different ways of getting oil from a reservoir, and, to radically oversimplify, the harder that you try to maximize the rate of production of oil from a well, then the shorter the overall life of the well will be, and there is a strong likelihood that the amount of oil, in total, that the well recovers will also decline with that increased extraction rate. This lesson, that of controlling the extraction rate from a reservoir to maximize absolute production volumes is one that Saudi Aramco practices, and because of that approach, has me quite doubtful that they will ever produce more than 12 mbd. (At least as long as the present faction of the House of Saud remains in power). To do so would hurt their absolute recoveries, and with the slower and more controlled extraction, they have demonstrated that they can recover higher percentages of the total volume of oil originally present in the reservoir. It is not, however, a philosophy that is widely adopted. And yet, instead of the owners of the wells having that prescience, on occasion it has been other external forces that have driven the extraction rates from the wells, and thus controlled the length of their life and the total ultimate recoveries. The Appalachian oilfields in the United States, where much of this story began, has a history that helps illustrate some of these points.

The Oil Age is famously credited as having started with the drilling of the Drake Well in Titusville, Pennsylvania in 1859, although Ohio claims that the "First Oil Well", was the Thorla-McKee well which was drilled and cased in oak in 1814. There is similarly a claim for the first great American oil well in Burkesville, Kentucky in 1829. I mention these as much to indicate that it was not that difficult initially to encounter oil in different parts of the country, and relatively close to the surface. The Drake well had only to extend down to 69.5 ft before it struck oil, and it made around 20 barrels of oil a day – but it was this well that opened the way to the oil industry of today.

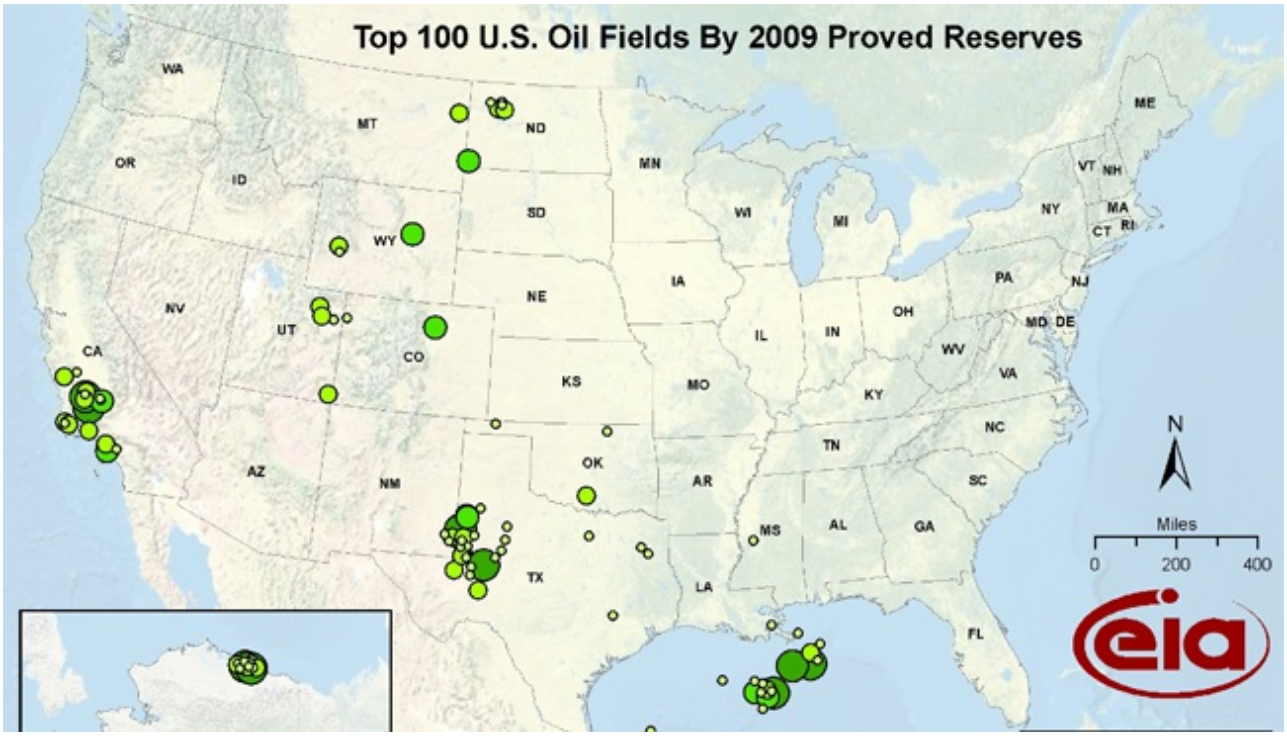


Geological column at the Drake well site. The oil was found in the Riceville Shale (The Paleontological Research Institution)

Following on from that development, the production of oil from the nearby oilfields, first of Pennsylvania and then also into West Virginia in what became known as the Appalachian Basin dominated early American crude oil supply. :

> Consider this - Pennsylvania was responsible for 1/2 of the WORLD'S production of oil until the East Texas oil boom of 1901.

Yet when we look at the map of the top oilfields ranked by proven reserves, as issued by the EIA, none of the fields in that region even appears today.

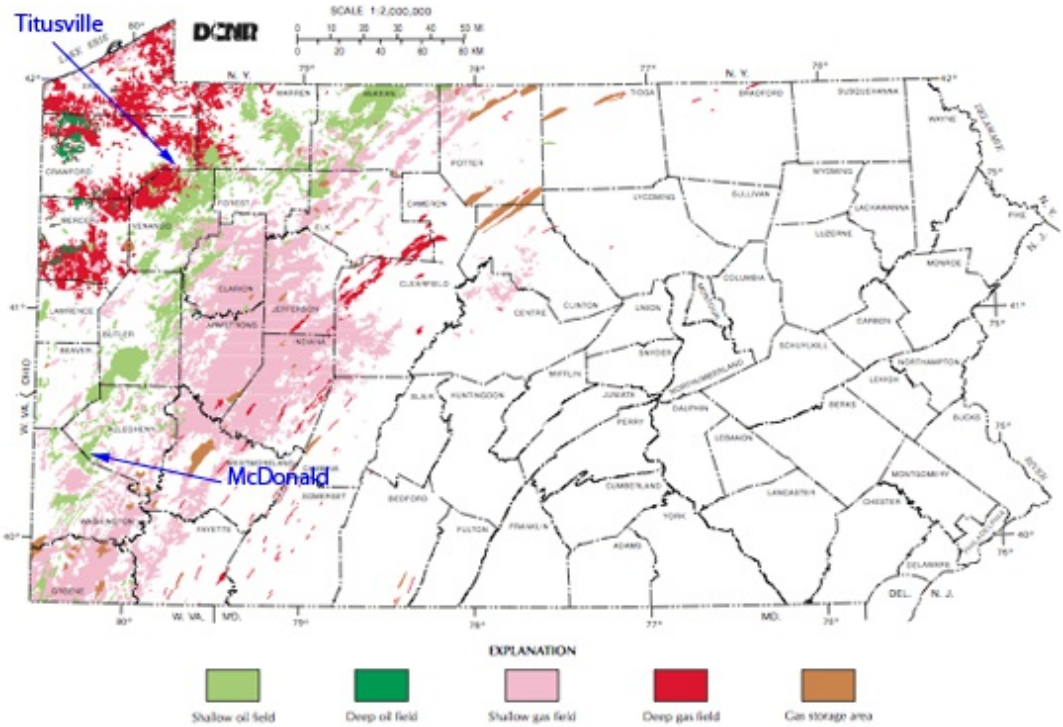


Top 100 oilfields ranked by proven reserves in 2009 (EIA)

There are two thoughts that come from this. The first is that just because an area was productive of oil at one time does not mean that it can continue to be so. And as productive fields are exhausted and production moves elsewhere the remaining oil in the field becomes less attractive as a reserve to be developed. The original Drake well at Titusville, for example, stopped producing after two years. Yet many of the wells that continued production were not produced with the tools that drive higher production today, and so tended to last much longer, but at low levels of production.

Which brings me to a second thought, which is more exemplified by wells in the Gulf of Mexico that were damaged during the Hurricanes in 2005. Until then these platforms had been producing small quantities of oil on a regular basis. But after the hurricane destruction those small quantities of oil that could be still recovered did not frequently justify the increased financial investment in extensive new drilling and repair that would have been required to re-create productive wells. And so the remaining oil in parts of the area was abandoned. Many of the wells in Appalachia ended up in a similar state.

The oil and gas fields of PA lie in the upper left (North-West) corner of the state, and are, at the moment, under much greater scrutiny again because of the natural gas that is found in the Marcellus shale that runs through the state.



Conventional Oil and gas fields in PA (PA Department of Conservation and Natural Resources)

The Marcellus is not shown on the above map, but I showed its extent in the recent post on the EIA shale gas report. Twenty-four fields are currently listed. Conditions during the oil boom at the end of the 19th Century were more intense even than the gas boom of today.

> Less than twelve months ago McDonald, Pennsylvania, eighteen miles west of Pittsburgh, was a sleepy and commonplace little coal-mining town. In six months it doubled in population and became the busiest and most typical oil town in the country.
>
> In this oil field on June 1st 1891 there were three completed oil wells. By November there were over three hundred wells in various stages, of which nearly one half were in and about McDonald.

Interestingly as Caplinger notes

> Drilling and production in the United States have been governed by the price of oil, classic supply-and-demand responses to economic reality. After the initial discovery of oil at Drake's well in 1859, prices were up to $16.00 a barrel, but high production quickly lowered the price to a fraction of this. Appalachian oil averaged $1.80 a barrel after the initial period of extremely high prices, reaching a low of 56 cents per barrel in 1892, and a high of $5.35 a barrel in 1920. Between 1859 and 1930 the price of oil in the United States averaged $1.34 per barrel. Well production in Appalachia averaged 0.6 barrels a day (the nation's lowest), while the national average was 8.4 barrels per day.
>
> However, Appalachia's oil wells were the longest-lived in the country, and proved their worth in long-term production. On average, they returned 2.9 percent of their initial

> drilling cost per year.

Of the 600,000 wells drilled in the United States between 1859 and 1930 about half were still producing in 1930, and of these 242,000 had been drilled in Appalachia, of which 20% were dry holes and 149,000 were still producing in 1930. The average cost to drill a well in Appalachia at that time was $11,474.

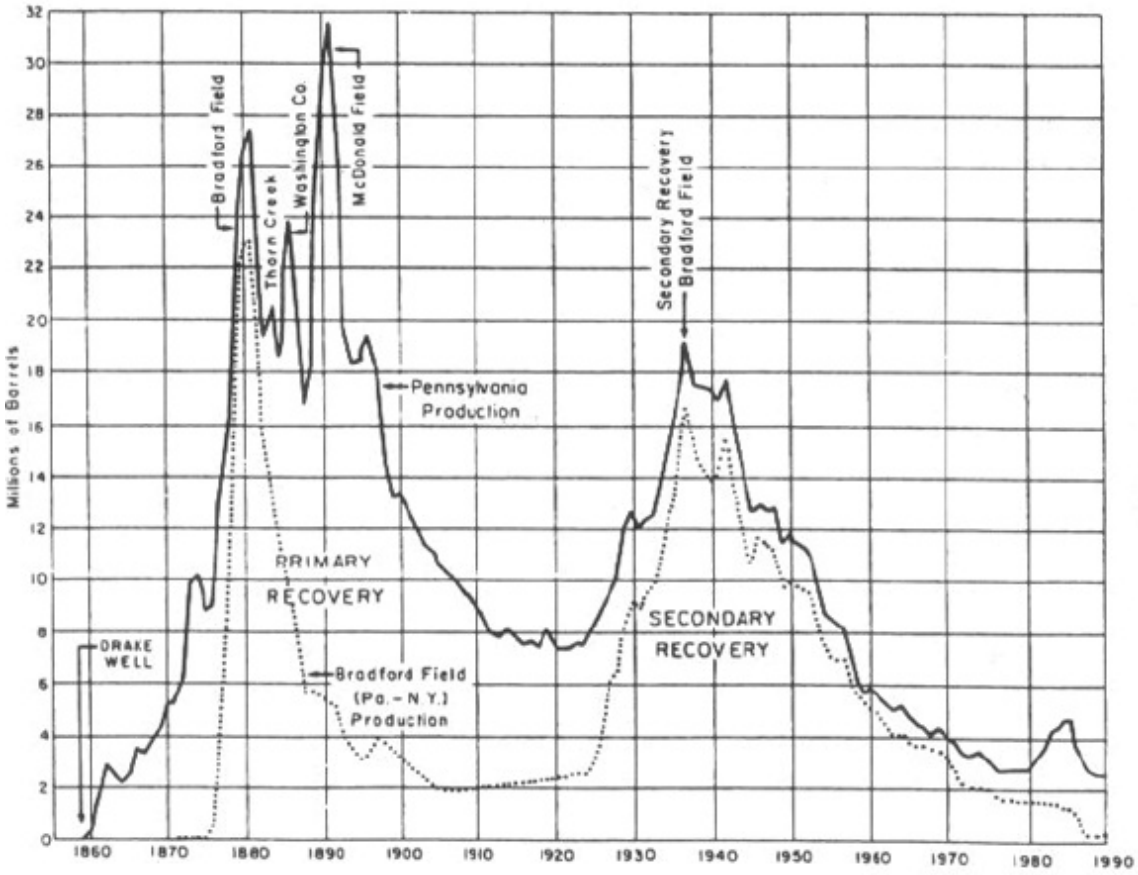
There were wells that were initially much more productive, but, as noted above, higher producers also tended to be shorter lived, (ibid)

> The Funk (or Fountain) well produced 300 barrels a day for over a year before suddenly going dry. The Empire well, drilled in September of 1861, produced 3,000 barrels a day for eight months, slowing to 1,200 barrels by May 1862 before production dropped to nothing. In October of 1861, a well drilled by William Phillips on the Tarr farm on lower Oil Creek began flowing 4,000 barrels a day, probably the largest flowing well in the region's history.

The Tarr Farm property, which once controlled the price of crude, is now long gone.

Yet not all wells ran dry that quickly. The well at the McClintock property in PA was drilled in 1861, and with long term care, and low production, is still producing 150 years later. It has, however, never produced more than 50 barrels of oil a day, and today only produces 1 - 2 bd, which is largely sold to tourists.

Unfortunately the typical well in PA was not that long lived, and the 350,000 that have been drilled, have collectively produced around 1.4 billion barrels of oil, since 1959. The Appalachian oil fields of PA oil had reached a production of 2 million barrels a year (mbpa) by 1862, and peaked at 32 million barrels a year (721 kbd) in 1892. By 1990 production had fallen to 2 mbpa again.



PA oil production (from Caplinger after Harper and Cozard

Oil production from the basin had fallen to not much more than a million barrels a year by 2001 and even though PA has no severance tax, as the following table shows, once a resource is gone . . . . . .

State	Severance Tax	Type of Severance Tax Imposed	Permit Fee	Length of Permit Validity
Pennsylvania	NO	N/A	$250/oil, $350/gas	12 months
Ohio	YES	$0.10 per bbl and $0.025 per MCF + county ad valorum tax	$250	12 months
West Virginia	YES	5% on gross production	$450	24 months
Kentucky	YES	4.5% on all production + variable county tax	$300	12 months
New York	YES	Based on real property value	$100 + $190 per 500 feet drilled	6 months

State regulations on wells in the Appalachian Basin (Center for Rural Pennyslvania)

There was some move to looking deeper (and more expensively) at regions of the state for more resources but that has been overtaken by the developments in the Marcellus Shale. Crude oil production from PA, however, rose from 1.3 mbpa in 1997 to 3.6 mbpa in 2008.