



Shale is dead, long live conventional oil

As a general rule, the most successful man in life is the man who has the best information

The US 'Sultans of Shale' have had it good for a long time, but the party in the Permian and other US oil shale basins is coming to an end. Not right away, but at most, the fast-depleting shale oil fields which produce via hydraulic fracturing and horizontal directional drilling, are likely to last another five to 10 years. After that, US oil companies will be looking elsewhere to reach or continue energy independence everyone is currently saying will come from shale. But the dirty little secret nobody wants to talk about is that shale's days are numbered. The mainstream media and other US oil industry cheerleaders haven't caught on to this yet, but more and more credible oil observers are starting to. This article explains why.

The shale boosters

It isn't difficult to see why media outlets, analysts, CEOs and other industry commentators have become a convert to the shale "religion".

Booming shale production has put the United States oil industry in a [position to overtake Russia as the world's global oil superpower](#). As fracking technologies evolved to successfully inject sand, water and chemicals at high pressure to crack tightly formed shale rock formations, thus allowing oil and gas to flow to surface via horizontal and vertical wells, drilling companies flocked to formations like the Bakken, Eagle Ford and Permian Basin. Between 2008 and 2017, US oil production nearly doubled to 9.35 million barrels a day, driven by production from shale-producing regions. Blame for the oil crash of 2014 largely rests with the United States for flooding the global market with shale oil.

According to the EIA, US oil output will average 10.3 million bpd this year and 10.9 million in 2019, driven by growth in Texas and North Dakota shale production. Russia, the largest oil producer, by contrast pumped 11 million

barrels a day in 2017 while Saudi Arabia, OPEC's biggest producer, pumped just under 10 million bopd, according to [Bloomberg](#).

On Feb. 26 [Reuters reported that the US is poised to surpass Russia and become the number one producer by 2019](#) at the latest, quoting the latest numbers from the IEA. It expects the country to surpass 11 mbpd in 2018. The organization's executive director does not see US oil production peaking before 2020, and expects yearly increases for the next five years.

While [OPEC has cut output](#) to compensate for the flood of US shale, there are no signs that the US is going to do the same. [Oilprice.com reported on Tuesday that the EIA revised its previous November 2017 monthly total upward](#), to 10.057 mbpd, beating the previous record of 10.044 mbpd from November 1970. The article notes the gains have been driven by eye-popping production in the Permian Basin – the most productive shale field – which is approaching 3 million bopd, triple that of 2009. A look at the table below shows that in every US oil and gas producing region, oil productivity has gained from February to March 2018.

Region	Oil production thousand barrels/day			Gas production million cubic feet/day		
	February 2018	March 2018	change	February 2018	March 2018	change
Anadarko	491	492	1	6,131	6,100	(31)
Appalachia	117	120	3	26,829	27,150	321
Bakken	1,215	1,222	7	2,220	2,248	28
Eagle Ford	1,289	1,307	18	6,456	6,518	62
Haynesville	42	42	-	7,906	8,095	189
Niobrara	573	579	6	4,813	4,860	47
Permian	2,919	2,994	75	9,754	9,970	216
Total	6,646	6,756	110	64,109	64,941	832

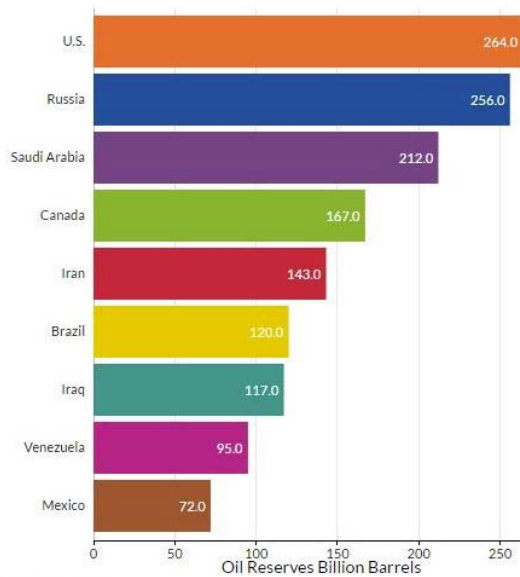
"The Permian is just now coming into its own," [Reuters quoted Randy Foutch, CEO of shale producer Laredo Petroleum, on the eve of CERAWEEK](#), a big energy conference in Houston. He confidently predicted Laredo will boost output 10% this year in the Permian, a sedimentary basin that straddles Texas and New Mexico. "We no longer have to find oil and gas. We've found it, and will pump it."

Meanwhile [US oil exports are surging](#) and net imports are falling, to 4.98 mbpd, the lowest level since 2001. Demand is also increasing, says the IEA,

with growth of around 1.5 mbpd in 2018, 200,000 of which is attributed to the US.

A [2016 study by Oslo-based Rystad Energy](#) had more glowing things to say about US shale, finding that the United States holds more recoverable oil reserves than Saudi Arabia and Russia – 264 billion barrels versus Saudi's 212 billion and Russia's 256 billion - all thanks to hydraulic fracturing. The study estimated over half the remaining US reserves are unconventional shale oil, "making the US one of the most energy secure countries in the world." The Institute for Energy Research goes further than that, gloating that the US has four times the oil in recoverable oil in shale reserves as Saudi Arabia's proven reserves: 2.6 trillion barrels.

U.S. Holds 264 Billion Barrels, Says Rystad



Source: Rystad Energy

The shale revolution is greatly exaggerated

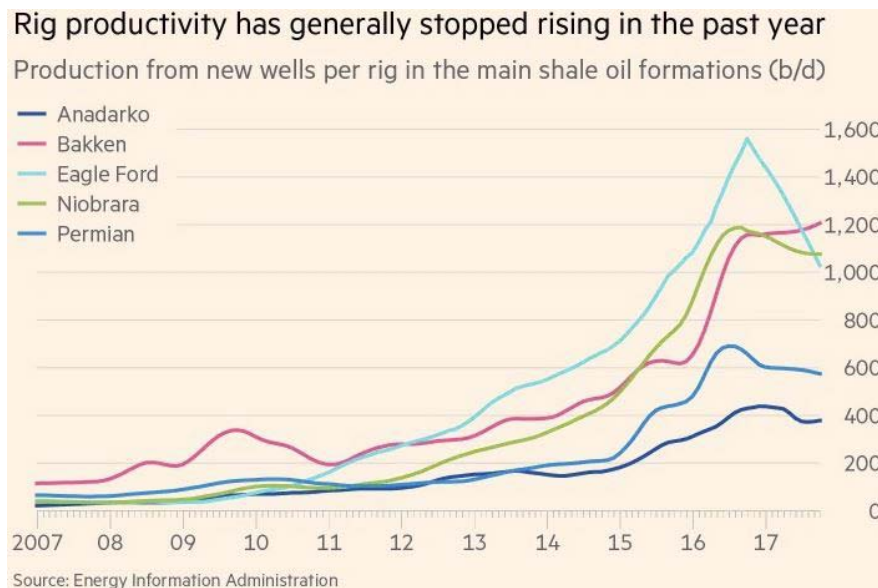
The numbers are impressive, but they are misleading. This week Kurt Cobb took issue with the energy independence argument, writing on Oilprice.com that [while the States does export 1.5 million barrels a day, it also imports 7.5 mbopd](#), leaving net imports of crude oil at 6 mbpd. Cobb also points out that the oil coming out of shale deposits is too light for many American refineries so much of it shipped abroad – a fact usually left out of stories about US oil exports. Oil imports are therefore more of the heavy crude variety that US refineries are able to handle, including

Canadian oil sands crude.

So the US isn't really gunning towards a situation of energy independence. For that to happen, it would have to increase its oil production to around 18 million bopd, to make it truly independent of imports. That's not going to happen.

While most articles suggest that shale production could go on at current levels for the next 20-30 years, the evidence actually points to a levelling off of shale production, as productivity increases stop and wells are tapped out, or drilled and never completed.

Productivity data from the EIA and charted by the Financial Times shows that while production in the main shale formations grew steadily from 2007, rising sharply in 2015 (the Eagle Ford peaked at nearly 1.6 million bopd) mid-2016, in the past year rates have declined.



Data from Baker Hughes showed that a year-long ramp-up by US shale operators hit a plateau last July, with some companies, like Pioneer Resources, lowering their targets.

The lower numbers have some predicting that US shale oil production could peak before 2025. This is because shale oil wells are gushers in their first year, then deplete rapidly. Shale companies are therefore money losers because they have to keep ploughing more money into production just to keep output flat, a phenomenon known as ["The Red Queen Syndrome."](#)

Shale wells typically bleed off 70 to 90% in their first three years, and drop by 20 to 40% a year without new drilling.

According to consultancy Wood Mackenzie, Permian production could peak in 2021 versus the more optimistic 2025.

A [report](#) from the Post Carbon Institute argues that the EIA's rosy forecast of strong US oil and gas growth for several decades – with shale oil not peaking until the 2040s – is simply wrong.

The report says the EIA has overestimated the Eagle Ford play area by 65%, available well locations are running out, and that the 'sweet' spots, the 20% of a field that usually has the highest productivity have already been drilled.

EnergyPost.com has this to say regarding sweet spots, *"Whereas conventional oil is mostly about finding oil in the first place, shale oil is rather about finding those places where the oil can actually be produced at commercial rates. Oil in the Bakken for instance was already discovered in the 1950s. Within a single play the EUR (estimated ultimate recovery) per well is highly variable. The key to success therefore is finding the sweet spots, with systematically higher EUR's. Even within a single sweet spot area well performance is highly variable, however. So far the industry has not been very successful in predicting sweet spots. As a result, it takes many wells before sweet spots (which may be the only places where commercial production can take place) can be located with some confidence. Hundreds of wells are needed to properly evaluate the play. Subsequently many thousands of wells are needed to produce. As a result, in each play different areas have highly variable break-even oil prices."*

It's not just numbers and graphs that are telling this story of shale depletion. Recently a shale industry trailblazer turned skeptic on soaring shale output, seemed to relish telling his colleagues at a meeting with the secretary-general of OPEC that US oil production won't keep rising at the levels the market thinks it will.

"The oil market is in a state of misdirection now," said Mark Papa, the former CEO of EOG Resources, a bellwether shale company that pioneered the shift from shale gas extraction to shale oil. Now 71, and head of smaller shale company Centennial Resource Development, Papa [suggested to the Wall Street Journal](#) that future supplies may be more constrained than experts believe. "Someone needs to speak out."

His main point? Shale isn't the "big bad wolf" that it has been made out to be. According to the WSJ, Papa "strongly takes issue with the notion — held by market analysts, executives and investors — that U.S. production will long swamp global supplies, perpetuating lower prices." That's because most of the drilling locations in North and South Dakota have already been tapped, and he pointed to operational challenges like sand shortages in the Permian Basin as a harbinger.

"Such constraints, coupled with mounting investor demands for returns, will equate to much slower U.S. oil production growth than what most forecasts expect," the newspaper quoted him saying. Continental Resources' chief executive Harold Hamm, another shale pioneer, also doubts the optimistic shale forecasts.

Delaying the inevitable

But what about [new technology](#) and the discovery of new shale fields? It's true that multi-pad drilling, better use of fracking materials and portable “walking” oil rigs have upped the productivity of once-dismal-producing shale oil wells. The latest is “cube drilling”, which targets all commercially viable shale layers at once, in three dimensions. [Futures reports that Encana has a 3D Texas well pad that hosts 19 shale wells](#) and pumps 20,000 barrels a day. Devon Energy has a similar 24-well pad in Oklahoma, and has over 10 multi-zone projects scheduled for 2018. These military-like operations are impressive, but they will only hasten the inevitable decline of shale.

Other fields of course will be explored as the producing basins go dry. In Denver, interest is peaking in a new field known as the DJ Basin, which is the least explored of the four major North American shale deposits. [The Denver Post reports that drilling activity has doubled since 2016](#), lifting the state's output to 397,000 barrels a day, an increase of 100,000 barrels in 2017.

There's also [a plan](#) afoot, driven by the Trump Administration, to drill for oil and gas in Utah, by shrinking two national monuments. But while the Bears Ears territory is thought to overlap with oil, gas and coal reserves, [the area is remote, lacks oil and gas infrastructure, making production costly, and has a poor record of historical drilling, with many wells plugged and abandoned](#).

The bottom line is that shale oil extraction is not a sustainable business model. Because drillers must keep drilling more wells to keep up with rapidly depleting fields, there is no way that the United States can achieve energy independence, let alone energy dominance, with shale oil.

Trade wars and tariffs – more bad news for shale

Rarely is government interference in free markets a good thing, and the same holds for Donald Trump's aggressive push to slap tariffs on imports of steel and aluminum. According to a [study conducted on behalf of the pipeline industry, 77% of steel used in line pipe is imported](#), either as finished pipe or raw material that is fabricated in the US. The States exports more line pipe than it imports, so the tariffs won't cause a surge of domestic line pipe production, but pipeline companies that use imported steel will see their costs go up. These companies will invariably pass the higher input costs onto their customers – oil and gas producers, thus increasing the cost of shale oil extraction.

That leaves conventional oil

[In 2012 the USGS reported](#) that excluding the United States, the world holds an estimated 565 billion barrels of undiscovered, technically recoverable conventional oil.

The three countries with the most oil reserves are, in order, Venezuela, Saudi Arabia and Canada (this includes conventional and unconventional reserves, including shale and oil sands). The United States is in 10th place, as the [table from World Atlas below shows](#).

Countries With The Largest Proven Oil Reserves

Rank	Country	Barrels (Millions of Barrels)
1	Venezuela	300,878
2	Saudi Arabia	266,455
3	Canada	169,709
4	Iran	158,400
5	Iraq	142,503
6	Kuwait	101,500
7	United Arab Emirates	97,800
8	Russia	80,000
9	Libya	48,363
10	United States	39,230
11	Nigeria	37,062
12	Kazakhstan	30,000
13	China	25,620
14	Qatar	25,244
15	Brazil	12,999

An important point to be made is that [over half of US oil reserves are located in its 100 largest fields](#) – with the largest field being the Eagleville field in the Eagle Ford Shale.

Top 10 Oil Fields

1. Eagleville (TX) – 238 million barrels
2. Spraberry (TX) – 99 million barrels
3. Prudhoe Bay (AK) – 79 million barrels
4. Wattenberg (CO) – 47 million barrels
5. Briscoe Ranch (TX) – 62 million barrels
6. Kuparuk River (AK) – 29 million barrels
7. Mississippi Canyon (Fed Gulf) – 15 million barrels
8. Wasson (TX) – 19 million barrels

- 9. Belridge South (CA) – 23 million barrels
- 10. Green Canyon (Fed Gulf) – 27 million barrels

Take a second look at the Eagle Ford.



OPEC

[Current estimates](#) have over 80 percent of the world's proven oil reserves located in OPEC member countries, with Middle Eastern reserves comprising 65 percent of the OPEC total.

The [top producing fields](#) are Ghawar and Safaniya in Saudi Arabia, Burgan in Kuwait, and Rumalia and West Qurna-2 in Iraq. Ghawar, the world's largest field, has an estimated 75 billion barrels of remaining reserves.

Will the oil pools in the Middle East be able to maintain output? The Saudis in particular keep their cards close to their chest, but there is evidence that Saudi fields are depleting. In 2016 despite crude prices in the \$40 range, there was a record number of drill rigs on the Arabian peninsula and the number had doubled from five years prior. Some explained the increased drilling activity as defending or increasing its market share, but a more likely reason is the need to replace declining output from old fields, some of which have been in production for decades. [Reuters market analyst John Kemp wrote in 2016](#) that it's likely the Saudis are trying to produce from newer, less developed fields (through more drilling) to ease the pressure on older fields like Ghawar.

In his 2005 book *Twilight in the Desert*, author Matthew Simmons studied field production records and concluded that the Saudi Kingdom was overstating its remaining reserves and would struggle to maintain future output. He was proven wrong, but one interesting chapter of his book discusses then-new techniques to improve oil production. In this section, Simmons points out that the Saudis have been injecting gas and water into depleting reservoirs in order to keep the pressure up, since the 1950s. By 1998 the amount of water being injected into the Ghawar and Abqaiq fields had reached around 12 million barrels a day.

But as deep underground aquifers began to lose their salinity in the 1970s, Saudi Aramco, the state oil company, began experimenting with seawater injection. In 1978 according to the book, the world's largest seawater intake and treatment plant was built on the shores of the Persian Gulf. It was initially designed to pump 4.2 million barrels a day of treated seawater into Ghawar, through 62 miles of pipelines.

In 2008 [CBS reported](#) that workers were building a large seawater injection system to pump over 2 million barrels of water a day into 120 Saudi wells.

The long term prospects of Saudi oil production do not look good if the results of a 2016 study in the *Journal of Petroleum Science and Engineering* are to be believed. [Reported in Middle East Eye](#), the peer-reviewed study says Saudi Arabia will see a peak in its production followed by a permanent decline, starting in 2028.

From 2005 to 2015 Saudi net oil exports declined annually by 1.4%, according to the article, while a Citigroup report said net exports would go to zero in the next 15 years. With 80% of the Kingdom's oil revenues coming from oil sales, it's a dark picture to imagine what would happen to a country whose population that has been weaned on cheap oil one day finds it has run out of black gold.

All of this is setting up for a massive bull market for crude oil. The perfect storm rolling in entails skyrocketing demand for oil (1.5 mbpd increase in 2018 alone), slowing production from current number 2 producer Saudi Arabia, and depleting shale oil fields. The likelihood of a major new oil field akin to the likes of Ghawar, Spindletop or Eagleville are almost nil. Last year the discovery of new oil resources fell to a record low, under 4 million barrels of crude, condensate and natural gas liquids [according to the IEA](#). That leaves existing conventional oil to fill the upcoming yawning gap in supply to fill the demand which despite the fossil fuel naysayers, is not going away.

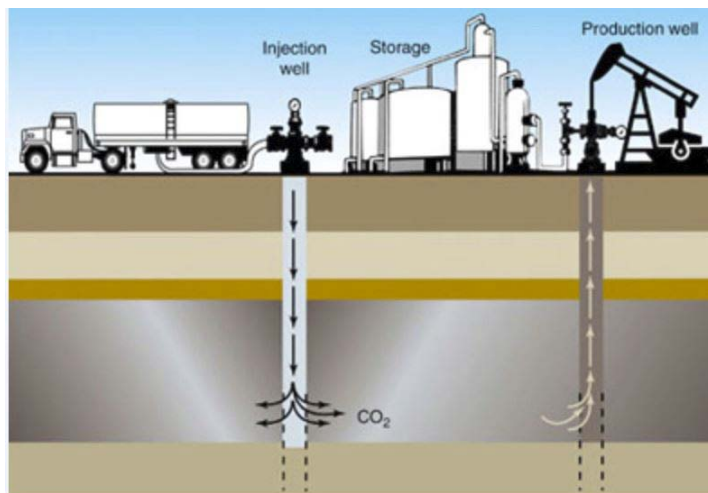
EOR techniques

What many do not realize is that when a well begins producing, only about a third is recoverable by primary and secondary recovery methods. When the pressure in the well drops, the remaining oil sits, unrecoverable. [According to the US Department of Energy](#), of the total 600 billion barrels of oil that have been discovered in the US, about 400 billion cannot be recovered by conventional methods. Around half of that oil, 200 billion barrels, is at depths where enhanced oil recovery (EOR) might work.

Conventional math, versus previously mentioned shale figuring, is illuminating. If the US is totally energy independent at 18 mbopd, 200 billion barrels equals 30.4 years of total independence. Of course the US might want to keep some oil imports, say 4.5 mbopd. Then the number extends to 46 years of conventional oil energy security.

So what is EOR and what are the different methods for pumping this stranded oil?

The first thing to understand is that the life of an oil well has three stages: primary, secondary and tertiary. Primary recovery is oil that rises naturally to the surface or can be lifted using pump jacks. Secondary recovery involves water or gas injections to coax the remaining oil to the surface. But the first two stages can leave up to 75% of the oil still in place, so tertiary recovery (EOR) comprises techniques that try to extract that remaining three-quarters of the oil still in the reservoir.



Carbon Dioxide EOR
Source: Lawrence Livermore National Laboratory

The three main types of EOR are thermal recovery, gas injection and chemical injection. With thermal recovery, heat (usually steam) is introduced to the reservoir in order to reduce the viscosity of the oil, allowing it to flow freely. Thermal recovery accounts for about half of applied EOR in the US, [according to Rigzone](#).

With gas injection, natural gas, carbon dioxide or nitrogen is injected into the reservoir. In this method of tertiary recovery, the gases mix with the oil to thin it and make it flow better. Gas injection accounts for nearly 60% of EOR production in the US, with CO2 the most commonly used gas.

Chemical injection introduces long-chain molecules called polymers into the reservoir to increase the effectiveness of water injection, aka water flooding. Detergent-like surfactants also help to lower the surface tension that prevents oil from moving through the reservoir. While less expensive than the first two techniques, chemical injection only accounts for about 1% of EOR in the US.

The industry is constantly on the hunt for new methods of EOR and one of the most effective involves generating a fluid pressure pulse that moves fluid into a greater number of pores, thus stimulating flow.

Globally, a 10% increase in the recovery factor could result in the production of about a trillion barrels of oil according to the [former president of the Society of Petroleum Engineers](#).

Conclusion

It's hard to find many sources out there right now that will dispute the thesis that shale oil is the key to ever-increasing oil production in the United States that will eventually put the nation on top as the world's largest oil producer. The theme fits in with Donald Trump's America-first agenda and it is being actively defended by Big Oil executives and government officials. But those with less to gain from shale's success have quietly been analyzing the future of this industry which 20 years ago didn't even exist. As shale oil drillers continue to follow Neil Young's mantra "it's better to burn out than fade away," by cranking up production to obscene levels, the result is that the demise of shale will only come faster than predicted – maybe even before the early 2020s.

Just a random thought but, wouldn't the smarter play be to revisit conventional oil production while slow playing, and exporting (remember the refinery problem), shale production to European refineries?

Here's a question for shale believers. The EIA reported supply fell by 605,000 barrels in Cushing, Oklahoma putting Cushing supply at the lowest levels since 2014. *How come the US cannot rebuild supply when daily production is ramping up?* Phil Flynn, over at [Resource Investor](#), says the answer is pretty simple, oil demand is skyrocketing and demand, not shale production or OPEC cuts, is the oil price driver going forward.

I believe that instead of hearing cheers for US energy independence there's going to be a very loud sucking sound heard around the world when shale's straw reach's the bottom of the glass. Trump's US energy policy is misguided at best short term, extremely detrimental long term.

The 'Sultans of Shale' are swimming naked. Combine the limited life of shale with the decline of decades-old fields in the Middle East, only kept alive through seawater flooding, and you have the makings of a very big problem: not enough supply to satisfy continuing oil demand.

Fortunately the industry has a solution to this dilemma, and it's called enhanced oil recovery. With two-thirds to three-quarters of oil still left in place from former producing wells, the potential for oil and gas companies to return to old wells and stimulate them is very big indeed.

I've got companies that excel at EOR technologies and companies targeting conventional oil production on my radar screen.

Are further signs of shale's inevitable demise on your screen?

If not, maybe they should be.

Richard (Rick) Mills

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