US Onshore Crude Production set for modest increase in 2020

Summary

The end of one year is always full of forecasts for the next and 2019 is no different. This article starts by taking a look at three US crude oil production forecasts that were published recently. It then moves on to a discussion on why these forecasts are so different, before presenting my own forecast of US crude oil production. The article then explores some alternative scenarios and details the sources that I used for my model inputs. The final section details how to obtain a copy of the model that was developed to create the forecast.

I predict a small rise in US crude oil production in 2020, to an average of just over 13 million barrels per day is the most likely outcome, with production maintaining that level through to about 2023 before rising steadily. I tend to agree with the IHS forecast and think the OPEC forecast is overestimating medium term US crude production by 1-2 million barrels per day.

I expect to see the rig count continue to fall until it gets to about 630 in 2021, before it starts to rise again, reaching about 830 in 2035. The alternate scenarios show that US oil production is sensitive to rig count in the short term but more sensitive to well productivity and rig efficiency in the longer term. US production is also shown to be quite resilient to changes in the rig count, suggesting shale is not suitable as a swing supplier.

Forecasting Season Is Upon Us

November saw the publication of three key forecasts for those of us who work in the E&P industry. The first was by IHS Markit, which predicted a dramatic slowdown in US shale oil production growth next year, to the extent that US oil production would be essentially flat from 2021 onwards[1]. The second was the International Energy Agency's (IEA's) world energy outlook, which painted a different picture, with US shale production continuing to grow and squeeze OPEC market share[2]. The third was OPEC's World Energy Outlook 2019[3], which seems to be even more bullish on US production than the IEA.

IHS predicts about 12.8 million barrels/day of US oil production in 2020, with modest growth picking up from 2022. While the IEA predicts similar 2020 US production growth, they also predict 19 million barrels/day of US oil production by 2029. OPEC forecasts total US production peaking at 22.8 million barrels /day in 2024, before declining to 22.2 million barrels /day by 2030.

It is hard to pin down how different the forecasts really are, as not only do they quote production in different years, but they use different production definitions. The IHS figure is for total US crude oil production. The IEA figure is oil production from shale, so it excludes US conventional production but appears to include natural gas liquids (NGLs) based on a reconciliation of the 2019

[1] "Report Forecasts "Major Slowdown" in US Oil Output Growth", Journal of Petroleum Technology, 6th November 2019
[2] "IEA See U.S. Shale Squeezing OPEC Influence", Wall Street Journal, 18th November 2019.
[3] "World Oil Outlook 2040", Organization of Petroleum Exporting Countries, November 2019

production. The OPEC figure is total liquids, which includes NGLs and biofuels, in addition to crude oil. They provide a detailed breakdown through 2024, but no detail beyond that.

The data does allow a comparison between IHS and OPEC through 2024 for total US crude production, but this comparison hinges on the reader's interpretation of 'modest' growth. Is 'modest' 2%, or is 'modest' more like 6%? I have tried a comparison with both in Figure 1, below.

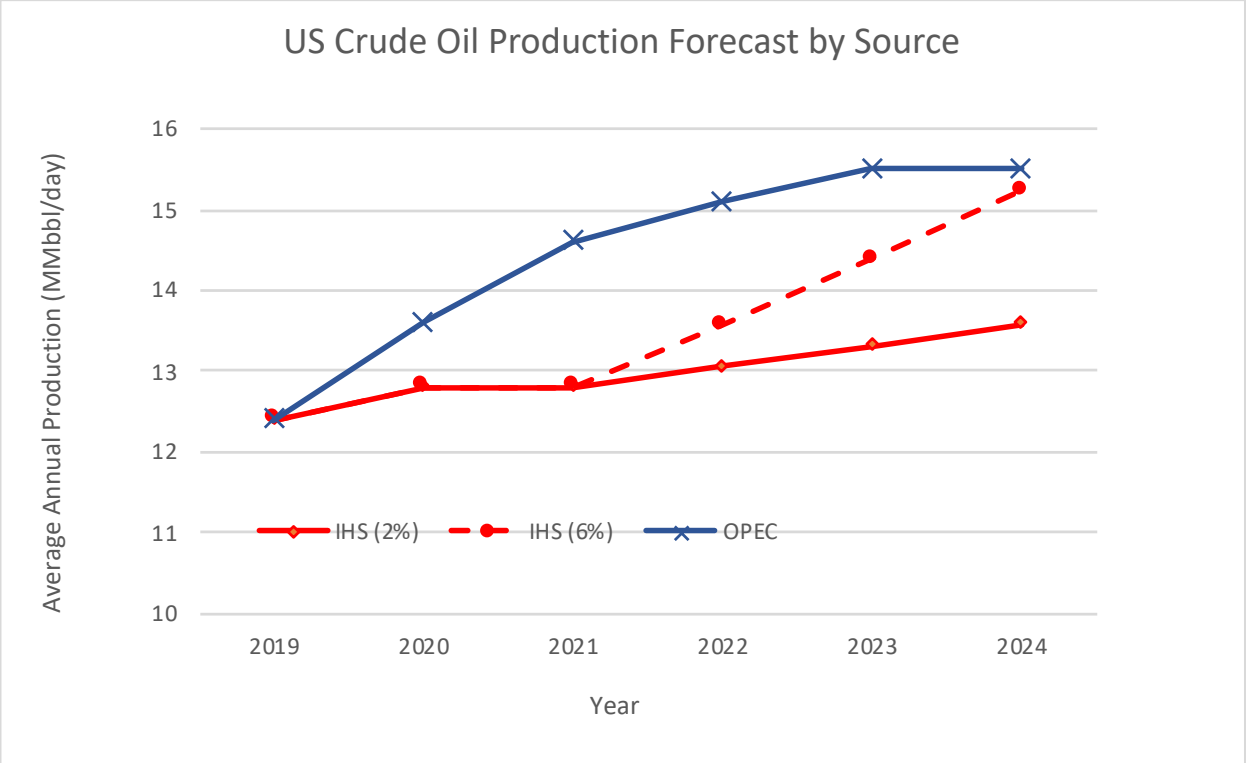


Figure 1 - Comparison of IHS and OPEC Forecasts

As Figure 1 shows, OPEC is substantially more bullish than IHS in general. It takes annual growth of 6% in the IHS forecast to meet OPEC production in 2024, a figure that feels more than modest.

Why are the forecasts different?

Forecasting oil production is difficult. In general, global conventional mature field decline can be characterized as a single number. The difficulty is in predicting incremental production. There are a couple of approaches that can be taken here. One is a top-down approach, which involves modeling the relationship between global GDP growth and global oil production, forecasting global economic growth and then calculating oil production from that forecast. The implicit assumption here is that global oil supply will track global oil demand.

The alternative is a bottom-up approach, which in the medium term requires a view on which fields will move into development and when and how they will perform. This is obviously dependent on the oil price and suffers from great uncertainty on each of the inputs. You would need a comprehensive global asset database to even attempt something like this and in the long term you would still need to adopt the top-down approach as the error bars around exploration are so wide.

Forecasting US production should be simpler because of the nature of shale oil production. The wells in each individual play decline in a similar fashion and the number of new wells that come on each year are driven by the rig count, on which there is reliable, publicly available data. For this reason, I would model global oil supply using a top-down methodology and US oil production using a bottom-up one. The forecast discussed in this paper is US production only.

Glenloch Energy Forecast Methodology

The methodology for my forecast of US crude oil production starts by separating shale ("Shale") and all other US production ("Conventional"). I then used the OPEC forecast for conventional production through 2024, applying a 5% terminal decline after that.

Initial rates for Shale wells were estimated from Energy Information Agency (EIA) data, the decline curve was based on a composite presented by Rystad Energy. Current Shale production, that is production that was already on stream in 2019, was assumed to be in year two of this curve and was declined accordingly. New Shale production for each successive year was driven by rig count projections. This is the key input into the model.

I included a couple of factors in the model – one is an efficiency factor and the other is a productivity factor. The efficiency factor reflects drilling rig efficiency improvements. The productivity factor changes the initial rate of the well and reflects the industry's transition from established sweet spots over time.

Glenloch Energy Forecast

I developed a Base scenario and then used the model to explore the impact of some sensitivities. These are described in Table 1:

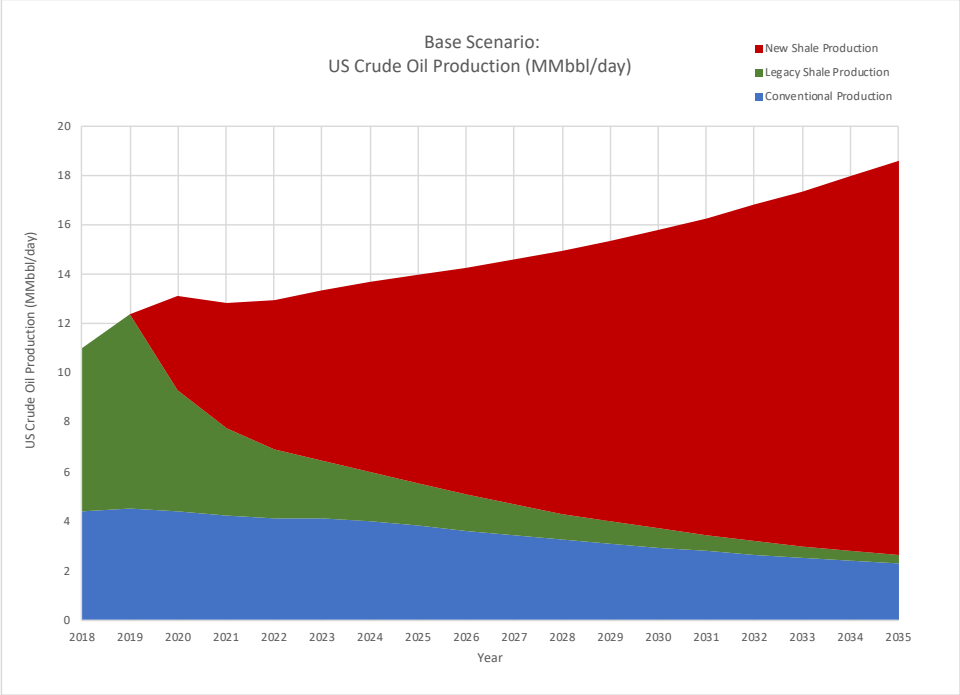
Scenario	Description
Base Case	Most likely case
OPEC	Parameters that are designed to reflect the OPEC forecast through 2024
Decline	Base forecast with a 5% decline in average annual first year production
Efficiency	Base forecast with 10% annual efficiency improvement in drilling and completion
Flat	Base forecast, rig count adjusted to maintain flat production to 2035

Table 1 - Glenloch Energy Forecast Scenarios

Base Scenario

The base scenario includes an annual 5% increase in drilling efficiency, an annual 2% decline in well productivity and the IHS estimate for 2020 and 2021 capital spending. Spending beyond 2021 is assumed to grow at 2% per annum.

The model predicts production peaking in 2020 at 13.1 million barrels per day, flattening out until 2023 before rising again until the end of the forecast period. The model tracks the IHS prediction closely through to 2021 and beyond in the IHS 2% growth case. US crude oil production by 2035 is nearly 19 million barrels per day, with more than 85% coming from Shale.



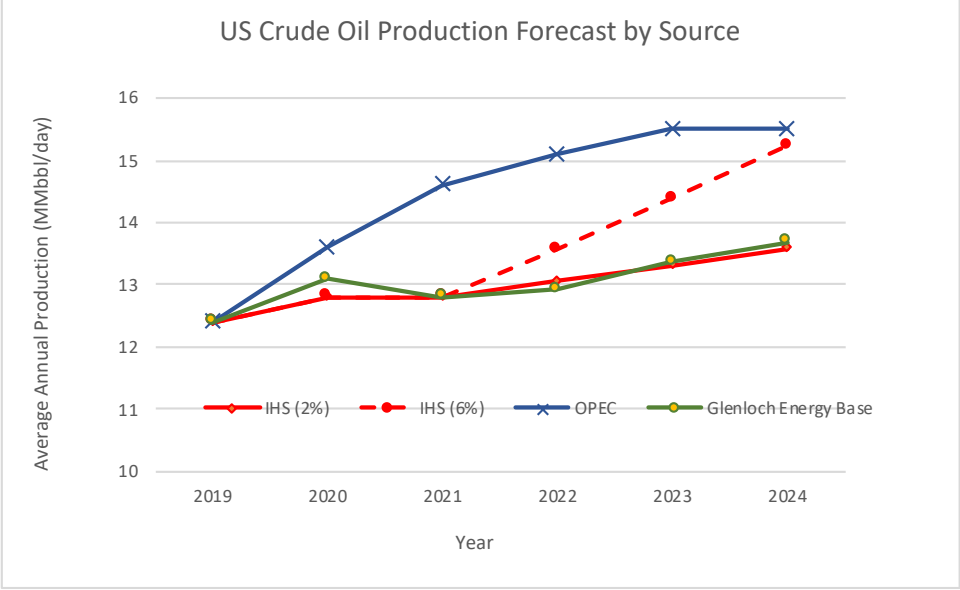
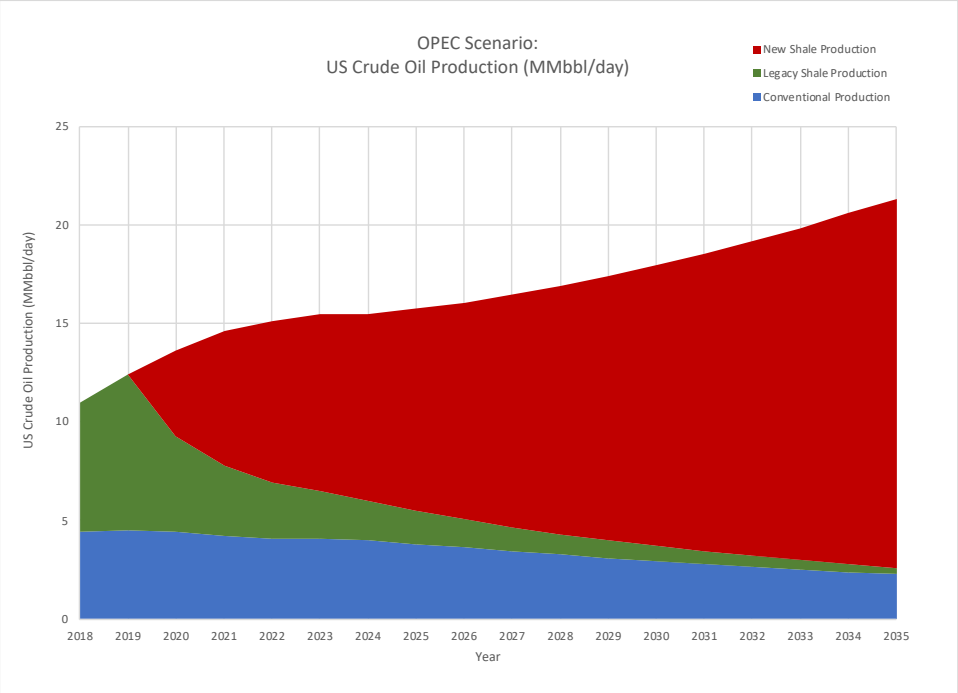


Figure 2 - Base case production plot and comparison with other forecasts

OPEC Scenario

The OPEC scenario required significantly higher rig counts through 2024 than in the Base scenario. The rig count would need to rise from 773 in 2019 to 776 in 2020, before jumping to 910 in 2021. They would then gradually decline through 2026 before trending up again in line with long term growth.



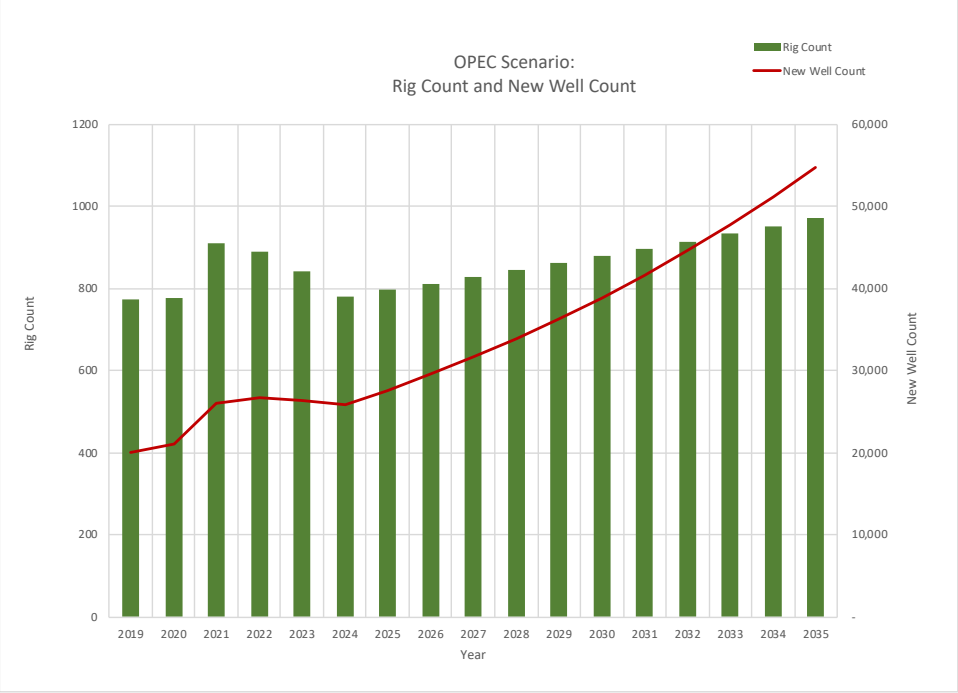


Figure 3 – OPEC scenario production forecasts and associated rig and well count

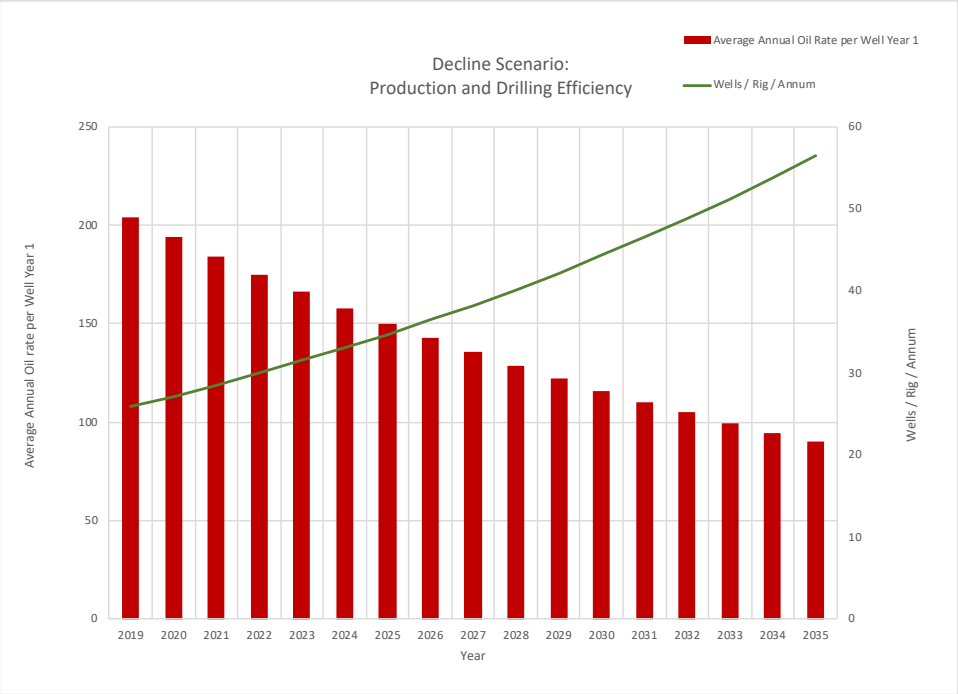
The rig count required to support the OPEC scenario doesn't seem consistent with the current investment climate in the US. The US shale oil rig count hasn't breached nine hundred since early 2015, the tail of the last boom. It would require much higher oil prices for a sustained period to get there again, which is not consistent with higher levels of US production

Based on the model, I believe that the OPEC forecast for US production is 1-2 million barrels per day too high over the forecast period to 2024.

Decline Scenario

The Decline scenario reduced well productivity by 5% per annum, as opposed to 2% per annum in the Base scenario. This is intended to explore the impact of moving from sweet spots to less prolific acreage over time. The impact of the 5% decline over the 15-year forecast period is to reduce the average annual rate in the first year from 194 barrels/day in 2020 to 90 barrels/day in 2035.

The impact on overall production is significant, with US production essentially flat from 2020 onwards, despite increased drilling efficiencies and investment. Reducing well productivity by 10% per annum results in a dramatic decline in US production over the forecast period.



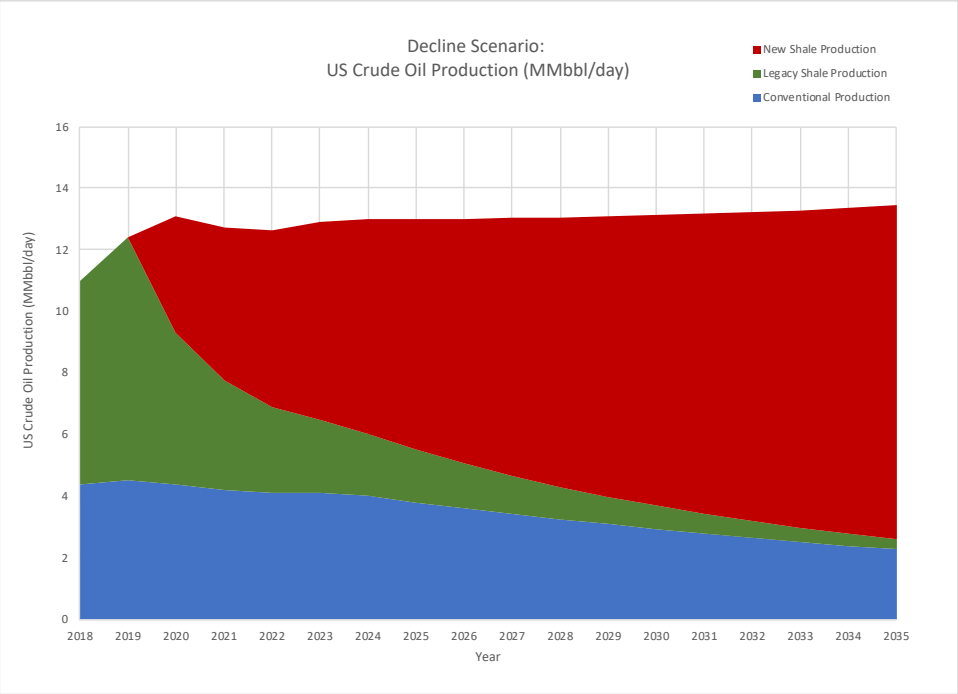


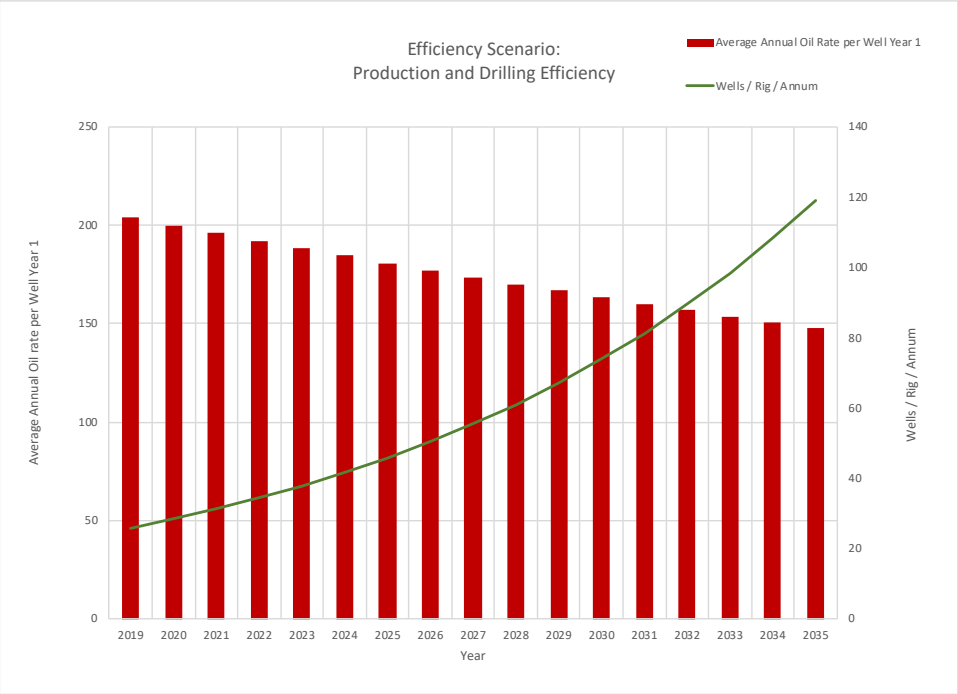
Figure 4 - Decline scenario well productivity and production forecast

The model shows that US production forecasts will be sensitive to maintaining well productivity on a like well basis. Well productivity has been improving, but this has been due to longer laterals. If we start to see lower productivity from new wells, this could be material for US production.

Efficiency Scenario

Drilling and completion efficiency have been improving as a result of better equipment and industry experience. Under the Base scenario, rig productivity improves from 27 wells/annum/rig to 56 wells/rig/annum between 2020 and 2035. Put another way, by 2035 a rig can drill and complete a well every 6.5 days.

In the Efficiency scenario, efficiency improves at 10% per annum, meaning that each rig can drill and complete 119 wells / annum by 2035, a well every 3 days. The impact of this on production is dramatic, with peak US oil production reaching more than 33 million barrels per day in 2035. By this stage, the industry would be drilling more than 98,000 wells per year.



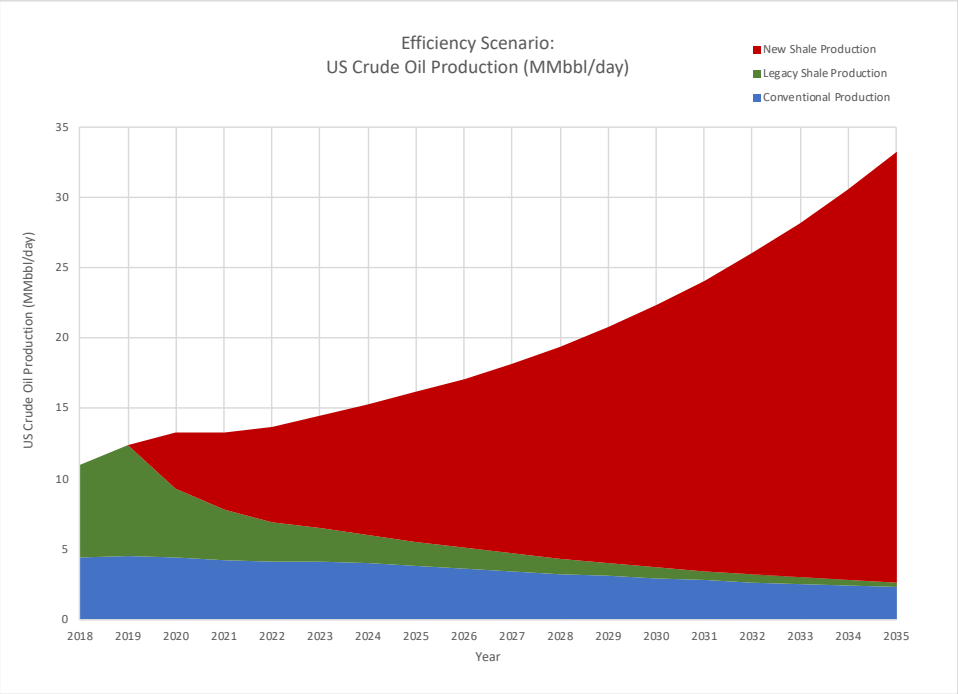
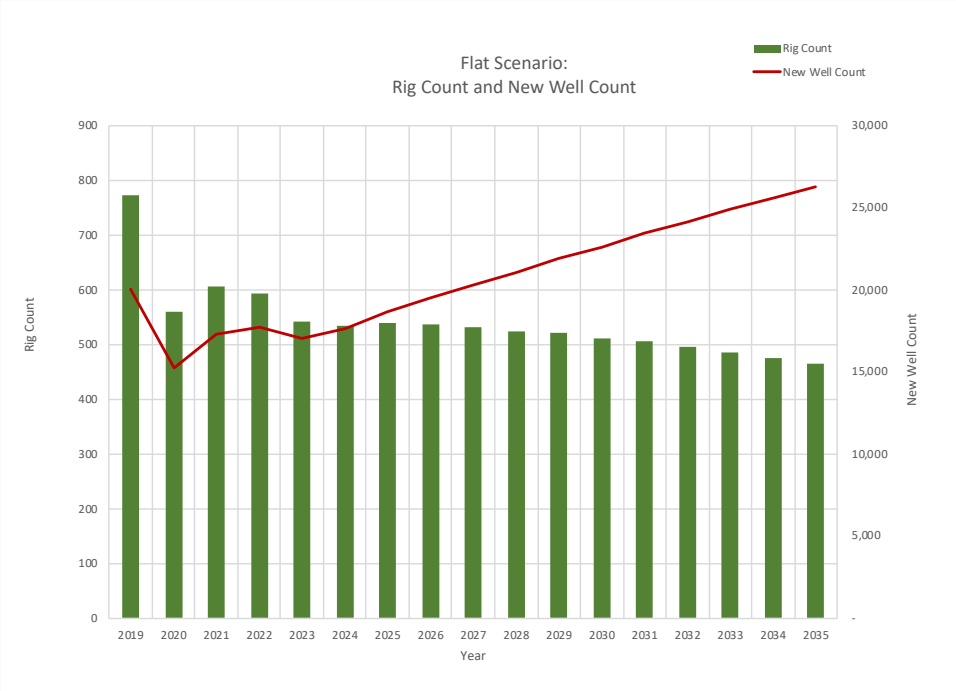


Figure 5 - Efficiency scenario well productivity and production forecast

This level of performance improvement and the resultant impact on production does seem a stretch when we view it today, but then history is filled with things that were impossible until they weren't. The Efficiency scenario also serves as a cautionary note for operator's own projections of production as it illustrates the impact of drilling efficiencies, which are baked into most forecasts, when compounded over time.

Flat Scenario

The Flat scenario modifies rig count to maintain production at 2019 levels. The scenario shows a steep drop in rig count from 2019 to 2020, from 773 rigs to 560. Rig count then bounces between 560 and 600 before beginning a gradual decline.



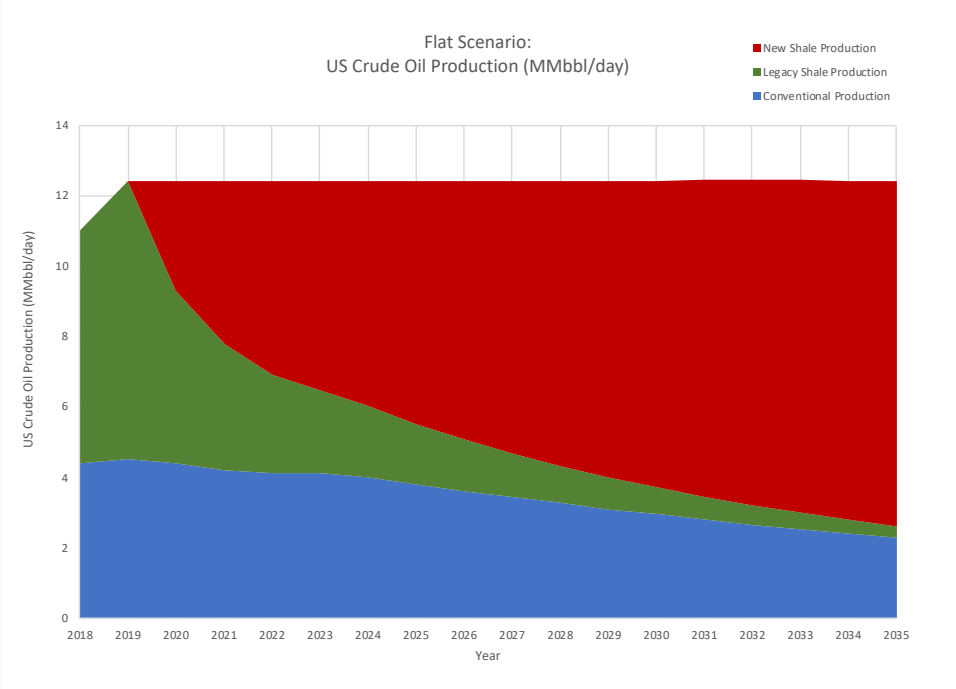


Figure 6 - Flat scenario rig count and production forecast

The key takeaway from this is that US shale production is more resilient to changes in rig count than is commonly perceived. The model shows the US does not require an ever-increasing rig count to maintain flat production. This does, of course, assume that the efficiency gains assumed in the base case model can be realized.

The second conclusion from this scenario is that US shale is not well suited to be a swing producer. It takes a big shift in investment levels and 12 or more months for actions to impact production. The Permian is not the next Ghawar.

Forecast Assumptions

This section details model assumptions and references source data for the Base scenario.

Inputs

Variable	**Source**
Conventional Production (2019 Average)	4.5 MMbbl/day. US GoM Crude plus US Alaska Crude plus US Other Crude[4]
Shale Production (2019 Average)	7.9 MMbbl/day[4]
Average production for a shale well in the first year	204 barrels/day, based on weighted 2016 data for Permian, Bakken, Eagle Ford and Niobara wells[5]
US shale wells drilled in 2019	20,000[6]
Land Rigs in Operation (2019 Average)	Baker Hughes rig count for onshore oil rigs over the first eleven months of 2019
Shale CAPEX (2019)	IHS forecast[1]

[4] Table 4.2, US total liquids supply over the medium-term, "World Oil Outlook 2040", Organization of Petroleum Exporting Countries, November 2019
[5] "Initial production rates in tight oil formations continue to rise", US Energy Information Administration, February 11th, 2016.
[6] "US Shale to Drill and Complete 20,000 Wells This Year", Journal of Petroleum Technology, 4th February 2019.

Table 2 - Input Data

Conventional Decline Curve

Conventional production from 2020 to 2024 was calculated as US GoM Crude plus US Alaska Crude plus US Other Crude[4]. A terminal decline of 5%[7] was applied.

Shale Decline Curve

The Shale decline curve was taken from a Rystad Energy article on Permian Basin declines[8]. Note that the decline is set to 0% in the first year as annual average rather than instantaneous values are used for oil rate and so decline is already incorporated in the first year of production.

A terminal decline of 15% was assumed. This is the modal decline in the Midland Wolfcamp Deep basin after 5 years[9].

Conclusion

I predict a small rise in US crude oil production in 2020, to an average of just over 13 million barrels per day is the most likely outcome, with production maintaining that level through to about 2023 before rising steadily. I tend to agree with the IHS forecast and think the OPEC forecast is overestimating medium term US crude production by 1-2 million barrels per day.

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[7] "World Energy Outlook 2008 Executive Summary", International Energy Agency. 12 November 2008.
[8] "Permian has the lowest oil rate declines", Rystad Energy, August 30th 2019
[9] "Permian Leads in Many Ways, Including Rapid Well Declines", Journal of Petroleum Technology, 22 August 2018