



DARK SIDE OF THE BOOM

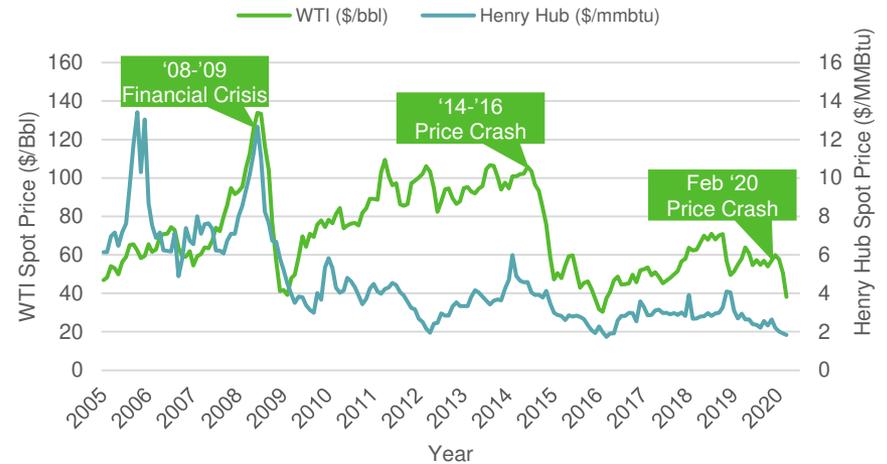
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Strategy & Analytics Group

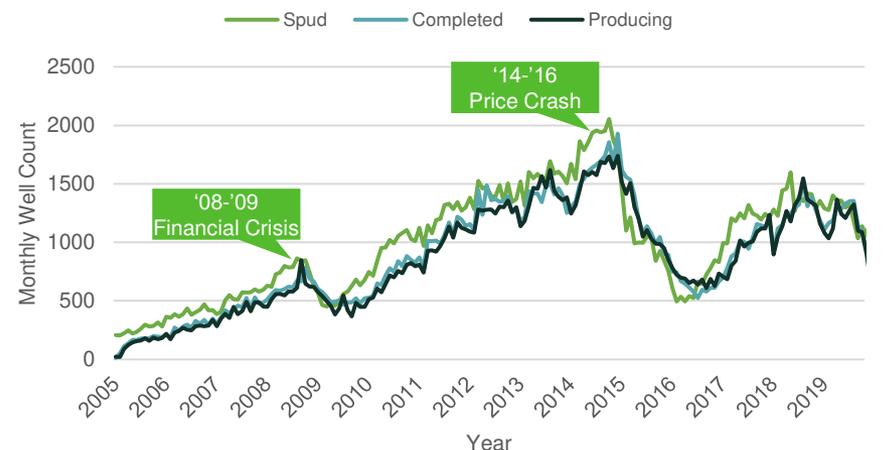
STATE OF PLAY

- The current market conditions for the energy sector represent a perfect storm of massive oversupply mixed with a dramatic demand reduction within a very short period, precipitating a fall in oil prices to at or near cost basis on a global scale.
- Prior to this crash, US onshore activity had seen somewhat of a rebound from previous lows circa 2015-2016 when prices fell 40-50% in a matter of months.
- Much of this rebound in activity came as US onshore operators adjusted to the realities of a new oil price environment. Improved operations techniques, field planning, and refocusing on “core” areas of development such as the Delaware and Midland Basins all drove a marked rebound between 2016 and late 2018.
- However since late 2018, operators had been under increased pressure from investors to show material returns for the massive sums of capital invested in unconventional development.
- All throughout 2019, the buzzwords of “capital efficiency” and “free cash flow” were accompanied by a shift away from raw recovery or volumes growth and towards optimizing assets based on returns. Further, this trend kickstarted some key consolidations in the industry—albeit at a relatively cautious pace.
- After feeling like the industry was finally starting to get its footing back, the Feb 2020 crash in oil markets has many analysts and industry veterans alike wondering “Where to next for US onshore?”
- Based on data from Enverus’ Rig Analytics and Well Spacing platforms, previous price crashes in 2008-2009 and 2014-2016 can be analyzed for lessons learned and provide some additional insights.

WTI and Henry Hub Spot Pricing 2005-2020



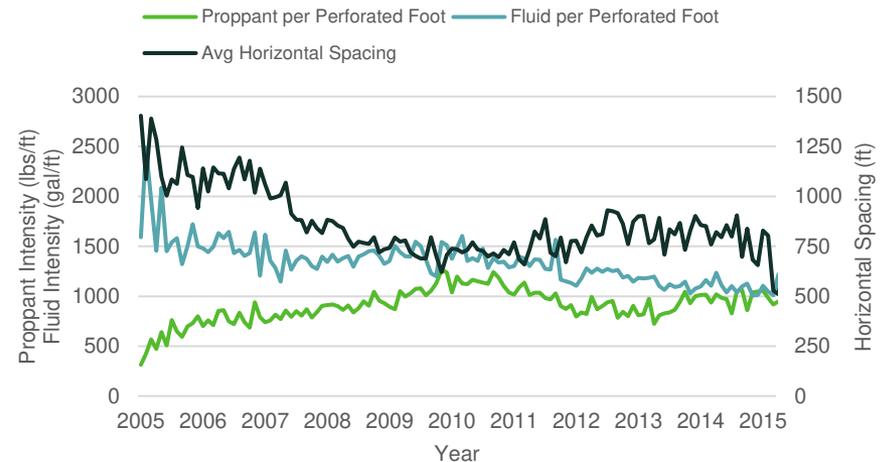
US Onshore Horizontal Activity



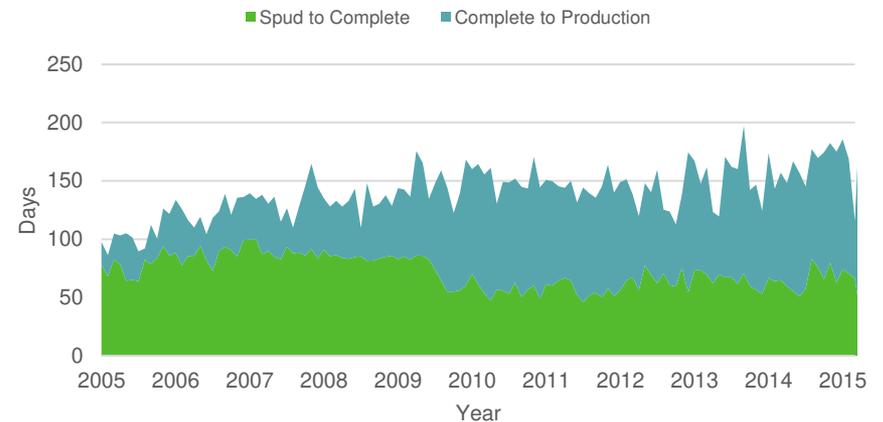
2008-2009 FINANCIAL CRISIS

- The years leading up to the 2008-2009 Financial Crisis saw peak supply theories drive oil prices up to \$140/Bbl and HH natural gas to over \$12/MMBtu, setting the stage for an inevitable reconciliation with fundamentals.
- The same years leading up to this price peak coincided with the development of the first major US unconventional shale play—the Barnett Shale. While this gas play set the stage for unconventional plays to dominate US production growth, it also presents a view into the impacts of a major market disruption on unconventional development.
- Between 2007 and 2009, the Lower Barnett saw steadily tightening well spacing from 1,000' to 700'. Proppant intensity rose steadily during this time by ~10%, while fluid intensity fell by ~8%. As activity fell in 2009 and natural gas prices consistently hovered roughly around \$4-5/MMBtu, well spacing, proppant intensity, and fluid intensity all declined somewhat in unison with well count as the remaining operators sought to salvage remaining acreage and generate returns to stay afloat.
- In terms of cycle times, average spud to completion time was relatively consistent pre-crash but dropped ~30% starting around mid-2009 as prices bottomed out. Meanwhile, completion to production times continued to increase until leveling off in 2010, thereby leading to slightly higher overall cycle times than before the crash.
- The Barnett highlights the dual importance of well spacing and cycle times in living within a depressed price environment. Given lower prices, returns take precedence over recovery and favor wider well spacing and less capital-intensive completions.
- The Barnett offers some lessons on cycle times, which were relatively constant and highlight a missed opportunity for optimizing returns. Further, the Barnett showed a minimal buildup of DUCs during the price crash, likely limiting operators in their ability to effectively manage capital expenditures on expensive completions.

Lower & Upper Barnett Completions & Spacing



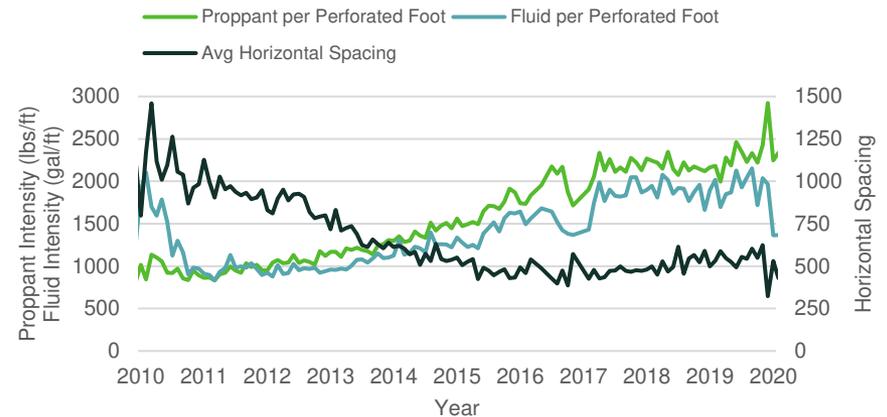
Lower & Upper Barnett Cycle Times



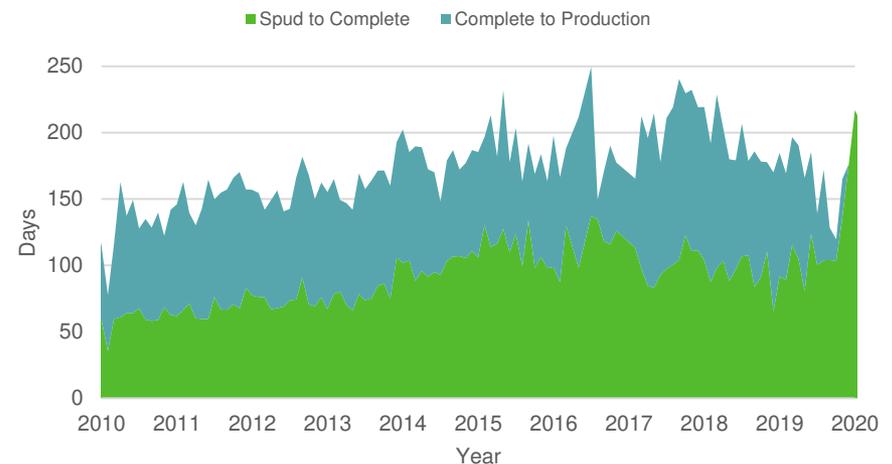
2015-2016 PRICE CRASH

- As markets rebalanced in the wake of the 2008-2009 Financial Crisis and oil prices re-stabilized in the \$60-80/Bbl range, unconventional onshore plays such as the Bakken, Eagle Ford, Niobrara, Delaware, Midland, and Marcellus took off. By far the leader in terms of well count between 2011 and 2016, the Eagle Ford epitomized the shale boom and offers unique insights into coping with a price crash.
- In the years prior to 2015-2016 price crash, the Eagle Ford exhibited rapidly decreasing well spacing from ~800' in 2012 to ~500' in 2015. This coincided with a 50% increase in proppant intensity and 30% increase in fluid intensity over the same period.
- However, while well spacing leveled off at ~500' following the collapse in oil price, proppant and fluid intensity continued to climb before finally leveling off around mid-2017. Only after mid-2017 did well spacing begin to climb slightly again—likely as a byproduct of focusing on free cash flow generation over volumes growth.
- Pre-crash spud to complete times show a cyclical rise and fall that matches cyclical DUC inventory buildup and drawdown, but little in the way of real improvements in the aftermath of the price crash. Completion to production times saw some mild improvements from 2014 to 2017, but reversed trend slightly afterwards as prices rebounded.
- Overall, cycle times appeared to fall slightly in the first year or two after the price crash then proceeded to continue rising following a moderate price recovery, likely reflecting the increased complexity of larger completions and associated flowback/facilities operations.
- Given the large number of parallels with the current price environment and the negative market perception on shale returns, the 2015-2016 crash shows the importance of rapidly adjusting operations to optimize for returns and cash flow above all else. Wider spacing, fit-to-purpose completions, and reduced cycle times seen in data from 2019+ show the importance of considering full cycle economics during operations and planning alike to lower breakeven costs.

Lower Eagle Ford Completions & Spacing



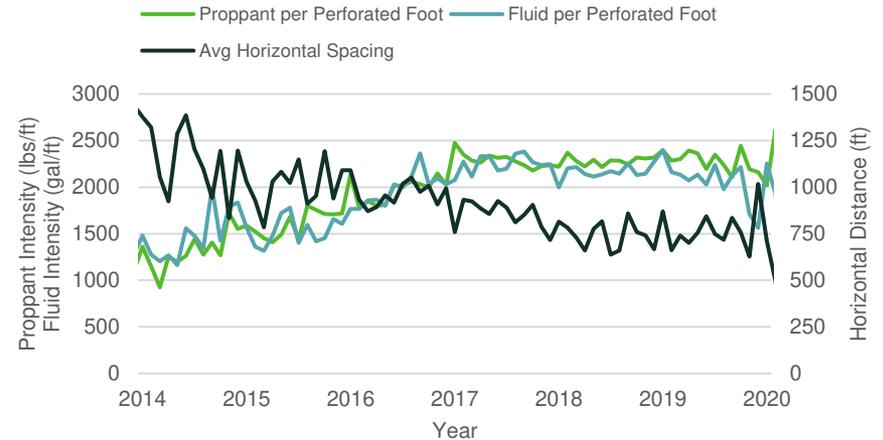
Lower Eagle Ford Cycle Times



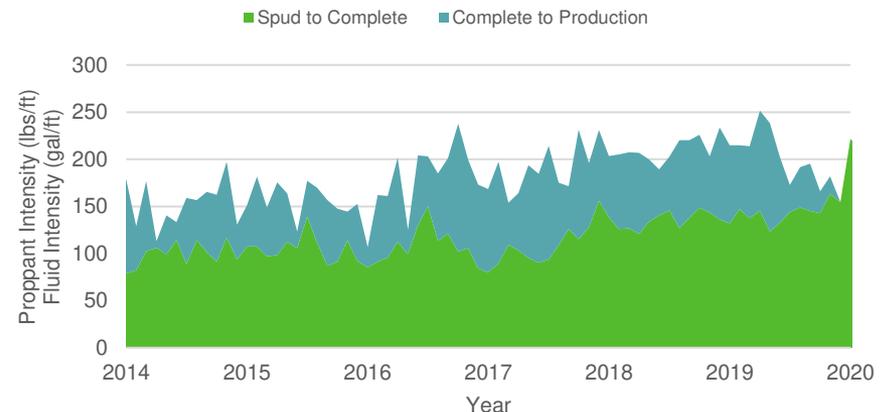
CURRENT MARKET

- Following the 2015-2016 price crash, prices remained depressed around ~\$40-50/Bbl until late-2017 when they began to rebound to ~\$60/Bbl starting in 2018. Around this same time, development in the Permian took off with the Delaware Wolfcamp A Lower and Midland Wolfcamp A leading the charge.
- The Delaware Wolfcamp A Lower showed a relatively moderate 25% reduction in spacing across the play between 2016 and 2018. More recent quarters have shown up-spacing efforts to be underway for many operators as well interference dominates development discussions and research alike.
- Unlike in the Eagle Ford and Barnett, the Delaware Wolfcamp A Lower operators have shown more constrained completion designs with relatively little overall change in design between 2017 and 2019 after a rapid ~30% increase in completion size between 2016 and 2017. More recent data from 2019 suggests a slight downward trend in completion sizing, likely as a result of continued optimization with well spacing and attempts to limit parent-child well interference.
- Cycle times in the Delaware Wolfcamp A Lower suggest recent improvements in cutting down the time between completion and first production, greatly helping reduce the delay between capital investment and cash flows—thereby boosting rates of return and improving cash flows. However, the continued challenge of appropriately managing DUC inventories continues to skew spud to complete values higher, thus somewhat offsetting the completion to production gains from a spud to production standpoint.
- The stagnation on completion and spacing design despite continued market volatility suggests that there is additional room for optimization to improve returns and lower breakeven costs—currently estimated in **Enverus Prodcast** as \$29-50/Bbl in Tier 1 and 2 acreage.

Delaware Wolfcamp A Lower Horizontal Activity



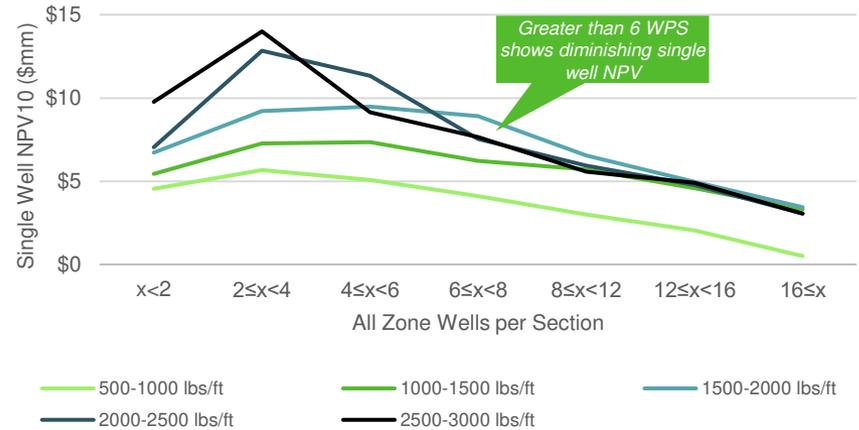
Delaware Wolfcamp A Lower Cycle Times



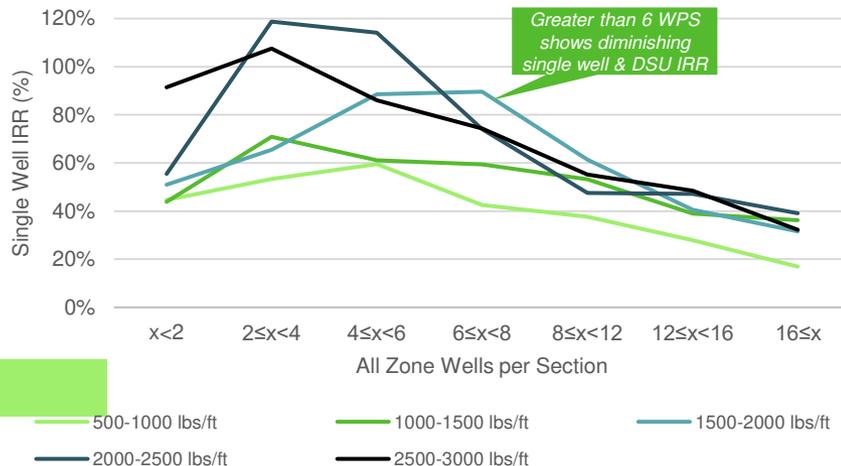
APPLYING LESSONS FROM THE PAST

- In terms of well spacing and completion design, the Delaware WCA Lower currently sits at an average of ~750' horizontal spacing (7 wells per section) and 2,250 lbs/ft proppant intensity.
- Based on an analysis using **Enverus WellCast** and **Enverus Well Spacing**, operators with wells currently planned at 7 WPS could realize substantial capital savings by reducing completions to between 1,500-2,000 lbs/ft.
- Open acreage would see significant economic improvements with a reduction to between 4-6 wells per section (1,320'-880'), should operators wish to continue at ~2,250 lbs/ft. Wider well spacing may also assist with mitigating well interference with parent wells.
- Finally, additional focus on cycle times, especially between completion and production, will help reduce the delay between investment of capital without associated cash flows, thereby boosting returns and helping lower breakevens in a world where every penny counts.

Single Well NPV10 vs. All Zone Wells per Section



Single Well and DSU IRR vs. All Zone Wells per Section



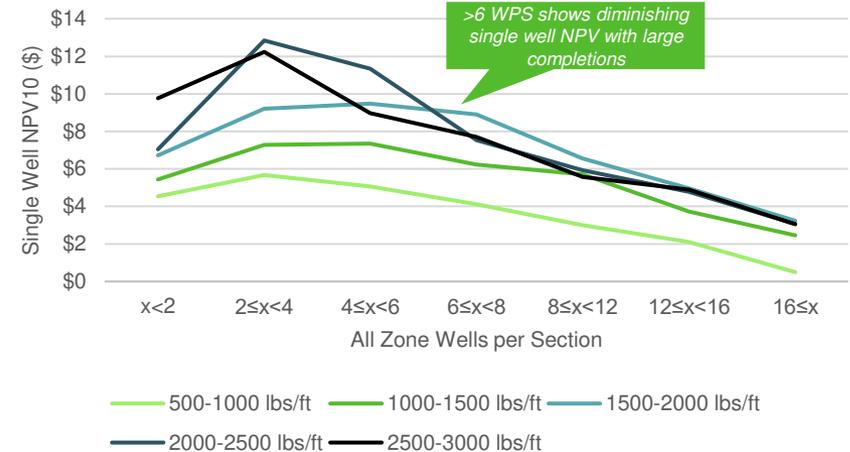
DSU NPV10 vs. All Zone Wells per Section



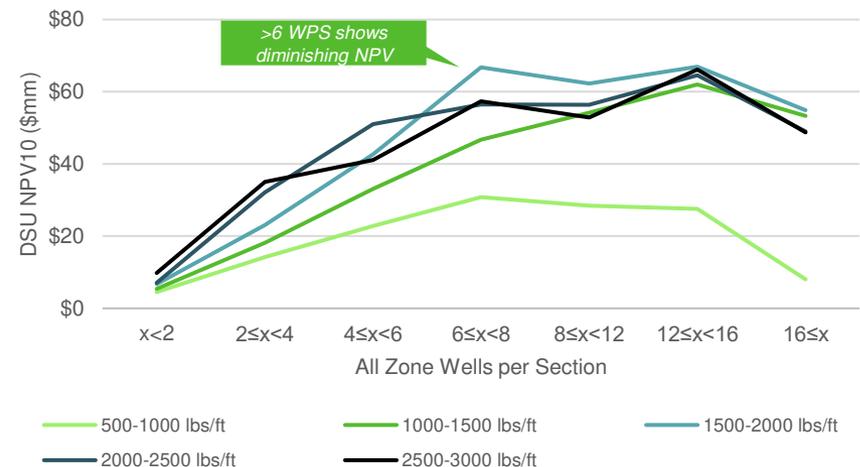
APPLYING LESSONS FROM THE PAST

- In terms of well spacing and completion design, the Delaware WCA Lower currently sits at an average of ~700' horizontal spacing (7-8 wells per section) and 2,250 lbs/ft proppant intensity.
- An economic analysis was run using **Enverus WellCast** to create type curves for various well spacing and completion combinations, according to groups of child wells in the Delaware Wolfcamp A Lower identified using **Enverus Well Spacing**. Area-specific assumptions for well costs, differentials, taxes, etc. for the Delaware from **Enverus Dynamic Basin Studies** were used to inform economic model inputs. Pricing was held at \$50/Bbl oil and \$2/MMBtu gas across all cases.
- Starting with an evaluation of NPV, operators with wells currently planned at 7-8 WPS could realize substantial capital savings and improve NPV on both a per well and DSU level by reducing completions to between 1,500-2,000 lbs/ft. Taking from lessons learned in the 2015-2016 price crash, this would alleviate issues associated with re-permitting and a drastic shift in PUD locations booked for reserves. It would also help to reduce capital intensity in a time where easy access to capital is scarce.
- However, assuming completion designs remain in the 2,000-2,500 lbs/ft design range, undrilled acreage would see significant economic improvements with a reduction to between 4-6 wells per section (1,320'-880'). Wider well spacing may also assist with mitigating well interference with parent wells. In the long term, a shift in the paradigm of onshore planning to wider well spacing would help insulate the industry against price volatility by allowing operators to alter completions sizing rather than entire development programs. However, this comes at the cost of stranding some resource and increasing the rate at which acreage is drilled through.

Single Well NPV10 vs. All Zone Wells per Section



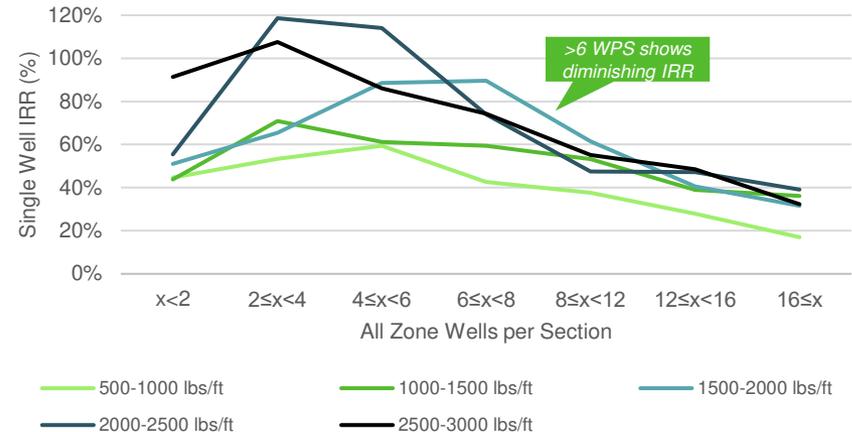
DSU NPV10 vs. All Zone Wells per Section



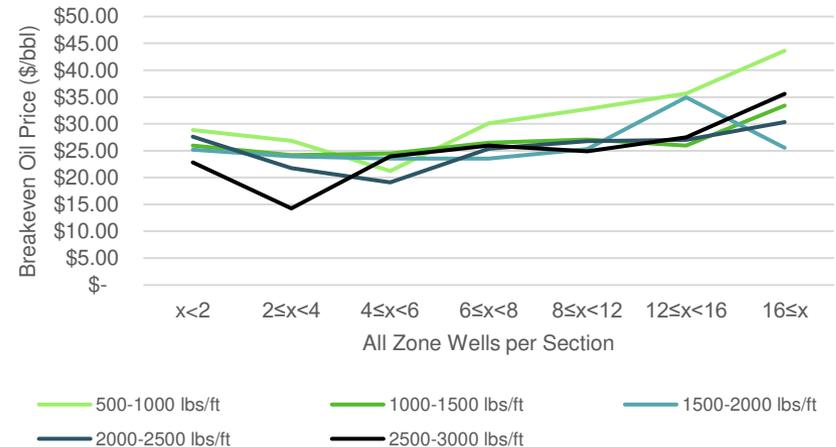
APPLYING LESSONS FROM THE PAST

- When examining IRRs for the various well spacing and completion size combinations, the near-term case for smaller completions is again evident at the current spacing of around 7-8 WPS. Looking more long term, operators could see significant upside in terms of both IRR and NPV by considering a wider well spacing of around 4-6 WPS, giving operators more room to optimize with larger completions where necessary as well as allowing for more standoff distance to parent wells.
- Breakevens show a similar story with larger well spacing showing consistently lower breakeven oil prices.
- In the near term, holding well spacing constant at 7-8 WPS, a shift from 2,000-2,500 lbs/ft to 1,500-2,000 lbs/ft would offer a ~\$3/Bbl drop in breakeven price.
- In the long term, assuming completions hold steady at roughly 2,000-2,500 lbs/ft, a shift from the current well spacing trend of 7-8 WPS to 4-6 WPS would offer a ~\$6/Bbl drop in breakeven price.
- Additional focus on cycle times, especially between the capital-intensive completion period and when a well begins producing, will help yield further improvements by boosting returns and helping further lower breakevens in a world where every penny counts.
- While the 2008-2009 Financial Crisis and 2015-2016 Price Crash were transformational to the industry in differing ways, mistakes from those eras in adjusting development strategy to suit the long-term realities of oil markets can serve as valuable lessons for the industry.
- Given the wealth of data the industry has created since the early days of the unconventional revelation, Enverus' platforms can offer powerful insights for operators, investors, and contractors alike trying to understand what it takes to weather this storm and come out stronger from it.

Single Well and DSU IRR vs. All Zone Wells per Section



Breakeven Oil Price vs. All Zone Wells per Section





THANK YOU!

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