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ENERCOM®

Energy Industry Data & Trends

RESERVES & VALUING MODERN OIL & GAS OPERATIONS

One of the most important considerations for a public company, whether in the oil and gas business or any other, is the valuation the company is receiving in the market. Improving valuations is one of the main goals of any management team, so identifying what drives the market is key. When oil and gas firms approach EnerCom with this exact question, our Analytics team dives into our database to analyze performance metrics of the company and its peers. While EnerCom tracks 44 different metrics on E&P companies, we tend to focus on five crucial metrics as the most important.

EnerCom Analytics' 5 Factor Model (5FM) examines different facets of operations and overall situation. The 5 Factor Model examines a company's three-year finding & development (F&D) costs per unit, its capital efficiency, operating and general & administrative expense per unit, three-year production replacement, and debt to trailing 12-month EBITDA.

These five factors measure some of the most important considerations affecting an oil and gas company by looking at efficiencies, growth performance and the balance sheet. Importantly, each of these metrics is a lever management has at least partial control over.

Shifting focus to efficiency can improve F&D costs, capital efficiency and OpEx, while focusing on growth can impact reserve replacement. Management may also choose to shift plays, if the available development opportunities are not sufficient to reach the levels desired. Management has perhaps the most control over debt levels, and can decide what priority the strength of the balance sheet will receive. Examining these questions in detail is a key function EnerCom Analytics plays in consulting corporate management.

In this Report – KEY SUMMARY POINTS:

- Three-year F&D ranges widely, but most companies spend less than $30/BOE
- Appalachian, Montney show consistently low F&D, but oil reserves can also be added at very low costs
- Influence of F&D on valuations fell significantly in 2017, and remains low
- Mid and small cap E&P companies show highest production replacement
- Diversified companies have lowest production replacement
- High PUD percentages can create high production replacement ratios
- Markets continue to reward production replacement, but not to the degree seen in past years
- Market attention is focused on operating metrics, which will be examined in next month's report

The Five Metrics

One of the most fundamental metrics for a company's long-term prospects is its production replacement. If a company is unable to replace reserves effectively, it in essence has a finite life span.

Excluding the effects of price fluctuations and asset sales, oil and gas companies continuously produce from reserves. The ability to replace this production, whether through the drill bit or transactions, is critical to any company in an extractive industry.

Furthermore, production replacement can act as a measure of growth. Firms that wish to grow must add reserves at a rapid pace, and the process of growing oftentimes involves adding large amounts of reserves. This is particularly important when talking to investors. It is much more difficult to make a convincing argument to invest in an equity which essentially has an expiration date.

EnerCom's production replacement ratio includes all reserve additions over the past three years, including revisions, compared to the firm's production over the same period. Adding back exactly the volumes that were produced would give a production replacement of 100%. If a company saw reserves fall during that period, likely as the result of large impairments, a production replacement value is incalculable.

Reserve considerations go beyond just replacing production, though, as the price paid to grow reserves is critical. Keeping finding and development costs low ensures operations are economic, and companies are able to grow in a sustainable manner. F&D costs are calculated similarly to production replacement, including all reserve additions and revisions, and dividing by costs incurred over the period. Like production replacement, if reserves fall during the period due to impairments an F&D cost is incalculable.

Capital efficiency examines how effectively a company spends its money, determining if recent capital expenditures have created EBITDA. The metric evaluates a company's trailing 12-month EBITDA per unit production, expressed as a percentage of three-year F&D costs per unit reserves added. If a company has a capital efficiency greater than 100%, this suggests it has spent money effectively, as it is making back more than the amount it has spent on adding reserves.

The metric most directly affected by operational efficiency examines trailing 12-month OPEX and G&A costs per BOE of production. This is one of the most important aspects of oil and gas operations, as preserving cash margins through low operating costs is key to an efficient company. While an oil-weighted company can support higher operating costs, lowering this metric can produce significant improvements in overall results.

Finally, the 5 Factor Model examines a company's balance sheet, measuring debt per trailing 12-month EBITDA. This metric became particularly important during the downturn, when debt levels soared while revenue dropped. While companies are no longer facing the existential threat of low commodity prices, balance sheet strength continues to be in the forefront of investors' minds with a push toward capital discipline which we have noted in previous reports.

This is the first of two monthly trends reports examining the 5FM and identifying the recent trends in the market which most affect valuations of oil and gas operations in recent years. This month's report will focus on reserve-based metrics, the three-year production replacement and F&D costs of different firms, while the next report will examine operating expenses, capital efficiencies and debt loads.

Examining reserve metrics such as production replacement and F&D costs over the past three years involves an elephant in the room -- the commodity price downturn. The current three-year data includes 2015, when falling prices led to significant impairments and downward revisions.

Most companies saw reserves fall in 2015, and for some reserves also fell in 2016. While improvements in operations and rising prices in 2017 reintroduced growth, making up for previous declines is difficult. Out of 121 major oil and gas companies, 15 saw reserves impairments outweigh additions and acquisitions in the past four years, and several others saw only slight net increases. Those with slight increases often see skewed reserves data, with excessively high three-year F&D costs.

The extreme example of this case is Rex Energy, which reported large impairments in 2015, but added reserves in 2016 and 2017. Overall, the company added a mere 46 MBOE of reserves over the three years, essentially flat for a company with over 170 MMBOE of total proved reserves.

Seven companies had three-year F&D costs above $50/BOE, a level that was judged to be skewed by heavy impairments and not representative of continuing results. These companies, therefore, are not included in most analyses of F&D costs.

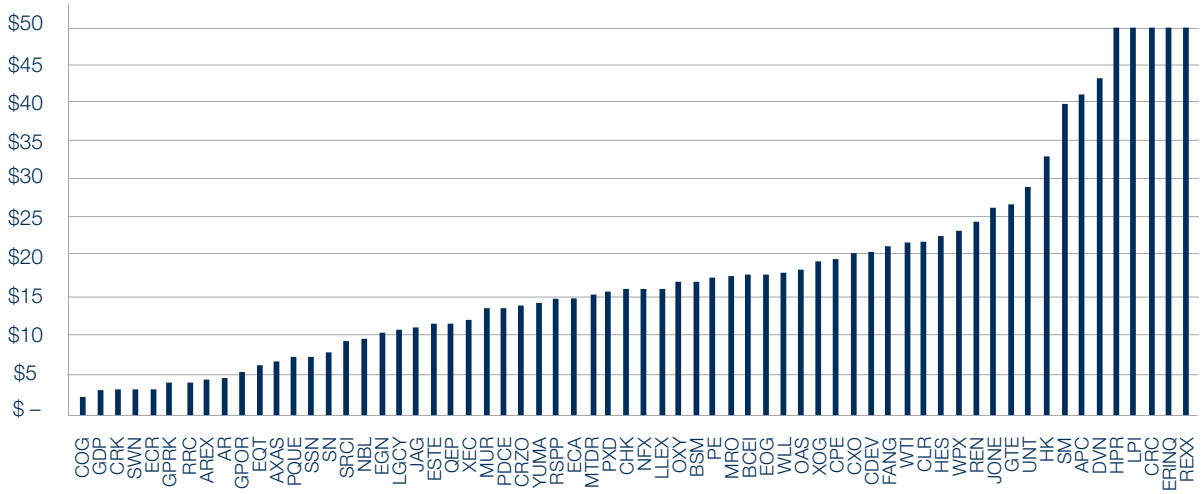
A total of seventeen companies were not included in production replacement analysis, typically because they were not able to increase reserves at all in the past three years.

Three-year F&D costs range from $0.83/BOE to $8,700/BOE

The 121 U.S. and Canadian companies in EnerCom's database showed significant variability in three-year F&D costs, ranging from Connacher Oil and Gas with a mere $0.83/BOE to the aforementioned Rex Energy with an F&D cost of $8,700/BOE. Not counting the companies that are skewed by impairments, U.S. and Canadian firms recorded an average F&D cost of $13.97/BOE. This average is an improvement from the average three-year F&D of both 2015 and 2016, which were $19.11 and $16.89, respectively.

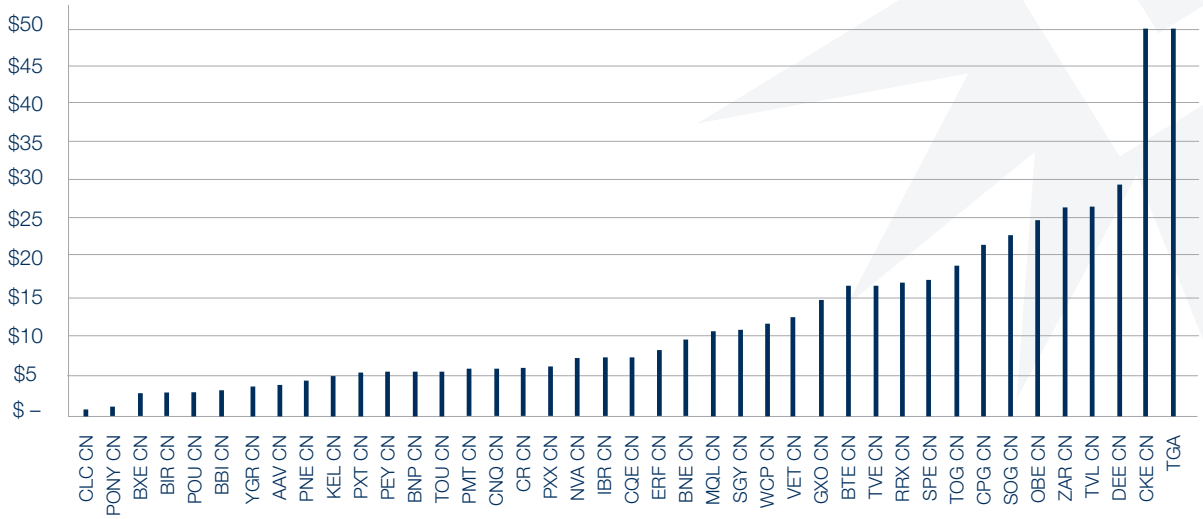
U.S. 3 Year F&D Costs ($/BOE)

Source: EnerCom Analytics



Canadian 3 Year F&D Costs ($/BOE)

Source: EnerCom Analytics



Canadian companies, in general, display a lower F&D cost than their American counterparts. The average three-year F&D among Canadian E&P firms is $10.96/BOE, compared to $15.96 for U.S. companies.

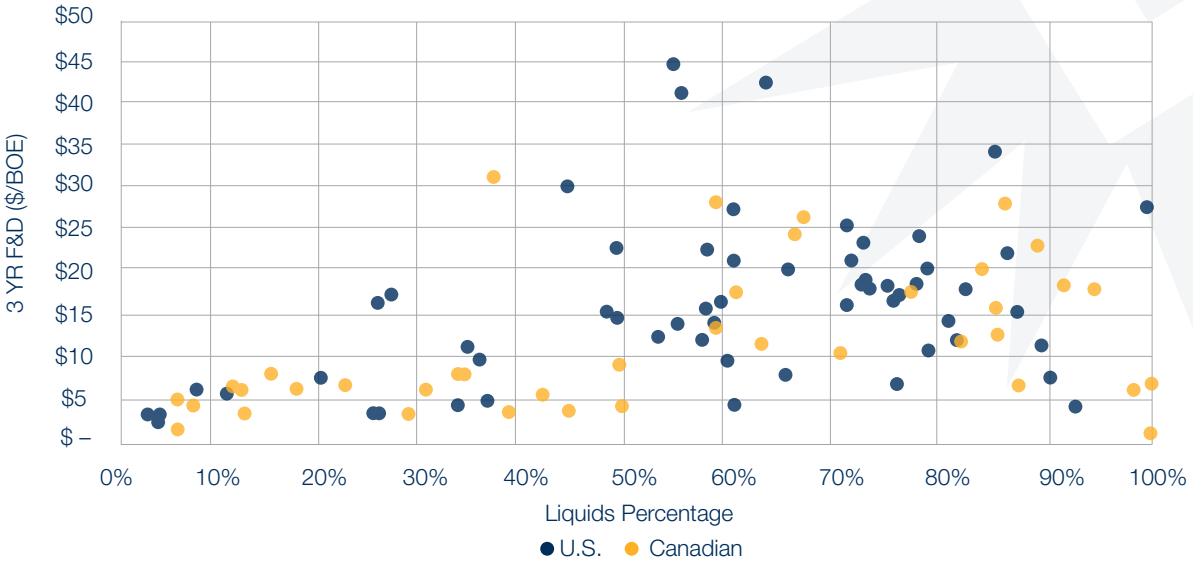
This disparity is likely due to several factors. First, and perhaps most importantly, is the location most Canadian firms operate. Many companies are active in the Montney, which is comparable to the Marcellus in the United States. The play is in the process of delineation, and has tremendous amounts of gas in place. It is cheaper to prove reserves in a gas play, particularly one as prolific as the Montney, and the companies operating there are benefiting from the depth of knowledge in the play and the resource's strong economics.

Furthermore, Canadian reserves standards are different from those in the U.S., and are generally more aggressive. Canadian companies are allowed to use strip pricing when evaluating reserves, while U.S. companies use an average of the price from the first day in each of the past 12 months. This has allowed Canadian companies to evaluate reserves at a higher price for both of the past two years, essentially contributing "free reserves."

F&D costs are partially dependent on a company's production mix, but not to the degree that might be expected. With the low price of natural gas, it would seem likely that gas-focused companies would show lower F&D costs than oil-focused firms. Most gas-weighted companies do have very low F&D costs, a trend more obvious in Canadian companies, but being oil-weighted does not necessarily mean a company has high F&D. Connacher, for example, is entirely oil-focused but reported the lowest F&D costs of any company in the EnerCom database.

U.S. & Canadian F&D vs Liquids Percentage

Source: EnerCom Analytics



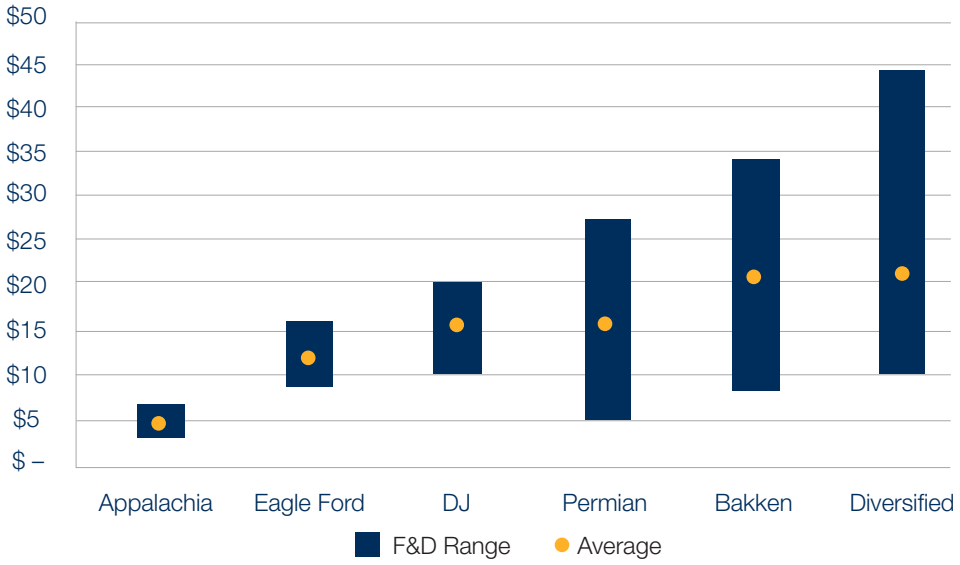
Gas-weighted Canadian companies show a remarkable consistency in F&D costs, far more so than their U.S. peers. This is likely a result of the unanimity of Canadian gas players. Almost all gas-focused Canadian companies are operational in one basin, the Montney, while U.S. gas firms have multiple basins to choose from.

Appalachian firms show very consistent, low F&D costs

Individual basins have varying F&D costs, with different levels of expense and consistency. Companies operating in the Marcellus and Utica reported consistent F&D, with a range of under $4/BOE. Firms in the Eagle Ford and DJ are nearly as consistent, while the Permian and Bakken have a wider range of F&D costs.

Basin F&D Cost

Source: EnerCom Analytics



In the most popular basin in the U.S., reported F&D costs per BOE range from a low of $4.68 to a high of $25.07. Generally, a Permian company's F&D cost is dependent on the means of acquiring reserves and the maturity of the company's position. Companies such as Approach, Abraxas and Energen reported the lowest F&D costs in the play, with each spending less than $11 to add a barrel of reserves. The low cost is in large part due to how these reserves were added. Each company increased reserves significantly in the past year, but almost none of the additions came from acquisitions. Spending on acquisitions accounts for a small portion of the total costs incurred by each firm, with Abraxas in particular spending less than 1% of its total costs incurred on acquisitions.

The most expensive Permian firms, on the other hand, show the reverse. Resolute, Diamondback and Centennial spent the most to add reserves in the past three years, with F&D costs between $21 and $26. Diamondback and Centennial each spent more than 80% of total costs incurred over the past three years on acquisitions.

Reserves growth through acquisition is the most costly form of additions a company can pursue. While there are a number of considerations which feed into a decision to purchase acreage, whether it has flowing production already or not, the acquiring company will pay a premium for those assets compared to adding reserves to existing acreage through the drillbit.

F&D has declined in importance in valuations over the past four years

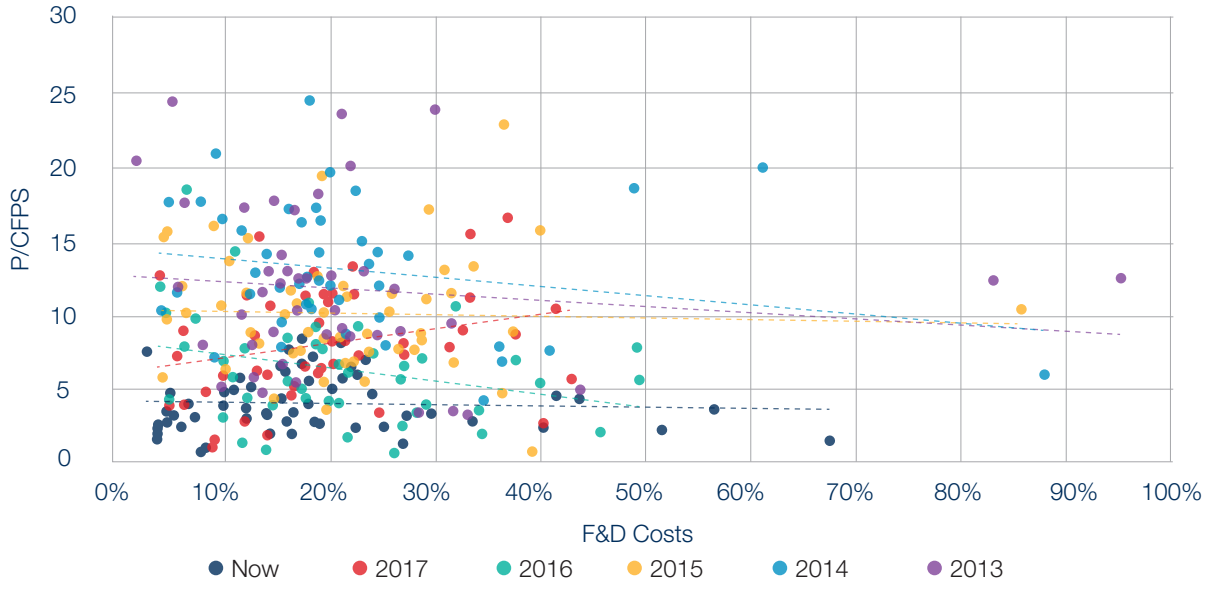
F&D costs are an important metric for the overall health of a company, and over the long-term markets typically reward companies that are able to replace reserves at low prices, but in the short term the emphasis placed on this metric has been highly variable.

As the downturn roiled oil and gas markets, investors shifted from focusing on fundamentals to catalysts. Management teams were forced to turn from increasing reserves at a reasonable price to simply preserving reserves in the face of falling commodity prices.

To analyze how markets factored in F&D costs into corporate valuation, EnerCom Analytics examined company three-year F&D values over the last six years, and compared these metrics with price/cash flow per share valuations in late March each year, immediately after reserves data is released.

F&D Costs and Price/Cash Flow Per Share

Source: EnerCom Analytics



The importance of F&D has varied significantly in the past six years, especially in the past three. F&D costs show a predictable relationship to valuation in early 2013 and 2014, before the downturn hit. While significant variability is present, as would be expected, generally F&D and P/CFPS had an inverse relationship, with lower F&D costs producing higher valuations. This relationship was slightly diminished in 2015, but generally held true during the initial portion of the downturn.

Low F&D costs remained important in 2016, as punishing commodity prices made companies with economic reserves more attractive. In an uncertain price regime, those firms that could grow reserves for minimal costs saw better valuations.

The relationship between F&D costs and valuations did not break down until 2017, after oil prices had already risen to above $50/bbl. This is likely due to several factors. First, the three-year data available in early 2017 covered 2014 through 2016. With low pricing for both 2015 and 2016, many companies did not see reserves increase at all in the period. Out of 79 companies, 27 had either decreases in reserves or F&D costs so high they were judged to be skewed by impairments. The market was forced to look elsewhere for ways to value firms.

In addition, the investment climate of early 2017 may be partly responsible for the breakdown in valuations and F&D costs. Investors were catching “Permian Fever” at the time, and companies in the basin became popular. Many of the firms with high valuations in March 2017 were companies with Permian operations, and investors were often willing to look past the high acreage prices it took to establish a position in the Permian.

Today F&D costs are playing only a minor role in company valuations. While a low F&D cost does produce a higher valuation, the benefit realized by a low cost is less than in any year from 2013 through 2016. The problems seen in 2017 are still present, the past three years may have included significant impairments and 21 companies were not included in the analysis for this reason.

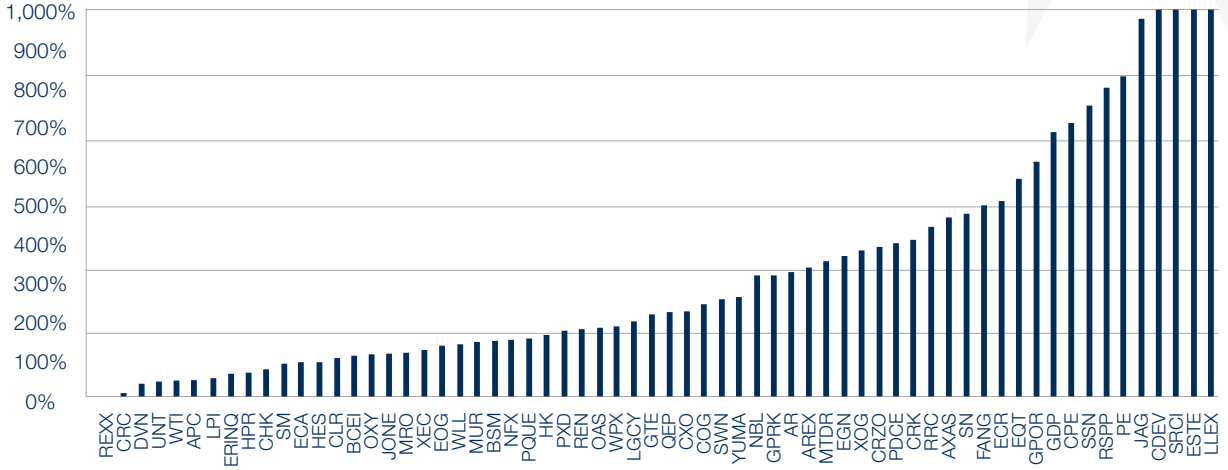
We expect that this situation will diminish in the coming years, as reserve data begins to reflect future operations more accurately. As markets continue to shift toward fundamentals, sustaining a low cost of reserves will increase in importance, as its implications for the long-term viability of operations cannot be ignored.

Production replacement varies even more widely than F&D

Production replacement levels are even more variable than F&D costs, as the production replacement in EnerCom's 121-company database varied widely. The lowest positive production replacement was achieved by Rex Energy, which replaced just over 0.1% of its production over the past three years. Canada-based Blackbird Energy, on the other hand, replaced 17,700% of production over the past three years, an order of magnitude more than the next highest production replacement recorded. Massive jumps in production replacement such as the one recorded by Blackbird often indicate a company with little or no production moving into development mode, skewing their numbers much higher. This is exactly the case for Blackbird.

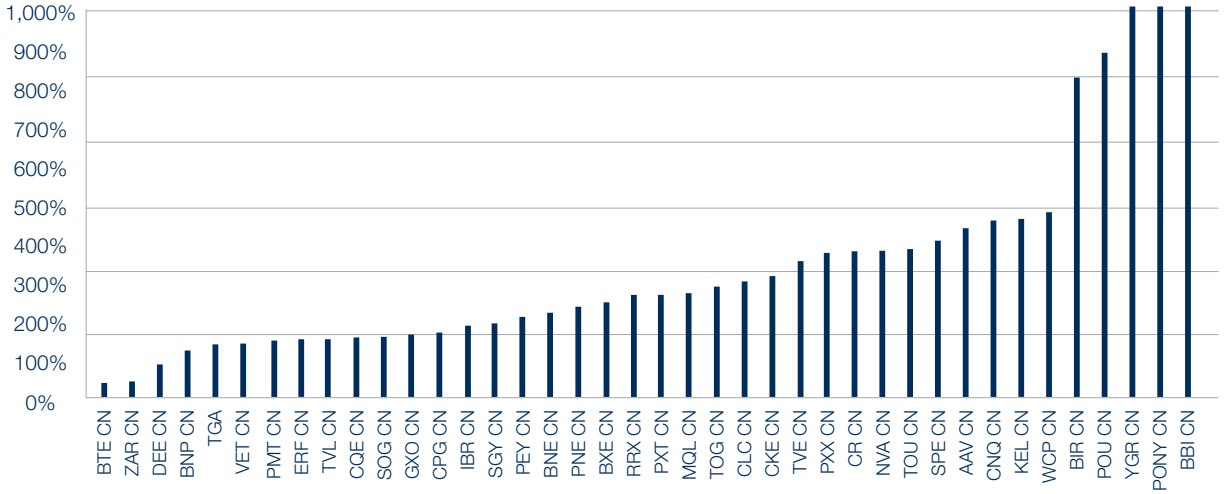
U.S. Production Replacement

Source: EnerCom Analytics



Canadian Production Replacement

Source: EnerCom Analytics

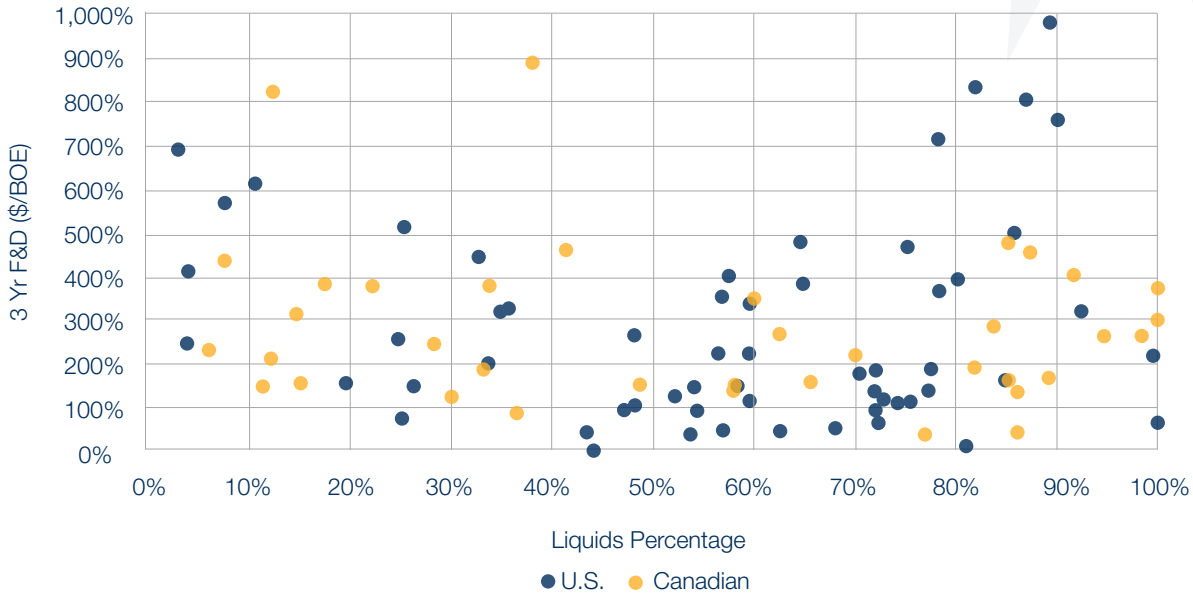


Production mix is unimportant, but company size is

There is less of a difference between U.S. and Canadian operations in production replacement than in F&D costs, and the regions are generally comparable. The primary difference is that almost all Canadian companies, aside from Blackbird and a few others, have replaced between 100% and 500% of production over the past three years, while U.S. companies show more variability. A total of 13 U.S. companies have added reserves but not replaced production over the past three years, only three Canadian E&P firms are in this situation. In addition, there are 13 U.S. companies that replaced more than five times production in the past three years, compared to only five Canadian firms.

U.S. & Canadian Production Replacement vs Liquids Percentage

Source: EnerCom Analytics



Unlike F&D costs, production replacement is unaffected by a company's production mix. Neither Canadian or U.S. companies show any major trends between product type and production replacement.

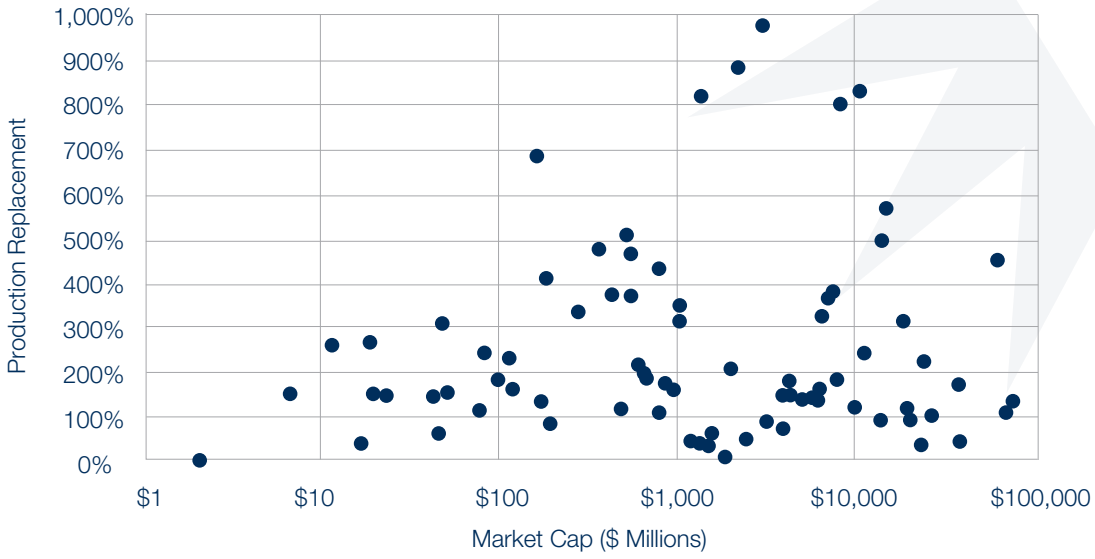
While there is little correlation between production replacement and the type of hydrocarbon produced, company size can have a significant impact on production replacement. Many large companies have relatively low production replacement ratios. For an established company with large reserves and production, adding more reserves can be difficult. Established operations are not likely to see significant reserve boosts from technical revisions, and the average large company's production volumes are significant. Despite this, however, the median large cap company replaced 173% of production over the last three years.

Replacing production is a much easier task for smaller companies, as most are in an earlier stage of a company's life cycle. Production volumes are generally lower, and large technical revisions or extensions are more likely. The median production replacement for mid and small cap firms reflects this, 261% and 359% for mid and small cap E&P companies, respectively.

This relationship does not hold true for the smallest E&Ps, though. Many micro-cap firms have only slightly replaced production, if at all. Thirteen micro caps replaced less than 200% of production, meaning they were growing production marginally compared to large, mid or small cap companies. While some companies, such as Lilis and Blackbird, were able to replace far beyond the previous year's production, the median micro-cap E&P replaced only 160% of production, lower than any other group.

Production Replacement and Company Size

Source: EnerCom Analytics

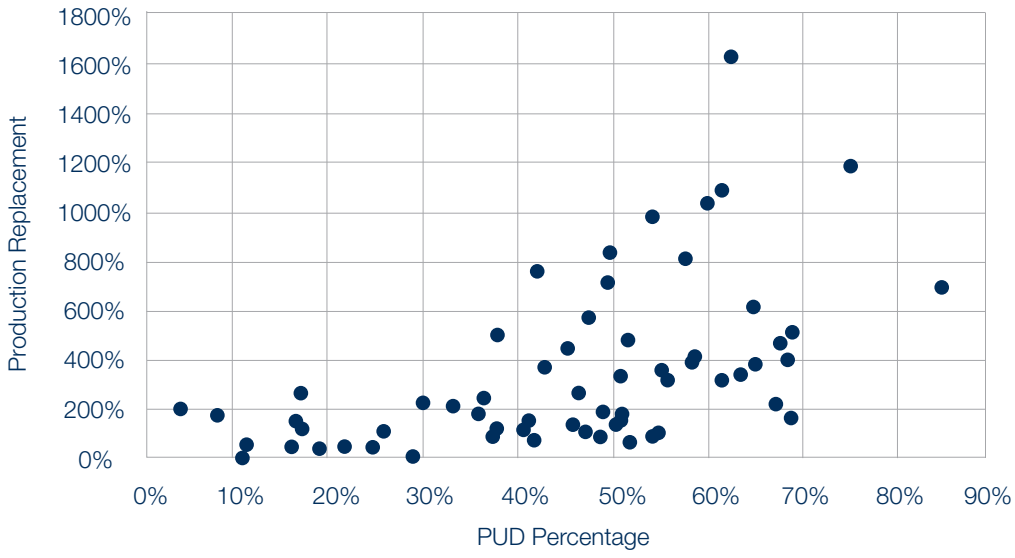


Reserve replacement is also softly correlated to proved undeveloped (PUD) percentage. Every company that replaced over three times production has at least one third of reserves undeveloped. While companies may intentionally try to "PUD up," increasing their holdings by booking proved undeveloped reserves, this is not necessarily the reason high production replacement is seen in companies with high PUD percentages.

Large increases in reserves are seldom accomplished through large increases in production, but rather through acquisitions, discoveries and revisions. These methods do not require significant production, and newly-added reserves through these methods are often considered unproved.

Production Replacement and PUD Percentage

Source: EnerCom Analytics

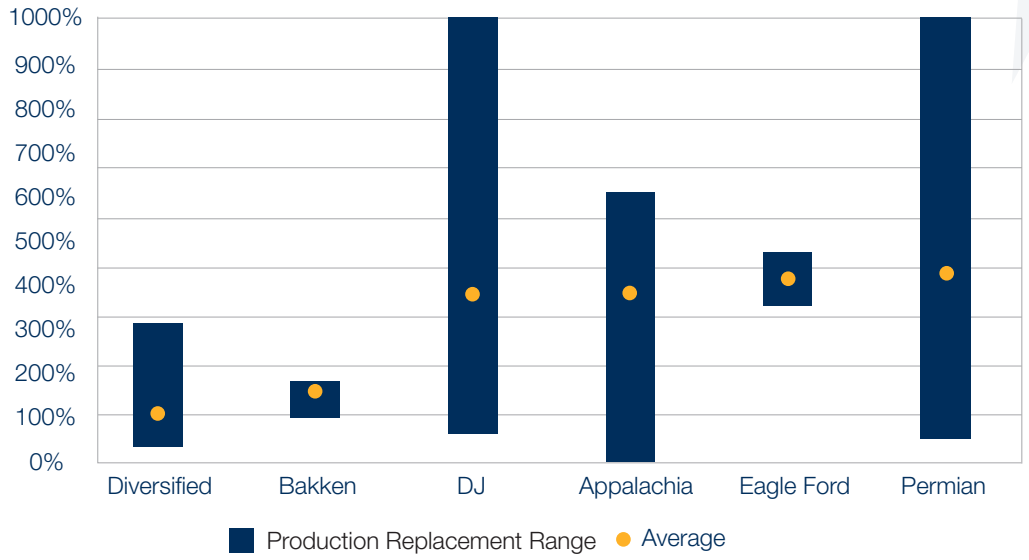


Median production replacement is highest in the Permian, but varies widely

Examining reserve replacement in specific basins is highly variable, with not only significant variability in amount replaced, but in the range in each basin. Companies operating in the Bakken and Eagle Ford, for example, display highly consistent production replacement ratios, with only a small difference between the largest and smallest value seen in the basin.

Basin Production Replacement

Source: EnerCom Analytics



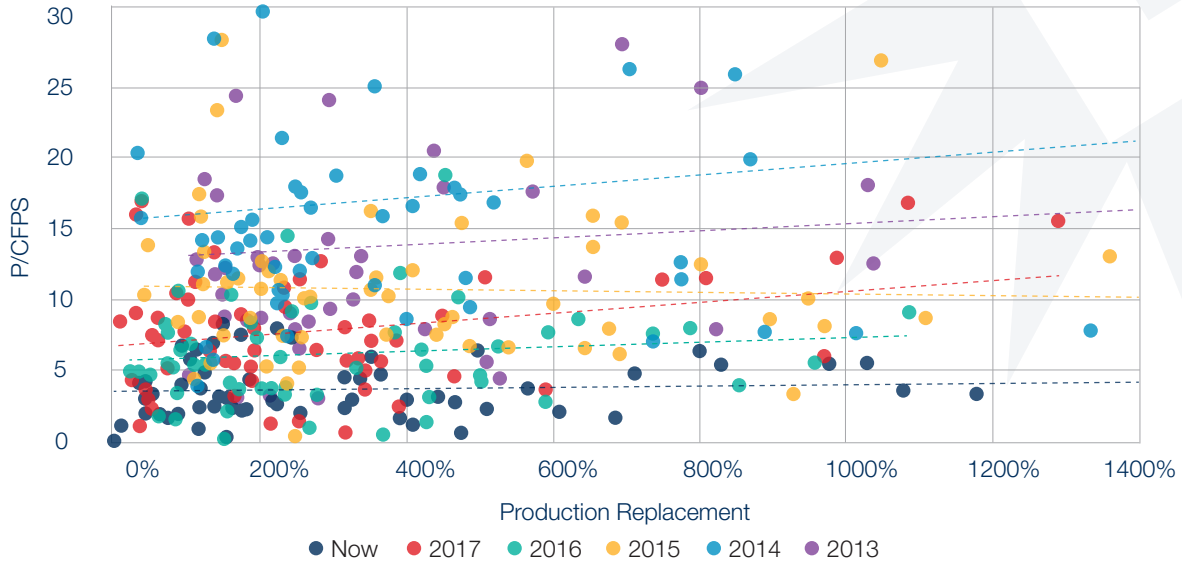
The Permian shows the widest range between highest and lowest production replacement, and also has the highest median production replacement ratio. As in many other basins, the highest Permian replacement ratios are seen in small companies with low historical production. Lilis and Earthstone each replaced over 11 times what they produced in the past three years, making these firms the highest not only among Permian companies, but in the overall U.S. E&P space. Other high-replacement companies are newly-established with aggressive growth plans, such as Jagged Peak and Centennial. Firms with lower production replacement are typically large companies, such as Cimarex, EOG and Pioneer. While these firms have been able to replace reserves, they fall behind their smaller, less-established peers.

Markets still value production replacement, but not to the same degree as before the downturn

EnerCom Analytics has analyzed production replacement and valuations, again using data from late March soon after reserves data is released. The relationship between valuations and production replacement is less variable than the relationship to F&D costs, but some shifts are noticeable. In theory, the market should reward higher production replacement, as it shows strong growth potential and sustainability of operations.

Production Replacement & Price/Cash Flow Per Share

Source: EnerCom Analytics



The market generally rewarded companies that showed high production replacement levels before the downturn, as the investing environment placed a high premium on the ability to grow. This relationship was not present in early 2015, as the ability to grow became a much lower priority, replaced by the struggle to adapt to weaker prices.

The ability to replace production produced slightly higher valuations in 2016, but the relationship was neither as strong nor as significant as before the downturn. Markets were primarily catalyst-driven, and while the ability to add reserves was valuable, it was far from the most important consideration.

The relationship between production replacement and valuations in 2017 is somewhat deceptive, for the same reasons as seen in F&D costs. Permian-focused companies were receiving premium valuations in early 2017, as the potential for the basin's vast opportunities was realized. Similar to this year, small, nimble Permian players were able to replace large amounts of reserves in 2017. Companies such as Jagged Peak and Centennial, then, were able to receive high valuations. If these companies are excluded, the relationship between production replacement and valuations becomes much less defined.

Today's markets slightly reward a high production replacement ratio. However, while markets do value this ability, it currently plays a smaller role in determining valuations than in most previous years. This is likely due to the same factors that have led markets to look beyond F&D costs. The downturn has stressed every company, and markets are often forced to factor in large impairments in 2015 and 2016.

Furthermore, the current investor sentiment generally does not prioritize growth. Cash flow and efficiency are the name of the game today.

We expect that this situation will change in the coming years, as reserve data begins to reflect future operations more accurately. As markets continue to shift toward fundamentals, sustaining a low cost of reserves will increase in importance, as its implications for the long-term viability of operations cannot be ignored.

Overall, F&D costs and production replacement have declined in importance in the market since the downturn. Investors are looking to other metrics to value companies as the ripples of the downturn continue to affect company metrics.

While trends in investor sentiment are difficult to predict, we believe that reserve metrics will become more important in the next few years. The ability of a company to replace production, and do so at a low price, is absolutely essential to a company's long-term health. In addition, as the downturn fades into the past these multi-year metrics will become more reflective of normal operations.

Next month's report will examine the other three metrics in EnerCom's 5 Factor Model, those relating to capital efficiency, operating expenses and debt loads. All three appear to be major priorities of investors, as efficiency and returns have become paramount. As production and reserves metrics became less reflective of companies' operations amid large price revisions, investors increasingly looked to expense and returns metrics. With two of the five metrics deemphasized by circumstance, we expect there was greater reliance on the other three metrics, and that companies that were able to show strong results for the remaining three factors received premium valuations.

A Word of Thanks

Thank you again for putting your trust in ENERCOM. Please do not hesitate to contact us with questions or additional needs. And, remember that you can get frequent updates and analysis on Oil & Gas 360® at **www.OAG360.com**