White Paper

# A New World Brings Steadier Gas Prices

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## Shareables

- A "manufacturing world" for natural gas, characterized by robust improvements in drilling efficiency, well completion techniques, and fracturing technologies, continues to evolve.
- These improvements have made gas supply much more responsive to price changes.
- As a result, natural gas prices are likely to be steadier and less volatile than in the past.

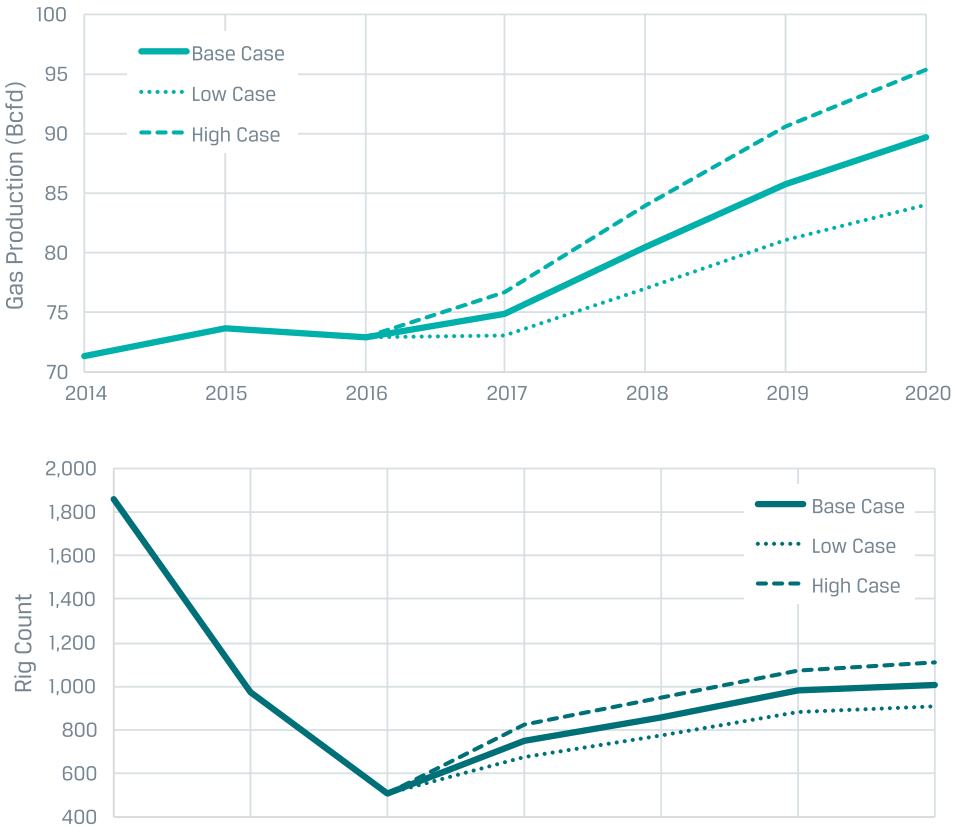
## Executive Summary

ICF forecasts robust gas production during the next 5 years, driven by domestic and export-led demand increases. Drilling rig efficiencies, improving well productivity, and rig count increases will continue in order to satisfy the growing demand. Natural gas supply has and will continue to become increasingly price elastic, reducing price volatility and potentially tamping down gas price increases. As oil and gas producers continue to improve well completion technologies, each well will become more productive and impactful on overall supply. Improved technology, when applied to the vast amount of undeveloped shale resource, will continue to make gas production more robust and flexible. Planners and investors should look for increasing price stability over the next 5 years.

## Trends in natural gas production and rig productivity

In its Base Case, ICF projects a 14 billion cubic feet per day (Bcfd) increase in natural gas demand by 2020, placing upward pressure on gas production. Production will, however, rise to meet demand. Such change is brought about by U.S. drilling activity that doubles from its 2016 level by 2020, as illustrated in Exhibit 1. Also, in the current environment, relatively small changes in drilling activity can have substantial impacts on gas production. ICF projects that gas production can swing up or down by 6 to 7 percent with a ten percentage point swing in rig activity; a change of merely 100 rigs in the U.S. changes natural gas production by 5 to 6 Bcfd by 2020. This change is a result of rig and well productivity improvements discussed below.

EXHIBIT 1. ICF'S PROJECTED NATURAL GAS PRODUCTION AND DRILLING ACTIVITY




Source: ICF, Baker Hughes

## Evolution of the Manufacturing World for Gas Production

The shale revolution has now been in place for over a decade. In this new "manufacturing world" for natural gas, oil and gas producers have continued to improve and refine technologies that are driving dramatic increases in gas resource recovery and well productivity. Such enhancements are being applied across the entire spectrum of drilling activity, including well siting, rig performance, and application of fracture treatments.

First, well siting has improved with the selection of new drill sites being focused in the most productive areas within shale plays. Multi-well drill-sites have also proliferated, and in some areas, producers are drilling 8 to 10 horizontal wells from a single well pad. This narrowing of the footprint for drilling operations has significantly reduced the cost of surface equipment on a per well basis and has also reduced the footprint for environmental impacts.

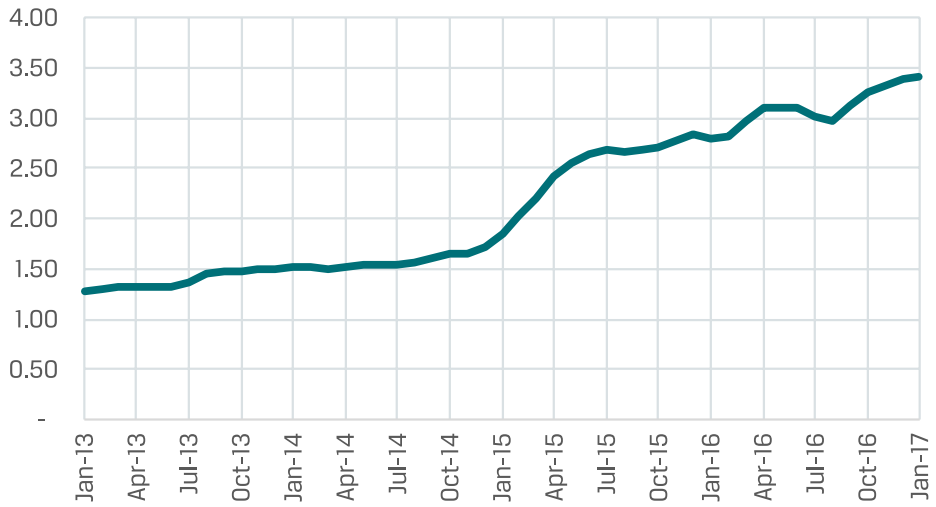
Second, rig performance has improved dramatically. Drilling rigs have become larger, and increased horsepower makes it possible for wells to be drilled and completed much more quickly than they were a decade ago. The number of days to drill and complete each well have been significantly reduced, translating into lower drilling costs since rigs are paid for daily. Increased horsepower and improved drilling equipment have also made it possible to lengthen horizontal laterals within wells, one of the factors contributing to growing well productivity.

Third, fracturing technologies have continued to advance. A horizontal well typically will have multiple fracture "stages" applied along its lateral to increase the well's contact with hydrocarbons contained in the producing formation. In some cases, there may be up to 30 to 40 different fracture stages applied within a single well. The positioning of each stage has become much better, with producers improving well logs and applying spinner surveys to locate where hydrocarbon content is greatest. Further, fracturing itself has improved. Rock mechanics has helped identify how best to fracture formations and provide guidance on the type and volume of proppant to apply. In short, fracturing technologies have continued to be honed and improved in the new manufacturing world for oil and gas production.

The result of these improvements, as shown in Exhibit 2, has been an impressive and sustained increase in well productivity. During a very short span of four years, well productivity has increased by roughly 300 percent. Indeed, recovery factors have increased significantly as the manufacturing process has been fine-tuned, and thus, estimated ultimate recoveries for wells have more than doubled over the past decade. These increases in drilling and well productivity, of course, translate into greater production growth over shorter periods of time. U.S. oil and gas producers are effectively able to "do more with less". The level of production increases that the U.S. has been seeing now only require 20,000 to 25,000 well completions per year, as opposed to the 40,000 to 50,000 completions that would have been required ten years ago.

EXHIBIT 2. NEW-WELL GAS PRODUCTION PER RIG (MMCFD)



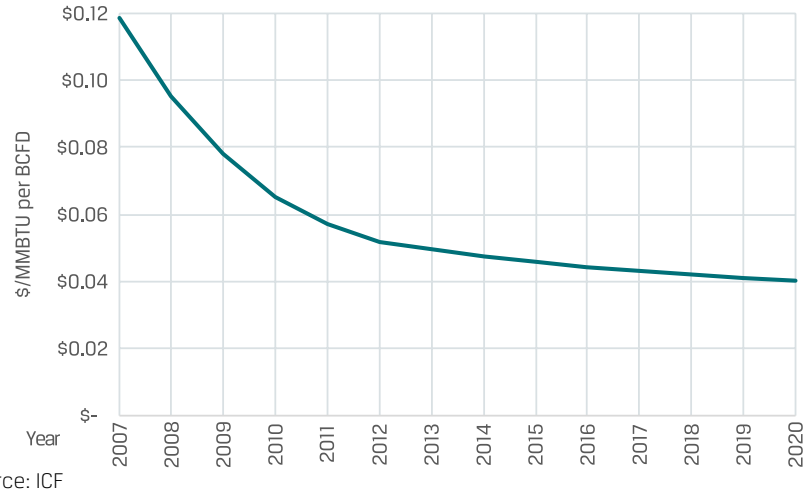

Source: Energy Information Administration (EIA), Drilling Productivity Report

## Natural gas price outlook

Long-term price elasticity of gas supply, a measure of responsiveness of gas supply to a change in gas price, has changed dramatically in recent years as the shale gas manufacturing model has continued to evolve. Gas production is generally becoming more responsive to gas price changes due to the technological advancements discussed above.

While the gas price change averaged well over 10 cents per MMBtu for everyone Bcfd of natural gas production change five to ten years ago, it is now around 5 cents for every one Bcfd. Thus, the drilling scenarios in Exhibit 1 above would show a variance of roughly 50 cents per MMBtu. In other words, gas prices in 2020 in the High Production Case would be roughly $0.50 per MMBtu lower than the gas prices in the Low Production Case. However, ten years ago, the price spread between the cases would have been much larger at well over $1.00 per MMBtu.

EXHIBIT 3. LONG-TERM PRICE ELASTICITY OF GAS SUPPLY ($/BCFD)




Source: ICF

**About ICF**

ICF (NASDAQ:ICFI) is a leading provider of professional services and technology-based solutions to government and commercial clients. ICF is fluent in the language of change, whether driven by markets, technology, or policy. Since 1969, we have combined a passion for our work with deep industry expertise to tackle our clients' most important challenges. We partner with clients around the globe—advising, executing, innovating—to help them define and achieve success. Our more than 5,000 employees serve government and commercial clients from more than 65 offices worldwide. ICF's website is **icf.com**.



But perhaps the more important finding associated with such a significant increase in price elasticity is that relatively small changes in drilling activity can have pronounced impacts on gas prices.

Recall from Exhibit 1 that the rig change between the High and Low cases was merely 200, representing a 20 percent change. Thus, gas price changes can be offset relatively quickly with very modest changes in producer activity.

## Steady Takeaways

Technological advances in drilling and fracturing have created a much more responsive gas supply. In the new natural gas manufacturing world that has evolved, ongoing technology improvements are likely to continue to increase well productivity. While price volatility will remain over short time periods due to unforeseen market conditions and changes, prolonged changes in price levels away from an "equilibrium" price will be less likely in the future. In addition, increased price elasticity for gas supply will dampen gas price increases as producers are better able to respond more quickly to demand and price increases.

## About the Authors

**Kevin Petak,** Managing Director of Natural Gas and Liquids Markets at ICF, has over 30 years of experience in the oil and gas business. He has led hundreds of studies focused on natural gas prices, gas supply and demand, and infrastructure development. He manages ICF's natural gas and natural gas liquids consulting teams focused on market forecasting, strategic planning and due diligence support, and oil and gas infrastructure analysis.

**Dr. Julio Manik** has over seventeen years of experience in the areas of energy modeling, engineering economics, and reservoir engineering. He is the lead analyst on projects related to hydrocarbon supply curves, oil and gas drilling and production, gas pipeline-supply-demand modeling, midstream infrastructure analysis, economic impact analysis, and issues related to reservoir simulation, multi-phase flow in pipeline,

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