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Is Shale Gas the New Black?

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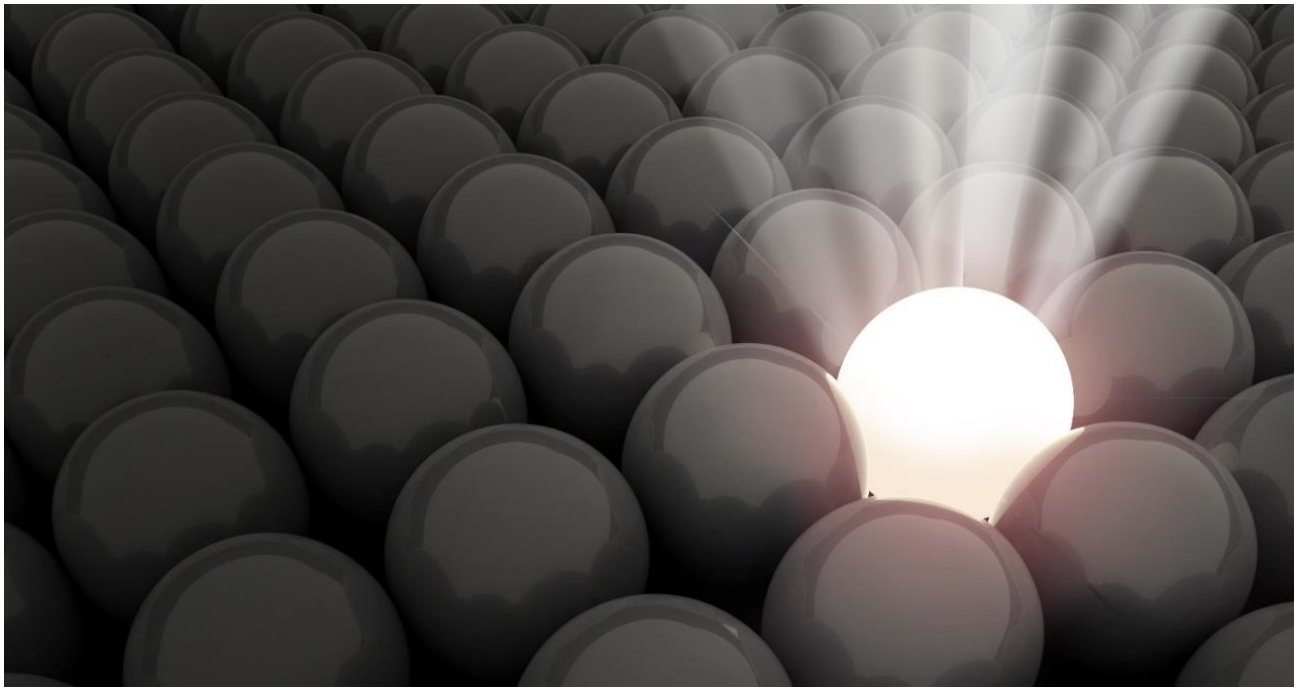

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Previously Martin worked for an Australian venture capital fund manager focused on high growth life sciences, information technology and clean technology companies. He also worked in technology commercialisation at the University of Melbourne, virology research at Murdoch University and cancer research at the University of Western Australia.

Martin has completed a Master of Applied Finance, has a PhD in Molecular Cell Biology, and a Bachelor of Science with first class honours

Introduction

The United States is currently experiencing an energy revolution due to the use of unconventional sources of hydrocarbons, in particular natural gas. This has broad reaching consequences for the US economy and indeed the global economy. Given the size of this thematic we have written this issue of *The Frontier Line* to explore the theme further and look at potential areas of opportunity for investors.

We have primarily approached this from the perspective of a core infrastructure investor, as many of the assets directly exposed to this thematic are infrastructure assets. However, the theme is considerably broader than this and will impact all asset classes in some way. Even at a relatively high level it is a complex and controversial topic.

What is shale gas?

Shale gas is natural gas found within shale rock formations and is a form of "unconventional" natural gas. Unconventional natural gas is not found in discrete pools or fields, as is the case for its "conventional" counterpart, and requires special recovery methods in order to generate a commercially viable level of flow.

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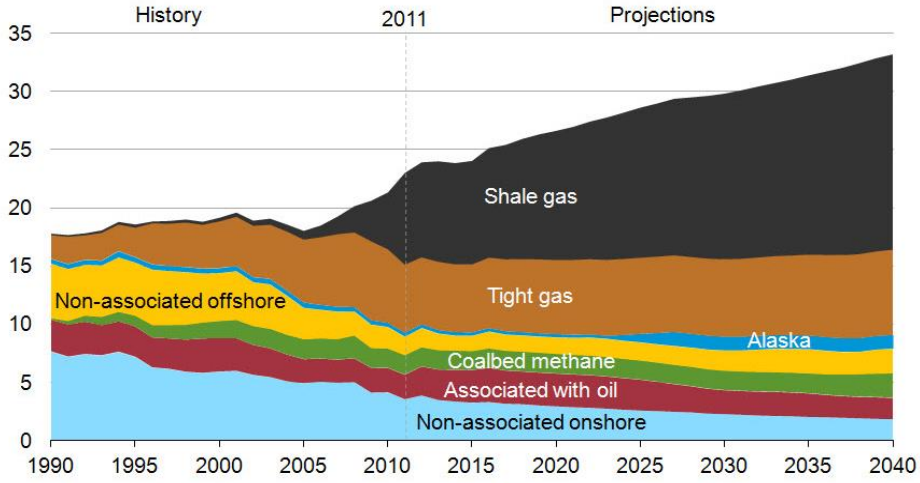
Two key extraction technologies are required for the production of shale gas, being horizontal drilling and hydraulic fracturing ("fracking"). Horizontal drilling allows the well bore to follow the gas bearing layer, hence increasing surface area exposure to this layer boosting gas production rate. Fracking uses high pressure water and additives to create and enlarge fractures within the gas bearing rock to increase permeability and enhance the flow of gas. These technologies are many decades old but they needed to be combined with conducive economic factors, such as high gas prices and capital availability, in order to trigger the shale gas boom we see today. Only since 2006 has production of unconventional natural gas in the US become significant. From less than 2% of US gas production in 2000 to 34% in 2011, shale gas is now expected to make up over 40% of production by 2020.

Shale oil can also be found and extracted using similar processes to shale gas. In addition, some formations of shale gas will produce "wet" gas, which can include other valuable hydrocarbon liquids in addition to the natural gas. These are called natural gas liquids (NGLs). Often all of these three classes of hydrocarbons are found in different parts of the same broad shale "basin". For example, in the Marcellus shale gas play, those wells in the western side of the play tend to produce wet gas and some shale oil, while those in the east produce dry gas.

Along with increased production rates there have been large increases in reported reserves of natural gas within the US. This, as well as increasing oil production, has led to predictions the US will be energy self-sufficient by 2035.

The US is by far the most developed shale gas market, but there are large estimated reserves in a number of countries including very large reserves in Russia and China.

Chart 1: US dry natural gas production (trillion cubic feet)



Source: US Energy Information Administration, Annual Energy Outlook 2013 Early Release

Impact of the shale gas boom

The "shale gas revolution", as it has been described, has had huge impacts on the US economy and is arguably the biggest supply side shock in US energy in the past century. A huge supply of gas has led to US gas prices dropping to historical lows and the resultant cheap energy has driven the return of manufacturing to the United States and has had a positive effect on employment. The impacts are broader than just the US. For example, in Europe coal prices have dropped (due to less demand from the US) which has in turn resulted in increasing levels of European electricity generation from coal.

In terms of the effects on infrastructure, while there has been significant amounts of well drilling, other infrastructure requirements have not kept up, most notably infrastructure involved in transportation (such as pipelines) and processing. This area is called midstream infrastructure. Some interstate gas pipelines have also been "stranded" due to the shale gas revolution changing the locations of supply and demand for gas.

Longer term effect of shale gas boom

The shale gas boom will have numerous longer term effects. One of the broadest effects will be the impact on energy sufficiency for the US which, if forecasts prove to be correct, would have significant geopolitical implications stemming from a shift in the reliance of the US on Middle Eastern oil supplies.

More specifically in relation to the impacts on the US economy, we are likely to see ongoing strength in the petrochemicals and manufacturing sectors and a decrease in reliance on coal and nuclear energy. Also US gas prices are likely to be lower than would otherwise be the case, though this will depend on how the US economy reconfigures itself to utilise this source of energy. The switch to gas usage from other energy sources will also impact on the pricing of these other commodities.

Changes in the required infrastructure

To capitalise on this opportunity, considerable infrastructure investment will be required. More midstream capacity will be required along with solutions for the disposal of used fracking fluids and other waste products (disposal wells). Increased investment will occur in liquefaction facilities which allow export of liquefied natural gas. We also expect increased reliance on electricity generation from gas, which will require additional gas-fired power plants. Conversely, this will reduce reliance on other electricity generation sources, particularly coal and nuclear, which will impact the infrastructure in place to serve those sectors.

Benefits

Shale gas may be environmentally beneficial as electricity generation from natural gas produces substantially lower carbon emissions than coal (approximately half). However, this is not clear cut as the gas itself is a stronger greenhouse gas than carbon dioxide and fugitive (escaped) emissions from shale gas can be a significant environmental problem.

As mentioned earlier, shale gas has the potential to reduce the dependence of the United States on foreign oil. This gives the United States additional security of supply and also reduces the influence of oil producing states (notably the Middle East) over the US.

Shale gas also provides a cheaper form of energy than many other mainstream energy sources and this cheap energy should provide positive flow through effects on economic growth.

Concerns surrounding shale gas

While there is a lot of enthusiasm around the potential benefits of shale gas, the extraction process presents many challenges and raises a variety of concerns across a range of areas and stakeholders.

At the surface, in the literal sense, there are environmental concerns around the impact of land clearing and habitat fragmentation due to the creation of numerous wells, pipes and roads.

There is also considerable controversy surrounding the fracking process. The process uses large amounts of water, which has to be sourced from somewhere. This is particularly problematic in regions that already have water shortages. There is a lot of secrecy around the constituents of fracking fluids with a number of the known constituents being potentially toxic. This in turn leads to concerns around groundwater contamination with these chemicals, though there seems to only be anecdotal evidence of this occurring. In theory fracking should not affect groundwater (as the shale deposits are typically much deeper), but some studies have found evidence of methane contamination in groundwater near extraction wells.

These various concerns around water contamination are not helped by the fact that fracking is exempt from much US Federal regulation, including the Safe Drinking Water Act of 1974. Once fracking of a well has occurred, both the fracking fluid and other water from underground (called produced water) will make its way back out of the well and will have to be disposed of. The produced water is often quite saline. A standard way to dispose of these fluids is into deep wells. Apart from the obvious questions that arise from pumping large amounts of contaminated water deep underground, there is some evidence that this can stimulate earthquakes, which could be a particular problem in densely populated areas. Other disposal methods that have been used include illegal dumping, which can have significant environmental impacts.

At a broader environmental level, there is a concern that a shift to electricity generation from natural gas will slow down the overall move to carbon neutral electricity generation. While natural gas generation is considerably better than coal with regards to carbon dioxide pollution, it is still a polluting form of energy.

Structure and regulation of US gas market

Energy markets are generally classified into three sectors. These are upstream, being the well operation and exploration stage; midstream, being gathering, transportation, processing and storage aspects; and downstream, which relates to gas usage such as the petrochemical industry, electricity generation and heating.

Figure 1: US gas market sectors

There are investment opportunities available across each of these streams, however in terms of core or core-plus type infrastructure investments, the focus is on the midstream sector. The upstream opportunities provide stronger links to commodities with less infrastructure-like characteristics. They are more akin to resources and private equity style investments. The downstream sector has some investments that would fall into core/core-plus infrastructure, but most would not due to competition and commodity exposures.

The midstream on the other hand contains a number of assets with infrastructure-like characteristics that arise from either regulation or contracts. Interstate pipelines are regulated by the Federal Energy Regulatory Commission (FERC), which gives a regulated rate of return. Other subsectors of the midstream typically operate under contracts, with the preference for an infrastructure investor being long-term contracts with little or no volume sensitivity.

The midstream is heavily dominated by Master Limited Partnerships (MLPs) which are listed entities that do not pay corporate income tax if income is from qualifying activities, (including activities around oil and gas) and can pass depreciation to investors. This gives these entities a large advantage with regards to cost of capital.

Infrastructure managers have raised MLPs as a potential exit route for investments that involve taking a core-plus asset and turning it into a core asset ("build to core"), or those assets that involve accumulating and aggregating smaller assets into a larger one (a "roll-up").

Regulation is important for the midstream sector, given the impact this can have on midstream assets, particularly pipelines. Gas and oil pipelines are treated quite differently with gas pipelines regulated by the FERC and under the Natural Gas Act of 1938, while oil pipelines are regulated under the Interstate Commerce Act of 1887. The outcome of this is that interstate oil pipelines are common carriers while interstate gas pipelines are contract carriers. This means gas pipeline customers can be given firm capacity on a pipeline. FERC also has federal "eminent domain" authority for gas pipelines, which means a FERC approved gas pipeline doesn't need approvals from local government and landowners. Most importantly from an investment perspective, interstate gas pipelines receive a regulated rate of return. Other regulation includes environmental, safety and rights of way, which can vary considerably between states.

Midstream subsectors

There are numerous categories of assets within the midstream, with the more notable sectors from the perspective of an infrastructure investor being:

- Gathering
- Transportation
- Processing / treatment
- Storage

Gathering

Gathering networks are low pressure pipes that connect to individual wells and feed into larger pipelines. Gathering networks are typically exempt from FERC regulation (determined by the "Farmland Criteria").

Infrastructure managers generally consider this an area with potential for investment as there are a number of fragmented assets too small to attract attention from MLPs plus there is the potential for gas producers to sell off their gathering networks. The infrastructure-like characteristics of these investments will depend on structuring and the type of contracts involved.

Our preference would be long-term take or pay gas gathering agreements with all current and future production from a district to be gathered by the network.

Risks for investors to consider would include regulatory (such as changes to safety requirements), counterparty and volume risks.

Transportation pipelines

FERC regulated (interstate pipelines) provide a regulated rate of return, and are typically underpinned by long-term contracts. The general consensus among managers, is that opportunities for investors are limited due to competition from MLPs which have costs of capital in the 4 to 6% range.

Despite potentially positive infrastructure characteristics, this area is unlikely to offer significant opportunity for infrastructure investors unless they are satisfied with lower rates of return.

There are also intrastate pipelines (not FERC regulated), which may be infrastructure-like due to contracts, however complexities arise in this sector due to regulation varying from state to state.

Risks can include stranding of the asset if supply and demand locations change, which is something that happened to a number of pipelines when the shale gas revolution started.

Processing and treatment

Shale gas can be "dry" or "wet". Wet gas contains natural gas liquids (NGLs), which are valuable, but need to be extracted to produce separate dry gas and NGLs. Any NGLs isolated from wet gas can be further fractionated into various hydrocarbon components.

Gas can also be "sour", which means it contains hydrogen sulphide which is corrosive and requires removal. Gas with low hydrogen sulphide is termed "sweet".

Gas can also be acid. These contaminants, as well as water, need to be removed. The facilities required for these various gas processing steps are potential infrastructure investment opportunities, and again infrastructure-like characteristics will depend on contract types and duration.

This sector typically has considerable volume and commodity price risk. For example, some contract types allow the processor to keep a fraction of the processed gas or NGLs, which leads to volume and price risk.

Midstream subsectors

Storage

Shale gas storage is used to meet demand over various timespans, from seasonal demand cycles down to much shorter period load balancing. There are a number of types of storage assets with the main ones being depleted oil/gas reservoirs, aquifer reservoirs and salt caverns. Each has differing characteristics that make them suitable for delivering gas over different time scales.

Those assets that can deliver gas over shorter time spans ("high deliverability") have performance more driven by commodity prices and are therefore less attractive to an infrastructure investor. Salt caverns fall into this category. Those assets that meet seasonal demand cycles (such as aquifers or depleted gas reservoirs) are more likely to have long-term supply contracts in place and hence are more attractive to an infrastructure investor.

Other opportunities

There are a number of other potential opportunities for infrastructure investors in the shale gas space. These include processing, disposal and/or recycling of wastewater produced from wells. This more accurately fits into the upstream category, however it has been raised by a number of managers as a potential opportunity with mid to high teens returns and long-term contracts. Similarly, well and pipeline monitoring systems may provide a potential area of opportunity.

Liquefied natural gas (LNG) export terminals can be attractive infrastructure assets. This is a highly regulated sector in the US with only eight approvals granted to export LNG to non-free trade agreement countries. These facilities typically operate under long-term take or pay contracts. The very large scale of these assets is likely to limit the total number built due to the limited number of counterparties that can sign contracts to accept the volumes such facilities export.

Other asset classes that access the sector

In addition to infrastructure, there are a number of other routes to access this sector including private equity, listed infrastructure and listed equities.

Private equity has played largely in the exploration and production part of the market, however we have also seen opportunities in private equity that take advantage of regulations (such as converting gas to products like ammonia, in order to circumvent export restrictions). Higher risk and more active investments in the midstream space could also fall under the heading of private equity.

Listed infrastructure allows access via the MLP sector, however the tax benefits only apply to US taxpayers. There are ways for foreigners to access these benefits (such as via a swap structure with US banks), but this introduces additional counterparty risk. MLPs are also rarely pure infrastructure plays and are very highly priced at the current time.

The shale gas thematic could be also accessed indirectly by selling "picks and shovels" e.g. fracking sand, transportation services or lease equipment, with this approach more likely to be accessed via listed equities or private equity. The shale gas theme could also be accessed much more directly via listed energy companies with significant shale gas exposures.

Risks

As with any investment there are a number of risks for investors to be aware of and manage. These will depend on the asset type, regulation and underlying contracts. There are also risks that are reasonably specific to shale gas investments. More specifically, examples include:

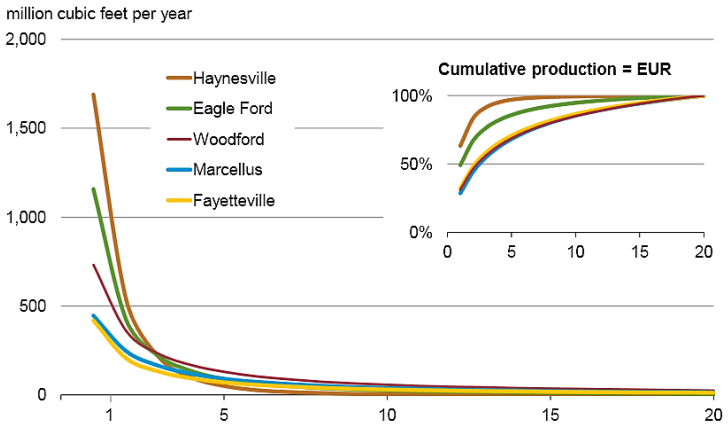
- Changes in regulation (including environmental and safety)
- Competition
- Counterparty
- Volume
- Changes in the source of gas (and stranding of assets)
- Rights of way for greenfield development
- Longevity of gas production
- Increasing costs – e.g. demand for labour and equipment

An example of a risk for shale gas related investments is the longevity of gas production feeding through a specific asset. This is a greater risk for shale gas than traditional gas as the decline in production for shale gas wells is much faster than traditional wells, plus there is still limited experience around the likely lifespan of shale gas wells.
The chart below shows estimated decline curves for an average well in different natural gas plays (EUR means estimated ultimate recovery).

The rapid drop off in production of individual wells means continuous drilling needs to occur to maintain or grow production. If the decline is faster than expected or drilling and production cannot be maintained, this can negatively impact on the value of assets dependent on that particular source of gas.

We have found that many of the risks, particularly those around environmental regulation and longevity of gas production, tend to be glossed over by the industry, but the potential impacts could be large. That said, risks can lead to opportunities if they are property understood, hence manager knowledge and skill will be important in what is a very specialised field.

Figure 2: Estimated decline for shale gas sites



Source: EIA Annual Energy Outlook 2012

Conclusions

The US shale gas sector is complex, large and in a constant state of change. There are numerous potential investment opportunities, however many of these will not be appropriate for a core or core plus infrastructure investor.

Of those assets that might be considered infrastructure, characteristics will vary considerably, being particularly dependant on contractual terms and regulation.

In terms of gross local currency expected return, assets that form the primary areas of opportunity (such as gathering networks) should generate mid-teen returns, while assets such as interstate gas pipelines are likely to return below 10% p.a. Size of the asset will also influence pricing as MLPs compete for larger assets. Hence, smaller assets are likely to be less competitively bid and where much of the opportunity lies.

We have found while the sector as a whole appears to be very large, it is unclear just what the true size of the opportunity set is for core or core plus infrastructure investors.

This is because despite considerable discussion on the thematic, the number of attractive infrastructure-like investments actually made by managers in this sub-sector is lower than expected. In part this is because many of the assets have a risk profile more appropriate for private equity.

Further, manager skill and relationships are very important in the sector; for the sourcing of investments, understanding them and structuring them correctly.

In conclusion we believe the US shale gas thematic is appealing, with some very attractive assets, and is worth considering as an exposure in a client's infrastructure configuration. However, any exposure should be via a manager with demonstrable expertise and deal pipeline.

In Frontier's experience such managers are reasonably uncommon, with I Squared one example of a manager that is suitable in the sector. Any exposure is also likely to be through a more diversified infrastructure fund, as those funds with a strong focus on the thematic (such as energy funds) take a more private equity style approach and are therefore riskier than preferred in an infrastructure configuration.

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