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THE ROLE OF FOREIGN DIRECT INVESTMENT IN RESOURCE-RICH REGIONS

Permian Basin Energy Producers Invest in Community Infrastructure: Motivation, Impacts, and Implications for Corporate Citizenship

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The Permian Challenge

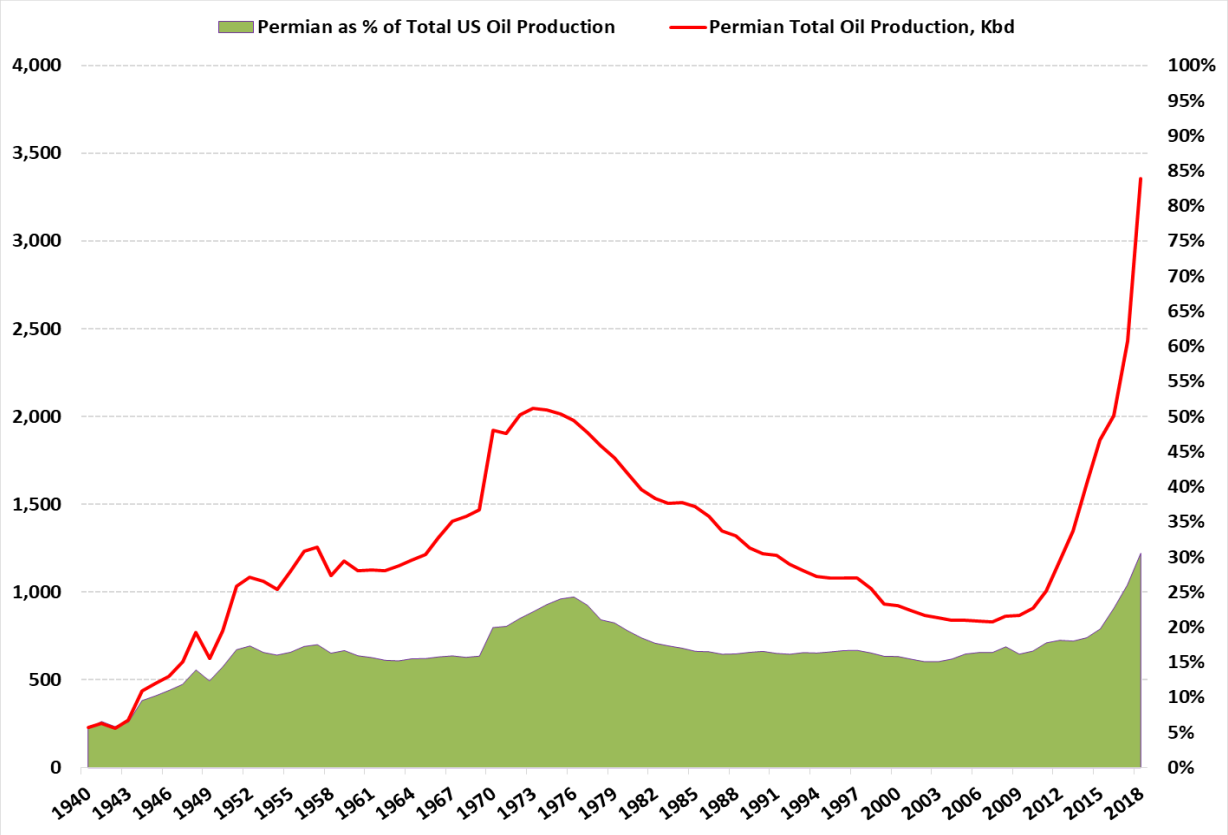
The Permian Basin underlies West Texas and Southeastern New Mexico, covering an area larger than the state of South Dakota. New drilling and completion techniques have broken the Permian's decades-long output decline, and the region now produces more oil per day than every OPEC member country aside from Saudi Arabia and Iraq. Intense oilfield activity has made communities in the basin such as Carlsbad, New Mexico, along with Midland/Odessa, Pecos, and Monahans Texas into boomtowns. Complex policy challenges are arising as "full speed ahead" resource development strains local infrastructure, including roads, schools, hospitals, housing, first responders, and others. These challenges will likely if WTI Midland realized crude oil prices remain between $55 and $65 per barrel on average over the next 3-5 years.

Volumetrically speaking, the Permian is in uncharted territory, as in 2018 it produced over 60% more oil than its prior historical oil production peak in 1973 and now accounts for roughly 1/3 of US oil production—itself an historical high (Figure 1). As of mid-2019, Permian oil output exceeded the maximum sustainable production capacity of Saudi Arabia's supergiant Ghawar Field.[1] Current production levels severely test the capacity and adaptability of both oilfield and community infrastructure. If community infrastructure fails to support the needs of local residents' and E&P and oilfield service companies in the Basin, this could jeopardize the future growth prospects of the world's largest single oil production center outside of the Middle East.

International oil & gas companies (aka "the Majors") have a long and varied range of experience developing resources in challenging environments that initially lacked many types of supporting infrastructure. Yet the Permian generally poses a different set of challenges than Angola, Kazakhstan, Nigeria, Papua New Guinea, and other such locations. To name a few, companies are protected by rule of law, there are no armed rebel groups menacing drilling sites, local politicians generally seek to engage constructively with energy producers, there is a pre-existing pipeline network and array of service companies, and local populations have deep and robust institutional memory when it comes to the oil & gas industry.

But paradigmatic differences notwithstanding, Permian communities also face some concerns shared by their counterparts in resource-rich regions overseas; for instance, central and regional governments failing to share sufficient windfall revenues to help the producing areas offset the burden of the boom and ensure community infrastructure is sufficient to support continued robust, competitively-priced resource development. On these questions, certain Permian challenges often do correspond to themes in the broader global discourse on the "resource curse."

Figure 1. Permian Basin Oil Production Since 1940, Annual Average ('000 bpd)



Source: New Mexico Oil Conservation Division, Texas Railroad Commission

This paper lays out and explains the core community infrastructure challenges created by the Permian oil boom, analyzes how the region's energy producers are responding to them, and concludes by distilling the key policy lessons involved and offering suggestions on ways to fine-tune corporate engagement with local infrastructure, civil society, and political actors as Permian Basin oil & gas production remains large and continues to evolve.

What Does "Community Infrastructure" Mean in The Context of a World-Scale Oil & Gas Development?

For the purposes of this analysis, "community infrastructure" items are public goods necessary for citizens and businesses alike to efficiently and safely conduct their operations. Examples include roads, schools, medical facilities, and first responders. Many of these items are taken for granted until the services they provide are suddenly strained so thin that outages, shortages, and systemic malfunctions become a reality. At that point, community members face the choice of either living with subpar—and potentially unsafe—conditions, or figuring out how to expand capacity (and most pressingly perhaps, how to pay for it and who pays for it).

When a community's population grows during an oil & gas boom period, commercial imperatives drive the expansion of grocery stores, vehicle dealerships, and other businesses responding to market demand signals—aka the opportunities to reap outsize profits from meeting underserved demand. But capacity in the "community infrastructure" space is often tougher to expand, for it frequently requires both large long-payback capital investments and the political consensus building necessary to justify such measures to voters.[2] Accordingly, community infrastructure capacity generally responds to demand more slowly than the local economic activity and demographic shifts that create the demand.

Community infrastructure capacity shortfalls can retard development of the local energy resources by imposing higher costs on companies operating in the area. Consider the following simple example of how community infrastructure can impact corporate bottom lines. Imagine a scenario where a company currently producing 25,000 bpd of oil trucks ¼ of that volume (6,250 bpd). At 130 barrels per truckload, this means the firm moves approximately 50 truckloads per day of oil. Assuming that a truck costs $120 per hour to hire[3], each hour of demurrage (truck waiting time in traffic jams, etc.) effectively reduces the producer's realized netback by $0.92 per barrel. Cargoes moved by road now commonly encounter 1-2 hour delays on key Permian transport arteries such as I-20, US HWY 285, SH302, RM 652, and NM 128.

And for a crude oil cargo like the example shown above, a 2-hour delay would impose an additional logistical cost equal to 82% of what it would cost to ship the oil by pipeline from Midland to the Corpus Christi area.[4] Each cent of additional cost shrinks producers' realized income and makes the area's production less competitive in global commodity markets where cost is king, and the lowest-cost producers reap the highest infra-marginal rents.

How is the Permian Boom Challenging Community Infrastructure?

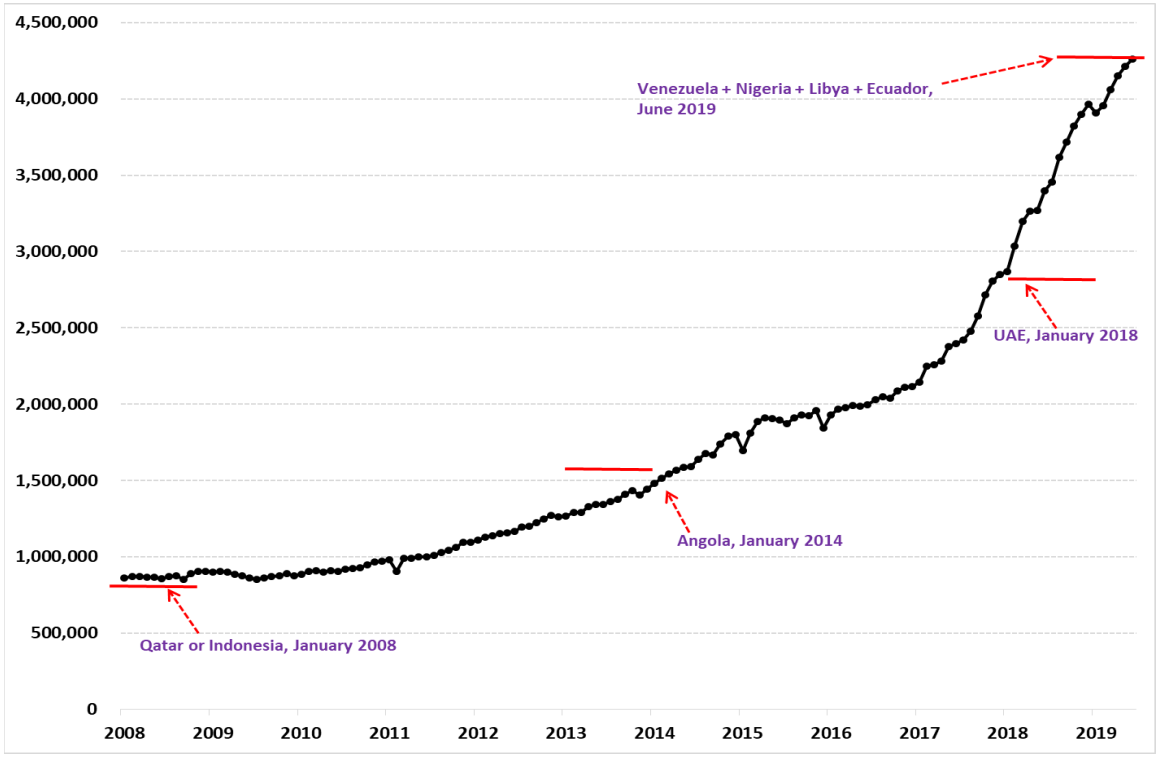
The Permian Basin's renewal as one of the world's premier oil & gas production hotspots challenges community infrastructure on four core dimensions: (1) scale and speed, (2) commodity input and labor-intensity, (3) commodity price volatility, and (4) uneven geographical distribution of physical activity versus population and financial/political capacity.

Scale and Speed

In January 2008 before the boom kicked off, the Permian produced on average a bit over 800 thousand bpd of oil—roughly equivalent to what OPEC members Indonesia and Qatar each pumped at the time (Figure 2). As 2011 rolled in, Permian production began to climb as E&Ps switched from focusing on unconventional gas production [due to a gas price crash caused in part by their own innovation and the supply glut in unleashed in North America] and instead increasingly emphasized liquids production, using the same horizontal drilling and hydraulic fracturing techniques that unleashed the gas revolution several years prior. By January 2014, the Permian was producing nearly as

much oil as Angola. After 2014, Permian production growth began to accelerate dramatically, and from 2015 through early 2018 basically doubled, and then added more than one million bpd by June of 2019.

Figure 2. Permian Oil Output Relative to Selected OPEC Producers (bpd)



Source: EIA, OPEC Monthly Oil Market Reports, Author's Analysis

The Permian now accounts for close to 5% of global liquids production and the scale and speed with which it has gotten there is staggering. From January 2015 through June 2019, the Permian added 2.5 million barrels per day of net oil output, *all* of which came from organic, drillbit-led activity. For context, Iraqi output grew by 1.3 million bpd during that same timeframe [mostly drillbit-led], Canadian operators grew oil production by 0.84 million bpd [based on the peak level achieved in August 2018 prior to mandated cuts in Alberta], and Russian producers drilled their way to a 0.74 million bpd increase [based on the near-term production peak in December 2018 prior to production cuts made under the OPEC+ agreement]. In other words, the Permian was the single biggest driver of organic oil supply growth worldwide.

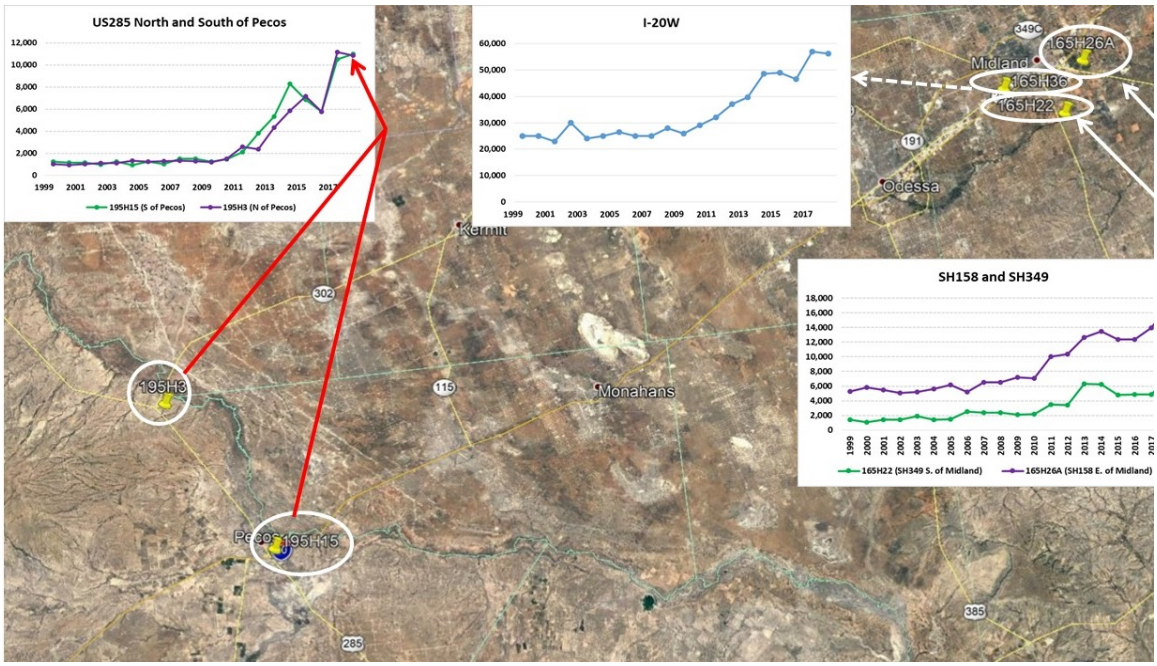
Commodity Input and Labor Intensity

Achieving such output growth required a different set of circumstances than what existed in the other oil provinces referenced above. Most notably, drilling and completing an average of 400- 500 horizontal wells per month in the Permian necessitates a sustained logistical mobilization that is, to the author's knowledge, unprecedented. The Permian Basin now consumes an average of approximately 5 million barrels per day of water for

fracturing completions[5] [roughly what the City of San Antonio uses], more than 600 rail cars' per day[6] worth of frac sand, and at least 2.4 million tonnes per year of steel oilfield tubular goods.[7]

The combined impact of these goods moving around is huge and is especially concentrated in and around the best rock—the "sweet spots" that drive an outsized portion of drilling and completions activity. Traffic volumes in Reeves and Midland Counties, in particular, have risen enormously in both absolute and relative terms since the boom began. On US HWY 285 north and south of the city of Pecos, Texas Department of Transportation meters indicate that average annual daily traffic counts on certain stretches of the road have risen as much as 9-fold since 2009 (Figure 3).

Figure 3. Changes in Annual Daily Traffic on Selected Roads Near Midland and Pecos, Texas

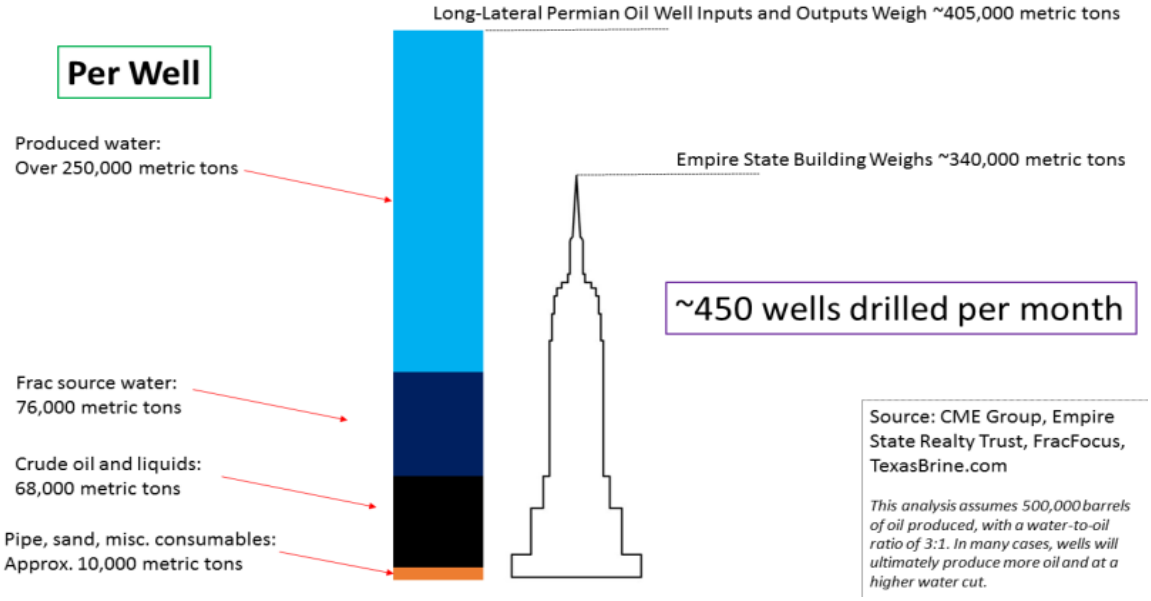


Source: Texas DoT, Author's Analysis

We select roads near Midland and Pecos for two reasons. First, these two cities lie near ground zero for the best rock in the Midland and Delaware sub-basins, respectively. Second, Midland has a long history of dealing with boom and bust cycles, and while the present boom is different than its predecessors in many regards, Midland has deep institutional memory of how to cope with swings in oil & gas activity. Pecos lacks this same reservoir of experience because Reeves County oil & gas production did not reach industrial scale until the unconventional revolution moved in over the past 7-8 years. Midland is also a much larger city with more resources and greater capacity to absorb intense and volatile impacts in road use, population, and other aspects of life affected by a resource boom.

So why are so many vehicles suddenly moving on roads in the Permian oil patch? Because unconventional wells require a lot more inputs than vertical wells do *and* because the pace of well drilling and completions has in many areas outstripped the ability of midstream service providers to connect wells to gathering systems until they have already been producing for some time. Producers' hunger for immediate cash intensifies the dynamic because they try to bring wells—especially ones expected to be oil-rich—online as quickly as possible. The author's modelling of a prototypical Delaware Basin horizontal well with a 2-mile lateral suggest that the combined lifetime mass of inputs used to drill and complete the well, and then the fluids produced from it exceeds 400 thousand metric tons, or roughly 1.25 times the mass of the entire Empire State Building (Figure 4).[8]

Figure 4. Mass of Inputs and Outputs from Drilling & Completion and Production from, a 2-Mile Lateral Delaware Basin Oil Well



Source: FracFocus, Company Reports, Author's Analysis

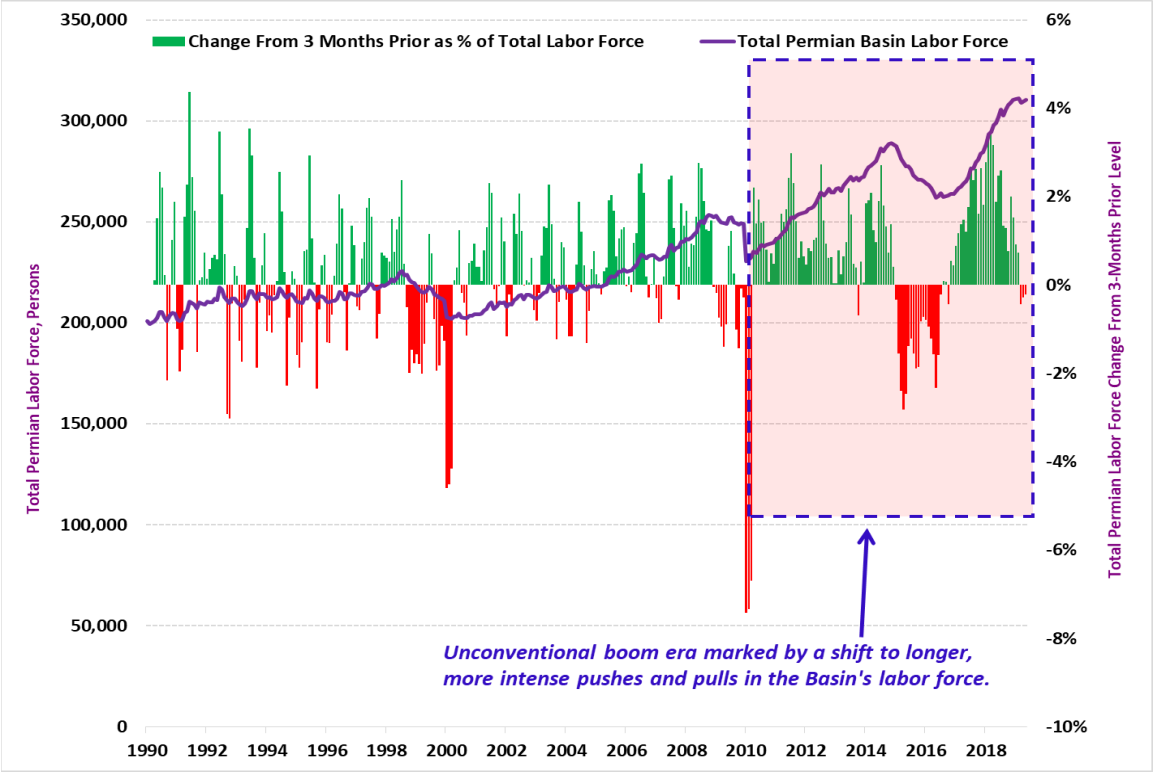
Unconventional wells produce the largest chunk of their oil, gas, and water within the first 2-3 years of well life, meaning that the total mass moved is "front loaded." This amplifies the intensity of local transportation impacts, since 200 thousand tonnes moved in three years (and the bulk of that in the first 18 months) is a very different proposition than the remaining 200 thousand tonnes transported over the well's remaining economic life of perhaps 15 years.

Permian wells' high transport intensity and operators' impatience when it comes to waiting for gathering systems to catch up with development (or midstream providers' slowness in connecting new wells, depending on which side of the pipe one sits) has real public safety consequences. In sports, speed kills. In unconventional oil plays, weight kills—literally. Texas Department of Transportation data from 2016 show that

the road fatality rate per 100,000 population for the core Texas Permian Basin counties is twice the US national average and roughly on par with that of Russia, one of the world's most dangerous industrialized countries to drive in.[9] To riff off the "weight kills" theme, the basic equation is goods = mass = trucks = congestion + road damage + traffic accidents. Accidents kill people, road damage strains local government budgets, and congestion can seriously impair oil companies' operational efficiency and the realized economics for the molecules they produce.

The services-intensive nature of unconventional oil & gas production coupled with the Permian Basin's scale and speed of activity has also created transformative, large demands for labor. Accommodating these workers—and in some cases their families a well—creates real challenges. To start, the speed of corporate operations generally exceeds the ability of housing providers to create new supply. Operators can bring Permian wells from "spud-to-sales" in as little as 45 days under ideal circumstances, and within 2-3 months under more generally existing conditions.[10]

Figure 5. Permian Basin Labor Force and Shift Toward Longer and Stronger Increases in Workforce Demand



Source: Census Bureau (via Federal Reserve Bank of St. Louis), Author's Analysis

During the boom's earliest innings, labor could be accommodated more easily because Midland and Odessa (as well as some smaller regional towns) had spare housing, apartment, and hotel capacity because up until 2007-2008, the Permian was widely perceived to be a basin in a slow, but terminal decline.[11] But once the headroom was

occupied, it became tougher and more expensive to house new arrivals, a trend that has continued to the present.

Commodity Price Volatility

There is a rich body of economic literature dating back to at least the early 1980s which examines the effects of oil price volatility on firms' investment decisions.[12] Research in the field has focused on oil's importance as an input cost for businesses and how uncertainty about the direction of oil prices can affect capital investment decisions. But for an investor contemplating a hotel, apartment, or other such capital project in the Permian Basin, oil price volatility impacts the decision much more profoundly because the investment does not simply treat oil as an input cost; rather, the asset will cater to demand driven by oil & gas activity, making it fundamentally a directional bet on oil prices. At least one recent study in *Energy Economics* found that firms in oil producing countries—who are presumably more directly leveraged to oil rents--reduced their corporate investment by greater amounts during times of oil price uncertainty than did firms in oil consuming countries.[13] While the author has not yet located a study specifically focused on oil price volatility's impact on investor decisions in the Permian Basin, the same dynamics cited in global studies appear to apply.

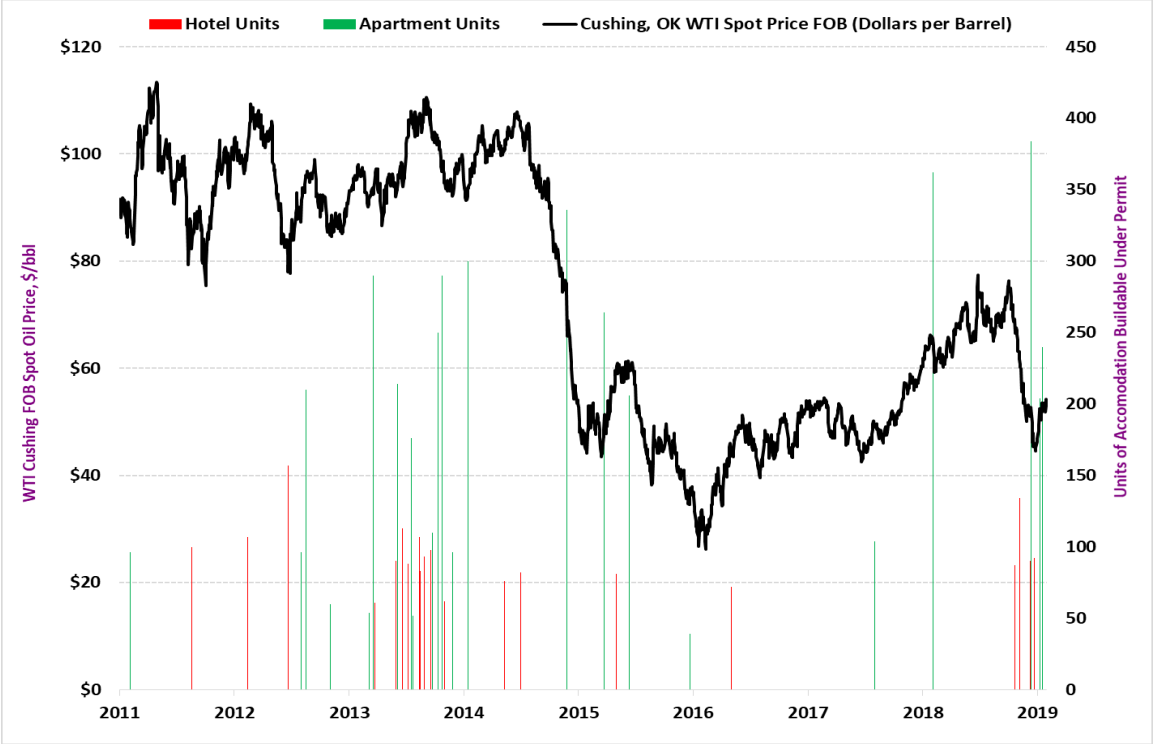
This author's working hypothesis is that in an uncertain oil price environment coming on the heels of a multi-year price downturn, investors' default position will likely be "build to the minimum expected oil price" or in many instances, stay on the sidelines until prices improve. Put simply, if a real estate project can generate cashflow with WTI at $40/bbl, then it delivers outsize returns with WTI at $65. Or perhaps it does not get built at all if an investor is more risk-averse or in the case of larger investors, if oil price exposure in the Permian makes projects elsewhere in Texas or the US more attractive on a relative basis as they compete for capital in the investor's portfolio.

Either path significantly raises the probability that critical supporting infrastructure for oil & gas activity—i.e. places for workers and their families to lay their heads each night—will turn out to be insufficient for even mildly positive oil price environments (anything above $50/bbl for WTI Midland). This contributes to the boomtown price phenomena of hotel room that should go for $125/night instead commanding $500/night during peak demand periods and Midland recently having the highest average apartment rental rates in the entire state of Texas.[14] It also helps explain the proliferation of "man camps" (temporary housing) throughout the Permian Basin.

Empirical data from Midland support the likely outcomes suggested by the economic studies referenced above. As an example of how commodity price risk can alter investors' willingness to respond to market demands, consider the dramatic slowdown in the apartment and hotel units permitted by the city of Midland, Texas following the 2014 oil price crash (Figure 6). Despite strong growth in oil production volumes and associated services activity and meaningful increases in local labor force numbers, developers slammed on the brakes in 2015 after frenetic permit issuance in 2013 and 2014.

Part of the slowdown could be attributed to the fact that in 2013 and 2014, the city granted developers permits for a combined total of 1,075 hotel rooms and 2,168 apartment units. But the fact that the labor force in Midland County alone rose by more than 5,000 persons between January 2015 and January 2019 and by more than 14,000 persons in the contiguous counties casts doubt on a backlog alone being the key factor behind slow apartment and hotel permitting between 2015 and late 2018.

Figure 6. Construction Permits Issued for Apartment and Hotel Units in Midland, Texas vs. WTI Cushing Crude Oil Prices



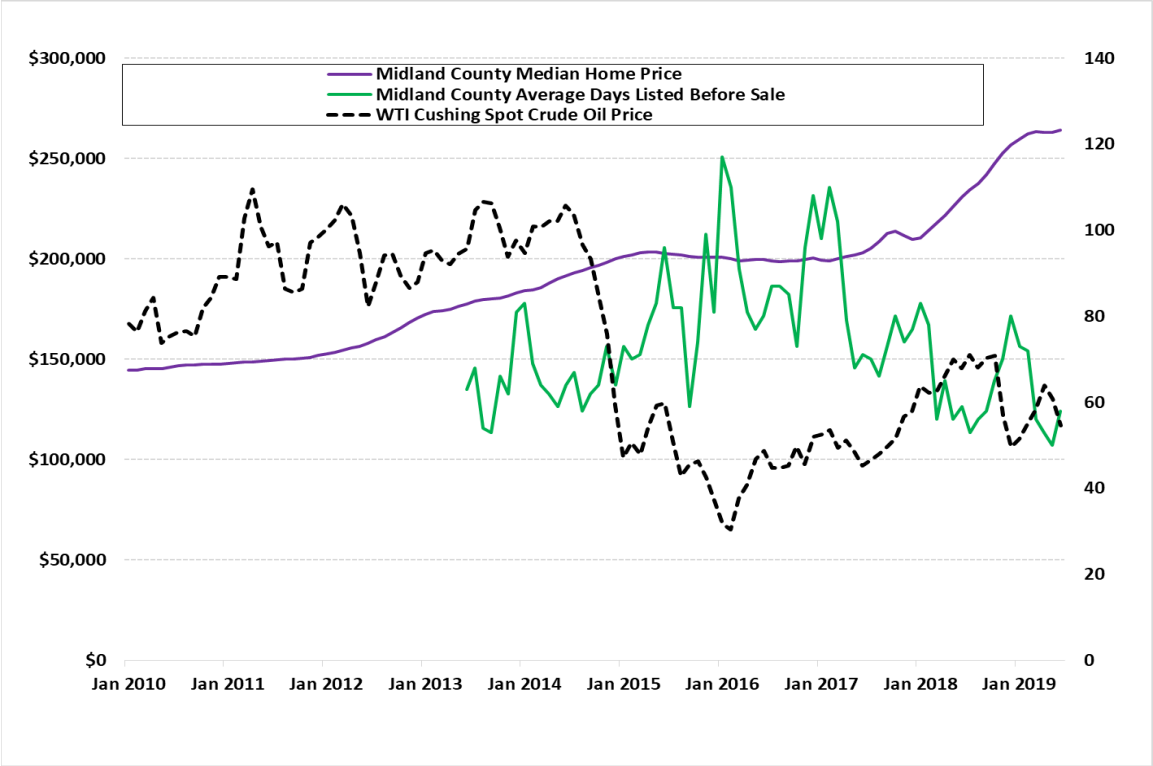
Source: City of Midland, EIA, Author's Analysis

The magnitude of labor force population increases during the oil price downturn, combined with that fact that home prices, apartment rents, and hotel room rates stayed strong through nearly the entire duration of the low oil price period suggest that demand in fact would have been sufficient to stimulate new construction beyond actual levels, had private investors been less spooked by oil price swings. Take for example the fact that Midland County's median home price remained steady through the worst of the downturn despite the time needed to sell a house spiking above 100 days during the oil price nadir in January 2016 and during a second period of uncertainty in late 2016/early 2017 (Figure 7).

Insufficient permanent housing capacity can weaken municipal finances on two primary levels. First, workers who only stay in town from Monday through Thursday are likely making the bulk of their retail purchases in other places, especially if they come solo to work and then return to their families in another city for weekends, a common practice

throughout the Permian. Second, the RVs, man-camps, and other temporary shelters that house transient workers do not expand the local real estate tax base.[15] This is a particularly critical vulnerability in Texas, where property taxes are an important contributor to municipal tax revenue since there is no state or local income tax.

Figure 7. Median Home Value and Time on Market for Midland County, TX vs. WTI Cushing Crude Oil Spot Price



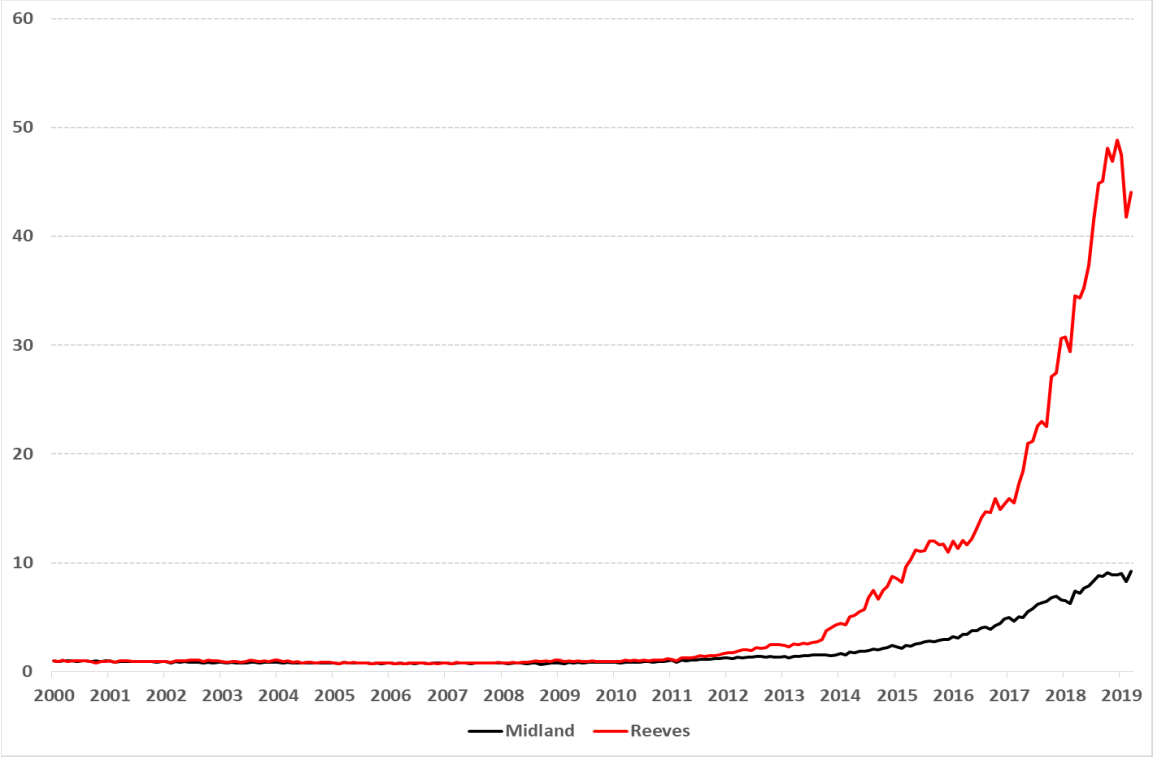
Source: EIA, Zillow, Author's Analysis

Furthermore, a lack of affordable housing can effectively price out lower-earning workers such as teachers and health care staff, who play irreplaceable roles in communities' ability to persuade workers to settle full-time with their families in a place like Midland or Pecos, rather than commuting from Dallas, Houston, or San Antonio. Housing shortages in Midland and Odessa have become sufficiently acute that the Midland Independent School District purchased two apartment complexes in June 2019 to make them available to teachers and school staff, while the Ector County Independent School District has struck at least one deal with an institutional landlord to make apartments available to school employees at discounted rental rates.[16] Strategic housing investments aimed at assisting teachers, first responders, and others who are not paid at oilfield levels, but are an integral part of the community's social fabric and wellbeing offer a potential community investment leverage point for companies operating in the Basin.

Uneven Distribution of Financial and Political Capacity Across the Permian Basin

Communities across the Permian do not have equal capacity to construct and maintain community infrastructure in the face of a sustained resource boom. This is particularly the case in the Delaware Basin, where the overall population is lower, communities are smaller and less well-resourced, and where oil and gas production has grown explosively off of a lower base than was the case in the Midland Basin. Take for instance production in Midland County (the Midland Basin's productive center of gravity) and in Reeves County, the production leader for the Delaware Basin. Using January 2000 as the starting point for an index in which that month's production equals "1" for each county, by March 2019 the combined output of oil & gas in Reeves County rose 45-fold from its January 2000 level, while Midland County's combined production rose by just under 10-fold (Figure 8).

Figure 8. Oil & Gas Combined Production Growth in Midland and Reeves Counties Since 2000 (Index, January 2000=1)



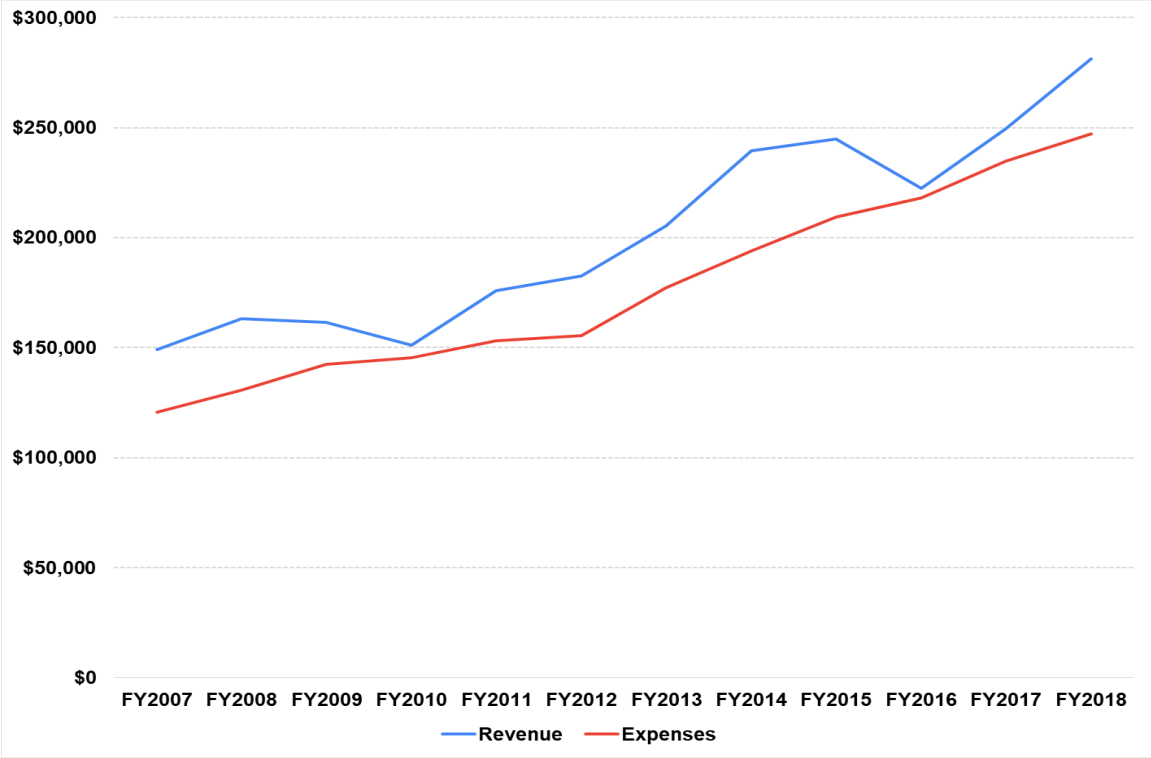
Source: Texas RRC, Author's Analysis

Both growth trajectories are phenomenal, but the magnitude of growth in Reeves County is especially high (Loving County has experienced and production growth of a similar magnitude). Smaller Delaware Basin counties and their communities do not have Midland and Odessa's economic and institutional capacity for meeting the formidable—and rapidly manifesting demands—that unconventional oil & gas development can place on a community. As such, the relative impact of the boom on

community infrastructure will be even more pronounced in the smaller Delaware Basin communities.

Municipal budgets offer a window of insight into a community's capacity to cope with the shale gale's force. The City of Midland's average revenue now approaches $300 million per year (Figure 9). This figure pales in comparison to the annual capital budgets of the Basin's larger oil & gas producers such as Concho Resources, whose anticipated 2019 CAPEX budget is roughly 10 times larger than Midland's municipal revenue.

Figure 9. Midland, Texas Municipal Revenues and Expenses ($000/year)



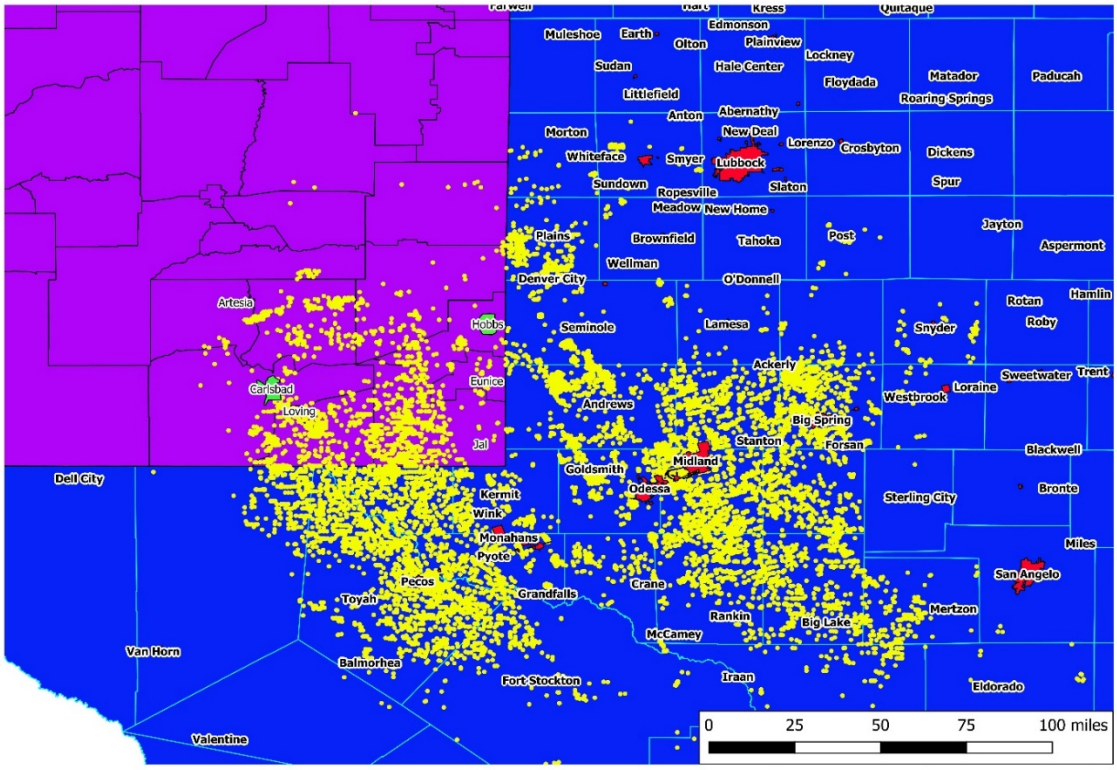
Source: City of Midland CAFR Reports, FY2008-2018

Yet communities such as Pecos find themselves in a much tougher fiscal position. Pecos, which we'll use as a proxy for smaller Permian Basin cities, only has about 1/10 the annual revenues of Midland despite the fact that the surrounding area is roughly as productive for oil and gas and is a beehive of activity. Thousands of wells have been completed in the past four years, as attested to by the yellow points shown in Figure 10, which plots well completions reported to FracFocus since early 2015.

Strong drilling activity continues. As of 23 August 2019, Reeves County hosted 53 horizontal drilling rigs according to Baker Hughes—more than Midland and Ector counties combined.[17] With resource development relentlessly pushing ahead, demands on community infrastructure will continue to accrue. Budget planning documents and public statements from officials throughout the Permian Basin indicate that they broadly

"get it" when it comes to the scale and importance of the community infrastructure challenges faced. The more pointed questions thus become (1) "how are communities moving from recognition to action, (2) "how can corporate entities benefitting from the Basin's prolific mineral resources potentially engage," and (3) "what specific private sector actions make the most sense given that the Basin offers a background environment that is in many important ways vastly different from what oil & gas developers have encountered in developing countries without the reasonably strong pre-existing physical and institutional infrastructure present in much of the Permian?"

Figure 10. Differential Impacts of Activity Especially Pronounced in the Sparsely Populated, But Hugely Productive Delaware Basin



Source: Census Bureau, FracFocus, Texas DoT, Author's Analysis

What Drives Corporate Engagement with Communities in Resource-Rich Regions?

Corporate investments by oil and gas producers in community institutions and infrastructure historically stem from several core motivations. The first set are those taken to improve local (and in many cases, global) perception and reputation of the company.[18] The second category is acts of corporate philanthropy and community investments aimed at placating various local interests who may feel "left out of" money flows from local resource development. The third category of motivation for corporate investments in community infrastructure is the reality that left unchecked, community infrastructure

limitations can become a bottleneck on development and strand resources. *In some cases, impairments can become sufficiently large that they negatively impact the overall valuations of firms working to develop a resource, a phenomena that has already happened with certain Permian-focused oil & gas producers.*[19] The fourth category of corporate investments in community infrastructure are those actions taken to compensate for local governments' lack of capacity or will to execute essential support infrastructure projects.

In Practice, Objectives of Investments in Community Infrastructure are Intertwined

In practice, these motivations are often intertwined and actions may simultaneously serve multiple end goals. For remote sites that are in less-developed countries that often lack reliable basic infrastructure such as all-weather roads, drinking water and sanitary sewer service, electrical power, medical clinics/hospitals, and schools corporate investments can help convince communities to support a resource development project whose rents will predominantly flow to far-away government and corporate entities. They also facilitate resource development, since better roads mean faster movement of materials, access to cleaner water and medical services mean healthier and more productive workers, and education can over a span of years help mold a more productive pool of local workers.

Investments aimed at placating local interests who feel bypassed by the economic benefits of a resource development boom become especially important in areas where rents flow primarily to the government (particularly central governments) and the developer corporations. Perception-based investments may not yield direct bottom line benefits for a corporate actor in the near-term, but they help maintain social license to operate over the longer term. This paper adopts the following definition of social license:

> *The demands on and expectations for a business enterprise that emerge from neighborhoods, environmental groups, community members, and other elements of the surrounding civil society.*[20]

Maintaining a well-stocked social capital account can help pre-empt local opposition to operations that in a worst case can delay or entirely foreclose development of a resource. Even in Texas and even in cases where the oil & gas sector is an important employer, companies cannot assume that social license to operate is perpetual. Those who do can find themselves the target of community opposition that in more extreme cases could broadly and significantly curtail industry operations.[21] The United States also differs from many overseas jurisdictions because well—funded national environmental groups can file lawsuits and pursue other pressure actions that elevate what are often local concerns into a state-level or even federal issue.[22] Such organizations do not need to obtain majority support within the local community to file suit, as a handful of plaintiffs generally suffices. As such, even a generally pro-industry environment such as the Permian Basin can still yield robust challenges to firms' practical ability to develop the resource deposits they've invested in. This adds another layer of motivation for community infrastructure investments that demonstrate

resource developers' substantial commitment to the community and which generally result from a process of deep engagement that can alert them early to potential challenges to their social license, allowing them to respond with maximum effectiveness.

Sharpening this point, many of the companies involved are either "pure play" firms with all of their resource holdings in the Permian Basin or derive an increasingly material portion of their production from the Permian.

On the negative (but lower probability) side of the ledger, opposition to their operations could become an existential challenge to the firm's value. And on the positive (and high probability) side of the same ledger, such firms' Basin-specific asset concentration, activities and investments that improve the local operational environment will, all else held equal, likely benefit corporate valuations.

To that point, targeted corporate investments in community infrastructure may actually yield greater benefits with oil poised to stay "lower for longer." When oil sells for $100 per barrel, infrastructure "band aids" such as housing workers in man camps, flying doctors in for the week to staff hospitals at significant extra expense, paying truck drivers more than $100,000 per year, and having run of the mill apartments leasing for $1,500 per month can be afforded. But when oil heads into a "lower for longer" regime where the price may fluctuate between $45 and $65 per barrel for years to come, costs start to matter. And community infrastructure both directly reduces costs—by having enough housing and hospitals, for instance—and also improves the efficiency of resource extraction (better roads). Investments in community infrastructure can also yield dividends through increasing the attractiveness of Permian Basin cities as places for workers to consider setting down longer term roots (affordable housing and better schools) as opposed to flying in from Houston on Monday and flying back on Thursday night.

Corporate Responses to Community Infrastructure Needs in the Permian Basin

Commercial actors in a fast-growing resource development play are well-positioned to engage with local and regional political and non-governmental institutions. Those most directly exposed to the economic upsides conferred by efficient development of the resource also have substantial incentives to align their field-level growth plans and private infrastructure investments with the investments in community infrastructure necessary to create a foundation for smoother, long-term growth.

What types of investments are companies making in community infrastructure?

Companies have followed several broad models of community infrastructure investment to date in the Permian, including:

- large, high-dollar public/private partnership projects such as Pioneer Natural Resources' agreement to upgrade Midland's wastewater treatment plant in exchange for guaranteed offtake of treated effluent for oilfield use;
- smaller, ad hoc investments in services providers needed by employees such as the Primrose School recently constructed in Midland with support from Anadarko, Chevron, EOG, and Oxy[23];
- smaller, ad hoc investments in community amenities that don't specifically benefit the company, such as XTO's funding of part of the Dennis the Menace Park project in Midland[24];
- investments through, or in collaboration with local philanthropic groups and an industry consortium such as the Permian Strategic Partnership.

The Consortium-Based Approach to Community Infrastructure Investment

The Permian Strategic Partnership deserves special attention, as its structure reflects a dynamic unique to the Permian Basin. Unlike overseas situations where somewhere between one and perhaps five companies dominate oil & gas production operations in an infrastructure poor area—such as Shell in the Niger Delta or ExxonMobil and OilSearch in Papua New Guinea—the Permian hosts hundreds of operators. Of these operators, 25 account for about half of Basin output. The Basin's diverse slate of producers and service companies creates a potential collective action problem, and the PSP's formation is oriented at least in part to help solve this.

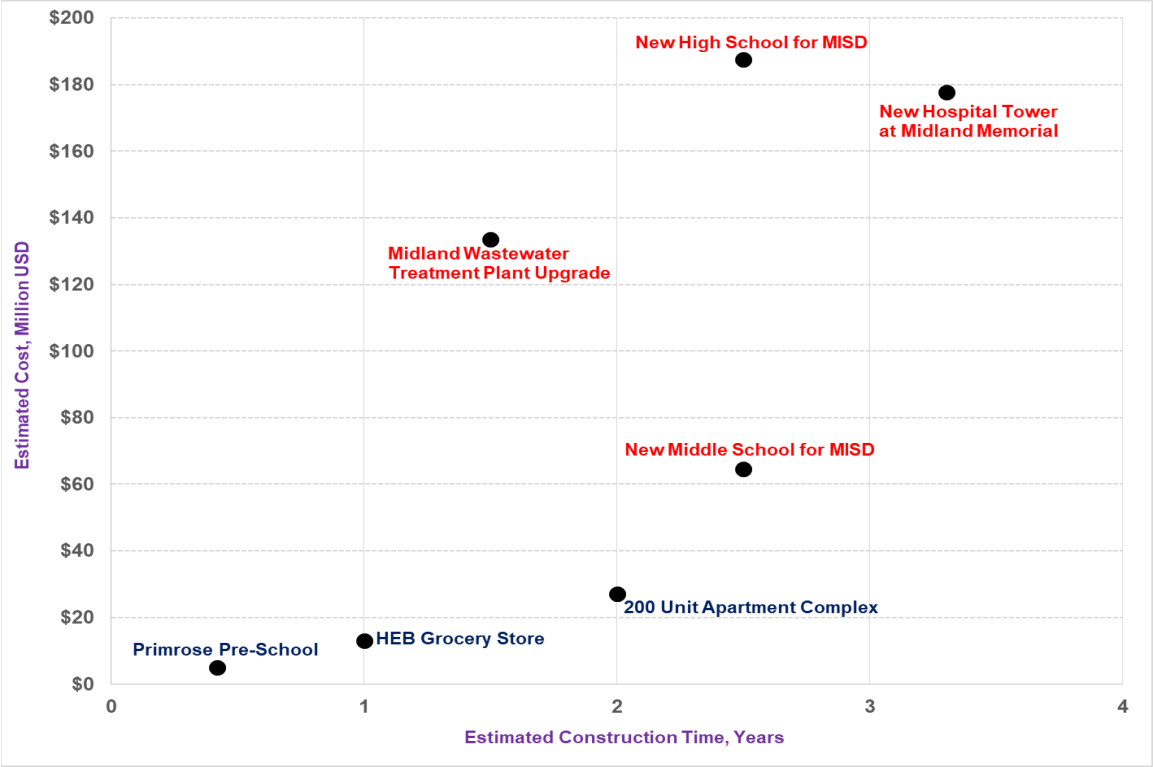
The PSP is a private coalition of energy producers whose mission is "…to improve the quality of place for Permian Basin families by partnering with local leaders to develop and implement strategic plans to foster superior education, accessible housing, a supportive healthcare system, safer roads, and workforce development."[25] As of November 2018, the PSP had committed to provide "more than $100 million over the next several years as seed money to spur additional private sector investment."[26] Five areas comprise the PSP's core priorities: (1) safer roads, (2) improved schools, (3) quality health care, (4) affordable housing, and (5) workforce development.[27]

Each of these focus zones offers opportunities for joint public-private investments, where companies can facilitate community infrastructure development but leave the prime mover and project execution roles to local and state government. Initial evidence also suggests the PSP will play a role as a de facto lobbying group for situations where oil industry infrastructure needs coincide with those of Basin communities. For instance, road needs invoke the Texas Transportation Commission, whose data currently show $353 million worth of projects allocated for the Texas Permian Basin from 2020-2022. West Texas is economically vital but has relatively few people compared to the Triangle and Rio Grande Valley, which demographically dominate the Texas legislature. Accordingly, an industry consortium like the PSP can help ensure a stronger voice in Austin and secure needed resources for maintaining and upgrading local transport infrastructure.

It is likely that cost of the infrastructure in question heavily influences the path taken. If the item needed is a $5 million dollar housing complex that costs half of what it takes to drill and complete a single horizontal oil well, a company would likely undertake the project itself. However, if the item is larger and is truly community-focused, such as building a new school, road, or a hospital addition involving more than $100 million, the companies will either defer to local governments that can fund projects through a bond issue or contribute a minority share of "seed money" to help attract a mix of private and public capital. As an example, consider the recent collaboration to fund the construction of 14 IDEA schools in Midland and Odessa by 2025, with $16.5 million of initial funding coming from the Permian Strategic Partnership alongside $28.5 million pledged by local foundations.[28]

Blue font in Figure 11 denotes projects carried out by private investors, while the red font indicates a project that is either public investment (often funded through bond sales) or a public-private partnership (Midland wastewater treatment plant upgrade). One trend become immediately apparent: private investors prefer projects with shorter construction times and lower capital requirements. This likely stems from their desire to minimize project risk and avoid having capital tied up for too long before an asset enters service and can begin amortizing itself.

Figure 11. Cost of Selected Community and Other Infrastructure Items Needed in Permian



Source: CBS7, KHOU, Midland Reporter-Telegram, MISD, Author's Analysis

Public-private partnerships are an area that remains broadly underutilized in the Basin. Pioneer Natural Resources is a notable exception, having struck two deals with the Cities of Midland and Odessa to upgrade municipal wastewater treatment facilities (Midland) and purchase treated effluent (Odessa). Pioneer's investments depart somewhat from the community infrastructure framework used throughout this paper because they use a directed corporate investment or long-term purchase commitment that underwrites improvements to a city's infrastructure and bolsters municipal financial health, but in this case renders the water produced a captive asset exclusively accessible to Pioneer. In contrast, firms that invest in roads, schools, parks, and other such items are creating infrastructure capacity that is more broadly usable both by the public and by other commercial interests.

Policy Lessons

The multi-million dollar question is "how globally applicable are the corporate engagement lessons operators are now learning in the Permian?" The preliminary answer is "not very." West Texas and Eastern New Mexico have:

- a long prior history of hydrocarbon production;
- a substantial pre-existing infrastructure base and a generally high level of community support for energy production and transportation assets;
- enjoy strong rule of law and predictable regulatory environments (particularly in Texas);
- do not suffer from violent unrest;
- have stable and (generally speaking) highly motivated and capable local government institutions that support industry activity and want companies to pay their fair share to offset costs imposed on the community, but are not corrupt and rapacious; and
- do not require nearly as high a level of corporate contributions to community infrastructure projects per barrel of oil produced as overseas projects have.

These characteristics set the Permian apart from nearly every other actual and prospective global unconventional oil and gas province. However, despite specific differences in pre-existing conditions, the process of corporate engagement with community infrastructure shortfalls in the Permian Basin reveals several core strategic challenges also faced by major resource producing areas outside the US.

Key Challenge: Where to Invest in Community Infrastructure?

Challenge one is where to prioritize investments both by sector of need (e.g. roads vs. schools vs. hospitals) and by geographical location (e.g. Midland-Odessa vs. Pecos vs. Hobbs vs. Carlsbad). PSP member companies operate all over the Basin, but with limited resources, there may be a push to prioritize certain sectors and communities over others. For example, companies seeking to re-locate white collar staff may

prioritize schools, healthcare, and other items geared to maximize attractiveness to families.[29] They will also likely prioritize making such investments in the Midland-Odessa, since this is where most firms have their Basin headquarters and because families moving in from the Houston or Dallas areas would likely much rather live in Midland than in Big Lake, Monahans, Pecos, Kermit, or Jal. Such decisions carry a high probability of having the large Basin metros—particularly Midland and Odessa—see infrastructure challenges more decisively addressed, while low-population areas such as Loving and Reeves Counties will bear heavy long-term impacts that are less likely to be comprehensively addressed and could outlast the boom.

This challenge is already manifesting. In July 2019, the PSP announced a $16.5 million commitment to support construction of IDEA charter schools in the Midland-Odessa area.[30] Then, in September 2019 came an announcement that attracted less public attention: the PSP would provide $250,000 to Eddy County and $250,000 to Lea County to "strengthen their ability to successfully compete for state, federal and private grant programs."[31] While the organization's decision to branch into New Mexico is laudable, a $500 thousand outlay spread across multiple communities begins to look disproportionately small relative to the local impacts of the oil and gas boom and the fact that Eddy and Lea are now respectively the 4th largest and the largest volume liquids producing counties in the entire Permian Basin.[32]

The immediate emphasis on training Eddy and Lea County communities to apply for grants from other funding sources risks creating the perception that the PSP will operate in a Midland-centric fashion, even though the burdens of the boom may arguably be more intense on a relative level in other areas of the Basin that lacked Midland-Odessa's pre-existing capacity and infrastructure base. Furthermore, the PSP and individual operators can—and probably should—be prepared to invest more in Southeast New Mexico community infrastructure to offset the "taxation without sufficient representation" situation currently faced in Eddy and Lea County.

This is in no way a knock on the hardworking state representatives and senators from Southeast New Mexico. Rather, the statement grows from the reality that these two counties produced more than 90% of New Mexico's oil and over half of its natural gas in Fiscal 2018, but only account for about 6% of the New Mexico population. As such, they are proportionately under-represented in the New Mexico Legislature despite the fact that revenues they generate are indispensable to the state's fiscal health and among other things, underpin public school funding statewide.[33]

New Mexico's demographic centers of gravity in the Rio Grande Valley (Albuquerque metro, Las Cruces, and Santa Fe) covet oil & gas revenues that are predominantly generated in Southeast New Mexico, but are reluctant to strategically reinvest in the community infrastructure of these economically critical resource producing regions. In this respect, the Southeast New Mexico Permian Basin faces a situation somewhat resembling that of certain countries abroad where central governments hoard resource revenues at the expense of politically under-represented sub-regions of the country

where the resources are actually produced and which bear the burdens of resource extraction operations.[34]

The current situation is unlikely to be resolved politically because the main population bases of New Mexico remain inextricably tied to the economic benefits conferred by oil & gas revenues, but are increasingly detached from the producing areas in cultural, political, and geographical terms.[35] Accordingly, corporate and NGO-driven investments may be critical to: (1) provide seed capital that can then be used to try and catalyze supplementary funding from state and federal political bodies (best case scenario) or (2) help compensate for state governments' reluctance to share sufficient resource revenues with the county and local governments in producing areas.

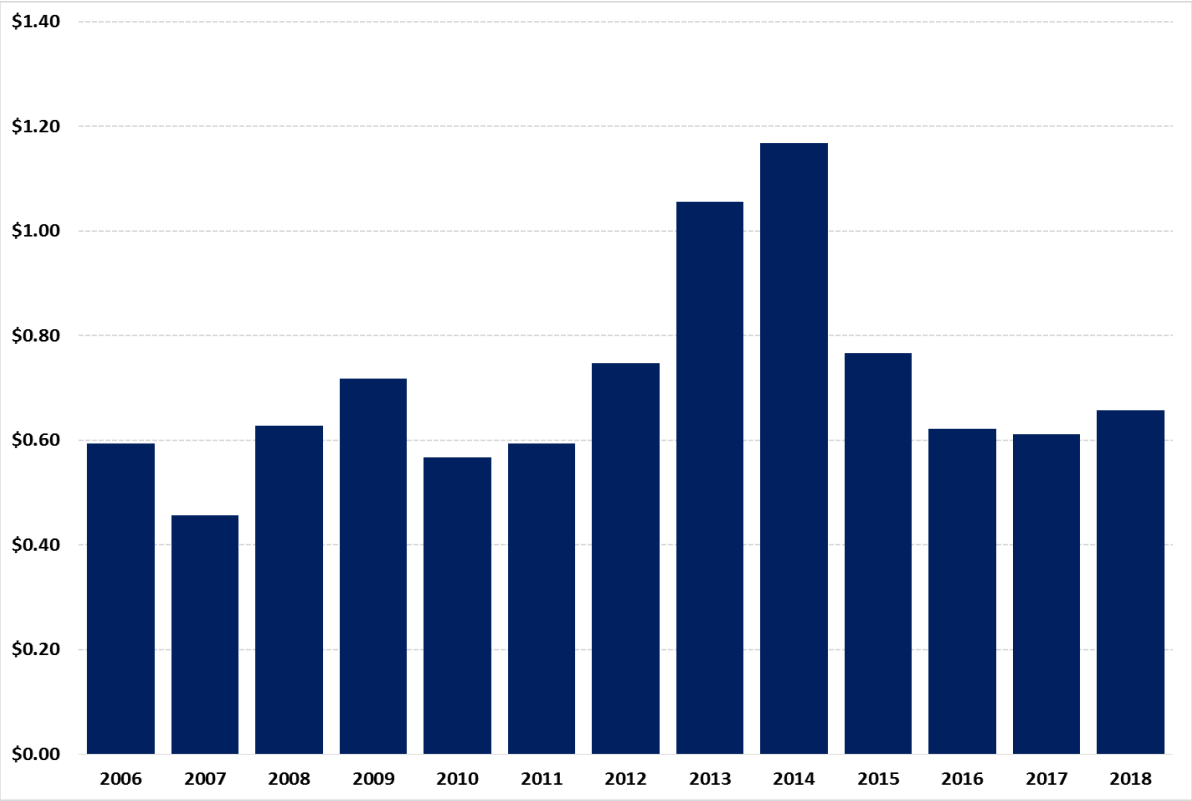
Key Challenge: Using Perspective To Persuade Energy Developers to Voluntarily Invest in Community Infrastructure

Challenge item two is to facilitate voluntary corporate support for community infrastructure by helping Permian operators realize that the burden of investing in community infrastructure is small relative to the returns they can make from the oil & gas operations that utilize the infrastructure in question. To contextualize Permian community investment levels, consider the level of spending in Nigeria, where corporate investments in community infrastructure are a key component of doing business. Nigeria gives a sense of how high producers' community investment levels might have to go in an environment lacking the significant local financial and institutional capacity that already broadly exists in the Permian. Corporate data from Shell show that in 2018, the company spent $0.66 per barrel of oil equivalent produced on community infrastructure and programs (Figure 12).

Applied Basin-wide to the Permian's August 2019 production of 6.7 million barrels of oil-equivalent per day, the Nigerian benchmark would suggest an expenditure on community items of $1.6 billion per year. The actual level of corporate investment in community infrastructure by oil & gas producers and services companies (i.e. items not directly tied to a specific business asset) in the Permian is far lower—probably $50 million/year or less at present.

Community investment levels could rise higher if oil prices stay high enough to sustain drilling and completions activity growth, but will likely never approach the per boe level required in a place like Nigeria. This in turn reflects a critical difference between corporate investments in community infrastructure in the Permian and those made in frontier destinations: Permian operators can give local governments a financial "boost" through seed money for projects, but do not have to fill in voids caused by institutional weakness, corruption, or incompetence (which often simultaneously afflict government structures in those resource-rich zones abroad that actually allow international oil companies to invest).

Figure 12. Shell Nigeria Community Investment Per BOE Produced



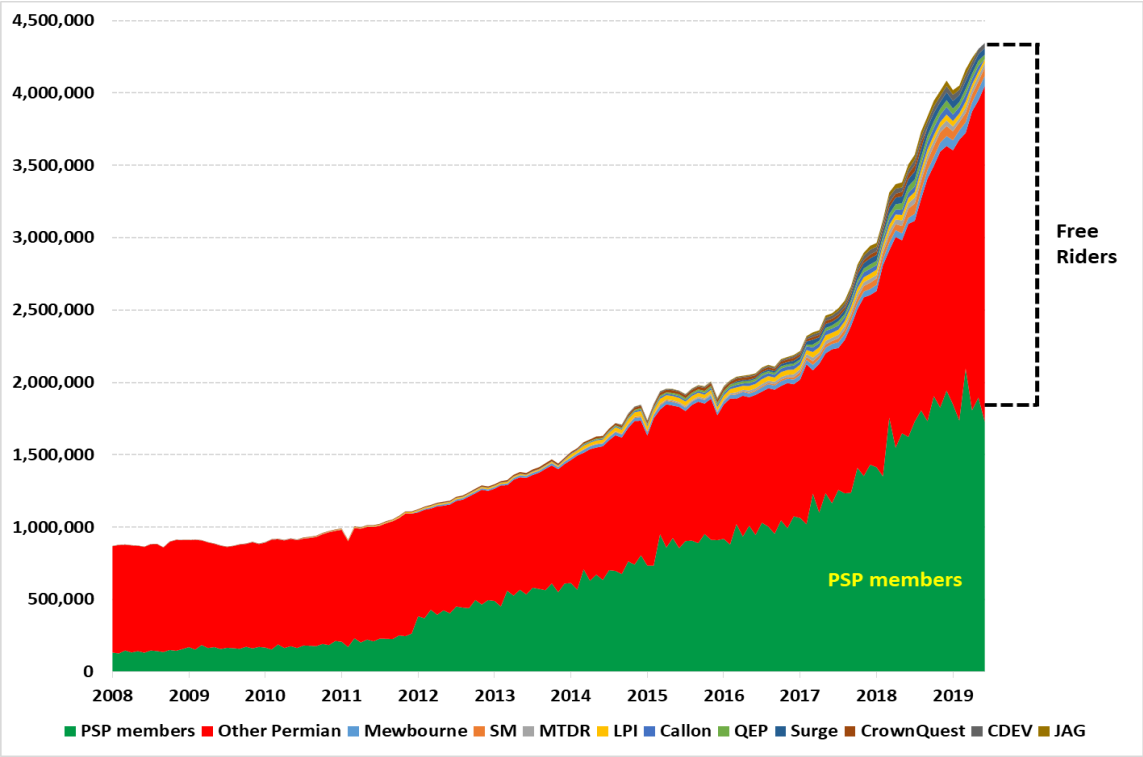
Source: Company CSR Reports, Author's Analysis

Key Challenge: The Free Rider Problem

Challenge three is the "free rider" problem. PSP member companies currently account for 40-to-45% of Permian Basin oil production in a given month (Figure 13). In other words, when it comes to consortium-based community infrastructure investment activities, 20 firms are bearing community investment costs whose fruits ultimately nourish all of the 100-plus operators actively drilling wells in the region. Only Halliburton and Schlumberger belong to the PSP on the oilfield services side, leaving hundreds of other firms to free-ride on commonly usable infrastructure. And on the midstream side, only Plains All American currently belongs to the PSP.

The disparity between PSP participation and operational presence in the Basin highlights not only a challenge (and arguably) an inequity in cost sharing. Rather, it suggests there is a huge opportunity to get more companies involved as partners for regional cities and counties for building shared community infrastructure. This complex mass of firms will almost certainly not agree to being housed under a single community investment umbrella, and the Basin may be better off for that. But what is clear is that certain firms' decisions to stay on the sidelines and have others bear the costs of community infrastructure investment may be rational in a textbook economic sense, but is detrimental to the Basin's ability to rapidly adapt to the molecule, freight, and human tsunamis it now must cope with.

Figure 13. Companies by Permian Oil Production vs. PSP Membership



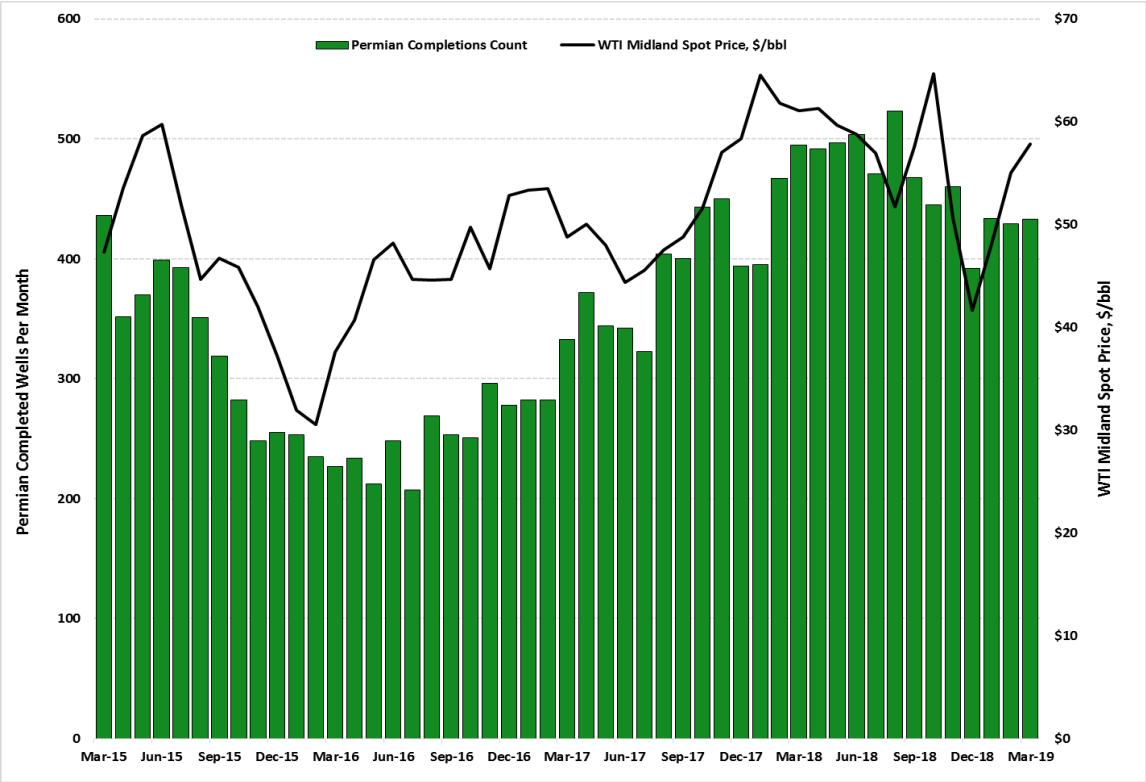
Source: EIA, NM OCD, PSP, Texas RRC

Furthermore, there are other business sectors who avail themselves of community infrastructure including wind power, large retailers (Wal-Mart), and transportation services companies. These firms should get more involved in supporting community infrastructure investments than they currently are.

Key Challenge: Managing Community Infrastructure Engagement Amidst Uncertainty about Future Demand

Challenge three is how to manage investment levels amidst volatile commodity prices and the fact that the Basin may be shifting onto a slower production growth path than previously expected. These dynamics are complicated and influence each other. Drilling and completion activity in the Permian tracks commodity prices, with meaningful slowdowns once WTI Midland falls below $45/bbl (Figure 14). Over the past two years, producers have become efficient enough that completions activity remains strong so long as WTI Midland is at $50/bbl or higher.

Figure 14. Permian Completions vs. WTI Midland Crude Oil Prices



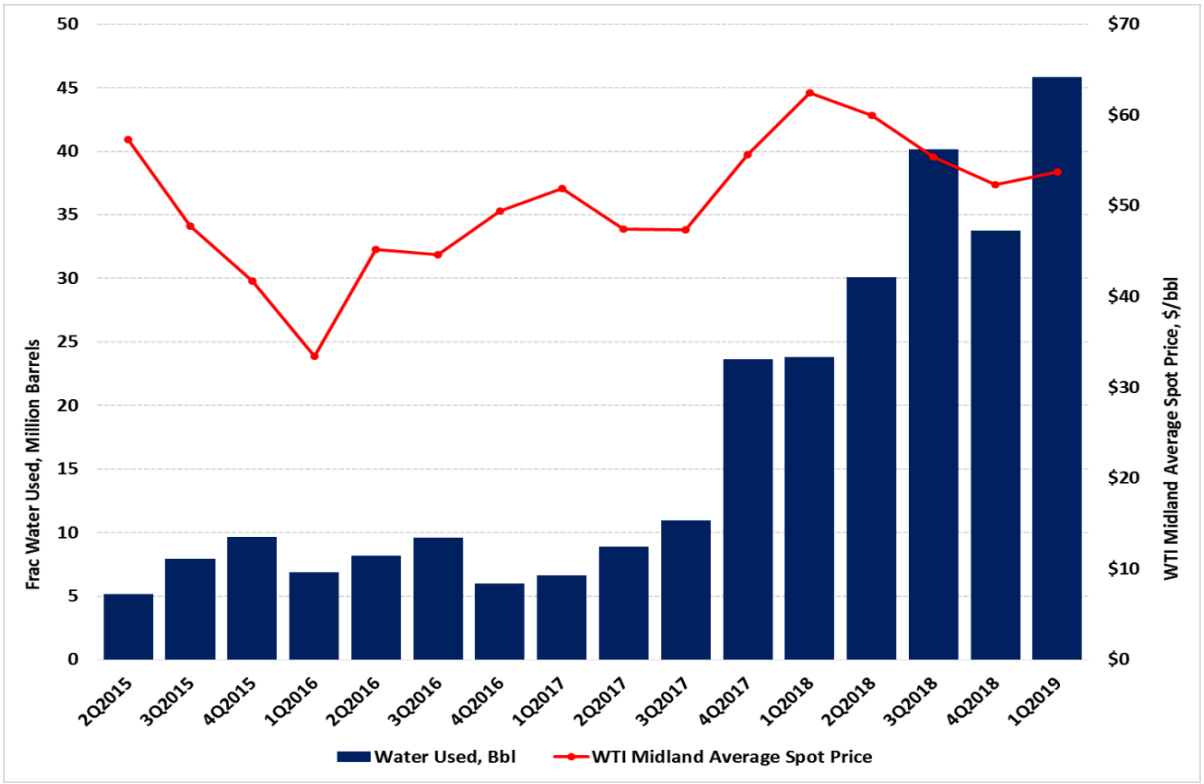
Source: Bloomberg (Prices), FracFocus (completions)

Concurrent with oil price movements, Permian operators are recalibrating their expectations for the number of well locations that may be geologically accessible at a given price level. For instance, imagine wells that were to be horizontally spaced 440 feet apart and were expected to yield a million barrels of oil apiece over their lifetime at an average price of $65/bbl and a defined drilling & completion cost. If parent-child interactions lower oil production per well to 650,000 barrels, either wells need to be spaced much further apart and cost less to drill and complete or oil prices need to average 35% higher to compensate. With so many moving parts, companies are likely to approach geological uncertainties by spacing wells more conservatively, which reduced the ultimate number of expected drilling locations across the Basin and trims the activities that ultimately drive demands on community infrastructure.[36]

The rise of the Majors in the Permian is also likely to shift operational patterns, even if production growth remains strong. The independent firms who have dominated the Permian for much of the boom period generally operate on a quarter-to-quarter planning basis. Higher oil prices mean "drill and complete as fast as possible" and lower prices cause slowdowns. Firms like XTO (ExxonMobil), Chevron, and Shell take a much different approach. On the front end of a development, their process appears ponderous relative to the nimble independents who may turn on a dime in response to market changes. But once a Major begins a drilling program and the unconventional reserves become just another portfolio asset, the progression of development is

relentless and is generally largely immune to near-term commodity price shifts. Here we use XTO, which is now the single most active driller among Majors in the Permian. This particular example uses XTO's volume of frac water pumped to measure activity, as this metric better captures the shift toward both horizontal wells and towards wells with longer laterals. Once XTO's completions ramp up in 4Q2017, activity continues to grow strongly despite oil prices actually gradually weakening during four of the last 5 quarters charted (Figure 15).

Figure 15. XTO Frac Water Pumped in Permian by Quarter vs. Average WTI Midland Oil Price



Source: FracFocus

Furthermore, the Majors' large acreage positions, deep balance sheets, and longer time horizons generally see them take a more comprehensive approach to a project, including supporting infrastructure and services. Altogether, this leads to a more stable development pattern, which is more readily adaptable by those who fund and construct housing, schools, water systems, roads, and other community infrastructure.

VII. Conclusion

Permian Basin community infrastructure constraints present a unique opportunity—and a singular set of challenges—for corporations that derive a material portion of their market valuation from Permian operations. Over the long-term, housing, schools, and medical care will be among the most perennially challenged community infrastructure

sectors. A groundswell of oil and produced water pipeline capacity coming online will help alleviate the burden placed on regional roads. Pipeline investments are also private endeavors, which shifts the largest logistical costs of oil & gas development more firmly back onto corporate balance sheets, as opposed to road infrastructure funded by public tax levies. Road burdens will remain significant, but greater access to crude and water pipelines can reduce the local road load by hundreds of thousands of tonnes per completed well.

Disruption factors may also reduce the demand call on community infrastructure in the Permian Basin. Automation comes foremost among these, since greater drillsite, frac site, and production wellsite automation could significantly compress the demand for oilfield labor. If pipelines move tonnage off of roads and automation displaces more of the field hands currently moving about in the ubiquitous white Ford, Chevy, and GMC pickups so beloved by services providers, pressure on roads and housing are both relieved. Automation may also change the composition of workers facing relocation into the Basin, favoring white collar technical staff based on Midland who are likely to bring their families, as opposed to living two weeks on/one week off in a man camp as many field workers do.

The Permian Strategic Partnership--along with other local consortia, chambers of commerce, and municipal governments--appear to be on the right path when it comes to handling the Permian community infrastructure challenge. They are approaching the problem in a measured manner that can be scaled up rapidly for effect, but also scaled down if activity slows. Unifying efforts through a consortium—whether the PSP or another forum—also helps optimize investment by reducing the risk of duplicative efforts. Emphasizing provision of "seed money" but letting government entities and their chosen subcontractors actually execute large infrastructure projects is a wise approach, as it reduces the risk that private corporations are seen as supplanting local governments, a dynamic oil & gas firms have periodically suffered from abroad.

Corporate funders will have to careful to encourage cities to adopt fiscal approaches that ensure they can meet expenditure needs. For instance, municipalities may in some cases need to increase tax rates to underpin investment in critical community infrastructure and maintain the will to do this even if such increases are, on their face, politically anathema in West Texas and Southeast New Mexico. If state governments are not willing to share revenue and private sector firms are not willing to financially support community investments, communities might also consider additional local taxation on equipment, activity, or resource severance itself (although this could prompt legislative pushback and raise political and legal questions about local control).

For-profit entities who are currently free riding on others efforts should contribute more. Greater participation in community infrastructure consortia likely cannot (and probably should not) be politically mandated. Smaller firms, and those backed by private equity sponsors with scant appetite for expenditures that do not immediately accrue to the bottom line are less likely to contribute voluntarily. There is an argument

that participating firms should informally encourage free riders to contribute to community infrastructure developments proportional to their respective means, even if small. After all, every Basin operator and service company uses the roads, has kids in schools, periodically goes to the doctor, et cetera.

If the Permian boom continues and firms continue to step up their engagement with community infrastructure, the Permian Basin's unique circumstances may help it become one of the few true success stories of oil & gas producers re-investing in the community and producing lasting gains for both companies and local communities.

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