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GULF OF MEXICO CONGESTION RISK: SIZING UP THE CAPACITY TO EXPORT US CRUDE VIA VERY LARGE CRUDE CARRIERS (VLCCS)

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The Permian Basin is one of the great US shale oil success stories. Located in West Texas and New Mexico, the basin has seen one of the biggest increases in output of any oil shale region, but it has stumbled on insufficient infrastructure to move new production barrels to market and faced severe price discounts as a result. In response, significant investments are being made to gradually resolve that ex-Permian bottleneck and bring those barrels to the Gulf Coast refining center.

However, the US refining network alone cannot fully absorb additional volumes of Permian crude. As a result, US oil exports from the Gulf of Mexico have already increased sharply and will continue to grow to accommodate Permian and other US crude production growth. Concerns are now growing that coastal infrastructure bottlenecks will limit waterborne crude exports. Until Gulf Coast export bottlenecks are also resolved, Permian producers will likely continue to face severe price discounts that could impact profitability and ultimately constrain incremental increases in oil production.

In the space of little more than a decade, US natural gas production has increased by 50 percent, and crude oil production has doubled — to volumes that are quite literally more than the US market knows what to do with. The United States has already become an energy exporting superpower since energy exports were fully legalized just a few years ago. Gross movements of waterborne oil liquids in the US Gulf of Mexico (GOM) are at record highs — in the context of strong waterborne energy and non-energy shipments overall — and just this year crude oil exports have become a meaningful part of that total volume.

In order to keep GOM exports growing, investments are being made to increase the capacity to send oil from the Gulf of Mexico via a class of tanker known as Very Large Crude Carriers (VLCC). Increased outbound VLCC capacity will not only allow for increased overall export volumes at cheaper per barrel transport costs in general but will also specifically exploit the economies of scale that make long-haul exports to the coveted Asian market most viable. While the prospects for additional VLCC loading capacity improve in a time frame of five or more years — particularly if multiple of the discussed offshore crude export terminal projects become firm — expected Permian growth between now and then could make for a very rocky path to debottlenecking. This commentary is an attempt to quantify short-term and longer-term GOM waterborne crude export capacity. It also raises questions about whether sharp growth in non-energy waterborne trade via the Gulf will have a positive or negative effect on decongestion of the energy trade, and whether the type of companies involved in developing new export infrastructure matters for the development of this market.

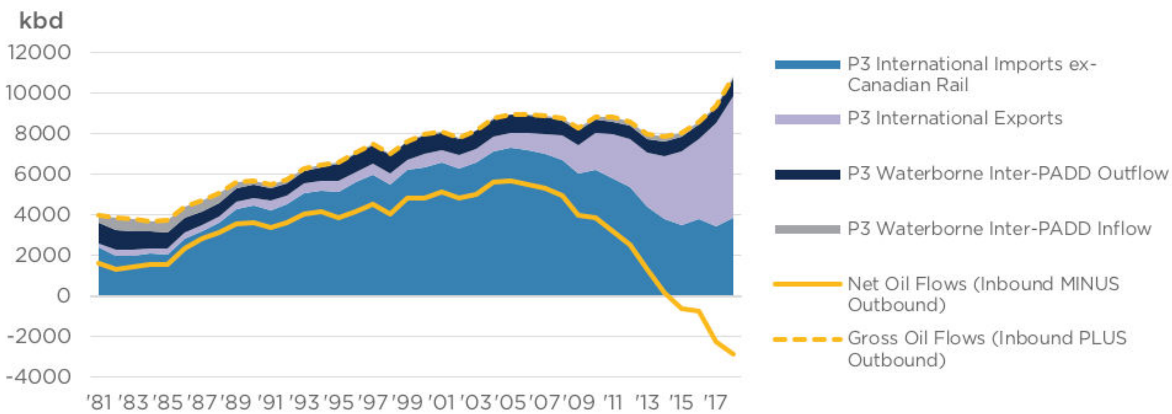
GOM Oil Volumes Are Already Unprecedented and Set to Grow amid Rising Non-Energy Waterborne Shipments

Since US oil production took off, imports of crude and refined products have fallen while exports of total liquids have increased. But this has not just been a reversal in direction — while *net* oil imports (imports minus exports) into the Gulf of Mexico PADD 3 region have fallen, *gross* oil flows (imports plus exports) have increased. Looked at another way, the decline in imports has plateaued in the last five years, even as exports have continued to grow. US Gulf port and waterway congestion is not a brand-new theme, but is increasing in urgency as Permian crude production, in particular, is expected to grow significantly.

Permian crude production growth is expected to be substantial. The reference case for the Permian in the Energy Information Administration's Annual Energy Outlook calls for five-year growth of nearly 1 million barrels per day of crude production in the US Gulf Coast and Southwest regions combined; the high oil price scenario puts incremental output from those two regions at close to 2.5 million bpd in the next five years.[1] Other forecasts are much more aggressive; IHS Markit, for example, sees 3 million bpd of growth between now and 2023 in the Permian alone.[2] The current bottleneck in moving crude from the Permian production region to the coast will be gradually resolved over the next 12–18 months. But with limited scope for expanding US refinery intake of crude, sellers will look to overseas markets. Existing waterborne export capacity will be increasingly strained as higher volumes of crude move to the Gulf Coast. Past precedent is no guide to a theoretical maximum volume because gross flows of total oil liquids in the GOM are at a historical high. The United States is already in uncharted territory.

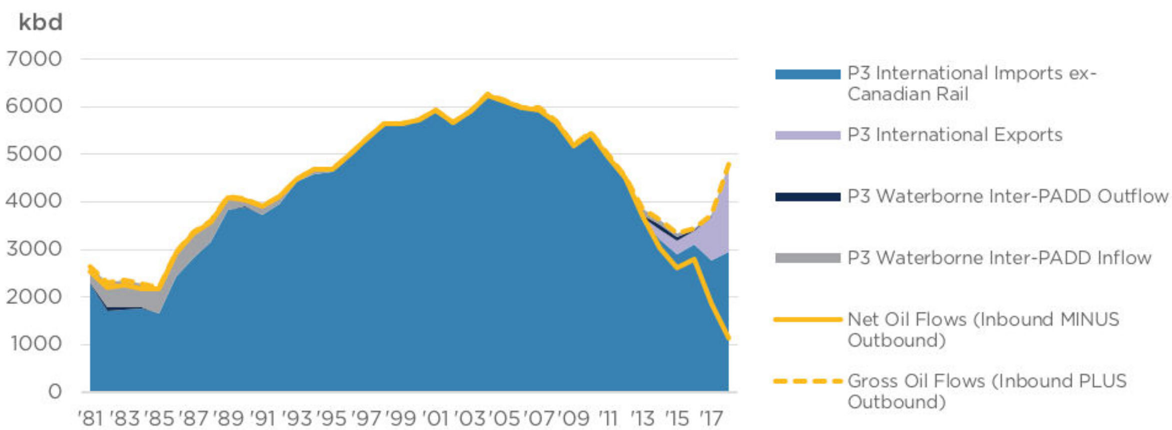
Importantly, crude exports are not growing in a vacuum; they are increasing in the context of increased waterborne flows of other energy products (LNG, LPG, refined products) and non-energy products. Rising traffic from other vessels, such as large container ships, could encourage port and waterway investments that would also benefit tankers but also could compete with tankers for investment in port expansions and associated infrastructure. Notably, the Panama Canal expansion — which still does not accommodate VLCCs — also incentivizes more and larger shipments of other kinds (energy and non-energy) from the US Gulf. The Port of Houston, for example (the second largest US port in terms of total tonnage), saw gross imports plus exports of containers increase by 28 percent between 2013 and 2017; gross imports and exports between Houston and the Far East, India, and Mideast increased 122 percent in that same period.[3]

Figure 1: Gross & Net PADD 3 Flows of Oil & Products



Source: Author's calculations based on Energy Information Administration data.

Figure 2: Gross and Net PADD 3 Flows of Crude



Source: Author's calculations based on Energy Information Administration data.

When It Comes to Exports, Size Matters

Just as long-haul crude imports to the United States are most economic on large vessels, so too are US crude exports. The per barrel cost of exporting crude from the US Gulf on a Very Large Crude Carrier (VLCC), which holds 2–2.5 million barrels of crude, is significantly lower than the per barrel cost on an Aframax sized vessel, which holds about 750,000 barrels. The longer the voyage, the more dramatic the economies of scale; savings are most significant on Asian routes, but it also usually pays to use a larger vessel for cargos bound for Europe, particularly when there is an opportunity for a vessel to carry cargo roundtrip rather than ballasting empty to its next loading location (as VLCCs bringing crude to the United States always used to do).[4]

Despite the obvious economic advantages for exports, no US coastal ports currently have the depth to accommodate fully laden VLCCs, and very few can accommodate even partial VLCC loading. Existing ports accept mostly Aframax sized vessels, with a few accepting Suezmax vessels (1 million barrel average capacity). In addition, the Louisiana Offshore Oil Pipeline (LOOP) accommodated inbound VLCCs historically and has been partially reversed to accommodate outbound VLCCs. Finally, offshore lightering areas are areas in open water in the Gulf where VLCCs or ULCCs can "park" while smaller vessels lighter oil onto or off of larger vessels, to transport the material to/from coastal ports. Lightering adds an estimated 50–75 cents per barrel to the cost of transport, but even with that incremental cost, VLCC transport from the Gulf is usually more economic than Aframax transport, especially to Asia. Thus, while economically advantageous, currently capacity to export crude via large vessels is limited by the existing infrastructure.

A Top-Down Look at GOM VLCC Export Capacity Based on Historical Precedent

At minimum, one can look at when US oil imports were at their highest for one proxy indication of how much outbound VLCC traffic could increase to accommodate crude exports, short of port expansions or new offshore terminals. For starters, it can be assumed that historically most PADD 3 imports from Mideast Gulf (MEG) countries and West African (WAF) countries would have arrived on VLCCs (West African imports to the US East Coast generally would have been carried on smaller vessels). Imports from those countries peaked on a monthly basis at 2.8 million bpd in April 2001 (they peaked at 2.45 million bpd on a 12-month rolling average basis).[5]

PADD 3 still takes in about 1 million bpd of crude from MEG/WAF origins. While that number could edge lower, it is hard to see it going significantly lower due to the quality mismatch between the increasingly light sweet crude produced in the United States and the heavier barrels needed by US refiners. Motiva Enterprises, for example, imported an average of 225,000 bpd from Saudi Arabia this year to date, and given both the crude quality issue and the commercial relationship, is one example of an import flow that is unlikely to go away.[6]

That leaves a very theoretical "VLCC loading capacity" in the Gulf of close to 2 million bpd based on historical precedent. As of June, EIA data shows about 1.25 million bpd exported from the Gulf to Asia/Mideast, and 550,000 bpd to Europe/Africa. While it is not clear how much of that volume was shipped via VLCC, those volumes do represent a theoretical "demand" for VLCC loading capacity — in other words, if that volume was not shipped on a VLCC, it probably would have been more economic to have done so.

Table 1: Today's VLCC Volumes in Historical Context

VLCC Volumes	Million barrels per day
Maximum Historical Est. Crude Imports via VLCC	2.8
- June 2018 Est. Crude Imports via VLCC	0.9
= Theoretical VLCC Loading Capacity	1.9
- June 2018 Crude Exports to Asia+MEG (Asia+MEG+Eur+Africa)	1.3 (1.8)
= **Theoretical "Spare" VLCC Loading Capacity**	0.6 (0.1)

Source: Author's calculations based on Energy Information Administration data.

This is a top-down "minimum maximum" for VLCC outbound loadings. In other words, if that volume of oil arrived via VLCC in the past, at least as much oil, in theory, should be able to be exported, though additional infrastructure changes at LOOP would be required.

A Bottom-Up Look at GOM VLCC Export Capacity — Specific Ways to Increase Volumes

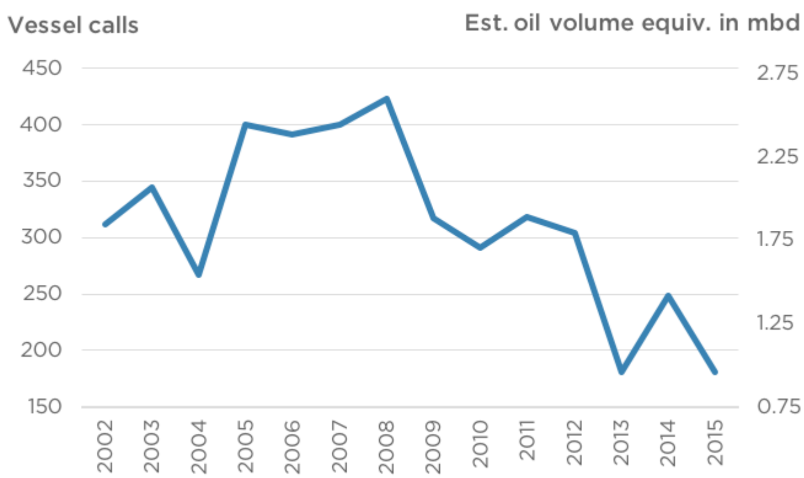
There are four main ways that exports via VLCCs could increase: incremental reversal of LOOP capacity; port expansions/dredgings to allow for at least partial loading of VLCCs; new offshore crude loading terminal projects that would allow for full loading of VLCCs; and increased full and/or partial reverse lightering offshore.

Data Note: A useful, but flawed data source for looking at past activity at US ports and lightering areas is the Maritime Administration's (MARAD) Vessel Calls in US Ports and Terminals data, which reports the number of calls per US port (including LOOP and lightering areas) and the deadweight tonnage of vessels making those calls. However, it is limited in several ways. First, the most recent data is from 2015, and thus does not reflect recent and significant changes. Secondly, MARAD made a methodology change in 2013 that makes it difficult to compare 2013–2015 data to 2002–2012 data. Third, MARAD's "tanker" category includes not only oil liquids but things like edible oils, beverages, etc. This is clearly not a concern for LOOP, but does cloud port data and lightering area data to an unknown degree. Finally, and most important with respect to lightering areas, MARAD data counts all vessel calls in a given port, whether or not a vessel loads or unloads at that port. This is not a critical distinction for LOOP or most ports, since vessels are not likely to call without an intention of loading or unloading. But lightering areas are simply offshore areas designated for lightering, and can also serve essentially as parking lots for ships that are waiting for any number of reasons, or even serving as floating storage.

Exports from LOOP: Useful, but Not Necessarily for Permian Barrels

Not surprisingly, when US crude imports fell, it impacted LOOP directly. LOOP handled a peak 423 calls in 2008 (which implies volumes of more than 2.5 million bpd of crude), according to the Maritime Administration's (MARAD) Vessel Calls in US Ports and Terminals data, and just 181 calls in 2015 (likely less than 1 million bpd of crude based on the average tonnage per vessel that called).[7]

Figure 3: Historical LOOP Port Calls & Crude Volumes



Source: Author's calculations based on Maritime Administration's (MARAD) Vessel Calls in US Ports and Terminals data.

Reversing the direction of LOOP from being an offloading facility to an onloading facility can be done with some relatively straightforward infrastructure changes. A portion of LOOP has already been reversed — the first VLCCs loaded earlier this year. In theory, additional infrastructure investments could add at least an incremental 1.2 million bpd of export capacity via VLCC without displacing current import activity, and more if inbound shipments were to fall further. In practice, though, the bigger obstacle to taking advantage of LOOP for crude exports will be the inland infrastructure needed to get crude supplies to LOOP. This is a more plausible option for Canadian or US Midcontinent barrels because of existing infrastructure to move barrels south to St. James, and ultimately LOOP, and options for pipeline reversals that would accomplish the same thing; it is less clear how Permian volumes would get to the LOOP economically and in size.

Port Expansions: Imperfect, but Lots of Bits and Pieces Will Add Up to Meaningful Volumes

The race is already on to deepen and widen existing inland ports to accommodate VLCCs, though it is important to note that even the most ambitious plans will not make those waterways deep and wide *enough* for VLCCs to fully load at port. Instead, the idea is that they will partially load, then top up using reverse lightering offshore. This will save time and money compared to fully loading a vessel via reverse lightering but is not quite a silver bullet.

Following an expansion project, Corpus Christi Ship Channel has already seen VLCCs (for partial loading of about 1.2 million barrels) transit this year from Occidental's Ingleside Energy Center. Similarly, the expansion has allowed for full loading of 1-million-barrel Suezmax vessels from the Buckeye Texas Hub terminal this year.[8] Buckeye is also planning the South Texas Gateway Terminal at Corpus Christi with partners Phillips 66 and Andeavor, which will have two berths capable of accepting VLCCs.[9] Further expansion at Corpus Christi over the next four years will widen the channel, replace a bridge to allow for taller clearance, and deepen the waterway from 45 to 54 feet — but that is still not deep enough to accommodate a fully laden VLCC, which would require 72 feet of depth.[10]

Enterprise also partially loaded a second VLCC in June at the Seaway Terminal in Texas City in July, and more of this type of activity would not be surprising. These bits and pieces will add up and have the advantage of modifying existing inland infrastructure as opposed to developing greenfield infrastructure. But to fully load, VLCCs will still have to use offshore reverse lightering, with its associated costs and time.

Offshore Loading Terminals: The Best Fix for Export via VLCC, but How Many and How Fast?

So far there is one application in play for a permit to construct an offshore crude export terminal and several more that are reportedly either being considered or even in the design/engineering stage and preparing to apply for permitting. All of these terminals would be purpose-built — they are being designed to accommodate full loading of VLCCs, have associated storage and pipeline capacity, only handle crude exports, and target Permian barrels specifically. Among the projects on the table are the following:

- Texas Gulf Terminals, Inc., owned by Trafigura, submitted an application to MARAD on July 9 to own, construct, and operate an oil export terminal offshore Texas (the notice of application was published in the Federal Register on August 6, and is currently the only application for an offshore export terminal that MARAD has received). The project will be constructed offshore from Corpus Christi with a loading capacity of 60,000 barrels per hour (equivalent to one VLCC in about two days). The application indicates an intention to load about eight VLCCs per month.[11]
- Enterprise announced on July 17 plans for an offshore Texas crude oil export terminal, which is intended to have the capacity to load at a rate of one VLCC (2 mb) per day.[12] Enterprise has not yet applied for permits; the project is in the design/engineering phase.
- RBN Energy reports plans by Oiltanking, Enbridge and Kinder Morgan to construct an offshore Texas crude loading terminal in the future in association with new crude storage capacity at Freeport.[13]
- JupiterMLP is planning the Jupiter Offshore Loading Terminal in association with a significant build-out of storage, dock, and pipeline capacity at the Port of Brownsville. Some

of the inland port work has already been permitted, but the offshore terminal project has not yet applied for permits. The JOLT plans capacity to load a VLCC in 48 hours.

- Per comments at this year's Argus Americas Crude Summit, Magellan Midstream Partners is considering and conducting preliminary engineering for a deepwater offshore Texas crude export terminal.[14]

Only one of these projects is anywhere near realization, but it is not hard to imagine that additional project proposals could emerge given the expected demand for export capacity. With respect to timeline, while at least one of these — non-permitted — projects has indicated that it could be operational as early as 2022, that seems unrealistic. The Deepwater Port Act outlines specific parameters for federal permitting. Public hearings on the application must be completed within 240 days of the application being deemed complete (in the case of Trafigura's application, this happened on July 31, 2018). MARAD must register a federal decision within 90 days of the final hearing. For any given application, MARAD also appoints an Adjacent Coastal State (Texas, in this case), which has 45 days from the final hearing to approve or disapprove of the application at the state level.[15] Less clear is how long Army Corps of Engineers approvals or EPA approvals under the Clean Air and Clean Water Acts could take, though presumably the incumbent administration will favor a rapid approval process to the degree it has jurisdiction to influence it. This timeline suggests that permitting could optimistically happen in the space of one year; Trafigura's application will provide a data point. Trafigura has not indicated an expected construction timeline. LOOP took ten years to plan and construct, but that is not necessarily a relevant precedent. Five years for permitting and construction seems realistic, if very ambitious.

Some of the companies involved with waterborne export infrastructure projects have direct interest in Permian crude production, like Occidental and Kinder Morgan. But most of the companies involved are midstream operators — aggregators, effectively — and several are privately held. Of the non-public companies involved in recently announced projects aimed at increasing waterborne crude exports, for example, Trafigura is a merchant, JupiterMLP is a master limited partnership, and Oiltanking is the subsidiary of a family-owned company. This is a departure from the historical experience at LOOP, which is a joint venture between Marathon, Shell, and Valero (refiners, essentially, at least in terms of their relationship with LOOP). This is an important change because, on the one hand, the shift in the type of companies involved with this infrastructure may make for more nimble responses to market conditions. Because these companies are not involved with export infrastructure for operational reasons per se (the way that a refiner importing crude would be), they can make decisions based on economic efficiency. But it also raises the question of transparency because these companies do not have the same reporting requirements and shareholder scrutiny that public oil companies would.

Reverse Lightering

The final option for expanding crude exports via VLCC is increased "reverse" lightering, from smaller vessels that receive crude at port, onto larger vessels offshore. How much lightering is a lot of lightering? RBN Energy suggests that reverse lightering of crude has increased from six VLCCs per year (~30,000 bpd) in 2016 to eight per month (more than 500,000 bpd) in the second half of 2017.[16] Reverse lightering of crude from offshore VLCCs/ULCCs to shore has become a hot topic, but data has been prone to misinterpretation. Oft-cited MARAD data implies that offshore lightering areas are currently (or as of 2015) the most active ports of call for tankers in the Gulf. But, as mentioned previously, MARAD records the number of calls made by vessels in a given port (and the DWT of those vessels), *whether or not the vessels load/unload at that port of call.* It measures ship traffic, not lightering activity.

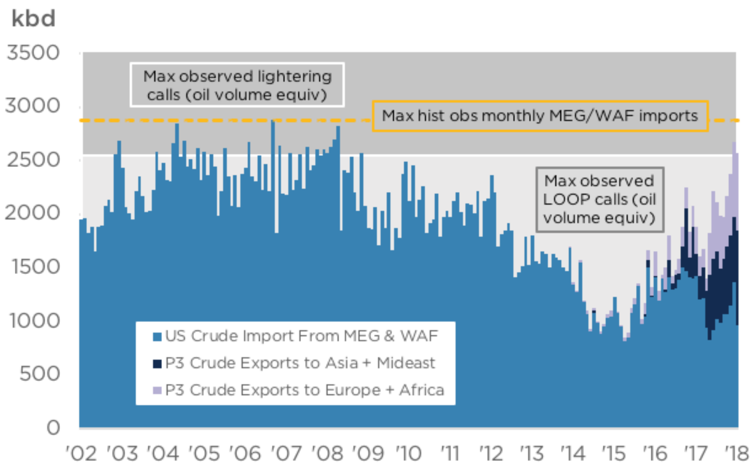
Prior to 2007–08 this was not a significant limitation of this data; the ratio of deadweight tonnage to number of tanker calls at that time was 200,000–250,000, suggesting that the vast majority of the tankers calling on lightering areas were VLCCs, and in fact there for lightering. However, around 2007–08 calls in lightering areas picked up significantly, and they increased exponentially after the 2013 methodology change. While it is hard to peg why definitively, crude and gasoline "floating storage plays" were in vogue during periods of steep oil market contango in that era; overall increases in US Gulf congestion likely also increased vessel wait times offshore at various times.

Suffice to say, the MARAD data no longer gives a clean estimate of lightering/reverse lightering in the Gulf. But the 2005–07 period, when imports were around historical highs, is instructive. In 2007, the oil volume implied by tanker calls to lightering zones was about 1 million bpd. It is not clear that 1 million bpd would be a limit for (reverse) lightering today, but based on historical precedent, it seems at least 1 million bpd could be reverse lightered, 500,000 bpd more than current reported reverse lightering volumes.

Conclusion

Per the latest EIA data, the United States shipped about 1.25 million bpd of crude to Asia and the Mideast in June, and about 550,000 bpd to Europe and Africa. That means 1.8 million bpd of crude was shipped on VLCC, or likely would have been, had that been an option. That volume, plus residual US long-haul crude imports from the Mideast and West Africa, is roughly equal to the volume of long-haul crude the United States imported at peak in 2007. In the short run, exports should tick higher as Suezmax and partial VLCC loadings at inland ports become more regular. Incremental export capacity of at least 500,000 bpd could be added through partial or full reverse lightering of large vessels. LOOP also has plenty of spare capacity to export if infrastructure adjustments are made, though is not likely to absorb large volumes of Permian crude specifically in the near future. However, greenfield offshore terminal capacity for VLCC loading is unlikely to come online in the next five years, given the time required for permitting and construction. If higher end forecasts of Permian production growth pan out, bottlenecks now seen in the Permian Basin will likely move to the Gulf Coast. That means that the same steep discounts earned by Permian barrels recently would continue because of a different infrastructure constraint, challenging the economics of Permian producers.

Figure 4: Giving Today's GOM VLCC Activity a Sense of Historical Scale



Max observed LOOP calls are from 2002–15. Max observed lightering calls are from 2002–07.
Source: Author's calculations based on Maritime Administration's (MARAD) Vessel Calls in US Ports and Terminals data and Energy Information Administration data.

One variable that is harder to nail down is how different segments of port capacity interact. US Gulf crude flows are not the only volumes on the rise. At 6 million bpd, gross GOM refined product flows (including gas liquids) have doubled in the past ten years and tripled in the past twenty. Flows of liquefied natural gas volumes to and from the region are at record levels. Non-energy traffic is also posting heady growth, particularly to/from Asia, inspired at least in part by the Panama Canal expansion. Does more traffic simply mean more incentives to invest in infrastructure, to the benefit of crude exports? Or is there more of a zero sums dynamic at play, where a focus on accommodating other increased traffic detracts from the ability to accommodate increased energy traffic in the GOM? Would the potentially negative effects of a trade war stymie the development of crude export infrastructure or free up resources to support it?

It is also important to note that, although it is still early days, there looks to be more involvement in new export infrastructure not only by midstream players (as opposed to oil producers or refiners) but also by non-public entities like Trafigura. On the one hand, this type of participation could add a degree of flexibility to the supply chain; many of these companies are opportunistic market facilitators, essentially, rather than industry operators with a defined purpose or function. But this is a different construct than we have seen in the past, and while it may make market flows more nimble, it could be at the expense of transparency.

Separate but related, another unusual feature of this rapidly developing market is that US waterborne crude exports are sold on a spot basis, while most crude exports globally are sold on long-term contracts. US crude exports are still very small in a global context but represent a growing spot trade. As volumes continue to grow, might term sales develop? What do either of those scenarios mean for future infrastructure contracting and commitments?

As with each stage of the tight oil / shale gas boom, the US market is in the process of building precedent where none exists. The industry always responds to bottlenecks, and company proposals for new infrastructure to facilitate GOM crude exports are likely to come fast and furious over the next couple of years. It will be important to watch not only the where and the when but also the who and how of those developments.

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