



The Abdullah Bin Hamad  
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# Al-Attiyah Foundation Research Series

Expert energy opinion and insight

## Global NGLs: the great US disruption

The US shale industry has upended markets far and wide — and the global natural gas liquids (NGL) market has been no exception. Surging American NGL output from the country's shale formations has sparked a revival in the American petrochemical industry and is yielding new supplies to global markets. This has disrupted long-established trade routes that saw Asia's growing markets depend mainly on Middle Eastern NGL supply. In the same way that Chinese, Japanese and South Korean buyers have embraced the US' low-cost crude and natural gas supplies, they are also eagerly snapping up US NGLs, which look set to grab the lion's share of Asian incremental demand. The shale industry is now a permanent fixture in global energy markets, suggesting this more competitive dynamic in global NGLs is here to stay too.

### The shale revolution and NGLs

The rise of the US' shale industry has transformed the country's NGL supply picture. While the major shale regions are typically divided into oil or gas plays, they all have areas within them that are more prone to liquids and gas; and all of them have NGL-rich areas — often referred to by producers as “wet” or “rich” gas. The Marcellus and Utica shales in the northeast are typically thought of as a dry gas play, though the region pumps around 0.75m barrels a day (b/d) of NGLs. The Permian, the US' leading tight oil region, produces around 1.2m b/d of NGLs. This broad base of NGL output has ensured that even as shale investment has shifted over the years from gassy northeast plays to more oil-rich shales in Texas and North Dakota, one constant has been steadily rising output of NGLs.

Production started to take off as shale drilling activity picked up in the wake of the 2008-09 financial crisis. US NGL output nearly doubled from October 2008's 1.75m b/d — a level that had held remarkably steady for decades — to around 3.5m b/d by the end of 2016, making the US by far the world's largest NGL producer, surpassing Saudi Arabia. Ethane and propane are the dominant fuels at around 1.2m b/d each, together making up about 70% of total US NGL output.

NGLs now account for nearly 30% of total US liquids output — up from less than 25% a decade ago — and have been central to the US becoming the world's largest liquid fuel producer. There is scope for that proportion to rise further. US producers still “reject” around 400,000 b/d of ethane — that is, they keep it in the dry gas stream, rather than separating it for marketing. This is mostly due to a lack of processing or transport capacity to get

these hydrocarbons to market. But this share of rejected NGLs is likely to fall in the coming years as investments continue to be made in infrastructure to separate, transport and process NGLs.

The outlook for future US NGL output growth will be a function of both drilling activity and the demand pull — the market's ability to soak up new supplies. Both fronts point to continued robust growth as producers and consumers, especially the petrochemical industry, have aligned in a virtuous cycle of investment: producers are pumping huge amounts of cheap supply, which is encouraging major investments in new processing plants, which will in turn encourage yet more production.

On the drilling front, the shale industry is emerging from the oil-price downturn in strong shape and investment has been quick to rebound. In March 2016, the US total rig count was up around 60% compared with a year ago, to around 770 — and rising. The recovery is so far focused around the Permian and other liquids plays, following a modest oil-price recovery and an aggressive campaign of cost-cutting that has made drilling these areas profitable at around \$50 a barrel.

Signs of activity are also picking up around the northeast Marcellus and Utica shale gas plays as well, where a huge amount of investment has been made in recent years in gas processing and fractionation facilities needed to separate NGLs from gas output. US natural gas prices have bounced off the decade lows seen last year and a raft of new pipelines coming on stream over the next year should relieve a bottleneck of supply and improve drilling economics. Both trends point to more drilling in US shale plays — and rising NGL output.

**FIGURE 01: US ETHYLENE PLANTS, PLANNED AND UNDER CONSTRUCTION**

Company	Ethane consumption ('000 b/d)	Completion date	Location
Occidental Chemical / Mexichem	40	2017	Ingleside, TX
Chevron Phillips Chemical	90	2017	Cedar Bayou, TX
ExxonMobil Chemical	90	2017	Baytown, TX
Dow Chemical	90	2017	Freeport, TX
Indorama	30	2017	Lake Charles, LA
Shintech	30	2018	Plaquemine LA
Sasol	90	2018	Lake Charles, LA
Formosal Plastics	95	2019	Point Comfort, TX
Axiall / Lotte	60	2019	Lake Charles, LA
Total Petrochemicals	60	2019	Port Arthur, TX
Shell	95	Early 2020s	Monaca, PA
<b>Total</b>	<b>770</b>		

Source: American Chemistry Council, company reports, Petroleum Policy Intelligence

### Petrochemicals bonanza

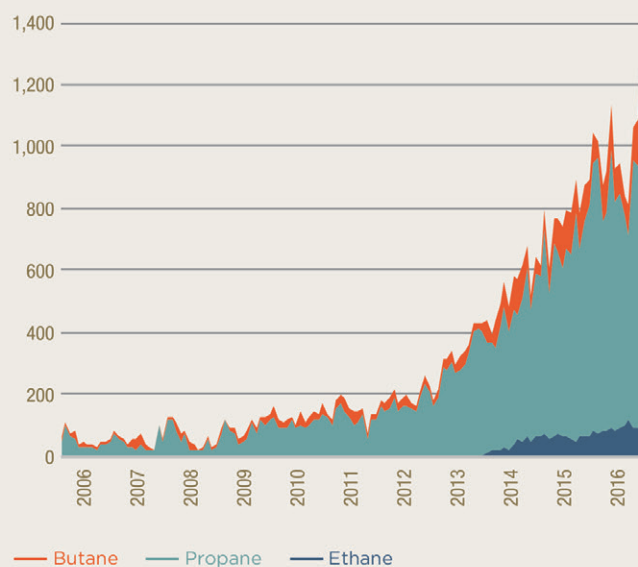
The market's ability to soak up the new supply is a more complex question, requiring investments from the well site in gas-processing and fractionation capacity, pipelines, and ultimately processing or export facilities. Yet here, too, a rash of investment in new projects over the next couple of years points to strong growth.

The US petrochemicals industry consumed a record 1.6m b/d of NGLs in 2016, and investments in new processing facilities will see a major step change upwards in US domestic demand for NGLs, especially ethane. According to the American Chemistry Council, an industry lobby group, more than \$150bn in new petrochemical projects will come onstream in the next few years to take advantage of the US' bounty of cheap NGLs. Occidental Petroleum, Chevron, ExxonMobil, Dow Chemical, Sasol and others are all investing in multibillion-dollar plants on the Gulf Coast that are due to open by 2020.

Much of the finished products will be exported. Shell committed in 2016 to building an ethane-cracking plant in Pennsylvania to take advantage of output from the nearby Marcellus and Utica shales; it is expected to start up in the early 2020s (see Figure 01). The projects in total are expected to add around 0.77m b/d in new ethane-processing capacity, a roughly 60% jump from current ethane output of around 1.2m b/d. These are big, complex projects that are likely to run into regulatory delays, making their timing uncertain. But recent commentary indicates most of the projects are on track to meet their deadlines.

New export facilities are providing another outlet for the US' growing NGL output. The US started exporting ethane by

sea for the first time in 2016 — first from Sunoco Logistics' 35,000 b/d Marcus Hook facility in the Northeast and then from Enterprise Product Partners' larger 200,000 b/d ethane-export terminal on the Gulf Coast. This added to existing pipeline infrastructure that allowed smaller volumes of ethane exports into Canada. Export capacity for propane and butane, which have more retail consumer uses than ethane, has also soared, rising from just 200,000 b/d in 2013 to 1.32m b/d today (see Figure 02).

**FIGURE 02: US NGL EXPORTS, 2006-16 ('000 B/D)**


Source: EIA



**FIGURE 03: MIDDLE EAST OPEC NGL OUTPUT FORECAST ('000 B/D)**

	2016	2017	2018	2019	2020	2021	2022	2016-22 Growth
Iran	848	912	932	960	977	994	999	151
Iraq	90	90	95	95	100	105	105	15
Kuwait	310	307	305	303	310	320	328	18
Qatar	1,198	1,242	1,263	1,256	1,255	1,254	1,253	55
Saudi Arabia	1,909	1,942	1,950	1,968	1,976	1,980	1,983	74
UAE	838	843	868	870	872	877	872	34
<b>Total</b>	<b>5,193</b>	<b>5,336</b>	<b>5,413</b>	<b>5,452</b>	<b>5,490</b>	<b>5,530</b>	<b>5,540</b>	<b>347</b>

Source: International Energy Agency

All of this will act as a strong pull for investment in new NGL production. Enterprise Product Partners estimates that NGL demand on the Gulf Coast will jump around 30%, from 3.5m b/d today to between 4.5m b/d and 4.7m b/d by 2020, with another 100,000 b/d of new demand in the Northeast.

This expected demand increase roughly matches estimates for supply growth. The International Energy Agency (IEA) thinks US NGL output will rise by 0.9m b/d by 2022 to 4.4m b/d, or around 180,000 b/d a year. The Energy Information Administration (EIA) is much more bullish, seeing growth coming quicker, in line with the ramp up in new sources of demand over the next couple of years. It sees output reaching 4.18m b/d by 2018 — up 280,000 b/d in 2017 and 460,000 b/d in 2018 alone.

Ethane output is set to grow fastest due to the new Gulf Coast ethylene capacity coming on stream. Ethane production, says the EIA, will grow more than 0.5m b/d from 1.29m b/d at the end of 2016 to 1.81m b/d by the end of 2018, a 40% jump. Propane output, meanwhile, is set to grow around 20% over the same period from 1.15m b/d to 1.36m b/d. By 2022, the EIA sees NGL output rising 1.3m b/d to around 4.8m b/d. Given the sharp increases in drilling activity and the fact that new petrochemical facilities appear to be running largely on schedule, the EIA's more bullish supply outlook appears the better bet.

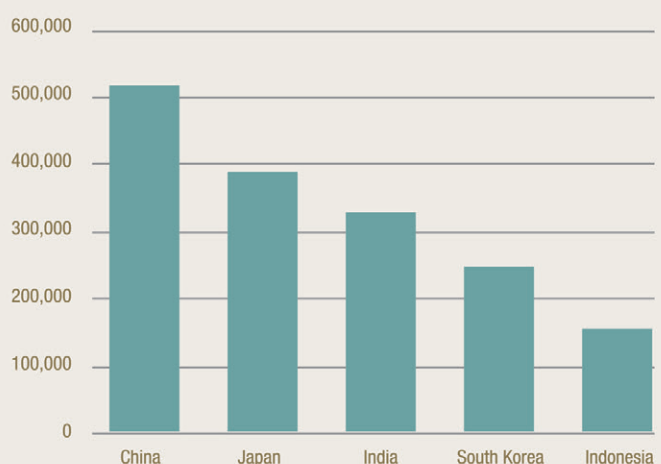
The biggest threat to these growth plans is low NGL prices due to the glut of supply, a familiar story for both crude and natural gas markets. The EIA's composite NGL price, which typically trades higher than natural gas prices but lower than crude prices, fell below \$4 per million British thermal units in early 2016, after trading in the range of \$10 to \$15/mmBtu from 2010 to mid-2014. But prices picked back up in the latter half of 2016, and reached \$7/mmBtu in early 2017. And as new petrochemical plants on the Gulf Coast come on line, demand and prices should pick up.

### OPEC nations still strong

While the centre of growth for global NGL output has shifted to the US, the Middle East's OPEC members will remain important and growing suppliers. Total NGL output from OPEC's core Middle East producers — Iran, Iraq, Kuwait, Qatar, Saudi Arabia and the UAE, which combined account

for more than 80% of the organization's NGL production — is set to rise by around 350,000 b/d, from 5.19m b/d in 2016 to 5.54m b/d in 2022, says the IEA (see Figure 03).

Iran looks set to lead NGL supply growth, rising 150,000 b/d to around 1m b/d by 2022, although this growth is the least certain of the Middle East's producers. It will depend on the country's ability to bring on line new phases of the massive South Pars gas project, the source of most Iranian NGL output growth. The country signed a preliminary deal with a Total-led consortium to develop phase 11 of South Pars last year and hopes to bring on line phases 17, 18, 20 and 21 of the 24-stage development soon. Each phase of the South Pars project is expected to produce around 30,000 b/d of NGLs. However, US President Trump has cast doubt over the continued growth of Iran's oil and gas industry given his hardline rhetoric and scepticism of the Iran nuclear deal.

**FIGURE 04: ASIAN LPG IMPORTS, 2016 (B/D)**


Source: National Statistical Agencies, PPI

Saudi Arabia, which the US unseated as the world's biggest NGL producer, is also set to see NGL output growth, largely driven by the \$3.5bn Shaybah NGL project, which started up last year. Saudi Aramco installed a new NGL processing plant at the massive Shaybah oilfield that can produce as much as 275,000 b/d of ethane and other NGLs, assuming the field is producing 1m b/d of oil.



NGL output from Shaybah is expected to feed domestic industry. The kingdom's NGL production is set to rise from 1.9m b/d in 2016 to close to 2.2m b/d by 2022.

Producing around 1.2m b/d in 2016, Qatar is the world's third-largest NGL producer thanks to its huge gas developments at the North Field. The \$10bn Barzan gas development will help add some new volumes over the coming years, pushing NGL output around 55,000 b/d higher by 2022, according to the IEA. However, the moratorium on new developments at the North Field means there is unlikely to be any significant new growth in NGL output.

### Canada and Russia seek growth

Outside the US and OPEC, major NGL producers are unlikely to see significant amounts of growth. Canada is a major producer and consumer of NGLs, which it uses as a heating fuel, and to feed its petrochemicals and refining industry and as diluent for the oil sands' heavy oil production. Canada's output stood at 0.77m b/d in 2016, around 20% of total liquids production. The IEA sees this level rising steadily in line with Canada's broader liquids output to 0.83m b/d by 2022.

The glut of NGLs in the US is being felt in Canada as well, where prices have collapsed and export opportunities to the US are drying up, which is deterring new investments in gas-processing and fractionation facilities. Longer term, the development of western Canada's vast shale gas reserves to feed new liquefied natural gas export plants would lead to significant growth in NGL output, and potentially exports to Asia. However, those projects are in limbo as investors grapple with a global LNG glut and low prices that have undercut the economics of new LNG megaprojects.

Russia's NGL output is likely to hold steady at around 300,000 b/d for the foreseeable future. However, the development of East Siberia's large untapped gas deposits could see NGL output rise significantly in the mid-2020s. As part of Gazprom's plan to send gas to China and the rest of East Asia, which is centred around the Power of Siberia pipeline, it is also building the Amur gas-processing facility, the largest such plant in Russia. Gazprom says it will be able to produce around 130,000 b/d of ethane, 52,000 b/d of propane and 27,000 b/d of Butane — a total of around 210,000 b/d of NGLs. Early engineering work has begun on the project, but completion is still some years away and will be tied to progress in construction of the Power of Siberia pipeline project.

### Asia to benefit and diversify

All told, assuming strong US supply growth, global NGL output is due to rise by around 1.9m b/d over the next five years, making up about a quarter of total liquids growth. The vast majority of this new supply will be consumed by new chemical plants being built in the US and in Asia's growing markets, where imports have been rising sharply.

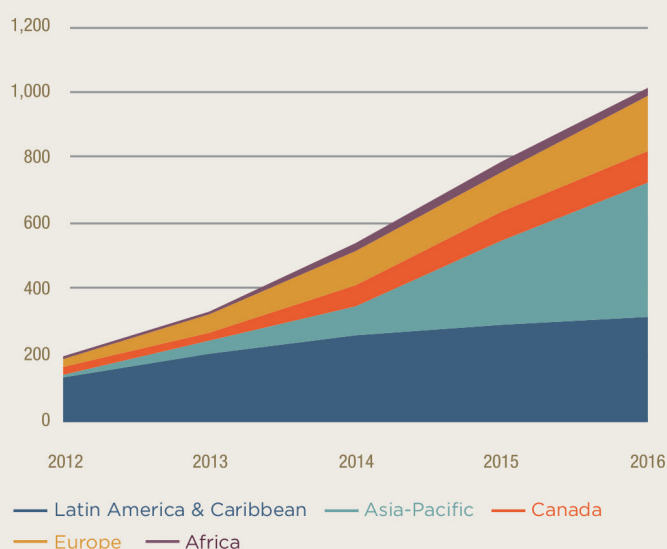
Asia's appetite for LPGs like propane and butane, which are more common feedstocks for the petrochemical industry along with naphtha, has been especially strong. Japan, India, China, South Korea and Indonesia combined make up more than 90% of import demand, and are seeing robust demand growth. Combined, they accounted for around 1.6m b/d in import demand in 2016 (see Figure 04). China has surpassed Japan as the world's largest importer, bringing in just

over 0.5m b/d of LPG in 2016. Japan was second at 380,000 b/d, followed closely by India at 324,000 b/d. Demand is booming in India and is likely to surpass Japan, which is a more mature market, over the next couple years. Facts Global Energy expects demand across the region to grow by around 20% from 2015 to 2020.

Middle Eastern producers have typically dominated supply into import-dependent Asia-Pacific markets. But the rise of US NGLs is disrupting the global NGL trade (see Figure 05). From less than 200,000 b/d in 2011, US shipments topped 1.2m b/d in late 2016, driven primarily by propane exports, which exceeded 1m b/d in December 2016 for the first time.

US propane exports were initially aimed at nearby markets in the Caribbean and Mexico. Exporters then targeted Europe, but as volumes have grown, US exporters have increasingly sought to penetrate the faster-growing Asian markets. From just 92,000 b/d in 2014, US exports to Asia-Pacific jumped to 403,000 b/d in 2016 and are set to rise on new supply contracts.

**FIGURE 05: US PROPANE EXPORTS BY REGION ('000 B/D)**



Source: EIA, Petroleum Policy Intelligence

### Conclusion

With the US making up the bulk of supply growth globally, and able to provide low cost fuel, it is likely to pick up the lion's share of growing Asian demand over the coming years. This trend has been welcomed by Asian buyers, which have seen lower prices and are keen to diversify their sources of supply away from Middle Eastern suppliers. In addition to being able to diversify sources of supply and pricing structures, the rise of US supply is also leading some petrochemical plants to shift away from their reliance on naphtha as a feedstock to potentially cheaper and more abundant propane and ethane feedstocks.

India in particular has been keen on US ethane supply. In a sign of the ways the US shale industry is reshaping the global NGL trade, the world's first ever Very Large Ethane Carrier took the first shipment of ethane from the Houston Ship Channel to India in December, part of a long-term supply deal Reliance industries signed to import the fuel from the US.





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