LPG Market Outlook

POTEN & PARTNERS

OCTOBER 2017

Export Snapshot (Million Tons)

Source	Nov 2017 Forecast	Nov 2018 Forecast
US	2.45	2.74
Middle East	3.26	3.47
Norway	0.39	0.38
West Africa	0.33	0.34
Algeria	0.71	0.73

Source: Poten

Import Snapshot (Million Tons)

Source	Nov 2017 Forecast	Nov 2018 Forecast
China	1.35	1.78
Japan	0.87	0.88
India	1.09	1.06
South Korea	0.75	0.76
NW Europe	1.00	0.99
Latin America	0.71	0.78
Med.	1.00	0.99

Source: Poten

INSIDE SECTIONS PAGE

US export forecast rises due to higher production outlook

Poten expects US exports to increase by 5.5 million tonnes between 2017 and 2019 due to increases in domestic production that will not be accompanied by growth in domestic demand. The major change to this month's forecast is a revision of production in the Marcellus/Utica region where the reaction to the start-up of the Mariner East pipeline expansion will be a step-change in production rather than a gradual increase.

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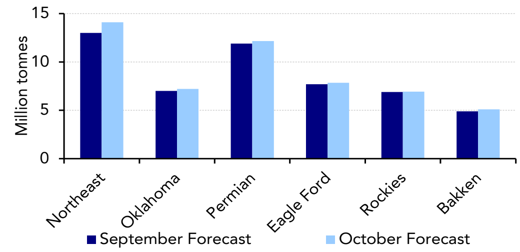
2019 US LPG production forecast comparison



Source: Poten

China's imports to grow more rapidly with additional petrochemical start-ups

Poten has added two, new petrochemical units to its China forecast; the addition of these units has resulted in an increase in the import requirements for the Chinese market with imports expected to total 25.3 million tonnes in 2019, a 40% increase from 2017 levels.

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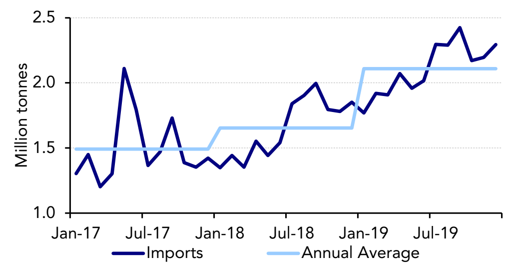
Chinese LPG import forecast



Source: Poten

Japanese import demand to rise in winter due to lower inventories

Demand for LPG in Japan has a strong seasonal component, and headed into the winter months, storage numbers appear to be on the lower side of the five year min/max range, indicating there may be a need for additional cargoes to head to Japan to make up this deficit.

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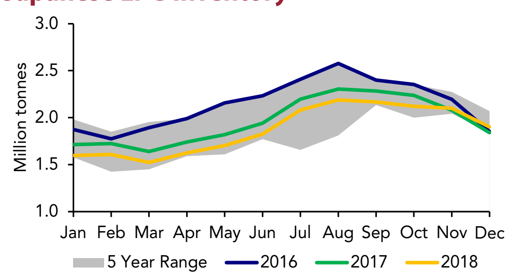
Japanese LPG inventory



Source: Poten

Major Forecast Changes

Category	Country	Months	Change	Reason
Production	US	all	+4%	Increase in Northeast production outlook
Exports	US	all	+6%	Increase in production expectations
Demand	China	3/2019 on	+3%	Added additional petchem units
Exports	Australia	10/17 - 7/18	-17%	Delay in startup of LNG projects

Global Summary

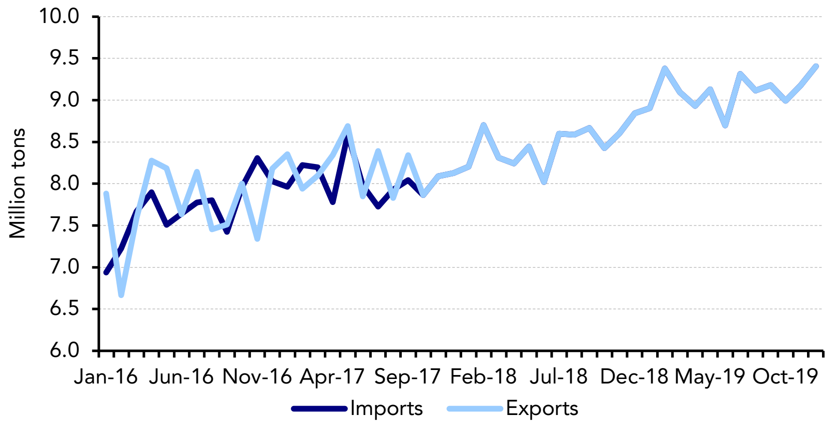
Global LPG trade is forecast to continue increasing over the next two years, rising by nearly 13 million tonnes between 2017 and 2019. The higher export volumes will come primarily from the US; however, increases are expected in the Middle East with other nations such as Australia contributing smaller additions.

In September, global exports rose sharply as the recovery from Hurricane Harvey pushed US exports higher than normal for this time of year. Prior to the storm, total shipments were expected to be low due to many cancellations, especially in the second half of the month. Exports out of the Middle East, however, were lower than in recent months, perhaps indicating the start of a trend similar to last year's Q3/Q4 where weaker volumes were recorded out of the region.

The global export forecast is similar to last month's with only slight changes seen due to modifications of timing of start-ups and new demand units added. Australia's increase in exports was delayed due to updated timing for the start-up of LNG projects. In China, additional PDH/BDH units were added to the forecast, increasing demand from petrochemicals during 2019. In the US, additional exports were added as production expectations for the northeastern US rose. Please see the country-specific sections for additional details on these changes.

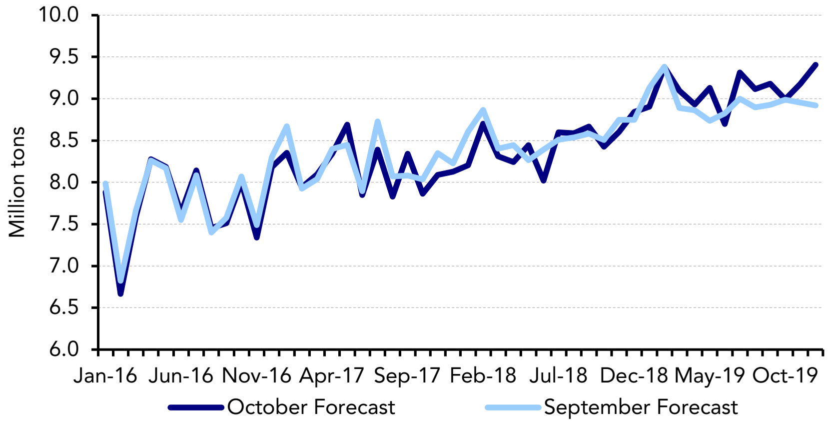
Northeast Asia will remain the largest importing region in the world, accounting for 23% of total global demand for LPG imports. In China, there has been little seasonality to demand with increases in import demand occurring regardless of the time of year. In Japan and Korea, there is more seasonality, and Poten expects that demand in Japan will be 10% higher over the next six months than in the previous six, peaking in January when more than 1 million tonnes are forecast to be imported.

Global LPG trade forecast



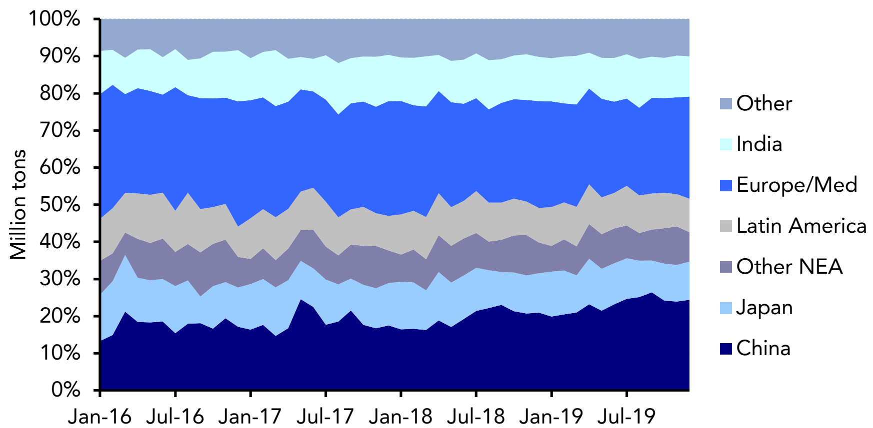
Source: Poten

Global export forecast comparison



Source: Poten

Global LPG imports by country/region



Source: Poten

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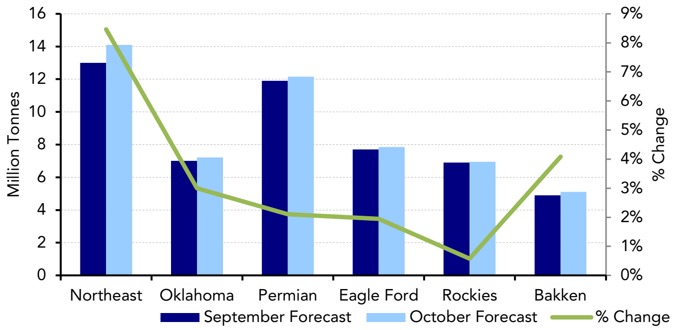
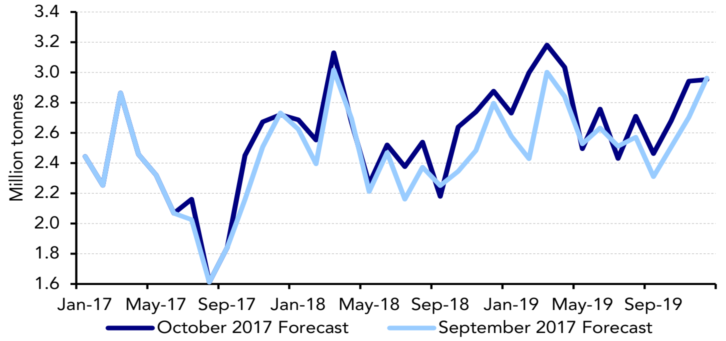
US exports to increase due to higher production outlook

2019 US LPG production forecast comparison



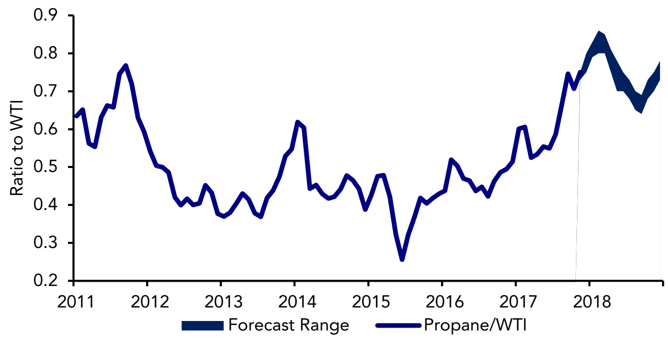
Source: Poten

US LPG export forecast comparison



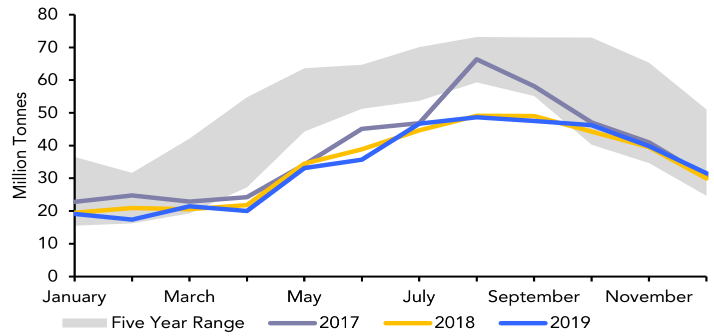
Source: EIA/Poten

US propane ratio to WTI



Source: Reuters/Poten

US propane days of demand in inventory



Source: Poten

Between 2017 and 2019, total US LPG production is forecast to increase by 7.7 million tonnes to 65.6 million tonnes. Roughly 5.5 million tonnes of this additional production is forecast to be exported with the balance going into US petrochemicals. Both the total US production outlook and outlook for US exports have increased primarily due to changes in the outlook for the Marcellus/Utica region of the US.

The expected increase in the production is due to a revised view on the impact of the Mariner East pipeline expansion in the northeastern United States. This project will expand the existing pipeline system which transports propane production from the Marcellus/Utica area to the coast for export. The new pipeline is expected to start-up in late Q1/early Q2 with the first tenders for LPG exports expected during that period. With the start-up of this pipeline, LPG production in the northeastern US is expected to increase as producers that have been holding back production due to limits on LPG takeaway capacity ramp up. This bump up in production, combined with a base line increase in overall production, has led to an increase in the forecast for the Marcellus/Utica volumes (shown as "Northeast" in the graph on the top left) of 1.1 million tonnes in 2019 or 8% for October's forecast compared to September's.

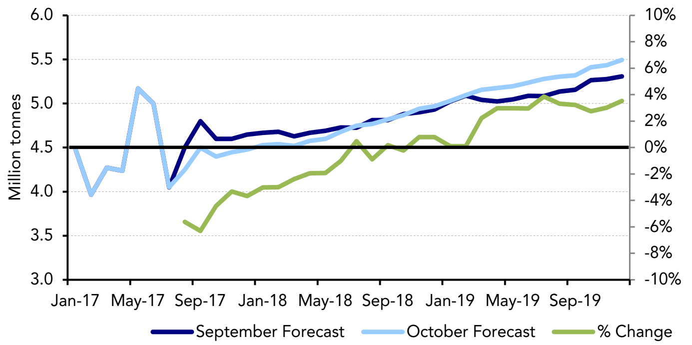
Given the increase in LPG production, total export volumes out of the US have increased as well with total export volumes out of the US in 2019 forecast to be 1.8 million tonnes higher than previously shown. This increase is only partly a result of the change in the Northeastern forecast as total production volumes in 2019 have changed for the rest of the US as well. Outside of the Northeast, the largest volume increase is in the Permian where approximately a third of the total US drilling rigs are currently operating. The largest percentage change is in the Bakken; however, the total volume of LPG out of that region will remain lower than in the rest of the country.

Given the aggressive outlook for LPG exports, US prices for LPG are forecast to remain high relative to crude oil. The graph on the bottom right shows the US propane ratio to crude oil from January 2011 through today with a forecast through the end of 2018. Given that overall storage levels and the number of days of demand in inventory are expected to remain low, upward pressure on prices will continue.

The only way for prices to come down would be a sustained period of cancellations out of the US. The export levels currently forecast, especially during the summer months, already include some cancellations; however, an additional three VLGC cargoes a month would have to be cancelled to bring the US storage levels to a more normal range. Three cargoes a month may not sound like many, but over the course of a year it would equal more than 2 million tonnes of LPG that does not

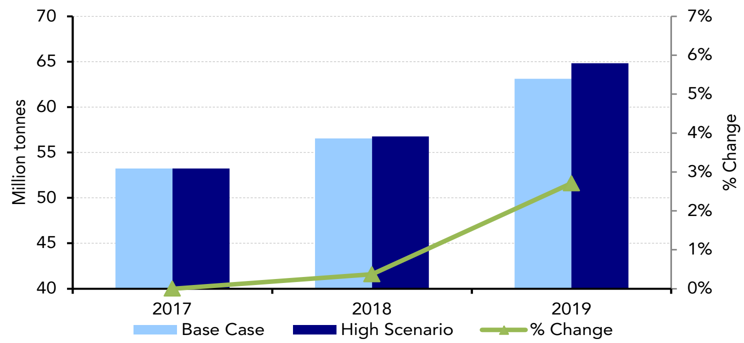
Chinese demand forecast rises with additional petrochemical start-ups

Chinese LPG demand forecast



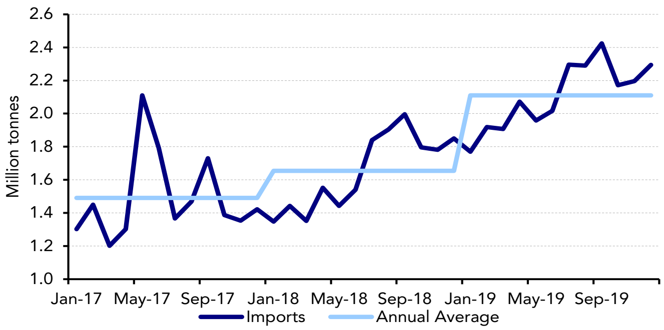
Source: Poten

LPG demand scenario - additional petrochemical facility construction



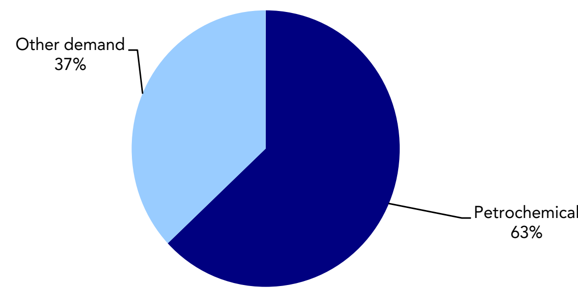
Source: Poten

China LPG import forecast



Source: Poten

Chinese demand growth by source - 2017 vs. 2019



Source: Poten

There have been two major changes to the Chinese demand forecast. The first is the delay of the startup of China Soft Packaging's 660,000 tonne per year PDH unit. The unit is now forecast to start-up in mid-2018 rather than in late-2017/early-2018. This unit consumes roughly 800,000 tonnes per year of propane when operating at full rates. That is why the October forecast for demand is lower than the September forecast as shown in the graph on the top right. The second is the addition of a new PDH/BDH unit expected to start-up in Q3 2019. This unit is expected to consume 600,000 tonnes per year of propane/butane when operating at full rates. In 2019, there is another PDH unit expected to start-up. In addition, the country's first LPG cracker is forecast to start-up late in the year. This unit could consume as much as one million tonnes per year of LPG.

Based on Poten's research there are as many as five PDH units currently "planned" for 2018 and 2019. It is unclear whether these units will go forward; certainly for a unit to start-up in 2018, construction must already have begun. However, there is the potential for additional demand from the petrochemical sector should one or more of these units move from planned to start-up between now and 2019. The graph on the top right compares the demand for LPG under the base case scenario compared to a scenario where two additional PDH units start-up during the forecast period, one in late 2018 and one in mid-2019. Were these two units to start-up, demand for LPG would increase by 3% in 2019 or 1.7 million metric tonnes. All of this additional material would be imported and would equal about 3.5 VLGCs per month of additional imports. Meeting this additional demand is certainly possible; however, it would put further strain on an already tight market.

In the base case, total exports for 2019 are expected to be 25.3 million tonnes, up 7.4 million tonnes from the 2017 number or 41% higher. Much of this demand growth is from increasing petrochemical demand, but there is rapid growth in other segments as well. The pie graph on the bottom right shows the source of demand growth in China broken down between petrochemicals and other demand, primarily for residential use in cooking and home heating with some commercial applications.

There is some downside risk to this forecast. New and existing petrochemical units (particularly PDH units) will run at lower rates if the economics are not beneficial. In today's market, integrated PDH plants are making positive margins; however, any shifts in the global polymer market could threaten those economics. BDH plants are less susceptible to LPG price swings as their end-use into gasoline tends to consistently provide positive economics. In addition, a slowdown in conversion to LPG use in residential and commercial applications would dampen growth in demand.

Australia's LPG exports to increase in 2018

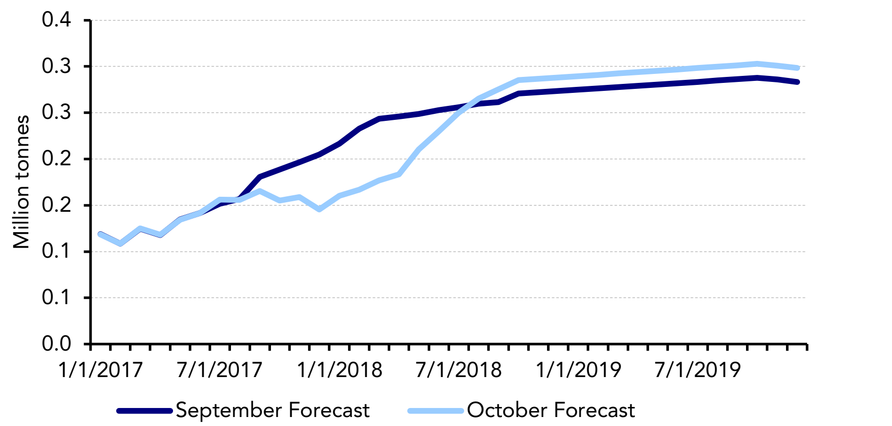
The new LNG projects starting up in Australia in 2018 will bring with them increased LPG exports. Two of the three projects starting up have associated LPG production with as much as 1.6 million tonnes available, primarily, to the export market. The most recent Poten forecast has updated the timing of these projects, reflecting the start-up of Ichthys in mid-2018 rather than late-2017. The graph on the top right compares the newest supply forecast to the previous one.

As a result of this change, Australia's exports for 2017 are forecast to be 1.4 million tonnes, up only 0.2 million tonnes from 2016. In 2018, on the other hand, exports are forecast to grow to almost 2.5 million tonnes. Nearly all of these additional exports will head to Northeast Asia, specifically Japan. Growth will continue in 2019 as the first full year of operations for the new units takes place. Following 2019, the growth in exports and domestic production is expected to be extremely small. Poten is forecasting an increase in exports of less than 1% between 2019 and 2020.

In 2017 through September, Australia has sent 23% of its exports to Japan. Over the past several months, additional material has been going to China, accounting for 26% of Australia's total exports for 2017. For comparison, in the first nine months of 2016, 37% of Australia's exports went to Japan with 27% going to China. The total export volume is higher with 980,000 tonnes exported in the first nine months of 2017 compared to 880,000 tonnes during the same period in 2016. Many of the contracts for the new exports are with Japanese firms, so the total volume headed that direction is expected to increase as the new projects start up.

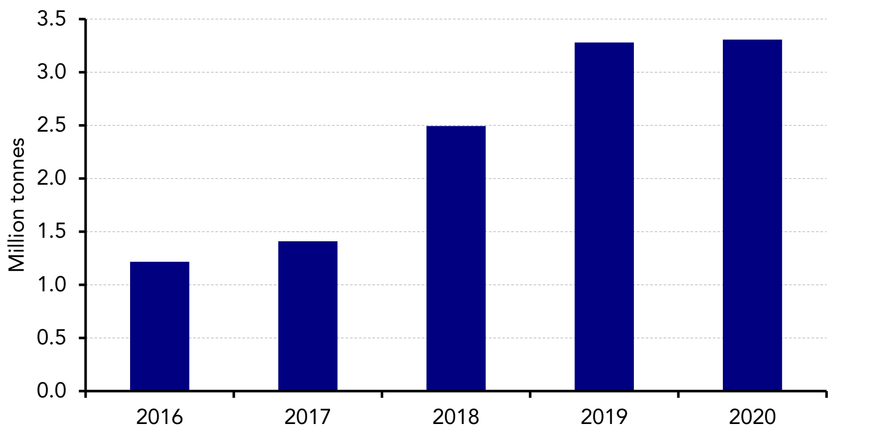
In addition to exporting LPG from the West Coast, Australia imports LPG into its East Coast. VLGCs arrive from destinations around the world, including the US. Total 2017 imports are expected to be around 500,000 tonnes, roughly equal to the total in 2016. Poten does not expect these import volumes to increase much in the coming years as growth in domestic LPG markets is sluggish.

Australia LPG gas plant production forecast



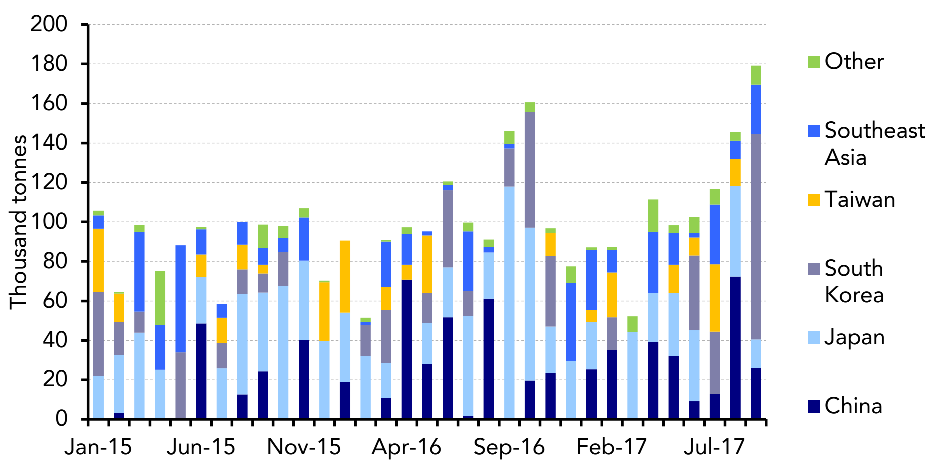
Source: Australian Government/Poten

Australia annual LPG exports



Source: Australian Government/Poten

Australia LPG exports by destination



Source: Poten/Reuters

Japanese demand for imports to rise in winter due to lower inventories

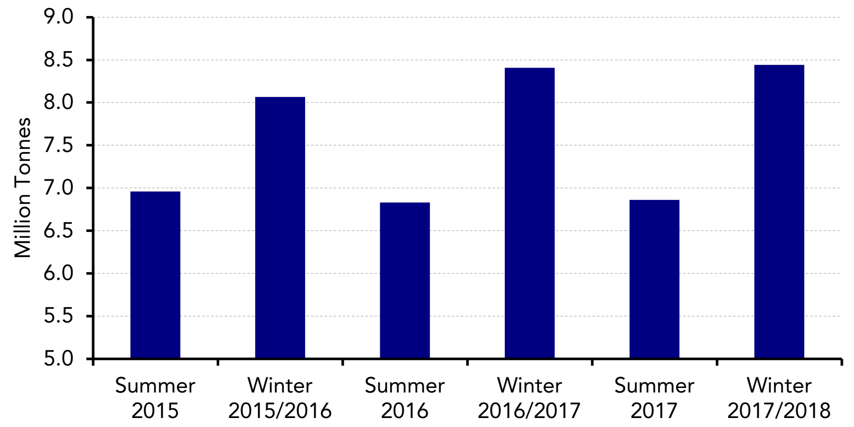
Japanese demand for LPG has a strong seasonal component. The top graph compares the demand for the six months between October and March to demand from April to September, labelled here as winter and summer months. There is a strong variation in demand between these seasons, consistent across all time periods. In general, demand for LPG is 15% higher in the winter months than in the summer months. Demand in the summer of 2017 was higher than in the summer of 2016, but slightly lower than in 2015 at around 6.9 million tonnes. Demand for this coming winter is expected to be roughly equal to last year's at 8.4 million tonnes.

The inventory position going into this winter, however, is not very strong. The green line in the middle chart shows estimated storage volume in Japan using METI's reported numbers as a baseline. Using these estimates, Japan appears to be headed into winter with storage on the lower side of average, certainly lower than the high figures seen in 2016. Given the current expectations for demand and import volumes, inventories at the end of the year may be lower than normal, toward the low point of the five year range.

Because of this lower storage, Poten is forecasting slightly stronger import volumes this winter than last year. There may be room for additional material to head toward Japan, especially in January and February when the total volume in storage is expected to be lower than is typical for that time of year. If additional material moves into Japan, however, it will be coming from an already tight global market and the price point may be high. That said, if there is a colder winter than normal, these additional tons may be required to balance the market.

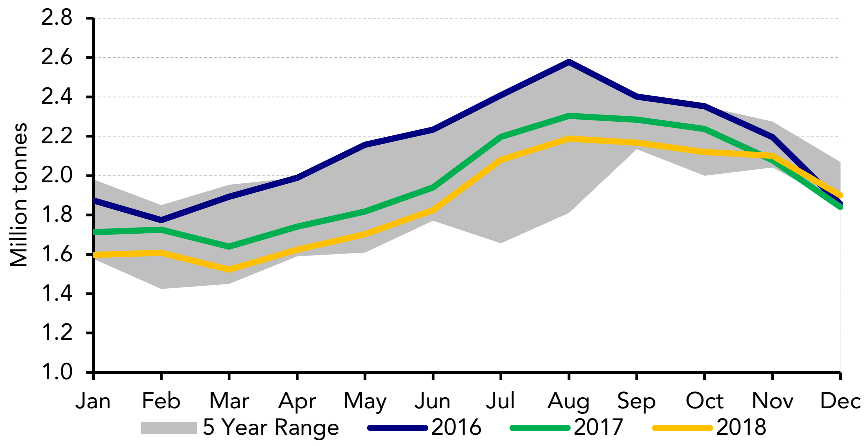
In 2019, no major shocks to demand in Japan are expected. There is not much room for additional growth in the retail segment and petrochemical demand, at least for now, seems to be steady. There is room for propane to move into steam crackers; however, it is not clear if those economics are positive given today's high propane price environment.

Japanese seasonal LPG demand comparison



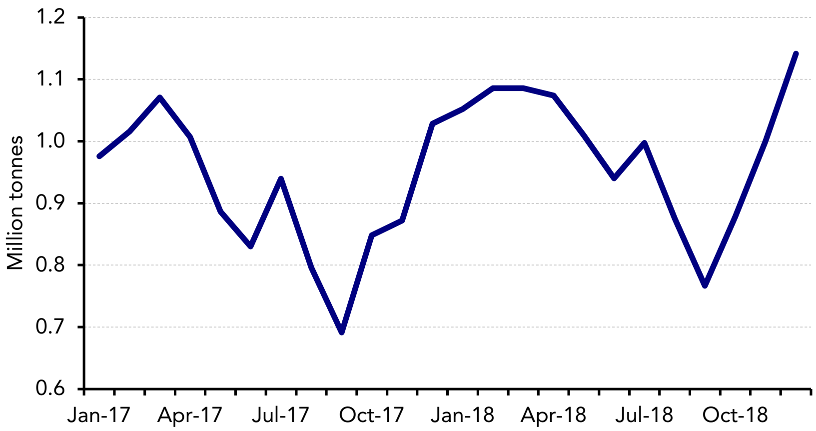
Source: METI/Poten

Japanese LPG inventory



Source:METI/ Poten

Japan LPG import forecast



Source: Poten

Southeast Asian demand heats up as economies expand beyond traditional fuels

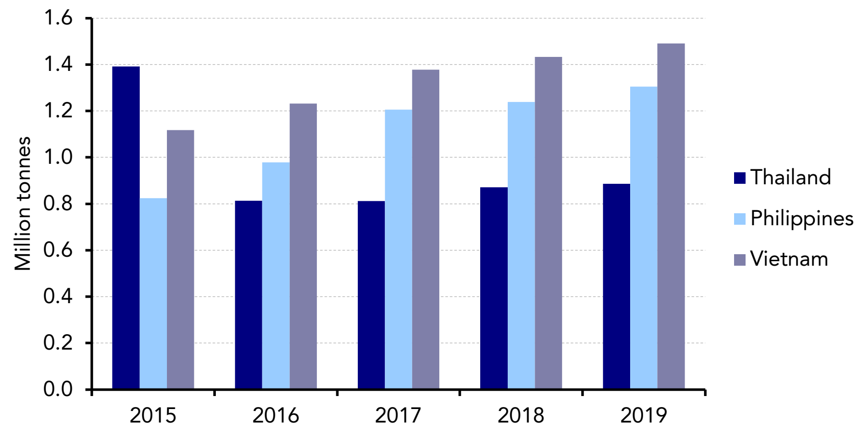
Demand in Southeast Asia will continue growing over the next several years, especially in Thailand, Vietnam and the Philippines. Indonesia is the dominant country in the region, taking more than 4.5 million tonnes of imports in 2017; however, these countries also play an important part in the dynamics of the region.

In Thailand, demand fell by more than 40% in 2016 after the removal of subsidies from LPG. However, so far in 2017, import volumes have rebounded slightly, up for the year by 3%. In the coming years, Poten expects demand for LPG to continue growing at a moderate pace as LPG use inches higher. In the Philippines and Vietnam, on the other hand, demand is expected to grow at a rapid pace, growing by 8% in each country between 2017 and 2019. The demand growth is pushed by the continued switching from traditional fuel sources to cleaner LPG.

The bulk of LPG into these three countries comes from the Middle East, in particular the UAE which accounts for 14% of the total imports. Other major trading partners include Qatar, Indonesia (which loads smaller cargoes), and Saudi Arabia. The import growth in the coming years will be sourced primarily from Middle Eastern nations with opportunistic shipments from the US and West Africa as economics dictate. Rarely do any of these nations take full VLGC cargoes, splitting large cargoes with China, Japan or Korea in many cases.

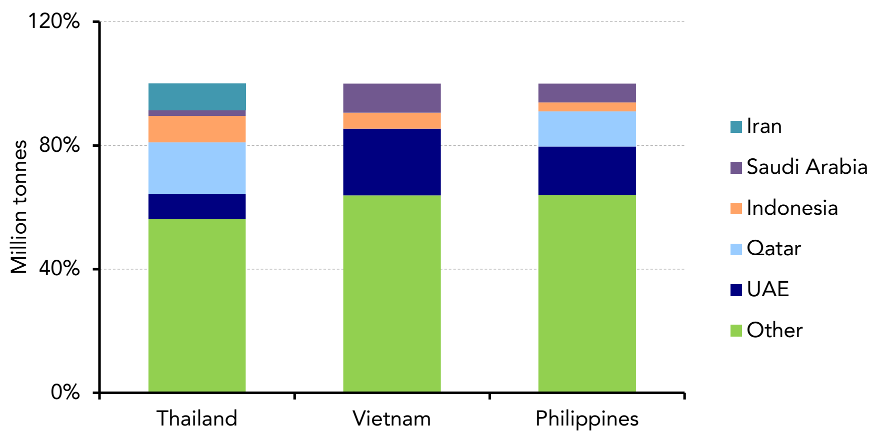
Thailand is the only nation of these three with a sizeable gas plant production base. Poten estimates that gas plant production of LPG is about 3.3 million tonnes per year; however, this volume has been decreasing and is expected to continue going down by about 1-2% per year during the forecast. This decline will increase the need for imports slightly; however, until a rigorous subsidy program is reintroduced in Thailand, demand growth is expected to remain slow.

Southeast Asia LPG imports



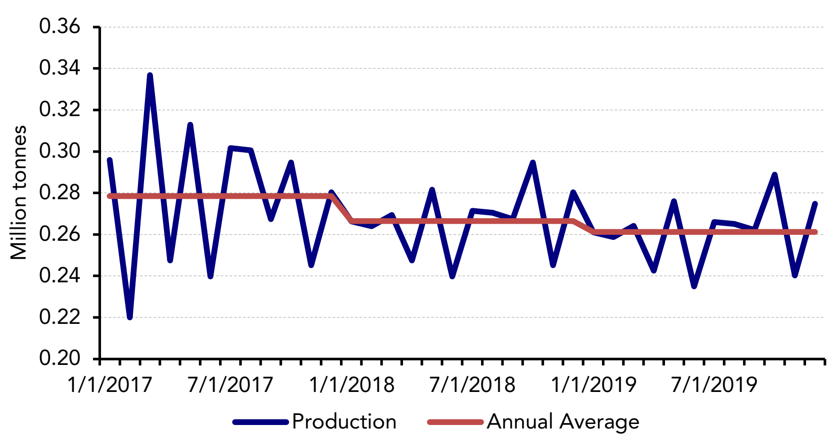
Source: Poten

Thailand, Vietnam and Philippines import sources, 2017 YTD



Source: Poten

Thailand gas plant production



Source: Poten

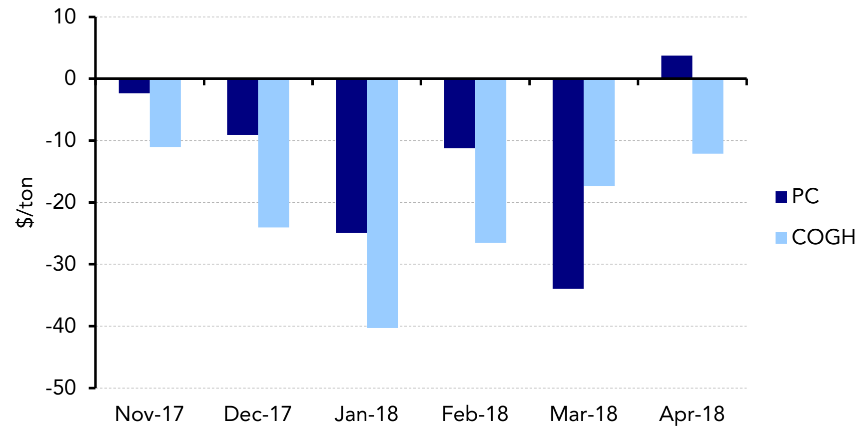
Globally, arbitrage economics are negative for the next six months

Global arbitrage economics are pretty poor in today's market based on swaps and future freight estimates. The only bright spot seems to be a positive arbitrage for deals being done in April 2018 via the Panama Canal; however, the margin for that is slim and will likely depend on the actual freight including any Panama Canal premiums priced into the deal. One interesting item to note is that based on current market futures, the economics to Asia via the Cape of Good Hope for March 2018 are better than those via the Panama Canal. This has to do with the differing delivery times. Shipments made in March 2018 to Asia via the Cape will arrive in mid-April or early May compared to a March arrival for those via the Canal. As a result, the longer route is more attractive. Or in this case it might be better to say the deals look less unattractive.

Arbitrage economics from the USGC to North Europe are negative for all time periods shown. This is consistent with what has been seen for the majority of this year. According to Poten's shiptracking models, roughly 650,000 tonnes of LPG have left the USGC headed toward North Europe from January 2017 through October 16. For comparison, 1.5 million tonnes left for North Europe during the first ten months of 2016. The difficult economics for the next six months indicate that those shipments are likely to remain low with little to no volume leaving each month.

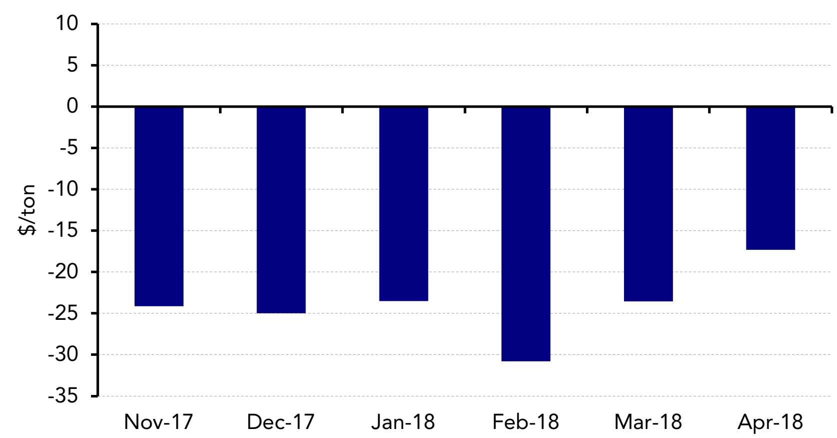
Economics from Europe to Asia are also faring poorly as shown in the bottom graph. Shipments from Europe to the East are not done on a regular basis; however, 370,000 tonnes have been shipped so far in 2017 compared to 250,000 tonnes for all of 2016. In August, three vessels left North Europe headed for Northeast Asia one headed for South Korea and two for China. Despite a short period of positive economics in September, no vessels have left since then.

USGC to Asia arb calculations



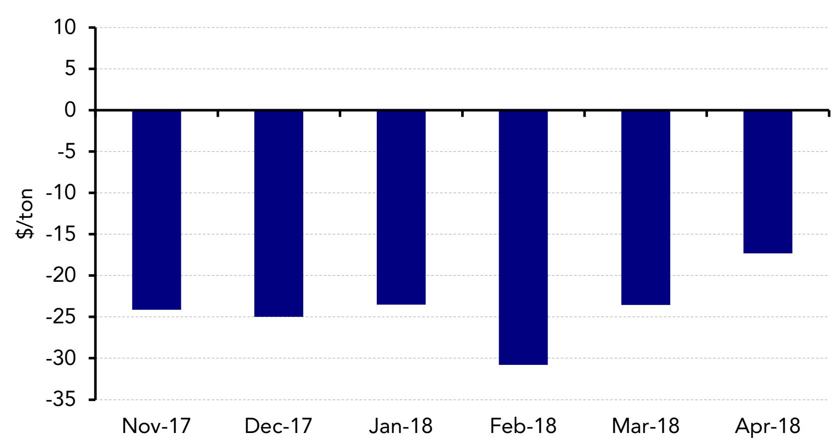
Source: Poten, freights calculated

USGC to Europe arb calculations



Source: Poten, freights calculated

North Europe to Asia arb calculations



Source: Poten, freights calculated

