

Cold, Rain and Snow: Weather Impacts on Energy

Outlooks on Natural Gas, Propane, Distillate and Coal

Anthony Yuen, Ph.D. AC

anthony.yuen@citi.com

+1 212-723-1477

Eric Lee

eric.g.lee@citi.com

+1 212-723-1474

Adriana Knatchbull-Hugessen

Adriana.KnatchbullHugessen@citi.com

+1 212-723-7193

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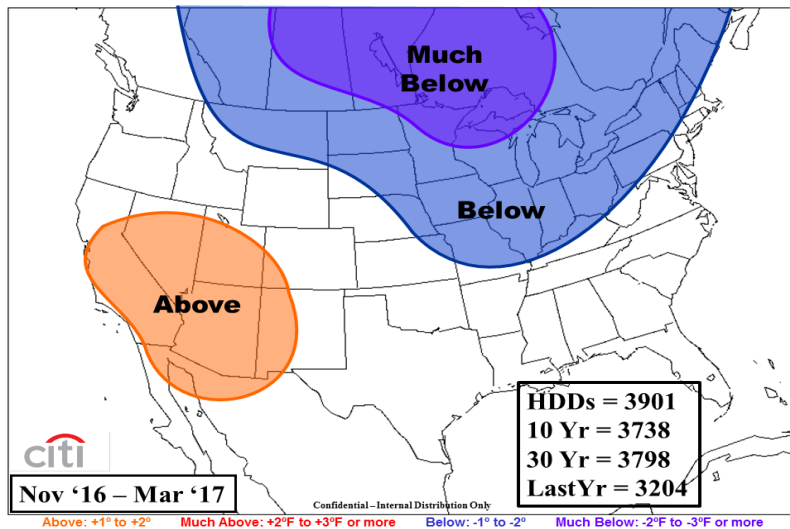
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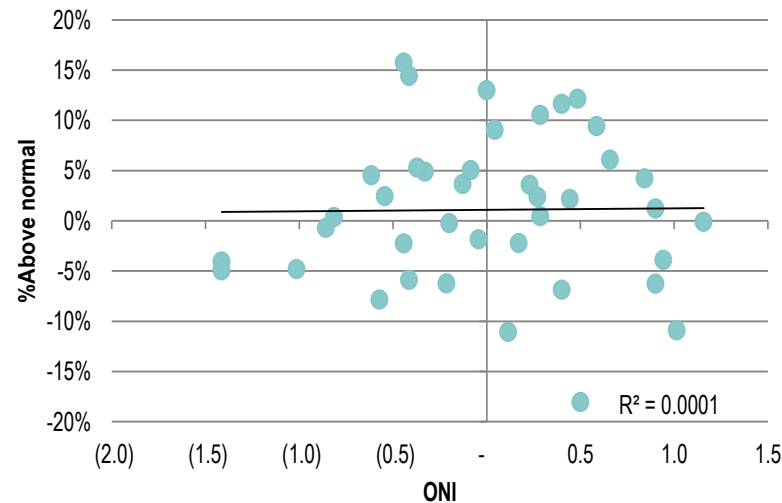
Commodities Views

Weather: cold winter expected, rain lingering on despite low chance of La Niña

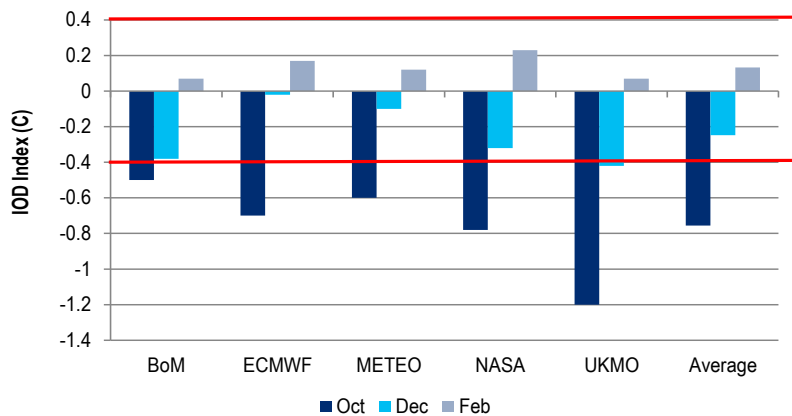
Citi Energy Winter Weather Outlook for North America



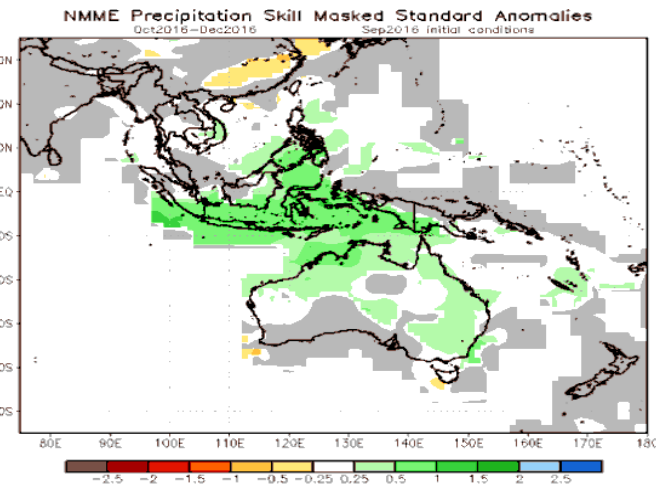
US HDDs compared with the 30-year normal vs. ONI. A more negative ONI would mean a stronger La Niña, but there is no strong relationship between El Niño/La Niña with HDDs



Forecasts of Indian Ocean Dipole quickly moving from the negative phase in Oct to neutral in Dec and positive in Feb



Precip forecasts (Oct-Dec) in SE Asia and Australasia, with heavier than usual precip in Indonesia but less so in Australia

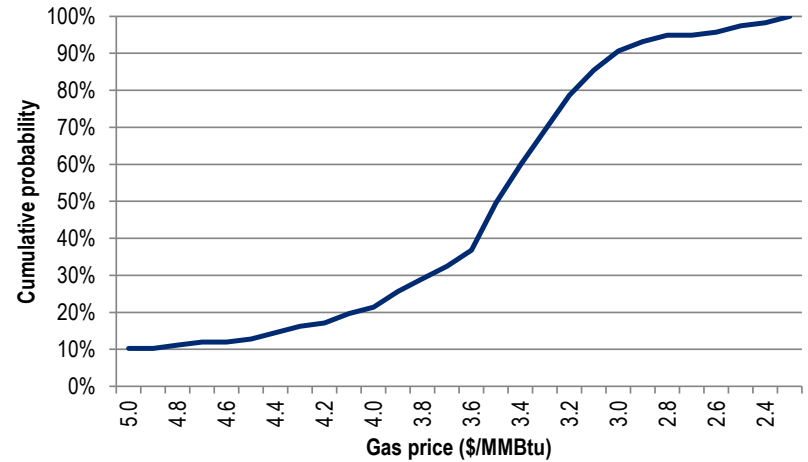


Source: Australian BOM, CanSIPS, ECMWF, JMA, METEO, NASA, NOAA, UKMO, Citi Research, Citi Energy

Natural Gas: A cold winter could lift prices to the high-\$3 or above \$4 in Cal17

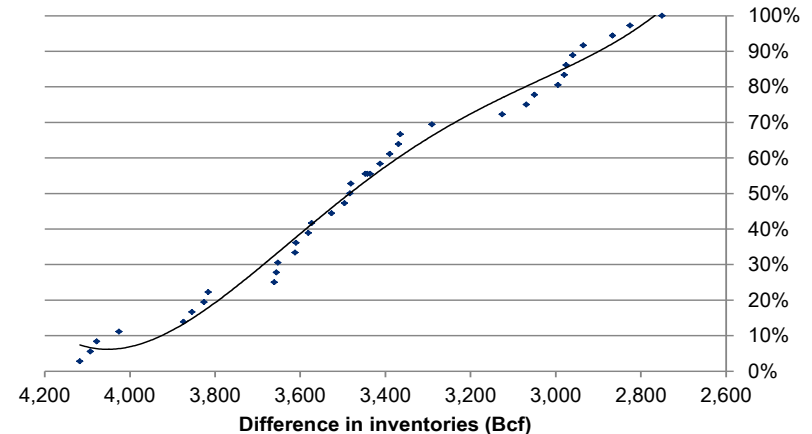
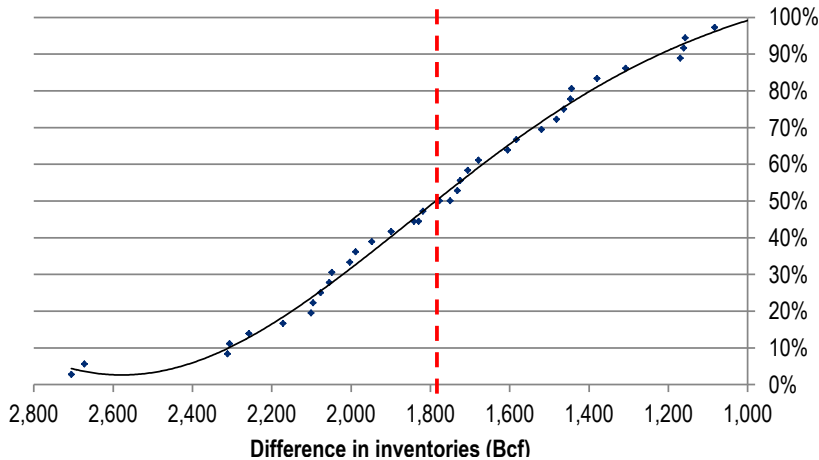
- 2017 Henry Hub natural gas prices could fall within a range between \$3.1 and \$4.0/MMBtu if the Nov'16 to Mar'17 weather were to fall within one standard deviation (the middle ~68%) of the mean winter weather.
- If Citi's meteorologist's winter weather forecast materializes, then prices could reach the high-\$3/MMBtu range.
- Supply assumptions: Citi assumes that 2017 US natural gas production growth to be 1.4-Bcf/d y/y, with imports from Canada similar y/y

Cumulative probability distribution of 2017 gas prices with 36 years of winter weather and 3 production cases



The end-Mar'17 storage levels could range from 1-Tcf to 2.7-Tcf: the high end if the mild 2011-2012 were repeated, or ~1-Tcf if similar to the cold 2013-14 winter

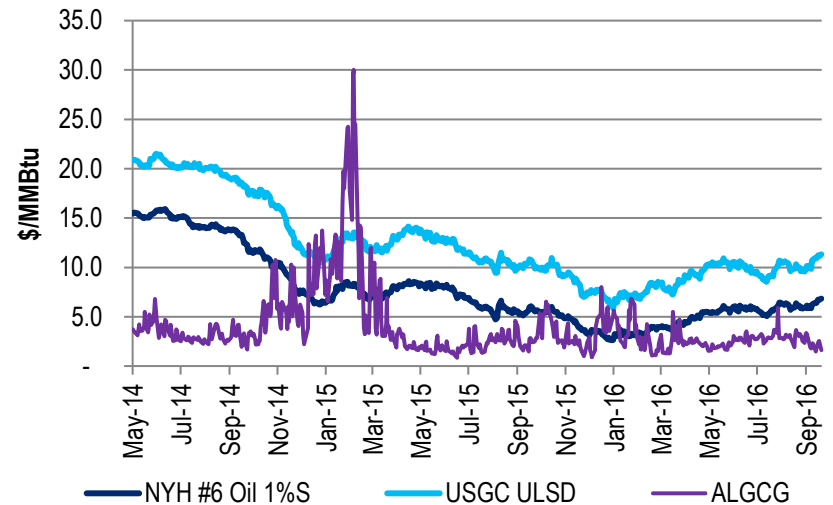
The end-Oct'17 storage levels could range from 3-Tcf to 3.9-Tcf within one standard deviation of



Regional prices could spike if colder-than-normal weather hits the US Northeast

- Regional prices could spike if colder-than-normal weather, similar to the polar vortices that hit the US in the 2013-2014 winter, were to take place.
- But the initial price spikes in natural gas prices would have to cross over two price thresholds (fuel oil and diesel), as natural gas-to-oil switching in power generation could help ease demand for natural gas in times of extreme tightness.
- If fuel switching from natural gas to oil in the power sector is insufficient to free up more natural gas, natural gas prices could surge.

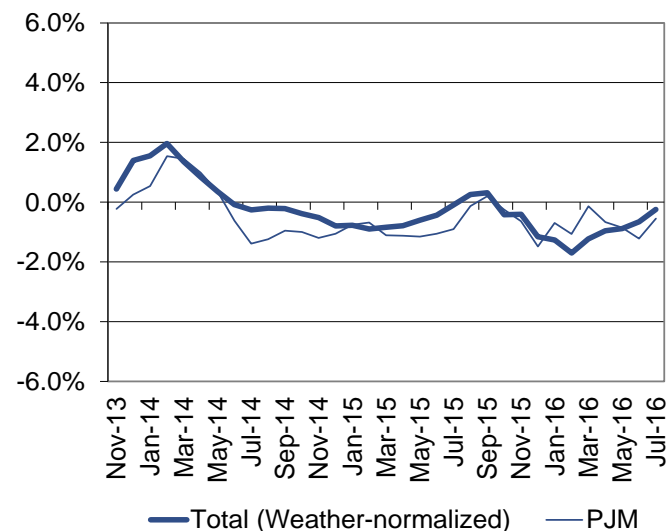
New England natural gas prices (ALGCG) spiked when demand surged, but there seemed to be soft price ceilings at where fuel oil and diesel generation costs are



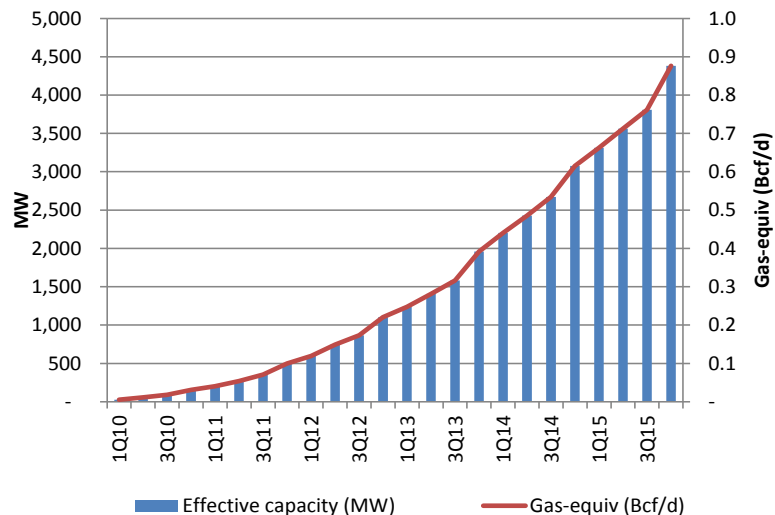
Three key factors could help ease tightness in the natural gas market

- 1. Growth of renewable energy generation**, amid near zero growth of weather-adjusted power demand nation-wide, could reduce gas demand for power generation by ~0.7-Bcf/d.
- 2. US LNG export arbitrage could narrow to zero** as Henry Hub prices approach the mid-\$3 range, and if UK's NBP prices fall below \$5.
- 3. Higher gas prices should raise gas drilling activity** and speed up the clearing of drilled-but-not-producing wells, essentially placing a soft cap on prices at the \$4 range.

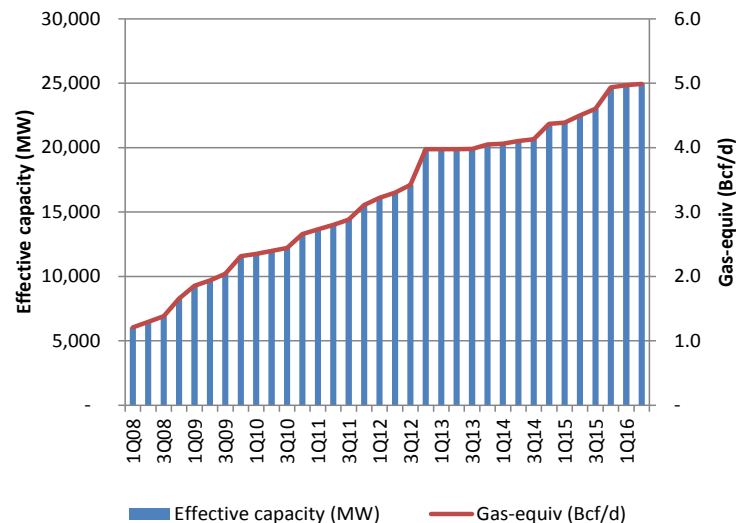
Weak power demand growth...



...the rise of solar PV capacity



... and the rise of wind generation could limit gas burn



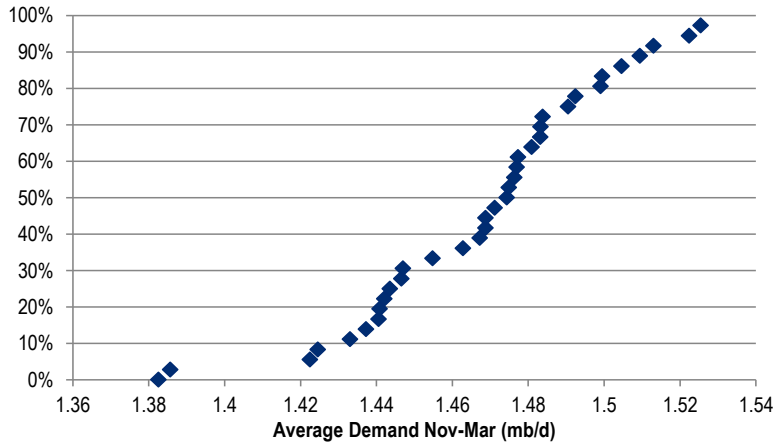
US monthly natural gas supply-demand balance based on normal weather

	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Y/Y Change	Annual
Total Supply	75.9	76.8	73.9	74.2	74.0	73.2	73.3	73.6	73.1	72.9	76.2	75.7	-1.4	74.4
Prod	72.5	73.7	72.5	72.0	71.7	70.9	70.5	71.3	71.4	71.1	74.4	74.3	(1.1)	72.2
LNG Imports	0.4	0.3	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.3	0.2	(0.0)	0.2
Exports to Mexico	(3.2)	(3.4)	(3.3)	(3.4)	(3.4)	(3.5)	(3.6)	(3.5)	(3.2)	(3.1)	(3.2)	(3.5)	(0.5)	(3.4)
Imports from Canada	6.2	6.2	4.9	5.8	5.8	6.1	6.7	6.1	5.6	5.9	5.9	5.9	0.7	5.9
LNG Exports	(0.0)	(0.1)	(0.3)	(0.3)	(0.3)	(0.5)	(0.5)	(0.6)	(0.9)	(1.2)	(1.2)	(1.2)	(0.5)	(0.6)
Total Demand	100.0	91.8	75.9	69.8	63.7	67.0	71.0	70.6	65.5	64.3	74.5	90.4	(0.0)	75.4
IND	23.3	22.9	21.6	20.8	20.0	19.9	20.1	19.8	19.3	20.6	22.2	23.0	0.5	21.1
ResComm	44.9	38.3	24.3	18.7	11.8	8.7	7.9	7.4	7.7	11.5	22.5	36.9	(1.5)	20.0
EG	25.0	23.8	23.8	24.1	26.0	32.5	37.0	37.1	32.0	25.6	23.3	23.8	1.4	27.8
Pipe Use	2.4	2.2	1.9	1.7	1.6	1.6	1.7	1.9	2.1	2.1	2.1	2.1	(0.4)	2.0
Lease and Plant Fuel	4.3	4.4	4.3	4.3	4.3	4.2	4.2	4.2	4.3	4.4	4.3	4.4	(0.0)	4.3
Transport	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1
Inventory (Bcf)	2,925	2,521	2,470	2,628	2,947	3,166	3,297	3,416	3,680	3,915	3,936	3,481		
	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Y/Y Change	Annual
Total Supply	73.7	74.0	72.8	73.5	73.8	73.2	73.7	72.7	72.4	73.0	73.4	73.2	-1.1	73.3
Prod	72.7	73.1	73.2	73.3	73.5	73.3	73.3	73.4	73.7	73.9	74.9	74.8	1.4	73.6
LNG Imports	0.4	0.3	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.3	0.2	0.0	0.2
Exports to Mexico	(4.4)	(4.4)	(4.3)	(4.5)	(4.5)	(4.7)	(4.7)	(4.7)	(4.7)	(4.7)	(4.6)	(4.6)	-1.2	(4.6)
Imports from Canada	6.2	6.2	4.9	5.8	5.8	6.1	6.7	6.1	5.6	5.9	5.9	5.9	0.0	5.9
LNG Exports	(1.2)	(1.2)	(1.2)	(1.2)	(1.2)	(1.8)	(1.8)	(2.4)	(2.4)	(2.4)	(3.1)	(3.1)	(1.3)	(1.9)
Total Demand	98.2	97.4	83.8	72.4	64.0	65.2	67.0	67.8	63.5	65.2	74.7	90.5	0.4	75.8
IND	24.0	24.2	22.6	21.8	20.8	20.7	20.4	20.8	20.9	21.2	22.5	23.3	0.8	21.9
ResComm	44.7	43.1	32.1	20.6	12.1	9.0	7.8	7.6	8.3	13.3	22.5	36.9	1.4	21.5
EG	22.9	23.8	22.5	23.5	24.4	29.0	32.1	32.7	27.7	24.0	23.0	23.5	(2.1)	25.8
Pipe Use	2.1	2.1	2.0	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	0.1	2.1
Lease and Plant Fuel	4.4	4.1	4.5	4.4	4.5	4.3	4.5	4.5	4.4	4.5	4.4	4.5	0.1	4.4
Transport	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1
Inventory (Bcf)	2,749	2,129	1,816	1,883	2,213	2,479	2,710	2,888	3,174	3,387	3,320	2,788		

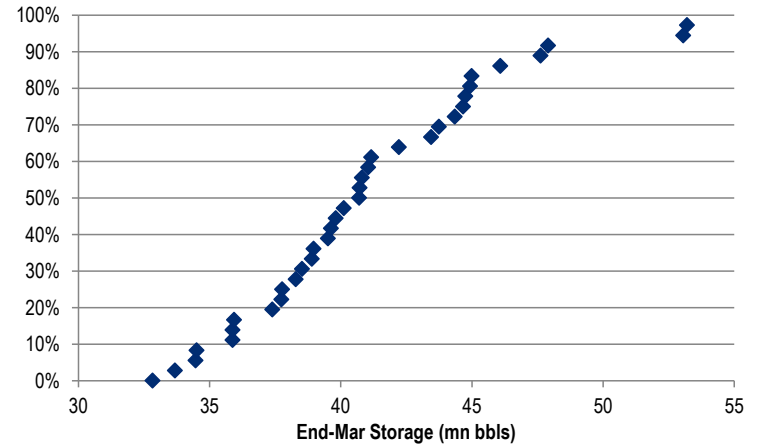
Source: EIA, Citi Research

Propane: Despite draws, inventories should stay slightly elevated post-winter

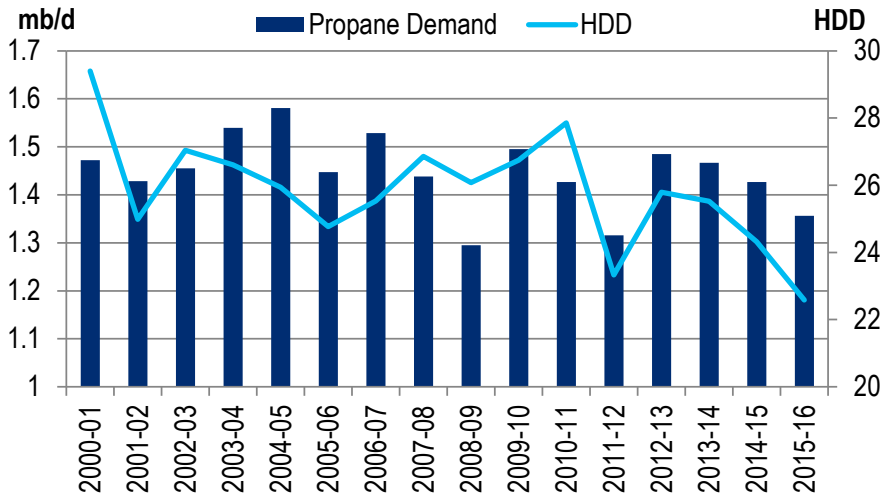
Cumulative probability distribution of forecasted 2016/17 Nov-Mar demand under 36 winter weather scenarios



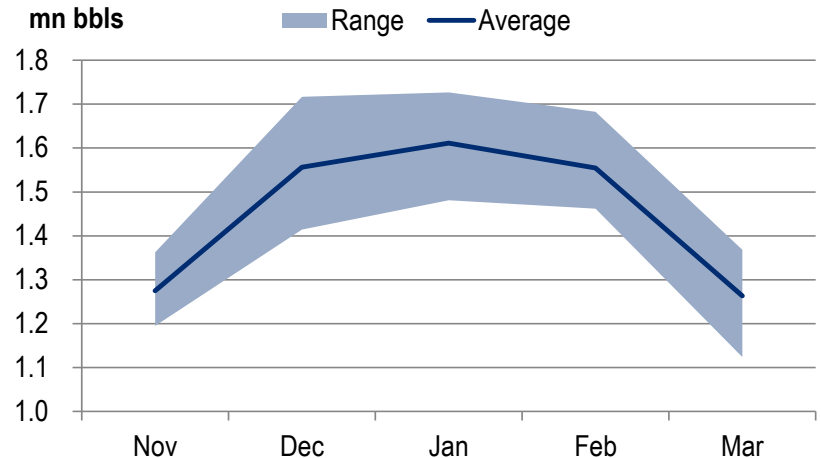
Cumulative probability distribution of forecasted end-Mar'17 storage level under 36 winter weather scenarios



Propane demand and average HDD days (Nov-Mar): Last year's mild weather reduced heating demand by ~100-kb/d versus the 15-year average



Range and average forecasted propane monthly demand under 36 winter weather scenarios

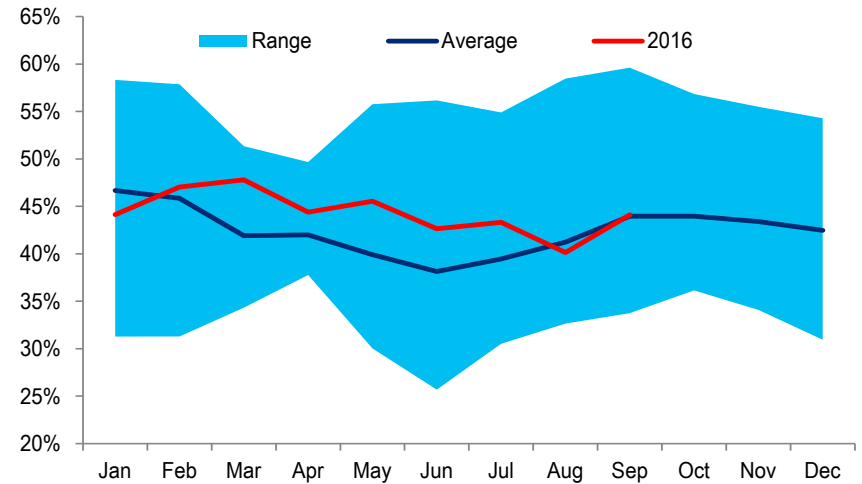


Source: EIA, Bloomberg, Citi Research

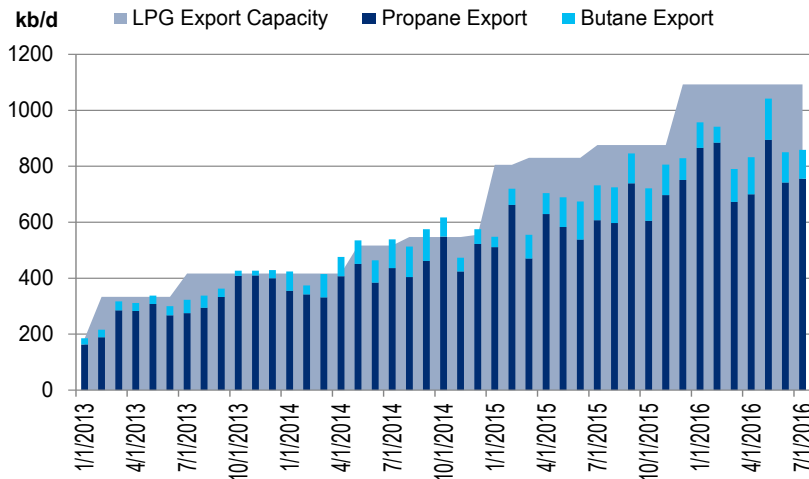
Propane price seasonality may be accentuated by the rise in exports

- On average, US Mont Belvieu propane prices show clear seasonality. After falling through the first half of the year, over the last two months, propane prices have begun to rise relative to crude.
- US propane price seasonality may be exaggerated this year as exports, now unconstrained by capacity, will be subject to demand seasonality in Asia. This should provide further support to US prices going in to the winter months as the arb into Asia will need to stay tight in order to keep US exports from exceeding available supplies.

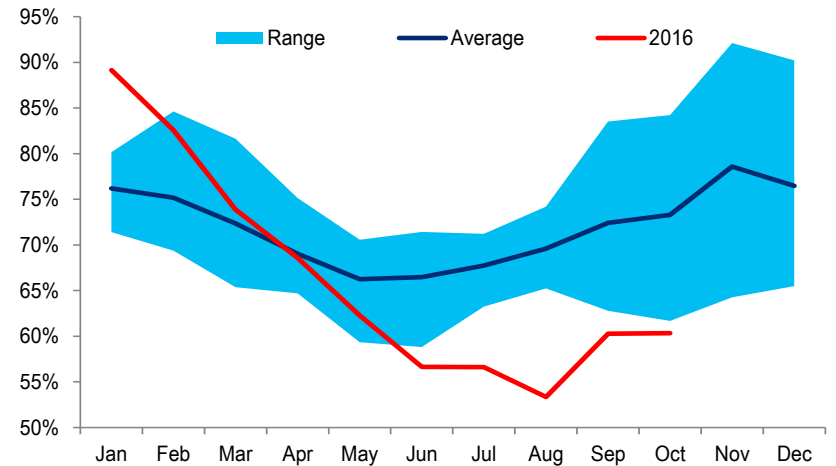
Mont Belvieu Propane Ratio to Crude 2016 and 5-year Statistics



US Exports of Propane and Butane vs Export Capacity

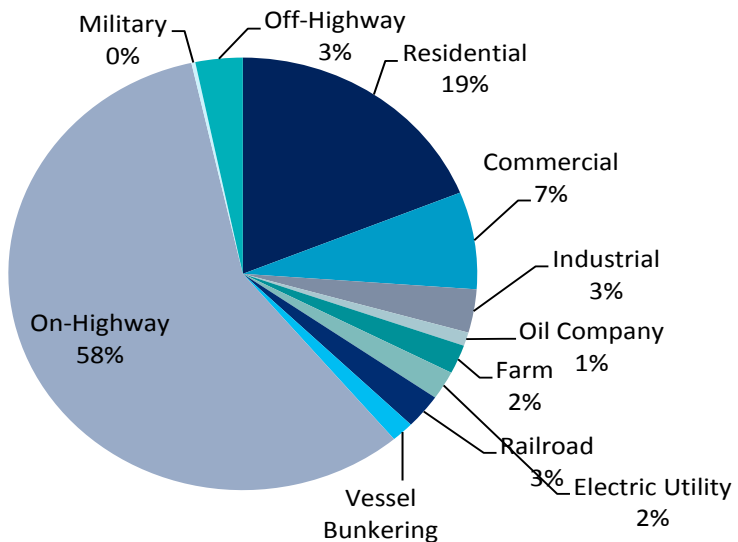


Asian propane price seasonality

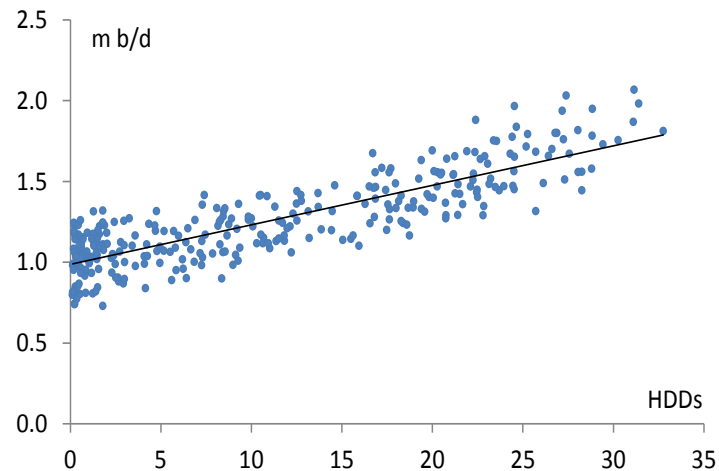


US distillates: Demand should be greater than last winter, peaking at >4-mb/d

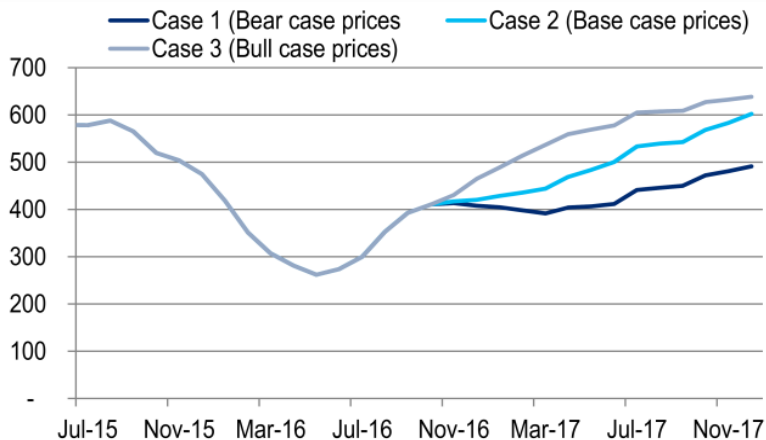
US East Coast (PADD 1) distillate demand by end-use



PADD I distillate demand versus HDDs

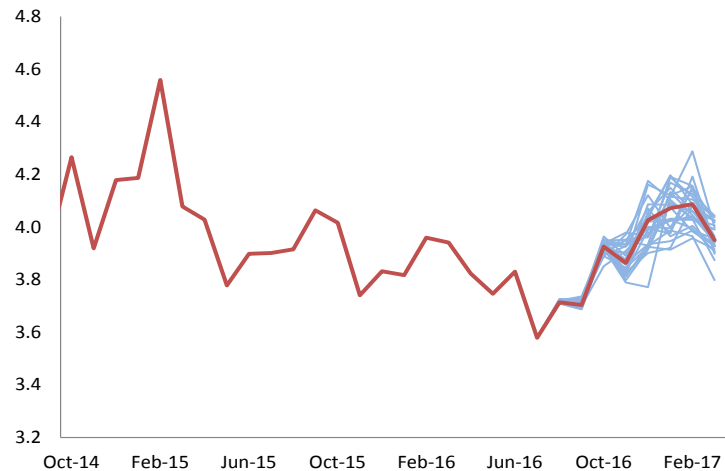


Modest recovery in US tight oil/shale gas rig counts should lead to slight growth in distillate demand



US distillate demand outlook

(10-year normal HDDs in red, 30 years of HDD cases in blue)



Coal: Prices should stay elevated on high natural gas prices, production issues

- **Prices of both US and global seaborne coal have surged:**
 - Price moves in the seaborne market mirrored the surge in late 2010/early 2011. Coking coal prices have more than doubled and Newcastle thermal coal prices have risen by ~50% vs. Jun'16
- **US:**
 - Prices and demand could rise due to (i) higher North American natural gas prices and (ii) the potential for US coal to be exported because of high seaborne coal prices
- **Australia:**
 - Unlike in prior years when weather has resulted in coal price spikes (2011 for coking coal in particular), the most recent supply disruptions have been due to ground conditions and rail track issues in Queensland
 - Queensland coking coal is more exposed than thermal coal
 - Lessons have been learnt from the past and the mines are now better prepared for major weather events
- **China:**
 - The impact of El Niño on coal markets has been mostly on the demand side during the past summer.
 - Weather disruptions on production have been limited this year, but heavy rains this past summer put pressure on coal transportation
 - More important, NDRC's 276-day production rule during May-Sept was the primary driver of China's coal supply cut, and the reverse of that policy recently may lead to sequential improvement of coal output in 4Q
- **Indonesia:**
 - Rain has disrupted coal production in 3Q16, in addition to Muslim festivals having reduced working days by about 7-10 days for most of the workers.
 - Some forecasters expect that the abnormally wet weather should continue into Jan/Feb'17

Appendix A-1

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