

Impact of the Panama Canal widening on U.S. LPG exports



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By

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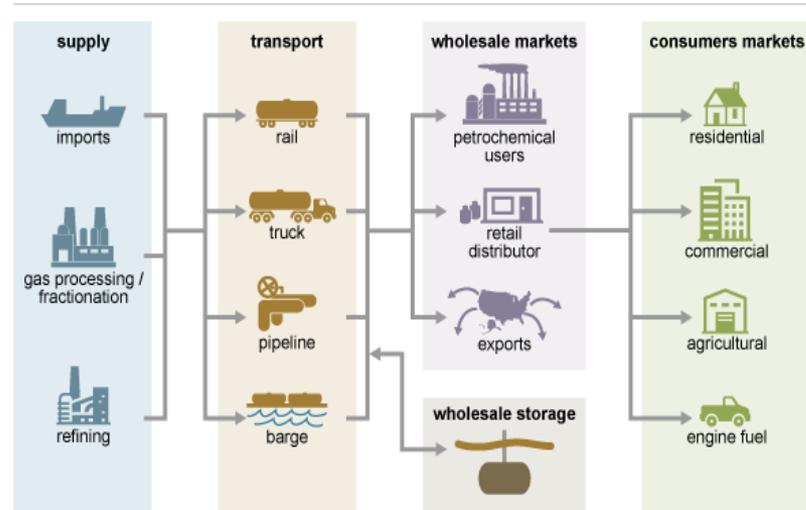
Industry Economist

Petroleum, Natural Gas, and Biofuels Analysis

Not all LPG is created equal

LPG	Uses	End-use products	End-use sectors
Ethane	Petrochemical feedstock for ethylene production; power generation	Plastics; anti-freeze; detergents	Industrial
Propane	Fuel for space heating, water heating, cooking, drying, and transportation; petrochemical feedstock	Fuel for heating, cooking, and drying; plastics	Industrial (includes manufacturing and agriculture), residential, commercial, and transportation
Butanes: normal butane and isobutane	Petrochemical and petroleum refinery feedstock; motor gasoline blending	Motor gasoline; plastics; synthetic rubber; lighter fuel	Industrial and transportation

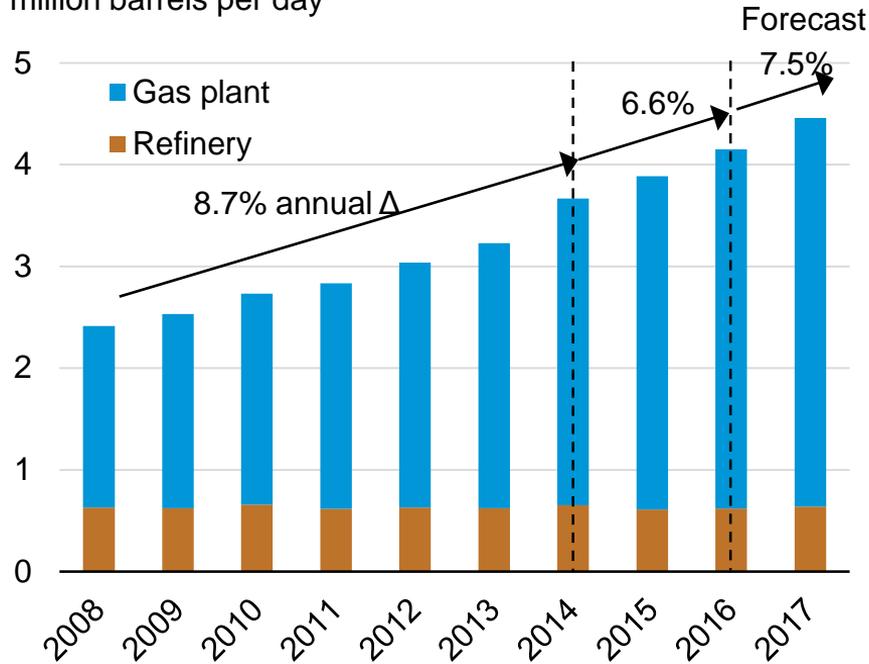
Propane supply and disposition



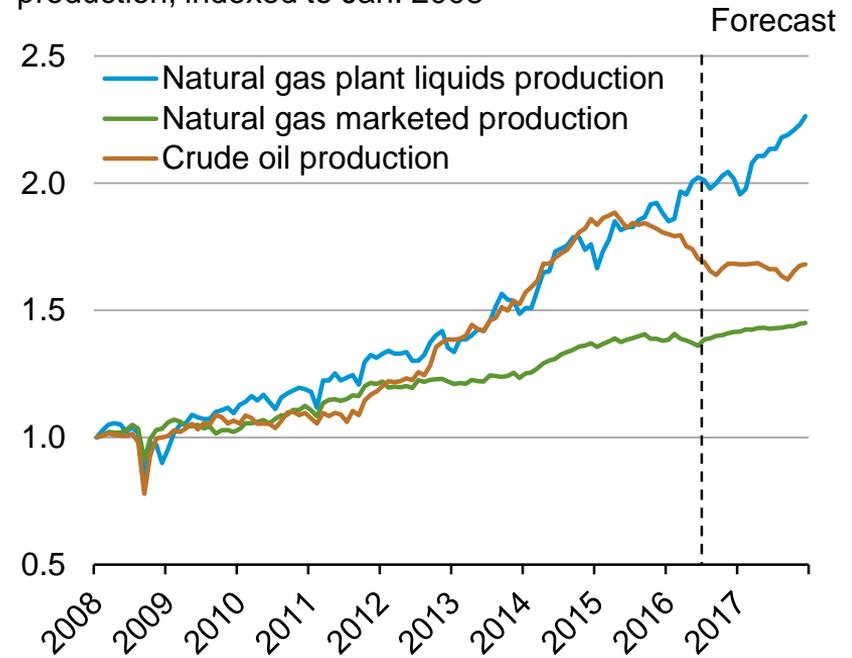
Source: U.S. Energy Information Administration

The road from net LPG importer to world's No. 1 exporter runs straight through a gas processing plant

HGL production by source
million barrels per day



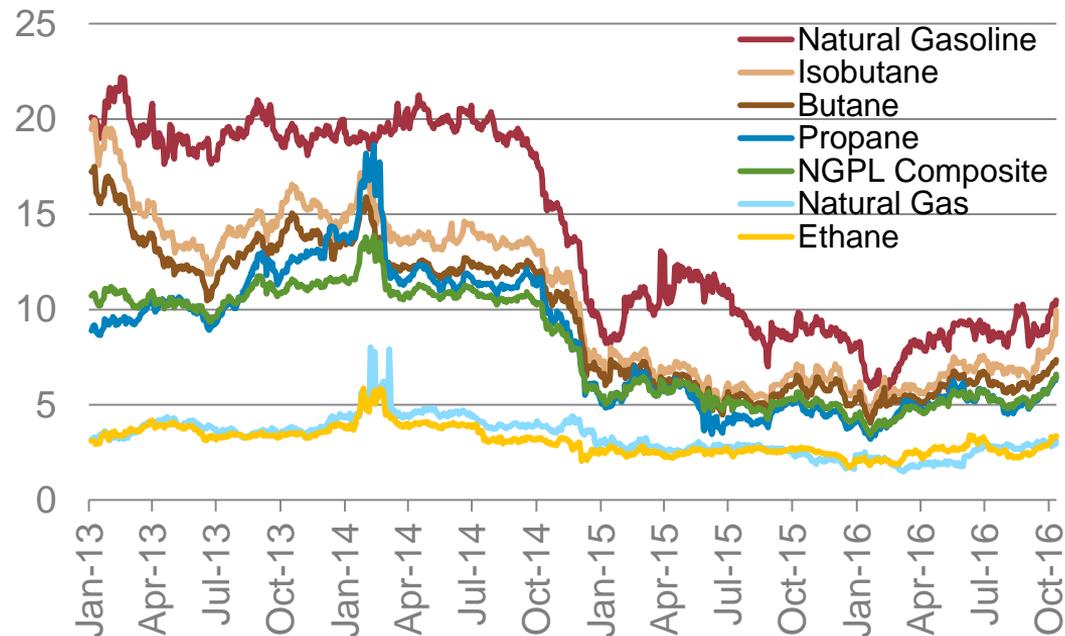
natural gas, crude oil, and natural gas plant liquids production, indexed to Jan. 2008



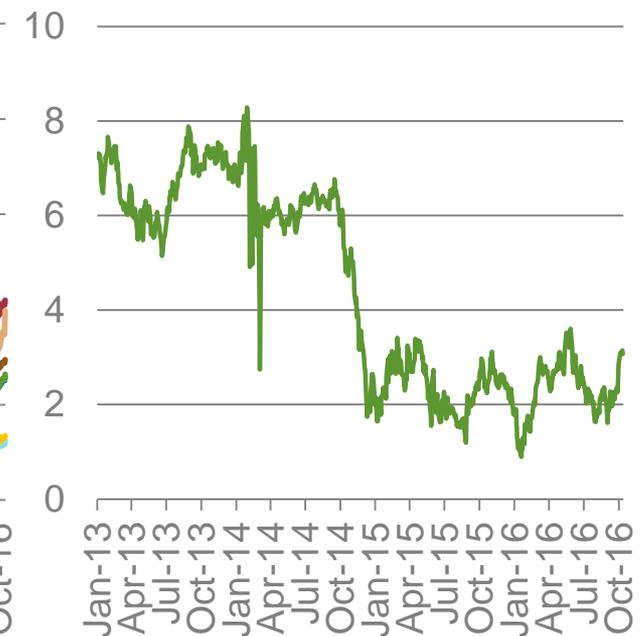
Source: EIA [U.S. Refiner & Blender Production](#) and [U.S. Natural Gas Plant Field Production](#); Short Term Energy Outlook Sept. 2016

International crude prices dictate U.S. LPG prices, and the great compression has not been kind to U.S. producers

Selected HGL prices
dollars per million Btu



Calculated fractionation spread
dollars per million Btu

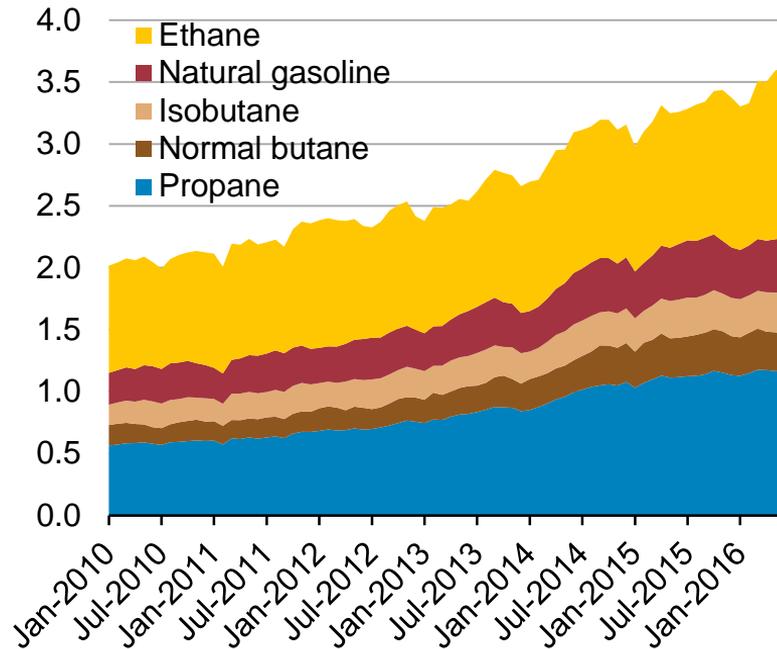


Note: All prices are daily end-of-day spot prices; natural gas is Henry Hub, and NGL components are Mt. Belvieu. NGPL Composite calculated based on calorific contribution of each purity to total NGPL barrel heat value

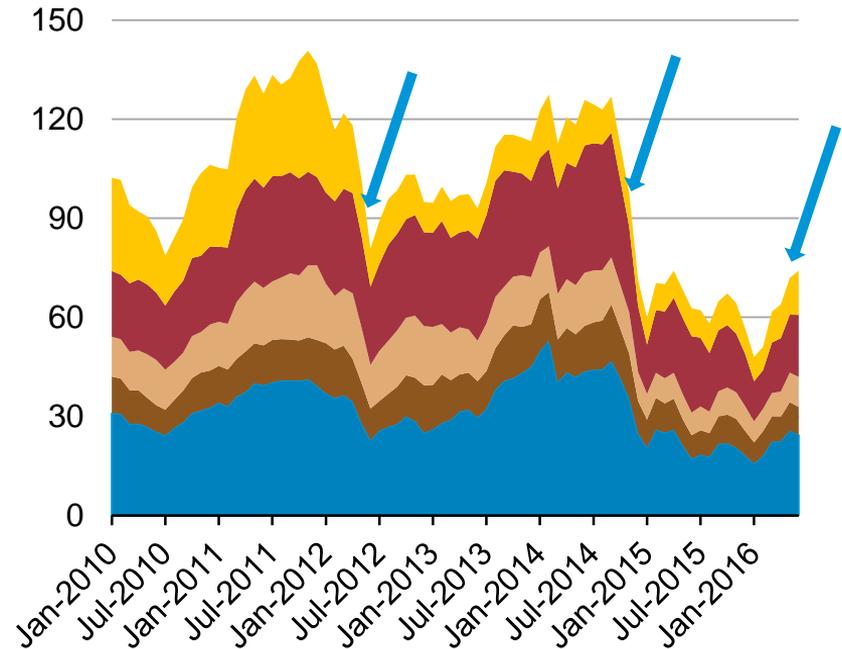
Source: U.S. Energy Information Administration based on Bloomberg.

Despite continuously growing production, U.S. producers have not seen consistent growth in revenue generated by natural gas liquids

NGPL production
million b/d



Estimated revenue generated by NGPL production
million dollars per day



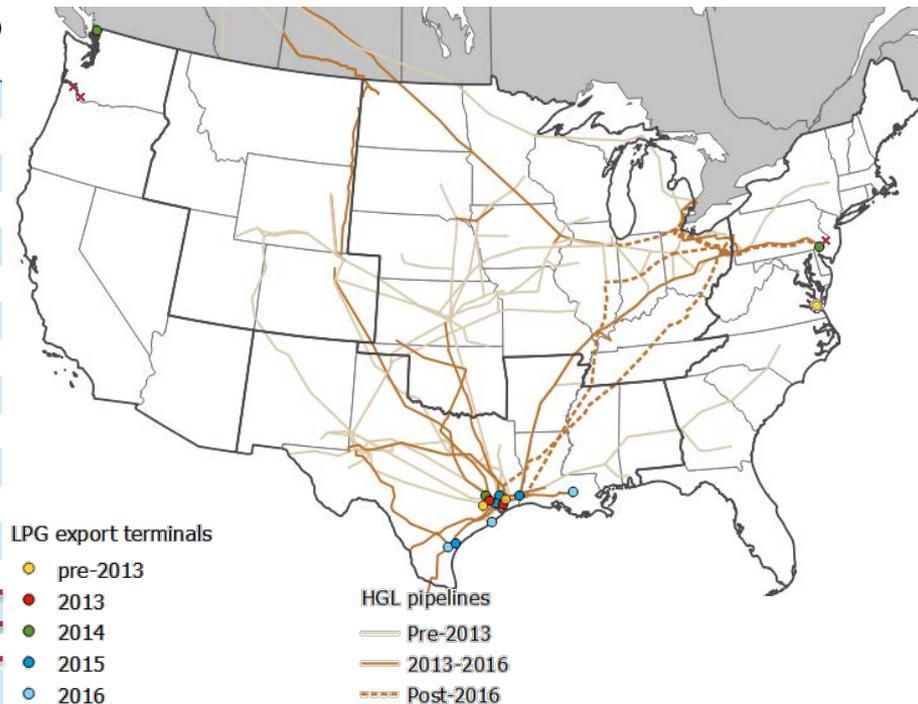
Sources: EIA and Bloomberg

Seeing higher net-backs, producers and midstream companies are looking to the export market for additional demand

Propane/butane export terminal projects

Company	Location	Terminal capacity		Investment (\$bil) *estimated		
		(1,000 b/d)	Startup			
Total Pre-2013	United States	196	pre-2013	--		
Enterprise	Channelview, TX	115	2013Q1	0.3*		
Targa Resources	Galena Park, TX	120	2013Q3	0.24		
Petrogas Energy	Ferndale, WA	30	2014Q2	0.24		
Targa Resources	Galena Park, TX	120	2014Q3	0.24		
Sunoco Logistics	Marcus Hook, PA	40	2014Q3	0.27*		
DCP Midstream	Chesapeake, VA	8	2014Q4	0.1*		
Sunoco Logistics	Nederland, TX	197	2015Q1	0.4*		
Enterprise	Channelview, TX	49	2015Q2	0.1		
Occidental	Ingleside, TX	66	2015Q3	0.4		
Enterprise	Channelview, TX	230	2015Q4	0.5*		
Buckeye/Trafigura	Corpus Christi, TX	50	2016Q1	0.35*		
EnLink	Riverside, LA	6	2016Q2	0.2		
Phillips66	Freeport, TX	150	2016Q3	0.8*		
Sage Midstream	Longview, WA	47	2016Q4	0.28*		
Kinder Morgan	Fairless Hills, PA	25	2017Q1	0.4*		
Pembina	Portland, OR	37	2018	0.5*		
Total	United States	1,234	1,181	2013-2018	4.8	4.1

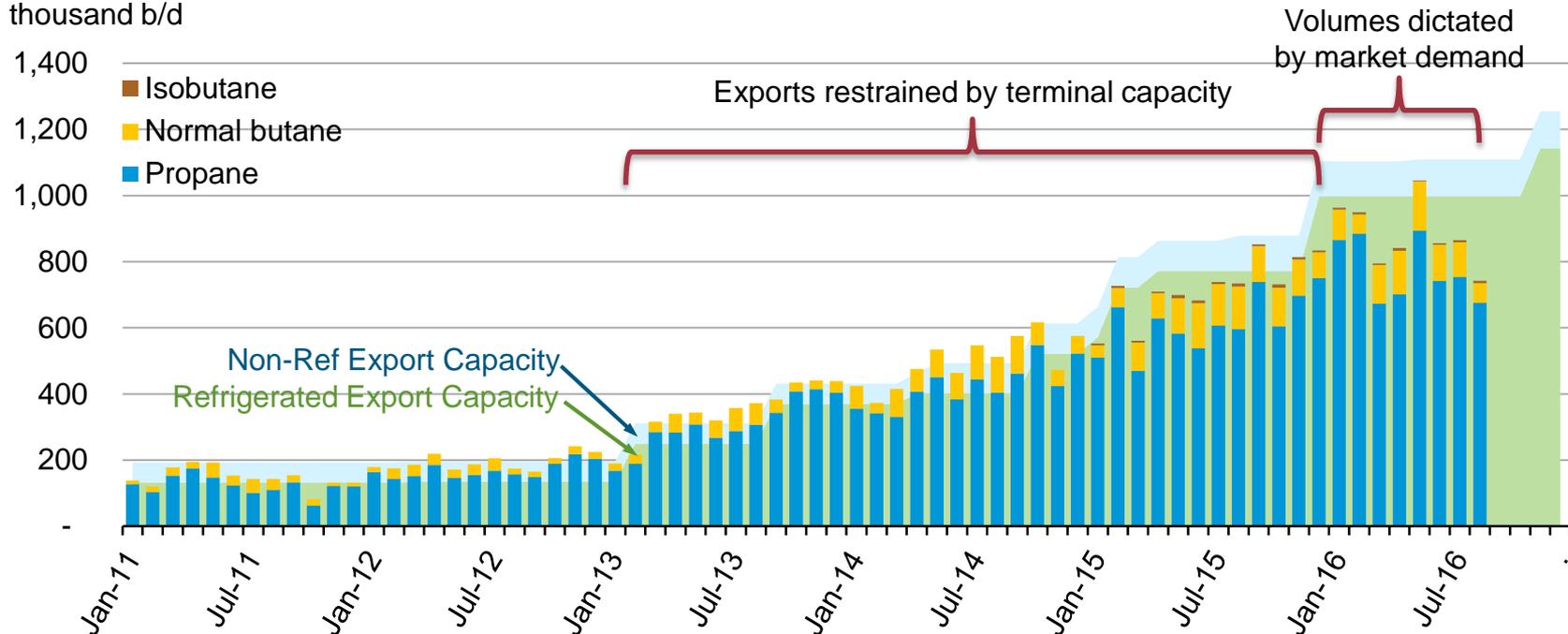
HGL pipelines and export terminals



Source: EIA based on news reports and company filings

After major terminal capacity build-out 2013 to 2016, exports of propane and butanes no longer constrained by terminal capacity

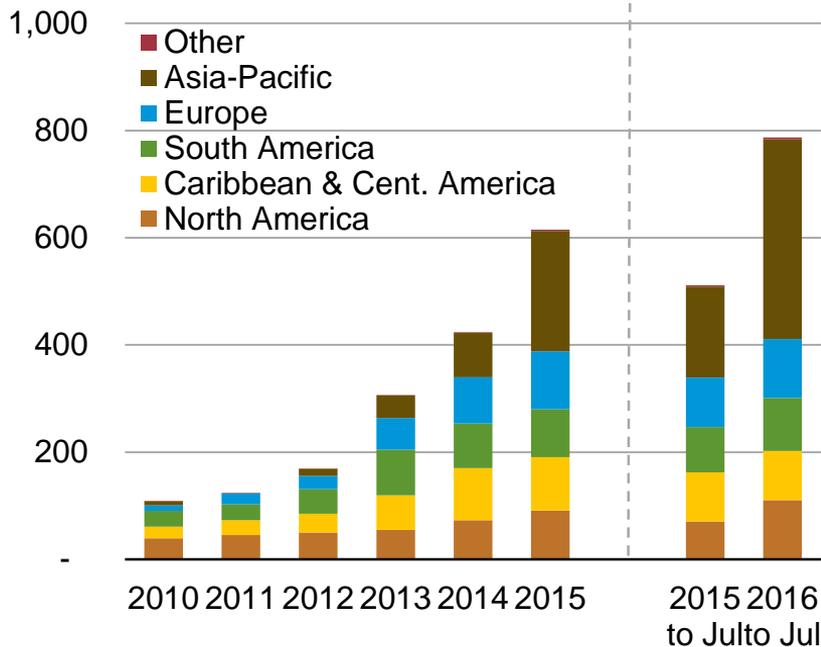
U.S. total exports of propane and butanes
thousand b/d



Source: Dept. of Commerce, EIA

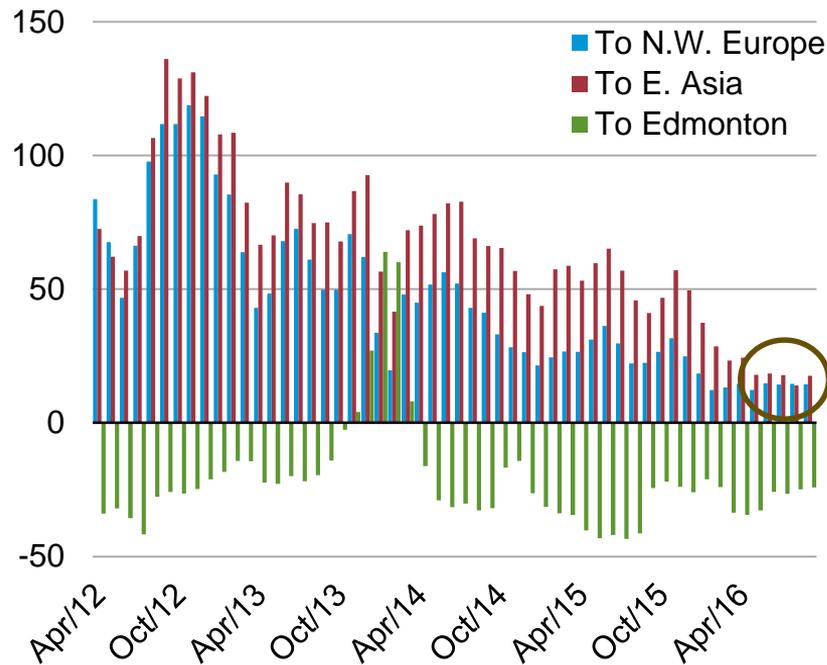
After saturating Latin American market, U.S. exporters reached Europe, then Asia, where petrochemical feedstock consumes most incremental LPG barrels

U.S. propane exports by destination
1,000 b/d



Source: EIA, Dept. of Commerce

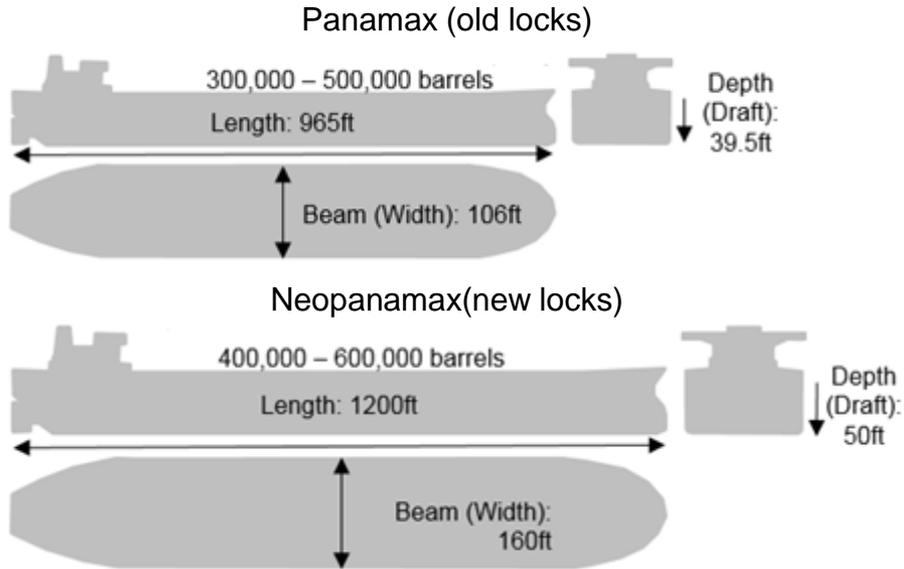
price spread between Mt. Belvieu and export destinations
cents per U.S. gallon



Source: Bloomberg

Panama Canal – the past and the future for LPG carrier transits

Panama Canal size restrictions and estimated product tanker capacity



Note: Ship capacities vary based on hull design, draft limitations, and types of product carried

Source: [U.S. Energy Information Administration](#)

The *Ronald N*, one of three currently-serving VLGCs capable of passing through the old Panama Canal locks, transiting the Miraflores Locks

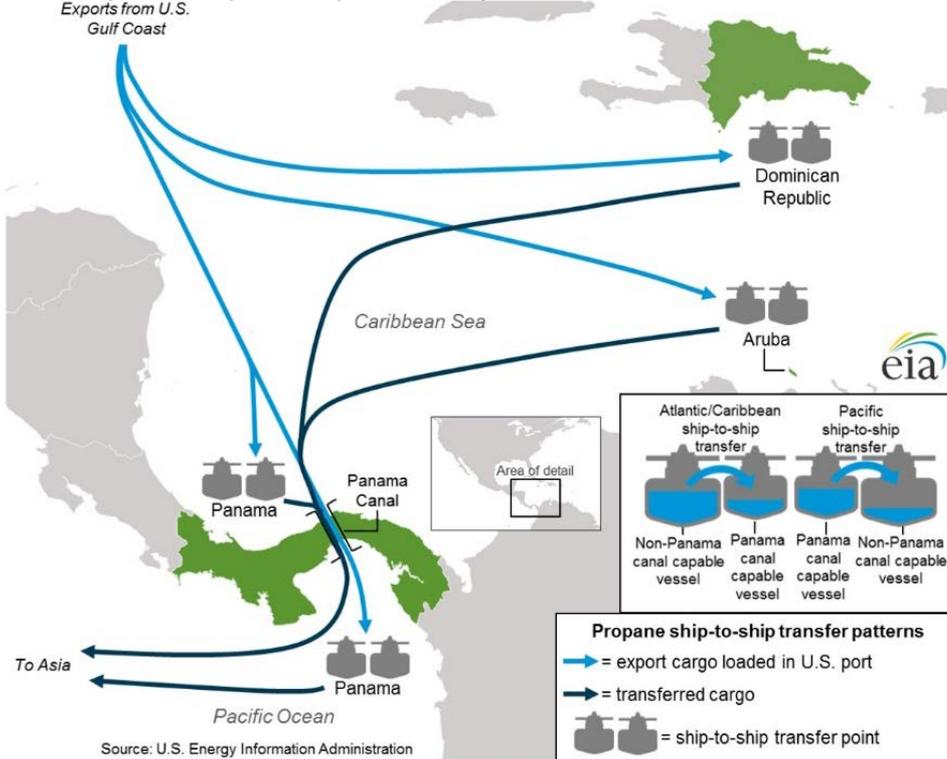


Source: Panama Canal Authority, picture taken June 17, 2012

Ship-to-ship transfers off of Panama are history. Is the canal expansion to blame?

Propane ship-to-ship transfer patterns

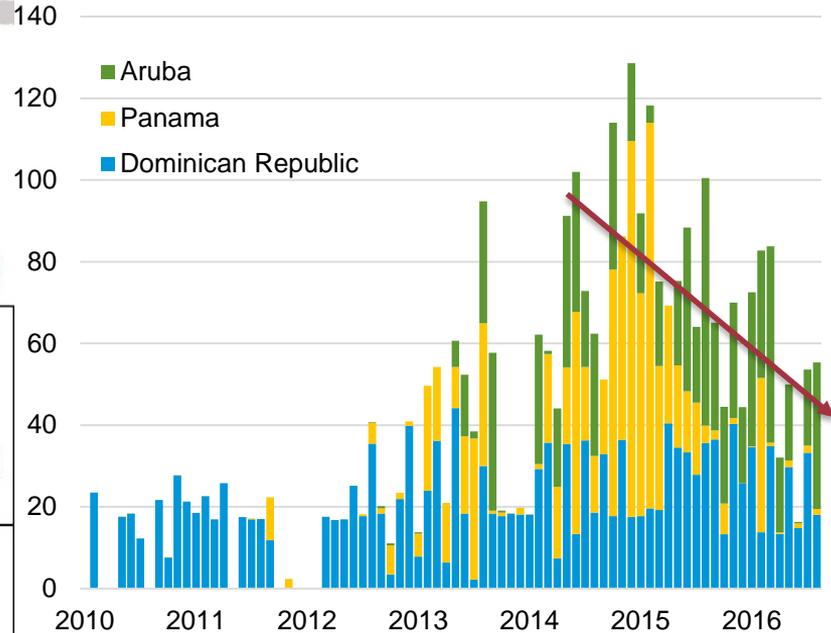
Exports from U.S. Gulf Coast



Source: U.S. Energy Information Administration

Monthly U.S. propane exports to potential ship-to-ship transfer destinations

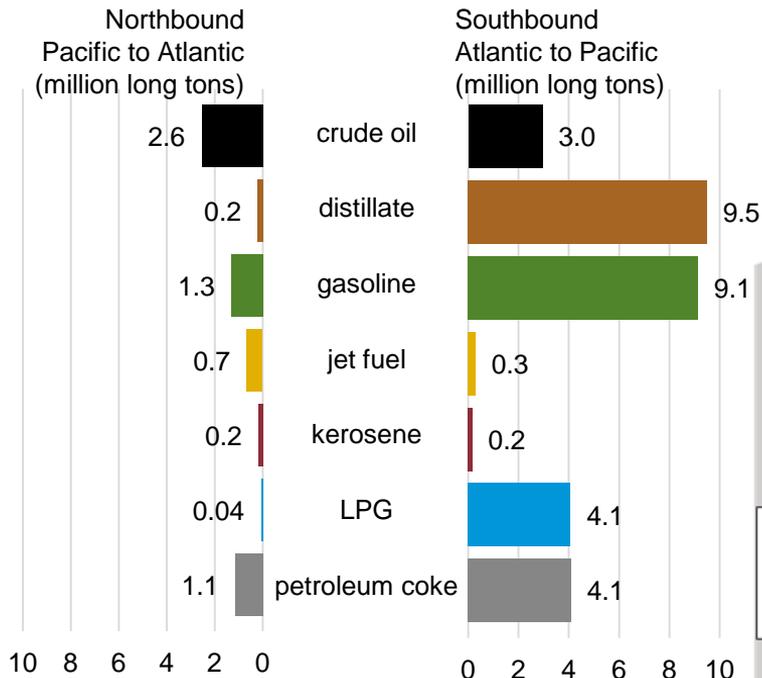
thousand barrels per day



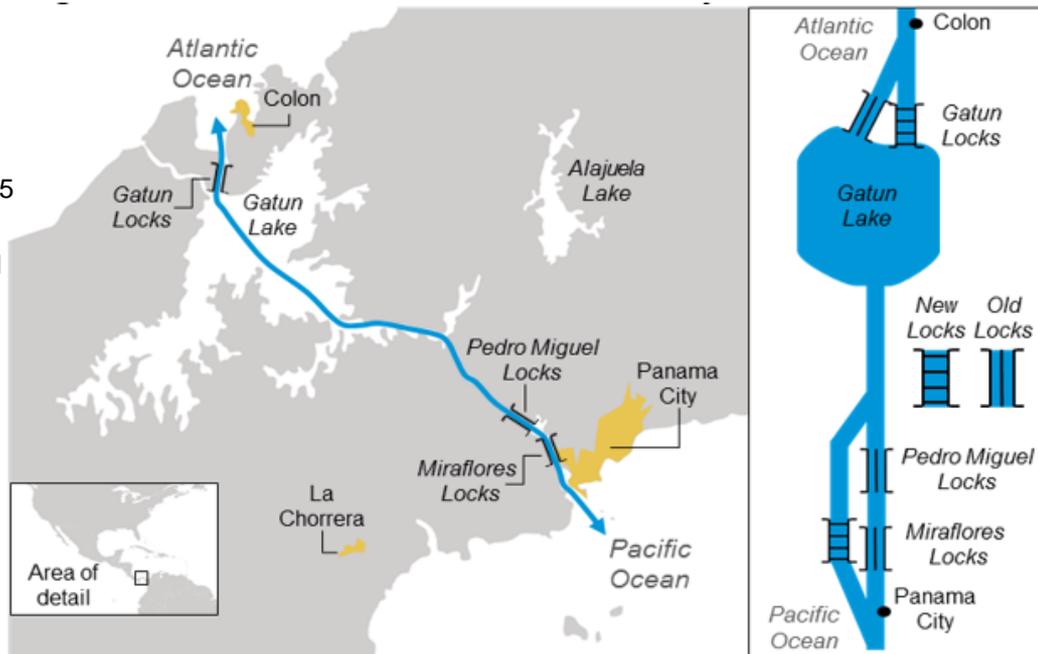
Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*

Panama Canal has seen a marked increase in LPG transits, nearly all Pacific-bound

Petroleum traffic via the Panama Canal, 2015



Panama Canal and lock system



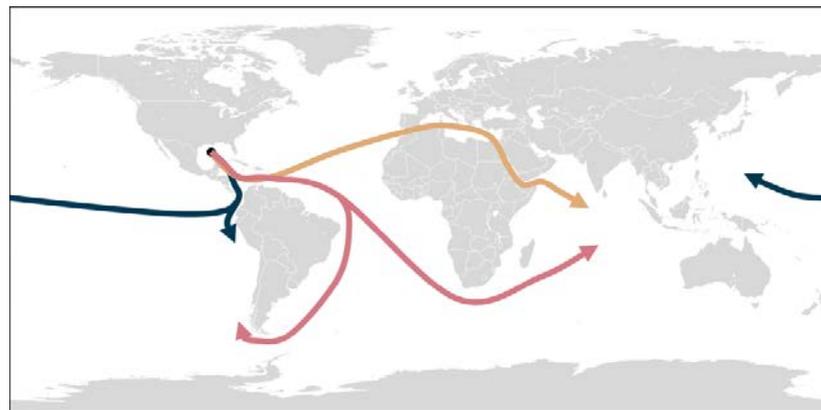
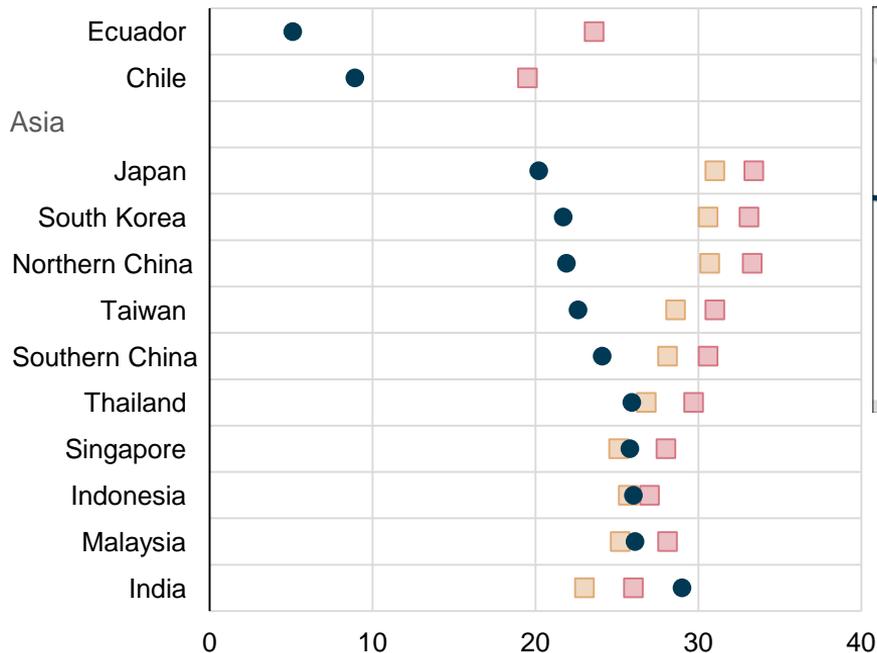
Note: A long ton is equal to 2,240 U.S. pounds, used in shipping to denote cargo volumes

Source: [U.S. Energy Information Administration](#), based on Panama Canal Authority

The expanded Panama Canal significantly reduces transit times to East Asia and Pacific South America

Approximate voyage time from U.S. Gulf Coast to major ports in selected countries
days

South America



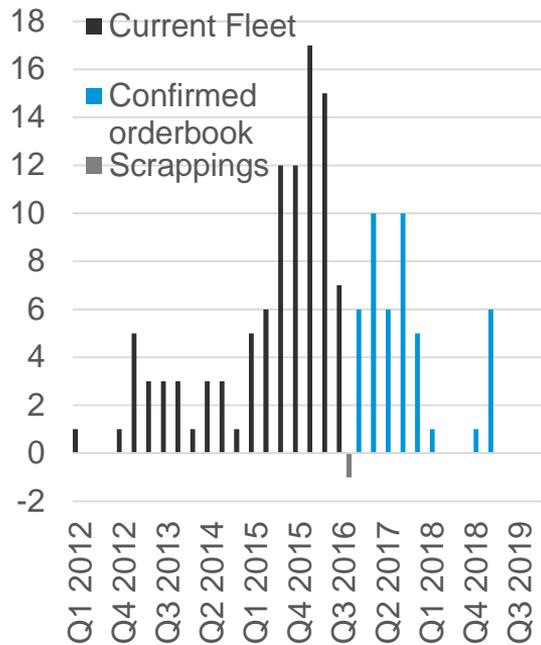
Panama Canal
Suez Canal
other

Source: [U.S. Energy Information Administration](#)

As VLGC fleet grows, rates decline, allowing U.S. LPG to travel longer distances with lower arbs

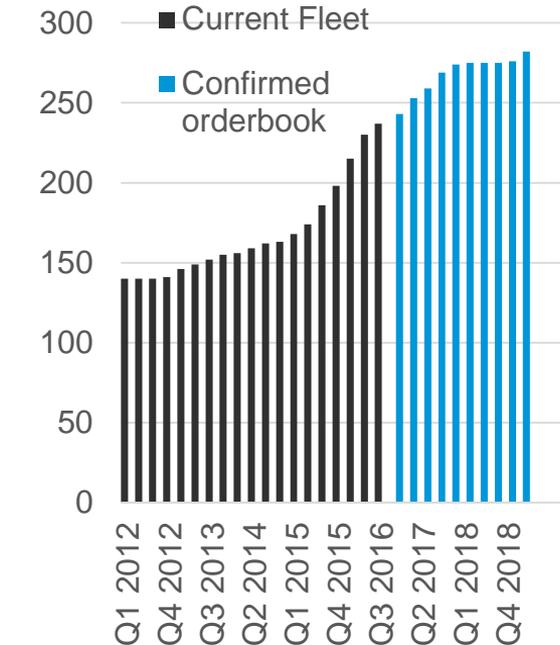
VLGC current fleet and orderbook

No. of ships



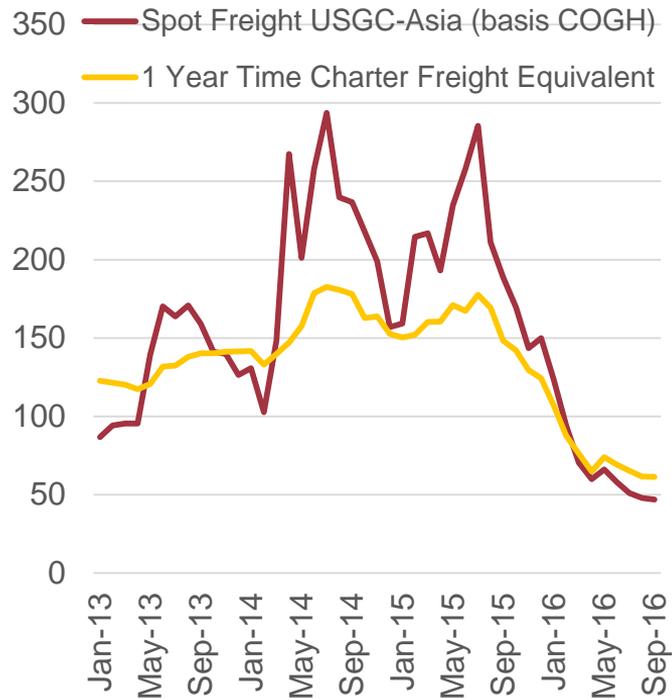
VLGC current fleet and orderbook

No. of ships



U.S. Gulf Coast to East Asia (basis COGH)

\$/tonne



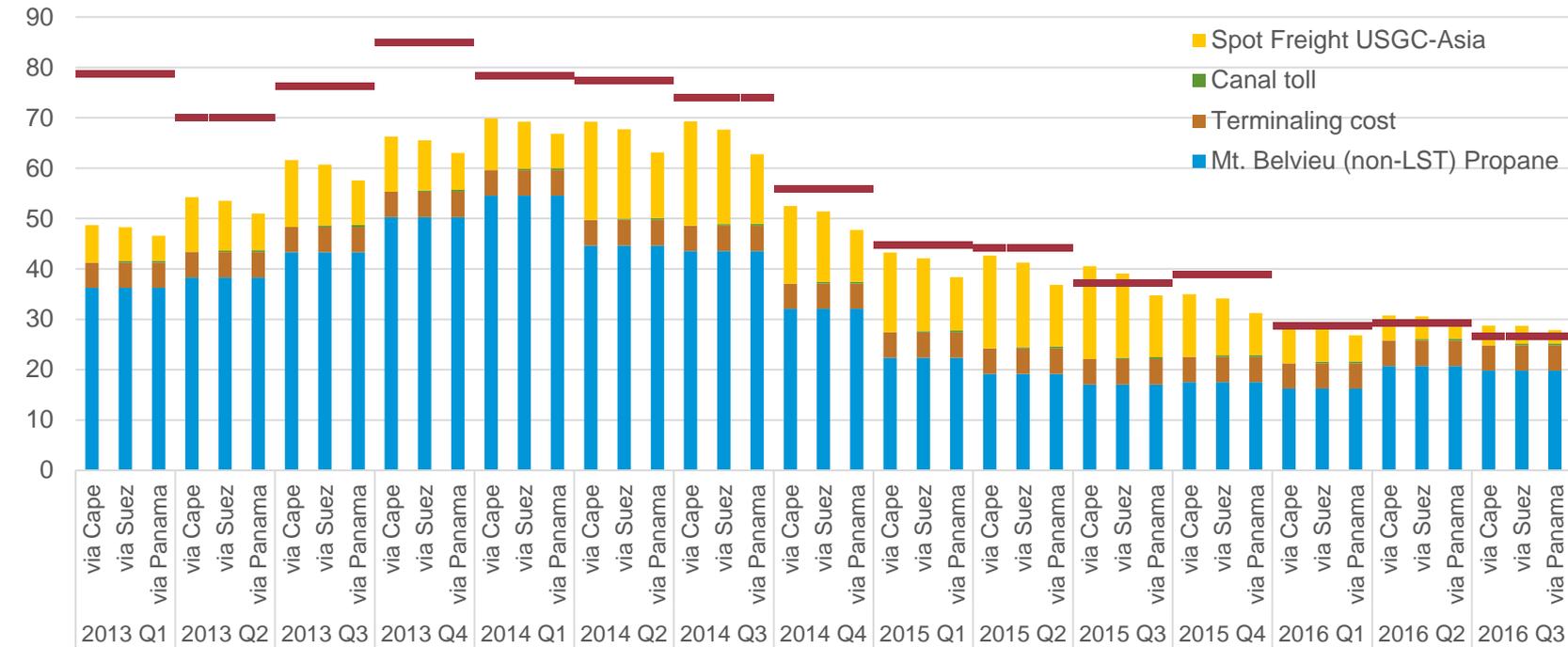
Source: Poten & Partners

Panama Canal vs. alternative routes from the U.S. Gulf Coast to E.

Asia: Fully loaded spot

Loaded cost of U.S. propane in E. Asia

\$/bbl



Assuming 33-day voyage around the cape vs. 21-day voyage through the Panama Canal

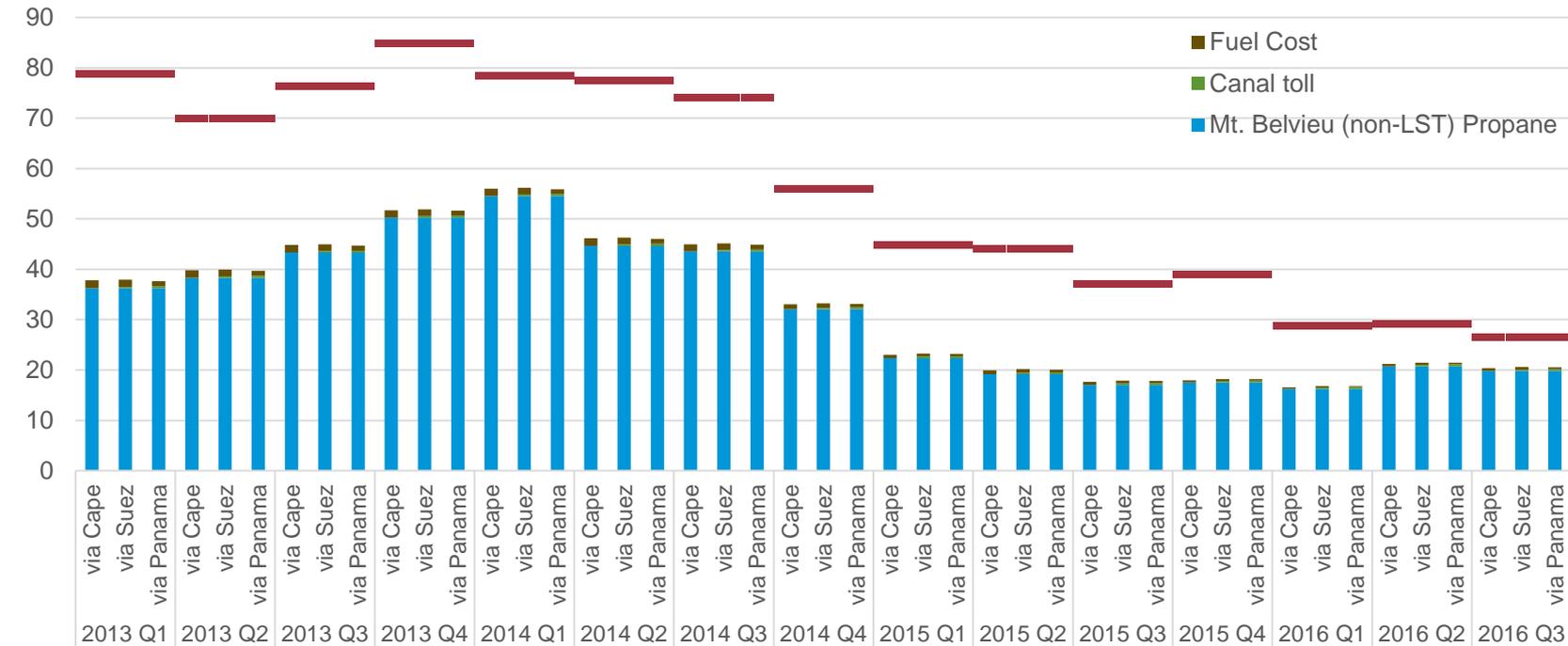
Sources: U.S. Energy Information Administration, Poten & Partners, Bloomberg

Panama Canal vs. alternative routes from the U.S. Gulf Coast to E.

Asia: Belvieu + toll and fuel

Loaded cost of U.S. propane in E. Asia

\$/bbl

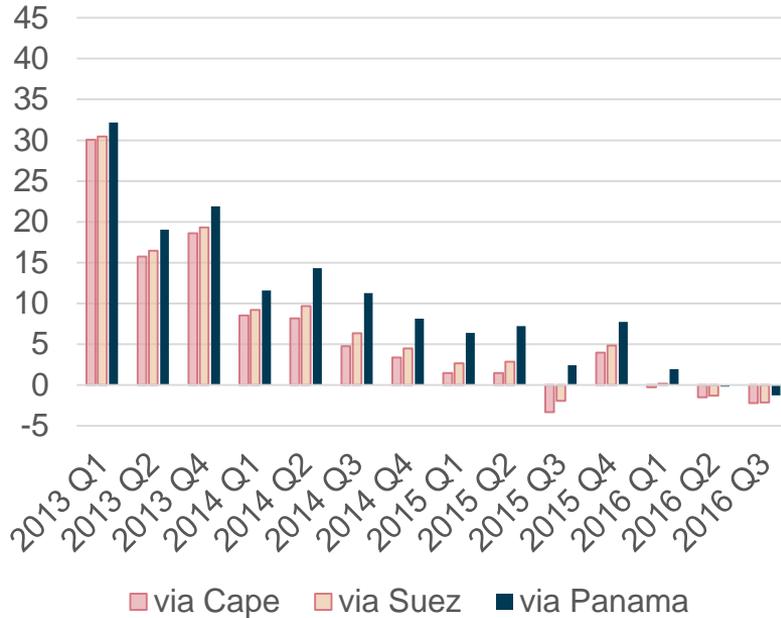


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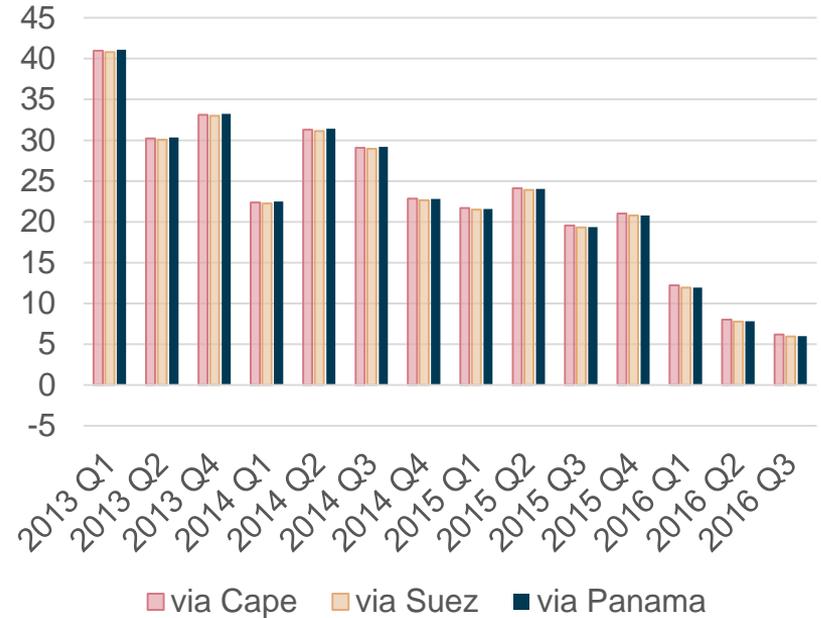
Sources: U.S. Energy Information Administration, Poten & Partners, Bloomberg

How does it all net out?

E. Asia propane spot less GoM commodity + transport
\$/b



E. Asia propane spot less GoM commodity + toll and fuel
\$/b



Sources: U.S. Energy Information Administration, Poten & Partners, Bloomberg

Recent EIA HGL-related data products

- *Short-Term Outlook for Hydrocarbon Gas Liquids* - supplement to STEO
http://www.eia.gov/forecasts/steo/special/supplements/2016/hgl/pdf/2016_sp_01.pdf
- Energy Explained: *Hydrocarbon Gas Liquids*
http://www.eia.gov/energyexplained/index.cfm?page=hgls_home
- Annual Energy Outlook *Issues in Focus: Hydrocarbon Gas Liquids Production and Related Industrial Development*
<https://www.eia.gov/forecasts/aeo/hgl.cfm>
- Drilling Productivity Report *Drilled but Uncompleted Wells (DUCs) Supplement*
https://www.eia.gov/petroleum/drilling/pdf/duc_supplement.pdf
<http://www.eia.gov/petroleum/drilling/>

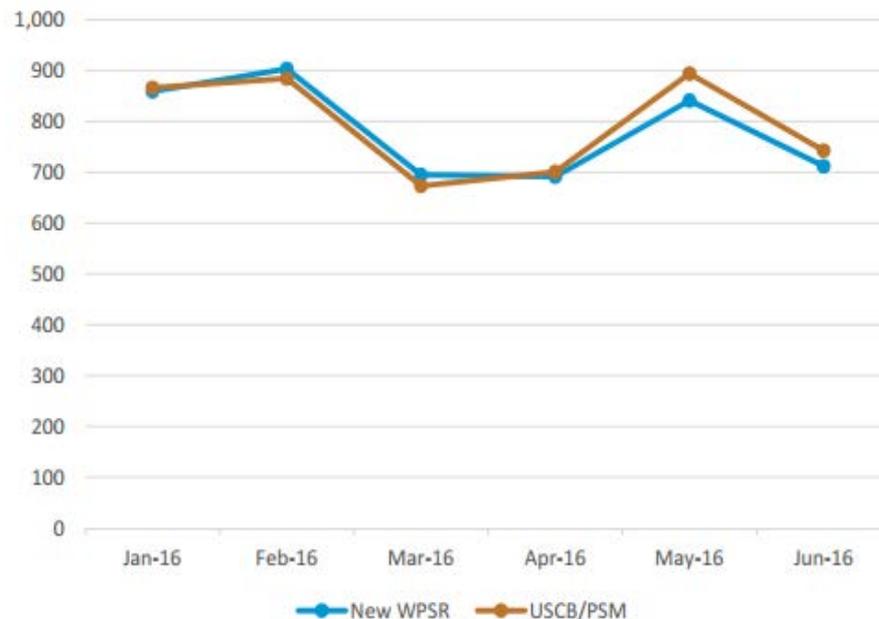
Thank you

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New EIA methodology for weekly exports data in Weekly Petroleum Supply Report (WPSR)

- Previous approach used reported monthly data and forecasted monthly export totals, with weekly exports shown flat
- Current approach uses daily exports data shared with EIA by Customs & Border Patrol that is parsed by EIA and summed to weekly using the same cut-offs as our surveys
- Because EIA does not have early access to Canadian imports data, these exports are modeled
 - U.S. exports data consist of imports reported by Statistics Canada as coming from the U.S.

Monthly propane exports for 2016
Thousand barrels per day

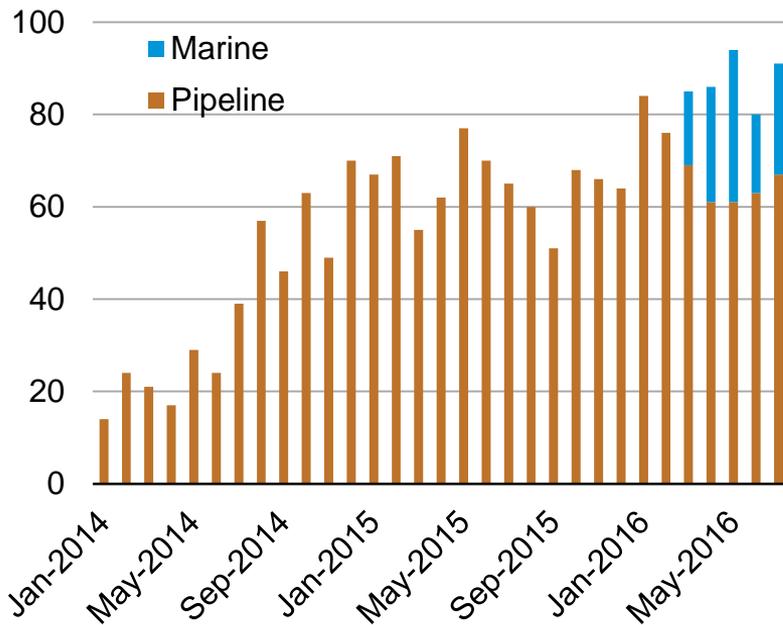


Source: EIA, [Statistical Methodology of Estimating Petroleum Exports Using Data from U.S. Customs and Border Protection](#)

U.S. now exports ethane to petrochemical facilities abroad via pipeline and tanker, and capacity for both is growing

- Initial exports moved to Canada by pipeline to feed existing petrochemical facilities in Ontario and Alberta
- March 2016, marine exports began to Norway from Marcus Hook, PA
 - First shipment to Sweden in September
- September 2016, marine exports began to Norway from Morgan's Point, TX
 - Shipments will head to the U.K., Brazil, and India
- Marine exports will equal as much ethane as 3 world-scale crackers by year-end 2017

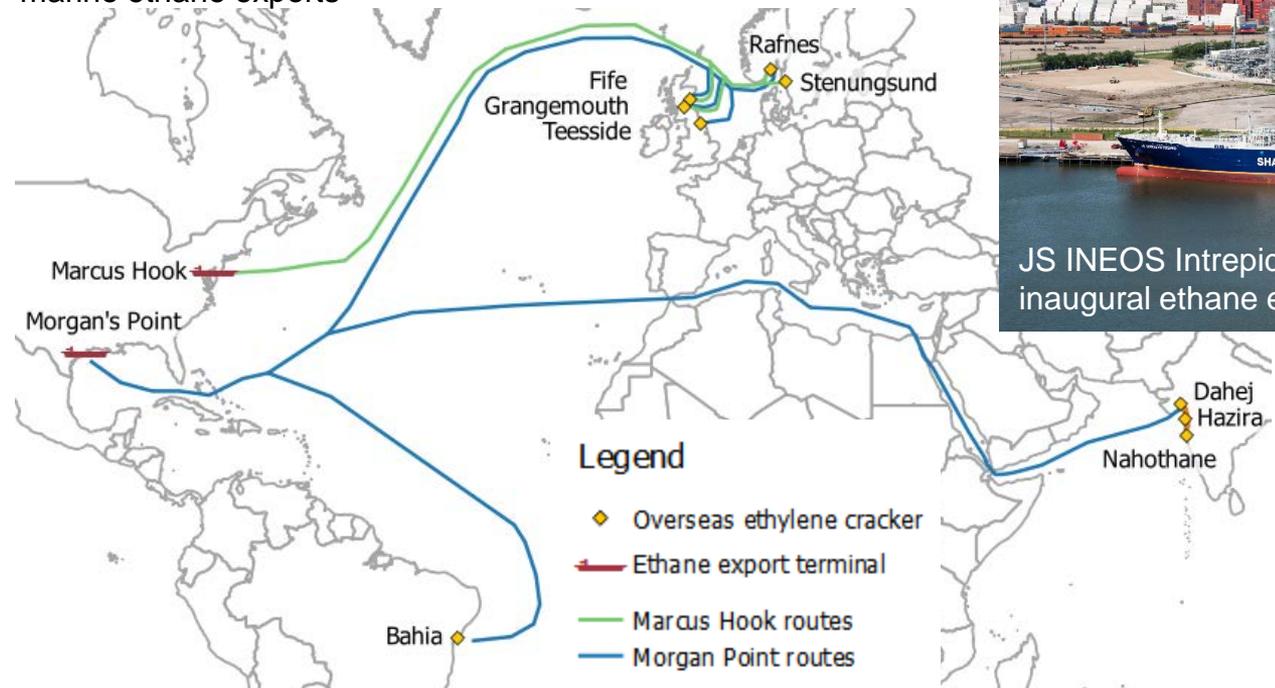
U.S. exports of ethane
thousand b/d



Source: EIA

U.S. ethane exports give new lease on life to older petrochemical facilities overseas

U.S. ethane export terminals and announced destinations for U.S. marine ethane exports



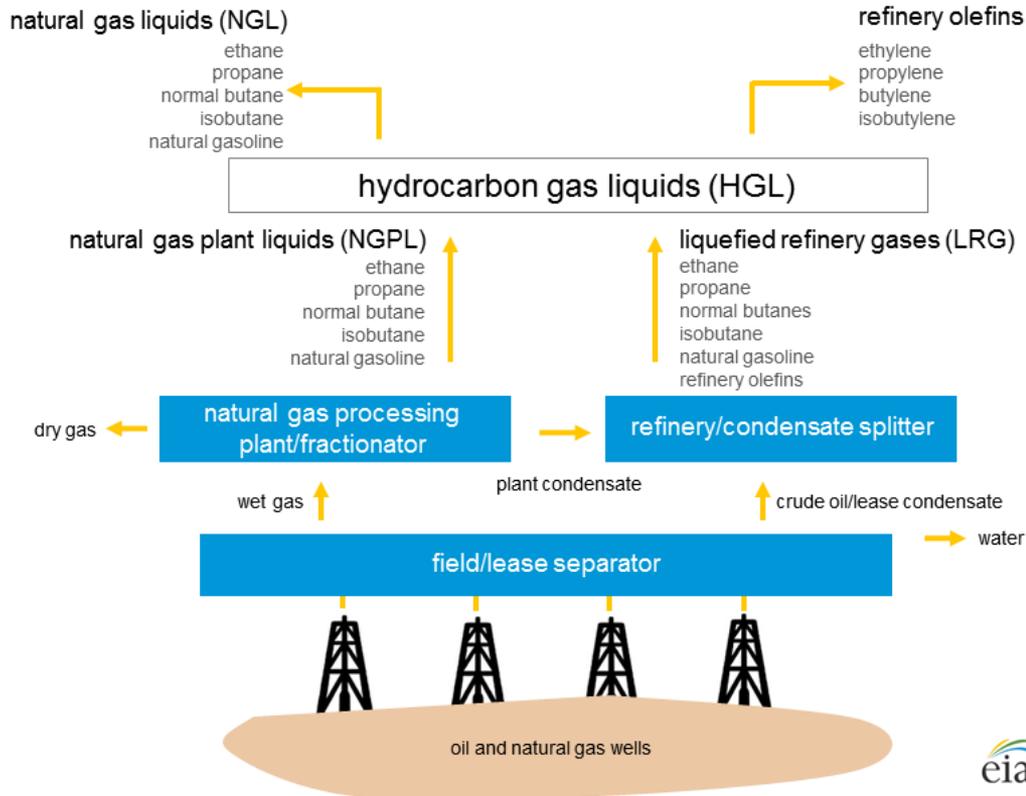
JS INEOS Intrepid loading at Morgan's Point, TX for inaugural ethane export to Europe

Source: EIA, company public filings and press releases; Photo courtesy of Enterprise Product Partners

What are HGL?

Sources, production, and types of hydrocarbon gas liquids

$$\text{NGPL} + \text{LRG} = \text{HGL} = \text{NGL} + \text{refinery olefins}$$



Source: U.S. Energy Information Administration