

Expanded Panama Canal could reroute LNG industry

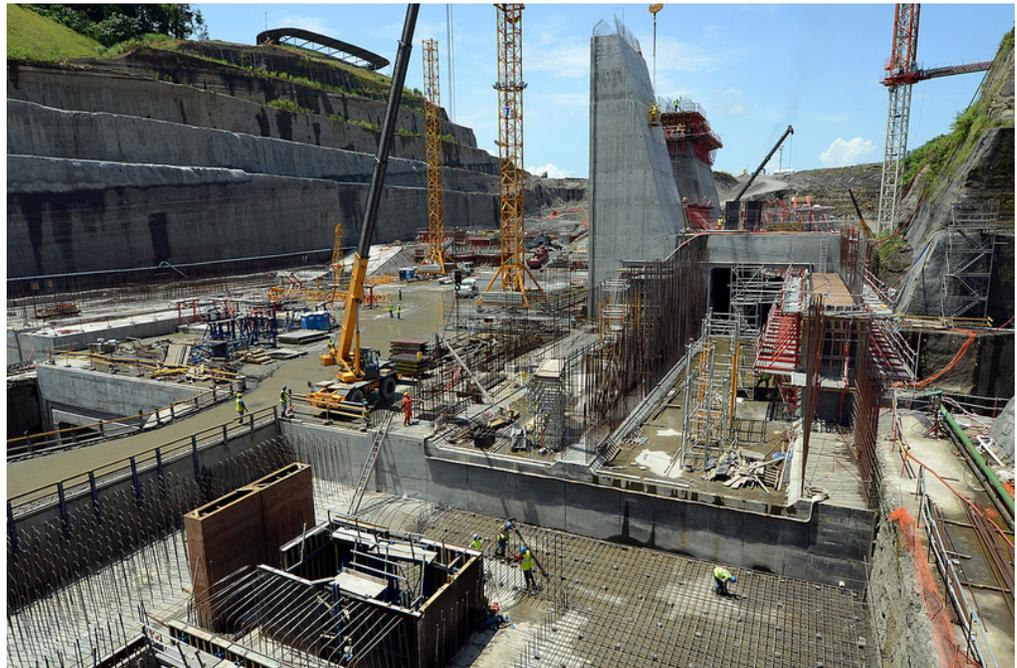
The liquefied natural gas industry awaits with anticipation an event in 2015 that could crack the framework upon which the industry has been built.

Opening a wider Panama Canal that year could disrupt the industry's core economic model that says LNG made in the Atlantic Basin generally gets sold to countries in the Atlantic Basin, while LNG produced in the Pacific-Australia Basin goes to buyers in that region.

If the canal widening and deepening erodes this rule of thumb, the logic of separate natural gas prices in North America, Europe and Asia could start to dissolve, edging the industry toward a more global pricing structure similar to the oil industry.

The canal could change the flow of money between LNG buyers and sellers, and that has their attention. Hardly an international gas conference goes by these days without some discussion and speculation about what the expanded canal will mean for the industry's future.

Peruvian LNG routed to Europe? Nigerian LNG tankered to Japan? Gulf of Mexico gas shipped to South Korea? And so on. Relatively little of that cross-pollination



Source: Canal de Panamá

The expansion of the Panama Canal (Third Set of Locks Project) will double the capacity of the Panama Canal by allowing more and larger ships to transit. The Panama Canal expansion should accommodate most of the world's superships when it opens in 2015.

occurs now, although some does, especially as Asian demand for LNG spiked in 2011. Almost all of the 11 liquefaction projects proposed for the U.S. Gulf Coast are bets that the canal will open Asian markets to Atlantic Basin liquefaction.

The \$5.25 billion canal expansion is one of the world's great transportation infrastructure projects now under way.

Panama is upgrading the 100-year-old canal to accommodate today's superships that don't fit the waterway now. A new, wider set of locks will run

parallel to the old locks — sort of like the way interstate highways in the 1960s updated the old U.S. highway system, allowing more traffic and shorter transit times.

The LNG industry operates on a large scale — multibillion-dollar liquefaction plants, colossal tankers — to achieve economies of scale. The fleet's 370 tankers are so big that only 6 percent of them can squeeze through the canal today, and none of them try, Kasper Walet with Amsterdam-based energy consultant Maycroft said at an LNG conference last year. But 80 percent will fit through the canal when the expansion is done.

"It should be a real game changer," Walet said.

Not everyone agrees with that, noting that tanker charters can cost over \$100,000 a day, and longer, two-ocean trips mean more days at sea and more money out of someone's pocket. Further, most tankers already are locked in to fixed routes between a given liquefaction plant and given LNG buyers. Relatively few tankers are available to free-lance shipments.

But in recent years as the gas-price gaps between North America, Europe and Asia have widened, more LNG shipments are chasing price, with tankers diverted to higher-priced markets and spot sales becoming common.

Last year, the spot market comprised 25 percent of LNG transactions, up from 16 percent in 2006, according to

the International Gas Union. Some see this as demonstration that in the right circumstances, the traditional industry model of Atlantic LNG for Atlantic buyers and Asian LNG for Asia isn't as rock solid as previously believed. The Panama Canal expansion might be timed just right.

LNG'S TWO DISTINCT REGIONS

Most of the world's natural gas moves to market as vapor in pipelines. Last year only 10 percent of the gas consumed was superchilled into a liquid, loaded onto tankers and shipped to customers, according to the BP Statistical Review of World Energy.

But LNG is the fastest growing sector of natural gas trade. And most forecasts predict it will remain so.

Asia is the biggest LNG market and the one holding the strongest growth prospects, as China and India continue to build their economies.

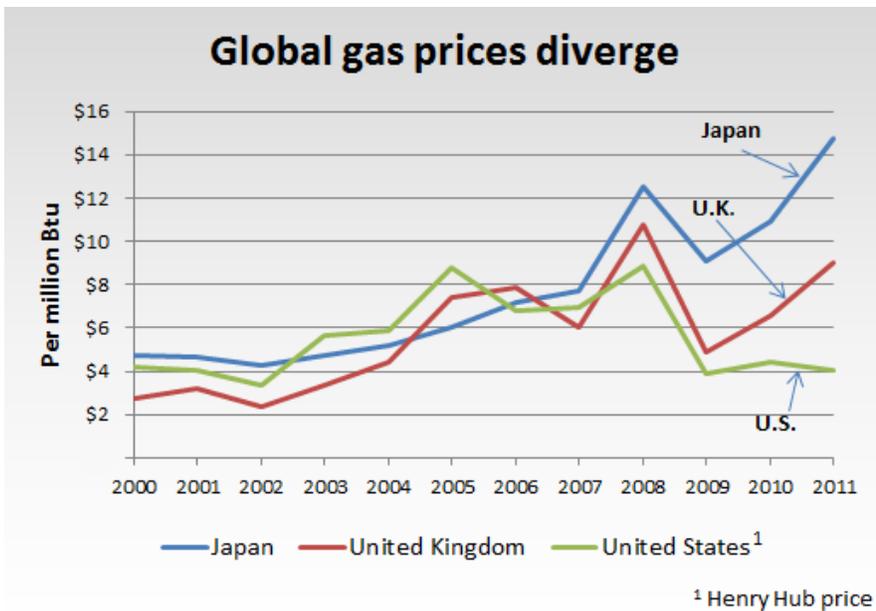
Still, Europe, South America and North America are LNG consumers as well.

Over time, the industry split itself into two distinct regions, each serving its own geographic neighborhood: Atlantic Basin LNG makers served Europe and eastern North America, and Pacific-Australia makers supplied the Far East.

Until recently, LNG prices in the two regions were similar, and due to the high expense of moving LNG long distances there was little financial advantage in shipping LNG from one basin to the other. For example, in 2009 the LNG price averaged \$9.06 per million Btu in Japan compared with a German imported-gas price of \$8.52, according to the BP Statistical Review.

In 2010 and 2011, 76 percent of LNG made in Atlantic Basin plants was sold to Atlantic Basin countries, according to the International Group of Liquefied Natural Gas Importers. Atlantic Basin LNG makers are Algeria, Egypt, Libya, Nigeria, Equatorial Guinea, Norway and Trinidad and Tobago.

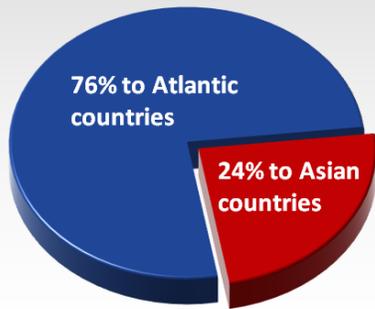
In those same two years, 98 percent of the Pacific-Australia LNG went to Asian buyers. These LNG makers are



Source: BP Statistical Review of World Energy 2012

Where Atlantic Basin LNG goes

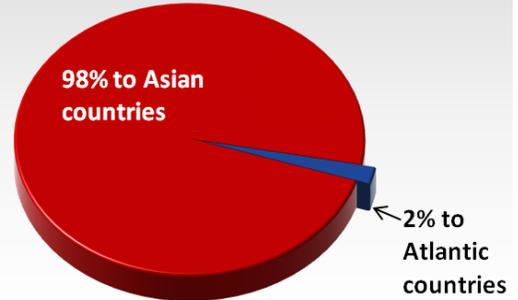
5.8 trillion cubic feet total in 2010 and 2011



Sources: International Group of Liquefied Natural Gas Importers; International Gas Union

Where Pacific-Australia LNG goes

8.4 trillion cubic feet total in 2010 and 2011



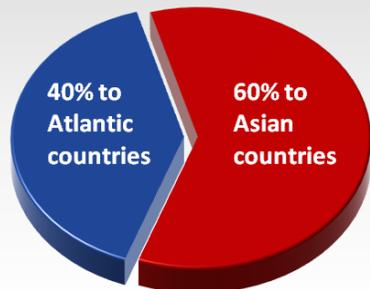
Sources: International Group of Liquefied Natural Gas Importers; International Gas Union

Australia, Indonesia, Malaysia, Brunei, Russia (Sakhalin), the United States (Alaska) and Peru.

Four Middle Eastern countries are swing producers, sending their LNG both east and west. Qatar, Oman, Yemen and the United Arab Emirates are located roughly equidistant from European markets via the Suez Canal and those in the Asia's Far East. They shipped about 60 percent of their LNG to Asia in 2010-2011.

Where Middle East LNG goes

8.4 trillion cubic feet total in 2010 and 2011



Sources: International Group of Liquefied Natural Gas Importers; International Gas Union

In marketing and logistics, distance can explain a lot. The United States conducts far more international trade with Canada than with Australia — two countries of about equal population and area — because Canada is a lot closer.

So it goes with LNG.

It costs less than \$1 per million Btu to ship LNG from Indonesia to Tokyo, according to recent figures from trade publication ICIS Heren. A like quantity from Australia to Tokyo costs about \$1.22. (A million Btu is roughly 1,000 cubic feet after the methane is turned

back into vapor.)

But shipping LNG from the Caribbean nation of Trinidad and Tobago to Tokyo costs about \$4.16 per mmBtu, from Norway about \$4.13, from North Africa about \$3.26. The buyer, seller or broker eats the extra shipping cost when LNG travels long distances — a potent incentive to avoid that cost.

Another disadvantage of long-distance LNG travel is that more ships are needed to deliver the same amount of gas, because each tanker's round-trip takes more time. LNG tankers aren't cheap. They cost roughly \$200 million to \$250 million each.

The industry generally expects the expanded Panama Canal will shave about \$1 per mmBtu off the LNG shipping cost between the Atlantic and Pacific and cut days from the transit time between the two basins.

The Panama Canal Authority is still studying what toll it might charge LNG tankers to transit the canal, so the final figure could be higher or lower. Whatever the toll, the bigger canal will improve the economics for shipping LNG very long distances, creating incentive to exploit pricing differences between the Pacific and Atlantic. If enough LNG chases the highest price and supply and demand rebalance, the price gap should narrow, some in the industry predict.

THE PROJECT

Panama had hoped to finish the canal expansion in 2014, the 100th anniversary of the original opening.

That date is getting pushed back due to a dispute this summer with a contractor over the quality of concrete to be used in constructing the new locks.

The existing 50-mile-long canal basically consists of three segments: Two lanes of locks on the Pacific Ocean side, two on the Atlantic side and a waterway in between largely consisting of Gatun Lake, plus a channel cut through the continental divide. The lake lies about 85 feet above sea level, so the locks raise or lower ships, depending on whether they're entering or exiting the lake.

The maximum size of a ship that can sail the canal now is 106-feet wide and 965-feet long, with a draft of no more than 39 feet. About 13,000 oceangoing ship crossings occur every year.

The expansion project is adding a third lane of locks. The new locks' chambers will be 180-feet wide, 1,400-feet long and 60-feet deep, dimensions that should accommodate most of the world's superships. The existing channels are being widened and deepened, too.

The Canal Authority says most of the dredging is done and the new lock design and construction is 31 percent complete.

Panama undertook the project out of two main concerns:

- That the existing canal was maxed out.
- That too many ships were too big for the canal.

Asia manufacturers shipping to U.S. East Coast markets increasingly were dropping their cargos at West Coast ports, with trains toting the merchandise on the remaining trip east.

In a 2006 document touting the canal expansion, the Panama Canal Authority said it held just a 38 percent market share of the Northeast Asia-East Coast trade, even though canal transit is cheaper and more reliable (but it ties up ships longer).



AN EPIC HISTORY

One hundred years earlier, the canal promised to transform how humans and commerce moved around the globe. More than 800,000 vessels have passed through the canal since then.

The canal's ribbon-cutting in 1914 culminated decades of dreams that a channel could be carved through the thin Panama isthmus.

Historian David McCullough in his book "The Path Between the Seas" said, "The fifty miles between the oceans were among the hardest ever won by human effort and ingenuity, and no statistics on tonnage or tolls can begin to convey the grandeur of what was accomplished. Primarily the canal is an expression of that old and noble desire to bridge the divide, to bring people together. It is a work of civilization."

A French-led effort started the muscular work of moving earth for a canal the 1880s. The French

envisioned a canal without locks. Anything above sea level in the canal's path would be mowed down. Championing the project was Ferdinand de Lesseps, father of the lockless Suez Canal, built in the 1860s.

This first substantial effort in Panama foundered on a massive scale. Mismanagement and corruption pervaded the project. Primitive excavation machinery couldn't cope with the jungle climate and terrain; landslides poured excavated soil back into the freshly dug channel. Yellow fever and malaria decimated the roster of experienced workers (it was only in the 1880s that scientists started figuring out that mosquitos transmitted these two diseases and many years later that they developed effective treatments). The French effort went bankrupt after about 10 years.

The United States picked up the project in the early 1900s, behind President Theodore Roosevelt's bully charge that envisioned a U.S. sea power reigning supreme in both the Atlantic and Pacific. A canal connecting the oceans would help fulfill this destiny.

The U.S. had a smarter plan than the French and learned from the French mistakes. The route was better — abandoning the idea of a sea-level trench in favor of damming a river to create Gatun Lake that ships would sail across for much of the route. Locks would raise and lower ships to appropriate elevations to make the crossing. Rigorous trenching through the mountainous continental divide no longer involved gouging down to sea level. Equipment was better, as were housing and hospitals. To ease epidemics of malaria and yellow fever, workers drained swamps and razed vegetation to destroy mosquito habitat.

The U.S. paid \$40 million for the French holdings in Panama, the largest real estate transaction in history, McCullough said. (The largest previous U.S. Treasury warrant was \$7.2 million, paid to Russia for Alaska in 1867.)

Construction started in 1904. Roosevelt himself visited the construction site two years later. In a talk to workers he called the project "one of the great works of the world. It is a greater work than you yourselves at the moment realize."

In 1914, as construction ended, the first boat motored through the new canal — an old French crane boat

Cost Estimate for the Third Set of Locks Project	
Project Components	Investment Estimate*
New Locks	
Atlantic Locks	1,110
Pacific Locks	1,030
Contingency for New Locks**	590
Total for New Locks	2,730
Water Saving Basins	
Atlantic Water Saving Basins	270
Pacific Water Saving Basins	210
Contingency for Water Saving Basins**	140
Total for Water Saving Basins	620
Access Channels for New Locks	
Atlantic Access Channels (Dredging)	70
Pacific Access Channels (Dry Excavation)	400
Pacific Access Channels (Dredging)	180
Contingency for Access Channels**	170
Total for New Locks Access Channels	820
Existing Navigational Channel Improvements	
Deepening and Widening of Atlantic Entrance	30
Widening of the Gatun Lake Channels	90
Deepening and Widening of Pacific Entrance	120
Contingency for Existing Channel Improvements**	50
Total for Navigational Channel Improvements	290
Water Supply Improvements	
Increase the Maximum Level of Gatun Lake to 27.1m (89') PLD	30
Deepening of the Navigational Channels to 9.1m (30') PLD	150
Contingency for Water Supply Improvements**	80
Total for Water Supply Improvements	260
Inflation During the Construction Period***	530
Total Investment	5,250M*

*Millions of Balboas, rounded to the nearest tenths
 **The contingency includes possible variations for each component
 ***Assumes a general inflation of 2% per year above what is included in the contingency

Source: Canal de Panamá

called Alexander La Valley returned to the Atlantic side. The start of World War I that summer torpedoed plans to parade an international fleet of warships through the canal for a grand opening — instead the SS Ancon, a canal cement boat, made the first official transit.

EXPANSION EFFORTS

It didn't take long before plans were drafted to enlarge the canal.



Source: Canal de Panamá

The \$5.25 billion Panama Canal expansion now under way should be completed in 2015.

The U.S. began dredging for wider locks on the Pacific side in 1940. Work on the Atlantic side started the next year. The U.S. secretary of war shelved both efforts in May 1942, five months after the U.S. entered World War II, freeing workers to join the Army and construction equipment to aid the military.

Over the ensuing decades, the canal was improved, with a series of channel widening and deepening projects starting in the 1950s. Lighting added in the 1960s and 1970s allowed nighttime crossings, according to a history provided by the Panama Canal Authority.

Today's impetus to transform the canal by building wider locks kicked off at noon on Dec. 31, 1999. At that moment, canal ownership shifted from the United States to Panama. And the new owner embraced the canal as a key to the nation's economic future.

By 2006, the new Panama Canal Authority, which runs the canal, rolled out the detailed expansion plan for a public vote.

Advocates appealed to Panamanians to consider the canal "our petroleum," which needs investment so that its commercial value can be extracted, producing jobs and reducing poverty. Critics warned of cost overruns, overly rosy projections of new traffic, and corrupt untrustworthy government officials.

Voters endorsed the project in an October 2006 referendum.

The canal widening not only has the potential to change the LNG industry, but East Coast U.S. ports are scrambling to expand to accommodate the superships that could come calling.

In a June 2012 report, the U.S. Army Corps of Engineers noted the canal's "new locks will be able to pass vessels large enough to carry three times the volume of cargo carried by vessels today." Without knowing for sure which ports will get traffic, the Corps is trying to figure out where U.S. navigation channels should be deepened and widened, whether bridges are high enough and if dock capacity is sufficient.

On the West Coast, the ports in Seattle, Oakland, Los Angeles and Long Beach all have 50-foot channels deemed deep enough for today's superships. But on the East Coast, only the Norfolk, Va., channels are that deep, although Baltimore and New York are deepening theirs, the Corps said.

Other ports are planning to spend billions getting ready for the day the expanded Panama Canal opens.



For more information, please visit our website: www.arcticgas.gov

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