

Why LNG doesn't trade like oil

The multibillion-dollar natural gas project proposed for Alaska looks similar to the oil pipeline built almost 40 years ago: Extract a hydrocarbon from the North Slope and send it through an 800-mile pipeline to a year-round port, then pour it into ships to take the product to market.

But comparing the two commodities is like comparing baseball and slow-pitch softball. Oil and LNG are in many ways related, but their markets are separated by essential differences in how they're played — especially the curves thrown at traders, and whether buyers or sellers have the home-field pricing advantage.

Oil is a global commodity trading rapidly, frequently and at enormous volumes on spot and futures exchanges among a vast array of producing, consuming, shipping and trading firms that have shaped the business since the first international oil deals more than 150 years ago. Prices are transparent and keyed to widely accepted benchmarks based in large part on the composition of the crude.

By contrast, liquefied natural gas is still largely a regional industry and, at 50 years old, much younger. Oil is the established old-timer, while LNG is the youngster trying to make the big leagues.

Despite its youth, LNG has some established traditions. It remains governed by the sanctity of long-term contracts and relationships between a relatively small number of buyers and sellers. Prices are less transparent than those for oil, though buyers are pushing to change the benchmarks for calculating prices.

The LNG trade is in its second decade of considerable growth, but still trades at a much smaller volume than oil. Much of that has to do with supply.

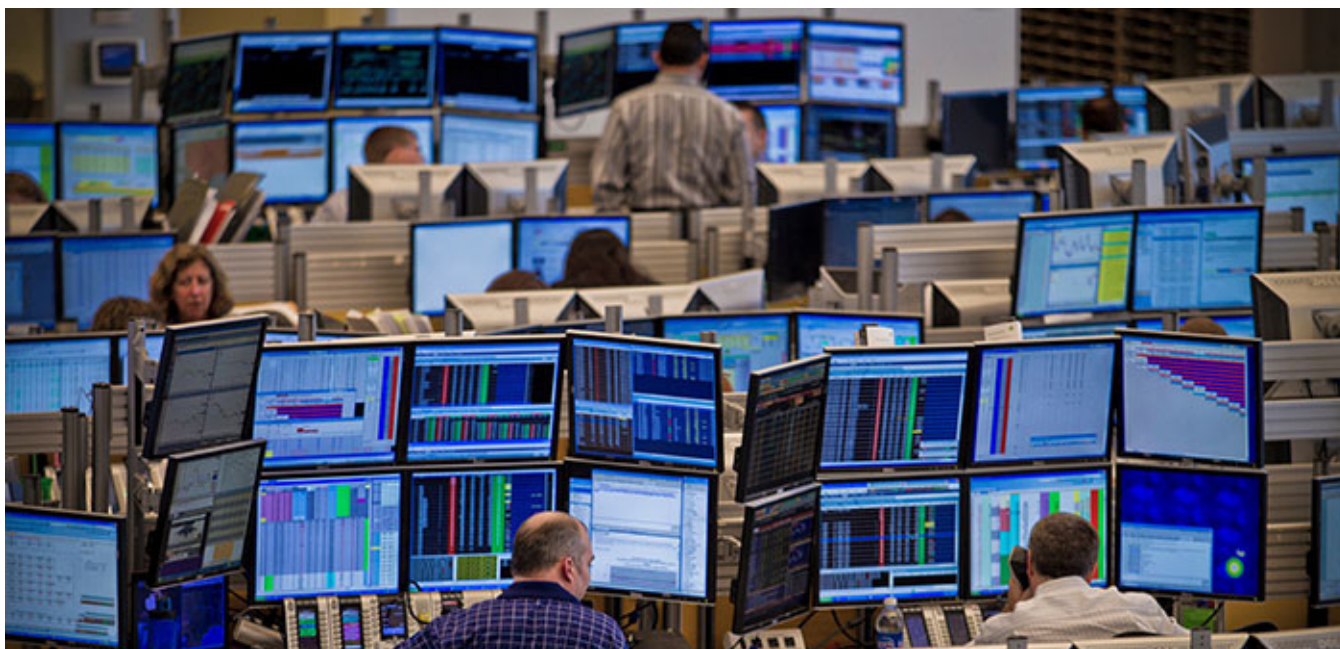
Oil vs. LNG markets

	Oil industry	LNG industry
Age of industry	150 years	50 years
Number of sellers	Many	Relatively few
Number of buyers	Many	Relatively few
Term of typical transaction	Daily, weekly, monthly, yearly	Multiple years
How traded	Commodity markets, private sales	Mostly private sales, some spot
Futures / options markets	Yes	No
Average daily value of exports, 2013	\$4 billion	\$500 million
Largest market	Transportation	Power, heating
Scale of market	International	Regional
Spot market	Large, very active	Small, but growing
Cost of typical tanker	\$100 million	\$200 million to \$250 million
Size of fleet	More than 4,000 tankers	Less than 400 tankers
Destination flexibility	Wide open	Little flexibility
Shipping percentage of market price*	1 or 2%	Up to 25%

* Summer 2014 prices

Source: Office of the Federal Coordinator research

September 2014



Source: BP

Much of the international trade in crude oil occurs on international exchanges, with buyers and sellers, investors and speculators working at a frenzied pace. Oil producers have their own trading rooms, too. "Traders monitor market information continuously and talk to brokers, refinery staff and people based in our production operations," the BP website says of the company's trading room.

Average daily global oil production is almost 15 times that of LNG on an energy-equivalent basis.

Of the almost 200 countries in the world, fewer than 30 import LNG and just 20 export the fuel, whereas nearly every country trades in oil.

Why is oil a global commodity, while LNG is not? The answer lies in supply, transportation and the number of buyers and sellers in each market.

OIL DOMINATES ENERGY TRADING

A crowd of shouting traders flashing cryptic hand signals in the pit of the New York Mercantile Exchange is perhaps the scene most emblematic of the world oil trade. The NYMEX, the largest physical commodities exchange in the world, is where much of the buying and selling of oil futures (contracts for future deliveries) takes place. Oil contracts are also traded through the Intercontinental Exchange in London and other smaller exchanges, as well as electronically 24 hours a day.

Light Sweet Crude Oil (also known as West Texas Intermediate) futures and options (the option to buy or sell oil at a future date) are the world's most

actively traded energy investments. The 850,000 WTI futures and options contracts traded on an average day represent 850 million barrels, almost 10 times daily global oil consumption.

Futures trading develops in the wake of vibrant markets in which prices are volatile and unpredictable. To minimize the risk of losses caused by price swings, buyers and sellers seek ways to lock in prices for deliveries at future dates. They may bet wrong and overpay or underpay as the market moves, but they will have protected themselves against too much movement — or profited if they bet correctly.

Speculators, who bet on the price swings and often have no intention of actually delivering or taking delivery of any oil, are another set of important actors on exchanges and frequently act as counterparties to buyers and sellers.

There is no equivalent in the LNG world to the frenzy of futures exchanges like the NYMEX. In fact, there is no futures trading at all.

Japan, the world's largest buyer of LNG, plans to list the world's first LNG futures contracts on the Tokyo

Commodity Exchange by sometime in 2015, but that will not mean LNG suddenly becomes a global commodity. In fact, most analysts do not believe it will be traded as a global commodity anytime soon, even if futures contracts are sold in Japan. There just isn't enough of it available and sold openly.

GROWING SPOT MARKET FOR LNG

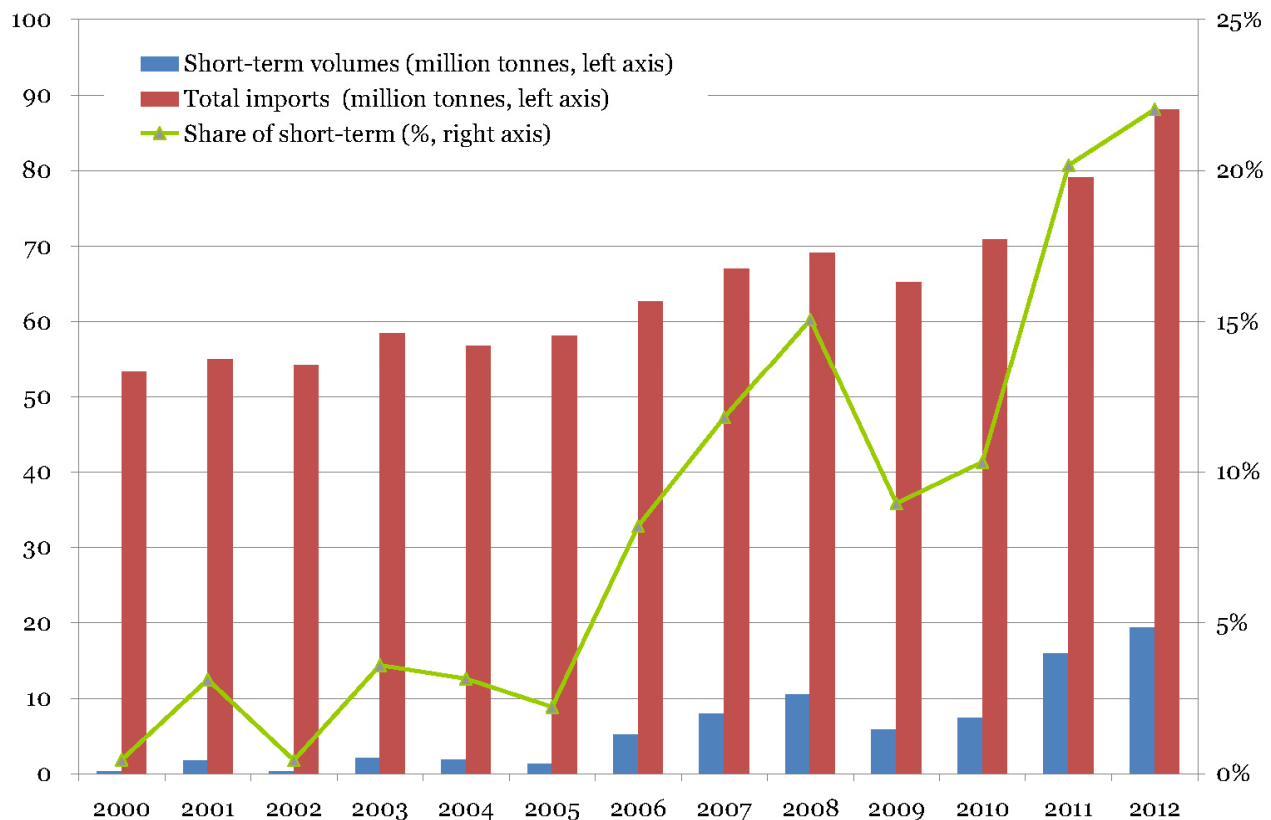
Oil is also traded on a spot basis for individual cargoes, with main spot markets or trading centers in Rotterdam for Europe, Singapore for Asia and New York for the United States. In contrast, most LNG changes hands privately through long-term contracts typically spanning 15 to 20 years.

The enormous capital cost of liquefied gas projects is one reason deals are most commonly cemented on a

long-term basis between producers and customers. Producers need the certainty that they can sell their product in order to attract financing for pricey investments in liquefaction plants, storage tanks and LNG carriers that cost twice as much as oil tankers. Even a small liquefaction project can top \$10 billion, with the larger and more complex projects costing \$30 billion and up.

Long-term contracts cover everything from upstream gas-supply agreements to shipping charters to loan arrangements and, of course, the LNG sale and purchase agreement. Nelly Mikhael, a New York City-based senior consultant at FACTS Global Energy, wrote in a July 2014 e-mail interview. The destination and any resale under these sales-and-purchase agreements are typically tightly controlled.

Short-term LNG sales to Japan grow



Source: Alaska Gas Pipeline Project Office

Short-term LNG sales to Japanese buyers have grown in recent years, reaching about 22 percent of Japan's purchases in 2012.

Still, spot trading and short-term contracts (considered to be four years or less) make up a growing segment of LNG trading — rising in the past decade from around 5 percent to 20 percent of worldwide trade.

For contracts starting delivery before 2000 the average length for contracts was 20.3 years, while contracts starting delivery after 2000 averaged 16.7 years. The shrinking contract durations are due to declining gas production at mature fields in Australia and Asia; new projects with smaller feed-gas reserves than those in the past; greater desire by producing countries to keep more gas for domestic use; and the rise of the short-term market, Mikhael wrote.

LNG enters the spot market for many reasons.

Projects sometimes produce more LNG than expected and sell the excess on the spot market. Or a project might reach a final investment decision without committing 100 percent of its production. Perhaps the developers could not secure long-term buyers for all of the volume (due to differences of opinion about key issues such as pricing). Or, satisfied that enough of the production had been sold under long-term contracts to turn a profit, they might choose to retain a little gas for opportunistic sales.

Buyers can also be a source of spot sales. Under less common but more flexible deals, buyers may be able to sell some of their cargoes on the open market. These deals let buyers rid themselves of excess LNG or play the spot market for better returns.

SUPPLY SPEAKS VOLUMES

The cacophony of the NYMEX, described as "a great roaring rug of squall" by journalist Lisa Margonelli in her 2008 book, "Oil on the Brain," is made possible in part by steady supplies of American crude oil with industry-accepted grading standards.

Ample supplies of a commodity are important for backing up contracts on a futures exchange. Sellers need to be able to guarantee that buyers will get the product, should they choose to take physical delivery.

The plentiful supply of West Texas Intermediate powers the NYMEX engine. Crude streams elsewhere in the world help keep other exchanges busy.

The LNG trade, in contrast, lacks oil's volume. Global oil production in 2013 was 86 million barrels per day; the export-import trade averaged 56 million barrels a day. The amount of LNG traded was equal to 5.9 million barrels of oil per day.

The problem is not the existence of natural gas itself, which is abundant. Proved reserves of oil in 2013 were almost 1.7 trillion barrels, and the natural gas equivalent was likewise impressive at 1.23 trillion barrels.

LNG COSTLY TO TRANSPORT

Oil enjoys a robust global transportation network of pipelines, tankers, trucks and trains. There are thousands of ports dedicated to loading and unloading oil; a large, competitive and flexible shipping fleet to carry oil from buyers to sellers; and hundreds of refineries around the world dedicated to making a wide range of petroleum products.

For LNG, transportation costs and logistics are a major impediment to expanding the market to the point where it could become a globally traded commodity like oil.

Most natural gas moves by pipeline, which works just fine on dry land or short distances underwater. But to cross an ocean, supercooling the gas into a liquid that can be loaded on to a ship is a more cost-effective way to move the molecules.

"The transportation of natural gas ... is a challenge much more difficult to overcome than arguably any other fuel," The World Energy Council said in its 2010 report, "Logistics Bottlenecks." The council was referring to both pipeline gas and LNG, but the transportation costs and challenges tend to be even larger for LNG.

Because of the high costs and technological complexities, liquefied gas is preferred to pipeline gas only when geopolitics, physical distances or ocean trenches render pipelines impractical or cost-ineffective.

Out on the high seas, oil wins on volume and cost.

Oil and LNG trade 2013

**Global oil exports
\$4 billion a day**



**Global LNG exports
\$500 million a day**



= \$500 million

Source: Office of the Federal Coordinator research

On average in 2013, the daily value of global oil trade was eight times that of LNG.

Almost 10 times more oil than LNG moved by sea in 2012, measured in tons per mile, according to the United Nations Conference on Trade and Development.

Oil is immensely more energy-dense and profitable per tanker load than LNG. The payload aboard a 1,000-foot long LNG tanker carrying a spot-sales cargo to Asia in summer 2014 was worth almost \$40 million. An oil tanker of the same size would be carrying more than \$100 million worth of crude.

CONSTRAINTS ON LNG TRANSPORT

LNG shipments are also relatively inflexible. They need special, and very expensive, terminals for supercooling the gas to minus 260 degrees and then regasifying on delivery, and the gas usually is contractually bound to specific destinations under the long-term deal signed by seller and buyer. Oil, on the other hand, is more easily put on tankers and unloaded wherever it is needed.

Transportation constraints have historically limited LNG to production, trade and delivery in either of two basins — Pacific and Atlantic. Until Japan's demand jumped and prices soared after the Fukushima nuclear disaster in 2011, there was

minimal cross-basin traffic. At which point increased demand and higher prices drew more Atlantic Basin LNG to Japan.

Transportation by sea could one day connect the major gas regions into a worldwide market, but many more tankers would need to be built.

There are about 4,000 oil tankers in the world, 500 feet long and larger, according to Poten & Partners, a global broker and commercial adviser for the energy and ocean transportation industries. During 2013, about 360 LNG tankers were in service. An additional 108 LNG carriers were on order, according to an end-of-year report by the International Gas Union. There,

too, oil has it beat — 600 oil tankers were on order, said an August 2014 report by Poten & Partners.

The expansion of the Panama Canal will help smooth the way for the budding LNG export trade along the U.S. Gulf Coast and cross-basin traffic. Most LNG carriers are too big to pass through the canal, but the expansion will enable 90 percent of LNG tankers to transit the isthmus.

The Panama Canal Authority said in 2013 that voyages to East Asia from Cheniere Energy's Sabine Pass LNG export plant under construction in Louisiana will be slashed by 20 days, round-trip. (Even so, the round-trip voyage could still take more than six weeks.)

LIQUEFACTION IS EXPENSIVE

The price tags of contemporary LNG projects, both proposed and under construction, commonly reach the billions if not tens of billions of dollars. Estimates for the Alaska LNG project to export North Slope gas to Asia range from \$45 billion to \$65 billion for a gas treatment plant to remove carbon dioxide and other impurities, 800 miles of 42-inch-diameter high-strength steel pipe, a huge liquefaction plant, LNG storage tanks and marine terminal.

The cost to process and ship oil to a refinery is small by comparison.

As an example, it costs less than \$10 to pipe a barrel of Alaska North Slope crude almost 800 miles to the terminal at Valdez and send it by tanker to U.S. West Coast refineries — leaving 90 percent of the value of \$100-a-barrel oil for production costs, taxes, capital investment and profit.

But for LNG, the pipeline, liquefaction and tanker costs of North Slope gas delivered to Japan could consume two-thirds of the fuel's value at summer 2014 Asian spot-market prices. Simply put, the profit margin for investors is much slimmer.

The liquefaction process is a big reason for the significant added expense to LNG. Liquefying Alaska North Slope gas will cost more than moving it 800 miles by pipe to the tidewater plant.

SMALLER MARKET, FEWER PLAYERS

The ubiquitous need for oil means many parties are either in the business of selling or buying it.

The huge number of crude oil buyers and sellers worldwide has enabled the creation of a transparent and liquid market.

Not so for LNG, which inhabits a much smaller realm. Oil pretty much has the transportation-fuel sector all to itself, while natural gas has to compete in the heating and electricity sectors with an array of energy sources including coal, nuclear, solar, wind, hydroelectricity, geothermal and even oil.

"Not every country in the world uses gas, and if they do, the quantities will be highly variable, because power generation fuel mixes vary so dramatically," Mikhael said.

And for consumers who do use natural gas, only a minority will be part of the LNG trade because pipeline gas deliveries cost less. In 2013, about 69 percent of gas traded between countries flowed via pipeline. The United States, the world's largest gas producer and consumer, burns only a trickle of LNG.

For some customer nations, LNG is used to guarantee supply diversity and supplement existing pipeline imports, but in other cases, like Japan, it is a

much more crucial part of the energy supply.

Japan buys LNG because no natural gas pipelines have been built to the island nation. In a move that shook the world LNG market, Japan's purchases jumped 20 percent following the 2011 meltdown at Fukushima, a catastrophe that prompted the Japanese government to take all its nuclear plants offline.

The dearth of LNG-producing and consuming countries — or lack of market depth — is one impediment to LNG becoming a globally traded commodity, like oil.

"The huge number of global oil producers, consumers, traders and shippers were a factor in the creation of a truly global crude oil market," Mikhael said.

She noted global LNG trade has grown in recent years, with new buyers and sellers joining the roster and more on their way over the next couple of decades. New or expanded LNG export plants in a dozen countries started production in the mid-2000s. Even the United States is poised to join the rush by 2016 when the first Lower 48 export project is scheduled to start shipping cargoes from Sabine Pass, La.

The World Energy Council predicts that between 2020 and 2050 global natural gas exports by pipeline and as LNG will almost triple. The push for cleaner-burning fuels is driving much of that demand growth, along with expanding economies in China, India and elsewhere.

Nonetheless, the enormous increase forecast by the council will not raise the numbers of buyers and sellers to the levels of those trading oil.

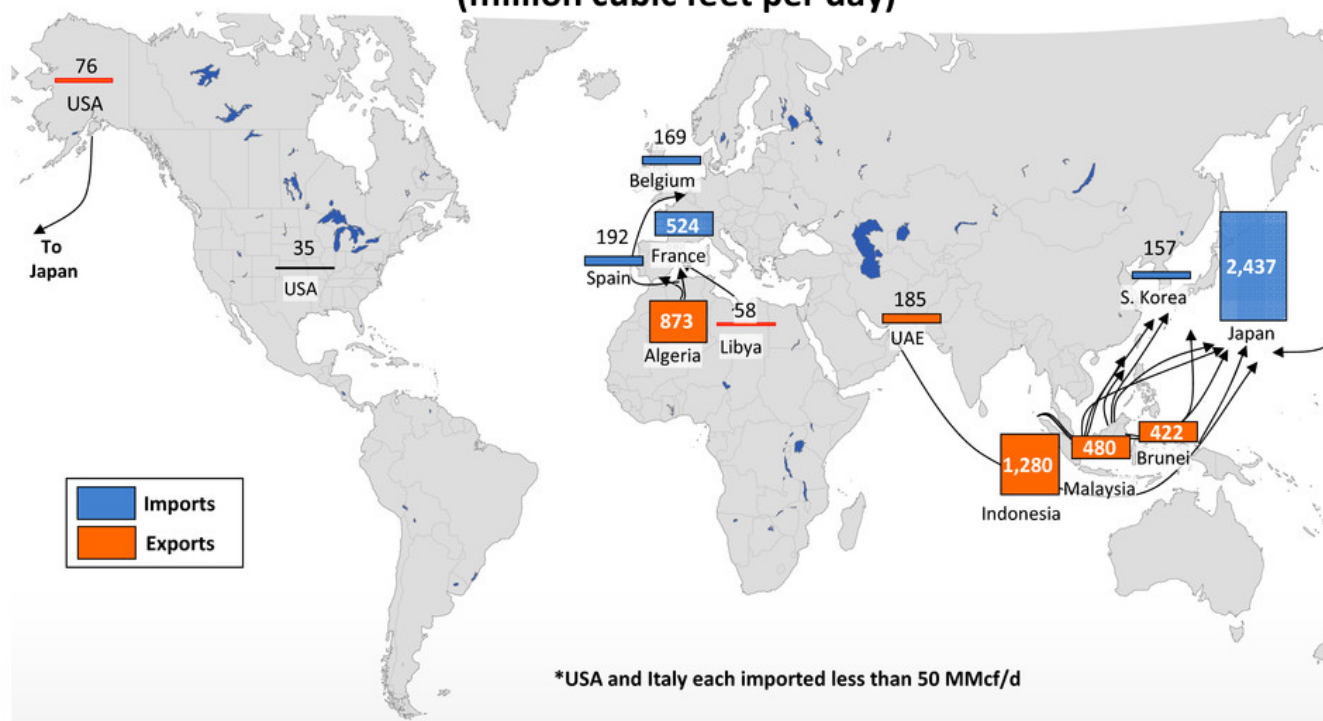
"It cannot and will not approach the sheer number of players that comprise and literally shape the world's crude oil market," Mikhael said. "LNG will never have the penetration enjoyed by oil, and hence, will remain comparatively small."

HOW MUCH IS IT, REALLY?

With high-speed electronic deals around the world, traders know how much oil costs at a particular moment. Not so for LNG.

Global LNG imports, exports in 1988

(million cubic feet per day)



Source: Cheniere Energy

Just 26 years ago, there were only seven LNG exporting nations in the world and just six importing nations. In 2014, the numbers are up to 20 exporting nations and 30 importers.

Over the past 30 years, three streams of crude have emerged as the primary price benchmarks for the oil trade: West Texas Intermediate, Brent Blend and Dubai. For any contracted amount of oil, one of these benchmark prices are plugged into a formula that also takes into account all sorts of variables that affect price, including quality, transportation and refining costs.

"The global prices of various grades of crude oil are exceedingly transparent, and can be learned by anyone with a telephone and/or an internet connection," Mikhael said.

But because of the different market conditions that prevail in various regions of the world, there is no such thing as a global LNG price. Rather, natural gas and LNG prices can generally be categorized by region.

They tend to trade regionally in large part because of transportation costs and logistics.

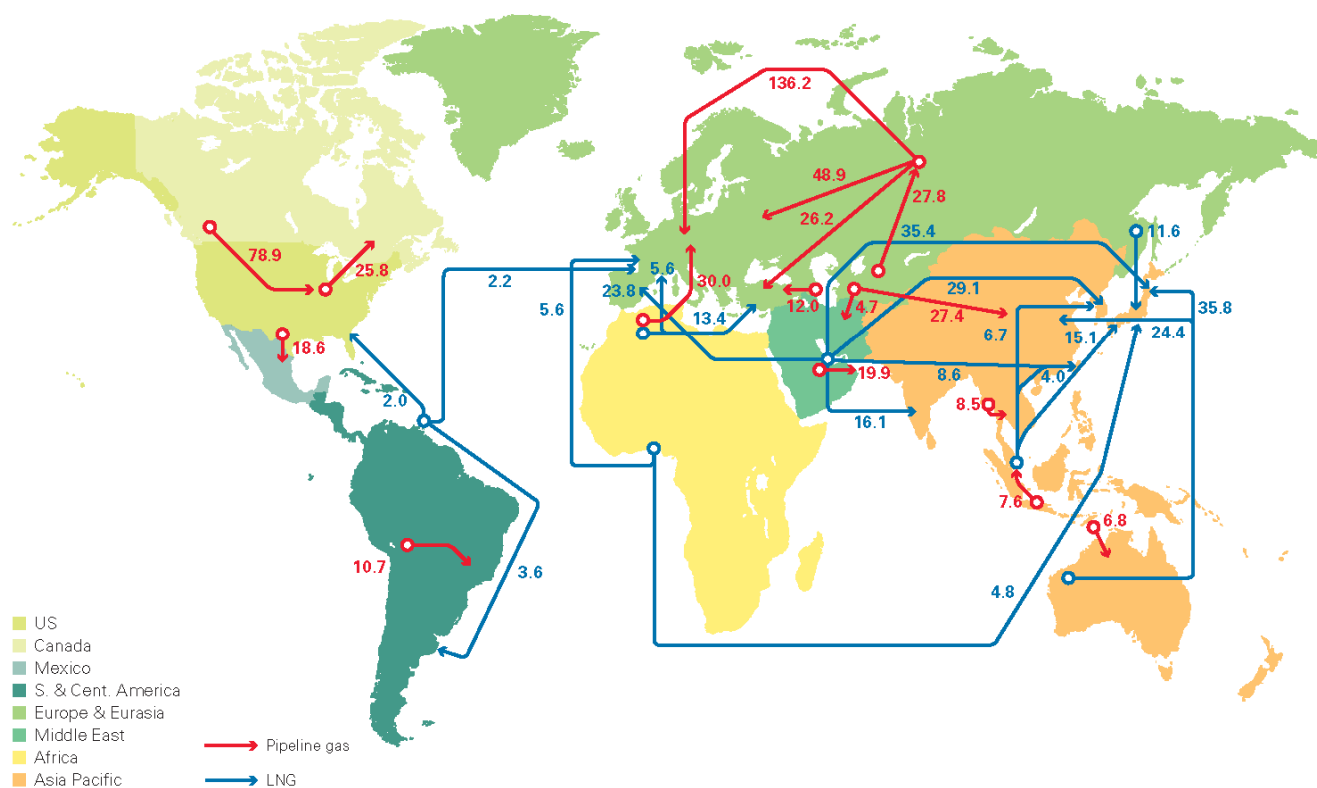
Each natural gas market — Asia-Pacific, Europe and North America — has separate internal dynamics that dictate their pricing. Their gas markets have different histories, sources of supply and varying degrees of reliance on imports:

- Pricing in North America's gas market is pegged to gas-on-gas competition; with so many producers and so much gas in the United States and Canada, the competition is every other supplier with the same access to the same pipelines.
- Asia's gas prices rise and fall with oil prices, as oil-derived products are a key alternative source of energy.
- Europe's system tends to be a blend of the two.

Oil's benchmarks are based on spot crude prices. But spot LNG markets aren't deep enough to serve as benchmarks, so they must rely on the closest substitute fuel to serve as an approximate price

Major trade movements 2013

Trade flows worldwide (billion cubic meters)



Source: BP

The data illustrates the flow of pipeline natural gas and LNG between sources of production and regions of consumption. Trade flows are on a contractual basis and may not precisely correspond to physical gas flows in all cases. Russia was the largest pipeline gas seller in 2013; Qatar the biggest in the LNG business.

marker. In Asia, it's the crude oil price — calculated on an energy-equivalent to gas — because LNG and oil were used interchangeably there for electricity and heating in the 1970s.

Most of Asia does not have the option of pipeline gas imports, which is one reason its LNG contracts remain chiefly pegged to crude oil prices. Buyers and sellers generally negotiate a pricing mechanism in their contracts called an S-curve to protect both sides in times of high and low oil prices. The curve softens the effects of the oil-price linkage, helping buyers when oil prices are high and ensuring that sellers don't give up too much when prices are low.

CHANGE IS POSSIBLE

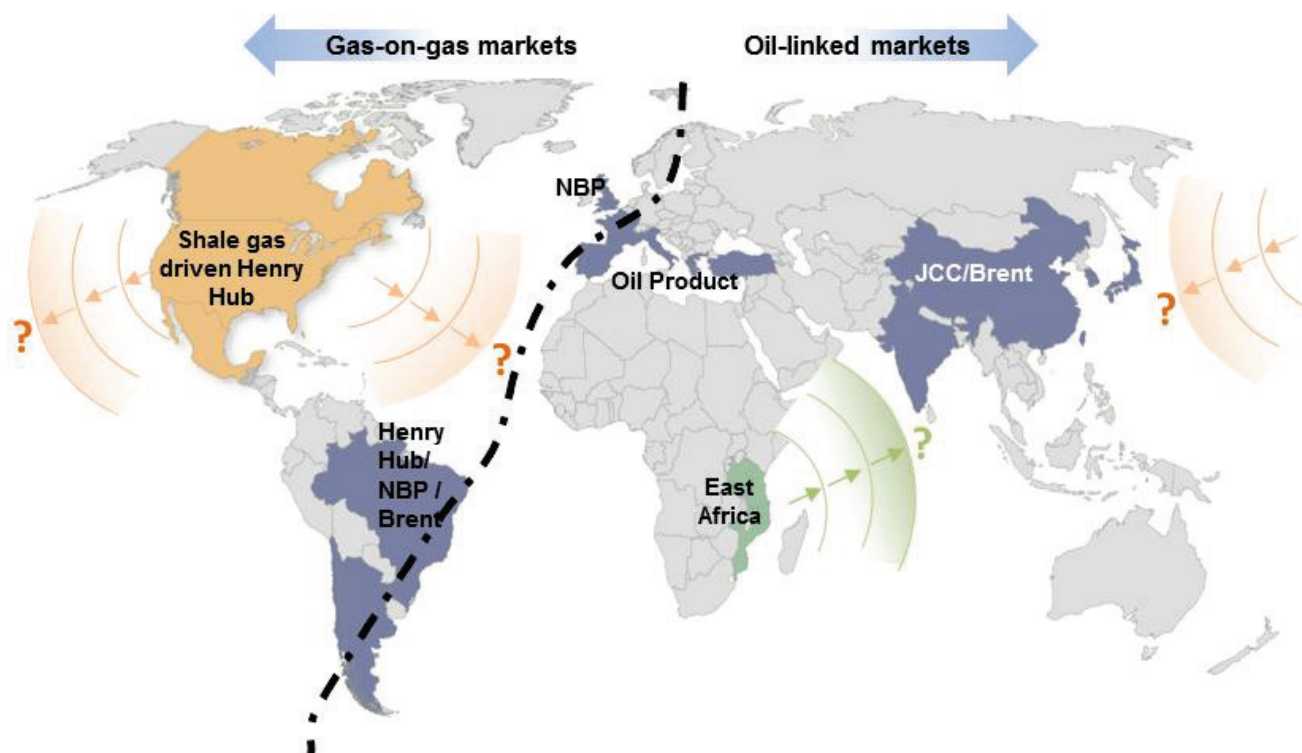
In recent years, Asian buyers have led the call to delink the historical price connection to oil and

instead would like to see upcoming North American LNG deliveries priced against the publicly traded U.S. gas market price. (If Lower 48 LNG export plants were operating in the summer of 2014, and their cargoes were pegged to U.S. prices, the LNG would be delivered to Asia at a significant discount to the traditional, long-term oil-linked prices.)

Some North American LNG project developers have balked at this, arguing that volatile U.S. gas prices would not provide the security they need to underwrite costly liquefaction plants. But other export project developers, particularly on the U.S. Gulf Coast, are open to the new pricing structure, as long as the customer takes the market price risk and they get paid a fixed rate for their liquefaction services regardless of gas market prices.

"One indexation is not necessarily better than the

Regional long-term contract pricing structure



Source: Poten & Partners

LNG prices vary by region. Asia is a predominantly oil-linked LNG market. Prices in continental Europe reflect oil product-linked and also hub-priced natural gas markets. Gas-on-gas market pricing dominates the United Kingdom (National Balancing Point), while much of Europe pays oil-linked prices. North American gas is tied to the Henry Hub, La., and other pricing points.

other. It simply depends on how much risk an individual buyer is willing to assume in order to have the price-risk diversity they want," Mikhael said.

While price negotiations continue, several gas buyers already have signed contracts for LNG from Gulf Coast and East Coast plants pegged to the U.S. gas pricing point at Henry Hub, La., giving them the new supply and price diversity they want.

In addition to changing benchmarks, LNG pricing could become more transparent in the future. Because so many deals are made privately in long-term contracts, prices are often hard to pinpoint. The Japanese government in April 2014 took a small step to clarify pricing by releasing average prices for spot-market liquefied natural gas sales.

The move by Japan's trade ministry, according to Reuters, was intended to "add transparency to an opaque market" amid concern about rising costs in the wake of the shutdown of nuclear plants after the Fukushima crisis.

But reshaping LNG pricing and markets to more closely resemble the oil trade will be a long, slow process.

In its 2013 report on establishing a gas trading hub in Asia, the International Energy Agency said the transition from a market dominated by long-term contracts and oil-index-based pricing to a competitive market with short-term contracts and market-based pricing "doesn't happen overnight."



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