

LNG IN THE AMERICAS

How Commercial, Technological and Policy Trends are Shaping Regional Trade

Alex Wood, Lisa Viscidi, and Jason Fargo*

The global natural gas market is changing drastically as a consequence of surging US shale production from Texas' Permian Basin and other unconventional plays. As recently as 2005, US gas output was on the decline, and the country was growing increasingly reliant on Canadian volumes shipped south by pipeline. At that time, with domestic production expected to drop significantly, plans called for the construction of several terminals to bring in liquefied natural gas (LNG) from across the globe. The shale boom, however, turned those expectations on their head. In 2009, according to US Energy Information Administration (EIA) figures, the United States became the world's largest gas producer, besting Russia.¹ Then, this past year, for the first time in decades, the country became a net gas exporter.

Most US gas exports are currently going south by pipeline, as Mexico – itself facing a long-term decline in domestic

production amid rising demand – is vastly expanding cross-border pipelines to take advantage of the emerging gas surplus north of the border, which has pushed the US' Henry Hub gas-price benchmark down to low levels. US natural gas exports to Mexico have nearly doubled from 2.5 billion cubic feet per day (Bcf/d) in 2013 to 4.7 Bcf/d in January, and new pipelines under construction are expected to boost cross-border send-out capacity to over 13 Bcf/d by the end of this year. Yet even with that market essentially locked up, expected production growth from the Permian and elsewhere means the United States will be increasingly awash in gas for the foreseeable future.

In response to the gas glut, US producers are increasingly turning to LNG exports to find new markets for their production. The ability to increase LNG exports will be driven mostly by market conditions. But the US government is looking to further push gas production and exports in a strategy dubbed “energy dominance,” with the aim of converting the United States into a major net energy exporter, reducing the trade deficit, and using robust energy exports to advance US foreign policy priorities abroad. As part of that policy US President Donald Trump has touted US LNG exports on recent foreign trips. Last year, he promoted US LNG in Europe as a solution to reducing the continent's current dependence on Russian gas. And, this past November, he took the chief executive of Houston-based LNG exporter Cheniere Energy to Beijing to help the firm strike local deals. The effort appears to have been successful, as Cheniere last month announced

Due to its geographical proximity and growing gas demand, Latin America and the Caribbean has emerged as a top market for US LNG.

*The report is authored by Alex Wood, Policy Analyst at the US Department of Energy, Lisa Viscidi, Energy, Climate Change & Extractive Industries Program Director at the Inter-American Dialogue, and Jason Fargo, Latin America Team Leader at Energy Intelligence Group.

a 15-year agreement to supply state-run China National Petroleum Corp. (CNPC) with 1.2 million tons of LNG per year.

The advent of US LNG exports means that domestic gas producers can sell their output anywhere in the world, and indeed many deliveries have gone to large Asian importers including South Korea, China, and Japan, as well as to Europe. Yet a good number of cargoes have gone closer to home, to Latin American and Caribbean markets. Mexico itself took more than 40 US LNG deliveries last year, making it by far the largest US LNG customer, with Chile, Argentina, and Brazil also importing a few cargoes. One reason is proximity, as transport costs from the United States to other countries in the Western Hemisphere are lower than those for deliveries to Asia. And the expansion of the Panama Canal, completed in 2016, means LNG tankers – which were too big for the old canal – can now travel through the locks, bringing US cargoes to Pacific Coast import terminals in Mexico and South America. A number of Latin American and Caribbean LNG importers are also benefiting from flexible contract terms and the ability to import small quantities of LNG thanks to technological advances. The administration’s focus on bilateral trade deficits with key nations could encourage some countries to ramp up US LNG imports to avoid penalties such as the recently-announced tariffs on steel and aluminum. In 2017, 30 percent of US LNG shipments went to Latin America and the Caribbean. As US liquefaction capacity increases, the region is sure to become an even more important market for US LNG.

For Latin America, the sudden availability of large amounts of US LNG presents an opportunity to diversify the region’s energy matrix, improve energy security and, in some countries, reduce greenhouse gas emissions in the power sector. Many countries in the region, particularly smaller, energy-poor ones in the Caribbean and Central America, have long relied on cut-price deliveries of fuel oil and diesel from Venezuela to run thermal power plants. However, with Venezuela in the midst of economic collapse and slashing its largesse, US-sourced LNG can provide an alternative power source. In addition, the carbon intensity of natural gas in the power sector is around 30% percent less than the carbon intensity of diesel. In South America, many countries are increasingly relying on natural gas for power generation amid popular opposition to building large hydroelectric dams. LNG is imported on the spot market to provide gas as an alternative to hydropower when water levels are low or as a firm energy source to complement intermittent wind and solar. Natural gas is also increasingly used for industrial applications and transportation in many Latin American countries.

The United States as a net gas exporter

As technological progress has enabled the profitable extraction of shale gas resources that only a few years ago would have been uneconomical, US gas output has soared.

FIGURE 1: US NATURAL GAS - IMPORTS & EXPORTS

Source: US Energy Information Administration

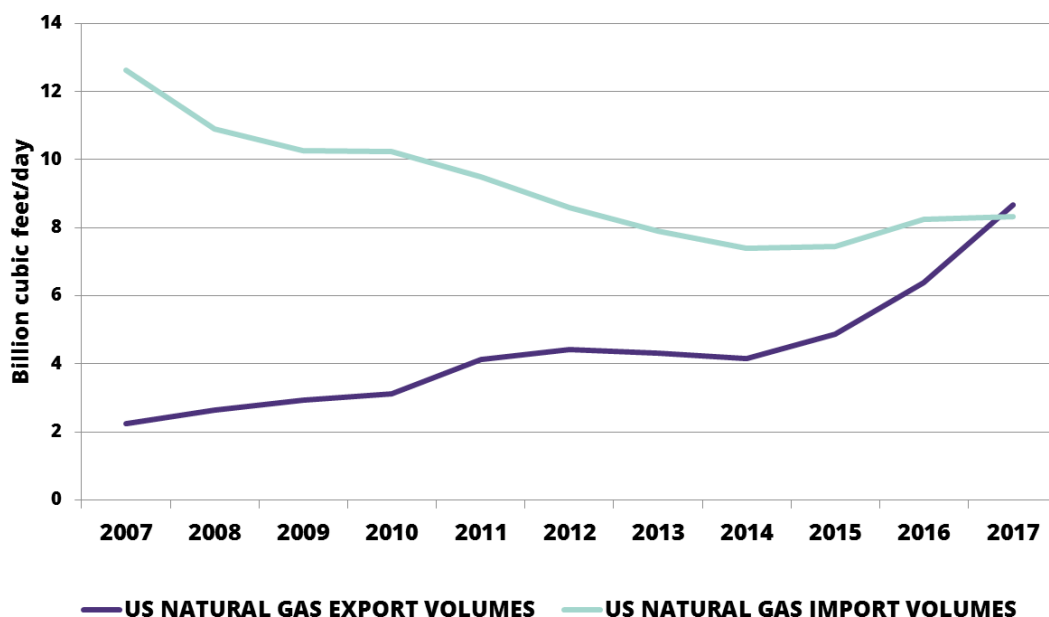
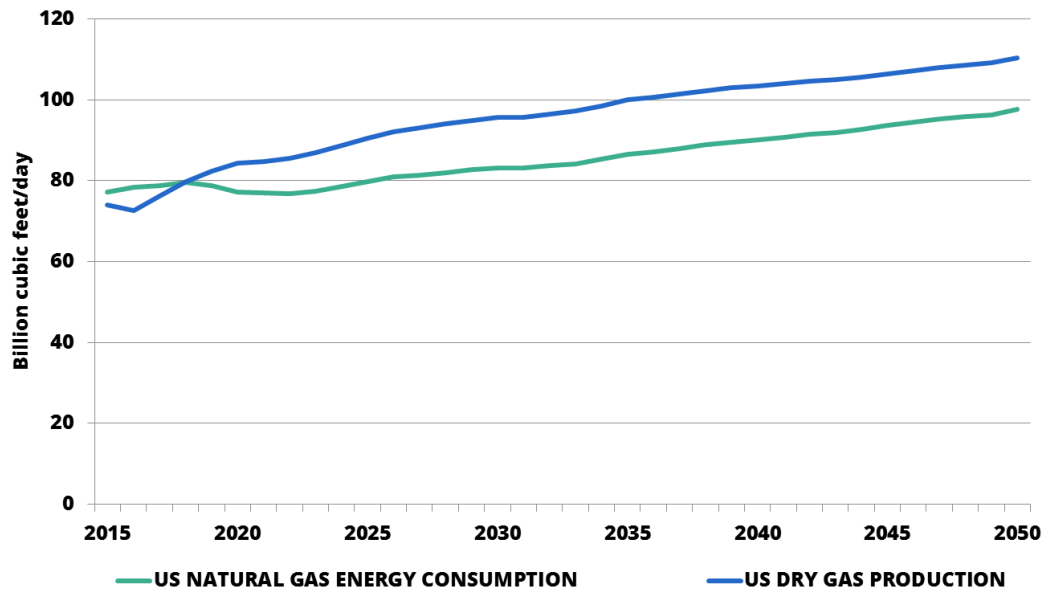


FIGURE 2: NATURAL GAS CONSUMPTION & PRODUCTION: PROJECTIONS TO 2050

Source: US Energy Information Administration



Production reached 73.5 Bcf/d in 2017, up from 52.8 Bcf/d a decade earlier. In 2018, the EIA estimates that dry natural gas production will average 80.4 Bcf/d. This is the highest year-over-year growth on record.² Consumption has also grown over the past decade, from 63.3 Bcf/d in 2007 to 74.2 Bcf/d in 2017.

With this upsurge, the United States became a net natural gas exporter on an annual basis in 2017 for the first time since at least 1957, with net exports averaging about 0.4 Bcf/d.³ Projected natural gas export growth, especially to Mexico, makes it likely that this trend will continue into the future.⁴

In 2016, the first US Gulf Coast LNG export terminal, Cheniere's Sabine Pass facility, came online in Louisiana. The terminal, with four trains, now has a liquefaction capacity of about 2.8 Bcf/d; a fifth train is currently under construction, while a sixth is planned. Once Sabine Pass reaches its full build-out, its total capacity will hit 3.5 Bcf/d.⁵ In addition, the Cove Point facility in Maryland, built by Dominion Energy, has just gone into service with a capacity of 75 million cubic feet per day. Four other LNG export terminals are planned for completion by the end of next year, bringing total export capacity to 9.6 Bcf/d, according to EIA estimates.⁶ LNG exports reached 186 Bcf in 2016 and 707 Bcf in 2017, growing by 380 percent. As this additional capacity comes online, US LNG exports are projected to continue increasing dramatically until reaching 4.4 trillion

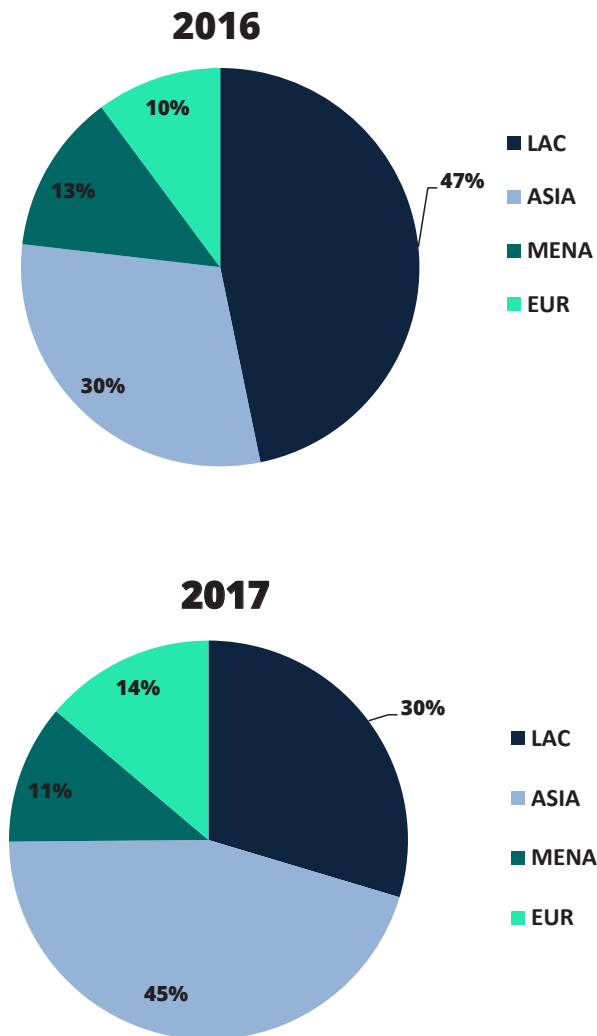
cubic feet in 2035.⁷ After that, projections through 2050 show exports holding steady at 4.4 Tcf.⁸

Mexico, with its yawning gap between domestic gas production and demand, has been the United States' number-one LNG customer since exports began. Indeed, while Asia remains the largest regional customer for US LNG exports, accounting for 45 percent of the total in 2017, Latin America and the Caribbean is not far behind at 30 percent. Though exports are growing rapidly, US suppliers face a series of challenges in bringing LNG export facilities online. Most critically, the rapid acceleration of US production has contributed to a global natural gas supply glut, putting downward pressure on LNG prices and creating a very competitive market to secure financing for the high up-front costs associated with LNG export terminals. Long-term supply contracts are especially important to secure financing for liquefaction facilities, the most expensive part of the LNG supply chain.⁹

The United States became a net natural gas exporter on an annual basis in 2017 for the first time since at least 1957.

FIGURE 3: US LNG EXPORTS BY REGION

Source: US Energy Information Administration



To raise the necessary capital, developers often turn to a mix of equity from capital markets, private equity investment, and debt financing from commercial banks, export credit agencies, and the bond market.¹⁰ Securing purchase commitments from creditworthy buyers is key to obtaining financing for export projects. Experienced, reputable investors can in turn help projects still under construction secure better offtake arrangements with buyers. As of October, more than 20 Bcf/d of export capacity had received final approval from the Department of Energy (DOE). However, only about 3 Bcf/d was operational, with another 10 Bcf/d under construction.¹¹

Because of difficulties securing financing, many projects that have secured regulatory approval have not yet begun construction.

In recent months, the Trump administration and the US Congress have made efforts to speed up the permitting process. Current law requires the DOE to grant applications to export LNG to countries with which the United States has free-trade agreements (FTAs) “without modification or delay.” To export LNG to non-FTA countries, a public-interest determination by the DOE, an opportunity for public comment, and an environmental review under the National Environmental Policy Act (NEPA) are required. Additionally, the Federal Energy Regulatory Commission (FERC) must approve the construction or expansion of LNG export terminals, which also requires a NEPA analysis.

Currently, approval processes for LNG export facilities are the same regardless of their export capacity. However, a proposed rule change announced by the DOE in September 2017 would speed up the process for small-scale natural gas export facilities that export less than 0.14 Bcf/d and 51.10 Bcf/year and qualify for a categorical exclusion under NEPA regulations. In October, Senators Bill Cassidy and Marco Rubio introduced the Small Scale LNG Access Act of 2017, which would amend the Natural Gas Act to include an expedited process for the approval of small-scale LNG projects. The DOE has already approved seven permits for small-scale LNG exports, with several more applications pending.

A second piece of legislation – the LNG Now Act of 2017, introduced by Cassidy and Representative Clay Higgins last summer – aims to reduce export restrictions for non-FTA nations. Since the first exports from Sabine Pass, LNG exports have gone to 26 countries, 21 of which do not have FTAs with the United States.¹² However, with the current LNG supply glut, financing is a much more significant obstacle than regulatory approval.

In fact, if all currently approved LNG export projects were operational, the United States would already rank number one in the world for global export capacity.¹³ Magnolia LNG, for example, has had regulatory clearance for an export terminal in Louisiana since April 2016 but has yet to obtain enough offtake agreements to secure financing. The low-price environment also erodes the profit margin for US spot LNG trade, and some buyers that own capacity at US export terminals – like India’s Gail – have tried to renegotiate pricing.¹⁴

US LNG exports in a global market

In spite of financing challenges, the six LNG export terminals already under construction in the United States are expected to be completed within the next five years.¹⁵ The United States could become the world's third-largest LNG exporter as soon as 2019.¹⁶ Global LNG capacity is expected to continue growing through 2035, led by the United States and Australia, rising almost 43 percent by 2025.¹⁷ The BP Energy Outlook predicts LNG trade will grow seven times faster than that of pipeline gas and account for around half of all globally traded gas by 2035, up from 32 percent in 2015.¹⁸ Asia will represent the lion's share of global demand, followed by Europe. South and Central

America, as well as the Middle East, will also see LNG demand growth, though to a lesser extent. Overall global demand for natural gas is expected to reach 500 Bcf/d by 2035.¹⁹

The competitiveness of US LNG depends on US natural gas prices as well as how they compare to international oil prices. The Henry Hub natural gas price, which serves as the United States' primary benchmark, has fallen significantly in recent years as supply has surged due to the shale revolution. After peaking at \$8.85 per million Btu in 2008, the Henry Hub price fell to \$2.99/million Btu in 2017. The decline in oil prices that started in mid-2014 has also lowered the potential price advantage of Henry Hub-linked LNG contracts compared to oil-linked ones. That said, as oil prices have begun rising again and are expected to continue on their upward trend, US LNG exporters with contracts

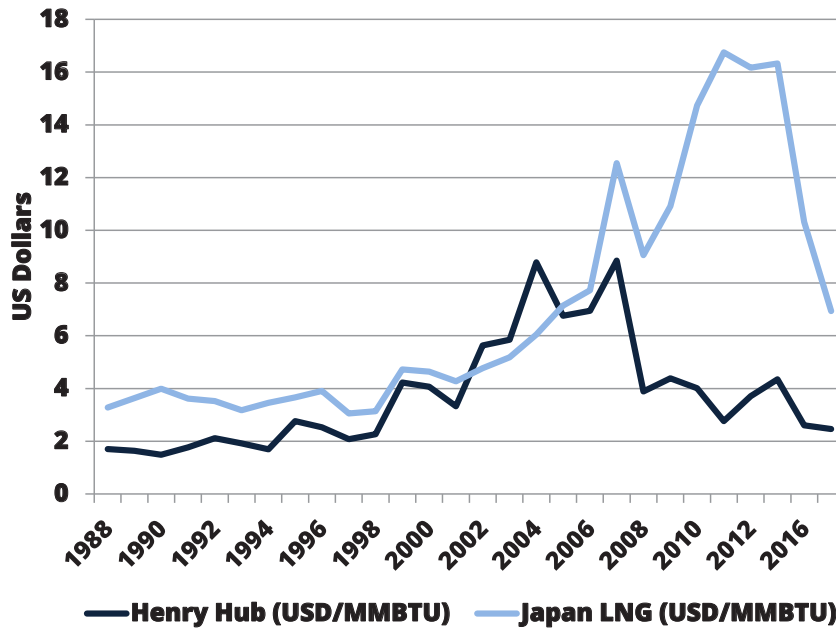
FIGURE 4: LONG TERM APPLICATIONS FOR SMALL-SCALE (0.14 BCF/D OR LESS) LNG EXPORT

Source: US Department of Energy

COMPANY	QUANTITY (A)	FTA APPLICATIONS (B) (DOCKET NUMBER)	NON-FTA APPLICATIONS (C) (DOCKET NUMBER)
Carib Energy (USA) LLC	0.03 Bcf/d: FTA 0.04 Bcf/d non-FTA (e) (l)	Approved (11-71-LNG)	Approved (F) (11-141-LNG)
SB Power Solutions Inc.	0.07 Bcf/d	Approved (12-50-LNG)	n/a
Advanced Energy Solutions, LLC	0.02 Bcf/d	Approved (13-104-LNG)	n/a
Argent Marine Management, Inc.	0.003 Bcd/d	Approved (13-105-LNG)	n/a
Strom Inc.	0.08 Bcf/d: FTA (m)	Approved (14-56-LNG)	Under DOE Review (15-78-LNG)
Air Flow North America Corp.	0.002 Bcf/d	n/a	Approved (F) (14-206-LNG)
American LNG Marketing LLC	0.008 Bcf/d(d)	Approved (14-209-LNG)	Approved (F) (14-209-LNG)
American LNG Marketing LLC	0.08 Bcf/d	Approved (15-19-LNG)	n/a
Floridaian Natural Gas Storage Company	0.04 Bcf/d(d)	Approved (15-38-LNG)	Approved (F) (15-38-LNG)
Flint Hills Resources, LP	0.01 Bcf/d(d)	Approved (15-168-LNG)	Approved (F) (15-168-LNG)
Eagle LNG Partners Jacksonville LLC	0.14 Bcf/d(d)	Approved (16-15-LNG)	Under DOE Review (16-15-LNG)
Carib Energy (USA) LLC	0.004 Bcf/d	n/a	Approved (F) (16-98-LNG)
Eagle LNG Partners Jacksonville II LLC	0.01 Bcf/d(d)	Approved (17-79-LNG)	Approved (17-79-LNG)

FIGURE 5: JAPAN LNG PRICES VS HENRY HUB PRICES

Source: BP Statistical Review of World Energy 2017



linked to Henry Hub are becoming more competitive. LNG also has a lower commodity risk, as the fuel cost – based on Henry Hub – is a much smaller proportion of the delivered cost compared to fuel oil or diesel for power generation.

This LNG supply glut – which is expected to continue through at least 2020, depending on demand growth in Asia – has driven down spot prices and created a very competitive LNG market. The BP Statistical Review expects this competition to cause long-term gas contracts to be increasingly indexed to spot prices.²⁰ The glut is also delaying or killing off some LNG projects that are on the drawing board, with export projects in the United States, Canada, and Australia among those being abandoned over the past two years. For example, the Pacific Northwest LNG terminal in British Columbia, proposed by Malaysia’s state Petronas, was cancelled in July 2017 due to market factors.²¹ Smaller, more nimble projects have fared slightly better – of the more than 20 export terminals proposed in British

Columbia, the only two currently moving forward are both smaller projects.²²

To gain an advantage in a crowded market, US LNG exporters are exploring innovative ways to cut costs and adjust contract terms to make their exports more attractive.

These flexible terms have the potential to reshape the global LNG market over the next few years. Traditionally, LNG has been bought and sold with long-term contracts of up to 20 years indexed to oil prices, with strict clauses mandating the point of delivery. But between 2018 and 2020, about 20 percent of these contracts will expire, and many more will expire over the next decade.²³ US exporters are now offering more flexible terms, like shorter contracts at fixed prices or prices tied to a buyer’s preferred index or blend of indexes. Furthermore, all US export contracts are written without destination clauses, meaning buyers are allowed to trade the LNG they purchase. New US LNG company Tellurian is developing a new model whereby buyers take an equity stake in projects in return for receiving LNG at cost. The widening of the Panama Canal has also made US LNG exports to Asia more competitive, even though some LNG shippers have complained of delays getting their vessels through the locks. In response to bottlenecks in the canal, some LNG shippers have sent their cargoes south, around the Cape of Good Hope or through the Strait of Magellan.

Technological advances, like small-scale LNG delivery

A number of Latin American and Caribbean LNG importers are benefiting from flexible contract terms and the ability to import small quantities of LNG.

technology, will also provide additional flexibility to US suppliers to ship volumes to small, nearby markets like the Caribbean. Small-scale liquefaction plants often use International Standards Organization (ISO)-certified tank containers, which allows the LNG to be delivered to any facility using conventional container shipping infrastructure and ships.²⁴ Floating storage and regasification unit (FSRU) technology will also allow countries with sea access to receive and regasify LNG without assuming the risk of investing in costly permanent gas infrastructure. FSRUs cost about 50-60 percent less than onshore terminals and can be delivered and operational in half the time.²⁵ The first FSRU was built in 2001, but the market for these vessels has grown considerably; as of July 2017 there were 26 operational FSRUs (23 as terminals and 3 as LNG tankers) around the world, and there could be as many as 50 in operation by 2025.²⁶

The shift towards more LNG trade compared to pipeline gas, coupled with expected future contract flexibility, will also contribute to increasingly integrated gas markets, as cargoes can be redirected in response to supply and demand fluctuations. While Australian LNG exports are likely to go almost exclusively to Asia, US LNG export destinations are expected to be more diverse, including Western Hemisphere countries as well as Asian and European buyers.

US LNG exports to Latin America & the Caribbean

Latin America's share of global gas trade is relatively small, representing just 7.5 percent of pipeline trade and 6.2 percent of LNG trade. However, several countries are increasing their LNG imports, particularly from the United States and other Western Hemisphere exporters.

Latin America is a net importer of natural gas, with 6.3 percent of global production and 7.3 percent of global consumption.²⁷ The region holds 276.6 Tcf of proved natural gas reserves, 4.2 percent of the world total, but a large share of Latin America's natural gas reserves remain undeveloped.²⁸ The region is also home to one significant LNG exporter of its own, Trinidad and Tobago, whose Atlantic LNG facility exported about 25.1 million cubic meters of LNG last year.²⁹ Trinidad and Tobago has seen its market share in the Western Hemisphere shrink as US demand for its LNG has dried up and new US LNG exports are displacing Trinidadian cargoes in other Latin American countries.

Gas consumption in Latin America and the Caribbean is growing mainly as a result of higher demand for electricity, which is increasing rapidly due to growing middle classes with access to appliances, expanding economies fueled by

FIGURE 6: LATIN AMERICA'S INSTALLED POWER GENERATION CAPACITY

Source: Climatescope 2017

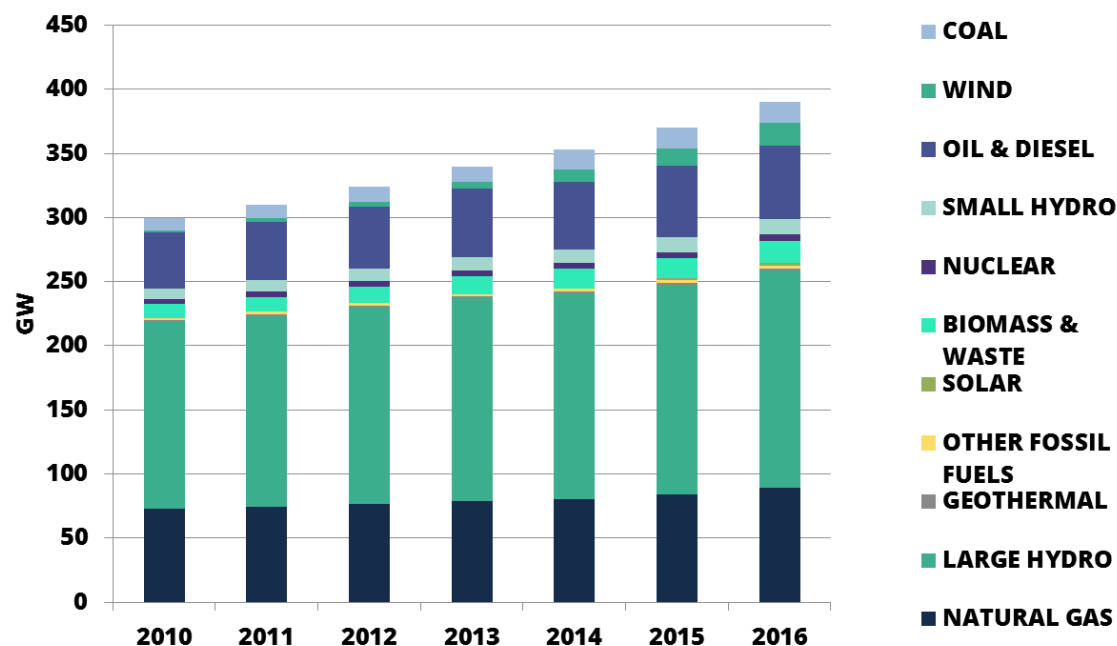


FIGURE 7: OPERATIONAL LNG INFRASTRUCTURE IN LATIN AMERICA & THE CARIBBEAN

Source: The Oxford Institute for Energy Studies, McKinsey Energy Insights & authors' updates



energy-intensive industries, and inefficient use of electricity. Electricity consumption in Latin America and the Caribbean is projected to grow by over 70 percent between now and 2030.³⁰

The share of natural gas in the region’s electricity matrix is growing as the share of other fuels declines. Latin America is dependent on large-scale hydropower for about half of all power generation. But there is little appetite for building new dams because of the social and environmental costs, including deforestation and the need to relocate entire communities. For example, in Chile the government has increasingly turned to LNG-fueled power generation after public opposition to the HidroAysén megadam in Patagonia led to that project’s abandonment in 2014. In April, Brazil’s Supreme Court ruled that hydropower dams in protected areas can no longer go ahead without the prior approval of lawmakers. Moreover, changing rainfall patterns due to climate change are making hydroelectric power more unreliable in some countries. In 2001, Brazil experienced a severe drought that led to a drop in water levels at hydroelectric dams, leaving millions of people and businesses without electricity. In 2016, Colombia imposed emergency energy-saving measures to avoid blackouts following a major drought. Meanwhile, several countries – notably Mexico and several Caribbean island nations – are converting oil-fired power plants to gas in order to lower costs and reduce pollution.

Power generation from non-hydro renewable energy sources is growing exponentially but from a very small base. Wind, solar, geothermal and biomass represent only 10 percent of the region’s electricity matrix. Intermittent renewable energy sources must be paired with firm energy sources, and natural gas is increasingly the favored baseload fuel.

Natural gas is also used for other applications such as transportation and heating. Natural gas vehicles can offer significant CO2 reductions, though they may result in a net increase if fugitive emissions – leaks – are significant. In Latin America, natural gas represents just 2 percent of transport sector fuels, though Argentina and Brazil have sizable fleets of natural gas vehicles (NGVs), while Bolivia’s fleet is growing rapidly.³¹ For example, Argentina has about 1.7 million NGVs in circulation with approximately 2,500 natural gas service stations, while 15,000 vehicles on average per year are converted from gasoline to run on compressed natural gas (CNG).³²

Mexico

In 2013, Mexico embarked on a wide-reaching energy liberalization, passing a constitutional amendment that essentially eliminated state control of both the hydrocarbons and power sectors. In oil and gas, the energy reform broke state-owned producer Pemex's 75-year monopoly. Over the past few years, international oil and gas producers have won dozens of exploration and production contracts via upstream bid rounds. At the same time, pipeline, shipping, and railroad companies have invested in transportation and logistics projects to sell oil and gas into the Mexican market. Last year, for example, Kansas City Southern and US-based Bulkmatric Transport Co. disclosed plans to invest \$50 million in a new liquid fuels terminal in Nuevo León state, which would be supplied by rail from the United States.

The ongoing energy reform in Mexico is significantly altering the way the country produces and consumes energy. Domestic production of natural gas peaked at 5 Bcf/d in 2010 and has since fallen to 3.2 Bcf/d in 2017. Meanwhile, gas consumption has doubled from 4 Bcf/d in 2000 to 8 Bcf/d today as new natural gas-fired power generation comes online, accounting for half of the growth. More demand from power generation is expected over the coming years, as state utility Comisión Federal de Electricidad (CFE) continues to convert fuel oil-fired power plants to cleaner and cheaper natural gas. At the same

time, industrial demand is also expected to rise as the CFE continues a massive program of new pipeline construction. Residential and commercial demand have also grown rapidly but still represent a small percentage of total demand. The establishment of local distribution companies aims to encourage more demand growth.

With rapidly growing natural gas demand and declining domestic production, Mexico grows more dependent on natural gas imports each day. The energy reform has encouraged investment in new pipeline infrastructure, both across the border to the United States and within Mexico. This year, a CFE-led plan to build 22 new pipelines covering 10,000 kilometers is expected to wrap up, tripling the capacity of Mexico's pipeline network. Through October 2017, gas imports from the United States averaged 4.6 Bcf/d, up from an average of 0.9 Bcf/d in 2010, of which 91 percent came via pipeline.

Before Sabine Pass came online, Mexico relied mostly on Peru for LNG supply, along with shipments from Qatar, Nigeria, and other suppliers. However, since receiving its first shipment of US LNG in the fall of 2016, Mexico has relied on its northern neighbor for 57 percent of its LNG supply, while Nigeria and Peru supply significantly lower volumes than before. Since the start-up of US exports, Mexico has been the single largest customer of US LNG, purchasing 22 percent of all LNG exports in 2017.³³

Mexico currently has three LNG regasification facilities in

FIGURE 8: NATURAL GAS SUPPLY IN MEXICO

Source: Sistema de Información Energética, PEMEX, EIA

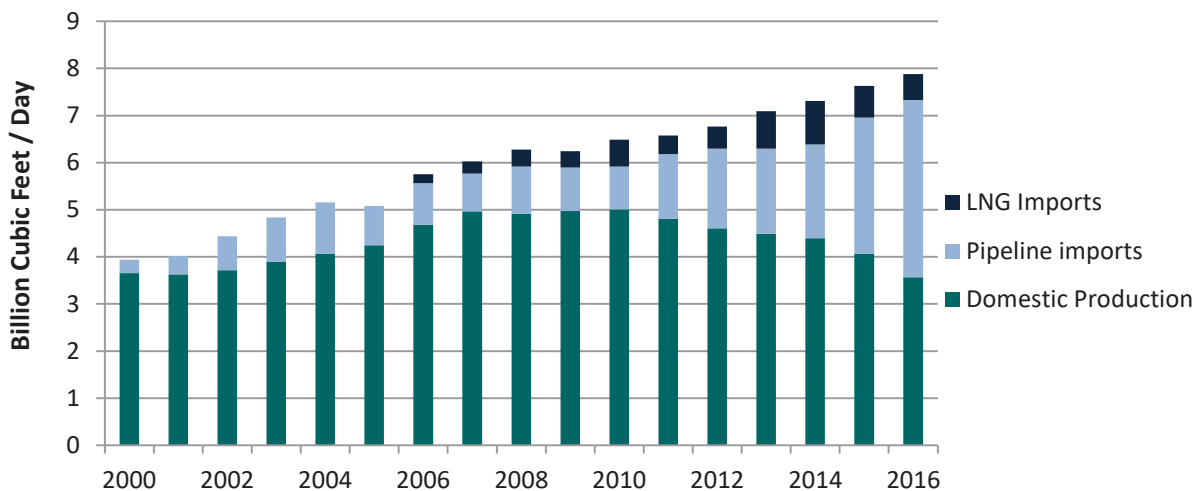


FIGURE 9: ADDRESSABLE MARKETS FOR LNG POWER GENERATION

Source: Oxford Institute for Energy Studies

REGION	INSTALLED CAPACITY (GW)	ADDRESSABLE POTENTIAL FOR GAS (GW)	POTENTIAL GAS/LNG MARKET (BCF/D)
Caribbean Islands	15.1	9.5	1.5
Central America	15.5	5.1	0.8
Total	30.6	14.6	24

operation. The majority of LNG cargoes imported by Mexico arrive at the Manzanillo terminal on the country’s Pacific coast. The Altamira terminal on the Gulf of Mexico also receives LNG cargoes, but the facility was only utilized at 35 percent of capacity in 2017. The Costa Azul terminal located in Baja California receives only small, sporadic shipments as local power plants are normally supplied via pipeline from the United States. The underutilization of the Costa Azul terminal has led its owner, Sempra Energy, to consider reconfiguring the terminal as a liquefaction plant to export natural gas sourced from the United States. However, the possibility of this reconfiguration occurring in the near term is low.

CFE and Pemex have tentative plans to co-develop a new LNG import project, with an FSRU located offshore in the state of Veracruz. Plans call for the FSRU to supply gas to central Mexico and the Yucatán.

Shipments of LNG have helped meet growing demand while the gas pipeline network remains under construction. As pipelines are completed and gas-fired power plants come online, LNG flows may begin to decline and yield to cheaper pipeline options, although markets on Mexico’s Pacific coast may remain dependent on LNG. The United States will likely remain the largest provider of Mexican LNG imports going forward, although at a declining rate as pipeline imports followed by domestic production increase over the next decade.

Uncertainty over the trade relationship between the United States and Mexico also poses a risk to LNG markets. Fears of US retaliation if Mexico does not make concessions on issues such as trade or a border wall have already led some Mexicans to call for the country to diversify its sources of energy supply. Some Mexican politicians, particularly on the left, are calling for Mexico to revisit its trade relationship with the United States. Indeed, a campaign to boycott US corn – dubbed “No Maíz Gringo” – was launched last year, with support from federal Senator Armando Ríos

Piter. Such calls to dissociate from the United States will likely grow louder if nationalist candidate Andrés Manuel López Obrador, currently the front-runner in Mexico’s July 1 presidential election, emerges victorious.

Changes to the North America Free Trade Agreement (NAFTA) could also make exporting US natural gas to Mexico more complicated. Current laws require “national treatment” for exporting gas to NAFTA countries, and it takes only a few weeks for the DOE to grant two-year blanket authorizations for gas exports to Mexico.³⁴ In contrast, export authorizations for non-FTA countries or those with FTAs that do not require national treatment for gas trade, require a public interest review, environmental review and period for public comment. If the elimination or renegotiation of NAFTA puts natural gas exports to Mexico into this latter category, when current authorizations expire, exporters will have to undergo the same protracted review process to export gas to Mexico.³⁵

Caribbean and Central America

Countries in the Caribbean could be considered ideal markets for US LNG sellers, as their proximity to the US Gulf Coast allows for low shipping costs and competitive LNG prices. Most countries in the region currently depend on expensive petroleum-based fuels such as diesel and fuel oil for power generation, leading to some of the highest electricity prices in the world. For these reasons, numerous Caribbean countries are exploring LNG projects, but significant challenges including infrastructure costs and financing issues have slowed the uptake of LNG in this region. Until recently, there were only two operating LNG import facilities in the Caribbean, one in the Dominican Republic and the other in Puerto Rico, but that has started to change over the past few years. In 2016, Jamaica began receiving shipments of US LNG to an offshore LNG storage

port, while Barbados began receiving imports of US-sourced LNG in ISO containers.

Central America is another important potential market for US LNG. The region faces high electricity prices that hinder economic growth, rising demand for energy in the power, industrial and transport sectors, and extremely limited domestic natural gas resources. However, to date only Panama has succeeded in building LNG import infrastructure. Central American countries face a number of barriers to importing LNG. There are economic challenges, including difficulty accessing finance and questions about offtakers' ability to pay. The markets in individual Central American countries are generally too small to make large LNG projects economically feasible, while the regional grid, SIEPAC, has capacity of only 300 MW and is underutilized. Many countries lack specific regulations for natural gas, including storage and distribution, and technical know-how. More broadly, a lack of regulatory stability has deterred private investment. International donors, such as numerous US government agencies and the Inter-American Development Bank, are assisting Central American governments to expand options for natural gas imports through multilateral workshops, technical assistance, capacity building and feasibility studies.

All told, in 2016 the Caribbean and Central America consumed only 0.27 Bcf/d (2.08 million tons per annum (mtpa)) of LNG, amounting to just 0.8 percent of global supply.³⁶ According to a report by the Oxford Institute for Energy Studies, the total potential market for LNG in the region is about 2.4 Bcf/d (17.9 mtpa), nearly nine times the volume consumed in 2016.³⁷ That forecast assumes all coal and petroleum generation would be replaced with LNG, which is an unlikely scenario. McKinsey Energy Insights projects that regional demand will reach 0.6 Bcf/d by 2025, mostly driven by current projects in Panama and new gas-fired power generation in Puerto Rico.³⁸

Additional LNG projects have been proposed or are under construction. At the same time, new strategies involving small-scale shipping via FSRUs are being developed to overcome the financial and infrastructure challenges these small countries face in making natural gas a feasible option. Shipping LNG cargoes on a small-scale vessel such as an ISO container allows the vessel to make multiple stops to offload portions of its cargo to small-demand markets, lowering shipping costs by dividing them among customers and providing a smaller supply option. According to McKinsey Energy Insights, such so-called "milk runs" could cut shipping unit costs by nearly 50 percent.³⁹ AES

is developing two projects in the Caribbean based on the small-scale distribution model. Additionally, FSRUs are being developed with smaller capacities to cater to such markets. FSRUs also offer the advantage of demand flexibility and leasing, enabling small countries to avoid the financial burden of developing a permanent onshore regasification facility, which is more costly and may be underutilized. Some Caribbean and Central American countries, such as Puerto Rico and El Salvador, are looking at utilizing FSRUs for gas imports.

At present, the key regional markets for US LNG are the Dominican Republic, Puerto Rico, Jamaica and Panama.

DOMINICAN REPUBLIC

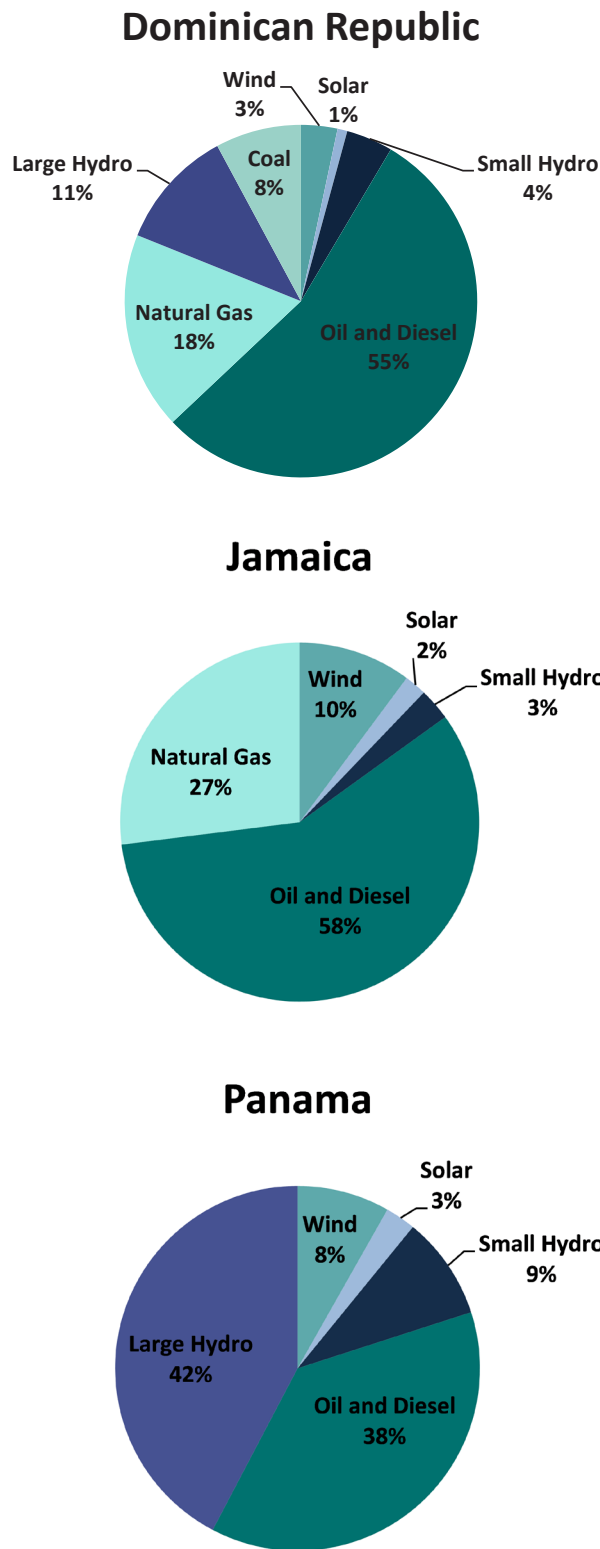
In the Dominican Republic, more than half of power generation is fueled by petroleum products, while natural gas represented 18 percent of the fuel generation mix in 2016, according to the International Energy Agency (IEA). The country received the first LNG shipment to its AES-owned Andrés terminal, which supplies natural gas to two power plants, in 2003. LNG demand growth was slow as petroleum products offered a cheaper option for electricity generation. In 2015, AES reconfigured the Andrés terminal to reload LNG for small-scale shipments to nearby Caribbean islands, as part of a strategy to develop a "hub-and-spoke" market to supply the Caribbean and Central America. The first reload shipment at Andrés took place in February 2017. The company intends to create new regional demand for natural gas by making small volumes available to markets not large enough to build a full-scale LNG terminal. If this strategy works for AES, US LNG could begin replacing petroleum as the generation source for many small island markets in the Eastern Caribbean.

Since 2016, the Dominican Republic has received three LNG shipments from Cheniere's Sabine Pass terminal.⁴⁰

Most Caribbean countries depend on expensive petroleum based fuels for power generation, leading to some of the highest electricity prices in the world.

FIGURE 10: ELECTRICITY GENERATION BY FUEL SOURCE, 2016

Source: US International Energy Agency, Energy Transition Initiative



A second import facility, the Antillean Gas Terminal, is currently under construction. An agreement was reached in 2015 to supply this terminal as well with US gas from Sabine Pass.⁴¹

PUERTO RICO

Energy consumption in Puerto Rico has changed rapidly in recent years as the island lessens its dependency on petroleum-based generation. Puerto Rico is examining further potential changes to its electricity generation mix as it rebuilds after last year’s devastating Hurricane Maria. As recently as 2011, petroleum accounted for about 80 percent of electricity generation, although in 2016 this figure fell to 47 percent, while natural gas represented 34 percent of generation.⁴² Puerto Rico’s only LNG import terminal opened in 2000, on the south side of the island in Peñuelas. A second import terminal, the Aguirre Offshore GasPort

Project, is proposed by Excelerate Energy as an FSRU off the southern coast. The project, planned since 2008, has been delayed by environmental and legal issues. In August 2017, as a result of the bankruptcy filing of the public utility, PREPA, Excelerate cancelled the contract. However, the company maintains the project is still in the works and claims it will enter service in 2019.⁴³

Hurricane Maria struck Puerto Rico on September 20, 2017, cutting power to more than 1.5 million people and destroying much of the island’s electricity transmission infrastructure. The island is now in a slow recovery, and steps are being taken to reevaluate the electrical grid and improve its resiliency in the event of future hurricanes or natural disasters.⁴⁴ This effort could impact the electrical generation mix and significantly increase natural gas consumption in place of petroleum.

Puerto Rico’s status as a US territory complicates matters somewhat. Under the Merchant Marine Act of 1920, familiarly known as the Jones Act, the shipment of goods between two US ports must be carried out on US-flagged vessels. Currently, there are no US-flagged LNG vessels, thus prohibiting any shipments of LNG from the mainland directly to Puerto Rico. Instead, Puerto Rico is supplied with LNG from Trinidad and Tobago. In the aftermath of Hurricane Maria, a Jones Act waiver was issued for Puerto Rico, allowing goods to flow on foreign ships. The decision to extend the waiver temporarily or permanently is still being debated. A permanent Jones Act waiver for Puerto Rico would open the door for US LNG to replace foreign-supplied gas.

JAMAICA

Jamaica has historically relied heavily on petroleum for electricity generation. In 2015, petroleum accounted for 90 percent of fuel use, with renewables representing the remaining 10 percent, but in 2016 natural gas made up more than a quarter of generation. Jamaica attempted to import LNG as early as 2004, but such efforts ran into repeated roadblocks with supply countries and project economics. In November 2015, Jamaican power utility JPS signed a supply agreement with US-based New Fortress Energy (NFE) to supply the 120 MW Bogue power plant with natural gas. NFE initially planned to supply the island with small-scale ISO cargoes from its Florida facilities, but the firm eventually decided on conventional cargoes instead, and the first LNG was supplied to the plant in 2016. In January 2018, NFE signed a 15-year contract with Golar LNG Partners to charter an FSRU in Jamaica. The imported LNG will fuel the upgraded Bogue plant and the new 190 MW Old Harbour Bay power plant, which is scheduled to come online in 2019. NFE has also signed an agreement for construction of a third natural gas power plant in Clarendon, with construction slated to begin this year.⁴⁷ When the plant is completed, Jamaica will have 404 MW of natural gas-powered generation, comprising approximately 44 percent of the country's total electricity generation capacity.

In addition to new gas-fired generation, Jamaica is urging the industrial sector to transition its fuel consumption to natural gas. Jamalco, a bauxite company, and the Heineken-owned Red Stripe brewery have signed natural gas supply deals with NFE as they transition from petroleum-based fuels.⁴⁸

NFE has also expressed interest in creating an LNG hub in Jamaica to supply other islands. The company has the supply and infrastructure lined up but would face competition from similar strategies being deployed by AES in the Dominican Republic and Panama. NFE has signed long-term agreements to supply Jamaica with LNG for three power plants, establishing a heavy US presence in the Jamaican energy transition.

PANAMA

Panama's domestic energy needs, combined with its strategic location, create a unique opportunity for growth in the country's LNG sector. Panama currently consumes no natural gas for electricity generation, relying mostly on hydroelectric generation with some petroleum and coal

Central American countries face a number of barriers to importing LNG, including difficulty accessing financing and questions about offtakers' ability to pay.

capacity. Electricity demand is expected to increase at a rate of 6 percent per year until 2030, mostly due to the Panama Canal expansion. The Panamanian government's 2015-2050 National Energy Plan calls for introducing natural gas-powered generation to the electricity mix, bringing gas from zero to 49 percent of the total by 2050.⁴⁹

In 2015, AES was awarded a contract in a competitive bidding process to construct a 380 MW combined-cycle power plant, along with an LNG terminal and storage tank, near the Caribbean entrance of the Panama Canal, in Colón. The facility began testing in January 2018 and should be online later this year. AES signed a joint venture agreement with France's Engie to market and sell LNG to countries throughout Central America from the LNG terminal, dubbed Costa Norte.⁵⁰ Most of the gas sold from Costa Norte will be sourced from the United States via the Cameron LNG project, which is scheduled to come online this year. Similar to the operation that AES established in the Dominican Republic, it is embracing the "hub-and-spoke" market strategy with its Panama facility, aiming to create new regional natural gas demand by importing large LNG cargoes and sending out smaller shipments to nearby Central American and Caribbean markets. Together with AES' Dominican Republic LNG facility, Costa Norte will give AES a combined capacity of 0.4 Bcf/d (3 mtpa) to supply smaller Caribbean and Central American markets with US-produced LNG.⁵¹ Panama could also export electricity from gas-fired power plants to other Central American countries through SIEPAC.

In 2015, Chinese-owned Martano Inc. secured another deal to construct a 400 MW combined-cycle gas power plant in Panama. The project is expected to come online in 2020 and will be sourced by LNG from Australia.

Other Central American countries such as El Salvador and Honduras are also exploring LNG options. In 2013, El Salvador awarded a contract for the construction of a

355 MW natural gas power plant, with Royal Dutch Shell the expected supplier of LNG via an FSRU. However, plans for this project were delayed, and the country is now considering an FSRU to avoid building expensive regasification infrastructure. El Salvador is looking to increase the use of compressed natural gas for vehicles, which would expand the natural gas market in the country. Honduras has asked the IDB to carry out a feasibility study for LNG.

South America

South America currently represents only 5 percent of global LNG demand, but it remains an attractive market for US sellers. Many countries on the continent are significant natural gas producers, but statist energy policies have dissuaded upstream investment, causing gas production declines. At the same time, political tensions between countries have deterred energy trade. As a result, regional producers' ability to supply their less-endowed neighbors has been limited. The mismatch between demand and domestic production in Brazil, Argentina, Chile and Colombia has led all four countries to rely on LNG to varying degrees, and US sellers are well positioned to compete in those markets.

BRAZIL

Brazil, South America's giant, accounts for half of all power demand on the continent. The country has historically

relied on hydro, which accounted for 65 percent of power generation in 2016.⁵² That same year, natural gas accounted for just 9 percent of power generation. In 2015, the power sector represented 39 percent of total gas demand – about the same as industry.⁵³ Domestic production of natural gas averaged about 3.9 Bcf/d in 2017, and production has been rising as Brazil continues to develop its natural gas resources, particularly in the country's giant offshore presalt fields.⁵⁴ The oil industry reinjects a large amount of produced gas to boost crude output, both because producers prioritize oil and because a lack of pipeline infrastructure makes it difficult to bring the gas to shore. In 2017, gas reinjection accounted for about 25 percent of gross production, an amount that exceeds pipeline imports from Brazil's main gas supplier, Bolivia. Utilization of two existing offshore pipelines and a third pipeline under construction will bring more gas to market.⁵⁵

Brazil has an import contract with Bolivia for supply of up to 1.0 Bcf/d, although Brazil opted to decrease this amount to 0.5 Bcf/d in February 2017.⁵⁶ The supply contract with Bolivia expires in 2019, and the two countries are already reported to have begun talks about renegotiating the deal. Brazil is widely expected to seek lower pipeline volumes from Bolivia due to increased domestic presalt production. That shift would open up gas supply from Bolivia to Argentina and potentially lower Buenos Aires' need for LNG imports.

Weak rainfall in 2012-2015 led to increased natural gas consumption for power generation as hydro generation

FIGURE 11: NATURAL GAS SUPPLY IN BRAZIL

Source: Brazilian Ministry of Energy and Mines, IHS Markit

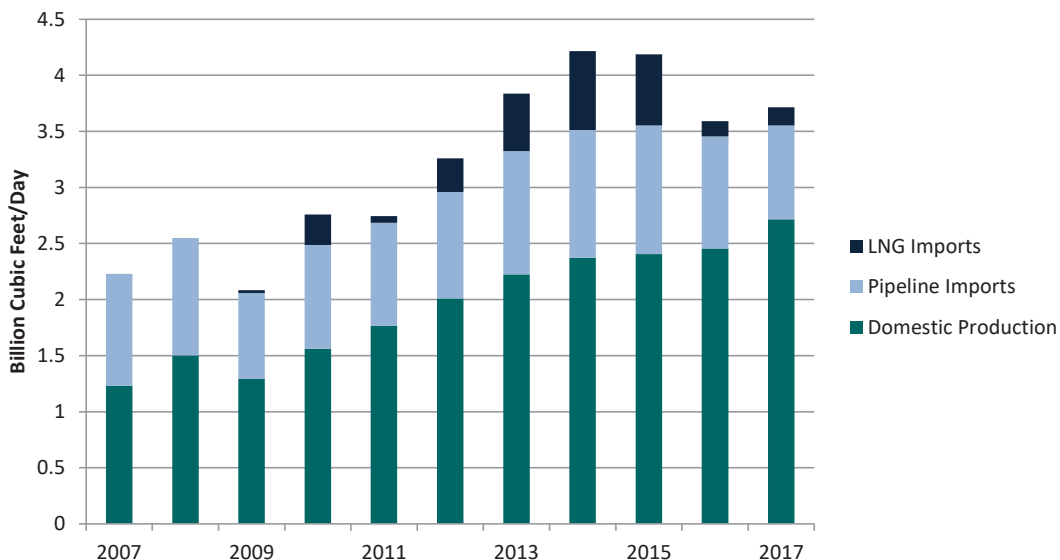
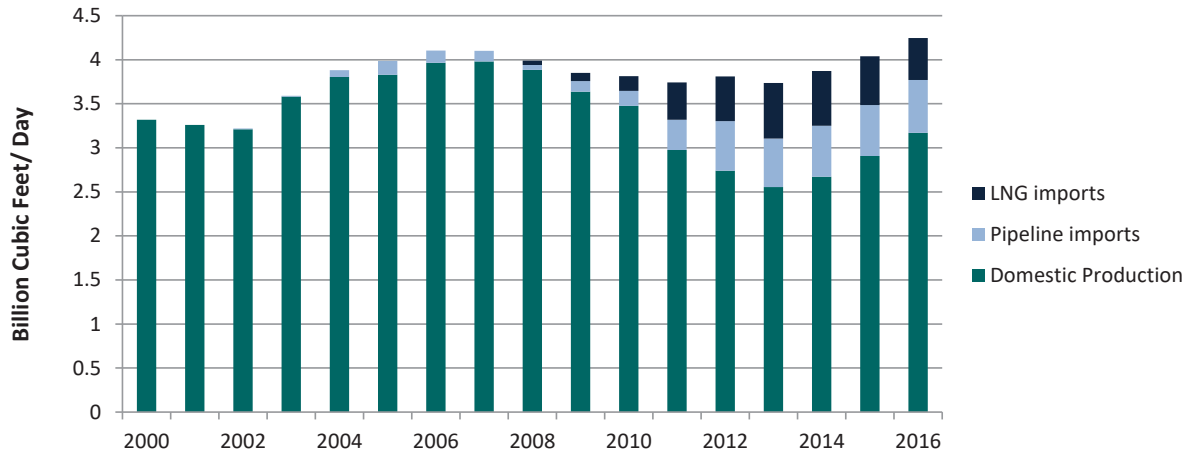


FIGURE 12: NATURAL GAS SUPPLY IN ARGENTINA

Source: Argentine Ministry of Energy and Mines



waned, which necessitated increased LNG imports. Increased rainfall in 2016, coupled with the second year of a sharp economic recession, led to lower gas demand for electricity. In 2017, overall LNG imports remained lower compared to 2012-2015; however, Brazil imported five LNG cargoes from the United States, as LNG supply from Sabine Pass ramped up.⁵⁷ More LNG is expected to flow from the Gulf Coast as new supply comes online and Brazil's natural gas demand grows.

For Brazil, LNG is mostly used as a source of backup power generation when electricity demand exceeds generation capacity of hydro and other renewable sources. For this reason, Brazil only purchases LNG on the spot market when needed. State-controlled oil and gas producer Petrobras is currently Brazil's only importer of LNG, with two operating FSRUs at Pecém and Bahia in the north of the country. A third terminal at Guanabara Bay near Rio de Janeiro is currently idle and without an FSRU.

However, Petrobras' long-term role as an LNG importer is in question. After a massive bribery and kickback scandal at the firm came to light in 2014, leading to asset write-downs and financial losses, Petrobras has sought to divest non-core assets. Chief Executive Pedro Parente, who took over the firm in 2016, has publicly expressed a desire to get out of the LNG business. But there has been no obvious movement in that direction.

Other non-state companies are mulling new regasification terminals that would involve LNG-to-wire projects for electricity generation and industrial use. The project most likely to come online is the Sergipe project, which has a contract for construction of a 1.5 gigawatt natural gas

power plant. The plant would be supplied by Ocean LNG, which is a joint venture of Qatar Petroleum and Exxon Mobil, and QP has said deliveries of LNG could begin in 2020.

Many more proposals are on the table, including offtake agreements with US exporters. The Brazilian government is showing support for these import projects through its "Gas to Grow" campaign, which calls for building up to seven LNG terminals by 2020.⁵⁸ Hydro capacity in Brazil is fully developed, so any growth in baseload power demand is likely to be met by natural gas, especially LNG as domestic production is expected to grow at a slower pace than demand. According to IHS Markit, LNG demand could increase nearly six-fold from 2017 to 2027.⁵⁹ Since Brazil does not have any long-term LNG supply contracts, US LNG would have to compete on the spot market with many other global suppliers including Trinidad and Tobago, Nigeria and Qatar.

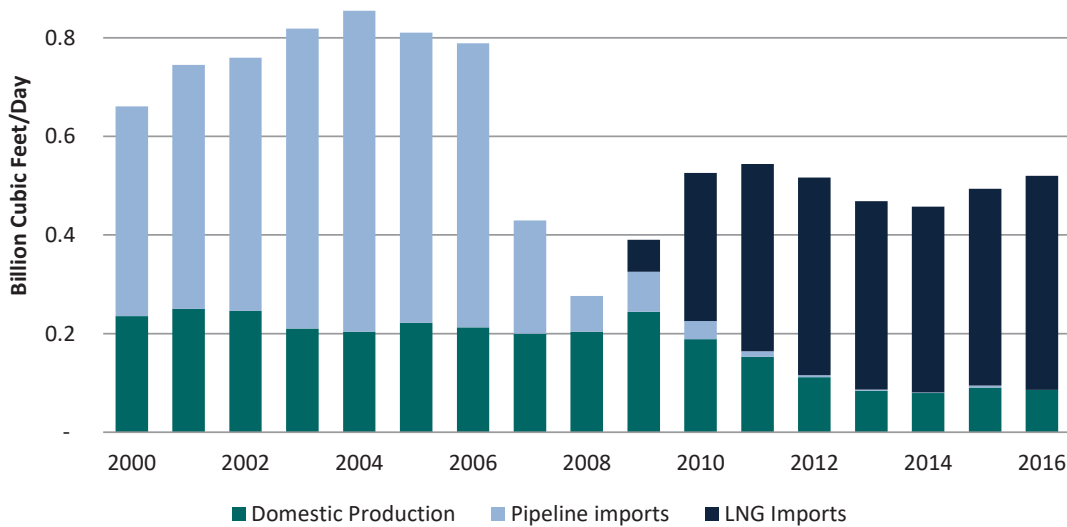
ARGENTINA

Argentina is a significant natural gas producer with enormous shale gas resources in the Neuquén Basin's Vaca Muerta formation and elsewhere. However, development of these resources is only now starting to hit its stride after President Mauricio Macri, who took office at the end of 2015, began dismantling energy price and foreign exchange controls that had been in place since Argentina's 2001 default and economic crisis.

After the end of Argentina's recession, gas consumption boomed, growing 60 percent between 2002 and 2016, largely due to economic expansion and government gas price subsidies. Today, electric power generation represents

FIGURE 13: NATURAL GAS SUPPLY IN CHILE

Source: Comisión Nacional de Energía, IHS Markit



about 35 percent of gas consumption, while industrial and residential demand represent 26 percent and 23 percent, respectively.

Argentina currently has two active FSRU terminals. The country’s first LNG imports arrived in 2008 at the Bahía Blanca terminal, while the second LNG terminal, in Escobar, was commissioned in 2011. Both facilities are located in the province of Buenos Aires. LNG is purchased on the spot market. At first, LNG imports were concentrated during the Southern Hemisphere’s winter months, but over time year-round deliveries became necessary as gas subsidies inflated demand even as domestic production fell.

Argentina relies on pipeline gas imports from Bolivia via a contract that expires in 2026. An agreement was reached in 2010 to gradually increase Bolivian imports by about 70 percent by 2021. However, the future of Bolivian supply is uncertain. Bolivia’s own demand has grown strongly in recent years, while new production has been slow to come online, and Bolivia’s export contract to Brazil takes precedence over other commitments. As a result, Bolivia has often been unable to meet the contractual volumes that it is supposed to send to Argentina. The shortfall of Bolivian gas has led Argentina to import gas via pipeline from Chile in recent years during months of peak winter demand.

Two additional FSRU projects have been proposed, but progress has been slow. One terminal planned by state LNG importer Enarsa would be an FSRU located near Bahía Blanca, with service potentially beginning in August 2018.

A second terminal, proposed by state-controlled oil and gas producer YPF, would be located near the existing Escobar terminal and is slated to come online between 2018 and 2020. It is highly unlikely that both projects would be built, due to concerns about excess capacity.

LNG supply to Argentina has come from a variety of countries via the spot market. In 2017, Qatar, Equatorial Guinea, and Trinidad and Tobago supplied a majority of Argentina’s LNG deliveries, while the US provided five cargoes from Sabine Pass. LNG demand in Argentina is expected to decline over time as domestic production from Vaca Muerta and other areas picks up speed. Output has been trending upward since 2014, and increased industry activity indicates more production increases in the near term. Wood Mackenzie projects that gas output from Vaca Muerta could exceed 0.67 Bcf/d by next year – around triple the 2017 level – and surpass 3.5 Bcf/d by 2026. Even with such growth in domestic gas production, LNG will likely continue to play a role in meeting peak winter demand going forward, and growing US LNG supply may push out shipments from other countries.

CHILE

Unlike many countries in South America, Chile lacks an abundance of natural hydrocarbon resources, relying on fuel imports to satisfy its energy needs. Argentina’s 2004 decision to largely cut off gas exports to Chile had a devastating effect, forcing the country to sharply restrict power usage until newly built LNG terminals could take up

the slack. Despite the fact that Chile borders Bolivia, with its abundant gas resources, Bolivian anger over the 1879-84 War of the Pacific, in which Chile seized all of Bolivia's coastline, has prevented development of a bilateral gas trade.

Coal and hydro together fuel most of Chile's power generation, but 61 percent of natural gas imported to Chile goes to the power sector.⁶⁰ Chile is likely to continue to expand LNG imports, with oil-fired generation transitioning to gas. Public opposition to large-scale hydro projects will also push Chile in the direction of greater reliance on gas-fired power plants, while residential and industrial demand for gas is expected to grow as well. Other renewable energy sources, particularly solar, are also growing rapidly.

Chile has two active LNG import terminals, in Quintero and Mejillones, which have operated since 2009 and 2010, respectively. The Quintero facility has been expanded once, with another capacity expansion proposed for the early 2020s. Mejillones is also being considered for expansion. Multiple new LNG terminals have been proposed for other parts of the country, but as with other LNG projects, not all proposals are likely to be completed.

Trinidad and Tobago has been Chile's primary supplier of LNG, providing 90 percent of the country's imports in 2015. However, with the onset of US LNG supply, volumes from Trinidad and Tobago have declined; in 2016, the United States accounted for 18 percent of Chile's total LNG imports.⁶¹ US deliveries to Chile will likely grow significantly in the future, as Chilean buyers have signed offtake agreements for the Corpus Christi and Cameron LNG facilities on the US Gulf Coast, which are set to begin operation by the end of next year.

COLOMBIA

Colombia relies on hydro to generate some 85 percent of the country's electricity. Natural gas production peaked in 2013 but has fallen since, with upstream investment stalling as companies pulled back following the 2014 plunge in oil prices. As a result, Colombia has transitioned from a net exporter to a net importer of natural gas.

Plans to import gas by pipeline from Venezuela have been under discussion since 2012, but given the political turmoil in Venezuela and the collapse of that country's energy sector, gas is unlikely to flow any time soon. In 2016, Colombia commissioned its only existing LNG terminal, in the Caribbean port of Cartagena. LNG is purchased on

the spot market and stored in two onshore storage tanks, which are utilized to provide intermittent supply for power generation based on the availability of hydropower. Since the facility opened, it has taken only two LNG cargoes, both from Trinidad and Tobago.

LNG imports are expected to increase slowly as domestic demand grows and production continues to decline. IHS Markit projects imports to plateau at 0.3 Bcf/d around 2028.⁶² The proximity of the Cartagena terminal to the US Gulf Coast creates a potential market for US exports as Colombia's appetite for LNG expands. In the short term, Colombia may rely on intermittent conventional shipments or look to Panama for small-scale supplies to meet seasonal demand.

Conclusion

The next few years will see a major shift in the hemispheric natural gas trade, as increased US LNG exports increasingly displace volumes from other exporters. Technological developments in small-scale and floating LNG, as well as a move toward more flexible contract terms, are making the regional gas market more liquid and allowing new markets to open up. Prices and distance from supply will mostly determine where US LNG cargoes end up.

However, policy may affect the LNG market as well. The Trump administration has taken an aggressive approach toward energy exports and helped American companies sign supply deals across the globe while continuing technical assistance on natural gas policy to neighboring countries. At the same time, the uncertainty over free-trade agreements is unfavorable to US gas exports. These policy dynamics could have significant implications for LNG exports to Latin America and the Caribbean in the short term.

Conditions in Latin American and Caribbean countries are a key variable. Will the countries with major gas reserves succeed in their efforts to boost production? Will concerns over climate change in the long term lead to a boom in non-hydro renewable energy generation, ultimately displacing gas? Will regional integration of gas and electricity trade expand, creating commercial opportunities to import US LNG in some countries while reducing the need for US gas imports in others? These issues will determine the extent to which Latin America becomes the next big market for US LNG exports.

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