

Mexico's Role in Sustaining the North American Petroleum Renaissance

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July 2018



ABOUT THIS REPORT

This report is part of the Energy Policy Research Foundation's multi-year research program evaluating the scale and scope of the North American petroleum renaissance. U.S. oil and gas producers are well integrated into the entire North American energy production and distribution platform. As U.S. producers expand oil and gas production, accompanied by increasing volumes of associated gas, access to the Mexican market remains an essential outlet for the long-term growth of U.S. natural gas production. This report provides an assessment of the Mexican market for that natural gas as well as the challenges and opportunities that Mexico's evolving energy sector face as it addresses its own set of infrastructure constraints and political disputes over energy policy. U.S. producers, and U.S. energy security, are not strictly domestic issues, but also rely upon on a long-term and stable trade relationship with Mexico.

Lucian Pugliaresi, President

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EPRINC has been a source of expertise for numerous government studies, and both its chairman and president have participated in major assessments undertaken by the National Petroleum Council. In recent years, EPRINC has undertaken long-term assessments of the economic and strategic implications of the North American petroleum renaissance, reviews of the role of renewable fuels in the transportation sector, and evaluations of the economic contribution of petroleum infrastructure to the national economy. Most recently, EPRINC has been engaged on an assessment of the future of U.S. LNG exports to Asia and the growing importance of an integrated North American energy market.

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INTRODUCTION

The close proximity between the United States and Mexico and growing cross-border infrastructure make Mexico an attractive market for U.S. natural gas producers in the Permian Basin. There are many benefits that result from the short distance between U.S. production centers like the Permian basin and the border states of Mexico, including affordable transportation costs in comparison to shipping gas to other countries. In recent years, there has been a rapid cross-border pipeline expansion from Texas to Mexico that has made the price of natural gas more competitive, as U.S. gas producers at the Permian basin can send their product to Mexico's growing natural gas market more efficiently.

This section of the report analyses Mexico's energy transition, and how midstream natural gas infrastructure is getting built in Mexico. It also describes the energy trade dynamics between the U.S. and Mexico. These are some of the identified key opportunities and risks in participating in Mexico's energy market:

Opportunities

- Liberalized energy sector
- Growing energy market
- Geographic proximity and logistics
- Cross-border pipeline interconnectivity and existing infrastructure

Risks

- AMLO's nationalist policies could undermine U.S. gas imports
- Infrastructure bottlenecks and capacity constraints
- Increased trade tariffs through a renegotiated NAFTA, and a disruption to the energy value chain between the U.S. and Mexico

ENERGY REFORM IN MEXICO

Mexico's state oil company, Petróleos Mexicanos (Pemex), was established in 1938 by then-President Lázaro Cárdenas who decided to expropriate all foreign owned oil assets in the country, nationalizing the energy sector. The creation of Pemex followed conflict over the nation's energy resources, and was seen as a national symbol. After many productive and successful years, Pemex experienced a steep decline in oil production and overall company productivity. Pemex went from producing 3.4 million barrels of oil per day (bpd) in 2004 to close to 1.9 bpd in 2017. The decline in production is mainly due to lack of investment going into innovative energy technologies, aging infrastructure, and inadequate business operations, largely caused by corruption.

President Enrique Peña Nieto passed an Energy Reform in December, 2013 which was

approved as secondary legislation in August 2014. The main objectives of the energy reform are to:

- Transform the natural gas model
- Enhance energy security
- Promote infrastructure development
- Establish a competitive gas pricing mechanism

Ultimately, the reform seeks to provide consumers with affordable, reliable, and clean energy. Since the passing of the historic energy reform, Mexico has sought to satisfy its growing energy demand by taking advantage of its newly liberalized energy sector. So far, the most economically sensitive way to satisfy its growing natural gas demand has been through U.S. imports via pipeline and to a lesser extent, LNG.

Over the years, Mexico has reduced its economic reliance on oil, substituting its energy demand with natural gas. Affordable natural gas prices from the U.S. have helped this energy transition, also leading to a decarbonization of Mexico's energy matrix.

Market conditions, tax reform, and a drop in oil prices are driving natural gas towards a larger role in Mexico's energy matrix, replacing oil in the electric sector and catalyzing an oil-to-gas fuel switch. This shift has boosted the competitiveness of renewable energy sources in Mexico. As a result, the country is on track to meet its renewable energy targets of increasing the share of renewable energy in the energy matrix to 35% by 2024. Without

affordable and abundant natural gas coming from the U.S., it is unlikely that this clean energy transition would have taken place as efficiently.

Mexico's natural gas reserves account for an estimated 545 trillion cubic feet and additional trillions of conventional reserves.¹ Abundant energy resources and a similar geologic characteristics to the U.S., especially in the Burgos Basin, make it an attractive location for green field projects in the years to come. The Burgos Basin, located South East from Texas, is an extension of the U.S. Eagle Ford Shale, one of the most prolific gas deposits in the world. The development of these resources will be more efficiently realized with U.S.-Mexico cooperation.

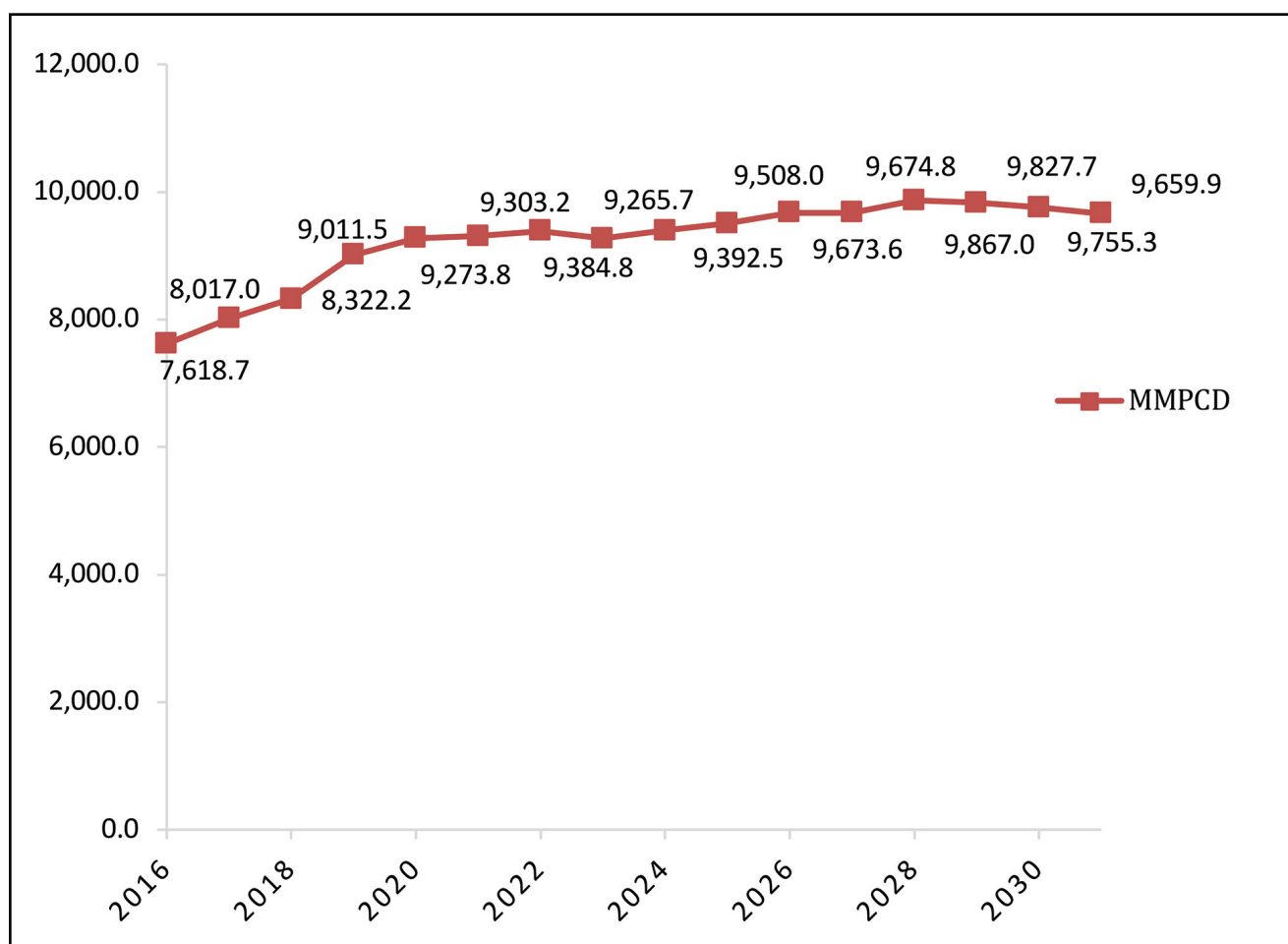


FACTORS DRIVING NATURAL GAS DEMAND

Mexico's energy demand is driven by a power sector thirsty for natural gas, as seen in the case study below. The Ministry of Energy estimates a 3.8 percent increase in average annual electricity demand for the next 14 years.² Mexico's energy infrastructure is being built through out the country both by private and public entities, strategically factoring in demand projections and additional electricity capacity requirements through out the country.

Mexico's energy ministry is adding significant natural gas-fired electricity generating capacity through 2031, replacing less efficient power plants that run on more carbon intensive types of fuels. The expansion of natural gas infrastructure has been a result of growing U.S. natural gas imports, and a decline in Mexico's energy production.

Figure I
Mexico Natural Gas Demand, 2016-2031 (MMcf/d)



Source: Data from SENER Prospectivas de Gas Natural 2017-2031

FACTORS DRIVING NATURAL GAS DEMAND continued

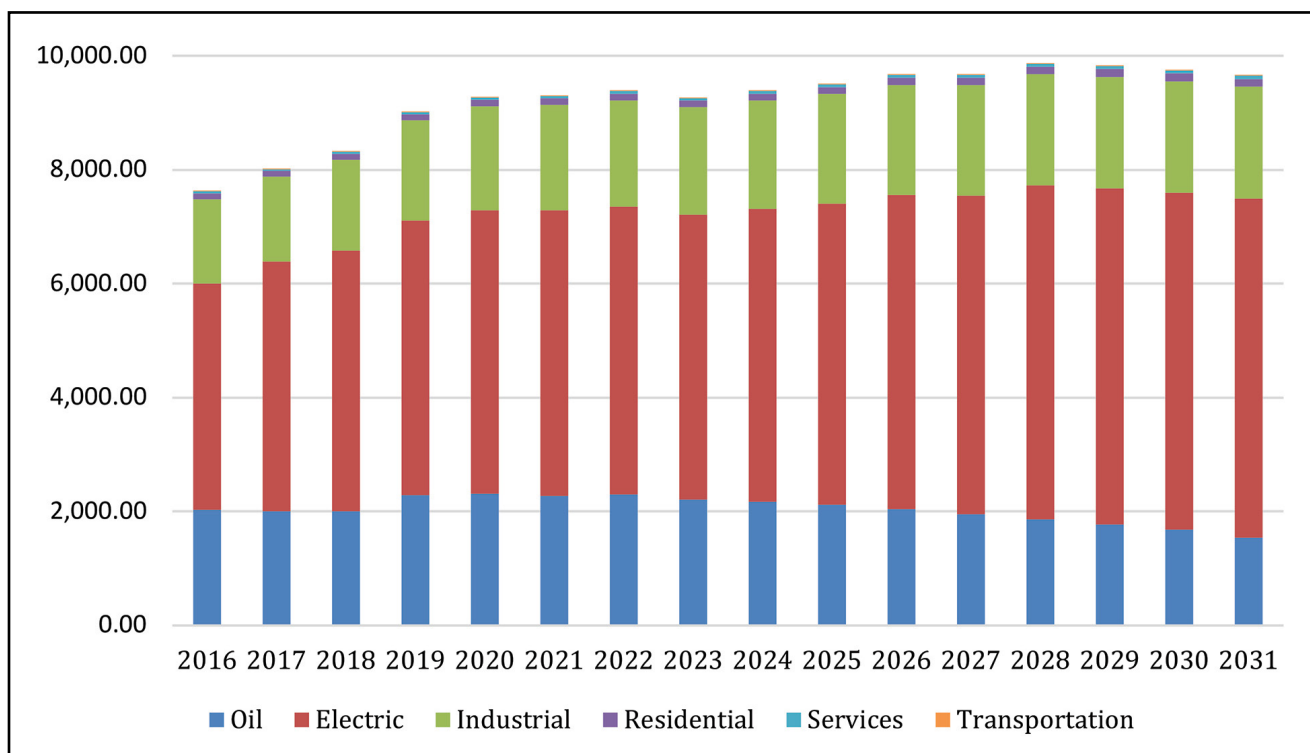
Sur de Texas- Tuxpan is under construction by a consortium between IEnova and TransCanada, and will have a capacity of 2.6 Bcf/d.³ This additional capacity will be enough to satisfy the projected demand demand growth in 2018-2019. La Laguna-Aguascalientes, Tula- Villa de Reyes, Villa de Reyes-Guadalajara, and Sur de Texas- Tuxpan, have all been adjudicated to the CFE and are projected to come online this year (Table 1).

The states that requested the highest additional pipeline capacity were Nuevo Leon (1.17 Bcf/d), Veracruz (0.83 Bcf/d), and Tamaulipas (0.66 Bcf/d).⁴ The interconnection between El Encino- La Laguna and the national distribution network will provide consumers along this corridor with access to natural gas coming from the Waha Hub in West Texas. This will also mean a higher capacity of gas flowing into the Northern region of Mexico. Helping the states of Monterrey and Tamaulipas meet their energy needs for both manufacturing and power generation.

A large part of the growing demand in Mexico is coming from the region of the Bajío in West North-Central Mexico, mainly because of the rapid industrialization that has taken place in the states of Jalisco and Guanajuato. As a result, CENAGAS has laid out recommendations to increase domestic pipeline interconnections, in order to further distribute natural gas throughout the country, which allows more gas to be imported from Texas.

Mexico's growing natural gas demand and domestic pipeline network expansion is driven by its power sector (Graph 1). Most of the downstream pipelines in Mexico that connect to an upstream cross-border pipeline are strategically built to feed into power plants. In addition, combined-cycle gas turbines (CCGT) have long-term contracts with CFE the utility state-owned company to increase the reliability and security of their natural gas supply and investments.

Figure 2
Natural Gas Demand by Sector, 2016-2031 (MMcf/d)



Source: Data from SENER Prospectiva de Gas Natural 2017-2031

A Case Study of the Topolobampo Combined-Cycle Power Plants in Chihuahua, Mexico

According to CFE's growth forecast, electricity demand in the Western region of Mexico will increase at an average of 4.8% annually.⁵ The energy regulatory commission approved a total capacity of 0.79 Bcf/d for the Western region in 2015 that is coming from the Permian basin. The Topolobampo II, a combined-cycle plant in the Mexican state of Chihuahua, is expected to enter operation in January 2019 and will have a total capacity of 778 MW that could consume about 0.1 Bcf/d of natural gas. A 34 km branch from the El Encino-Topolobampo pipeline will transport 0.25 Bcf/d of natural gas to the Topolobampo II and III combined-cycle plants in the state of Sinaloa.⁶ The two power plants will represent an additional capacity of 1,475 MW in the state of Chihuahua.⁷ Chihuahua is expected to reach 3,261 MW by 2030. The Topolobampo plants will be powered by natural gas coming from the Permian basin. The Topolobampo III combined-cycle plant with a 697 MW capacity will come online in early 2020.⁸

ENERGY TRADE BETWEEN THE U.S. AND MEXICO, NAFTA

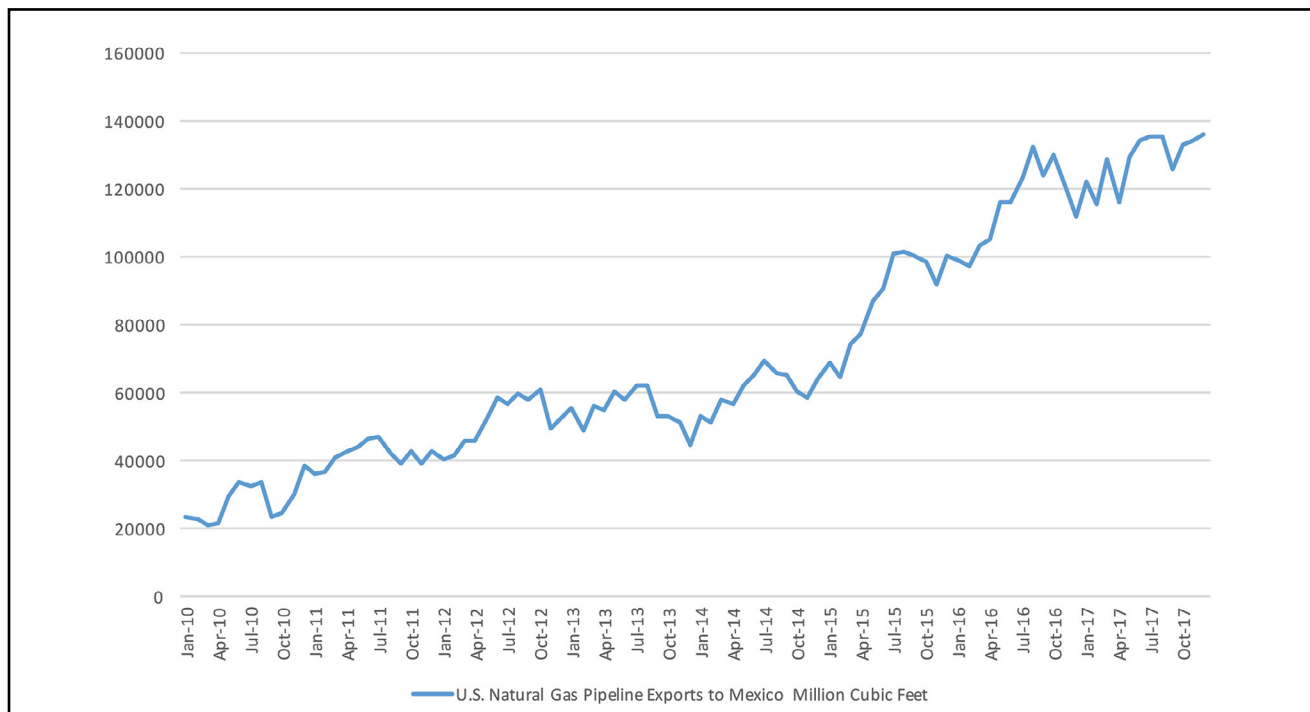
Mexico and the U.S. energy trade consists of three main exchanges. Mexico has abundant oil resources and has historically kept high production levels in comparison to other countries. It mainly ships its heavy crude oil to the U.S. for processing at the Gulf Coast Refinery in Texas. Consequently, it imports refined products from the U.S., including gasoline. In recent years, Mexico has reduced its economic reliance on oil, substituting its energy demand with natural gas. As previously mentioned, this has been in part due to falling oil production and an oil-to-gas fuel switch in the power sector. This trend has led to fewer Mexican exports of oil to the U.S.. At the same time, natural gas production in the U.S. has skyrocketed as a result of the shale revolution, and exports of this type of fuel have increased significantly over the last decade.

Mexico and the U.S. maintain a history

of strong economic integration that has been reinforced by NAFTA since 1994. Mexico is the United States' second-largest export market and third-largest trading partner. In 2017, the bilateral trade of goods and services totaled \$623 billion in 2017.⁹ Moreover, 6 million American jobs rely on trade with Mexico. Pipeline exports from the U.S. to Mexico went from 0.9 Bcf/d in 2010 to 4.5 Bcf/d in 2017.¹⁰ Mexico's readily accessible energy market has contributed to the United States emerging status as a net natural gas exporter.

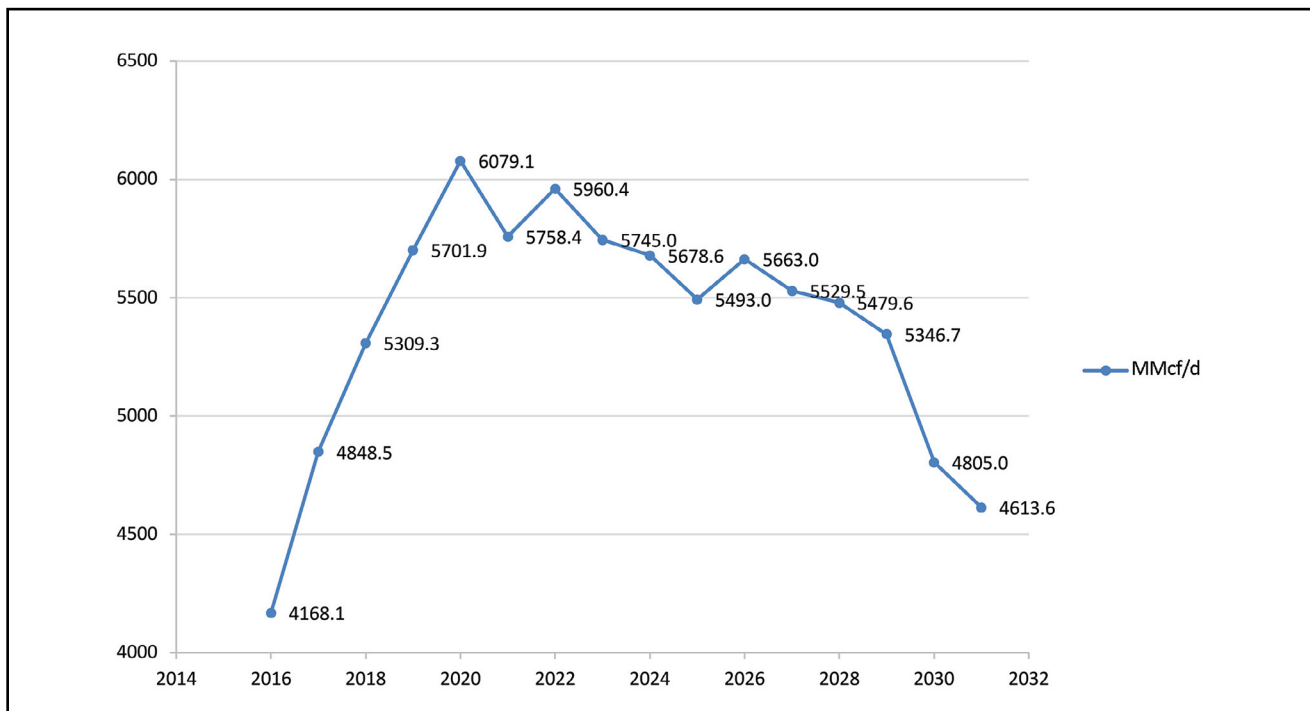
According to SENER's annual natural gas report, Mexico's natural gas imports are projected to rise up to 6079.1 MMcfd in 2018.¹¹ Falling to 4805 MMcfd in 2030 and continuing a downward trend from there on, as domestic production begins to take off.

Figure 3
U.S. Natural Gas Pipeline Exports to Mexico (Million Cubic Feet)



Source: Data from EIA

Figure 4
Natural Gas Imports, 2016-2031 (MMcf/d)



Source: Data from SENER Prospectiva de Gas Natural 2017-2031

MEXICO'S MIDSTREAM BUILD-OUT

Background and Context

Since the passing of the energy reform, Pemex has been gradually giving up its dominant position in the natural gas midstream segment. The company must release 70% of the volume of its gas supply portfolio. Data from Mexico's Energy Regulatory Commission (CRE) shows that the company has already lost 32% of the total gas it supplied in 2017.¹² Until recently, Pemex had close to absolute control over gas pipeline capacity that did not allow room for healthy market competition and discouraged the participation of other gas marketers.

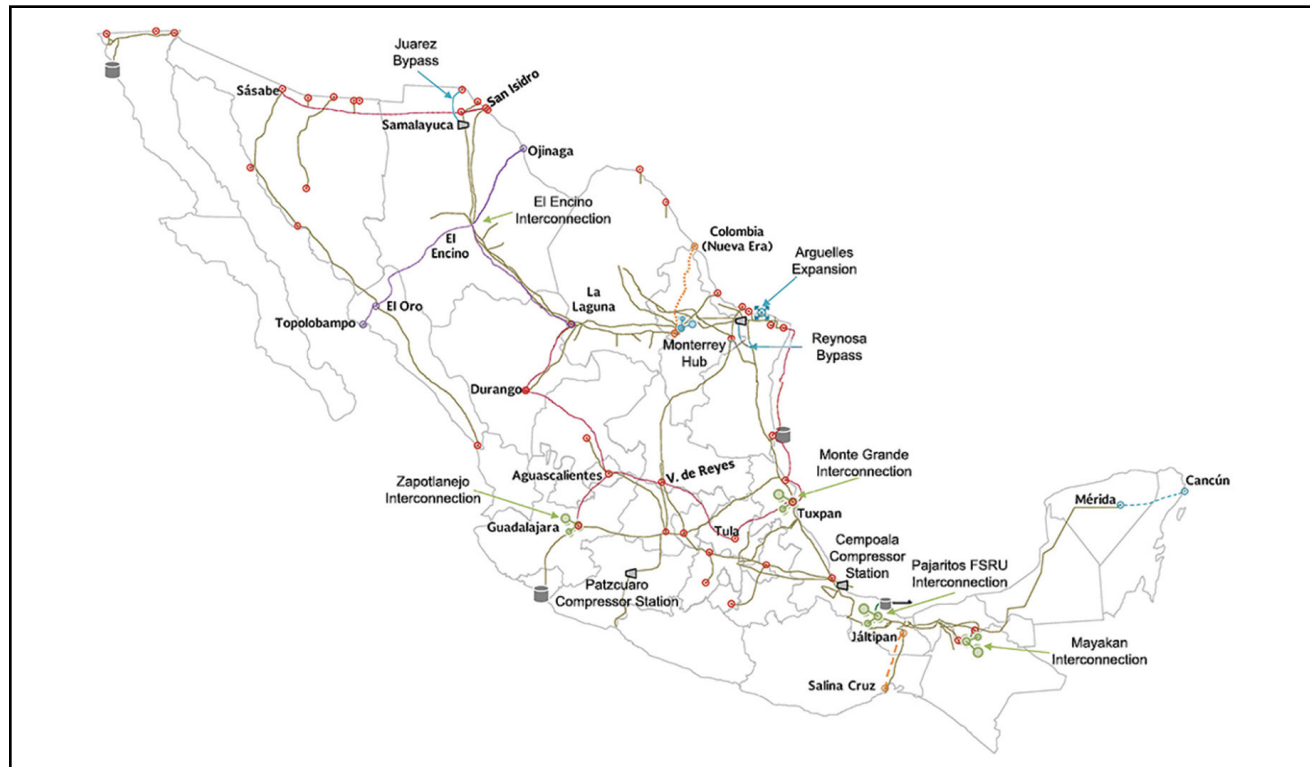
The CRE has taken several measures to create a more transparent and competitive energy market. On June 16, 2017 the regulatory agency removed Pemex price cap, allowing natural gas to be sold in the country on a competitive market basis. The elimination of this price cap has already led to an increase in natural gas production.

An important potential market for CFE is in pipeline capacity. CFE's current pipeline capacity is mainly used by big industry players such as the automobile and cement industries. In 2016, the industrial sector consumed a total of 124,385 GWh.

CFE's corporate objectives include maximizing the value of pipelines in two strategic ways. The company will seek a timely entry into gas pipeline operation that will capture fuel cost savings, enabling a more efficient generation.¹³ At the same time, the commercialization of the capacity of natural gas pipelines with third parties will allow for additional economic gains.

SISTRANGAS, operated by CENAGAS is the longest transportation system in Mexico, with a total length of 10,068 km.¹⁴ It supplies natural gas to 21 Mexican states. This system has a capacity of 6.4 Bcf/d at 27 injection points and 112 extraction points. Capacity contracts in this system are scheduled to be renewed this year.

Figure 5
Project Map for Third Annual Review of Sistragas 5-Year Plan



Source: Natural Gas Intelligence, Cenagas

Mexico's state power utility, Federal Electricity Commission (CFE) is the country's largest natural gas consumer driving demand in Mexico. CFE's fuel marketing business segment is managed by affiliated companies CFE international and CFEnnergia. CFE currently has 2,886 km of pipelines which is insufficient to satisfy rapidly growing demand in cities like Querétaro, Guadalajara, and Guanajuato, which currently have high electricity prices.¹⁵ In order to satisfy this growing demand, a total of 4,495 km of pipelines are under construction.

Mexico's midstream infrastructure projects

The current pipeline system is experiencing several bottlenecks, making it challenging to efficiently ship the natural gas from production

centers in West Texas to demand centers in Mexico, particularly in the Central and Central-West regions. Today's infrastructure constraints in the domestic pipeline network are partly a result of a neglect to the country's energy sector prior to the energy reform. While this problem cannot be fixed overnight, the progress made since the passing of the energy reform has been remarkable.

Mexico's energy ministry (SENER), laid out a five-year plan for the expansion of natural gas pipeline infrastructure. Mexico's domestic network now includes 12 additional pipelines (3,200 miles) with a total capacity of 9.7 Bcf/d.¹⁶ The Northeast and Central regions of Mexico have benefitted from an expansion of cross-border capacity and infrastructure build-out.

Table I
Strategic Projects in Development

Project	State	Length (km)	Capacity (MMcf/d)	Date of Operation
Tuxpan-Tula	Hidalgo, Puebla and Veracruz	283	886	Dec-18
La Laguna-Aguascalientes	Aguascalientes, Zacatecas and Durango	600	1,189	2018
Tula-Villa de Reyes	Hidalgo and San Luis Potosí	420	886	2018
Villa de Reyes-Guadalajara	Aguascalientes, Jalisco and San Luis	305	886	2018
San Isidro-Samalayuca	Chihuahua	23	1220	2017
Samalayuca-Sasabe	Chihuahua and Sonora	650	472	Nov-18
Sur de Texas-Tuxpan	Tamaulipas and Veracruz	800	2600	Oct-18

Source: Data from CENAGAS 3a. Revisión Annual del Plan Quinquenal de Expansión del Sistema de Transporte y Almacenamiento Nacional Integrado de Gas Natural 2015-2019

Mexico currently holds about 6 or 8 days of storage capacity, compared to the average OECD country that holds about 25 days.¹⁷ Natural gas demand in Mexico will continue to grow over the next decade, adding pressure to the already supply constrained regions that are already vulnerable to energy supply shortages. Further investments on storage capacity are vital to prevent disruptions and improve energy security in the country.

The lack of underground storage facilities in Mexico, has raised concerns among industry players, particularly in today's political environment and tensions over the renegotiation of NAFTA. In order to build resilience against potential shortages and external shocks, CENAGAS, has identified 15 potential sites for underground natural gas storage in empty basins distributed in the regions of: Burgos, Veracruz, and Macuspana- Muspac.¹⁸

ENERGY SECURITY CONCERNS

While Mexico realizes the economic and logistical benefits of importing gas from the U.S., the country also realizes the risk of becoming overly reliant on their neighbor north of the border. The close ties between the U.S. and Mexico's energy market make Mexico vulnerable to U.S. supply disruptions.

From late August to September of 2017, Hurricane Harvey in Houston affected U.S. Gulf Coast refining operations, driving some of them to shut down. This had implications for Mexico's fuel prices and availability due to the fact that Mexico is one of the largest buyers of U.S. refined products. U.S. gasoline exports to Mexico account for 80% of all Mexico's gasoline imports, mainly coming from the U.S. Gulf Coast refineries that can process Mexico's Maya heavy crude oil.¹⁹ Mexico has built three LNG import terminals that have helped maintain a short-term balance of supply, alleviating the risk of energy shortages in the country and external market shocks. "From February 2016 through December 2017, U.S. LNG exports to Mexico totaled 168 Bcf, or 19% of U.S. LNG exports, making Mexico the largest destination for U.S. LNG exports."²⁰ However, an increase in pipeline capacity over the last couple of years has begun to displace LNG exports to Mexico.

President-elect Andres Manuel Lopez Obrador

(AMLO), will carry efforts to maximize upstream domestic production. Regardless of this push, it will take close to a decade for production levels to reach a point that can substantially replace U.S. natural gas and gasoline imports. So far, the Mexican government's strategy has been to increase production gradually with a long-term view, as most energy projects take several years to materialize.

AMLO's nationalist views suggest that he would seek to improve energy security in the country by cutting U.S. imports and increasing domestic energy production. One of the ways in which he plans to raise gasoline production is by building two energy refineries in the states of Campeche and Tabasco, located in southeast Mexico. Each refinery will cost somewhere between \$6- \$10 billion dollars and take about two years to build.²¹

The refineries that exist in Mexico today are working at a little less than half their capacity, because of their poor operational state. Upgrading the ones that already exist, which are at their lowest production rates in 27 years, would be a better alternative than spending large sums of capital in new ones.²² Greater economic gains can be realized by investing in exploration and production than in building new refineries which have small margins and a high capex.

CONCLUSION

Since the passing of Mexico's energy reform, it has been Mexico's priority to expand its natural gas import capacity to bring cheap natural gas from the U.S.. The expansion of cross-border pipelines between Texas and Northern Mexico, as well as a rapid expansion in Mexico's domestic pipeline network, has been key in securing an affordable, reliable, and clean fuel source for both Mexican and U.S. consumers.

The bilateral energy integration between the United States and Mexico has made the North American continent more energy secure and independent. Increased energy independence in the region has been largely attributed to the U.S. shale revolution. However, the level of success that has been realized over the last decade would

have not been as effectively accomplished without Mexico as a close ally and trading partner. There are still several challenges for the continent to realize its full potential, but these challenges like energy infrastructure development, can be more easily solved by both countries working together.

Both countries can secure their own interests, while positively affecting the other, as has been the case through NAFTA. A stronger energy policy coordination approach through a renegotiated NAFTA could further improve energy trade dynamics between the U.S. and Mexico, reducing the risk of lower natural gas prices for U.S. natural gas producers in the Permian basin while increasing energy security for consumers in Mexico.

¹Technically Recoverable Shale Oil and Shale Gas Resources: Mexico. (2018, September). Retrieved April, 2018, from https://www.eia.gov/analysis/studies/worldshalegas/pdf/Mexico_2013.pdf

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³*Tercera Revisión Anual CENAGAS Plan Quinquenal de Expansión del Sistema de Transporte y Almacenamiento Nacional Integrado de Gas Natural 2016-2019* (pp. 12-61, Rep.). (n.d.). SENER Secretaría de Energía.

⁴Ibid.

⁵*PRODESEN Programa de Desarrollo del Sistema Eléctrico Nacional 2018-2032* (Rep.). (n.d.). SENER Secretaría de Energía.

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⁷Ibid.

⁸Topolobampo III combined cycle plant. (n.d.). Retrieved from <https://www.bnamericas.com/project-profile/en/central-termoelectrica-topolobampo-iii-central-de-ciclo-combinado-topolobampo-iii>

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¹³Principales Eelementos del Plan de Negocios 2018-2022. (2017). *Comisión Federal De Electricidad*. Retrieved May, 2018, from [https://www.cfe.mx/inversionistas/Documents/Plan de negocios/180223 CFE PDN 2018-2022 Publica.pdf](https://www.cfe.mx/inversionistas/Documents/Plan_de_negocios/180223_CFE_PDN_2018-2022_Publica.pdf).

¹⁴*Prospectiva de Gas Natural 2016-2030* (Rep.). (n.d.). SENER Secretaría de Energía.

¹⁵Principales Eelementos del Plan de Negocios 2018-2022. (2017). *Comisión Federal De Electricidad*. Retrieved May, 2018, from [https://www.cfe.mx/inversionistas/Documents/Plan de negocios/180223 CFE PDN 2018-2022 Publica.pdf](https://www.cfe.mx/inversionistas/Documents/Plan_de_negocios/180223_CFE_PDN_2018-2022_Publica.pdf).

¹⁶*Tercera Revisión Anual CENAGAS Plan Quinquenal de Expansión del Sistema de Transporte y Almacenamiento Nacional Integrado de Gas Natural 2016-2019* (pp. 12-61, Rep.). (n.d.). SENER Secretaría de Energía.

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¹⁸*Tercera Revisión Anual CENAGAS Plan Quinquenal de Expansión del Sistema de Transporte y Almacenamiento Nacional Integrado de Gas Natural 2016-2019* (pp. 12-61, Rep.). (n.d.). SENER Secretaría de Energía.

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²²Ibid.