MEXICO NATURAL GAS & LNG MARKET REPORT

August, 2019

Abstract

This report covers the natural gas & LNG markets in Mexico and its interconnectivity to global markets

Guillermo Suarez

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EXECUTIVE SUMMARY

The Mexican government has been facing several missteps in their policy decisions regarding oil and gas, however recent developments have made Mexico a strong choice with a wide berth of possibilities for potential investments in the private sector, with several avenues existing to bypass the government altogether and work directly with private companies. This change comes after many of the energy sector development plans were stopped and/or delayed after the new government leadership questioned or disallowed many of the rules and regulations that were the hallmark of the previous administration's Energy Reform. One of the biggest impediments was the stoppage of the upstream bidding rounds and the participation of private oil and gas companies in the Mexican energy sector.

The initial attitude of the new Government was to restore power back to the national oil company Pemex and the Federal Electricity Commission (CFE). This decision caused further deterioration in domestic oil and gas production, demonstrating to the Mexican Federal Government that they cannot operate without the participation and support of private companies. Last April 30th at the annual National Petroleum Convention organized by the Mexican Association of Hydrocarbons Enterprises, Rocío Nahle, the Energy Minister, and Alfonso Romo, Head of the President's Office, recognized that Pemex needs the collaboration, expertise, and support of world-class oil and gas companies, along with significant new sources of capital if they intend to reverse declining production and reserves. The Ministry of Energy (SENER) is evaluating the new ventures and mechanisms that will come through the farm out association programs with Pemex. They will likely move around sharing expertise and the supply of qualified manpower and capital.

One of the biggest hurdles for the development of unconventional gas resources is that President López Obrador promised that he would not allow fracking during his term, which would make it impossible to generate tight oil reserves. However, this issue is now under the scrutiny of the new Pemex officials and the Mexican Petroleum Institute and they will reach a technical verdict around November of 2019.

Another additional point of discussion in this update is the pipeline construction delay due to land ownership struggles and the new natural gas supply opportunities that arise from this.

In the international scenario, there have been many changes regarding the LNG markets and players that affect supply in Mexico. There are additional business opportunities for potential traders and investors in Mexico addressed by this updated report with information about the new Free Trade Agreement to be confirmed by the Governments of Mexico, Canada and the United States.

Background

The first step taken towards the Mexican Energy Reform was achieved in 1995 when natural gas trading, transport, distribution and storage activities were open for private industries. Natural gas exploration and production activities were reserved for PEMEX only. By the time the 2013 Energy Reform was approved, Mexico had already acquired 18 years of experience in dealing with fuel-related activities in regulation and operation. Business opportunities for private companies are now open throughout all the value chain in an open market.

The present study was prepared bearing in mind the complex global natural gas markets. Natural gas in gaseous state is transported through pipelines and in the case of North America, most systems are physically interconnected between Canada, the U.S. and Mexico. For this reason, the three countries were analyzed together, including particular details for each specific market.

Regarding liquefied natural gas (LNG), the market analysis was made globally since this fuel moves by sea-borne ships with very complex logistics including port storage and inland trucking. In Mexico LNG is stored at three port terminals and then re-gasified, compressed and injected into the natural gas pipeline system: Energía Costa Azul (Sempra Energy/IEnova capacity = 1.3 BCFD) in Baja California, Altamira LNG Terminal (Vopak/Enagas capacity = 545 (million cubic feet per day, MMCFD) in Tamaulipas and the KMS Terminal (Korea Gas, Mitsui, Samsung capacity = 500 MMCFD) in Manzanillo, Colima.

The Pajaritos, Veracruz interconnection point to the System requested by PEMEX TRI, will arrive to Mexico by means of a Floating Storage and Regasification Unit (FSRU) with a capacity of 390 MMCFD and is scheduled to start operations in January 2019. On July 20th, 2018 Mex Gas Supply –subsidiary of PEMEX- made an announcement to increase the FSRU to 600 MMCFD. The project includes a pipeline system that will interconnect with the National System of Natural Gas Transport (SISTRANSGAS) grid aiming to solve the supply crisis in southern Mexico. In June 21, 2019, PEMEX cancelled this project although there are at least 12 companies interested in the deal. The business opportunity to rescue the FSRU project for the time being consists in approaching Energía Mayakán that already supplies 250 MMCFD of natural gas by pipeline to the Yucatán Peninsula seeking partnerships thus bypassing PEMEX. Mayakán has a pipeline system ending at the CFE plants in Valladolid and is planning to extend to Cancún, in the State of Quintana Roo for which they are planning to call for an open season to increase their throughput to 500 MMCFD (see the FSRU analysis in Annex 4).

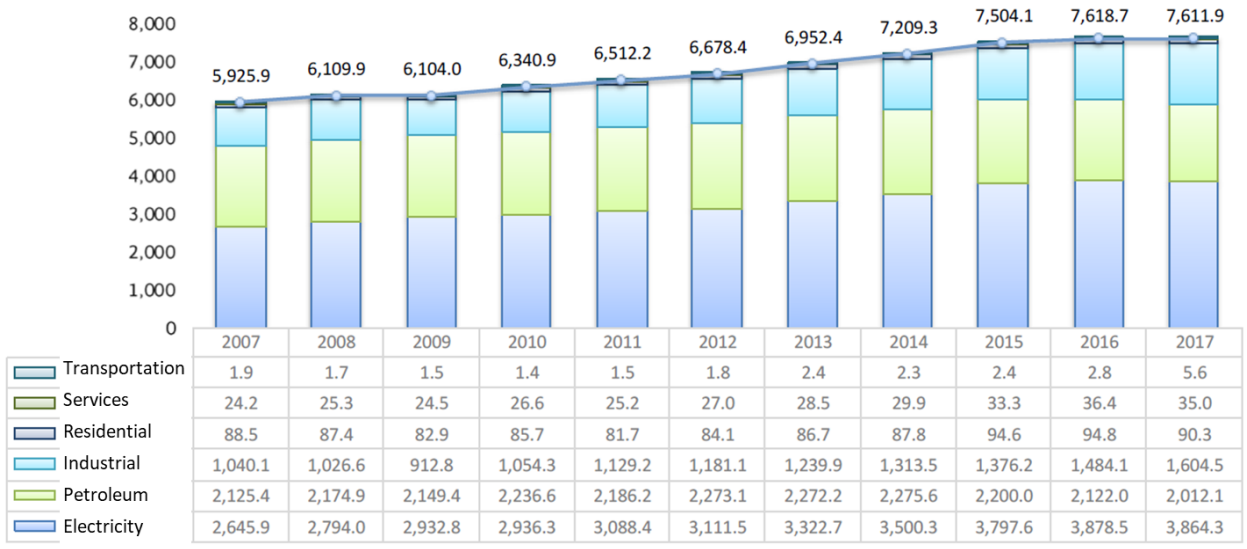
To this date, there is only one liquefaction plant operating in northern Mexico, Solensa with a capacity of 2 MMCFD. Solensa is authorized to buy and sell U.S. LNG transported by cryogenic trucks and/or railroad. There is only one project in Mexico to reconfigure the Energía Costa Azul plant from regasification to liquefaction using U.S. gas to supply the Asian market.

To analyze natural gas demand in the country, Mexico divides into five consumption regions: Northwest, Northeast, Center-Occident, Center and South-Southeast. The region having the

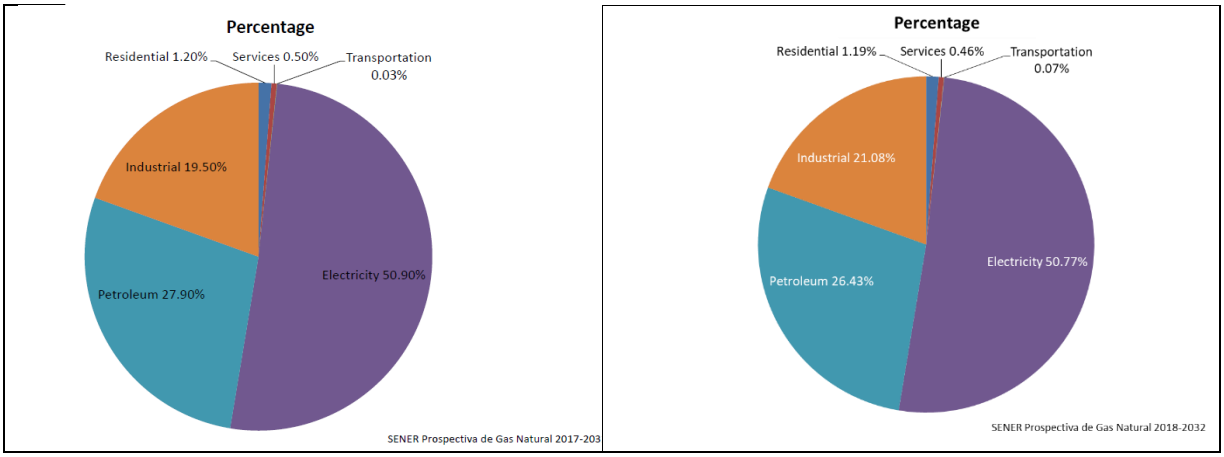
largest national demand share of natural gas in 2016 was Northeast with 32.8%, with a volume of 2,499.5 MMCFD (million cubic feet per day), that is 1.4% more than in 2015 and, on the contrary, the region with lesser demand was Northwest, reaching a volume of 608.1 MMCFD, representing an 8.0% share of the total national demand.

The total natural gas demand in July 2018 was 8,700 MMCFD that is 4% higher than July 2017. The overall demand in 2017 was 7,900 MMCFD.

Figure 1 Historic Natural Gas National Demand in 2017 (MMCFD)



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Transportation	1.9	1.7	1.5	1.4	1.5	1.8	2.4	2.3	2.4	2.8	5.6
Services	24.2	25.3	24.5	26.6	25.2	27.0	28.5	29.9	33.3	36.4	35.0
Residential	88.5	87.4	82.9	85.7	81.7	84.1	86.7	87.8	94.6	94.8	90.3
Industrial	1,040.1	1,026.6	912.8	1,054.3	1,129.2	1,181.1	1,239.9	1,313.5	1,376.2	1,484.1	1,604.5
Petroleum	2,125.4	2,174.9	2,149.4	2,236.6	2,186.2	2,273.1	2,272.2	2,275.6	2,200.0	2,122.0	2,012.1
Electricity	2,645.9	2,794.0	2,932.8	2,936.3	3,088.4	3,111.5	3,322.7	3,500.3	3,797.6	3,878.5	3,864.3



Following the implementation of the Integral Strategy for Natural Gas Supply (EISGN) made public in August 2013, there are continuous efforts to guarantee natural gas supply through the expansion of the pipeline transport network.

In the 2016-2031 Outlook, by 2031 SENER estimates that natural gas demand increases by 26.8% with respect to 2016, reaching a volume of 9,656.9 MMCFD. Demand will increase in most sectors, except for the petroleum sector, which will decrease 24% from 2016; on the other hand, the electricity sector will have most of the share with 61.6% of the total demand.

The electricity sector will have a fossil fuel demand of 7,244.2 MMCFD of natural gas equivalent, representing an increase of 25.6% from 2016. In this sector, natural gas will have a share of 82% of the total fuel consumption going from 3,965.7 MMCFD in 2016 to 5,947.2 MMCFD in 2031, as a result of the implementation of the development of natural gas infrastructure and CFE strategy to substitute expensive and polluting fuels for natural gas, together with the conversion of power centrals to dual fuels.

Many of the policies involved in mature natural gas markets obey international drivers, standards and agreements and reference is made to them continually throughout this study. References are made to the International Energy Agency (IEA), the U.S. Energy Information Administration (EIA) and other global institutions.

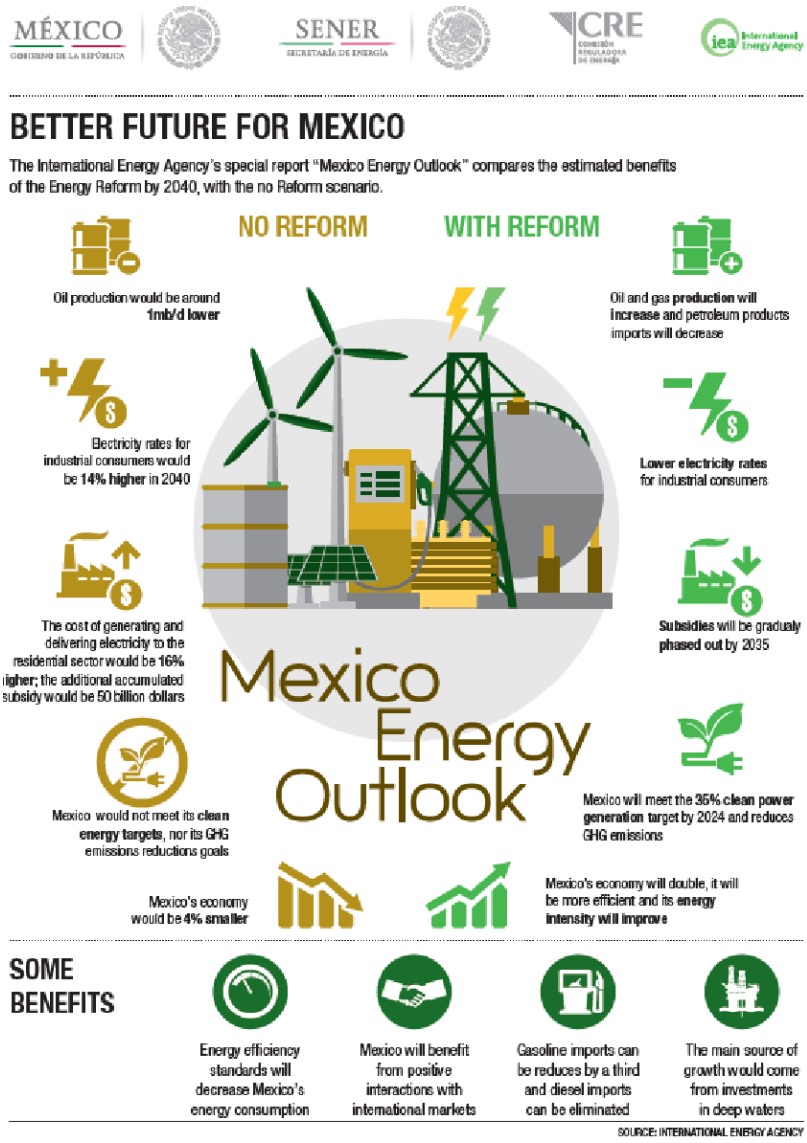
Figure 2 Natural Gas Regional Demand in 2017 (MMCFD)

By January 1, 2017, the total remaining reserves of gas in Mexico reached a volume of 28,950 thousand million cubic feet, distributing 57% in onshore regions, 35.79% in shallow waters and 7.17% in deep waters. Between 2000 and 2017 3P reserves have declined by 63% and between 2010 and 2017 by 52.7%. By January 1, 2017, the total remaining reserves of gas, reached 28,950.3 thousand million cubic feet; that is 11.1% under 2016. Proven reserves 1P of natural gas by January 1, 2018 are 10,022.4 thousand million cubic feet; that is 3.65% less than in 2017. January 1, 2018 reserves 2P are 19,377.9 thousand million cubic feet and 3P, 30,020.4 thousand

million cubic feet.

In 2018 and 2019, reserves were compiled with information gathered from PEMEX and private companies known collectively as Petroleum Operators[1]. The existing downward trend for 1P reserves is still present in 2019 decreasing 3.67% from 2018 down to 9,654.4 thousand million cubic feet; however Y-O-Y 2P reserves started to show an increase by 7.46% to 20,824.4 thousand million cubic feet and 3P reserves increased by 7.82% to 32,367.6 thousand million cubic feet. The accumulated drop in 3P reserves between 2010 and 2019 was -42.58%; for 2P was -44.48% and -47.14% for 3P.

Figure 3 Energy Structure in Mexico



For the development of the natural gas market in Mexico the Ministry of Energy (SENER), in close communication with the industry, as well as with the Energy Regulatory Commission (CRE) and the National Natural Gas Control Center (CENAGAS), submit for public consultation the *Public Policy on energy applicable to the constitution of natural gas storage* (Public Policy). The Public Policy shall contribute to the publication of aggregate information of natural gas supply, demand and stocks, which will provide key elements for the best decision-making of the economic agents in the market.

The Third Revision of the Natural Gas Transport and Storage Five-Year Plan 2015-2019, considers the results of the First Public Consultation made between September 28 and October 18, 2017 aiming to identify the potential natural gas demand for

[1] https://www.gob.mx/cms/uploads/attachment/file/455323/20190412._Reservas_de_Hidrocarburos_al_1-ene-2019._OdG_Final_web_cnh.pdf

transport and storage nationwide. The consultation was made by CENAGAS to identify the needs of various users of this system, as well as locating the places where they are needed and finally, define the timeframe to assist requests.

The results of the consultation showed that there is the need for a transport capacity of 4,637 MMCFD and storage for 3,683 MMCFD. Additionally, the companies showed interest in the following services: (i) park & loan, (ii) backhauling, (iii) natural gas swaps in different regions, (iv) online measurements and (v) pipeline maintenance in specific branches.

In August 30, 2018 Cenagas issued the preliminary bidding documents for underground gas storage for at least 10,000 MMCF in the Jaf field in the State of Veracruz. To this date, Mexico does not have natural gas storage facilities except for the LNG plants.

One of the provisions included for the natural gas opening transition is that first-hand pricing (VPM) must follow open free market supply and demand drivers in compliance with the Hydrocarbons Law. At present VPM must comply with a formula, but on a temporary basis only until the market establishes new prices schemes.

Unconventional Gas Sources

There are three segments for natural gas supply that are at their early stages of development: shale, coalbed methane (CBM), and biogas. There are very few shale wells operating in Mexico, but there are several areas still to be developed for exploration and reservoir assessment for oil and gas. PEMEX has been performing fracking activities since the 1960s, both for well drilling and secondary recovery of mature fields.

CBM has been known in Mexico for many years and there has been a lot of disinterest in developing this market. CBM has caused many coal mine accidents and the way this has been handled is through venting. Mine owners have stopped any efforts to extract CBM and shale gas from their assets claiming granted coal-mining rights. Biogas is in the renewables portfolio and it is at its earliest stages of development in Mexico. The Mexican natural gas market faces some geopolitical risks. There are three main macroeconomic points of pressure in Mexico: the North American Free Trade Agreement (NAFTA), the Mexican 2018 elections and the U.S. Fiscal Reform. There are also some additional points of pressure including:

(i) The World Bank Group (WBG) intends to stop upstream petroleum-related financing after 2019 as announced at One Planet Summit in December 12, 2017. WBG's President Jim Yong Kim, the World Bank Group made a number of new announcements in line with its ongoing support to developing countries for the effective implementation of the Paris Agreement's goals to reduce carbon emissions.

(ii) Mexican elections. Independent analysts have seen changes in Mexico as a model for economic development, and most of them are worried about a possible regression since leftist Andrés Manuel López Obrador (AMLO) has already won the Mexican presidency. Just as he was

declared President elect with 53.1% of the votes (30.1 million voters) and his party, Morena, obtained a vast majority in the Senate and Congress.

AMLO is having second thoughts about cancelling the 2013 Energy Reform and he has already met with sector leaders. During recent press announcements during August and September, AMLO's energy team has gained knowledge about the real financial, technical and economic benefits already obtained by the Reform. Now, the ideas have switched over into a revision "obeying the best interests for the nation."

AMLO's position about shale is that he will not allow fracking during his mandate, thus being unaware that PEMEX has been using this technique for over 30 years. In any case, Dr. Fluvio Ruiz, the intended director of PEMEX Exploration and Production (PEP) with AMLO, expressed during a personal interview at a Mexican Bar of Attorneys meeting that this particular issue will be worked out during the first year of the new Government.

López Obrador's team endeavored in private company contract revisions to find out if there were any acts of corruption involved, which was quite improbable since bids were public, open to international players and contest processes followed strict world-class guidelines.

Alfonso Romo, the new head of the Presidential Office, announced last September 13th that the contract revision process was almost over and no contracts would be cancelled. AMLO's team will have meetings with all bid winners to find out about their needs so that they can comply with their committed targets.

Regarding natural gas, AMLO has warned oil and gas producers that his Government will NOT allow any gas flaring and/or venting into the atmosphere so that this fuel must be fed into the grid.

What remains unchanged is AMLO's intention to refurbish all the refineries in Mexico and build at least one more in Tabasco. He has stated that PEMEX will not keep on exporting crude oil since it is needed to produce fuels in Mexico.

"Making a 'U' turn away from the present reforms would be damaging for the Mexican economy", was stated by Fatih Birol, Executive Director of the International Energy Agency (IEA). Mexico became a member of the IEA in February 2018.

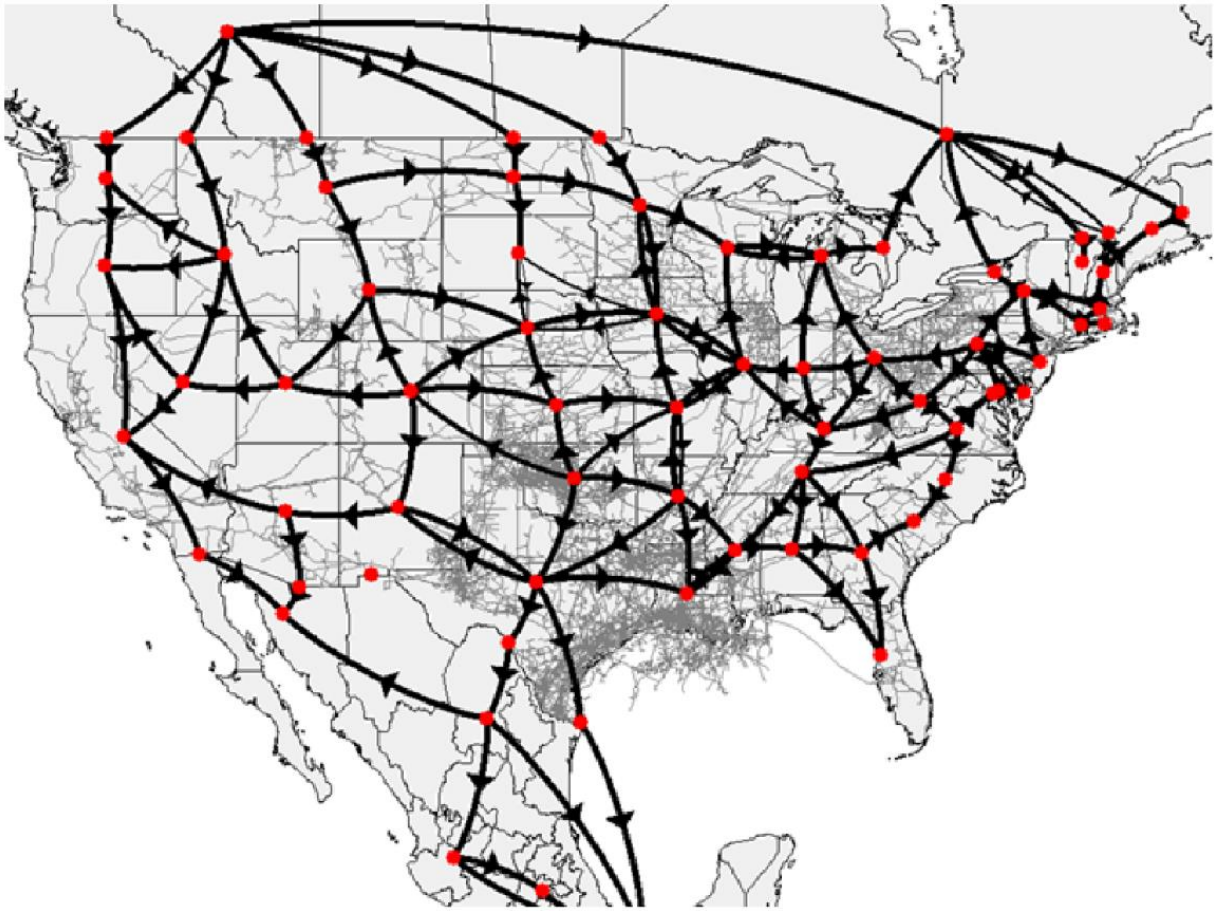
(iii) The negotiations of the North America Free Trade Agreement (NAFTA) –now called USMCA)- compromise the relationship of Mexico, Canada and the U.S. in most sectors of the economy in the three countries. The imposition of a tariff on steel and aluminum products from Mexico, Canada and the European Union posed a delay on the renegotiation of NAFTA into 2019. By mid-June the three countries had the final drafts ready for internal discussion and approval.

In August 27, 2018 Mexico and the U.S. finally reached an agreement and signed it on a preliminary bilateral basis since Canada was dealing with some trade discrepancies. The U.S.

Government intended to split USMCA into two separate bilateral treaties, but Mexico and Canada were in disagreement. Finally, at the end of 2018, just before the incoming Mexican President took office, the three countries signed the Agreement. On May 29, 2019, Trudeau tabled a bill in the House of Commons to implement the USMCA, but by the end of June there was still no approval or confirmation. On June 20, 2019, the Senate of Mexico ratified the agreement. By the end of June 2019, the United States had the document still under revision since Democrats in Congress were still seeking tougher labor and environmental enforcement provisions and were discussing the tariffs imposed on Mexican and Canadian steel and aluminum (See Annex 2 for additional risk analysis).

Since natural gas has a great deal of existing cross-border infrastructure between Canada, the U.S. and Mexico, it is expected that its trade remains flexible and free because any trade barrier would have caused a series of problems along the market chain as shown in the following graph prepared by the U.S. Energy Information Administration (EIA) in its Natural Gas Market Module for April 2018. Oil, gas, and petrochemicals, negotiated in the bilateral treaty, are free from trade barriers which would have directly affected gas producers, traders, pipeline operators, and final customers.

Figure 4 Natural Gas Market Module Network for Mexico, Canada, and the U.S.



Note: Figure 4 represents the flows (black arrows) from hub to hub (red circles) as determined by EIA's Natural Gas Market Module (NGMM) in a given year[2]. Flows that are bidirectional indicate that in a given year, there is a monthly (seasonal) variability in the direction of natural gas flow through the pipeline network. The level of granularity was used to approximate the existing infrastructure (gray lines). For the natural gas and LNG module and formulas, please refer to the EIA document from October 2018 at the footnote.

(iv) Transparency, accountability and corruption in the energy sector. In order to terminate unfair deals once and for all, meetings and agreements between the regulators CRE and CNH will be public and subject to a code of ethics, which includes rules to prevent possible conflicts of interest. These are other issues that the new Government will keep as a priority (please refer to Annex 2).

(v) Historical mistakes in pipeline development have caused some pipeline projects to become stranded. Before the 2013 Energy Reform PEMEX and CFE used their power as monopolies such that whenever they needed to install a new oil, gas / fuel pipeline, or transmission lines, they would negotiate the necessary Rights-of-Way (ROW) with land owners. In the cases where a land owner would not oblige their requests, they would proceed with land expropriation practices by force. The result was that by September 2018, there were six natural gas pipelines stopped because of bad negotiations with local communities.

According to S&P Global Platts, up to September 19, 2018 the delay in the construction of six new pipelines has caused that LNG imports increased during the first eight months of 2018, thus creating an impact in final power and natural gas prices. LNG imports reached 730 MMCFD that is an increase of 14% over 2017 with 640 MMCFD. This was caused by higher demand by final customers, and lower gas production from PEMEX.

Mexico is importing LNG at around 11 US$/MMBTU; in contrast Mexican natural gas was quoted at 4.10 US$/MMBTU according to the Wholesale National Natural Gas Prices published by the Energy Regulatory Commission (CRE).

CFE is risking meaningful investments for US$5,015 million on pipeline projects still under construction and/or due to start operations at any moment. During the months of April and May 2019, CFE questioned seven pipeline contracts and called for international arbitration aiming to nullify some of the clauses instead of giving then clearance to start operations (See Annex 2).

By the end of 2018 the South of Texas – Tuxpan submarine pipeline was expected to start operating by TransCanada (TC Energía) and IEnova. This pipeline finished construction in June 11, 2019 but CFE decided to question the Contract won through a bidding contest complying with

[2] October 2018 Update https://www.eia.gov/outlooks/aeo/nems/documentation/ngmm/pdf/ngmm(2018).pdf / Update for January 2019 https://www.eia.gov/outlooks/aeo/assumptions/pdf/natgas.pdf

international parameters applicable for this type of projects. This US$2,600 million project is at risk and the Canadian Government has already filed a complaint with the Mexican Government.

Due to legal protections promoted by affected communities, pipelines such as Guaymas – El Oro from IEnova and the Samalayuca – Sásabe, from Grupo Carso, have been unable to operate. The IEnova pipeline started operations in 2017 and was stopped by the opposing yaqui indian community at Loma de Bácum where they unearthed part of the line. The Samalayuca – Sásabe pipeline is also listed for arbitration and the risk is for US$571 million. The Guaymas – El Oro pipeline is not included in the arbitration list.

The other case is the Tuxpan – Tula pipeline that has been delayed due to the finding of an archaeological site. The expected startup date of the TC Energy project was December 2018. The arbitration process is risking US$458 million.

The pipeline projects from Fermaca due to start operations this year and also included in the arbitration list are La Laguna – Aguascalientes and Villa de Reyes – Guadalajara with investments for US$473 million and US$284 million respectively.

The Tula – Villa de Reyes pipeline from TC Energy also programmed to start operations in 2019 is also in the CFE's list, risking US$554 million.

NATURAL GAS & LNG MARKETS IN MEXICO AND ITS POSITION IN THE INTERNATIONAL SCENARIO

METHODOLOGY

Introduction

Given that the final objective of the information gathered throughout this study is for trading purposes, the analysis was made on sweetened natural gas already made suitable for immediate use, disregarding sour gas coming directly from wells in oil and gas fields. The only references included for this type of gas are their reserves and potential volumes.

This research paper follows the structure of the latest version of the Prospectiva de Gas Natural (Natural Gas Outlook) 2017-2031 issued on December 31, 2017 by SENER (Ministry of Energy), and updated with data from the 2018-2032 Outlook issued on November 23, 2018. The natural gas market was analyzed from historical data (2007 – 2017) and the forecast under two growth scenarios (2018 – 2032). Another key document sourced was SENER's Public Policy on Energy Applicable to the Constitution of Natural Gas Storage published last March 26, 2018. In some sections of this report the analysis of the Mexican natural gas market was made from 1990 to 2040 by using data from the International Energy Agency (IEA) and the Asia Pacific Energy Research Centre (APERC).

Due to the different characteristics of the natural gas markets, provisions were taken to split the analysis of natural gas in gaseous form (traded in Mexico mostly by pipeline and/or compressed (CNG)) and liquefied natural gas (LNG), which is traded into Mexico by cryogenic sea-borne ships, and is then re-gasified to be compressed and fed into the national pipeline transport network and/or delivered to the Federal Electricity Commission (CFE).

The global natural gas market data was extended with BP's Energy Outlook 2018, issued on February 28, 2018 covering the time span 1970-2040.

The main sources for the LNG market were GIIGNL or Groupe International des Importateurs de Gaz Naturel Liquéfié (International Group of Liquefied Natural Gas Importers), IEA and the global LNG market information was enriched by Shell's LNG Outlook 2018, covering 1980 to 2100, published on February 26, 2018; and Shell Global Sky Scenario to meet with the Paris Agreements to 2100.

Wherever possible all sections of this report include market opinions expressed by company officials to the press and/or from direct interviews with Government officials and trade organizations such as the Mexican Association of Hydrocarbons (AMEXHI).

Data was sourced directly from international conferences, trade shows and direct research and interviews with the consultant's customers. Some of the information obtained was obtained from private events by direct invitation only.

Additional Mexican market sources include the National Center of Natural Gas Control (CENAGAS), National Integrated System of Natural Gas Transport and Storage (SISTRANGAS), Federal Electricity Commission (CFE), National Hydrocarbons Commission (CNH), Energy Regulatory Commission (CRE), Petróleos Mexicanos (PEMEX), Reforma newspaper, Federal Commission of Electricity (CFE), Seeking Alpha and Rigzone.

Additional international information was obtained from the Asia Pacific Energy Research Centre (APERC), Bloomberg's New Energy Outlook 2017, U.S. Department of Energy (DOE), Energy Information Administration (EIA), Inter-American Development Bank (IADB), International Energy Agency (IEA), International Gas Union (IGU), McKinsey Global Gas & LNG Market Outlook to 2030, Natural Gas

Intelligence (NGI), Organization for the Economic Cooperation and Development (OECD), PPHB Energy Investment Bank, World Energy Council (WEC), World Bank Group (WBG), Groupe International des Importateurs de Gaz Naturel Liquéfié (International Group of Liquefied Natural Gas Importers), and several trade publications.

Conversion factors – At the end of this report in Annex 5, there is a list of conversion factors used in this study. Information sourced comes from the U.S., Mexico, Europe and the Asia-Pacific region, so there is a combination of metric and British units. In all cases data was left in the units of origin. Given that the natural gas formula in Mexico is linked to the U.S. market hubs, it is most commonly traded daily for pipeline operations in thousand cubic feet (MCFD or MMCF/D), million cubic feet (MMCFD or MMCF/D), and reserves in billion cubic feet (BCF) or trillion cubic feet (TCF); in terms of energy content natural gas in Mexico is traded both in Gigajoules and/or million British Thermal Units (MMBTU) although numbers are almost the same in both systems since Gigajoule = 0.9479 MMBTU.

The worldwide market for liquefied natural gas (LNG) is traded in cubic meters and/or metric tons since this product is normally transported overseas by ship and inland by cryogenic trucks. Once LNG is delivered at any regasification plant, it is sold in its gaseous state either by volume or heat content. The LNG market is always linked to natural gas in its liquid or gaseous state at a pre-defined set of volume, pressure and temperature.

Please note the existing differences in nomenclature between the U.S., the UK and the metric system for billion, trillion, etc.

Graphs – Most graphs in this study are dynamic so that the reader can easily go through the plot and revise the exact number. In some of the charts where it is essential to see the numerical trends in the plots, it was decided to attach the source tables and/or show the numerical values in the graphs.

SECTION 1
GLOBAL NATURAL GAS AND LNG MARKETS

THIS SECTION HAS BEEN PULLED FROM A DIFFERENT PORTION OF THE REPORT IN ORDER TO GIVE THE READER A BETTER UNDERSTANDING OF THE CONTENT OF THE DOCUMENT

GLOBAL NATURAL GAS AND LNG MARKETS

Natural gas is the cleanest fossil fuel and is the first choice for the conversion of fuel consumption to comply with worldwide environmental commitments to 2030. The second largest demand energy source in power generation is natural gas, representing 22% of generated power globally and the only fossil fuel whose share of primary energy consumption is projected to grow. [3]

The worldwide market for liquefied natural gas (LNG) is traded in cubic meters and/or metric tons since this product is normally transported overseas by ship and inland by cryogenic trucks. Once LNG is delivered at any regasification plant, it is sold in its gaseous state either by volume or heat content. The LNG market is always linked to natural gas in its liquid or gaseous state at a pre-defined set of volume, pressure and temperature.

Key Findings Affecting the Global Natural Gas and LNG Markets

1. Natural gas plays a significant role in the global energy mix. It is the number three fuel, reflecting 24% percent of global primary energy, and it is the second energy source in power generation, representing a 22% share.

2. Natural gas has the potential to play a significant role in the transition to a cleaner energy future due to its high energy content, which results in lower emissions of carbon and volatile organic compounds (VOCs) at combustion, relative to coal and oil. Natural Gas is the cleanest fossil fuel. These characteristics of gas provide substantial environmental benefits such as improved air quality, and reduced CO_2 emissions.

3. Demand projections for natural gas exports to Asia, particularly China and Japan, have been revised down as importing nations push to improve energy security and reduce the impact of volatile commodity markets on domestic energy prices.

4. In particular, unconventional gas, shale, and coalbed methane (CBM), reflected more than 10% of global gas production in 2014 and is entering global markets as LNG, disrupting the global supplier landscape and creating increased competition in regional natural gas markets.

5. The shifting dynamics in natural gas pricing in recent years can be attributed to regional supply and demand imbalances. North America prices collapsed in 2009, driven by a domestic oversupply, while from 2011-2013, the Japanese nuclear crisis drove prices sky high in Asia.

6. Currently, the fall in demand in Asia and growing export capacity in Asia and North America, have created an oversupply globally. As further supplies come to the market, it appears likely that the current market oversupply and low price environment will continue in the short to medium-term.

[3] WEC 2016-10 World Energy Resources (WEC = World Energy Council)

7. Opportunities (Headwinds)

- Advances in supply side technologies have changed the supply landscape and created new prospects for affordable and secure supplies of natural gas.
- Natural gas markets are becoming more interconnected as a result of gas-to-gas pricing, short-term trade and consumer bargaining power.
- In meeting COP21 objectives, gas has a key role to play in displacing more carbon intensive fuels in both transport and power generation, especially in rapidly growing economies.

8. Challenges (Tailwinds/chokepoints)

- The future of demand is highly uncertain at current prices. Policy support and reduced cost structures for natural gas projects are needed for gas to become more competitive in importing regions.
- Infrastructure build-out, government support and the closure of regulatory gaps are needed to unlock the socioeconomic and environmental benefits of natural gas.
- Several technologies exist today to create new markets for gas, but many require support from governments to penetrate markets.

Natural gas is the only fossil fuel whose share of the primary energy mix is expected to grow. However, the “Golden Age of Gas” that was once predicted, has failed to take off due to slower demand growth than expected. Whereas in 2013, the market needed more natural gas, namely liquefied natural gas (LNG) to respond to the Japanese nuclear crisis, in 2016, demand for natural gas has slowed in Asia and declined in Europe.

Upstream oil and gas companies in Australia, the Middle East, Africa, and North America who bet on old forecasts for Asian demand growth, capitalized on the period of high commodity prices and large capital budgets to drive technological advances. In particular, advances in the unconventional gas process, enabled suppliers to develop reserves that were once deemed too expensive. New supplies are emerging at a time when demand is slowing, and suppliers with large inflexible investments in natural gas assets are scrambling to stay afloat.

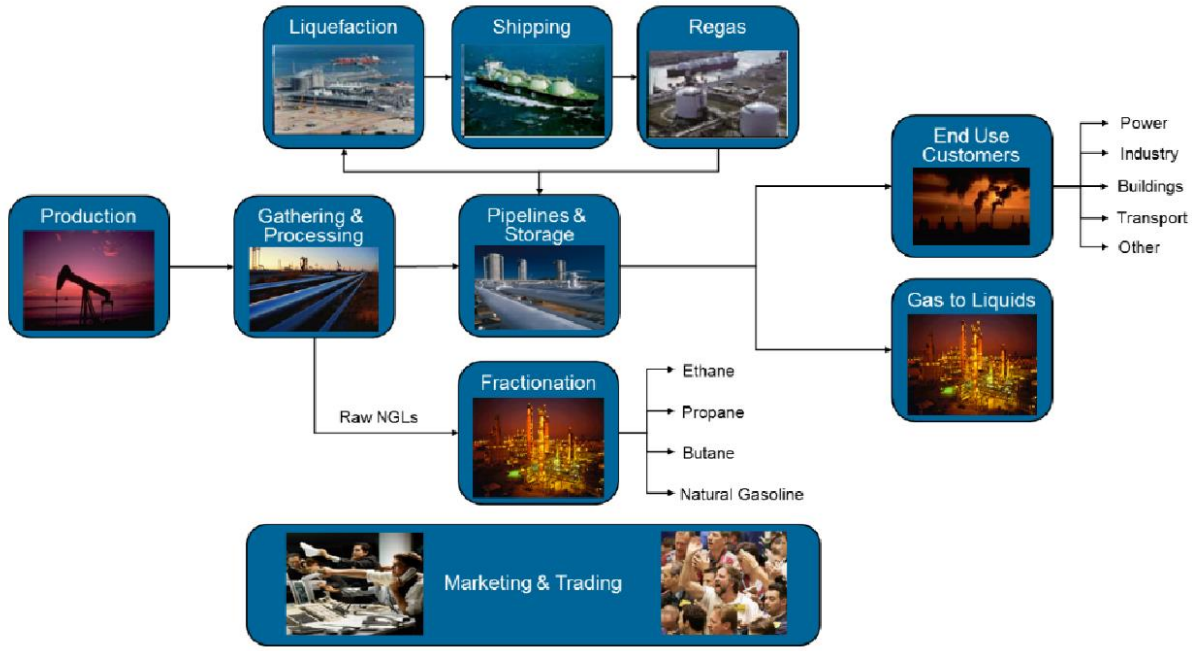
Natural gas has the potential to play an important role in the world’s transition to a cleaner, more affordable and secure energy future. In developing regions, such as sub-Saharan Africa and India, natural gas can be used to electrify growing communities. As the lowest carbon emitting fossil fuel, natural gas also has the potential to serve as a cleaner source of baseload power. However, natural gas faces a variety of technical, socio-economic and environmental challenges. For example, in importing nations, the economic risks of import dependency and exposure to volatile commodity prices make gas a less attractive fuel source. Industry and regulators have also not managed to fully address issues with land-use, water management, air pollution and methane emissions associated with unconventional gas supplies.

This section will summarize key technical, economic, socio-economic, and environmental themes emerging in natural gas. It concludes with an outlook on the future for natural gas. As further supplies come to the market, it appears likely that the current market oversupply and low price environment will continue in the short to medium-term. Whether or not natural gas can achieve price competitiveness will play a significant role in the future demand for this fuel.

Natural Gas Value Chain

The following figure outlines the major components of the natural gas value chain. This value chain illustrates that many technology factors impact the transition from production to end use by consumers. Natural gas trade plays a crucial role in the value chain as the supply of natural gas is oftentimes not in the same location as the demand. Additionally, the financial trade of natural gas has also increased in importance and application in recent years.

Figure 5 Natural Gas Value Chain



Source: Accenture

Exploration and Production

One of the most important recent technological breakthroughs in natural gas development is the progress seen in the drilling and production of unconventional resources. Developments in upstream unconventional gas operations have created substantial potential for added natural gas supplies. The most impressive results to date are in the US, where in 2015 natural gas

production in the US's top seven shale basins reached 461 billion cubic meters (bcm).[4] Additionally, unconventional gas development has made significant progress in Australia, China, the UK and Argentina.

Shale Gas[5]

The shale gas value chain consists of additional processing compared to the conventional gas value chain. The drilling process involves many more wells than in a conventional operation and involves multiple rigs for vertical and horizontal well drilling. The completion process requires additional stimulation via hydraulic fracturing. There are many more handoffs and there is much higher logistical complexity involved in managing materials and equipment on site. Leading companies have been able to apply technology innovation and manufacturing principles to drive significant time, and therefore cost improvements in shale and tight oil operations. Cost reductions are driven by reduced drilling and completion times, lower total well costs, and increased well performance.

Drilling technology improvements include longer laterals, improved geosteering, increased drilling rates, minimal casing and liner, multi-pad drilling, and improved efficiency in surface operations. Completion technology improvements include increased proppant volumes, number and position of fracturing stages, shift to hybrid fluid systems, faster fracturing operations, less premium proppant, and optimization of spacing and stacking. Looking forward, well costs will trend higher as service companies cut back on discounts in a sustained low price climate. However, the combination of cost reduction and productivity improvements mean that collectively, the unit cost of production in US$/boe will continue to trend downward.

Unconventional projects are considered highly flexible, mainly due to the ability to hold inventory in the form of uncompleted wells. Drilling wells without completing them provides unconventional operators with the flexibility to complete wells and increase supply only when prices are attractive. As of June 2015, the EIA estimated that there are between 2,000 and 4,000 uncompleted wells in the United States representing about 250,000 bpd of production. Advancements in technology and efficiency also translate to smaller "footprints", less waste generated, cleaner and safer operations, and greater compatibility with the environment.

The International Energy Agency (IEA)[6] made an assessment of the worldwide conditions of unconventional resources: shale, tight gas, coalbed methane (CBM), etc. IEA considers that the U.S. will keep on leading gas production during the period between 2016 and 2022.

Figure 6 EIA Drilling Productivity Report for Shale Gas

[4] EIA (2016) Drilling Productivity Report

[5] WEC 2016-10 World Energy Resources (WEC = World Energy Council)

[6] IEA 2017-10-18 Dr. Fatih Birol - LNG reshaping the global gas market

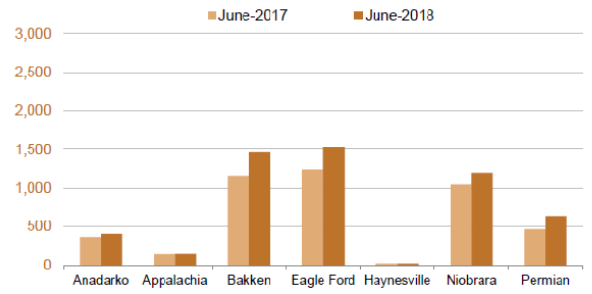
Year-over-year summary

Drilling Productivity Report

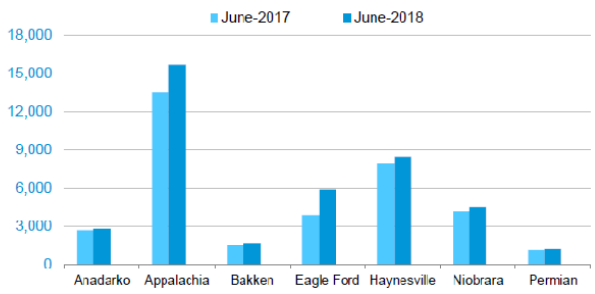
May 2018

drilling data through April
projected production through June

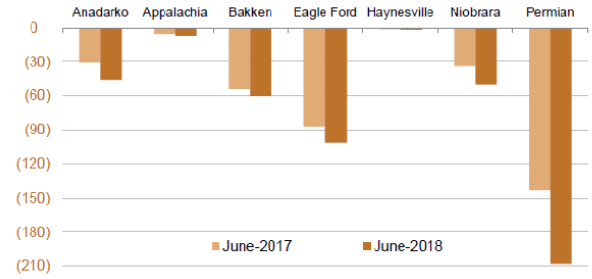
New-well oil production per rig
barrels/day



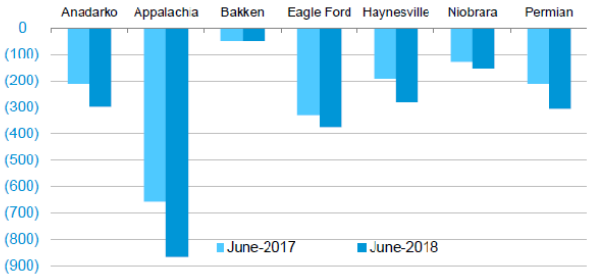
New-well gas production per rig
thousand cubic feet/day



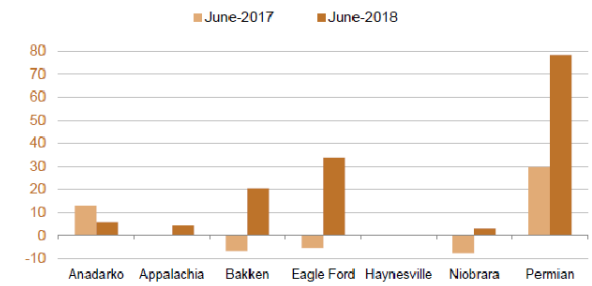
Legacy oil production change
thousand barrels/day



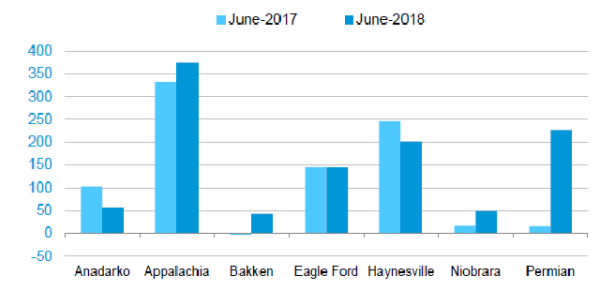
Legacy gas production change
million cubic feet/day



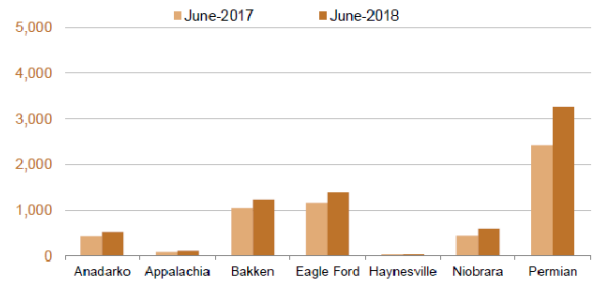
Indicated monthly change in oil production (Jun vs. May)
thousand barrels/day



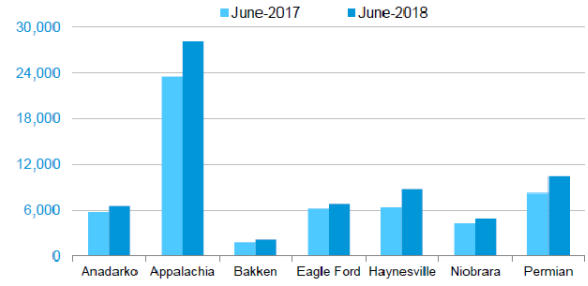
Indicated monthly change in gas production (Jun vs. May)
million cubic feet/day



Oil production
thousand barrels/day



Natural gas production
million cubic feet/day



INEXS

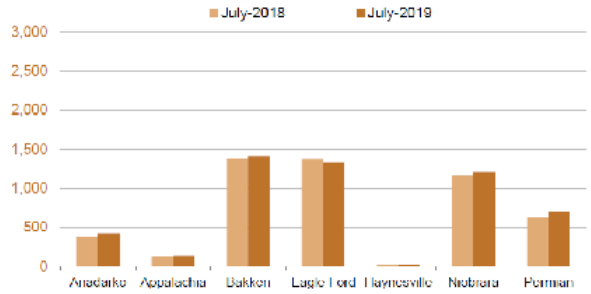
Year-over-year summary

Drilling Productivity Report

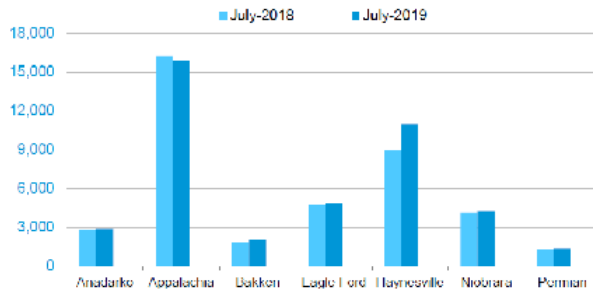
June 2019

drilling data through May
projected production through July

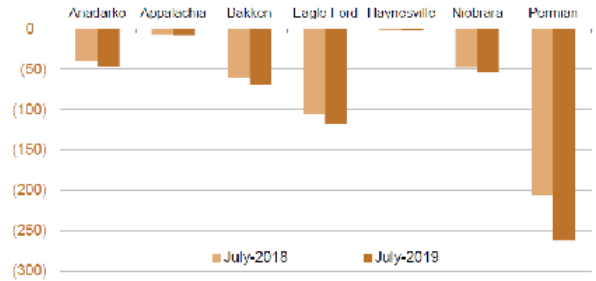
New-well oil production per rig
barrels/day



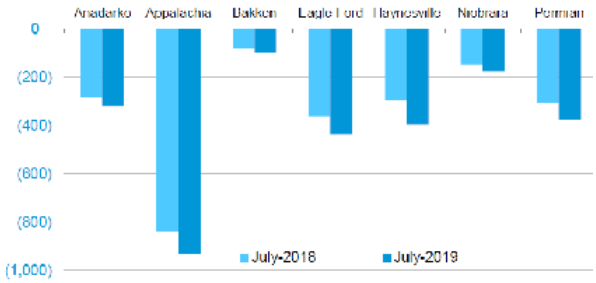
New-well gas production per rig
thousand cubic feet/day



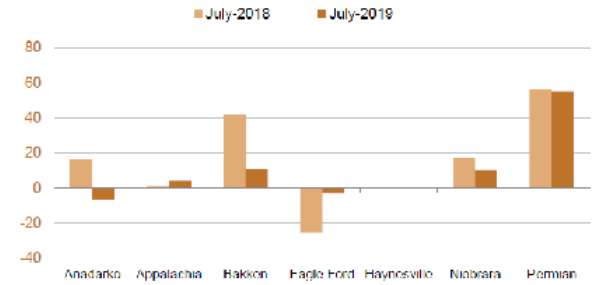
Legacy oil production change
thousand barrels/day



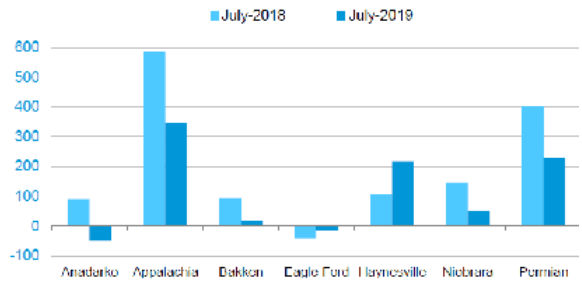
Legacy gas production change
million cubic feet/day



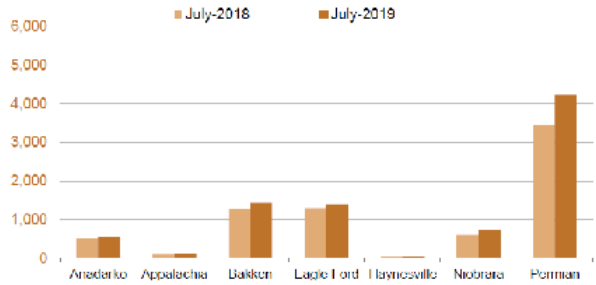
Indicated monthly change in oil production (Jul vs. Jun)
thousand barrels/day



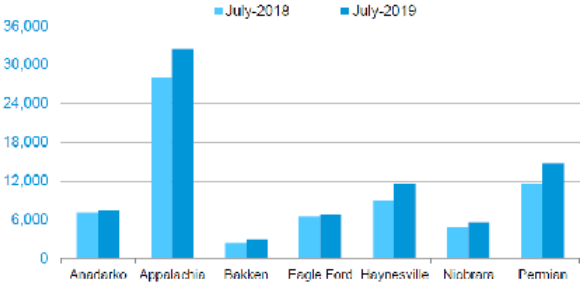
Indicated monthly change in gas production (Jul vs. Jun)
million cubic feet/day



Oil production
thousand barrels/day

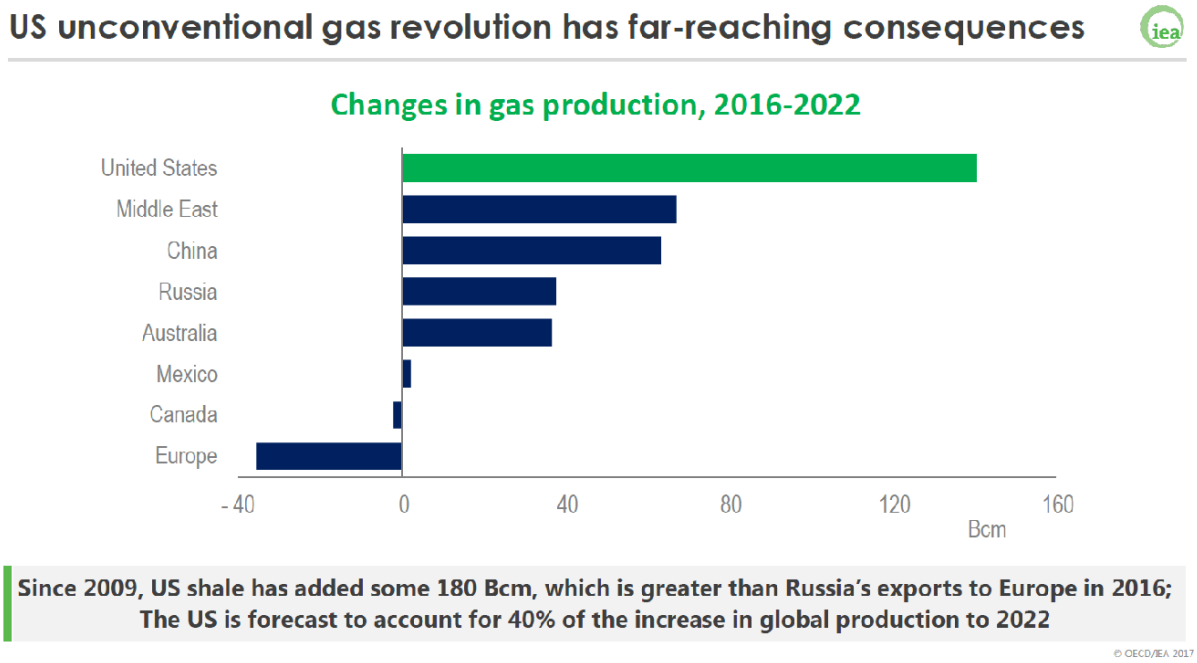


Natural gas production
million cubic feet/day



INEXS

Figure 7 The U.S. Will be Leading the World Gas Production to 2022



Coalbed Methane (CBM)

CBM production began as a coal mine degasification and safety technique developed in the U.S. during the 1970's. In 2016, CBM production is commercially well established in several countries and successful production is occurring from a wide range of coal types, ages, and geologic settings. However, in all cases the keys to commercial success are favorable geologic conditions (good coal thickness, gas content/saturation, and permeability); low capital and operating costs; and favorable gas markets and sales prices.

Like shale gas, CBM operations require additional stimulation in the completion process. This technology has proven most effective in the U.S., Canada, and Australia, though China, and India also have operations in play. Indonesia also has strong potential for CBM developments due to a very high reservoir quality.

Australian operations have been particularly successful and are set to surpass U.S. production by 2020. As of June 2015, Queensland Australia had ~1,141 bcm of CBM reserves. In 2014, Queensland Australia[7] produced ~12.2 bcm of CBM and China produced 3.6 bcm of CBM. The Chinese Ministry of Land and Resources (MLR) targets production of 30 bcm/year by 2020.

Australia is also a pioneer in utilizing CBM as a feedstock for liquefied natural gas (LNG exports). The country has started up three CBM to LNG projects since 2014. These three projects (QCLNG, APLNG, and Gladstone LNG) currently represent 21.4 million tons per annum (mtpa) of export

[7] Queensland Australia (2016) Queensland petroleum and coal seam gas 2014-2015, Australia

capacity. Looking forward, technical advances will continue to improve the economics of the process, and technology holds the best hope for process viability in the future.

Small-Scale LNG (SSLNG) (Please refer to Annex 4)

LNG import terminals and liquefaction plants with a regasification or liquefaction capacity less than 1 mtpa is Small Scale LNG (SSLNG). Other elements of the SSLNG market are bunkering facilities used by LNG fueled vessels, infrastructure to supply LNG as a fuel for road vehicles and LNG satellite stations. The SSLNG market is developing rapidly, especially as a transportation fuel and to serve end users in remote areas or not connected to the main pipeline infrastructure.

Significant SSLNG import, break bulk and regasification is already present in China, Japan, Spain, Portugal, Turkey and Norway. Global installed capacity of SSLNG is 20 mtpa across more than one hundred facilities. Further, many terminals are expanding services to include small-scale reloading and bunkering.[8]

Most demand growth for SSLNG is in China where efforts are in place to get clean fuels to fight air pollution in cities. In the U.S., the price differential between oil and gas is the primary driver for SSLNG. With the abundance of shale gas in the region, prices favor gas over other fuels in transport and power. Stricter regulations on the marine sector are stimulating the use of SSLNG as bunker fuel in Europe and North America.

In Latin America, the drivers include monetizing stranded gas supplies and reaching remote consumers. A transparent and profitable business model is needed to make SSLNG viable. The supply chain is not always economic due to the small scale nature of the deliveries and the relatively small size of the market. However, as technology solutions mature, standardization, modularization and therefore competitiveness are expected to increase.[9]

Floating LNG Liquefaction

Since 2014, 69 MTPA of floating liquefaction capacity has been proposed globally. Four projects have been sanctioned, accounting for 8.7 MTPA of capacity. Many FLNG proposals announced in the past few years aim to market gas from smaller, stranded offshore fields, which become less attractive in a low price climate, especially when compared to brownfield projects as evidenced in the next figure. As a result, in the short-term, FLNG project development

[8] International Gas Union (2016) World LNG Report

[9] International Gas Union (2014) Small Scale LNG