PART II: IMPACT ANALYSIS OF NEW POLICIES ON THE US NATURAL GAS MARKET?

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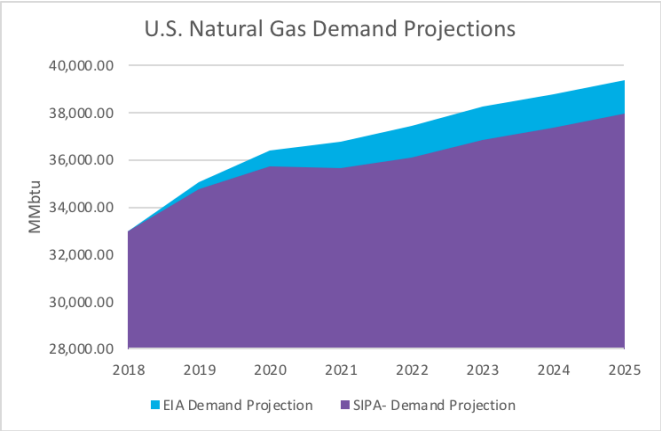
Executive Summary

The Trump Administration has introduced several policy changes to achieve its objective in maximizing US natural gas potential and become a dominant player in the international market. The SIPA Capstone analysis shows that, in the next 5 years, there could be an incremental production of 0.9702 Tcf as a result of the Tax Reform, Environmental Reform, and the Solar Tariffs. However, this gain could be offset by the decrease in demand from Mexico due to the introduction of 30% export tariff If the producers fail to find another market for the gas. The charts below show the demand projection up to 2025.

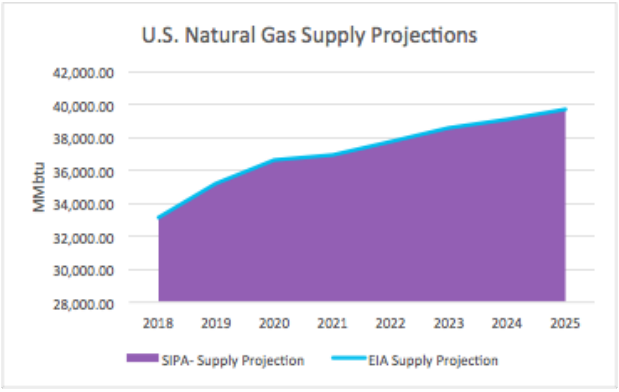
Figure 1: U.S. Natural Gas Demand Projections 2018-2025



Source: SIPA Capstone Analysis, EIA Baseline

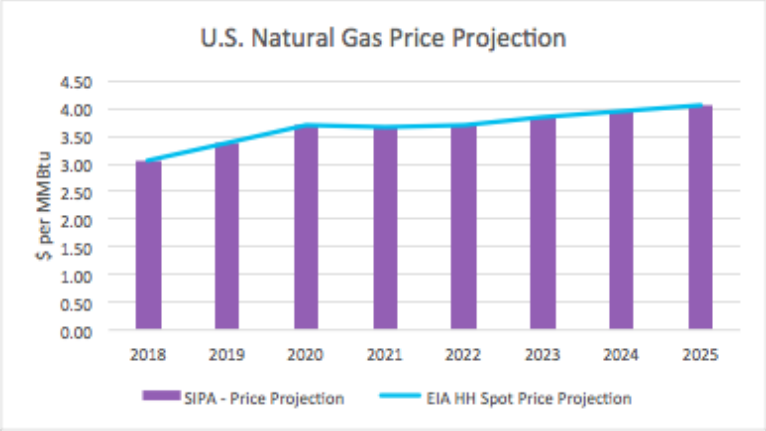
In addition, the U.S. natural gas supply and price has been projected into 2025 to show a policy impact that is minimal and will be unlikely to change the projection from the EIA baseline.

Figure 2: U.S. Natural Gas Supply Projections 2018-2025



Source: SIPA Capstone Analysis, EIA Baseline

Figure 3: U.S. Natural Gas Price Projections 2018-2025



Source: SIPA Capstone Analysis, EIA Baseline

The policy change in the Bureau of Land Management (BLM) regulation and offshore drilling acreage will not have an impact on the U.S. natural gas supply. The removal of the hydraulic fracturing rule will result in a cost reduction of approximately $14 to $34 million per year, which is relatively low compared to the overall production cost level. The new offshore drilling proposals in the Atlantic coastline and Pacific Coastline are unlikely given the states' opposition to these projects in their jurisdictions. The Alaska offshore drilling proposal is likely to pass but has yet to attract new investors into the area. Currently, extra lease sales proposed in the Gulf of Mexico are a result of the expiration of GOMESA Moratorium, which should already be included in the baseline study.

Pipeline permitting will have a slight impact on the natural gas market. The changes to the 2016 New Source Performance Standards will result in a slight production increase of 257.4 MMcf by 2025. Environmental permitting changes regarding the timetable of permitting could potentially narrow the price differential at a faster pace by increasing capacity earlier than with the previous average length to receive permits. However, the amount is unclear since we cannot assume every project would be in service two years earlier since that assumes every project would be completed with a 4-year permitting delay. Overall, the quantifiable impact is very small.

The import and export of natural gas from and to a nation with a free trade agreement requires national treatment for trade. The authorization should be granted without modification or delay as the trades with FTA countries are considered to be in the public interest. The national treatment encompasses only the commodity; whereas, the procedure to obtain the necessary permits for the import or export facilities (LNG terminals, pipelines and so on) does not differ between either FTA or non-FTA countries. In this respect, the U.S. has preferential treatment for gas traded with Canada and Mexico. While the Canada and U.S. natural gas markets integrated before NAFTA and it will be difficult to change their unified nature, Mexico and U.S. trade relations are fragile. If the Trump administration decides to impose a 30% tariff, Mexico will be the one and only country on which U.S. imposes export tariffs in the natural gas trade. In such a situation, despite all its new pipeline investments and its energy reform agenda, Mexico may replace up to 4 Bcf/d equivalent of natural

gas with fuel oil in its electricity generation. This would create a demand shock in U.S. markets. Nevertheless, the impact on this negative demand shock on Henry Hub Prices, assuming that everything else stays constant, would be very limited.

The change in corporate tax rate from 35% to 21% will allow the natural gas producers to free up cash and invest in new projects. SIPA analysis on twelve fields coming from four major US natural gas basins shows that, on average, there will be a 0.21/Mcf increase in the Life-of-Filed realized gas price, assuming the tax rate stays at 21% in the future. Furthermore, it is projected that the Equivalent Price Impact (EPI) of a lower tax rate will increase the production in 2022 by 0.95 Tcf (3.52%), compared to 2017 level.

The recent tariffs imposed on imported solar modules and steel product will impact the U.S. natural gas market. The solar tariff is expected to reduce solar installation capacity for 2018-2022 and lead to an aggregate 28.3 Bcf demand increase for natural gas over the same period. On the steel tariff side, the tariff policy will increase material cost by 9% on pipeline related product and therefore will increase the gas supply cost.

Introduction

The second part of the BNEF Capstone project analyzed the impacts of the policy interventions found in the Midterm Report to have an effect on the US natural gas market. The quantitative impact reflects the expectation of the market movement as well as the outlook of the Trump Administration energy policy. In addition to NAFTA, BLM regulation, environmental and permitting changes, and Corporate Tax rate change, the SIPA Capstone team previously examined the effect of the LNG export policy and the President's intention to revitalize the coal industry. While there have been efforts by the current administration to enhance the LNG export permitting process, the impact seems to be minimum. Meanwhile, given the projected long term low gas price and the environmental pressure to limit emissions as a result of the Paris Agreement, it would be difficult to see a recovery of the US coal industry in the future. Therefore, the second half of this report will examine the impact of NAFTA, BLM regulation, environmental and permitting changes, Corporate Tax rate change, and solar and steel import tariff on U.S. natural gas market.

SIPA FINAL REPORT

NAFTA IMPACT

$2.77

Henry Hub gas price as of April 29, 2018

11.2 Bcf/d

U.S. cross border pipeline export capacity to Mexico, as of April 2018.

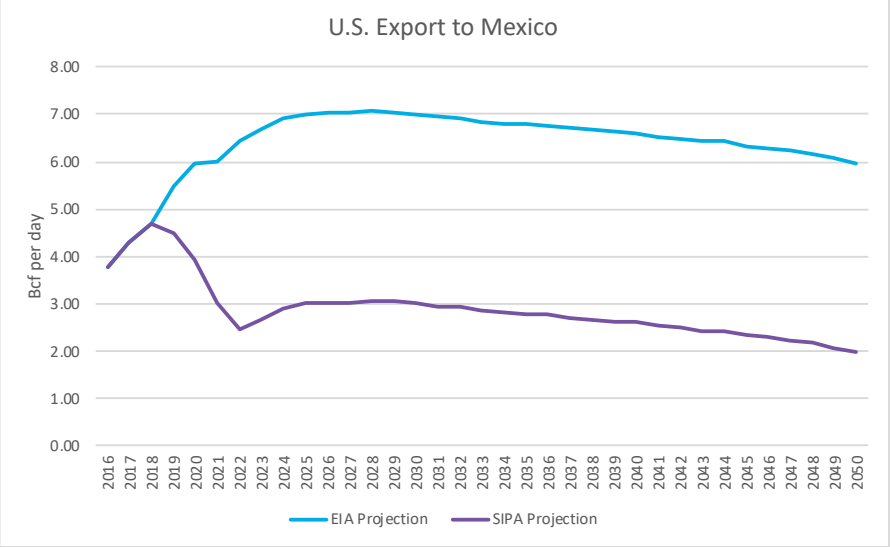
4.61 Bcf/d

U.S. average gas export to Mexico, as of Jan. 2018.

There is no tariff imposed on any non-FTA country and Canada and the U.S. have an intertwined market and pre-existing trade agreement that would protect it from potential NAFTA changes. Therefore, if the Trump administration decides to impose 30% tariff on the gas exported from U.S. to Mexico, Mexico will be the one and only country on which U.S. imposes export tariffs in natural gas trade.

- 60% of Mexican natural gas demand is supplied by U.S. natural gas.
- 53% of U.S. total export goes to Mexico.
- Current U.S. cross-border pipeline export capacity to Mexico is 11.2 Bcf per day. 3.2 Bcf/d more capacity is planned by the end of 2018.
- 54% of Mexican electricity generation depends on the natural gas.
- In Mexico, the closest substitute to natural gas in electricity generation is fuel oil.
- Mexico is planning to reduce fuel oil usage for electricity generation to 10% according to its Energy Reform agenda and its commitment to fuel oil. As long as their commitment continues, even with 30% tariff-imposed prices, Mexico would continue to trade with U.S.
- Mexico may replace up to 4 Bcf/d equivalent of natural gas with fuel oil despite its investments in pipeline network and its commitment to the Paris Climate Accord. This would create a demand shock in U.S. markets. Yet, its impact on the Henry Hub prices would be, at most, 3 cents per MMBtu.

Figure 4: U.S. Export Projection to Mexico



Source: EIA and SIPA Capstone

Current policy situation

U.S. has a preferential treatment for Free-Trade Agreement countries (FTA) under the National Gas Act. Therefore, the natural gas traded with FTA countries is treated as a national commodity. However, the procedure to obtain the necessary permits for the import/export facility (LNG terminals, pipelines and so on) does not differ for FTA or non-FTA countries. The national treatment of the gas encompasses only the commodity itself. In terms of tariff imposition, there is no difference among FTA and non-FTA countries either. No tariff is imposed on the natural gas traded with non-FTA countries.[1]

The Canada and U.S. gas markets are well-integrated, and they behave like one market. It would be very difficult to change this unified market structure. If NAFTA is cancelled, the previous free-trade agreement – Canada-U.S. Free Trade Agreement, CUFTA – will remain in power. However, the cancellation or renegotiation of NAFTA would create a demand shock in the U.S. natural gas market, originating from Mexico. According to officials from the Mexican Ministry of Energy (SENER), the Trump administration mentioned a 30% tariff on the gas exported from U.S. to Mexico. If it is implemented, Mexico will be the one and only country on which U.S. imposes export tariffs in natural gas trade. However, the sharpness of the Mexican demand decline depends on the price elasticity of Mexican natural gas demand.

Policy Proposal: 30% tariff imposition on the gas exported to Mexico

The U.S. exported, on average, 4.61 billion cubic feet per day (Bcf/d) of natural gas to Mexico in 2017 (4.23 Bcf/d via pipelines and 0.38 Bcf/d via LNG vessels).[2] The current U.S. pipeline export capacity to Mexico is 11.2 Bcf/d with another 3.2 Bcf/d capacity planned by the end of 2018.[3]

According to NGI, Mexico's average daily demand was 8.02 Bcf/d in January 2018 from which 5.5 Bcf/d is imported. The U.S. imports were 4.89Bcf/d which accounts for 89% of the total import. Mexico's electricity generation heavily depends on natural gas with 54% of electricity generated by natural gas fired power plants equivalent to roughly 4 Bcf/d of natural gas. In 2031, Mexican power plants are forecasted to consume 5.95 Bcf/d which will account for nearly 62% of national demand.[4] According to SENER Natural Gas Outlook 2016-2030, more than 4.3 GW of fuel oil (the first substitute for natural gas in electricity generation) were converted to natural gas generation in 2016. Between 2018 and 2020, 6.2 GW of fuel oil-fired plants will be replaced by natural gas and 4.7 GW more from 2021 to 2029. Therefore, reforms in the Mexican electricity sector aim at clean energy generation by keeping the fuel oil generation at 10% for only peaking times.

In this respect, the price elasticity of Mexican gas demand depends on the U.S. pipeline import prices and capacity, LNG import prices and capacity, fuel oil prices for electricity generation, and Mexican Energy Reform Agenda.

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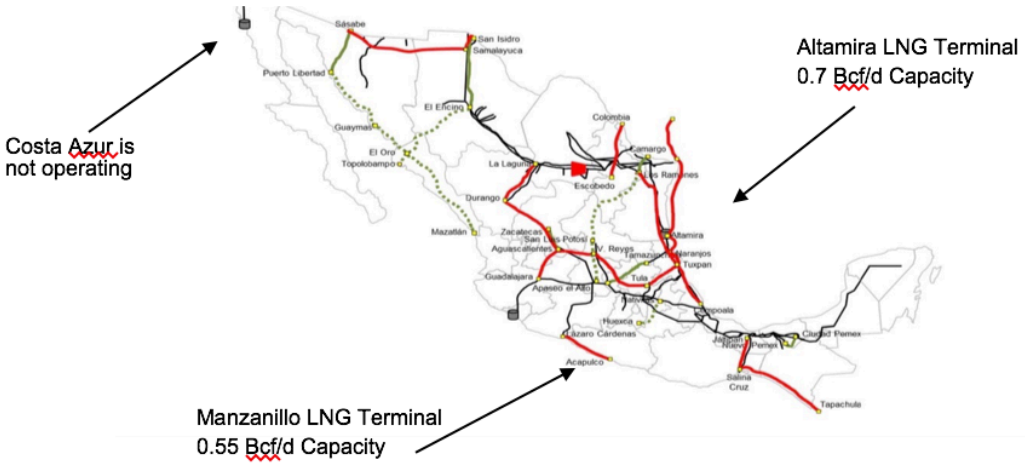
[1] This information derived from the interviews with former Assistant Secretary of U.S. Department of Energy.
[2] EIA, "The value of U.S. energy exports to Mexico exceeded import value for third year in a row" March 14, 2018. https://bit.ly/2FPgic5
[3] EIA, "The United States exported more natural gas than it imported in 2017" March 19, 2018. https://bit.ly/2u1rCgs
[4] Peter de Montmollin, "SENER Sees Mexico's Natural Gas Demand Rising 27% by 2031" January 12, 2018. https://bit.ly/2vU7ZIf

According to a Mexican Energy official from the Energy Regulatory Commission (CRE), Mexico cannot replace U.S. imports with LNG because there is not enough LNG import capacity. There are three LNG import terminals in Mexico: Altamira, in the Gulf of Mexico with a daily capacity 0.7 Bcf and two on the Pacific coast, Manzanillo with a daily capacity 0.55 Bcf and Costa Azur which is currently not functioning. In February 2018, those two LNG terminals imported gas mostly from the U.S. because of the startup delays on pipelines downstream from the U.S.-Mexico border.[5] Therefore, Mexico relies on U.S. in its LNG import as well.

Regarding pipelines, 12 new projects with total capacity of 9.7 Bcf/d inside Mexico will come online by the end of this year.[6] The U.S. pipeline capacity to Mexico is 11.2 Bcf/d with another 3.2 Bcf/d capacity added by the end of this year. The average daily U.S. pipeline export to Mexico is 4.7 Bcf.

Figure 5: Mexico New Pipeline Projects



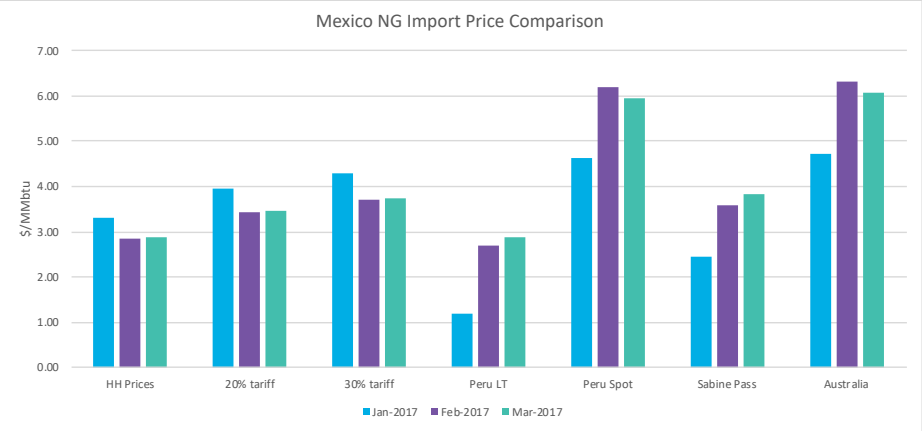
Source: Mexico Five Year Natural Gas Plan 2012-2019[7]

Therefore, in a worst-case scenario Mexico will replace the natural gas it imports from the U.S. with fuel oil for its electricity generation at the expense of Paris Climate Accord and its energy reform agenda. However, Mexican officials do not disclose the amount of immediate replacement and only claim that in the short-run they will continue to trade despite the 30% tariff imposition.

In order to understand how much natural gas would be replaced by fuel oil in electricity generation, we need to evaluate the natural gas prices in Mexico. The trades in the Mexican gas market are priced with U.S. indexes like Henry Hub and Houston Ship Channel, plus the cost of transport.[8] The LNG and Henry Hub price comparison for Mexico is below.

[5] Peter de Montmollin, "Mexican LNG Imports Climb 42% in February Year/Year" April 10, 2018. https://bit.ly/2r6splh
[6] EIA, "New U.S. border-crossing pipelines bring shale gas to more regions in Mexico" December 1, 2016. https://bit.ly/2FevSKA
[7] Mexico Ministry of Energy (SENER), "Five Year Natural Gas Plan 2012-2019" Retrieved from https://bit.ly/2j6AVUs
[8] Peter de Montmollin, "Natural Gas Prices Drop in All Six of Mexico's Trading Regions" April 19, 2018, https://bit.ly/2Jz5blE

Figure 6: Mexico Natural Gas Import Price Comparison

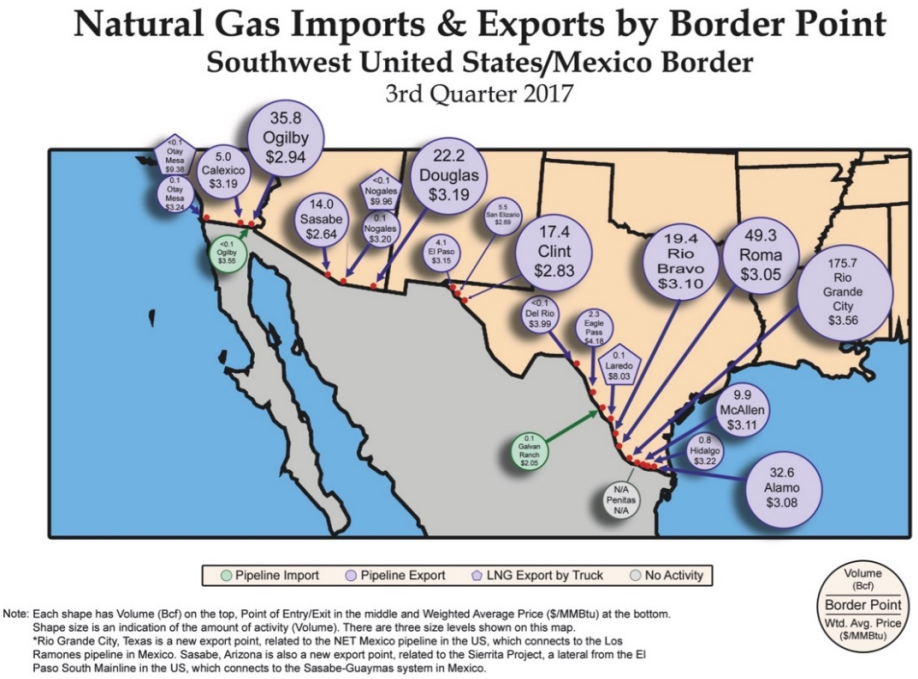


Source: EIA and S&P Global Platts[9]

Figure 1 shows that even with thirty per cent increase in Henry Hub spot prices, U.S. pipeline import prices would remain cheaper. However, as a political decision and at the expense of Mexican Energy Reform and their commitment to Paris Climate Accord, they might have to switch to fuel-oil. In this respect, in a very short period of time (one to three months) there would not be any change in trade. But in three to twelve months, they can switch to fuel oil which is equivalent of 1 Bcf/d of natural gas. More detailed prices at the U.S. point of exit are shown below. Currently, in all U.S. exit points the pipeline prices are lower than the spot prices.

[9] EIA, Henry Hub Spot Prices https://bit.ly/2JDkfPn
Mexico LNG import Prices are Retrieved from S&P Global Platts https://bit.ly/2HEm3a2
The LNG prices are the prices at the LNG terminals and does not cover the transportation costs inside the Mexico. Therefore, it is accurate to compare them with Henry Hub spot prices.

Figure 7: Natural Gas Imports & Exports by Border Point



Source: DOE, Natural Gas Imports and Exports Third Quarter Report[10]

[10] Department of Energy, Natural Gas Imports and Exports Third Quarter Report 2017, https://bit.ly/2r5mZ0c

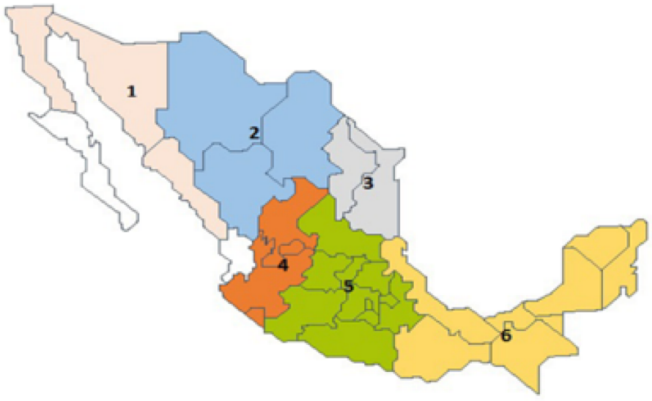
Figure 8: Mexico IPGN Prices

MEXICO IPGN PRICES

Month	MXN/GJ	US/MM	COs	VOL	DEALS
Jul-17	69.4485	4.1048	14	2986	98
Aug-17	72.8156	4.3141	17	7325	114
Sep-17	69.0214	4.0913	17	4660	97
Oct-17	70.4169	3.9677	22	5086	142
Nov-17	75.3159	4.1873	20	4817	138
Dec-17	73.2271	4.0529	21	4876	147
Jan-18	78.1289	4.3379	20	5168	153
Feb-18	80.4542	4.5567	22	5496	146
Mar-18	68.8548	3.8882	22	5346	166

Regional Breakout of March 2018 IPGN

Region 1	100.6019	5.6809	-	547	9
Region 2	68.9135	3.8915	-	275	14
Region 3	62.6351	3.5369	-	1711	32
Region 4	75.4006	4.2578	-	519	21
Region 5	78.9646	4.459	-	1938	77
Region 6	74.5146	4.2078	-	356	17



Source: Natural Gas Intel[11] NG prices together with transportation cost.

Effect of the policy

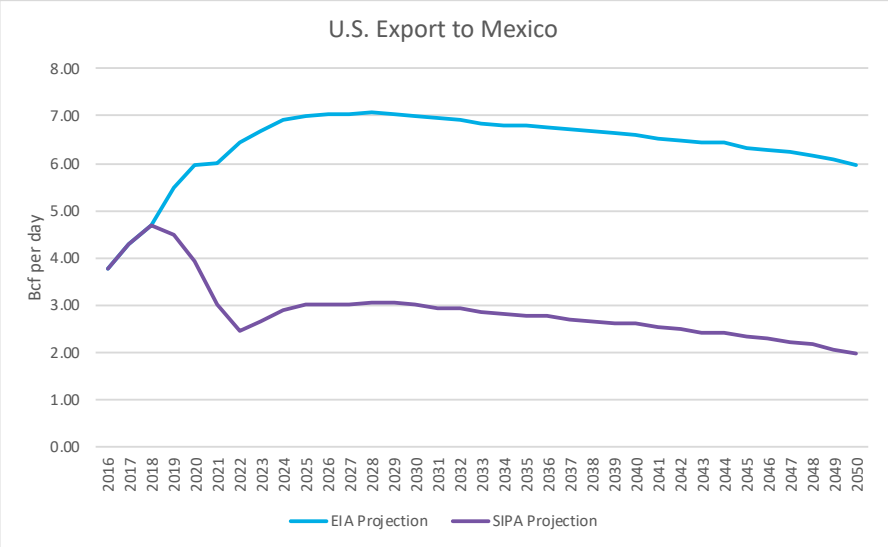
According to Mexican Energy Officials, Mexico can replace 1 Bcf/d equivalent of gas with its own fuel-oil in one year and it can increase this replacement up to 4 Bcf/d in four years.

In its reference case scenario, EIA predicts that U.S. pipeline and LNG exports to Mexico would increase until 2020. By the mid-2020s, Mexican domestic natural gas production begins to displace

[11] Peter de Montmollin, "Natural Gas Prices Drop in All Six of Mexico's Trading Regions", April 19, 2018. Retrieved from https://bit.ly/2Jz5bIE

U.S. exports. Increasing natural gas exports to Mexico are the result of more pipeline infrastructure to and within that country, allowing for increased natural gas-fired power generation. By 2030, pipeline export growth to Mexico slows down, and LNG exports (to the rest of the world) grow.[12] However, the hostile political environment would accelerate the Mexican production and Mexican domestic natural gas production would begin to displace U.S. exports by 2020. According to information derived from Mexican Officials, the export decline in a realistic worst-case scenario is shown below.

Figure 9: US Export Projection under NAFTA Impact in Comparison to EIA Projection



Source: SIPA Analysis and EIA Energy Outlook

The Impact on the U.S. Natural Gas Supply

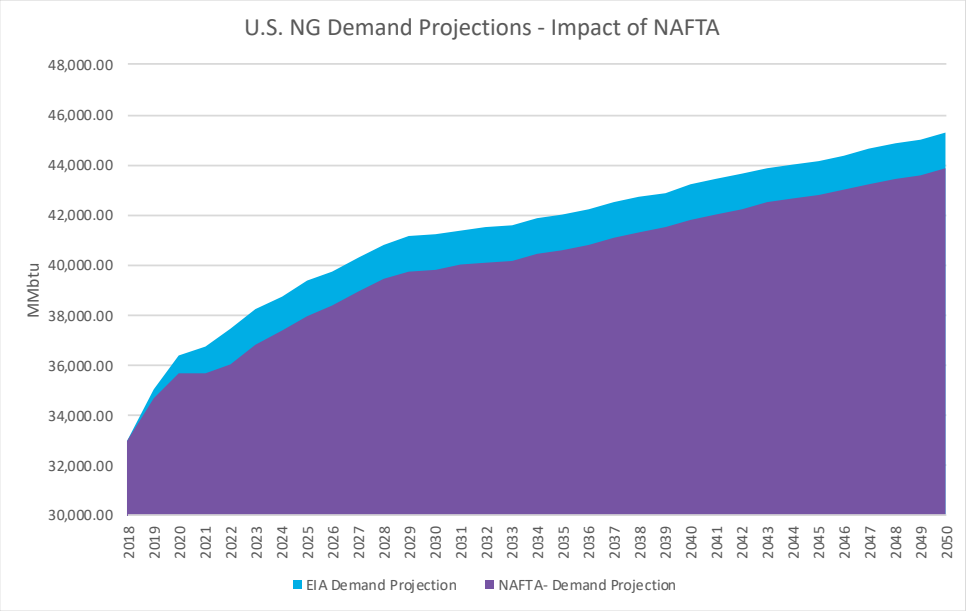
The impact of Mexican demand decrease on the U.S. market would be evaluated by looking at the U.S. price elasticity of Supply. According to Vipin Aurora[13], we can calculate the changes in natural gas supply in the United States with respect to "Economic Activity" shock, "Energy Demand" shock and "Speculative Demand" shock both in the short and the long-run.[14] The price elasticity of natural gas supply is 0.05 in the short-run; whereas it is 0.18 in the long. This means that 1% decrease in demand results in 0.05 per cent decrease in the prices in the short-run (one month); while in the long-run (one year) the price decline would reach to 0.18 per cent.

Keeping all else constant, 1 Bcf daily demand decline in 2019 accounts for 0.18% of U.S. daily total demand and it would affect the Henry Hub prices only $0.01. In the next year, while percentage decline in demand increases, its impact on Henry Hub prices remains low (3 cents increase holding all else constant). Therefore, at most the demand declines 0.68% and the prices increase $0.03.

[12] EIA, Annual Energy Outlook 2018, p.74, https://bit.ly/2JB52yc
[13] Vipin Aurora, 6 March 2014, "Estimates of the Price Elasticities of Natural Gas Supply and Demand in the United States" http://mpra.ub.uni-muenchen.de/54232/
[14] Short-Run 1 week, 1 month or 1 quarter; Long-run is 1 year, 5 years and 15 years according data type. In our analysis, we have chosen 1 month as short-run, 1 year as long run as we mostly use monthly data.

When all else is hold constant, the negative demand shock is relatively small. Mexico's demand decline represents at most 3.69% of overall U.S. demand in 2023 at mostly ranging around 3% of U.S. demand.

Figure 10: U.S. Natural Gas Demand Projection under NAFTA Impact



Source: EIA and SIPA Capstone team calculations[15]

[15] The projection is leveraged upon EIA's 2018 Annual Energy Outlook projection and all volumes in MMbtu and prices are in U.S. dollar per MMbtu.

Pipeline Permitting & Environmental Review

The Trump Administration has proposed changes to the National Environmental Policy Act and to the Clean Air Act. The following changes would affect pipeline permitting and have a potential impact on the U.S. natural gas market: establishing one lead agency for environmental reviews, a new pipeline permitting timetable for FERC, and changing 2016 New Source Performance Standards.

0.03%

Production Increase without the New Source Performance Standards.

3

Historical pipeline projects that would have been affected by new proposals

National Environmental Policy Act Changes: Reduced Pipeline Permitting Length & One Lead Agency

Currently, under section 309 of the NEPA, the EPA is required to review and publish comments on most environmental impact statements. Under the new infrastructure plan, one lead agency would develop a single environmental review for use by all agencies without EPA review or input.

Since FERC is already the lead agency under NEPA and the Energy Policy Act of 2005 for interstate pipelines, this new proposal would mean that FERC would usually develop the environmental review with sufficient information to inform decisions for all necessary federal agencies. Those agencies would then have 90 days to issue their authorizations and permits, and together they would coordinate on a single Record of Decision.

In March 2018, the Office of Management and Budget and the Council on Environmental Quality issued a Memorandum of Understanding (MOU) that established a new permitting timetable, which required federal agencies to process environmental reviews as “One Federal Decision.” The MOU also reduced the average time for each agency to complete the required environmental reviews and authorization decisions from the date of publication of a Notice of Intent (NOI) to prepare an EIS to two years.[16] On April 9, 2018, the EPA, FERC, the Advisory Council on Historic Preservation, the Federal Permitting Improvement Steering Council, U.S. Army Corps of Engineers, the Department of Homeland Security, Energy, Transportation, Commerce, Agriculture, Housing and Urban Development, and the Interior all became parties to the MOU.

The MOU established:

1. Formal scoping and preparation of a Draft EIS (DEIS) within fourteen months, beginning on the date of publication of the NOI to publish an EIS and ending on the date of the Notice of Availability of the DEIS.
2. Completion of the formal public comment period and development of the Final EIS (FEIS) within eight months of the date of the Notice of Availability of the DEIS; and
3. Publication of the final ROD within two months of the publication of the Notice of Availability of the FEIS.

[16] MEMORANDUM OF UNDERSTANDING IMPLEMENTING ONE FEDERAL DECISION UNDER EXECUTIVE ORDER 13807 (2018). https://www.whitehouse.gov/wp-content/uploads/2018/04/M-18-13.pdf

Impact

Federal Permitting Agencies:

FERC previously required other federal and state agencies to respond within 90 days of its final environmental document therefore the three-month requirement in the new permitting timetable may have limited effects.[17] The 90-day timeline lacked strict enforcement, however, so the new policy may still achieve its delay reducing purpose. Additionally, under the Clean Water Act Section 401, permitting authorities have one year to review after receiving an application before FERC can issue a waiver overriding that authority. FERC historically does not override water permit denials unless past the one year period. The New York Department of Environmental Conservation used this particular policy to deny permits to the Constitution Pipeline and the Northern Access Pipeline both of which FERC has not overridden when appealed by the companies.

States:

The Associate Director for Regulatory Reform at the Council on Environmental Quality, Mario Loyola, said these changes will give more responsibility for environmental review to states and that regulatory authorities delegated to states, such as the permits under the Clean Air Act, will remain with them. Even if FERC leads the environmental review, it will not override a state's authority unless due to noncompliance with the established timetable. (Such as in the case between the New York Department of Environmental Conservation and the Valley Lateral Project.)

Costs:

Compared to the previous average of 4.1 years from Notice of Intent to prepare an environmental assessment/impact statement to Record of Decision issuance, this change could result in a decrease in delay costs for companies. Most companies already factor in environmental review and permitting delays when planning their projects, but this is not publicly available information, so actual cost impact is unclear. Additionally, even though this new timetable limits permitting delays, FERC can revise and reissue the Notice of Intent and this would reset the timetable.

The initial infrastructure proposal with these changes also suggested a reduced statute of limitations of 150 days for appeals on FERC's and other permitting decisions (down from two years). Under the existing rule Section 41007, actions challenging a federal authorization and requesting a judicial review of the NEPA process for Covered Projects must be filed within two years of the final agency decision or approval.[18] This shortened judicial review period would save legal fee cost for companies.

Supply:

With the new schedule requirements for an environmental review average reduced to 22 months, pipelines should be expected to reach completion two years sooner than the current 49-month average. This will not affect overall supply in the EIA forecast, but may move forward supply amounts.

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[17] FERC: News Release - Commission Acts to Implement Energy Policy Act Mandate for Consolidated Record in Natural Gas Proceedings. June 28, 2010. Accessed April 10, 2018. https://www.ferc.gov/media/news-releases/2006/2006-2/05-18-06-C-2.asp.

[18] Arnold & Porter. "Expediting Environmental Review and Permitting of Infrastructure Projects: The 2015 FAST Act and NEPA | Publications and Presentations." Arnold & Porter. Accessed May 1, 2018. https://www.arnoldporter.com/en/perspectives/publications/2015/12/expediting-environmental-review-and-permitting.

This expanded pipeline capacity will narrow price differentials with an estimated price decrease of .17% for each 1% addition to supply.

Effects of One Federal Decision:
Though the lead agency could be any agency that has the most authority in that region and depends on the project, it is likely that for interstate pipelines, FERC will be lead agency.

To understand the effects of the new One Federal Decision policy, this report examined all of the projects on hold, cancelled, or rejected in the EIA 2018 Energy Outlook and found the following:

- Two projects that would have avoided delays:
  - Leidy Southwest could have avoided appeals by the Sierra Club since the appeal was a year after FERC;s decision and the new infrastructure policy has a 150-day statute of limitations.
  - Leach Xpress was delayed due to an EPA comment during the review period which stated that FERC's Environmental Impact Statement did not meet NEPA requirements. FERC then had to revise and issue another Final Environmental Impact Statement. Under the new policy, there would be no EPA review.
- One project may have avoided cancellation:
  - The Jordan Cove/Pacific Connector project was cancelled due to a lack of need and because FERC did not think the benefits outweighed the adverse effects to landowners such as eminent domain and environmental impact. Under this new FERC, there is potential it would have been approved. The company reapplied to FERC in September 2017, so it may now be approved.

2016 New Source Performance Standards Changes

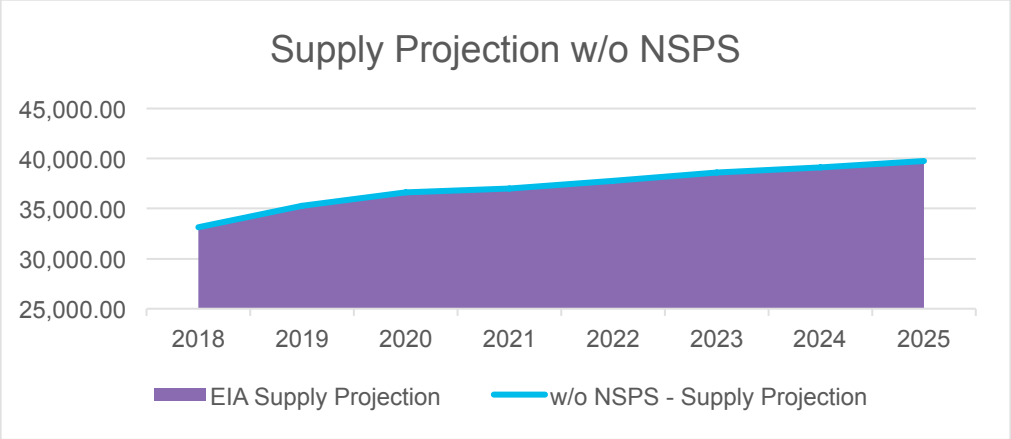
Section 111 of the Clean Air Act established new methane emissions standards in 2016. The EIA baseline included these standards, but the NSPS amendment occurred in 2018. According to a previous EPA report on the economic impact of these changes, removing these particular standards will result in a slight increase in production of 0.03% between years 2020 to 2025.[19]

Figure 11: Economic Impact of New Emission Standards

	2020	2021	2022	2023	2024	2025
Baseline Production	0.11	0.11	0.12	0.12	0.12	0.12
Increase w/o NSPS	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%
New Production (MMcf/d)	0.110414	0.113175	0.116004	0.118904	0.121877	0.124924

Source: EPA Report

[19] Regulatory Impact Analysis of the Final Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources. Report. EPA. May 2016. Accessed February 23, 2018. https://www3.epa.gov/ttnecas1/docs/ria/oilgas_ria_nsps_final_2016-05.pdf.



What to Watch

In July 2017, the U.S. House of Representatives passed two energy bills with targeted reforms to the federal government's oil and natural gas pipeline permitting and siting policies. Under the new administration, it can be expected that Senate versions will be introduced and the Memorandum of Understanding policies may become law.

How the One Federal Decision will play out between states and FERC regarding pipeline permitting and approval, will determine the severity of these changes. Despite the White House Council on Environmental Quality officials claiming states would keep regulatory authority, FERC may interpret the new Memorandum of Understanding requirements differently.

Particular projects to watch: the Pacific Connector re-application and New York permitting denials. Regulators are still fighting FERC in court over the Valley Lateral Project, but after the court voted against the regulators the first time, Millennium began construction in December 2017 and the court rejected the New York Department of Environmental Conservation a second time in March 2018 on the grounds that the state should have just denied the application instead of accepting an incomplete one. Cases where this happens could become more common.

Appendix

Figure 12: Historical Review of Projects Meeting New Timetable Requirements

Project	FERC Decision	New requirements Effect	Review Length
Leach Xpress (Columbia Gas)	**Approved.**	**Yes.**	**15 months.**
	Context: EPA review & comment that FERC Environmental Impact Statement does not meet NEPA requirements (factor in climate change)	**Context:** Now no EPA review. This project would have received certificate sooner, after initial Final Impact Statement in Sept. 2016	1st FEIS- 9/2016 2nd FEIS- 7/2017 Certificate issued- 12/2017
	Approved.	**None.**	

Constitution Pipeline	**Context:** NY DEC denied water permit based on lack of relevant info from company and the damage the project would do to water supplies along route. Appeal to FERC 1/2018 but FERC affirmed that a waiver of a CWA 401 water-quality review occurs following one year after an agency receives an application. Petitioning Supreme Court.	**Context:** Water permit agency has a year to review application under the Clean Water Act Section 401. **Reason:** Denied within reasonable amount of time. (4/2016)	FEIS- 10/2014 Certificate issued- 12/2014 Permit application issued 3 times, last in 2015.
Southeast Market Pipelines	**Approved.**	**None.**	
	Context: FERC approved, but Sierra Club appealed in U.S. Court of Appeals claiming the environmental impact statement (EIS) by FERC failed to consider the impact of greenhouse gas emissions. FERC insisted that GHG impact defies measurement. Court vacated all permits.[20]	**Context:** Each step would have fallen into new policy timeline.	NOI- 5/2015 DEIS- 9/2015 FEIS- 12/2015 Certificate- 2/2016 Sierra Club hearing request- 3/2016 Court Vacates permits- 7/2017 Certificates reinstated- 3/2018
Leidy Southeast	**Approved.**	**Yes.**	
	Context: Received FERC approval and NJ and Pennsylvania issued water quality permits. Delaware Riverkeeper Network & NJ Conservation Foundation appealed in court in 2015.[21] Court turned away the lawsuit 5/2017.	**Context:** Environmental groups would not have been able to file an appeal a year later since new statute is 150 days.	File- 9/2013 Certificate issued- 12/2014 Placed into service- 11/2015
Valley Lateral Project	**Approved.**	**None.**	
	Context: FERC approved, but NY DEC denied water quality permit. Commission said the state had waived its right b/c failed to act on the WQC within a one-year timeframe as required under the CWA.[22]		Permit application- 11/2015 FEIS- 5/2016 DEC requested info- 6/2016 Received requested info- 8/2016 Certificate issue- 11/2016
Jordan Cove/Pacific Connector	**Approved.**	**Yes.**	
	Context: Rejected with lack of prejudice by FERC in 2016 due to lack of need/LNG customers & adverse effects on landowners. Reapplied 9/2017 with benefits redefined and route adjustments.	**Context:** Potential to pass under new FERC that is less worried about adverse environmental effects.	
	Approved.	**None.**	

[20] Court Rejects FERC EIS, Orders Another for Trio of Southeast NatGas Pipelines." Natural Gas Intelligence. August 22, 2017. Accessed April 1, 2018. http://www.naturalgasintel.com/articles/111481-court-rejects-ferc-eis-orders-another-for-trio-of-southeast-natgas-pipelines.

[21] Appeals Court Upholds Transco's Leidy Southeast Expansion Permits." Natural Gas Intelligence. August 10, 2016. Accessed March 29, 2018. http://www.naturalgasintel.com/articles/107367-appeals-court-upholds-transcos-leidy-southeast-expansion-permits.

[22] "New York Urges Court to Vacate FERC OK for Valley Lateral." Natural Gas Intelligence. January 19, 2018. Accessed April 03, 2018. http://www.naturalgasintel.com/articles/113106-new-york-urges-court-to-vacate-ferc-ok-for-valley-lateral.

Northern Access Pipeline	**Context:** Water permit denied 4/2017. (Based on an opinion that the project did not adequately protect wetlands, waterways and wildlife.)[23]National Fuel appealed decision with FERC to see if it can move forward without DEC.	**Context:** Company would need to adjust project to receive water permit. FERC historically doesn't override water permit denials unless past the 1 year period.	FERC issued ROD-2/2017
Northeast Energy Direct	**On Hold.** Kinder Morgan cancelled the project because could not find sufficient utility customers.		
Demicks Lake Pipeline project	**Cancelled.** **Context:** Stalled development of gas processing plant. ONEOK Partners suspend development of gas processing plants due to low crude oil prices.[24]		
Access Northeast	**Cancelled.** **Context:** Financing problems- trying to get ratepayers to pay for expansion. Massachusetts court denied this and prohibited regulators from approving contracts.		
Sooner Trails Project	**Withdrawn.** Company withdrew FERC pre-filing application		

Source: SIPA Analysis

Figure 13: Federal & State Agencies Responsible for Permitting

Permit	Lead Agency/Issuer
CWA section 402 (pollutions discharged into WOTUS, Storm Water Runoff)	EPA National Pollutant Discharge Elimination System (NPDES) program or the state NPDES permitting authority.
CWA section 404 (dredged material discharged in WOTUS)	U.S. Army Corps of Engineers or, for certain waters, a state with an approved Section 404 permitting program. *Permit decisions use environmental criteria developed by EPA.*
CWA section 401 (project may affect water quality)	State water quality agency. (or EPA if none)

[23] Summerson, Mia. "TOP 10: Dramatic Year for Northern Access Pipeline Project (No. 10)." Niagara Gazette. December 21, 2017. Accessed April 5, 2018. http://www.niagara-gazette.com/news/local_news/top-dramatic-year-for-northern-access-pipeline-project-no/article_18ae6b8d-abac-5a5c-9ae6-599ca073ea88.html.

[24] "FERC Starts Environmental Review of Proposed North Dakota NatGas Pipeline." Natural Gas Intelligence. July 28, 2015. Accessed April 15, 2018. http://www.naturalgasintel.com/articles/103133-ferc-starts-environmental-review-of-proposed-north-dakota-natgas-pipeline.

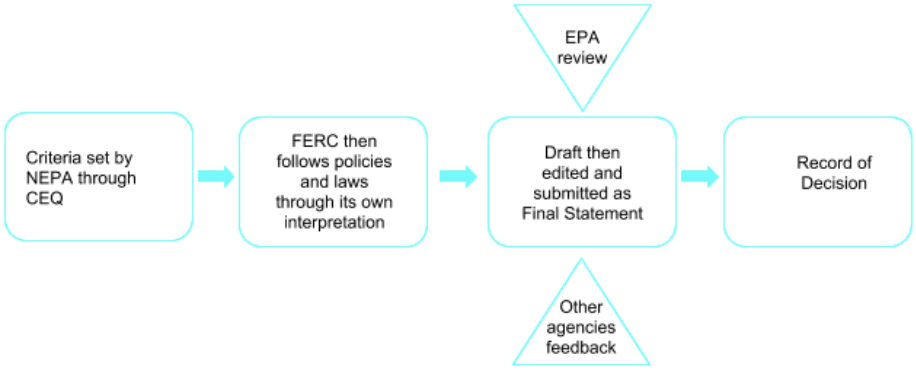
Clean Air Act	State Implementation Plans (or EPA if none)
NEPA (interstate and intrastate)	FERC. Under NEPA, FERC is responsible for developing an environmental review of the project with an Environmental Assessment (EA), an Environmental Impact Statement (EIS), or both.
Rivers and Harbors Act of 1899 (pipelines that affect navigable waters)	Army Corps of Engineers
Endangered Species	Fish & Wildlife Service or Department of Commerce's National Marine Fisheries Service
National Historic Preservation Act (section 106)	The Advisory Council on Historic Preservation or state historic preservation offices.
Section 307 of the Coastal Zona Management Act (CZMA)	State Agencies

Source: SIPA Analysis

Environmental Review/Criteria:

Council on Environmental Quality (CEQ) was established as part of NEPA of 1969 to ensure Federal agencies meet their obligations under NEPA and to oversee NEPA implementation, primarily through issuing guidance and interpreting regulations that implement NEPA's procedural requirements.

Figure 14: Environmental Review Process and Structure



Source: SIPA Analysis

BLM Federal Land Management and Offshore Drilling Acreage

The Trump Administration is moving forward to remove a series of restrictions on onshore drilling to speed up the onshore oil and gas production process. At the same time, the administration is proposing a new program for offshore drilling. The following changes would have a potential impact on the U.S. natural gas supply:

- Eliminating hydraulic fracturing rule
- New Offshore Drilling Program

Removing restrictions on onshore drilling

Eliminating the hydraulic fracturing rule will reduce the compliance cost for producers by approximately $14 to 34 million per year. The reduction in cost is minor compared to the overall cost.

New Offshore Drilling Proposal Impact

In the midterm report, our research found out that in spite of the Trump administration's ambitious plan in opening up nearly 90% of US water for offshore drilling, only the extra lease sale in the Gulf of Mexico is likely to happen. The question posed for the follow-up study is: how will adding new lease sale in Gulf of Mexico boost supply? And if it does, how long is it going to take to develop those areas?

In the current lease sale schedule for 2017 to 2022, two lease sales are scheduled for each year in the Gulf of Mexico. In Trump's new offshore drilling proposal, this will remain the same. The only difference is that in his new proposal, one lease will be added for each year from 2023 to 2024 for the Eastern and Central Gulf of Mexico. Those areas are currently under GOMESA Moratorium and have been banned from drilling since 2006. The moratorium is due to expire in 2022. The interest in developing in those areas is high. Right after President Trump signed an order to roll back Obama's offshore drilling limits last April, the Nation's top oil group, American Petroleum Institute stated they wanted regulators to consider to allow drilling in the Eastern Gulf of Mexico[25]. But in President Trump's offshore drilling proposal, those areas are still not open until the expiration of GOMESA Moratorium. Thus, although BOEM will receive more bids for those areas from those two extra lease sales, the hike in the gas production should have already been included in the baseline study and should not be considered as an impact of the Trump Administration's new BLM policy.

It historically takes five to ten years for a producer who has won a bid to actually start drilling.[26] During this period, the producer will pay the annual rent from $100 to $5,000 per acre in some extreme cases, depending on how much competition there is between companies, but they do not need to pay the royalty until they start producing. Based on the long horizon of the development process, even if President Trump moved the two extra lease sales ahead of the expiration of GOMESA moratorium, it is highly possible the decision will be reversed by the next administration.

[25] HENRY, DEVIN. "Oil Lobby Pushes for Offshore Drilling in the Eastern Gulf of Mexico."

[26] Fericy, Jacob. "Interview with BNEF Analyst." E-mail interview by author. April 2018.

What to Watch

On March 28, 2018, the Interior Department asked for public comment about drilling in the Beaufort Sea off Alaska's coast which is part of the agency's new offshore oil and gas leasing proposal in offshore Alaska. A coalition of environment groups claimed that planning for a Beaufort lease sale this early in the process of President Trump's five-year plan is a clear sign that the decision to include the Arctic has already been made.[27]

The industry currently may not be interested in drilling in offshore Alaska yet because of high cost and risk. Additionally, the profit margin to produce in this area is overshadowed by easier-to-access onshore fracking opportunities from the shale boom. However, depending on the future price of the oil price, their indifference may reverse.

[27] Siegel, Josh. "Interior Department Gauging Industry Interest in Drilling off Alaska's Coast."

Tax Reform and Impact on incremental Supply

$0.21/Mcf

Price benefit for natural gas producers under tax reform

0.95 Tcf

Production increase due to the price benefit change

The change in corporate tax rate from 35% to 21% will allow the natural gas producers to free up cash and invest in new projects. SIPA analyzed twelve fields from four major US natural gas basins to show, on average:

- There will be a 0.21/Mcf increase in the Life-of-Filed realized gas price, assuming the tax rate stays at 21% in the future.
- The Equivalent Price Impact (EPI) of a lower tax rate will increase the production in 2022 by 0.95 Tcf (3.52%), compared to the 2017 level.

Equivalent Price Impact

The Equivalent Price Impact (EPI) of Corporate Tax Rate Change is a measure of price increase or decrease that can produce relatively the same outputs, which are measured by Net Present Value and Internal Rate of Return, in case there were no change in tax rate. If the “Competitive Market” assumption for the US Natural Gas sector is true, then each producer in the market is a price taker. These companies can maximize profit by optimizing the variable that they can control, namely the production, and will adjust the level of output depending on the price level.

The EPI measurement provides the equivalent price change and the new prevailing market price of the change in tax rate from 35% to 21%. Assuming that all else is equal and producers react as if there were an actual price movement, the long-run and short-run impact on the total production can be measured by using the price elasticity of the U.S. Natural Gas supply.

The assumption that producers will treat the change in the Corporate Tax rate as if it were a price movement is predicated on the fact that profit maximizing entities value money today more than that of the later period. Having a lower tax payment means firms can obtain more cash flow today by accelerating reserves depletion. The same cash flow increase can also occur from a price increase condition.

The result of the analysis on 12 fields from 4 major US natural gas basins (Anadarko, Appalachian, Gulf Coast, and Ark-La-Tex), which account for approximately 70% of the total recoverable reserves value, shows that, on average, the impact of the tax reduction from 35% to 21% is equivalent to having a $0.21 per Mcf or 7% increase in their Life-of-Field realized gas price, assuming that the tax rate remains at 21% in the coming years.

Price Elasticity of U.S. Natural Gas Supply

The price elasticity of supply becomes a relevant piece of information in projecting the U.S. production level in the future as the country shifts its status from net importer to exporter. According to Vipin Arora from the Energy Information Administration,[28] the U.S. gas market has a positive price elasticity of supply for both intervals. The study selects samples from the EIA data throughout the 1993-2013 period and finds that price elasticity of supply is less responsive towards the energy demand, but is

[28] Vipin Aurora, 6 March 2014, “Estimates of the Price Elasticities of Natural Gas Supply and Demand in the United States” http://mpra.ub.uni-muenchen.de/54232/

showing stronger association with the factors that are causing the energy demand to change, notably economic growth or inventory demand. The author further argues that the change in energy demand was probably seen as a temporary event while the change in the economic growth or the inventory is seen as something that is more fundamental and can have longer repercussion.

The study classifies the economic shocks that determine the price elasticity of supply into four categories: Economic Activity, Energy Demand, Speculative Demand, and Supply. Figure 15 shows the summary of findings.

Figure 15: Price Elasticity of U.S. Natural Gas Supply

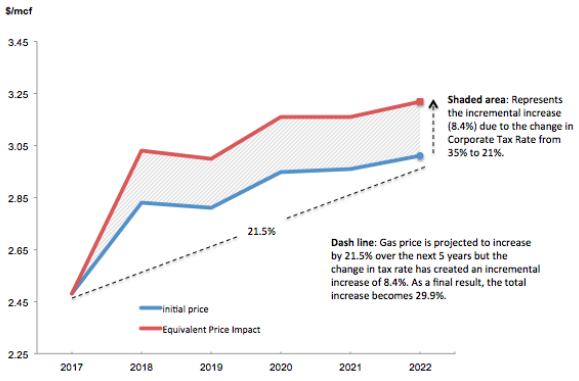
Timeframe	Economic Activity	Energy Demand	Speculative Demand
1 Year	0.21	0.07	0.43
5 Years	0.42	0.18	0.31
15 Years	0.4	0.17	0.48

Source: "Estimates of the Price Elasticities of Natural Gas Supply and Demand in the United States" (Arora, 2014)

Production Impact

Based on the analysis of the 12 natural gas fields, the change in Corporate Tax rate will create an effect similar to an incremental price increase of 8.4% between 2017-2022. The original gas projection shows an increasing trend. However, the tax rate change is going to allow the producers to benefit from having the additional free cash flow that can be used to increase their production. Figure 16 describes the incremental impact of the tax reform.

Figure 16: Equivalent Price Impact

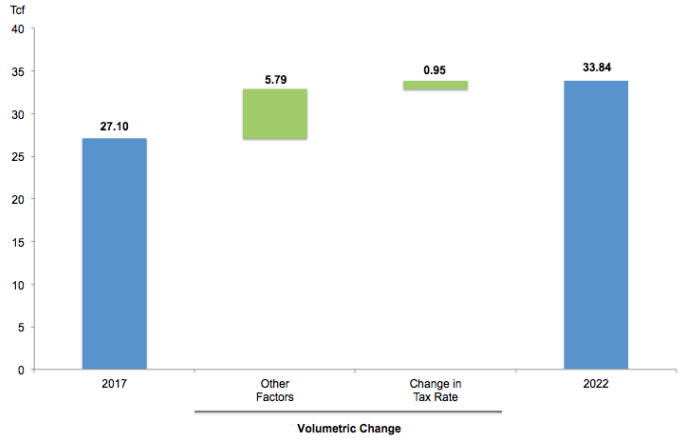


Source: SIPA Capstone BNEF Analysis using Wood Mackenzie data

The Corporate Tax rate modification can be categorized as an "Economic Activity", and according to the study, a 1% increase in gas price over the next five years will increase the total U.S. production by 0.42%. As a result, around 3.52% (8.4 * 0.42%) increase in U.S. production between 2017-2022 can be attributed to lower tax rate. A five-year period (2017-2022) is selected for the analysis given that it

would be a reasonable timeframe to assume the continuity of the tax reform policy. Figure 17 shows the breakdown of dry gas production increase between 2017-2022 using the EIA 2018 Annual Outlook.

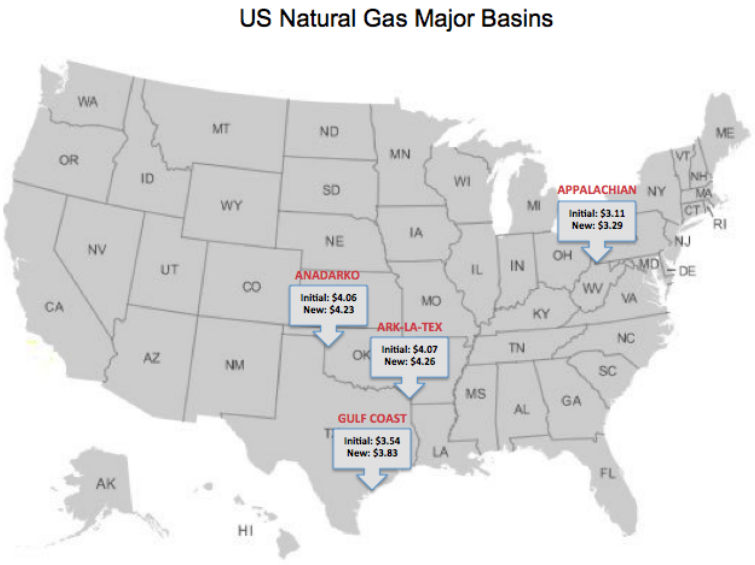
Figure 17: EIA 2018 Annual Outlook: U.S. Dry Gas Production 2017-2022



Source: SIPA Capstone BNEF Analysis using EIA data

Appendix

Figure 18: Equivalent Impact on Life-of-Field Realized Prices ($/Mcf)



Source: SIPA Capstone BNEF Analysis using EIA data

Other Policy Updates

28.28 BCF

Total demand increase for natural gas over the period of 2018-2022 to make up the loss in solar generation

25%

tariff imposed on steel and steel product import intended to protect domestic steel and manufacturing industry

9%

effective tariff on natural gas pipeline related product taking into account the countries exempted from the tariff

Solar Tariff Impact on Natural Gas Demand

Based on the first stage of research, the SIPA analysis found that the aggregate decrease in installed solar capacity over the next five years will be 7.5 GW. The yearly reduction is presented below:

Figure 19: Annual Reduction on the Aggregate Decrease in Installed Solar Capacity

	2018E	2019E	2020E	2021E	2022E	*UNIT*
Projected Installation	10,899	14,210	14,498	14,360	14,831	*MW DC*
Reduction %	-7%	-16%	-13%	-12%	-6%	
Reduced Installation	763	2,274	1,885	1,723	890	*MW DC*
Solar Output Gap	378,716	1,128,577	935,566	855,410	441,722	*MWH*
Gas demand increase	2.87	8.56	7.10	6.49	3.35	*BCF*
				Total	**28.28**	***BCF***

Source: SIPA Analysis

Assuming 17% module efficiency and that the solar panels can produce energy for 8 hours/day, we got a total of 3,739,991MWH loss in energy generation. Assuming all of the loss in solar generation is met through increased energy demand from natural gas-fired generation, an aggregate demand increase of 28.28 Bcf for natural gas over the period of 2018-2022 is expected.

Steel Tariff Impact on U.S. Gas Market

On March 1, 2018, President Trump announced his intention to enforce a 25% tariff on steel and a 10% tariff on aluminum imports, based on Section 232 investigation conducted by Department of Commerce.[29] In a tweet issued the next day, President Trump asserted that "Trade wars are good, and easy to win." [30]

On March 8, Trump signed an order to impose the tariffs. The tariffs were intended to protect U.S. industries from unfair competition and to bolster national security, one of his main promises during the 2016 presidential campaign.

Development and Impact

Although the President initially announced the Tariff as a protection mechanism against all other countries, he later temporarily excluded Argentina, Australia, Brazil, South Korea, Canada, Mexico and the European Union, the U.S.'s biggest trading partner, until May 1, 2018 as discussions continue.[31] In addition, South Korea would have a capped amount of the exempted product at around 70% of its steel export to the U.S.

The implication for the steel and aluminum tariff is more from the pipeline perspective. The core of the oil and gas pipeline business depends on infrastructure and processing facilities where material cost

[29] "Section 232 Reports." Department of Commerce. March 08, 2018. Accessed April 29, 2018.
[30] Trump, Donald J. March 2, 2018.
[31] Wroughton, Lesley. "Trump Temporarily Excludes EU, Six Other Allies from Steel Tariffs." Reuters. March 23, 2018. Accessed April 29, 2018.

is a significant portion of capital expenditure. The tariff will increase the cost for new pipeline construction and pipeline maintenance, increasing the cost of supply.

Using the 2017 U.S. steel import for pipeline related product by country (exempted and non-exempted) and types of product, the SIPA analysis calculated the overall effective tariff impact to the U.S. gas pipeline industry. [32] The countries temporarily exempted from the steel tariff account constitute more than 52% of the total American steel import for pipeline related product. If South Korea is considered, from which about 70% of its steel export are exempted, the tariff exempted import accounts for 70.51% of the steel import specific to pipeline and related industry.

Figure 20: Steel Import Countries Information

Countries exporting line pipe, plate or coil to the U.S.	Cut-to-length plate (metric tons)	Plate coil (metric tons)	Line Pipe <= 16"	Line Pipe 16.1-24"	Line Pipe >24"	Sum Metric Tons related to Line pipe	Approx. Annual Value ($ mm)	U.S. import %	Tariff	Total Tariff impact
Argentina			11,418			11,418	11	0.49%	-	0.00%
Australia		3,987				3,987	3	0.13%	-	0.00%
Austria	21,578		12,173			33,751	24	1.07%	-	0.00%
Belarus			22,356			22,356	22	0.98%	25%	0.25%
Brazil		10,740	15,163			25,903	22	0.98%	-	0.00%
Canada	19,034	63,555	38,556	163,674	7,361	292,180	276	12.33%	-	0.00%
China				12,402	7,396	19,798	21	0.94%	25%	0.23%
Czech			15,455	4,765		20,220	20	0.89%	-	0.00%
Finland	8,496					8,496	5	0.22%	-	0.00%
France	109,427				14,020	123,447	76	3.40%	-	0.00%
Germany	102,993	4,505	78,013	40,463	69,867	295,841	257	11.48%	-	0.00%
Greece			16,890	112,258	11,636	140,784	149	6.66%	-	0.00%
India			26,974	52,559	74,707	154,240	166	7.42%	25%	1.85%
Israel			16,898			16,898	16	0.71%	25%	0.18%
Italy	9,715	29,112	42,493	21,870	72,210	175,400	171	7.64%	-	0.00%
Japan	8,112	4,869	52,725	54,210	14,327	134,243	133	5.94%	25%	1.49%
S. Korea*	14,607	54,774	230,306	82,191	30,072	411,950	392	17.52%	8%	1.31%
Mexico		22,954	85,440			108,394	99	4.42%	-	0.00%
Netherlands		12,485				12,485	9	0.40%	-	0.00%
Oman				4,961		4,961	5	0.22%	25%	0.06%
Philippines			10,241			10,241	10	0.45%	25%	0.11%
Romania					6,170	6,170	7	0.31%	-	0.00%
Russia	12,288	25,529	24,472			62,289	49	2.19%	25%	0.55%
South Africa			22,659			22,659	22	0.98%	25%	0.25%
Taiwan	11,362		39,820			51,182	45	2.01%	25%	0.50%
Turkey	11,022	46,049	38,870		49,341	145,282	132	5.90%	25%	1.47%
Ukraine			20,769			20,769	20	0.89%	25%	0.22%
UK	21,366	21,442	17,053	6,146	5,894	71,901	57	2.55%	-	0.00%
Vietnam			19,252			19,252	19	0.85%	25%	0.21%
Sum	**350,000**	**300,001**	**857,996**	**555,499**	**363,001**	**2,426,497**	**2,238**	**Effective Tariff**		**9%**

**shaded area are tariff exempted, S. Korea is subject to cap.*

Source: ICF

Source: SIPA Analysis

A recent interview with CP Industries also reflect the aggregate cost increase for pipeline producers. “The tariff will add about 10 percent to the cost of CP Industries’ cylinders”, which store gas at high pressure and can serve Navy, NASA or Energy company. Additionally, the company estimated that it could get only a fifth of the steel pipe it needed domestically, from only one American firm. Domestic

[32] "Feasibility and Impacts of Domestic Content Requirements for U.S. Oil and Gas Pipelines" ICF. May 17, 2017. Accessed April 29, 2018.

pipes are also delivered in random lengths and require additional milling, cutting and testing, raising processing costs by about 16%.[33]

Although the short-term cost increase to the domestic pipeline maker is 9%, the magnitude of overall impact on the U.S. gas market is undetermined. In 2017, pipeline cost was estimated to be 22.1% of the capex of the oil and natural gas industry[34] and a 9% increase translates into an almost 2% incremental cost increase for pipeline companies. However, companies make decisions on new pipeline construction depending on more factors than the pipeline material price and those factors may have greater effect on the overall supply and demand for natural gas.

What to Watch

On **May 1**, the President will determine which exempted countries will be permanently exempted or subject to the steel and aluminum tariff.

China is expected to file a complaint to WTO and might take retaliation measures against the U.S. which might lead to an early sunset of the tariff policy.

Domestic energy and pipeline related industry groups are lobbying for steel tariff exemptions on the OTGC product. If the negotiation is successful, the impact on the gas industry and the price of supply will be lower than projected.

Conclusion

The SIPA Capstone team found that the proposed Trump Administration policy changes will result in minimal impact that is likely to only change the projection from the EIA baseline slightly.

The U.S. natural gas market will most likely be affected by the following:

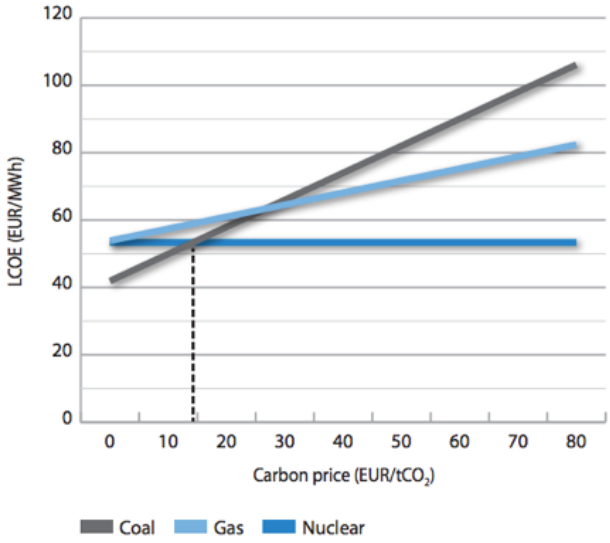
The rise of Energy Storage as a potential replacement for gas-peaker plants may have a profound impact on natural gas demand. As the cost of batteries continues to decline, 32% of the gas-peaker plants may be at risk of replacement by 2027.[35] On average, between 2019-2027, around 9.8 Tcf (33.3%) per year of U.S. natural gas supply will be used in the power sector.[36] Apart from the low gas price environment, the fuel switching from coal to gas in the power sector is also predicated on the flexibility of gas turbines to ramp up and down. As a comparison, the start-up time for a typical gas turbine ranges from 4-45 minutes in hot starts and 4-250 minutes in cold starts, compared to 100-300 and 450-900 for coal power plants.[37] Ramping range of 25-50 MW/min for gas turbines is also higher than that of coal power plants, with the average range of 2-40 MW/min.[38] Because of this, natural gas

[33] Porter, Eduardo. "'How Long Can We Last?' Trump's Tariffs Hit Home in the U.S." The New York Times. April 10, 2018. Accessed April 29, 2018.
[34] ICF. Ibid.
[35] Emma Foehringer Merchant, "Have We Reached Peak Peaker? 'I Can't See Why We Should Build a Gas Peaker After 2025'," Greentech Media, December 12, 2017, accessed April 27, 2018, https://www.greentechmedia.com/articles/read/battery-storage-is-threatening-natural-gas-peaker-plants#gs.4jrTj_E.
[36] "EIA Annual Energy Outlook 2018," Energy Information Administration, February 6, 2018, , accessed April 27, 2018, https://www.eia.gov/outlooks/aeo/.
[37] Miguel Angel Gonzalez-Salazar, Trevor Kirsten, and Lubos Prchlik, "Review of the Operational Flexibility and Emissions of Gas- and Coal-fired Power Plants in a Future with Growing Renewables," *Renewable and Sustainable Energy Reviews*, 1st ser., 82 (2018): 1497-1513, accessed April 27, 2018, doi:10.1016/j.rser.2017.05.278.
[38] Ibid

power plants possess a unique characteristic that places them as a perfect complement for intermittent solar PV and wind generation. This combination will become more apparent in many jurisdictions as the world moves toward a low carbon future.

Conversations around **Carbon Pricing** as a solution to mitigate the Climate Change are no longer an exclusive subject for politicians from the left. The Climate Solutions Caucus, a bipartisan group in the House of Representatives that has 58 members coming from the Democratic and Republican parties, is advocating for a policy that imposes a "fee" on carbon emission.[39] Although the implication of a price on carbon emission is still unknown, depending on the level of the taxation, it could potentially alter the current electricity generation mix in the U.S. power market. Figure 21 describes the relationship between carbon price and the Levelized Cost of Electricity of Nuclear, Coal, and Natural Gas power plants.[40]

Figure 21: Coal, Natural Gas, and Nuclear LCOE Comparison Under Different Carbon Price



Source: OECD

[39] Carbon Fee and Dividend Policy," Citizen's Climate Lobby, accessed April 27, 2018, https://citizensclimatelobby.org/climate-solutions-caucus/.
[40] *Carbon Pricing, Power Markets, and the Competitiveness of Nuclear Power*, publication (OECD, 2011), accessed April 25, 2018, https://www.oecd-nea.org/ndd/reports/2011/carbon-pricing-exec-sum-2011.pdf.

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