

Paper #3-6

NATURAL GAS EXPORTS TO MEXICO

Prepared for the Demand Task Group

On September 15, 2011, The National Petroleum Council (NPC) in approving its report, *Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources*, also approved the making available of certain materials used in the study process, including detailed, specific subject matter papers prepared or used by the study's Task Groups and/or Subgroups. These Topic and White Papers were working documents that were part of the analyses that led to development of the summary results presented in the report's Executive Summary and Chapters.

These Topic and White Papers represent the views and conclusions of the authors. The National Petroleum Council has not endorsed or approved the statements and conclusions contained in these documents, but approved the publication of these materials as part of the study process.

The NPC believes that these papers will be of interest to the readers of the report and will help them better understand the results. These materials are being made available in the interest of transparency.

The attached paper is one of 57 such working documents used in the study analyses. Also included is a roster of the Task Group that developed or submitted this paper. Appendix C of the final NPC report provides a complete list of the 57 Topic and White Papers and an abstract for each. The full papers can be viewed and downloaded from the report section of the NPC website (www.npc.org).

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Working Document of the NPC North American Resource Development Study
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Summary

The current Secretaria de Energia - The Mexican Ministry of Energy (Sener) plan shows roughly 500 MMcf/d of net imports from the US by 2024. The average for 2009 was over 800 MMcf/d. If we assume that Petróleos Mexicanos (Pemex) produces natural gas to the level forecast by Sener, that LNG is imported to Mexico using a 50% capacity factor for their 2 Bcf/d of regasification capacity, and that most of the new power capacity additions are natural gas-fired, then the amount of natural gas to be imported from the US by Mexico by 2024 is closer to 2.5 to 3 Bcf/d. This is consistent with the EIA AEO 2010 Reference Case that projects US exports to Mexico at 2.33 Bcf/d in 2025 (Table associated with Figure 77, US Net Imports of Natural Gas)

Mexico's Natural Gas Supply

Mexico has three main sources of gas supply: domestic production; net imports from the US (a source of demand for US natural gas production) and LNG imports. Domestic natural gas production has averaged 5,451 MMcf/d over the last five years (2004-08) and was 6,014MMcf/d in 2008 (Sener's *Prospectiva_Gas Natural_2009-2024*). The Burgos Basin in Northeast Mexico currently produces over 1 Bcf/d and has substantial potential for future increases should Pemex be able to deploy the necessary capital for its production. However, the potential for gas new supply could be offset by quickly growing demand for natural gas for power generation. The latest projection for the generation sector produced by the Comisión Federal de Electricidad - the Mexican state owned electric company (CFE) anticipates the construction of over 14 GW of natural

gas-fired generation by 2024. This could substantially increase natural gas demand and could call for increased imports from the US or from LNG.

Net imports from the US have averaged 810 MMcf/d over the last five years (2005-09) and were 855 MMcf/d in 2009 (Energy Information Administration). Import flows occur at fifteen pipeline points along the Mexico-US border with some points being bi-directional, capable of import and export. Figure 1 below displays the location of the major cross border pipeline connections.

Figure 1

Mexico Gas Imports/Exports



- | | |
|---------------------------|------------------|
| 1 Tijuana | A Costa Azul * |
| 2 Mexicali | B Sonora Pacific |
| 3 Los Algodones | C Topolobampo |
| 4 Nogales | D Manzanillo ** |
| 5 Naco | E Matamoros |
| 6 Agua Prieta | F Altamira * |
| 7 Ciudad Juarez | G Coatzacoalcos |
| 8 San Agustín Valdivia | H Yucatan |
| 9 Piedras Negras | |
| 10 Ciudad Mier | |
| 11 Arguelles (Kinder) | |
| 12 Arguelles (Enterprise) | |
| 13 Reynosa (Tetco) | |
| 14 Reynosa (TGP) | |
| 15 Reynosa (Rio Bravo) | |

*Operational

** In construction

Source: Ziff Energy, Mexico's Natural Gas Supply/Demand Outlook to 2016, 12/2008

The amount of natural gas crossing the US border with Mexico is important to forecasts of future US natural gas demand. From east to west areas the interconnections can be summarized as follows (see Figure 1 above):

1. South Texas to the Mexican state of Tamaulipas. In this area Mexico can both import and export natural gas via a number of pipelines that are bi-directional. The aggregate capacity to import natural gas from the US is 1.6 Bcf/d and to export 750 MMcf/d.
2. West Texas to the Mexican state of Chihuahua. Mexico sources the natural gas required for this market from west Texas and supplies physical volumes down to the City of Chihuahua located approximately 350 kilometers from the US / Mexico border. The aggregate capacity to import is 390 MMcf/d.
3. Arizona to the Mexican state of Sonora. The Sonora state sources all of its gas from the United States. The aggregate capacity to import is 190 MMcf/d
4. California to the Mexican state of Baja California Norte. Normally Baja California Norte sources its gas from the US; however the system is bi-directional by virtue of an LNG Regasification Terminal located in Ensenada, Mexico. The aggregate capacity to import is 830 MMcf/d and to export 800 MMcf/d.

Figure 2



Source: El Paso Corporation

In addition to domestic natural gas production and imports from the US, Mexico has two operational LNG import facilities at Altamira (500 MMcf/d of regasification capacity) and Ensenada (1,000 MMcf/d of regasification capacity) and is currently building a third facility at Manzanillo (500 MMcf/d with regasification capacity).

Natural Gas Demand Outlook for Mexico

The Mexico national gas balance below has been prepared based upon a review of two Mexican Government Agency planning documents. These agencies are: Secretaria de Energia - The Mexican Ministry of Energy (Sener) and CFE. The planning documents reviewed were:

- Sener – Prospectiva de Mercado de Gas Natural (2009 – 2024); this is the Energy Ministry’s forecast for the natural gas markets in Mexico.
- CFE’s Programa de Obras e Inversiones del Sector Electrico (2010 – 2024); this is CFE’s long-range plan for projects and investments in the electric sector.

On an annual basis Sener issues a number of forecasts for the different energy markets in Mexico. The natural gas forecast utilized covers the period from 2009 to 2024. Sener has based its planning scenario on a GDP growth rate of 2.7% per year in Mexico throughout the period. The forecasted national natural gas balance (sources and supply) is summarized in Table 1 below.

Table 1

National Natural Gas Balance, 2008 to 2024, Planning Scenario

(MMcf/d)

Year	2008	2010	2015	2020	2024
Supply					
Production	6014	6650	7548	8210	8668
Imports					
Logistics *	855	778	681	908	909
Balance	128	35	-	-	84
LNG	356	586	1769	2027	2027
Total Supply	7352	8048	9998	11145	11688
Demand					
Pemex **	3269	3966	4233	4449	4725
Industrial	1024	954	1219	1308	1401
Electrical	2796	2744	3319	4403	4864
Other ***	114	117	156	182	192
Total Demand	7204	7782	8928	10341	11182
Exports ****	148	266	1070	803	505

Source: SENER

*Logistics – is that gas that is imported on the border with the US to supply the Mexican market, at points where they either do not have the supply or infrastructure to meet the local demand.

**Includes reinjection and Pemex's own use

***Includes residential, automotive and service sectors

****Total Demand + Exports = Total Supply, includes inventory variations. Exports mostly will come from the Costa Azul LNG regasification terminal

Sener is forecasting an:

- Increase in natural gas demand of 2.8% per year
- Increase of domestic natural gas supply of 2.3% per year
- Increase in natural gas imports of 5.2% per year, to match the demand growth
- Much of the increase in imported natural gas is via LNG, LNG imports being forecasted to grow at 11.5% per year, whereas imports from the United States are shown growing only at a rate of less than 0.5% per year.

Sener in their planning document as well examines a high and low economic growth case for Mexico. They examine a GDP growth rate using a high case of 3.5% per year and a low case of 1.8% per year, versus the base case of 2.7%. Using these different GDP growth rates, the change in the natural gas demand in 2024 increases by 2% in the high case and declines by 1.6% in the low case.

There are a number of market parameters that can affect this forecast, most importantly the future price spread between oil and natural gas. If the large price spread between natural gas and oil continues, then Pemex will focus much more of its limited investment capital on the production of oil versus natural gas, likely causing a short fall on the forecasted domestic production of natural gas shown above.

Another consideration concerns the predicted LNG imports. Mexico currently has three LNG regasification terminals, two of which are in operation (Altamira and Costa Azul) and one in construction (Manzanillo). The aggregate capacity to receive and send out natural gas for these three terminals is 2 Bcf/d. To meet the forecasted volumes of imported LNG all three terminals will have to be operating a full capacity, or one or more of these terminals will need to be expanded, or a new terminal will need to be developed. The two operating terminals are currently dispatching natural gas at less than 50% of their aggregate capacity, indicating the aggressive growth profile assumed by Sener in its projection. This simply means that if the current terminal dispatch rate is less than 50 %, the SENER assumption that these terminals will eventually operate at 100 % is aggressive.

Considering the abundant supplies of US natural gas (which under this scenario will be priced as an attractive alternative to imported LNG), it remains to be seen if this amount of LNG actually is delivered to Mexico. Also, given that Mexico has no natural gas storage capacity, in a low gas price environment relative to oil, it seems less likely that LNG will go to Mexico, versus the US Gulf Coast, where ample natural gas storage exists.

If the three terminals operate at close to the historical 50% capacity factor, this will increase (versus the Sener forecast) the need to import gas from the US to Mexico by approximately 1 Bcf/d by 2024.

In the power generation projection, CFE considers levelized natural gas prices of US\$7.30 per MMBtu and Heavy Fuel Oil (HFO) in a range from US\$7.40 to US\$8.60 per MMBtu (domestically produced HFO versus imported HFO).

Abundant US gas supplies coupled with competitive gas prices versus oil should drive:

- More imported US natural gas versus imported LNG
- A higher level of dispatch for the natural gas-fired power plants on CFE's system
- More of forecasted generating capacity that CFE intends to add will be natural gas-fired

During this planning period of 2009 to 2024, CFE forecasts adding the following amount of new generating capacity (see Table 2);

Table 2
CFE 2009 to 2024 Generation Capacity Additions

Technology	MWs
Gas Fired Generation	14,235
Hydroelectric	3,514
Coal Fired Generation	3,478
Geothermal	311
Internal Combustion	316
Wind	507
Open Technology	14,848
Total	37,208

Source: CFE

In the CFE plan, Open Technology generally refers to large capacity additions where CFE has not specifically identified the choice of fuel or technology. In many cases these capacity additions will be via Independent Power Producers (IPPs) who will sign 25-year

power purchase agreements. It will be up to the IPP to define its fuel selection. Given the competitive nature of the bidding process for awarding these power purchase agreements, in most cases the IPP will select natural gas-fired power plants. This factor alone could increase the demand for natural gas imported from the U.S. compared to the Sener forecast by another 2 Bcf/d by 2024.

Mexican Imports from the US

The View to 2024

The current Sener plan shows roughly 500 MMcf/d of net imports from the US by 2024. The average for 2009 was over 800 MMcf/d. If the abundant amount and competitive nature of the US natural gas supply should continue, it is likely that natural gas imports from the US will be higher than Sener projections. If we assume that Pemex produces natural gas to the level forecast by Sener, LNG is imported to Mexico using a 50% capacity factor for their 2 Bcf/d of regasification capacity, and that most of the new CFE capacity additions (currently labeled as Open Technology) are natural gas-fired, then the amount of natural gas to be imported from the US by Mexico by 2024 is closer to 2.5 to 3 Bcf/d versus the 500 MMcf/d projected by Sener.

View Beyond 2024 to 2050

Demand for natural gas in Mexico over this period of time should be influenced by many of the same factors that will affect the US growth in natural gas demand. These factors include economic growth and power generating options and technology.

One area that is different between the US and Mexico is whether the Mexican economy can provide the incentives necessary to promote the wide scale use of renewable energy, specifically wind and solar. Secondly, and a more important factor, is the current per

capita consumption difference between the US and Mexico, which is roughly 7 to 1. This means that should the middle class in Mexico continue to grow, there should be a difference in the annual increase in natural gas demand between the US and Mexico. For example if the forecast for US growth in natural gas demand over the next 50 years is 1.5% per year, then in Mexico it should be 30 to 50 % higher than in the US (i.e. 2 to 2.25 % per year). To be more objective we could take a look at the last 11 yrs (1998 to 2008) and see how the Mexican gas demand has increased on an annual basis versus the US. In 1998 it was 4.06 BCFD and in 2008 it was 7.204 BCFD. This is an approx 6% per year growth rate. US 1998 total gas consumption was 22.246 Tcf, and in 2008 it was 23.227 Tcf, representing an annual growth rate of 0.43%.

EIA Outlook for US Exports to Mexico

For the EIA AEO 2010 Reference Case the EIA projects US exports to Mexico at 2,248 MMcf per day, US imports from Mexico at only 55 MMcf/d resulting in net US exports to Mexico of 2,193 MMcf per day. This projection is quite a bit higher than Sener's projection. Under the EIA AEO 2010 High Shale Case US exports to Mexico would be 2,554 MMcf/d, EIA's highest export case.