

The Energy Reform in Mexico Implications for the Asia-Pacific Region

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**The Energy Reform in Mexico
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Ayako Sugino

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FOREWORD

During the 11th APEC Energy Ministers Meeting (EMM11) held in Beijing, China on 2nd September 2014, the Ministers issued instructions to the Energy Working Group (EWG). This includes an instruction to Asia Pacific Energy Research Centre (APEREC) to continue its cooperation on emergency response so as to improve the capacity building in oil and gas emergency response in APEC region.

Following this instruction, APEREC has started implementing the Oil and Gas Security Initiative (OGSI) in November 2014. One of the three overarching pillars of the OGSI is the publication of the Oil and Gas Security Studies (OGSS).

The OGSS serves as a useful publication to APEC economies by having access to developments and issues on oil and gas security, and information on individual economies' policies related to oil and gas security including responses to emergency situation. The research studies included in OGSS will help encourage the APEC economies to review and revisit their respective policies, plans, programmes and measures on oil and gas security, and may probably help them adopt appropriate approaches to handling possible supply shortage or supply emergencies in the future.

I would like to thank the contributors to the OGSS for the time they have spent doing research works. May I however highlight that the independent research project contents herein reflect only the respective authors' view and not necessarily APEREC's and might change in the future depending on unexpected external events or changes in the oil and gas and policy agendas of particular economies or countries.

I do hope that the OGSS will serve its purpose especially to the policy makers in APEC in addressing the oil and gas security issues in the region.

Takato OJIMI

President

Asia Pacific Energy Research Centre

A handwritten signature in black ink, consisting of a stylized 'T' followed by a series of loops and a long horizontal stroke.

ACKNOWLEDGEMENTS

I would like to thank all those who contributed to the completion of this report in various forms. It would not have been completed without their valuable contributions. I wish to express my deepest appreciation to Mr. Christopher Wilson, Deputy Director of the Mexico Institute at the Woodrow Wilson International Center for Scholars, and Mr. Wataru Matsumura, First Secretary at the Embassy of Japan in Mexico. This report has benefited enormously from their valuable contributions.

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Executive Summary

The research work is intended to examine the Mexico's oil and gas market, its recent reform, and major challenges ahead.

In December 2013, Mexican congress passed Constitutional amendments which allow foreign or private companies to participate across the entire value chain of Mexico's oil, gas, and electricity industries. The main objectives of the reform are to promote exploration and production in order to expand the domestic production, refining and distribution of oil and gas; to increase the private investment in these activities; and to lower electricity tariffs.

The government has implemented the reform steadily; the secondary bill to implement the reform was passed by congress in August 2014. Mexico's Energy Ministry announced the areas for exploration and production that will remain under the control of PEMEX as a result of the company's request at the "Round Zero". In December 2014, SENER announced the tender for its first oil blocks in shallow water areas under a production-sharing regime, namely the "Round One".

Despite these milestones, the settings of the global energy market are not so favorable. The dramatic fall in crude oil prices, which halved in only six months starting from June 2014 is curtailing many upstream projects, including those in Mexico. More importantly, the United States, Mexico's main traditional destination for crude exports, is progressively more self-sufficient due to its growing domestic production from shale formations.

As a net exporter of crude oil but a net importer of oil products and natural gas, Mexico faces many challenges in the aftermath of its energy reform. On one hand, the reform is expected to expand domestic oil and gas production in the medium and long term, which opens the possibility for Mexico to strengthen its role as an exporter of oil and probably of gas too, to serve the Asia-Pacific markets. On the other hand, the steady growth in Mexico's domestic energy demand calls for a reliable and stable supply that is competitively-priced in order to support robust economic growth. These two issues serve as the rationale for this research.

As of the end of March 2015, the result of Round One was unknown. However, questions regarding attractiveness of blocks offered and poor fiscal condition of the contract were pointed. In refining sector, configuration projects at PEMEX's six refineries were also suffering from low oil price and budget cut. In gas and power sector, the Energy Reform paved the way for investors to build new natural gas fired power plants and pipelines. Under the new regime, the national electricity company embarked

on massive investment in new generation capacity, mainly natural gas combined cycle, and natural gas pipelines. These projects will double Mexico's import capacity of cheap U.S. gas in next five years. However, as a negative effect, cheap gas supply from the U.S. may diminish investment on domestic gas production.

The Mexican government is continuously working for improvement in investment climate, and external environment including crude oil price will affect the progress of the reform, so continued and careful observation will be needed.

Introduction

In December 2013, Mexican congress passed Constitutional amendments which allow foreign companies to invest in Mexican energy sector. Mexico's President Enrique Peña Nieto signed it into the law after ratification by states congresses.

In March 1938, in the wake of oil workers strike, Mexican President Cárdenas expropriated the assets of nearly all of the foreign oil companies operating in Mexico. Prior to this, the oil industry in Mexico was dominated by international oil companies. but the expropriation called for the creation of Petróleos Mexicanos, Pemex, Mexico's National Oil Company, to guide the industry. Since then, PEMEX kept the monopoly over the entire value chain of the oil and gas industry in Mexico.

As in the oil industry, the electricity sector has been dominated by the state-owned company Comisión Federal de Electricidad, CFE, established in 1937, although its monopolistic power has been gradually diluted.

Nonetheless, the energy reform enacted in 2013 was groundbreaking in that it enables private companies to participate across the entire value chain of Mexico's oil, gas, and electricity industries . The main objectives of the reform are to promote exploration and production in order to expand the domestic production, refining and distribution of oil and gas; to increase the private investment in these activities; and to lower electricity tariffs.

So far, the government has been implementing the reform steadily; the secondary bill was passed by the congress after four-months debate and signed into law by the President on August 11 in 2014. Mexico's Energy Ministry, Secretaria de Energia (SENER), announced the areas for exploration and production that will remain under the control of PEMEX as a result of the company's request at the 'Round Zero' and both state-owned companies, PEMEX and CFE were reorganized with new board members that include experienced business people from the private sector. By December 2014, SENER announced the tender for its first oil blocks in shallow water areas under a production-sharing regime.

Despite these milestones, the settings of the global energy market are not so favorable. The dramatic fall in crude oil prices, which halved in only six months starting from June 2014 is curtailing many upstream projects, including those in Mexico. More importantly, the United States, Mexico's main traditional destination for crude exports, is progressively more self-sufficient due to its growing domestic production from shale formations.

As a net exporter of crude oil but a net importer of oil products and natural gas, Mexico faces many challenges in the aftermath of its energy reform. On one hand, the reform is expected to expand domestic oil and gas production the medium and long term, which opens the possibility for Mexico to strengthen its role as an exporter of oil and probably of gas too, to serve the Asia-Pacific markets. On the other hand, the steady growth in Mexico's domestic energy demand calls for a reliable and stable supply that is competitively-priced in order to support robust economic growth. These two issues serve as the rationale for this research.

This document examines the Mexico's oil and gas market, its recent reform, and major challenges ahead. In so doing, key potential areas for cooperation between Mexico and other APEC member economies are identified, to pursue APEC's mission of promoting sustainable economic growth and prosperity by means of open trade and investment.

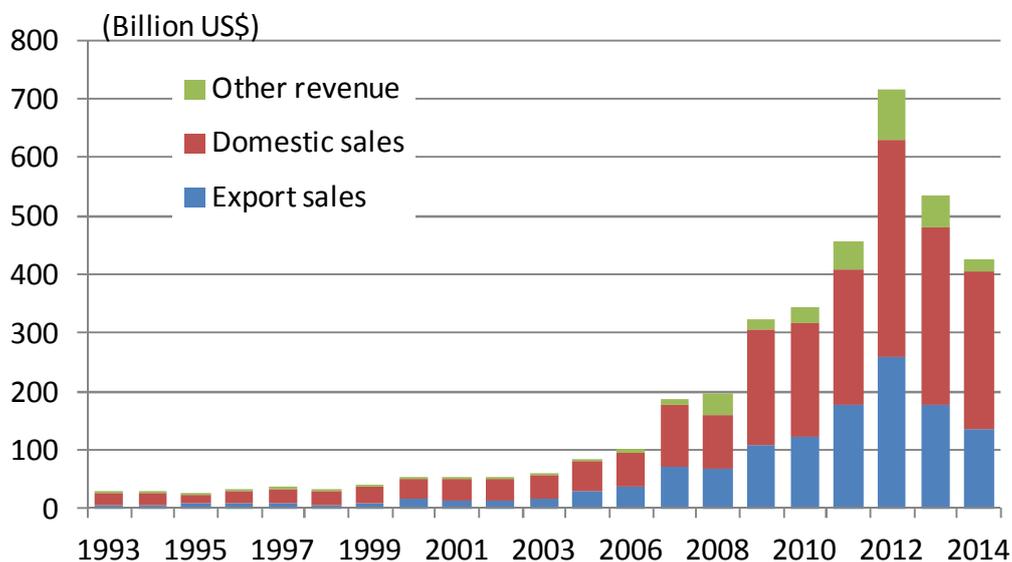
1. Background to Mexico's Energy Reform

1-1. Economic Importance of Energy Sector

Mexico is the world's ninth largest producer of hydrocarbons. In 2014, production volume of crude oil and natural gas were 2.4 million barrels per day and 6.5 million cubic feet (0.2 million cubic meters) per day, respectively (SENER 2015).

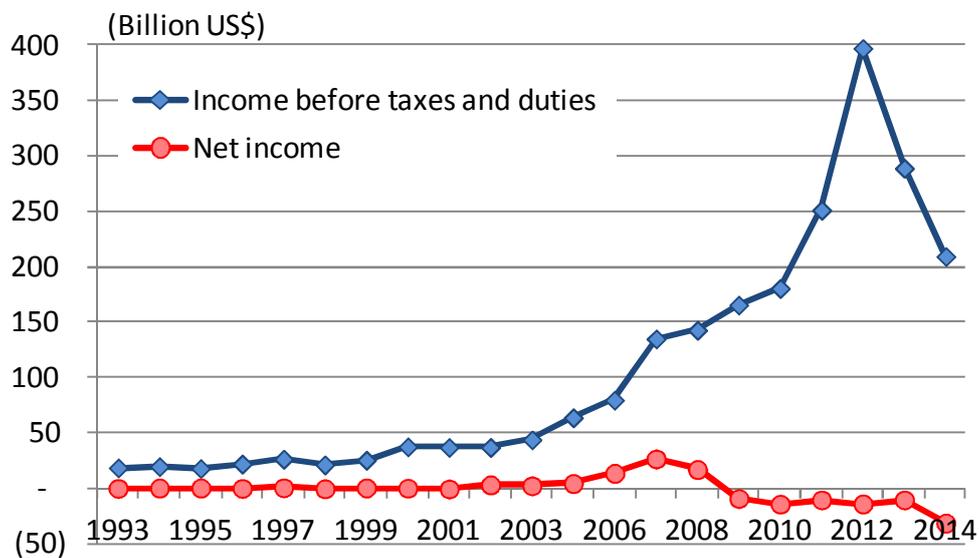
As its national oil company, PEMEX is a large contributor to Mexico's economic activity. PEMEX is the world's seventh largest crude producer, and eleventh largest integrated oil and gas company, employing 160,000, making it Mexico's single largest employer (Wall Street Journal 2013). Income from the hydrocarbon sector also makes up a significant portion of the government's budget, with industry earnings accounting for approximately one-third of total government revenues (Samples and Vittor 2013). Fiscal contribution of PEMEX, on the other hand, put pressure on the company's finance along with payroll cost.

Figure 1: PEMEX's revenue structure



(Source) PEMEX (2014a and 2014b)

Figure 2: PEMEX's income and estimated taxes and duties payment



(Source) PEMEX (2014a and 2014b)

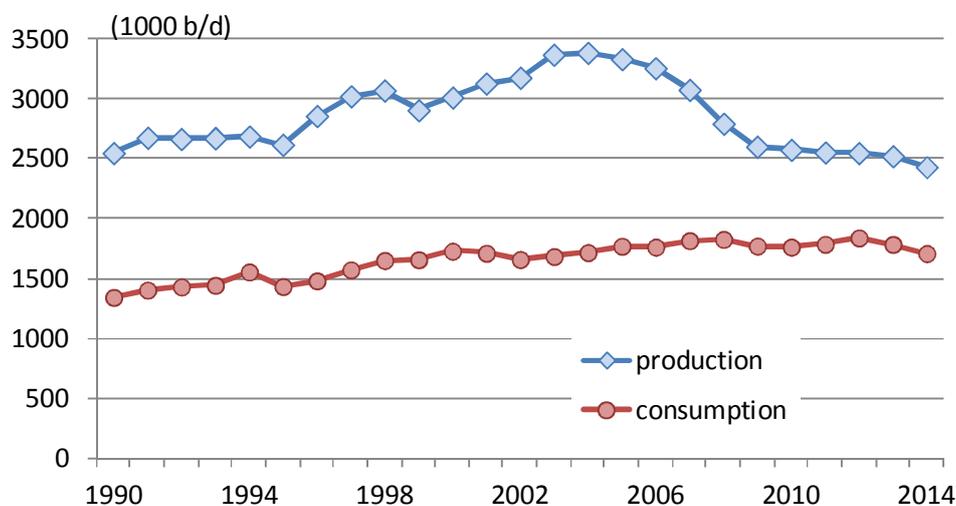
In addition to its economic significance, Mexico's energy sector has been closely tied to domestic politics and governance as well.

1-2. Supply and demand of oil and gas

1-2-1. Crude oil and refined products

On the supply side, Mexico is a large producer of crude oil, with approximately 2.4 million barrels per day of output in 2014; however, production has declined from a peak of 3.4 million barrels per day in 2004 (SENER 2015). While production has dropped, demand, having risen since the mid-1990s, has remained relatively steady, reaching a peak of 1.8 million barrels per day in 2008, before declining to its current level of 1.7 million barrels per day in 2014 (SENER 2015). While Mexico has historically been and remains a net-exporter of crude oil, declines in oil output have narrowed the gap of implied exports from 1.8 million barrels per day in 2005, to 1.2 million barrels per day in 2014. If crude production continues to fall, it has been estimated that Mexico could become a net-importer in the future (Segal et al 2011).

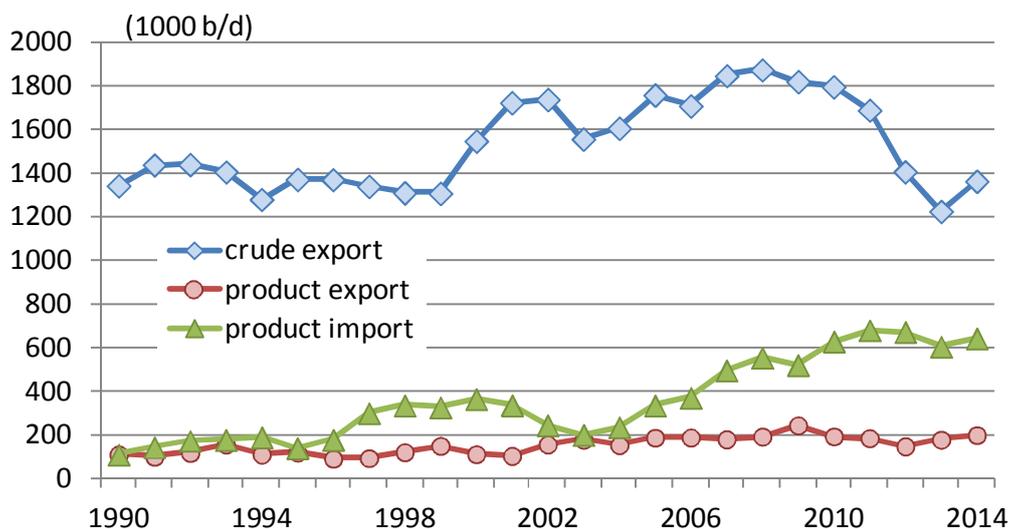
Figure 3: Mexico Oil Supply & Demand



(Source) SENER (2015)

Mexican oil exports are primarily sent to the United States, with volumes also sent to European and Asian economies as well. In 2014, the three largest destinations for Mexican exports were the United States with 0.79 million barrels per day, followed by Spain with 0.16million barrels per day and India at almost 0.08 million barrels per day (SENER 2015).

Figure 4: Mexico Imports/Exports of Crude Oil and Refined Products

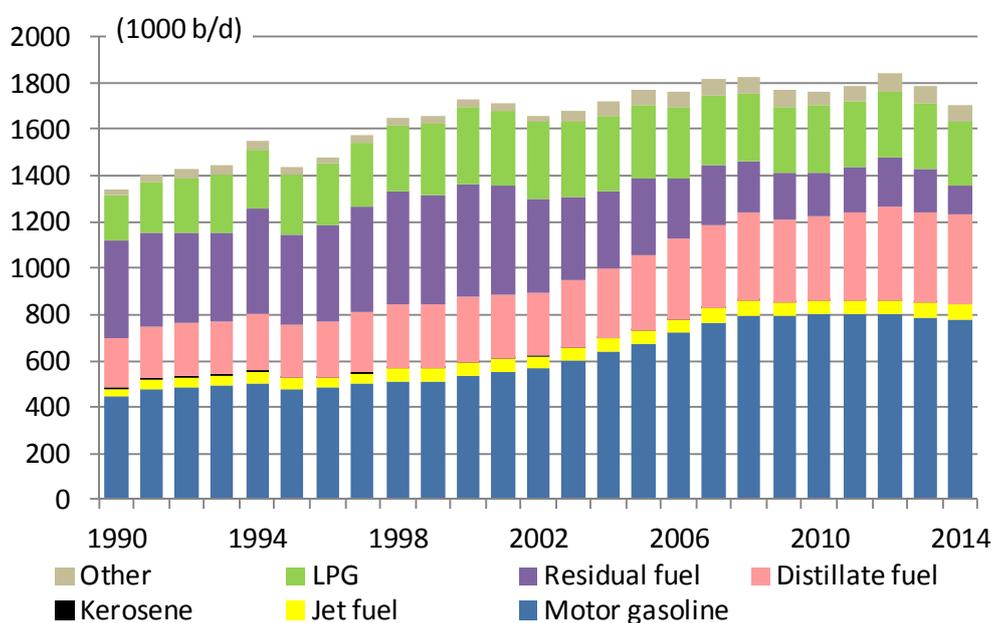


(Source) SENER (2015)

On the demand side, Mexico's refining sector has not kept pace with domestic consumption, with fixed refining capacity of 1.6 million b/s, an amount which has only

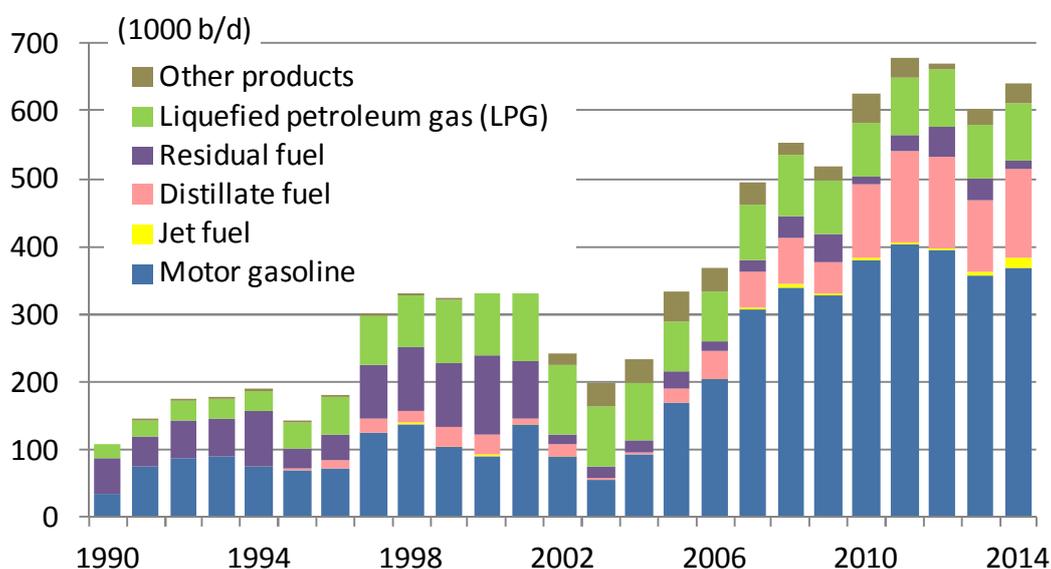
grown by 0.13million barrels per day capacity since 2000. Furthermore, recent declines in refinery throughputs, which dropped from 1.39 million barrels per day in 2009 to 1.16 million barrels per day in 2014, has resulted in Mexico increasing imports of refined petroleum products, which have grown from 0.28 million barrels per day in 2003 to 0.64 million barrels per day in 2014 (BP 2015). Increased imports have particularly occurred in the form of motor gasoline and distillates from the United States. Mexico is also a significant importer of liquefied petroleum gas (LPG), as it is one of the largest markets in the world for this fuel.

Figure 5: Mexico Refined Products Demand (by type)



(Source) SENER (2015)

Figure 6: Mexico Refined Products Imports (by type)

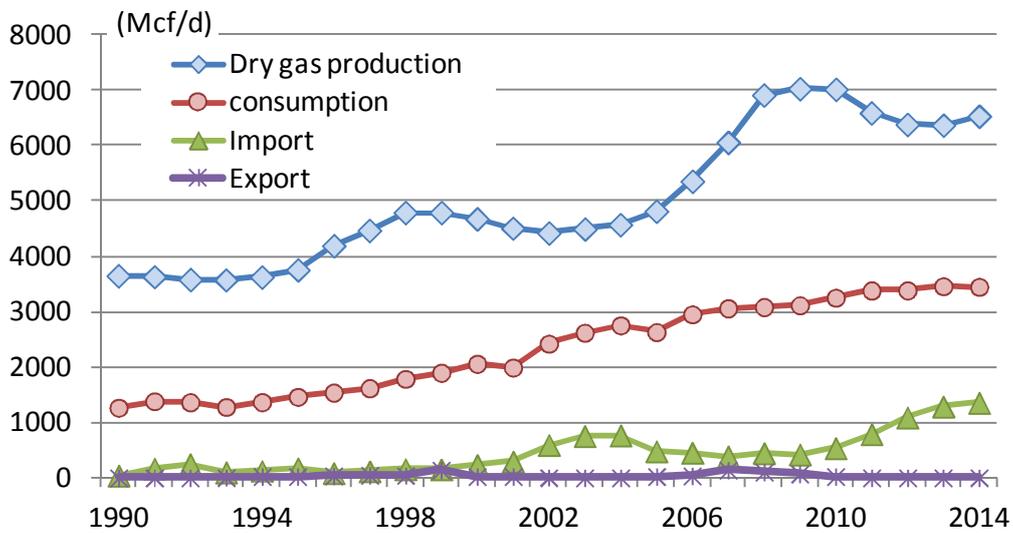


(Source) SENER (2015)

1-2-2. Natural Gas and Liquefied Natural Gas

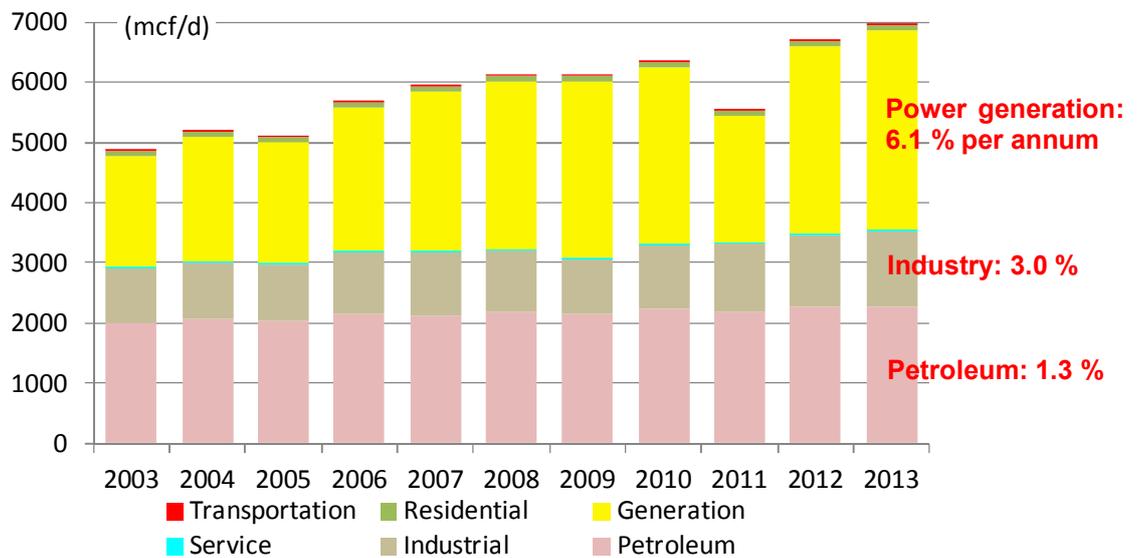
Mexican natural gas production has grown over time, rising from 0.95 trillion cubic feet (27 billion cubic meters) in 1993 to 1.8 trillion cubic feet (50 billion cubic meters) in 2011, before declining to 1.6 trillion cubic feet (45 billion cubic meters) in 2013 (EIA 2014a). Domestic natural gas demand has grown at a brisk rate driven by increases in the electricity generation and industrial sectors (Morales 2013). As demand growth has continued to outpace that of supply, Mexico's implied net-imports have grown. In order to offset the growing shortfall, Mexico has seen a significant increase in its gas imports, which have grown from 20 billion cubic feet (560 million cubic meters) in 1990 to 650 billion cubic feet (18 billion cubic meters) in 2013.

Figure 7: Mexico Natural Gas Supply, Demand, Imports and Exports



(Source) EIA (2014a)

Figure 8: Mexico Natural Gas Demand by sector

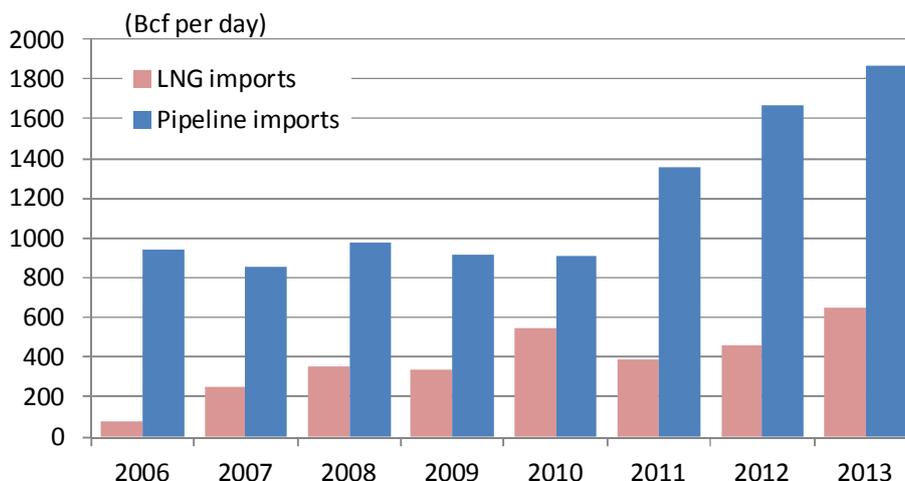


(source) SENER (2014a)

Mexico imports gas via two routes, by pipeline from the United States and via liquefied natural gas (LNG) imports at its three operating regasification plants at Altamira (0.6 billion cubic feet or 17 million cubic meters per day) in the Gulf of Mexico, Energia Costa Azul (1 billion cubic feet or 28 million cubic meters per day) on the Pacific coast in Baja California, and Manzanillo (0.5 billion cubic feet or 14 million cubic meters per day) on the Pacific Coast (EIA 2013a). In 2013, LNG imports from Mexico were

sourced from, Nigeria (1.14 million tonnes), Norway (0.25 million tonnes), Peru (1.84 million tonnes), Trinidad & Tobago (0.29 million tonnes), Qatar (1.17 million tonnes), Yemen (0.39 million tonnes), and Indonesia (0.25 million tonnes) (GIIGNL 2014). Pipeline imports from the US, which bring gas from fields such as the Eagle Ford, account for approximately 80% of Mexico’s foreign-sourced natural gas, and the bulk of its recent growth in imports (EIA 2014a).

Figure 9: Mexico Natural Gas imports by type



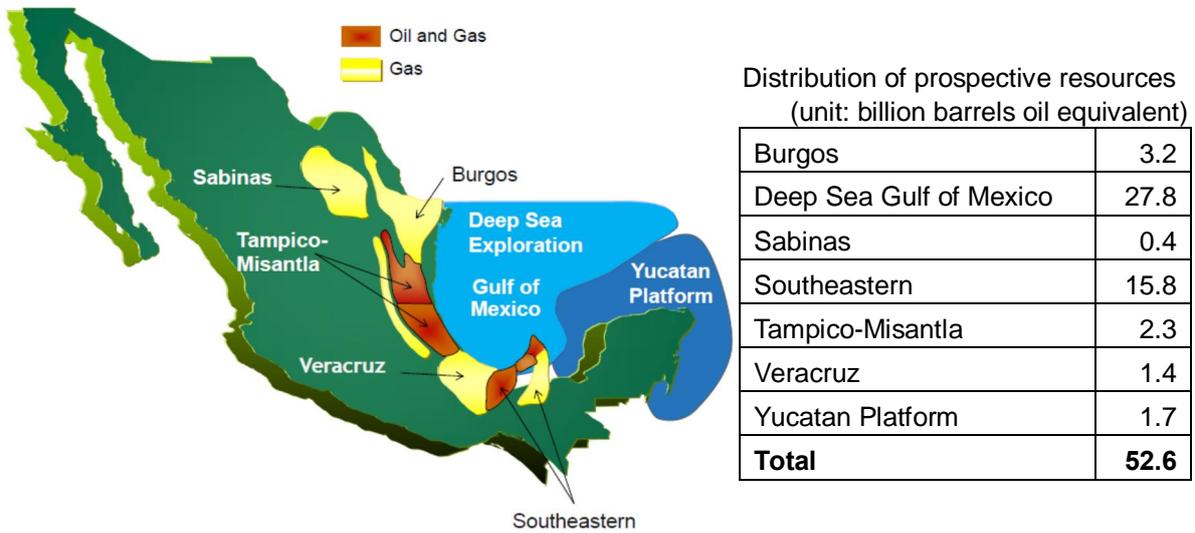
(Source) EIA (2014a)

1-3. Hydrocarbon Supply Overview

1-3-1. Resources

Mexican hydrocarbon resources are mainly located in the economy’s eastern to southeastern region along the Gulf of Mexico, although significant deepwater resources in the Gulf of Mexico remain unexplored. As Figure 8 shows, PEMEX has undertaken very limited exploration activity in the Gulf of Mexico, in contrast to the U.S. side.

Figure 10: Mexico's Prospective Basins



(Source) PEMEX (2014c) and SENER (2014b)

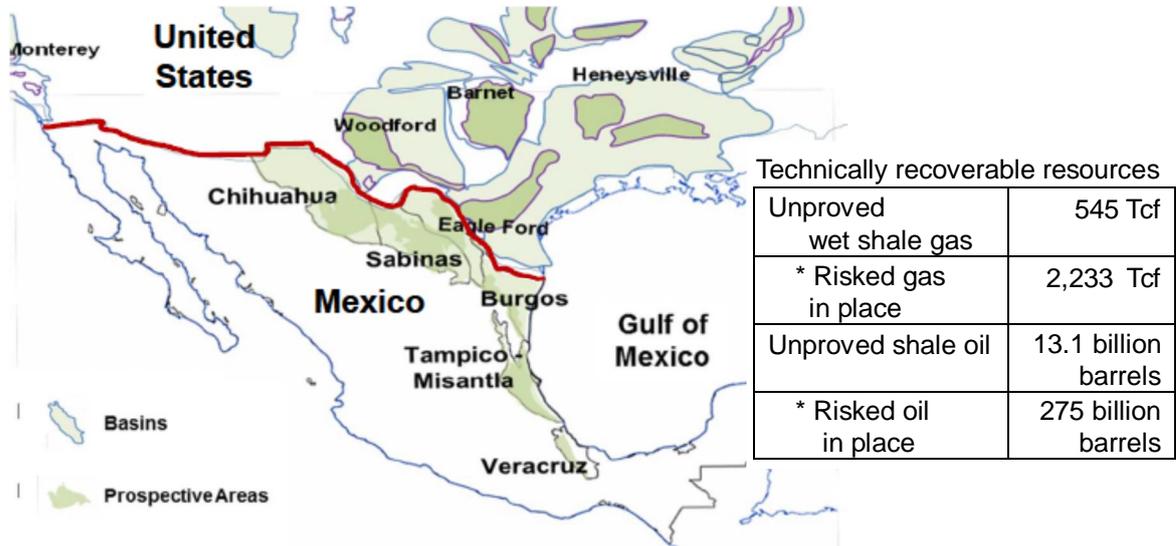
Figure 11: Deepwater Infrastructure



(Source) PEMEX (2015)

In addition to conventional hydrocarbon resources, there may be significant oil and gas resources from shale formations in Mexico. According to the U.S. EIA (2013b), Mexico has 545 trillion cubic feet (15 billion cubic meters) of technically recoverable shale gas resources and 13.1 billion barrels of technically recoverable shale oil resources. The 8th largest shale oil and 6th largest shale gas resources.

Figure 12: Shale potential



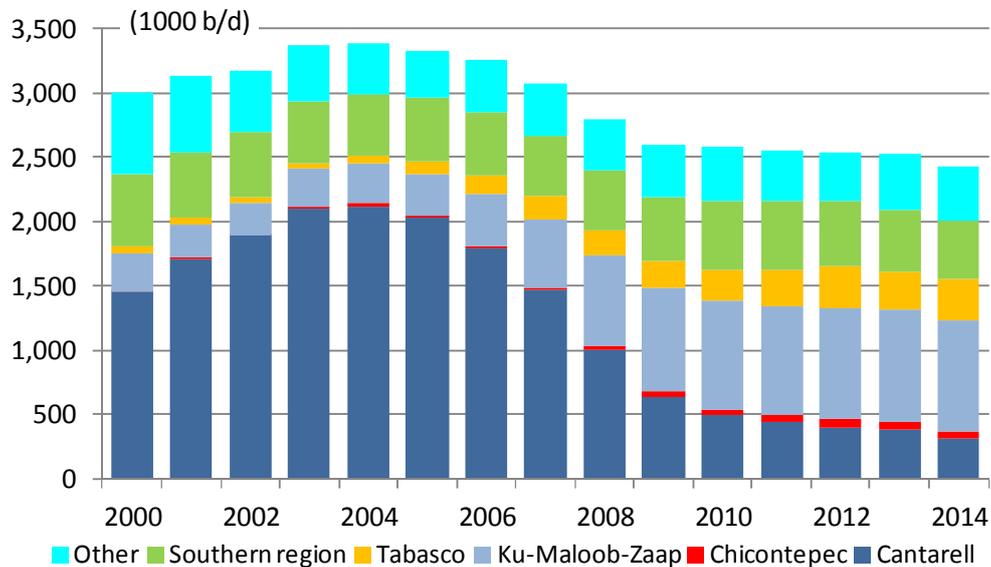
(Source) PEMEX (2015) and EIA (2013b)

Mexico does not have the technical capacity to effectively explore or produce hydrocarbon resources in deepwater and shale basins. This is one of the reason that IOCs are keenly interested in Mexican energy reform (Seelke et al 2015).

1-3-2. Crude Oil

Mexican oil production has dropped by one quarter (0.86million barrels per day) between 2004 and 2013, as upstream exploration activity has not kept pace with declining output at the economy's mature basins, which have historically served as the backbone of Mexican production. In particular, Mexico's large Cantarell field has seen significant declines as production dropped from a height of 2.1million barrels per day in 2004 to 0.38million barrels per day in 2013 (CNH 2014a). Production increases at other offshore fields such as Ku-Maloob-Zaap and in Tabasco have helped to offset production declines at Cantarell; however, these fields are also mature and not expected to serve as a long-term solution for growing production. A key challenge regarding the state of Mexico's upstream activity in the oil sector is that approximately 80% of its oil fields are estimated to be in advanced or declining stages of production and 90% of oil production comes from fields discovered more than 20 years ago (Samples and Vittor 2013). Significant exploratory work will be needed to boost Mexican crude production.

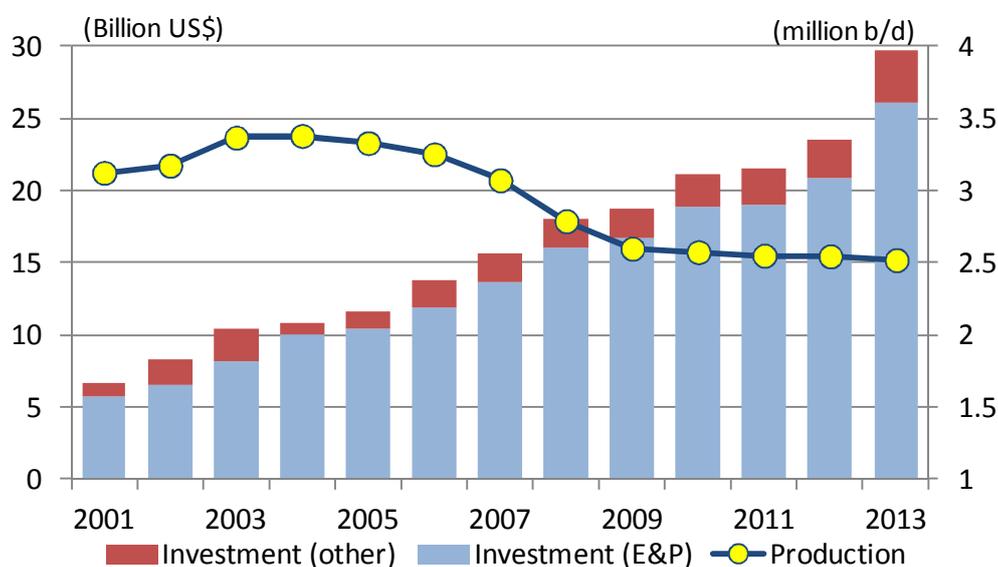
Figure 13: Mexico Crude Oil Production (by field)



(Source) CNH (2015)

Another key factor influencing Mexican production trends has been the capital investment required. While production has faced declines that have more recently been stabilized, the amount of investment required to undertake this stabilization has grown significantly. Between 2001 and 2013, PEMEX investment in upstream production and exploration has grown from US\$5.7 billion to US\$26.1 in 2013, albeit production saw little output gains (PEMEX 2014d). With challenging new resources playing an important role in the future production profile of Mexico, it is likely that economy-wide investment needs will continue to rise, increasing the need for capital, expertise and technology to grow Mexican oil production.

Figure 14: Mexico's Hydrocarbon Sector Investment and Production



(Source) PEMEX (2014d) and SENER (2015)

1-3-3. Natural Gas

Mexico's proven reserves of natural gas have not kept pace with its significant growth in production through 1990s and 2000s, and as a result, the reserve/production ratio has declined over time. Mexico's natural gas reserves currently stand at 17.2 trillion cubic feet (482 billion cubic meters), or about 10 years of production at 2012 levels (Oil and Gas Journal 2013 and PEMEX 2013a). Thus, intensive exploration & development works is required to cover the expected growth in natural gas production, on the background of demand expansion. Mexico has substantial resources of both conventional and unconventional natural gas resources, but production has not increased rapidly enough to satisfy the demand. In the face of "shale gas revolution" in the United States, booming gas production in the Eagle Ford Shale, Texas, on the northern side of the U.S.-Mexican border, is expected to influence similar levels of development in the Mexican side.

According to the EIA, one important contributing factor to low levels of domestic natural gas production relative to prospects has been the divergence in prices between natural gas and crude oil, which has led to a prioritization of investment in higher-grossing crude oil production by state company, PEMEX, over similar endeavours in the area of shale and natural gas (EIA 2014b). Additionally, it is important to note that lack of exploration technology, or absence of competitive service industries, inhibits investment on natural gas development in Mexico despite its rich resource.

1-4. Increasing Electricity Demand and Lack of Investment

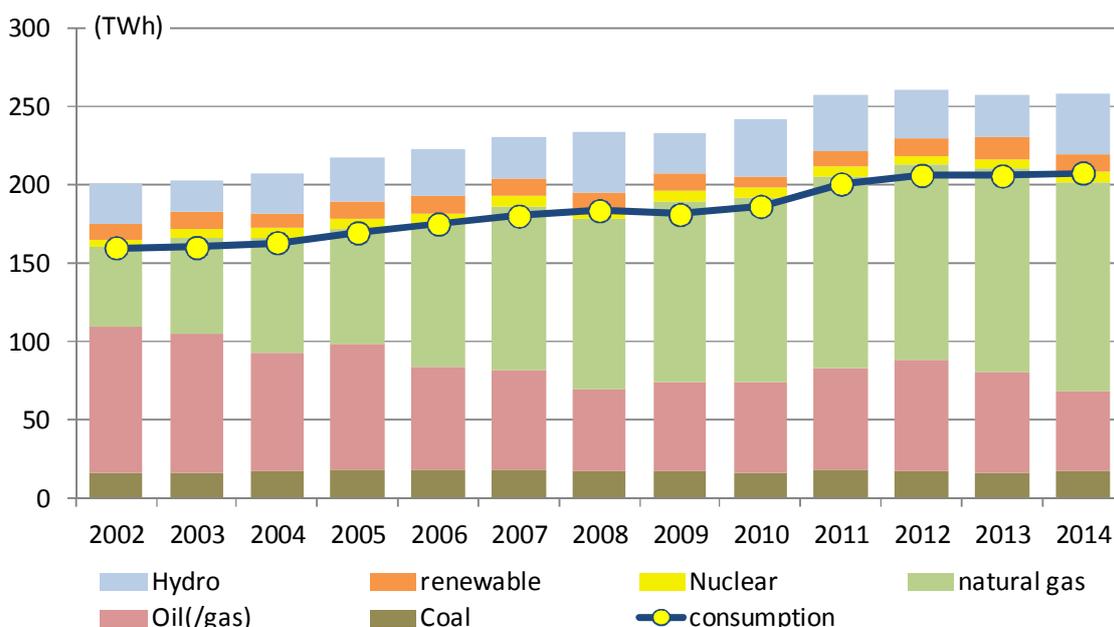
As power generation sector accounts 47.8% of domestic natural gas consumption, and power generation is the fastest-growing sector, electricity market is closely connected with natural gas market.

Mexican electricity demand has been steadily increasing over the past three decades. One nuclear power plant started operation in 1990, and in 2008, the government introduced the Renewable Portfolio Standard. However, non-fossil fuel generating capacity is limited, and Mexico was highly dependent on natural gas fired power plant, which makes 56% of fuel mix in 2013.

In 1992, reforms to the Law of Public Service of Electricity passed and implemented in 1993 permits cogeneration and auto-generation by private entities as well as IPPs. IPPs output has been sold to CFE and resold to consumers. In 2013, CFE accounted for 83.8% of effective installed generation capacity in Mexico and private generators accounted for 16.2%.

Factors like the lack of flexibility for wholesale transactions outside of CFE, and lack of clarity with regards to contracts for the purchase of natural gas from PEMEX, have discouraged potential IPP investors. On the other hand, electric price subsidies continued to stimulate electricity demand growth through the 1990s and 2000s (Center for Energy Economics and Instituto Tecnológico y de Estudios Superiores 2013).

Figure 15: Mexico Electricity Demand & Net Generation



(Source) SENER (2015)

2. Timeline of the Energy Reform

2-1. Constitutional Amendments & Secondary Law

In December 2013, Mexico initiated energy reforms, culminating in its Congress passing constitutional changes that will open the country's oil and gas sector to greater foreign investment. The reforms are comprised of several key features (Palacios and De Lourdes 2014, O'Neil and Taylor 2014, Seelke et al 2015, Bower and Fuentes 2014, and Oil and Gas Journal 2014) :

- State ownership of hydrocarbon resources: Maintaining state ownership of subsoil hydrocarbon resources, by allowing private companies to take ownership of those once they are extracted and to book reserves for accounting purposes.
- E&P Contract Models: Four types of contract models (licenses, production sharing contracts, profit sharing contracts and service contracts) will be awarded through a new bidding process for companies wishing to participate in resource development.
- Permit Schemes for Mid/Downstream: Permitting for private companies to invest in Mexico's mid- and downstream energy sectors will be available.
- Changes to PEMEX board structure: PEMEX will be transformed into a "State Productive Enterprise" with greater autonomy, and will compete or partner with private companies in the resource sector. The company's board structure will be updated and a more flexible fiscal regime will be established.
- Round Zero: PEMEX submitted an initial request ("Round Zero"), on the assets it sought to maintain under its current and future development portfolios. It means E&P activity is opened up for private companies but PEMEX, the traditional monopoly will keep some portion of hydrocarbon reserves, which is attractive for PEMEX itself.
- Institutional Arrangements: Under the energy reforms, various ministries and agencies including the energy ministry (SENER), upstream regulator (CNH), downstream regulator (CRE) and finance ministry (SHCP), will have current

functions reinforced and new roles granted to support building of administrative capacity to implement energy reforms.

- New Agencies: New agencies will be created to oversee operation of the natural gas pipeline and storage system (National Centre for Control of Natural Gas, CENAGAS) and electricity sector (National Energy Control Centre, CENACE), as well as one to oversee safety and the environment, (National Agency of Industrial Safety, Energy and Environmental Protection - ASEA).
- Mexican Petroleum Fund: A sovereign wealth fund to be operated by Mexico's central bank, will be created to manage cash flow generated by Mexico's hydrocarbons sector.
- CFE Reform: CFE will be transformed into a State Productive Enterprise with greater autonomy, and will compete with private companies in the competitive electricity market, newly created along with open transmission access.
- Transparency Measures: According to SENER, in order to ensure transparency, bid rounds and guidelines will be made public, transparency clauses will be included in oil and gas contracts, disclosure of all payments related to oil and gas contracts will be made and external audits will be undertaken.

In August 2014, Mexico passed the Secondary Legislation which will implement reforms and seek to address important topics including:

- Providing details on forthcoming contract types.
- Addressing issues related to eminent domain.
- Detailing applicable taxation and royalty systems.
- Providing more details on transparency and financial reporting.
- Clarifying function and interaction of regulatory entities.
- Specifying rules and guidelines related to local content requirements.

2-2. Round Zero Results & Round One Details

On March 21st, 2014, PEMEX submitted its request to SENER and CNH for the following resource assignment under "Round Zero"

Figure 16: PEMEX Round Zero Reserves/Resources Request

(unit: billion barrels oil equivalent)

	Requested by PEMEX	Total Listed
2P Reserves	20.6 Bboe (83% of total)	24.8 Bboe
3P Reserves	31.3 Bboe (71% of total)	43.8 Bboe
Prospective Resources	34.5 Bboe (31% of total)	112.8 Bboe
	- Conventional: 25.6 Bboe (48.7%)	- Conventional: 52.6 Bboe
	- Deep waters: 4.7 Bboe (29%)	
	- Shallow waters: 3.6 Bboe (63%)	
	- Onshore: 6.5 Bboe (82%)	
	- Unconventional: 8.9 Bboe (14.8%)	- Unconventional: 60.2 Bboe

(Source) PEMEX (2014e)

On August 13, 2014, SENER/CNH announced that PEMEX would be awarded 100% of its requested 2P reserves (20.6 billion barrels of oil equivalent), but opted to award a smaller 21% proportion (23.4 billion barrels of oil equivalent) in prospective resources to the company relative to its request for 31% (34.5 Bboe) (SENER 2014c)¹. The assets awarded to PEMEX include its base of onshore and shallow water resources, as well as some unconventional and deep water assets including in the Perdido Fold Belt in the Gulf of Mexico (Platts 2014). PEMEX may sign contracts with private or foreign companies to develop these assigned reserves/resources. PEMEX plans to migrate its existing nine service contracts to new production-sharing terms in the first half of 2015, and to request SENER permission to farm-out six shallow water fields. Upcoming farm-outs will also include four onshore mature fields, two deepwater gas fields and two deepwater oil fields in the Gulf of Mexico (Argus 2015).

The remaining fields and areas not assigned to PEMEX in Round Zero will be offered through bidding processes to private and foreign companies beginning December 20, 2014. The area will include 169 blocks encompassing 28,500 square kilometers, 109

¹ 23.4 Bboe assigned to PEMEX include 7.5 Bboe in shallow waters, 5.9 Bboe onshore other than Chicontepec, 4.8 Bboe in deep water, and 5.2 Bboe non-conventional. (SENER 2014c)

blocks of which will be in areas for exploration, with a further 60 in currently producing areas (Energy Intelligence 2014). The bid round will include reserves and resources in areas such as conventional onshore and offshore, as well as heavy oil, Chicontepec region, deepwater and unconventional resources (SENER, SHCP and CNH 2014).

Figure 17: PEMEX Round Zero Reserves/Resources Award

Type of project	Blocks	Surface (km ²)	Volume (Bboe)	4 yr. estimated investment (bn USD)
Exploration (prospective resources)	109	25,903	14.6	19
Extraction (2P reserves)	60	2,597	3.8	15.1
Pemex Farm-outs (2P reserves)	14	612	1.6	16.4
Total	183	29,112	20.0	50.5

(Source) SENER, SHCP and CNH (2014)

On December 11, 2014, CNH published the bidding guidelines for the award of production sharing contracts for 14 areas in shallow waters (CNH 2014b and Rigzone 2015)². It includes rules of bidding process, prequalification requirements, and bidding schedule, etc. At the same time, SENER published the contract model and SHCP published the economic conditions. 25 years production sharing contract will be comprised of 3 to 5 years of exploration period and up to 22 years development years, with minimum work requirement in each stage. Fiscal elements include 30 % corporate tax, contractual payment during exploratory phase, exploration & production activities tax, royalties, cost-recovery limit etc.

On December 11, 2014, CNH began accepting request for access to data rooms, and by the end of February, sixteen foreign companies submitted requests. Wood Mackenzie pointed that all blocks are in the outskirts of the acreage retained by PEMEX in Round Zero, raising questions regarding their attractiveness (as it means these areas are beyond PEMEX's technical or financial capabilities) (Wood Mackenzie 2015). There is another argument that poor fiscal condition of the contract is discouraging IOCs, rather than recent low oil prices.

Bid submission and awarding of the contracts is scheduled around July 15. This first bidding session will indicate potential investors' expectations about bidding over heavy oil, deep waters or non-conventional, which will follow. In terms of the attractiveness

² On February 27, CNH announced that it made another nine shallow extraction blocks available through five contracts.

for potential investors, In January 2015, Mexico's Secretary of Finance told recent drop in oil price may delay bidding on some oil and gas exploration and production contracts (Latin Correspondent 2015 and Fox News 2015).

2-3. Refining sector

As described above, refining sector is now open for foreign investment. Companies may build and operate new refineries in Mexico with approval of SENER, and PEMEX can form joint ventures at its current refineries.

However, it is hard to expect a new refinery built in foreseeable future because retail prices of petroleum products are suppressed by the government at low level, property of Mexican domestic crude (heavy oil makes more than 50%) requires huge capital cost for secondary units, and the new refinery will be forced to compete with highly sophisticated refineries in the U.S. Gulf region. In point of retail prices, as part of Energy Reform, imports of gasoline and diesel will be liberalized in 2019, and in 2020, retail prices of gasoline and diesel will be liberalized. Liberalization of retail prices of other refined products will follow.

Since 2013, before the Constitutional reform passed the Congress but after the President proposed Energy Reform, PEMEX has been proceeding configuration projects at six refineries it owns. PEMEX states purpose of the configuration projects as follows; to increase profitability by producing higher value distillates products; to receive more heavy oil volumes with increased process capacity; to reduce output of residual fuel oil and balance the market (PEMEX 2015). For example, in February 2013, PEMEX awarded a contract for revamping conversion unit at Cadereyta refinery to French engineering company Technip (Technip press release, February 2013), and in September 2014, PEMEX awarded another contract for Minatitlan refinery to Spain's Técnicas Reunidas (Oil and Gas Journal 2014).

The configuration projects will cover dozens of units. In 2015, PEMEX was expected to shut 23 units from April to September, make processing volume and utilization rate lower (anticipated at 1.195 million barrels per day and 75.8%), and require more import of gasoline and diesel (Reuters 2014a). But on February 16, 2015, PEMEX announced it will delay refinery reconfigurations (Reuters 2015 and Platts 2015a). PEMEX board of directors approved cuts of 62 billion pesos (\$4.16 billion), or a reduction of 11.5% compared to the budget authorized by Congress due to falling oil prices. Moreover, prior to the energy reform, in 2008, the Mexican government had announced the construction of a new refinery in Tula, Hidalgo which nonetheless, never took off.

When PEMEX completes the refinery reconfiguration projects, it will eventually increase output of gasoline and supply ultra-low sulfur diesel. At the same time, production of residual fuel oil will decrease, in parallel with CFE's fuel switch from residual fuel oil to natural gas.

More intake of heavy crude at domestic refineries will enable Mexico to export more light- and middle-grade crude oil. At the same time, Mexican light- and middle-grade crude oil face intense competition in the U.S. Gulf Coast, its natural market, with U.S. light sweet crude from the Eagle Ford Shale. Now Mexico is seeking a market in Asia; in January 2015, it was reported that Japanese refinery Cosmo imported 1 million barrel cargo of Isthmus crude (API gravity 33.6, 1.3% sulfur) from Mexican port of Salina Cruz (Platts 2015b). The company imported Isthmus in January 2014 for the first time in 10 years. Korea's GS Caltex is also scheduled to load 1 million barrels of Isthmus in February. Japan's JX Nippon Oil and Korea's Hyundai Oilbank are also importing Isthmus in 2015 (Bloomberg 2015). And India imported 500,000 barrels of Mexican extra light Olmecca (API gravity 39.3, sulfur 0.8%) in February 2014 (Reuters 2014b). According to the reports, PEMEX exported Isthmus to Asia at discount prices (Bloomberg 2015)³. Whether PEMEX will find a new firm market in Asia or not it is closely correlated with its progress on upstream development, and with the progress in the configuration of its refineries.

Figure 18: PEMEX refinery configuration projects

Refinery	Current capacity(1000 b/d)				Capacity to be added(1000 b/d)		
	Distillation	Fluidized catalytic cracker	Catalytic reforming	Desulfurization	Fluidized catalytic cracker	Catalytic reforming	Desulfurization
Salamanca	245	40	39	115	25	11	132
Cadereyta	275	90	46	187			77.5
Madero	190	60	30	130			90
Tula	315	80	65	219	40	50	110
Salina Cruz	330	80	50	165	33	48	152
Minatitlan	285	72	49	190			55
Total	1,640	422	279	1006	98	109	616.5

(Source) SENER(2014b)

³ Pemex, sold its Isthmus light crude in February to Asian buyers at \$7.85 a barrel below the average of the benchmark Oman and Dubai grades (Bloomberg 2015)

2-4. Gas and Power market reform and massive investment in natural gas infrastructure

As part of the Energy Reform, private companies (means the entity other than PEMEX, including CFE) are allowed to build natural gas pipelines, import and sell natural gas. Wholesale natural gas market where producers, importers, marketers and large-scale customers trade natural gas was established, and independent natural gas transportation pipelines operator, namely CENAGAS was created.

In August 2014, Mexico also passed the New Electricity Law which will open the electric industry to private sector participation in generation, transmission, distribution and power marketing activities.

New Electricity Law paved the way for CFE and foreign investors to build new natural gas fired power plants and pipelines. Under the new regime, CFE, which owns 83.8% of domestic generation capacity in 2013, will face competition from private generation companies. As of 2012, 15,317 MW of installed capacity, or 36.6 % of total domestic capacity, has been in operation for 30 years or more, so recent years, CFE has been proceeding rehabilitation and modernization. Modernization involves retirement of oil-fired, coal-fired, or simple cycle gas turbine, and new construction of natural gas combined cycle, gas turbine, and renewable. As a result of Energy Reform, private companies will also invest in generation capacity, both natural gas combined cycle and renewable (SENER 2014d)⁴.

To supply natural gas to power plants to be built⁵, CFE is conducting or preparing for tender on pipeline projects, including five international pipelines to import 2.63 billion cubic feet (74 million cubic meters) per day from the U.S. by 2017. PEMEX is expected to complete the second phase of Los Ramones project, to import 2.1 billion cubic feet (59 million cubic meters) per day of natural gas from the U.S.

⁴ According to SENER's projection, total 5448MW will be added, of which combined cycle makes 58% (3182 MW), Hydro makes 13.8% (750 MW), gas turbine makes 9.6% (521 MW), and debottlenecking will contribute 11% (600 MW) of capacity addition (SENER 2014d)

⁵ Industrial use makes 51% of domestic natural gas demand, but 33% comes from petroleum sector; for fuel use, injection, feedstock for petrochemical plants, etc. The share of industrial sector is 18%, and most of plants locate in northeast and mid-west regions. Primary energy source in industrial sector is electricity, because auto assembly is the leading industry, electrical equipment and industrial equipment follow. Natural gas demand in residential sector is primitive. In 2012, residential sector accounted for only 1 % of total domestic demand as Liquefied Petroleum Gas is dominant fuel for households.

Figure 19: Natural gas pipeline system in 2013 and planned expansion



(Source) SENER (2014a), , PEMEX (2013), , U.S. Trade and Development Agency (2014), and Pricewaterhouse Coopers (2014)

On the U.S. side, there were several pipeline projects completed in 2014 and total export capacity reached 5.7 billion cubic feet (160 million cubic meters) per day by the end of December 2014, so in next 5 years, total pipeline capacity between the U.S. and Mexico will exceed 8 billion cubic feet (224 million cubic meters) per day. In addition, PEMEX has a vision of a liquefaction plant at Salina Cruz and LNG export to Asia (PEMEX 2014f). PEMEX states that the Transoceanic Corridor project will allow PEMEX to move hydrocarbons from the U.S. Gulf Coast to the Pacific reducing shipping costs and time compared to Panama Canal and optimizing vessels fleet routes.

And in February 2015, Sempra Energy, which owns and operates the Energía Costa Azul LNG receiving terminal on the west coast of Baja California, signed a Memorandum of Understanding (MOU) with PEMEX for the cooperation and coordination in development of a liquefaction project at the site (Sempra Energy 2015). These projects indicate the possible presence of Mexico as an oil and gas supplier to Asia-Pacific market.

Figure 20: Major natural gas pipeline projects

Project	entity	capacity (mcf/d)	note	operation
Waha (U.S.) – Ojinaga (U.S.)	CFE	1,350	* import	2017
Ojinaga – El Encino	CFE	1,350	Connect with Waha - Ojinaga PL	2017
El Encino – La Laguna	CFE	1,500		2017
Waha (U.S.) - Samalayuca	CFE	1,450	* import	2016
Branch line to Villa de Reyes	CFE	276	Initially connect with Los Ramones II, later, with Aguascalientes . Tula PL	2015
Tucson (U.S.) - Sasabe	CFE	200	* import	2014
Sasabe – Guaymas – El Oro	CFE	770		2015
		510		2016
Ehrenberg (U.S.) – San Luis Rio Colorado	CFE	130	* import	2017
Colombia - Escobedo	CFE	500	* import	2017
Agua Dulce (U.S.) – Frontera - Nuevo Leon - Centro (Los Ramones phase 1 & 2)	PEMEX	2,100	Phase 1 start operation in 2014 * import	2016
Los Ramones - Cempoala	PEMEX	n.a.		2017
Jáltipan - Salina Cruz (Transoceanic Corridor)	PEMEX	750 . 1,000		n.a.

(Source) SENER (2014a), PEMEX (2014f), U.S. Trade and Development Agency (2014), IEnova (2014) , Kinder Morgan (2015)

3. Potential areas of regional cooperation

3-1. SENER's Long-term forecast for Mexican energy supply/demand

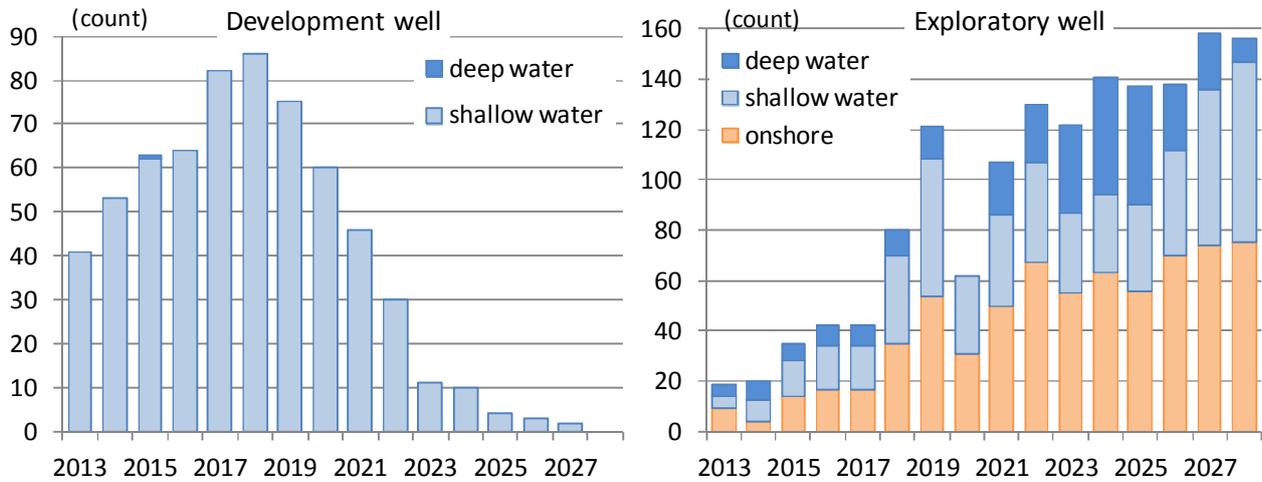
In December 2014, SENER published its latest long term (fifteen years) outlook for crude oil, petroleum byproducts, natural gas, electricity and renewable energy.

3-1-1. Oil market

In its outlook for petroleum market, SENER assumed price of Brent crude oil, will stay between 75 dollar per barrels and 85 dollars during the time period 2014-2028. It's significantly lower than 2013 version, when WTI crude oil price was assumed to stay at annual average 95.6 dollar per barrel.

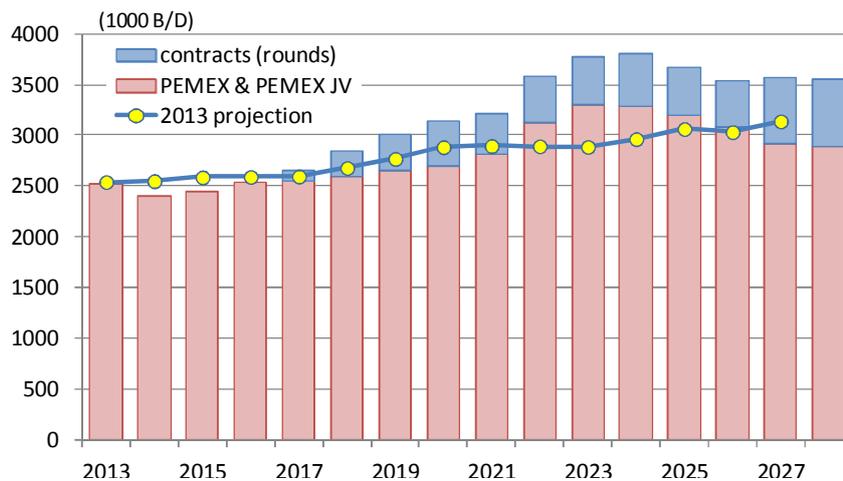
Based on the lower price assumption, however, SENER expects intensive exploration & development activity. Number of onshore development wells will increase from 525 in 2014 to 2047 in 2028. Number of development wells in shallow water will also increase rapidly; this number does not include future development. In addition, following the petroleum sector reform, SENER projects a lot of exploratory wells, including deepwater. As a result of accelerated E&P activity, domestic crude oil production will increase steadily in a decade and will peak in 2024, at 3.80 million b/d. In 2027, projected crude oil production is 3.56 million b/d, 12.9 % higher than SENER's 2013 prospective (3.14 million b/d in 2027). 18% of production (647 thousand b/d) will come from IOCs (as a result of Round 0, Round 1).

Figure 21: SENER's prospective for number of wells



(Source) SENER (2014a)

Figure 22: SENER's prospective for crude oil production

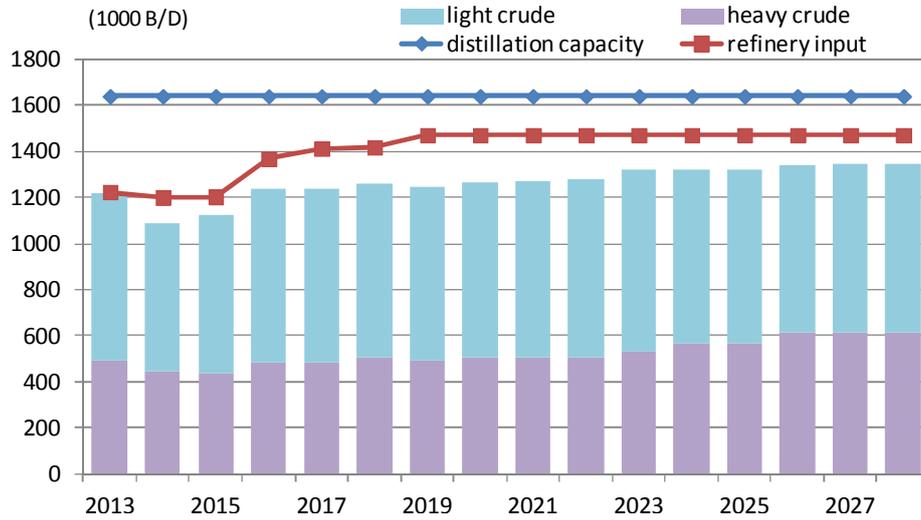


(source) SENER (2014a)

Demand for crude oil will be met by domestic crude oil in the future. PEMEX has six refineries with total distillation capacity at 1.64 million b/d, and there be no addition. But PEMEX plans to upgrade secondary units in three refineries. As a result of the investment, PEMEX refining will produce more gasoline and diesel, and less residual fuel oil. However, it's not enough to meet domestic demand for refined products. In 2013, Mexico imported 358 thousand b/d of gasoline, and the volume of import will reach 629 thousand b/d in 2028. Diesel import will increase from 101 thousand b/d to 136 thousand b/d. In case of residual fuel oil, both production and import will decrease,

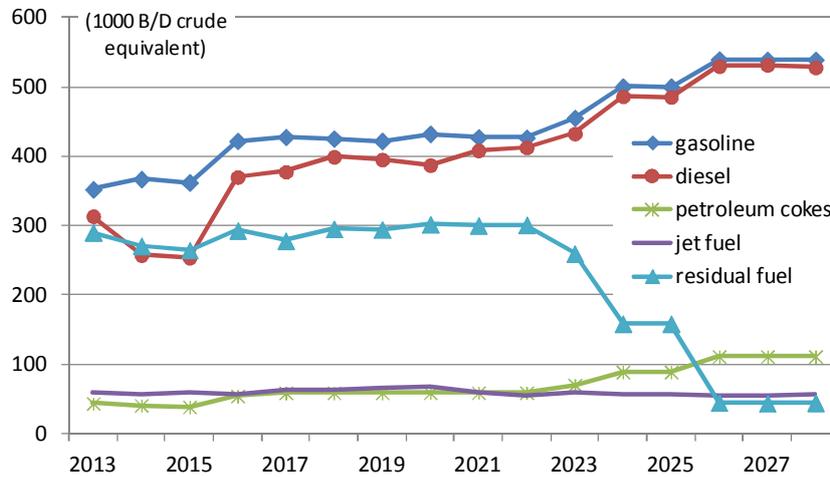
in parallel with dramatic drop in domestic demand, result from fuel switch in power generation sector.

Figure 23: SENER’s prospective for refining activity



(Source) SENER (2014a)

Figure 24: SENER’s prospective for production of refined products

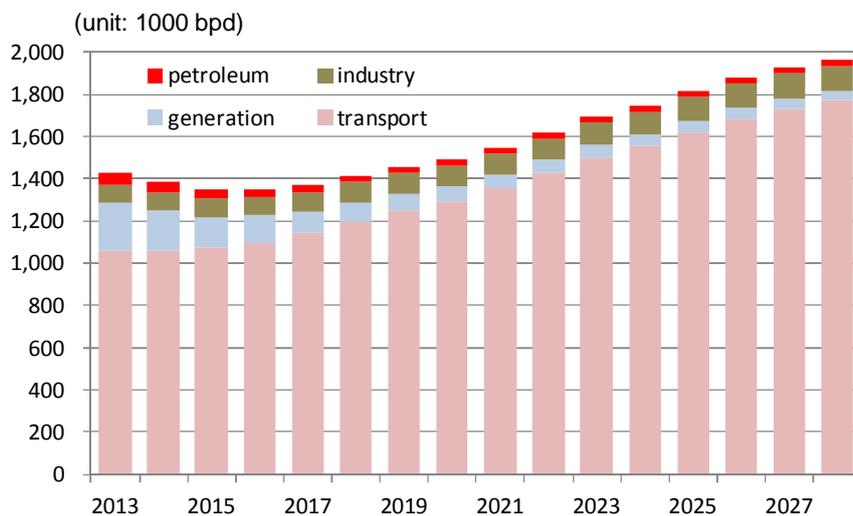


(Source) SENER (2014a)

Industrial demand will increase slightly, but most of demand growth will happen in transportation sector. The latest prospective differ from previous version in that it does not contain product price assumption. While retail price is set to be liberalized by 2018, there is no mention of future price structure.

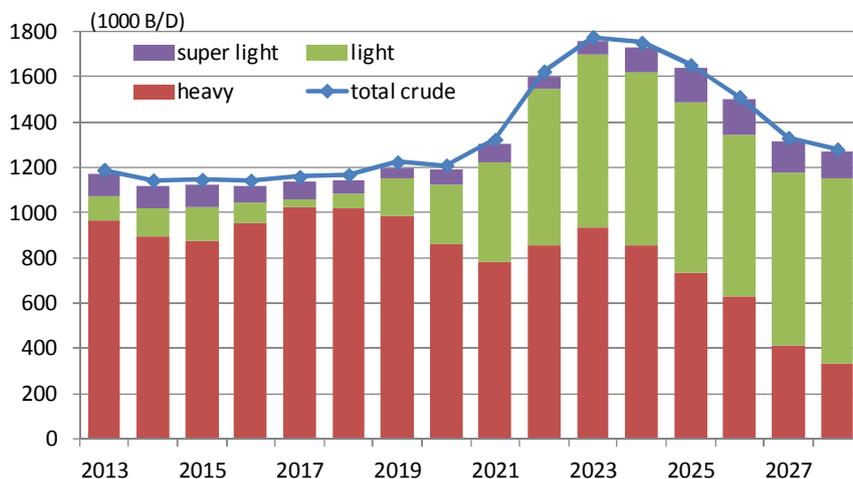
As a result of increase in crude oil production, and marginal rise in refinery input, crude oil export will increase by 2023, then decrease gradually.

Figure 25: SENER’s prospective for petroleum demand by sector



(Source) SENER (2014a)

Figure 26: SENER’s prospective for crude oil export



(Source) SENER (2014a)

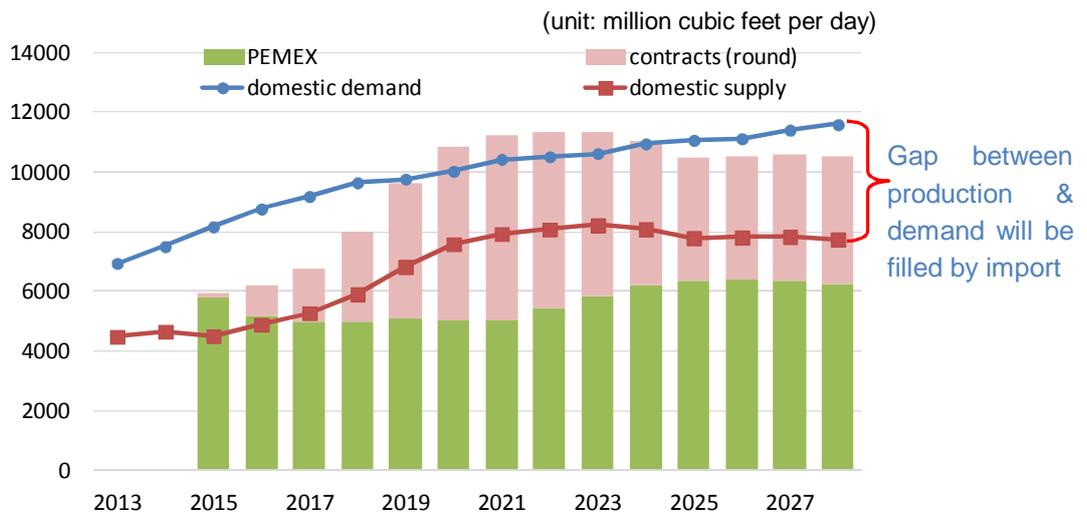
3-1-2. Natural Gas market

In the prospective for natural gas and LPG market, SENER expects steady increase in natural gas production. PEMEX production, mainly come from currently producing wells and development wells, will be stagnant, but IOCs will make a significant contribution after 2018. After 2021, domestic market production will plateau, but it

depends in future bid rounds. Despite prospective growth of natural gas production, domestic supply will not be enough to cover domestic demand. Mexico will continue to import natural gas.

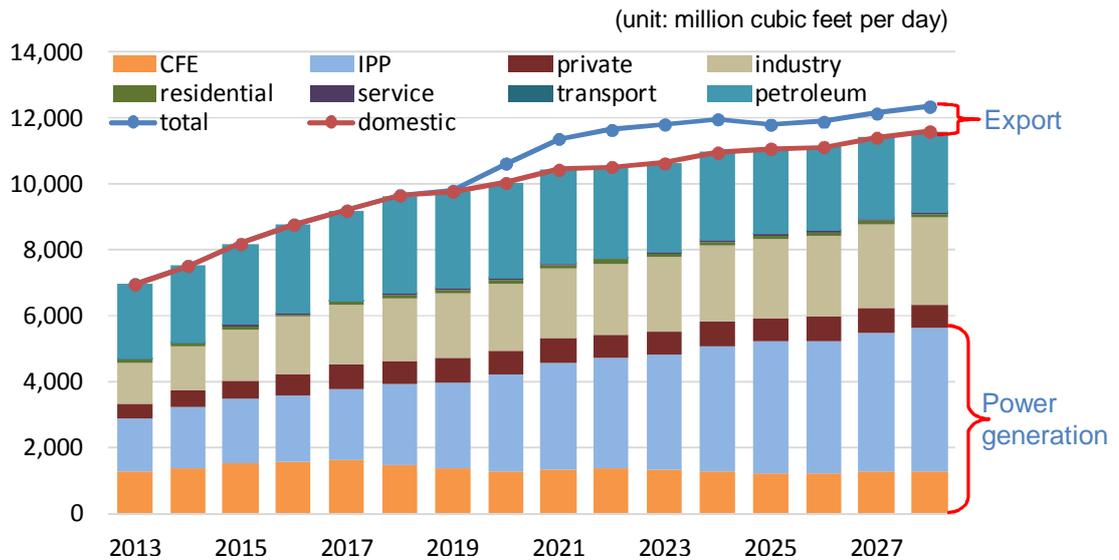
Natural gas demand in power generation sector will increase at an annual rate of 4.7%. Industrial demand will increase at an annual rate of 5.5%.

Figure 27: SENER's prospective for natural gas supply



(Source) SENER (2014a)

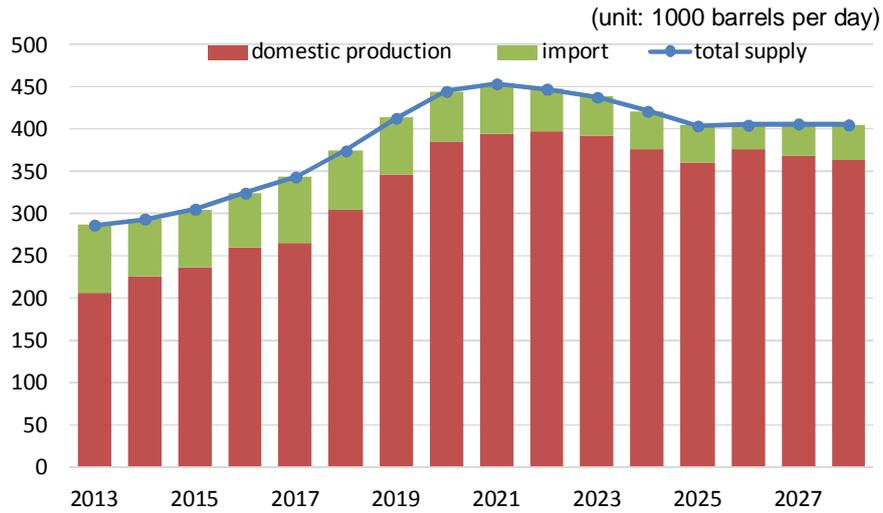
Figure 28: SENER's prospective for natural gas demand by sector



(Source) SENER (2014a)

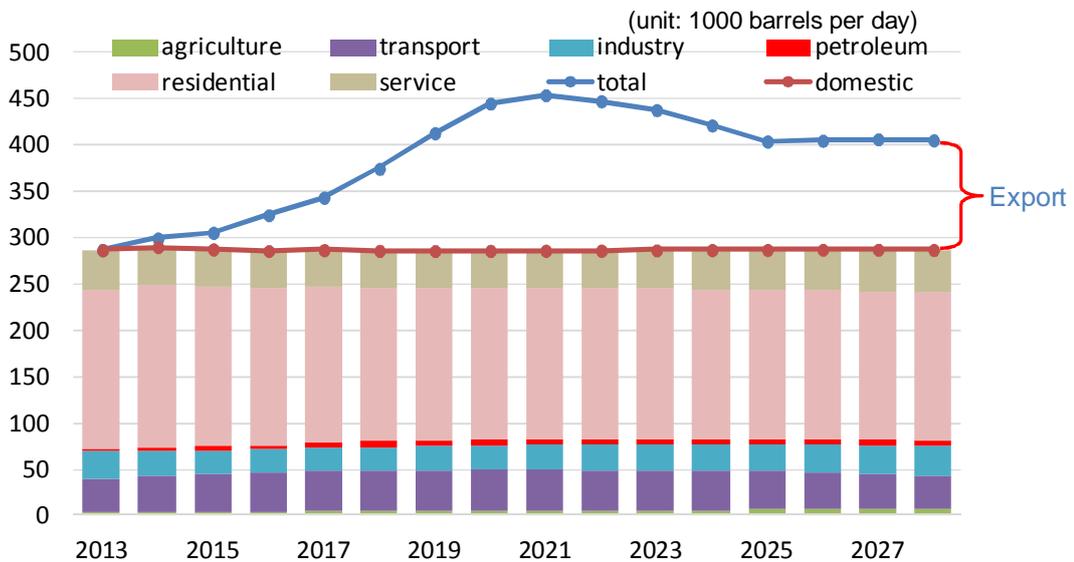
SENER estimates that domestic production of LPG, both from oil/gas wells and plants, will increase. Residential sector makes about 60% of domestic LPG demand, and it will maintain a 56% share in 2028, while household consumption of LPG will decrease slightly. Incremental supply of LPG will head for export.

Figure 29: SENER’s prospective for LPG supply



(Source) SENER (2014a)

Figure 30: SENER’s prospective for LPG demand by sector



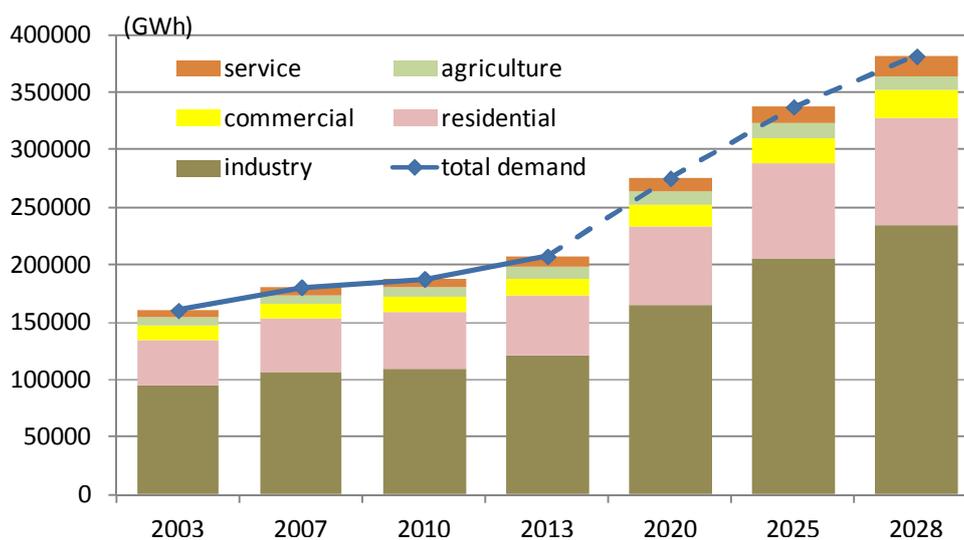
(Source) SENER (2014a)

3-1-3. Electricity market

In the prospective for electricity market, SENER expects domestic electricity consumption will increase at an annual rate of 4.4% by 2028, with an annual GDP growth of 4.4%. Industrial demand will increase at an annual rate of 4.5%, followed by commercial and service sector at 4.1%. In 2012, system loss of National Electric System amounted to 21% of domestic electricity consumption. By 2028, entities like CFE, CENACE will conduct reduction program of electric system losses, and in 2028, expected system loss will constitute 13.5% of domestic electricity consumption.

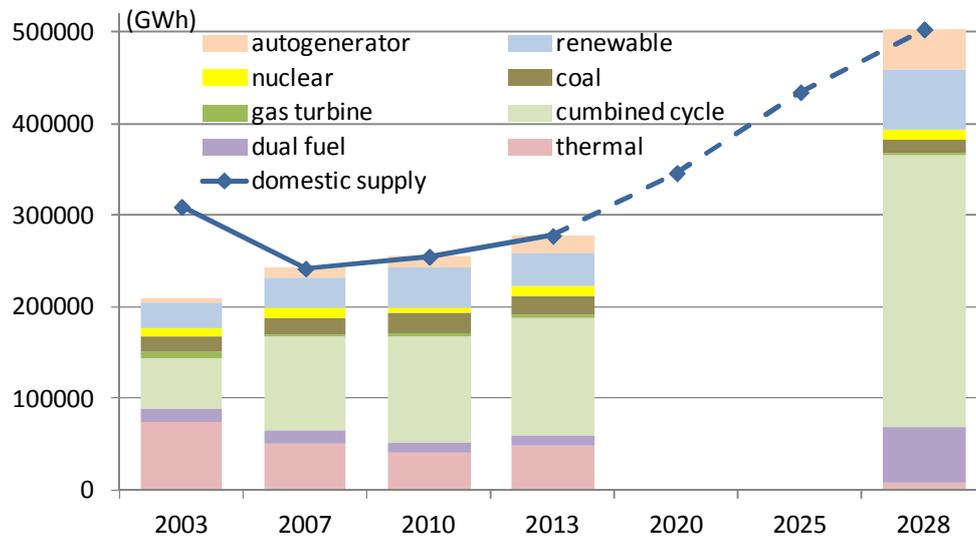
In 2013, combined cycle generation made 45.7% of total generation by electric power producers. In 208, the share will increase to 58.9%, while shale of oil fired power generation will decrease from 17.4% in 2013 to 1.7% in 2028.

Figure 31: SENER’s prospective for electricity demand by sector



(Source) SENER (2014a)

Figure 32: SENER's prospective for electricity supply by technology



(Source) SENER (2014a)

3-2. Long-term prospects by other institutions

As described above, SENER expects intensive E&P activity and steady crude oil production increase (at annual rate of 2.3%) under 75-85 dollar per barrel situation. SENER also estimates increase in natural gas production, mainly from newly developed wells by IOCs. Despite production expansion, Mexico will continue to depend on natural gas import, to cover its growing natural gas demand for power generation and industry.

SENER's projection is a little different from PEMEX's strategy presented in 2014. PEMEX stated that in the short term, the company will make the best efforts to maintain current production level at 2.3 million barrels per day, and in the mid-term (by 2020), it will increase production to 2.6 million barrels per day, and in the long-term, achieve 3 million barrels per day. When IOCs' production is added, PEMEX estimates total domestic production could reach 4 million barrels per day by 2025. In natural gas sector, PEMEX estimates that by 2017, Mexico will achieve self sufficiency on natural gas, and in 2020, PEMEX will start to export natural gas, including LNG. However, it must be noted that 'self sufficiency' refers to the balance between the sum of domestic natural gas production and import from the U.S., and domestic gas demand.

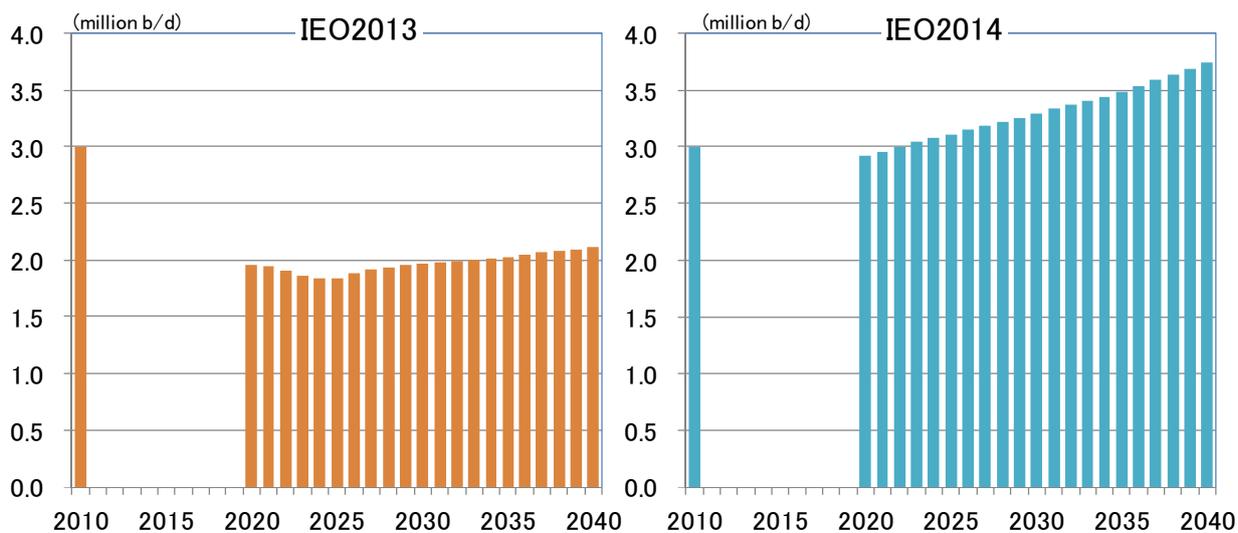
For comparison, U.S. Energy Information Administration analyzes mid-and-long-term and changes in the Mexico's energy supply. In its 'International Energy Outlook 2014', published in September 2014, EIA raised projection for oil production in Mexico drastically. As showed below, EIA sees Mexican oil production will start to increase in 2017. It must be noted that oil price assumption in IEO 2014 is upward trend, from 98.9 dollar per barrel to 115.3 dollar in 2028, 141.5 dollar in 2040.

IEO2014 does not include projection for Mexican oil trade balance, but in Annual Energy Outlook (AEO) 2014, published in May 2014, EIA estimates that thanks to increase in U.S. domestic oil production, the U.S. net crude oil import will decrease by 2016 then steadily increase. It means that it's difficult to find outlet in the U.S. market for Mexican crude.

IEO2014 does not provide a projection for natural gas production in Mexico. In IEO2013, EIA raised the volume of Mexican natural gas production significantly from IEO2011. Abundant shale gas resource in Mexico contributed the revision and constitutional reform was not reflected into IEO2013. This robust projection is affected by 1) projection for Mexico's gas demand, base on GDP growth, industrial production and population, 2) availability of U.S. gas export to Mexico, base on U.S. domestic gas supply-demand and committed volume of LNG export. The gap between Mexican gas demand and supply from the U.S. could be filled by Mexican domestic production. Despite production increase, IEO2013 states that Mexico will remain net gas importer in long-term future and the volume of net import will grow.

On the demand side, IEO 2013 shows only projection for combined Mexico and Chile. However, EIA expects rapid increase in industrial energy demand and electricity consumption in two economies⁶. In both sectors, fuel switch from liquid to natural gas will contribute to the gas demand increase. This projection supports SENER's prospect for Mexico's energy consumption in industrial and power generation sector, and fuel switch from liquid to natural gas.

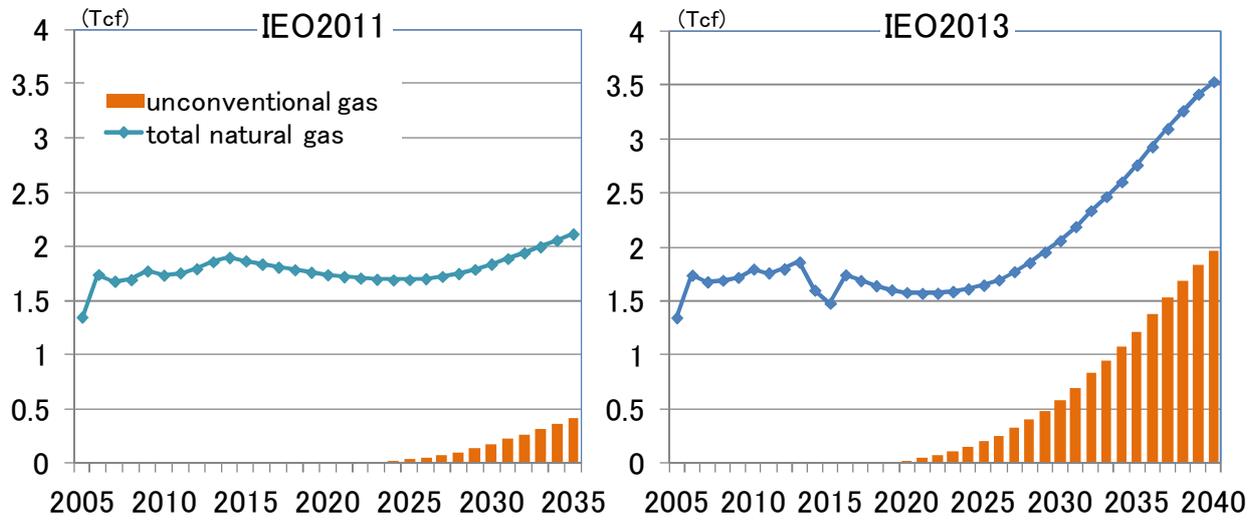
Figure 33: EIA's projection for oil production in Mexico



(Source) EIA (2013c and 2014c)

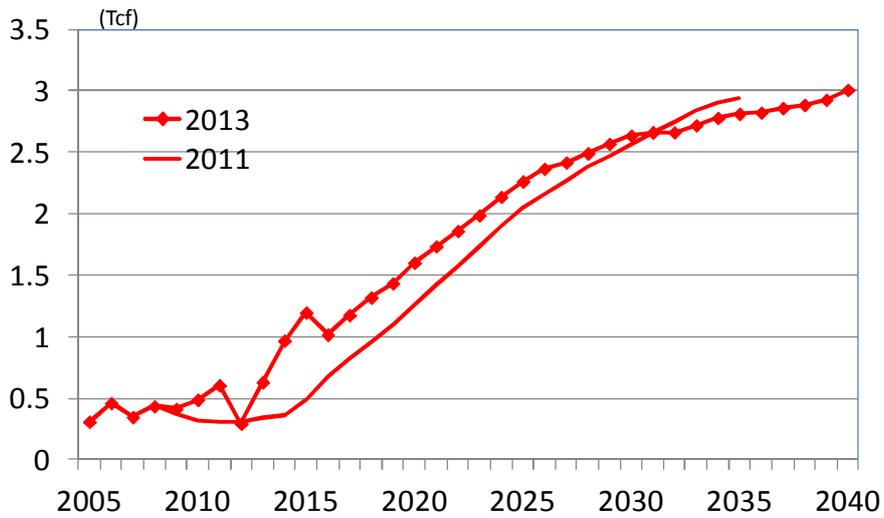
⁶ EIA does not clarify the breakdown between two economies.

Figure 34: EIA's projection for natural gas production in Mexico



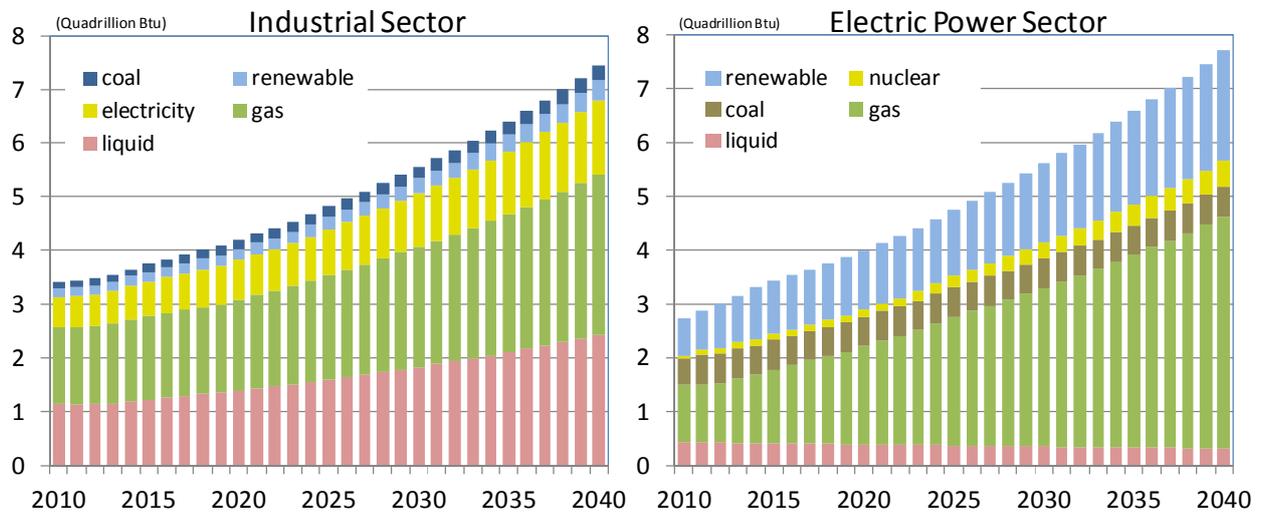
(Source) EIA (2011 and 2013c)

Figure 35: EIA's projection for natural gas import to Mexico



(Source) EIA (2011 and 2013c)

Figure 36: Projection energy demand by source

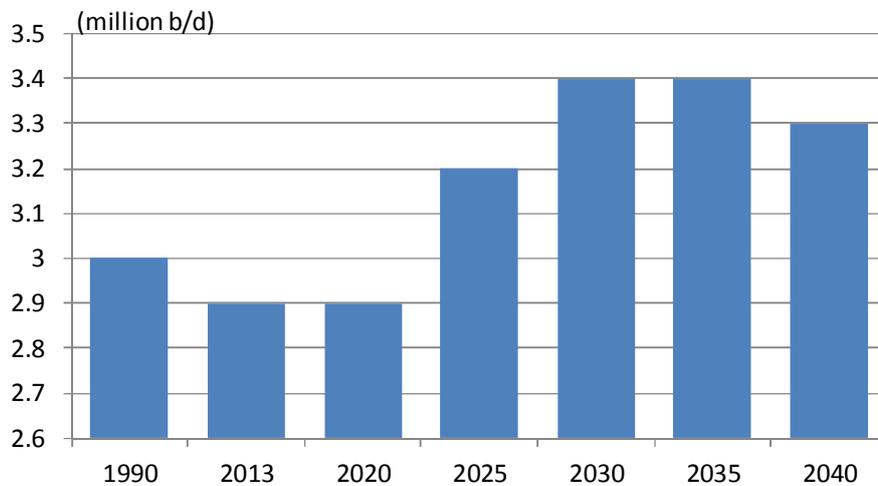


(Source) (EIA 2013c)

The International Energy Agency (IEA)s World Energy Outlook 2014 includes brief description about Mexicos oil and gas supply. It states that the reform will be effective, though more slowly than planned, with Mexican oil production reaching 3.4 million barrels per day by 2030 but declining slowly thereafter to 3.3 million barrels per day in 2040. IEA expects tight oil production will make some contribution after 2025, and the volume will be over 0.4 million barrels per day in 2040.

In the natural gas sector, IEA predicts that Mexican production will increase by about 50 billion cubic meet per year (4.83 billion cubic feet or 135 million cubic meters per day), by 2040. Its larger than expected incremental supply in Nigeria, but less than that in Mozambique.

Figure 37: IEA's projection for crude oil production in Mexico



(Source) IEA (2014)

3-3. Mexico's challenges to make its energy reform operational

As described in the previous sections, the energy reform enacted intends to create a positive cycle in Mexico; in the short term, it aims to reduce the fiscal burden imposed on PEMEX to allow it increase upstream investment; at the same time, opening upstream sector for foreign investment and pave the way for PEMEX to cooperate with IOCs to extract hydrocarbons in Mexico more efficiently.

PEMEX planned to promote mid- and downstream projects to become a competitive player in the liberalized market. CFE invests in generation capacity, transmission lines, and gas transportation to gas-fired power plants, to keep up with growing electricity demand. This will spur natural gas demand; in the short term, additional natural gas demand will be met by imports from the U.S.

In the midterm, abundant hydrocarbon resource, attractive contract conditions, and Mexico's advantageous access to huge oil & gas market in the U.S., will stimulate foreign investment in upstream sector in Mexico. Domestically produced natural gas will support gas demand for power generation in the long term. Increased oil and gas supply will hopefully bring down energy costs for Mexican consumers and industries, and provide new oil and gas export opportunities.

However, so far, situation is moving towards a different direction. In response to steep drop in crude oil in the last six months, almost all upstream companies cut upstream spending; the contract term for Round One shallow water blocks was not attractive enough to invite IOCs in such market conditions; and PEMEX is pressed to delay its downstream projects.

Listed below are a few agendas for promoting required investment smoothly.

<Upstream Oil and Gas Sector>

, for International Oil Companies (IOCs) are looking for investment opportunity and additional reserves, it was a milestone that Mexico opened up its upstream sector to foreign investors first time since 1938. For Mexico itself, expected investment in upstream oil sector and increase in oil production/ petroleum export revenue provides growth opportunity. However, before Mexico win the upstream investment, favorable upstream contract terms, transparent and reasonable regulatory policy including environmental management, labor relation, workplace safety, will be essential. And public safety is a fundamental condition to attract investment especially in onshore E&P activity, which involves on-land construction works. Public safety is also important for construction of pipelines and other infrastructures, and safeguarding of these assets.

As described above, currently bidding round for blocks in shallow water is undergoing. Deep water and heavy oil will follow, and in the long term, SENER has a policy to begin a full-scale process for exploration and development of unconventional resources.

We have already seen that in the Americas or Europe, there are strong concerns about environmental impacts of hydraulic fracturing. Environmental regulation and competent service industries are particularly important when Mexico attempts to develop its oil and gas resources.

<Downstream Petroleum Sector>

Upgrading programs have been carried out at Mexico's six refineries. As of March 2015, drop in crude oil price hits the programs, but ultimately, PEMEX's programs will increase gasoline and diesel productions, and decrease output of residual fuel oil from its refineries.

It is consistent with CFE's fuel switching from liquid to natural gas, and overall direction of fuel switching in Mexico. However, as a result of investment in coking equipment, production of petroleum cokes will increase, so PEMEX will need to find a new market. To utilize petroleum cokes cleanly, power generation (Integrated Gasification Combined Cycle: IGCC) is one of the options. Other options include raw material in chemical sector, or fuel in non-ferrous metal sector.

PEMEX welcome joint venture partners which will supply finance, technical expertise to upgrade their refineries in response to changing petroleum demand/ supply and tighter quality specifications. However, the attractiveness of such investment depends on;

- Liberalization in domestic petroleum product markets (now only gasoline and diesel price liberalization is scheduled but all product markets could be liberalized in the future)
- Forecast for expansion in domestic crude supply, and API grade of crude oil.

<Natural Gas market>

Mexican natural gas demand will increase steadily. There are many pipeline projects already undergoing and these projects will double Mexico's import capacity of cheap U.S. gas in next five years. However, as a negative effect, cheap gas supply from the U.S. may diminish investment on domestic gas production.

In the long term, if and when companies invest in unconventional gas development, shale gas related activities like equipment supply, water and sand supply, water treatment will spur investments as soon as production steps up.

<Electricity market>

Power generation in Mexico is already highly dependent on natural gas, and share of natural gas will increase even more. The government promotes power generation from renewable energy sources, but incentive measures for renewables include a certification mechanism, guidelines for grid connection are still under discussion.

Coal and oil currently account for 11% and 16% of Mexican power generation, respectively. According to SENER, coal and residual fuel oil are more expensive than natural gas in Mexico, so it is rational to shift from coal or oil to natural gas. However, larger share of natural gas in power generation mix means more vulnerability to gas price fluctuations not only in Mexico but also in the U.S.

Energy efficiency, including "loss reduction program" of National Electric System, is always the most important area of cooperation. If Mexico consumes electricity more efficiently, it can invest more onto other social and economic development programs. Currently, retail prices of electricity are regulated. In the long term, it is desirable that Mexican consumers and industries enjoy affordable electricity without government subsidy.

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