MAJOR INFRASTRUCTURE PROJECTS IN MEXICO

A Resource Guide for U.S. Industry

Sponsored by the U.S. Trade and Development Agency

Prepared under contract by:

The Seneca Group LLC
500 New Jersey Avenue NW, Fourth Floor ▪ Washington, DC 20001
Tel. +1 (202) 783-5861 ▪ www.seneca-llc.com

OCTOBER 2014

This report was funded by the U.S. Trade and Development Agency (USTDA), an agency of the U.S. Government. The opinions, findings, conclusions, or recommendations expressed in this document are those of the author(s) and do not necessarily represent the official position or policies of USTDA. USTDA makes no representation about, nor does it accept responsibility for, the accuracy or completeness of the information contained in this report.

About This Guide

The U.S. Trade and Development Agency (USTDA) helps companies create U.S. jobs through the export of U.S. goods and services for priority development projects in emerging economies. USTDA links U.S. businesses to export opportunities by funding project planning activities, pilot projects and reverse trade missions while creating sustainable infrastructure and economic growth in partner countries.

This guide has been developed to provide U.S. companies and exporters with an overview of Mexico's infrastructure sectors, the sector development plans in place through 2018, and to provide profiles of a sample of specific, upcoming projects of potential interest.

Currency amounts converted from Mexican Pesos (MXN) to United States dollars (USD) have been done so using a rate of 13.12 pesos to one dollar. Due to fluctuations in currency values, different levels of engineering and cost estimation completion for different projects, and differing timing of cost information publication, the monetary values within this report should only be considered approximate. Unless explicitly indicated otherwise, all currency values are in United States Dollars (USD).

All exhibits and images are sourced from Mexican government publications, unless otherwise indicated.

Authors

This report was developed under contract to USTDA by the Seneca Group LLC, based in Washington, DC. Inquiries may be directed by telephone to +1 (202) 783-5861 or to Richard Sherman at sherman@seneca-llc.com. Visit our website at: www.seneca-llc.com

Acknowledgements

The authors wish to extend their sincere thanks to the team at the United States Commercial Service office in Mexico City for their support provided during this project. We are grateful to the officials at Mexican federal agencies who generously opened their doors to meet with us to present a number of the exciting projects that have been included in this Guide.

3.4 Energy

3.4.1 Electricity Generation, Transmission and Distribution

Sector Background

Mexico's national electricity system includes 530,334 miles of transmission and distribution lines. The national territory of the country is divided into nine electricity management regions with 8 control centers located in Mexico, Puebla, Guadalajara, Hermosillo, Gomez, Palacio, Monterrey and Mérida. Baja California is administered from Mexicali. The National Control Center (to be transferred to CENACE) is located in Mexico City and oversees the national grid.

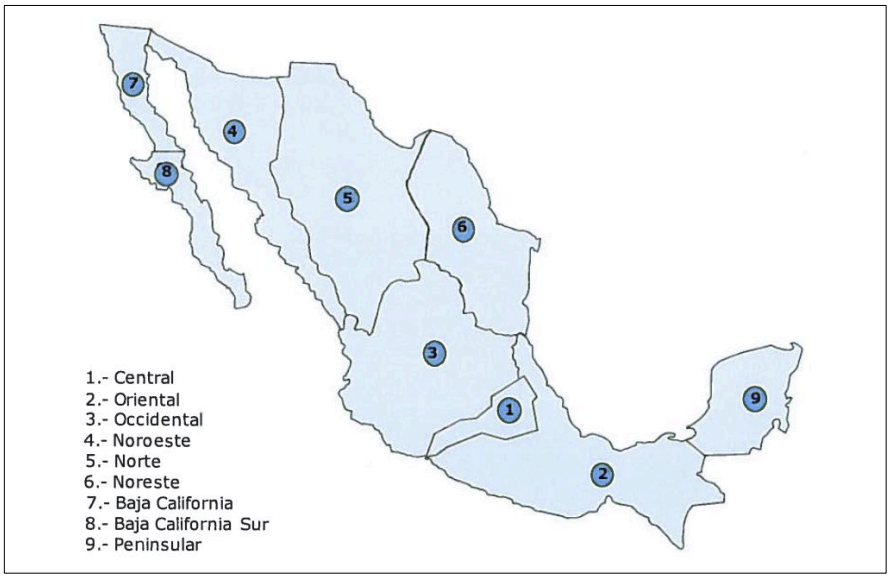


Figure 70: The Nine National Electrical System Administrative Regions

This infrastructure connects an effective generating capacity of 64,860 MW. Of this, 64 percent was capacity within CFE and 36 percent capacity of permitees (independent operators). Of the electricity generated for public service 41,184 MW was provided by CFE and 12,418 MW came from independent power producers. By 2013, the reserve margin of the interconnected system was being maintained at 21.6 percent.

Sector	2005	2006	2007	2008	2009	2010	2011	2012	2012 as %
Industrial	99,720	103,153	106,632	107,651	102,721	109,015	116,984	121,736	59%
Residential	42,531	44,452	45,835	47,451	49,213	49,407	52,505	52,771	25%
Commercial	12,989	13,210	13,388	13,627	13,483	13,069	13,675	14,001	7%
Agriculture	8,067	7,960	7,804	8,109	9,299	8,600	10,973	10,816	5%
Services	6,450	6,596	6,809	7,074	7,803	7,723	8,089	8,388	4%
Total	**169,757**	**175,371**	**180,468**	**183,912**	**182,519**	**187,814**	**202,226**	**207,712**	**100%**

Table 35: Evolution of Mexico Electricity Sales by Sector (GWh) 2005-12

The evolution and centralization of the system occurred rapidly through the second half of the twentieth century through the present day. In 1960, the generating capacity was 3,021 MW, provided by a collection of isolated systems. Over the next decades, the systems were standardized on a frequency of 60 Hz and interconnected through networks of high-tension lines of 400 and 230 kV. Major steps in capacity came from a series of large thermal and hydroelectric power plants. Mexico's first nuclear power plant, Laguna Verde, a boiling water reactor design, was commissioned in 1995 and provides 1.37 MW of power. The system has seen growing diversity as more hydro, geothermal, wind, solar and combined cycle thermal power, including natural gas, have been added to the generation mix. Today, the national electrical system is a single, interoperable network, with the exception of Baja California, which is connected to, and exchanges power with, the Western Electricity Coordinating Council in the United States.

Since 2002, Mexico has substantially shifted the primary fuel sources it uses for electricity generation. Fuel oil has dropped from 37 percent to 18 percent as the source of TWh, replaced largely by natural gas, which rose from 29 percent to 50 percent as the source of TWh of gross generation for public service use.

Mode	Type	2002	2012	2012 MW as % of Total	Chg. in MW 2002 - 2012
Fossil Fuel	Coal	2,600	3,278	6.2%	678
	Conventional Thermoelectric	14,283	11,923	22.4%	(2,360)
	Combined Cycle	7,343	18,029	33.9%	10,686
	Turbogas	2,890	2,968	5.6%	78
	Internal Combustion	144	252	0.5%	108
	Dual	2,100	2,100	4.0%	-
Non-Fossil Fuel	Hydro	9,608	11,544	21.7%	1,936
	Geothermal	843	812	1.5%	(31)
	Wind	2	598	1.1%	596
	Nuclear	1,365	1,610	3.0%	245
	Solar	-	1	0.0%	1
Total		**41,178**	**53,115**	**100%**	**11,937**

Table 36: Public Service Electricity Generation Capacity in MW by Fuel Source, 2002 – 12

Mexico's electricity sector includes participation by private sector permitees, operating under contracts that allow them to perform transportation, transformation and handover of electricity. Permits are issued on a case-by-case basis by CRE. This includes entities producing power for their own or private industry use, as well as entities producing power for sale back onto the grid via CFE. The independent and small producer permits were designed for generators of power destined for sale to CFE, with small producers limited to 30 MW per permit.

Permitee Mode	Permits	Authorized Capacity (MW)
Independent Power Producers	27	13,616
Self Supply	428	4,972
Cogeneration	64	3,305
Export	4	1,330
Continuous use	38	496
Import	27	170
Small Producers	1	5
Total	**589**	**23,894**

Table 37: 2012 Electricity Permitees by Type and Volume (MW)

The independent producers, self-supply, cogeneration and export have all increased the amount of electricity they generate since 2009. As of 2012, an additional 4,205 MW was under construction, of which 59 percent was for self-supply and 31 percent was for two exporters. Another 1,953 MW of capacity was in final project preparation, including 115 MW of cogeneration and 29 MW of self-supply.

Figure 71: Evolution of Permitees Electricity Generation 2009 -12 in MW

The growth of the transmission and distribution network has been steady, with a general replacement of lower capacity lines with higher capacity lines as measured in kV.

Units	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Growth, km	As %
System Kilometers	675,385	727,075	746,911	759,552	773,059	786,151	803,712	812,282	824,065	845,201	853,490	178,105	26%
Miles	**419,665**	**451,783**	**464,109**	**471,964**	**480,356**	**488,491**	**499,403**	**504,728**	**512,050**	**525,183**	**530,334**	**110,669**	**26%**

Table 38: Growth of Mexico's Electricity Network 2002 – 12

The trunk transmission network consists of 400 and 230 kV lines, making up 6 percent of the network miles. The network includes 276,262 substations of which 57 percent support transmission.

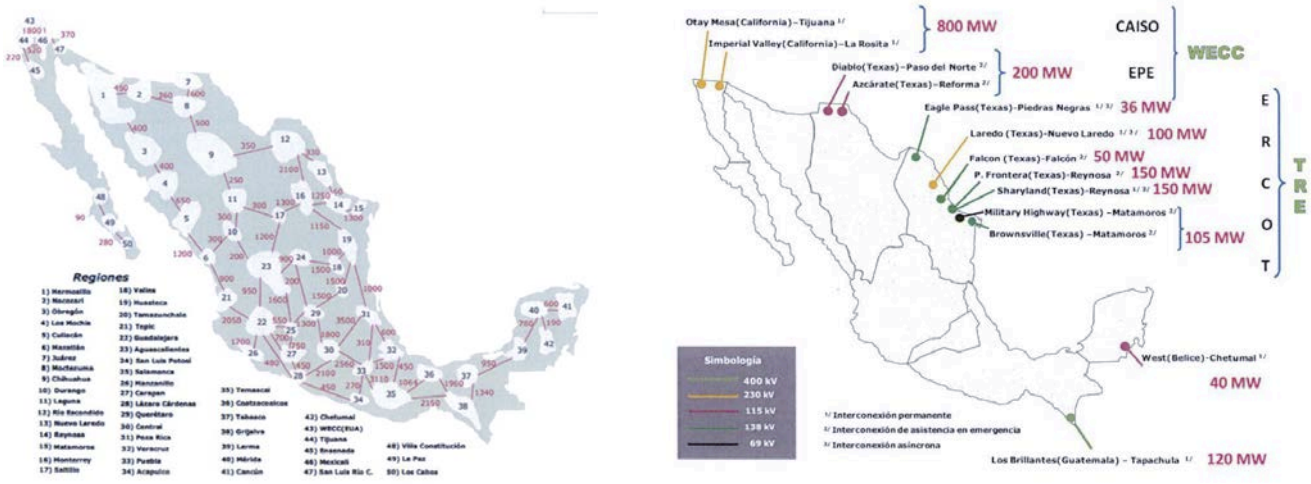


Figure 72: National Electrical System Interconnections and Capacities

Mexico's imports and exports of power are quite small relative to total demand and production of the system, and the system is not dependent upon neighboring countries. Connections are primarily used to optimize power supply and better manage occasional contingencies. Historically, Mexico has maintained a small positive balance of power, with exports slightly exceeding imports. In 2012 the country had net imports of 1,049 GWh.

Government Role

The role of the government versus the private sector, and the role of the government entities involved in the electricity sector is at the time of this writing undergoing significant changes, following sectoral reforms that involved fundamental changes in Mexican law with implementing legislation passed in August of 2014. The structure prior to the changes passed into statute in 2014 is illustrated below:

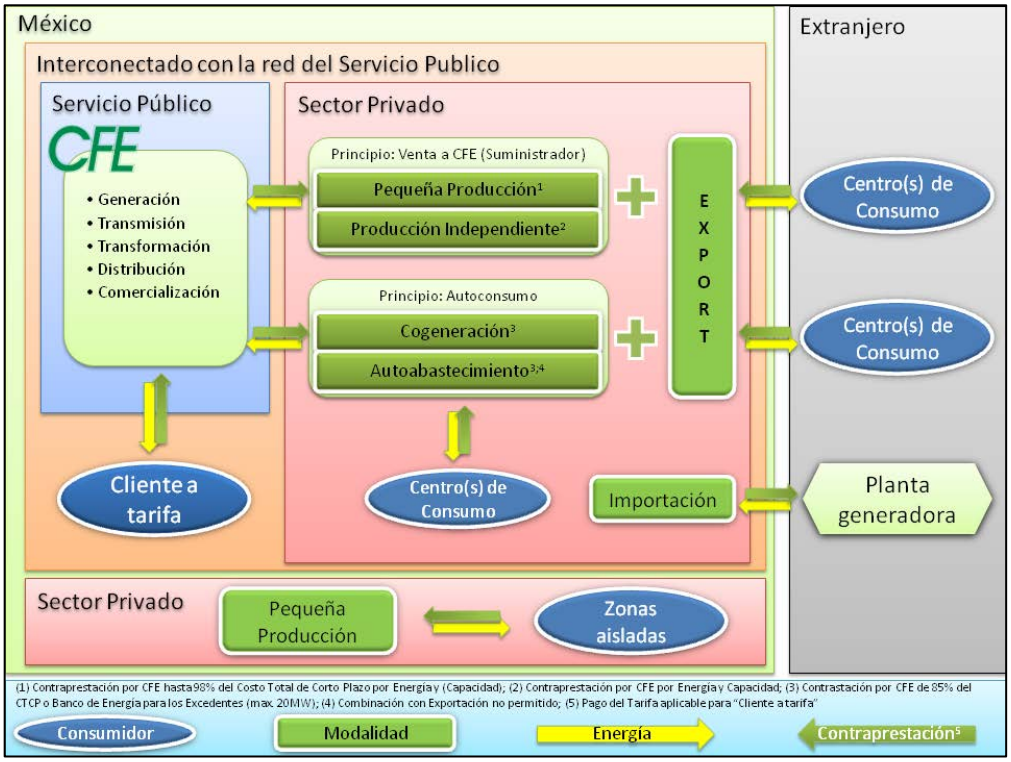


Figure 73: Economic and Institutional Structure of the Electricity System to 2014

Federal Electricity Commission

CFE is the state-owned, national electrical utility company of Mexico. Historically, CFE has held the mission of executing the state's constitutional obligation to control and develop the national electrical system and industry. CFE absorbed all the private utilities in the country under laws passed in 1960, and in 2010 completed absorption of the remaining major public electric utility, Luz y Fuerza del Centro, which provided service to the State of Mexico and the Federal District, and some parts of adjoining states. In August of 2014, energy sector reforms changed the character of CFE to a "public productive enterprise" and have removed its responsibility as system operator, which will be taken over by CENACE.

Energy Regulation Commission

In 1992, the Public Service Law for Electrical Energy created an entity subordinate to the Secretariat of Energy that would be responsible for managing the interaction between the public sector and the private entities entering the market due to the reforms associated with the law. A 1994 law specific to the Commission (CRE by its Spanish acronym) strengthened its autonomy within SENER and consolidated further responsibilities within it that had previously been scattered across different agencies. In 2008, CRE was further strengthened and given clear authority over areas of the petroleum industry, in addition to its responsibilities for the electricity and natural gas sectors. At this point, CRE had the formal responsibility for promotion of the efficient development of:

- The supply and sale of electricity to public service users;
- The generation, export, and import of electrical energy by private entities;

- Services of transmission, distribution and retail marketing of electricity between public and private providers;
- The initial sale of gas, oil and petrochemical products;
- Pipeline transmission and storage of natural gas and petroleum products;
- Transport and distribution of bioenergy products by pipeline.

CRE is responsible for protecting the interests of the general public as consumers of energy, promoting competition in the market, supporting national coverage, and promoting the stability, reliability, and security of provision of energy services. CRE balances the need for producers and providers to make a profit with the public service interest of provision of reliable, efficient and affordable energy to users. CRE uses a range of regulatory and legal tools to fulfill its mission, including directives, model and standard contract requirements and standards, as well as having the power to make enforceable judgments that levy fines or other administrative penalties.

CENACE

The Centro Nacional de Control de Energía (CENACE) is a quasi-independent agency aligned with SENER that is responsible for the operation of the national electric power system in the role of an independent system operator (ISO). It is a guarantor of open access to the national transmission and generation networks, and will promote development of the wholesale power market in Mexico. This agency was created by law on August 28, 2014 and within 90 days will absorb the relevant assets and responsibilities previously provided by CFE in performing these functions, performing the role of the national independent system operator.

Challenges and Goals

SENER conducts a rolling, rigorous, long-range forecast of electrical energy demand based on numerous factors including economic growth, population, achievements in energy efficiency, reduction of waste and theft, and projected prices of various fuel sources considering goals for the generation mix. Strategic capacity needs are projected over the medium and long range, most recently 2013 – 2018 and 2019 – 2027. In the period through 2018, to meet projected demand, an estimated 16,059 MW capacity must be added, through construction of new generation plants or rehabilitation or modernization of existing plants. From 2019 – 2027, an additional 30,855 MW is projected to be required.

Units	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	Total
CFE, New	2,346	2,314	3,020	2,946	2,734	3,457	3,322	3,535	2,292	3,334	4,439	3,303	4,440	**41,482**
Incremental	146	114	25	-	-	-	-	-	-	-	-	-	-	285
Self-Supply	74	-	3,682	200	200	200	200	200	200	200	200	200	200	5,756
Total	**2,566**	**2,428**	**6,727**	**3,146**	**2,934**	**3,657**	**3,522**	**3,735**	**2,492**	**3,534**	**4,639**	**3,503**	**4,640**	**47,523**
Cumulative	*2,566*	*4,994*	*11,721*	*14,867*	*17,801*	*21,458*	*24,980*	*28,715*	*31,207*	*34,741*	*39,380*	*42,883*	*47,523*	

Table 39: Generation Capacity Additions through 2027 (MW)

The framework of recent and new energy laws supports a shift of the generation mix to substantially increase the share of power from green energy sources. There are two scenarios for this. In the first scenario, based on goals established in the 2012 General Law on Climate Change, the mix of clean energy generation capacity would increase to 31.9 percent by 2018, composed of 18.4 percent hydro, 4.1 percent wind, 1.8 percent nuclear and 2.4 percent from a mix of geothermal, solar and biogas plants. In SENER's alternative scenario, based on

goals established in the 2011 Law for the Implementation of Renewable Energy (LAERFTE by its Spanish acronym), the use of non-fossil fuels would reach 35 percent of the power mix by 2027. Mexico will retain nuclear power generation as a function exclusive to the state, and they intend to expand this capacity as feasible to support achievement of clean energy goals, through construction of a new plant and/or expansion of the Laguna Verde station.

Technology	MW	As %
Combined Cycle	28,796	69%
Hydro	3,822	9%
Clean Carbon	2,800	7%
Other Renewable	2,800	7%
Wind	2,704	6%
Turbogas	536	1%
Geothermal	255	1%
Internal Combustion	43	0%
Solar	-	0%
Total	**41,756**	**100%**

Table 40: New Public Service Generation (MW by Type) through 2027

Mexico's electricity generation will remain dominated by thermoelectric fossil fuel generation, with coal remaining roughly steady, the biggest change, as described previously, will be the projected swap of fuel oil for natural gas.

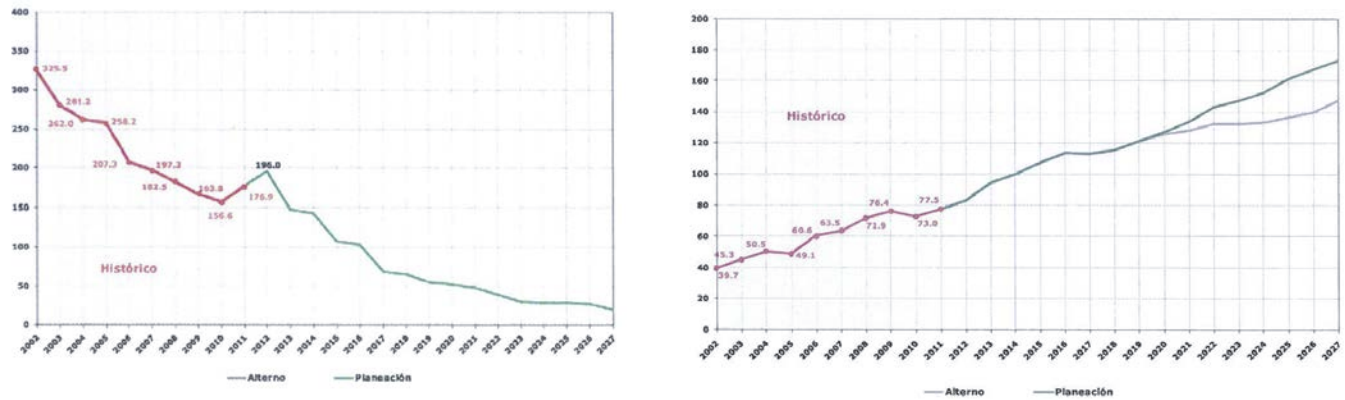


Figure 74: Consumption of Fuel Oil (Mbd) and Natural Gas (MMm^3/day) for Electricity

Mexico has to date achieved successes with previous reforms that have introduced private participation into the electricity sector, in the form of financed turnkey contracts for generating assets and through self-supply, where generation assets are built by the private sector for dedicated private, industrial power supply purposes. These are notable for the increase in wind power generation schemes that have been implemented, in particular. Self-supply, cogeneration and distributed generation are expected to continue to have a continued and growing impact on the market.

Mexico faces a strategic challenge in its efforts to balance the needs to finance the maintenance and development of the electrical system while providing electricity at affordable prices to both industrial and residential consumers. Historically, rates have been proposed by CFE and then set by the tax authority, and

subsidies to consumers (largely residential customers) are mostly provided indirectly by the mechanism of the state making up losses incurred on provision of this by CFE, but also to some degree by charging relatively higher rates to industrial customers. Electricity rates to residential consumers were a relatively low ~USD $90.19/MWh as of 2013 and rates charged to industrial customers were ~USD $114.74/MWh. This is the opposite of the situation in most countries in the OECD.

Category	2008	2009	2010	2011	2012
Transmission Losses	2.2%	2.4%	2.4%	2.0%	1.6%
Distribution Losses	15.7%	16.1%	16.1%	15.9%	15.3%
Total Losses	**18.0%**	**18.5%**	**18.5%**	**17.9%**	**16.9%**

Table 41: Losses in Electricity Transmission and Distribution 2008 - 12

The subsidized rates to consumers create particular externalities, they are a disincentive to investments and implementation of efficiencies in the use of power generally. The state intends to address these challenges and goals through several mechanisms contained within the latest reform. By opening up the sector to more private participation and capital, the intent is that supply of electricity will be improved, particularly through the provision of renewable energy destined for industrial customers, and at lower costs by implementing innovative technologies, improved management, and private financing. Investments in transmission, distribution and retail infrastructure will include initiatives to improve the efficiency of equipment and to improve accountability for provision of electricity. Currently, CFE experiences significant losses due to waste and theft of power across the network, particularly in the distribution segment.

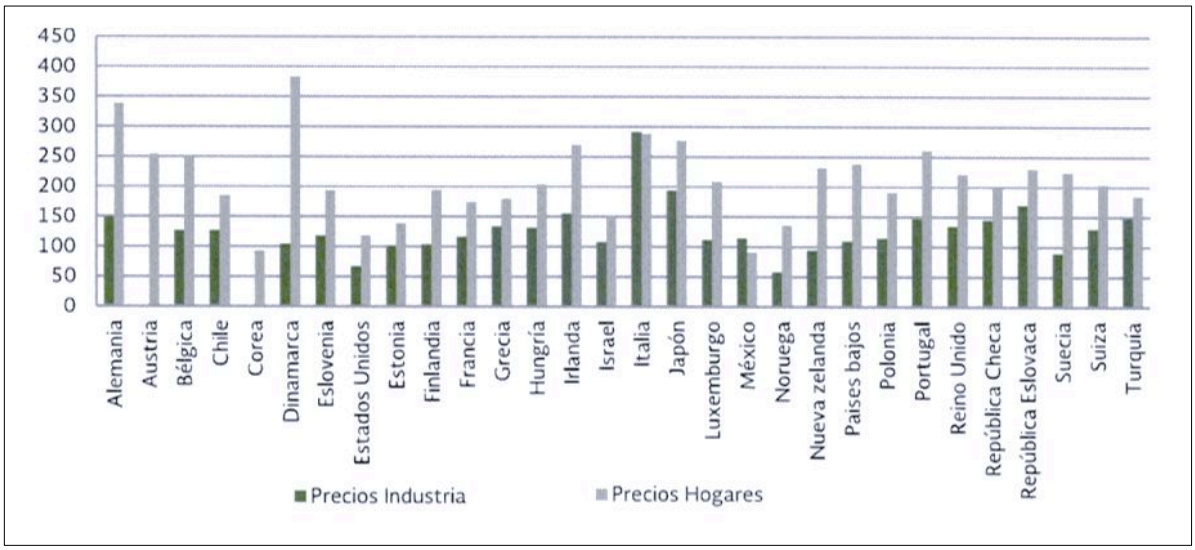


Figure 75: Electricity Tariffs in USD/MWh for OECD Industrial and Residential Customers

The transfer of the management of the national electrical system to an independent system operator CENACE is another key facet of the reform, intended to support the other initiatives by providing non-discriminatory and open access to the electrical network to all participants.

Quantitative goals for the electricity sector set in SENER's program through 2018 include:

- Maintaining a system reserve margin of at least 17.5 percent (currently at 21.6 percent).
- Achieve all the planned capacity increases in the 121 priority electrical energy transmission links identified, from the present 23 (19 percent).
- Increase the percentage of the population with access to electricity service from 98.11 percent to 99 percent.
- Improve the reliability of the electricity system by reducing the average interruption in service from 55.8 minutes per year to 34.8 minutes.
- Increase the percentage of installed generation capacity through renewable and clean technologies from 28.4 percent to at least 34.6 percent.
- Raise end use compliance of electricity with the national energy efficiency regulatory regime from 46 percent of consumption to 51 percent.

Major Projects

To meet projected demand and to achieve the various national goals for the sector, the government is promoting a wide range of projects including generation, transmission, distribution and efficiency improvements. In this section we highlight details of some of the major projects and provide summary information on others.

The PNI identifies 118 electricity sector projects that should begin or end between 2014 and 2018. The projects represent the strategic shifts in energy policy in Mexico, in four areas:

- Displacement of oil with natural gas as a fuel for electricity generation.
- Dominance of combined cycle technologies in new thermoelectric generation assets being constructed.
- Production of more energy from clean sources including hydro, wind, nuclear, solar and geothermal sources.
- Increased involvement of the private sector in development and operation of electrical power system assets.

These projects represent USD $28 billion in spending and can be broken out in several ways.

Technology	USD, Billions	As %	MW	As %
Combined Cycle	$ 13.00	45%	16,922	63%
Hydroelectric	4.40	15%	2,786	10%
Wind	3.67	13%	2,891	11%
Transmission and Distribution	3.00	10%	N/A	N/A
Nuclear	2.38	8%	2,450	9%
Solar	1.07	4%	629	2%
Cogeneration	0.36	1%	382	1%
Internal Combustion	0.35	1%	162	1%
Geothermal	0.33	1%	240	1%
Gas Turbine	0.27	1%	390	1%
Total	**$ 28.83**	**100%**	**26,852**	**100%**

Table 42: PNI Electricity Projects by Fuel Type, Investment, and Planned Megawatts

Oriental I-IV Nuclear Power Plants

The largest discrete project in the PNI is the proposed construction of two new nuclear energy plants, designated Oriental I/II and III/IV. These would be located in the State of Veracruz adjacent to the present Laguna Verde nuclear station. Two reactors would come into operation each year in 2026 and 2027. Total investment is projected to be **$2.38 billion.** No further documentation has yet been made available on this initiative by the government.

Combined Cycle Northeast Power Generation Project

This project will construct a new natural gas fired combined cycle electricity generation plant with 889 MW of initial capacity in the State of Nuevo León near Escobedo. This project will be developed under the independent power producer (IPP) scheme. Proposals may consist of various combination s of gas turbines, heat recovery systems and steam turbines. The scope for providers will include design, construction, testing, and operations of the generating system, water supply system, and fuel supply system. The plant will operate using natural gas provided by CFE's network. The total investment is expected to be **USD $1.4 billion**. CFE will issue the call for tenders in 2014, expects awards by February of 2015. Construction should be completed by the end of 2017.

Guerrero Hydropower Generation Project

This project will construct 455 MW of hydropower capacity in the State of Guerrero. Public documentation on this project is not particularly clear at the time of this writing, however this would seem to be the installation of two generating units at the La Parota dam, constructed on the Río Papagayo at a site to the northeast of the city of Acapulco. The estimated investment is **USD $1.1 billion**.

Paso de la Reina Hydroelectric Project

Project Type:	Dam and Hydroelectric Generation Station
State(s):	Oaxaca
Projected Investment:	USD $1.2 billion
Timeline:	2015 – 2020
Project Sponsor(s):	CFE

This project will construct a hydropower generation station using the waters of the Río Verde, roughly between the cities of Santiago Jamiltepec and Tataltepec de Valdés in the southwest corner of Oaxaca. There are multiple components to this greenfield project. A 531 foot high by 3,000 foot wide concrete faced rock dam will be constructed to create the reservoir. Twin 1,600 foot temporary bypass tunnels will be built on the right bank of the site while the dam is built and the generation cavern constructed on the left side. Two groups of Francis type inward flow reaction turbine generators will be installed within the cavern with a capacity of 540 MW. Water will be fed to the generators through twin 820 foot tunnels. The works will include a 115 KV transmission line running 50 miles from Tlacatepec to the substations Pinotepa Nacional and Santa Rosa on the coast. A compensating reservoir 7 miles downstream may serve to include a mini-hydro plant of 5 MW installed capacity.

Figure 76: Location of the Paso de la Reina Hydropower Project and View of the Rio Verde

Total investment is projected to be **USD $1.2 billion**, with major component costs illustrated in the table below.

Component	Cost
Access Infrastructure	308,695,968
Dam	305,446,537
Electromechanical Equipment	166,939,530
Relocation Payments and Environmental Remediation	124,760,009
Exhaust	100,342,118
Temporary River Bypass Tunnels	88,690,359
Hydroelectric Plant	74,458,168
Oversight	55,887,074
Substation and Transmission Lines	11,160,661
Community Development Projects	8,483,406
Total	**$ 1,244,863,830**

Table 43: Major Cost Components of the Paso de la Reina Hydropower Project

Pre-investment studies budgeted at USD $6 million, including technical feasibility, topographic, geological/physical and environmental impact were initiated in 2014. These studies may be completed by 2015 and project construction is expected to take 5 years.

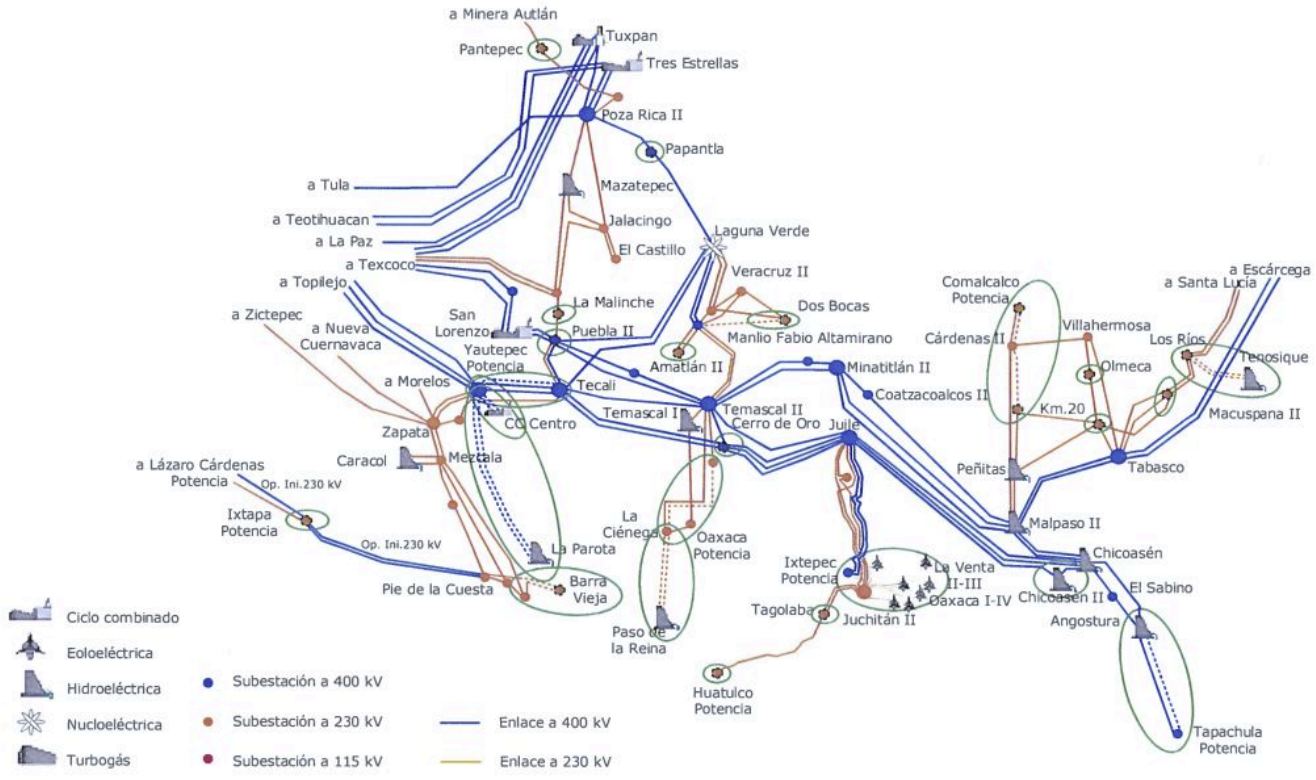


Figure 77: Planned Connections to the Paso de la Reina and La Parota Generation Stations

Project Contacts

Project Sponsor(s)	U.S. Trade and Development Agency	U.S. Commercial Service Mexico
Ing. Juan Francisco Hernández Pérez Chief CFE Center for Project Preparation, +52 (55) 317-0462 Ext 6186 juan.hernandez@cfe.gob.mx	Mr. Keith Eischeid Country Manager for Mexico and Central America Tel. +1-703-875-4357 KEischeid@ustda.gov	Ms. Karen Allen Commercial Officer +52 (55) 5080-2195 Karen.Allen@trade.gov Mr. Francisco Ceron Commercial Specialist: Energy & Water +52 (55) 5080-2000, ext. 5211 Francisco.Ceron@trade.gov

Topolobampo II & III Combined Cycle Natural Gas Generation Projects

As of this writing, the first of this two-part project, referred to as Topolobampo II, is being tendered, and involves construction of a combined cycle natural gas generation plant with an installed capacity of 820 MW. It will be sited in Ahome, Sinaloa near the port of Topolobampo. CFE currently generates electricity using fuel oil at the Juan de Dios Bátiz thermoelectric plant with a capacity of 320 MW.

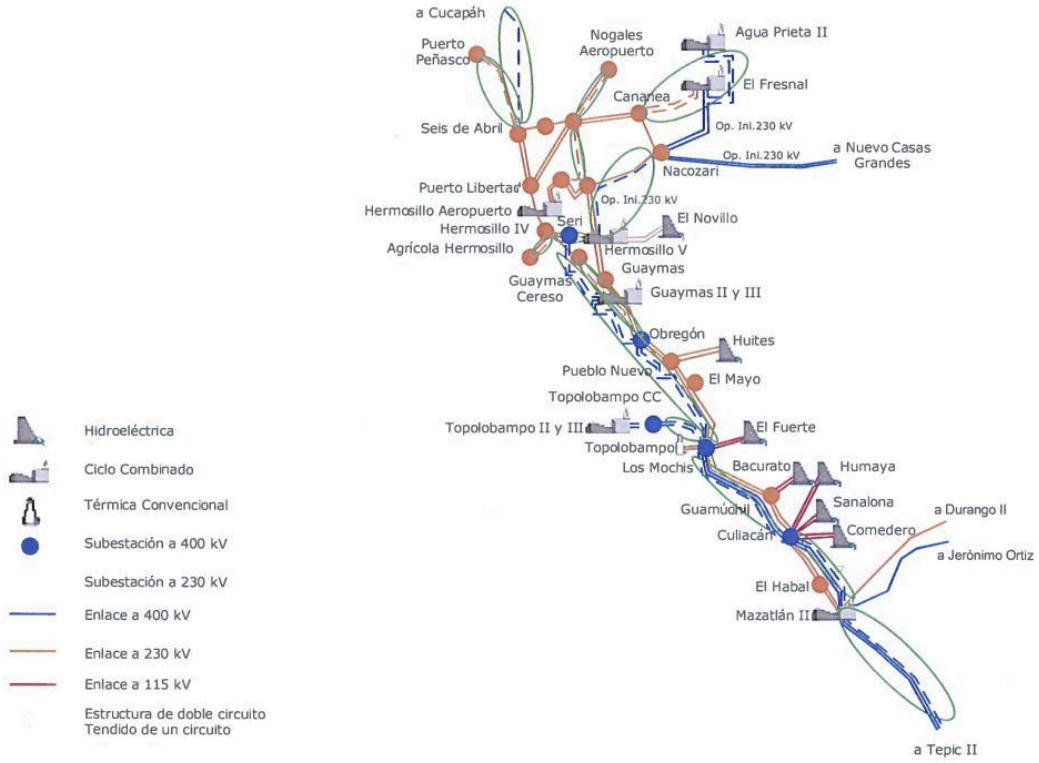


Figure 78: Integration of the Topolobampo II & III Plants into the Regional Electrical Grid

This project will be developed using the IPP mechanism and different configurations of gas turbines, heat recovery systems and steam turbines may be proposed. Bidders will be expected to perform the engineering and design tasks, provide all equipment and materials, spare parts and special tools and perform testing and commissioning. The scope of the project will include a new electrical substation. Tendering is underway as of the fourth quarter of 2014 with contracts to be awarded in the second quarter of 2015, and operations should commence in the second quarter of 2018. The total investment projected is USD $1 billion for Topolobampo II. Topolobampo III is a similar project, to construct combined cycle natural gas generation capacity in the vicinity of the first, adding capacity of 680 MW. Topolobampo III is expected to be tendered in the third quarter of 2015 (announcements in November of 2014) with operation beginning in 2018, with a total additional investment of USD $912 million. In 2015-16, another USD $57 million will be invested in the existing plant infrastructure to enable the addition of the new natural gas generation capacity, including burners, improvements to the existing steam turbines and plant control systems. The associated transmission project for Topolobampo three will include construction of 3 electrical substations and 3 transmission lines for a cost of USD $129 million. Total investment in all components will exceed USD $2.1 billion.

Project Contacts

Project Sponsor(s)	U.S. Trade and Development Agency	U.S. Commercial Service Mexico
Ing. Jose Everardo Inda Durán, Regional Director CFE Tel. +52 (55) 662-259-1201 jose.inda@cfe.gob.mx	Mr. Keith Eischeid Country Manager for Mexico and Central America Tel. +1-703-875-4357 KEischeid@ustda.gov	Ms. Karen Allen Commercial Officer +52 (55) 5080-2195 Karen.Allen@trade.gov Mr. Francisco Ceron Commercial Specialist: Energy & Water +52 (55) 5080-2000, ext. 5211 Francisco.Ceron@trade.gov

Guaymas II & III Combined Cycle Natural Gas Power Plants

CFE plans to build two new natural gas fired combined cycle power plants, Guaymas II & III. The plants (modules) are to be procured using international competitive bidding and the financed public works regime, whereby the government finances the design and build of the plant prior to transfer for operations and payment of the contractor. The plants will be built in the city of Empalme in Sonora, near the port of Guaymas. CFE will provide the natural gas supplied, while the contractor will be responsible for all materials, works, and services leading up to successful commissioning, and spare parts and tools. The substation components will be part of the tenders. Two modules will be constructed for a total capacity of 1,408 MW. Bidders may propose different combinations of one steam turbine and either 2 or 3 gas turbines and heat recovery units for each module. Guaymas I will go to tender in the fourth quarter of 2014 and Guaymas II in the first quarter of 2015, with both units coming on-line in mid-2017. These projects will require with a new transmission networks. For Guaymas II 6 transmission feeder lines and 6 substations will be built, for an investment of USD $144 million. For Guaymas III USD $128 million will be spent on transmission infrastructure. The total expected investment for all components is **USD $1.786 billion**.

Southeastern Wind Power Centers III - VI

Project Type:	Wind Power Generation and Transmission
State(s):	Oaxaca, Puebla, and Morelos
Projected Investment:	USD $2.8 billion
Timeline:	2015 – 2020
Project Sponsor(s):	CFE, CRE

Mexico has begun to develop wind power on a significant scale. Over 1,300 MW of capacity was added in 2012, 512 MW of which was developed through the IPP structure for self-supply during the first "Open Season" programs. By 2027, an additional 2,704 MW of capacity is programmed just for public service use, not including self-supply.

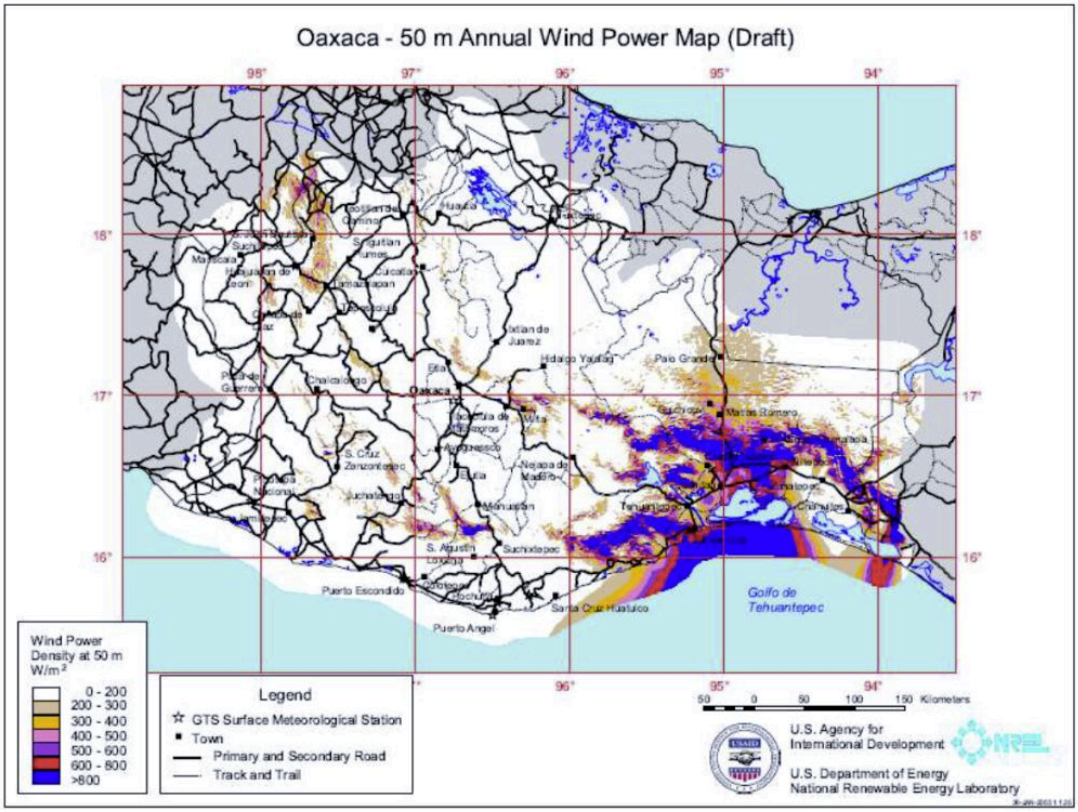


Figure 79: Wind Power Map of the Isthmus of Tehuantepec

CFE is conducting pre-investment studies for the development of 4 new sites in Oaxaca, with 14 wind power generation plants of 30 MW of capacity each, totaling 1,200 gross MW of installed capacity planned. The projects will help meet regional reserve margin requirements in the face of steady, projected growth in demand for electricity of 4.5 percent p.a. and support the achievement of the aggressive renewable energy goals the government has established. These will be procured through a second Open Season program for the Isthmus of Tehuantepec area in Oaxaca, similar to those programs already established for Baja California (885 MW, La

Rumorosa), Tamaulipas (1,666 MW), Puebla and previously in Oaxaca (1,130 MW, La Venta and Oaxaca facilities), with those respective capacities programmed to come online by 2017. Generation capacity will be developed by private companies as IPPs, providing energy to the grid for public service use, and as self-supply, dedicated to provide power to specific private customers.

The new areas under evaluation include two potential sites: one near the municipalities of Madalena Tlacotepec, Asunción Ixtaltepec, San Pedro Comitancillo, Santa María Mixtequilla and San Blas Atempa, and another west of Juchitán, near the municipalities Santo Domingo Ingenio, Santiago Niltepec and San Dionisio del Mar. The respective gross installed capacity will be 285 MW for Southeast II and 300 MW each for Southeast III – V.

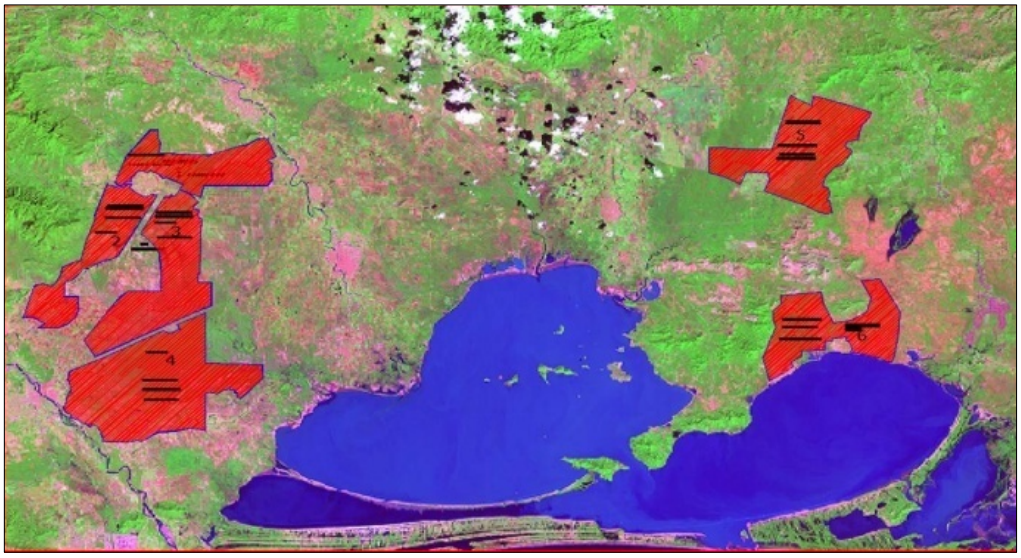


Figure 80: Southeastern III - VI Wind Power Plant Siting Study Regions

The PNI calculates the investment in the four new generation sites at USD $1.978 billion. The pro-forma estimate for components in the feasibility documentation identifies an additional USD $300 million, broken out as below:

Component	Cost, USD
Core generating and transformation equipment	1,596,142,826
Civil works	268,035,930
Supplies, services, spare parts, and special tools	128,525,638
Electromechnical works (installation, mounting, interconnection)	107,074,473
Electrical components	71,659,326
Shipping, insurance and taxes	71,167,089
Engineering	30,829,573
Testing equipment and services	30,583,454
Additional infrastructure (access roads, water, substation, facility power)	21,163,865
Instrumentation and control	11,321,448
Mechanical components	2,746,164
Total	**2,339,249,785**

Table 44: Estimated Costs by Component Southeast Wind Power Projects III - VI

The current regional electricity transmission network will be at full capacity upon commissioning of the first Open Season wind power projects, combined with the new hydroelectric power capacity coming on-line at Paso de la Reina and La Parota. To accommodate the hydropower and additions from the second Open Season, a new transmission network will be developed, including more than 723 miles of 400 and 230 kV lines, 6 substations of 400 and 230 kV, with capacity of 2,625 MVA and 2,500 MVAr of compensation, plus 18 high-tension feeders. This new network will extend from Xipe northwest to the vicinity of Mexico City.

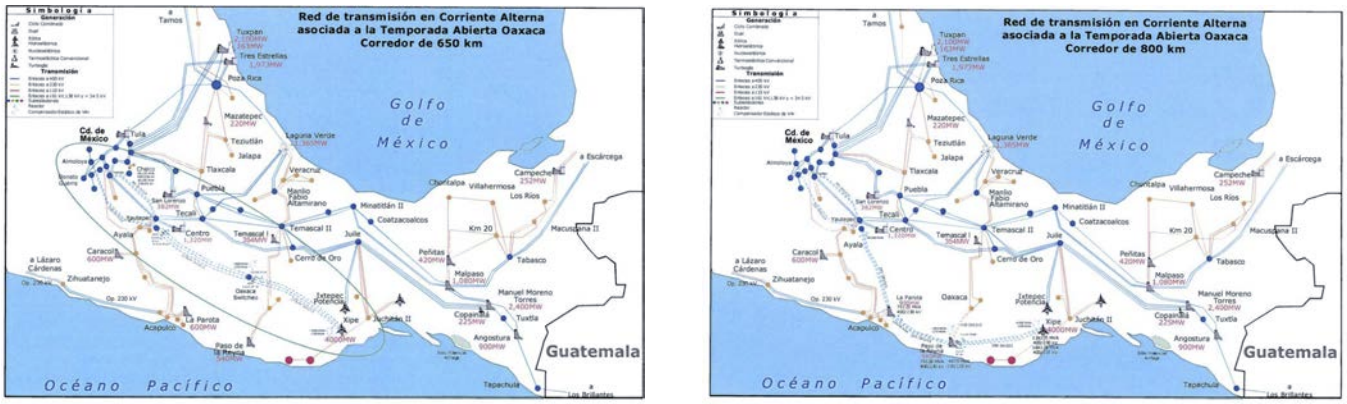


Figure 81: Alternative Routings for Transmission Lines for Oaxaca Wind Power Projects

The PNI estimate for the associated transmission works is USD $448 million, combined with the wind power generation component for a total of **USD $2.8 billion**. The second Open Season process is underway, and a number of firms are in negotiations with the government, having made proposals to construct and operate generation stations in return for guarantees, capital and agreements to buy power by CFE. The various feasibility and technical studies (over USD $4.2 million in study investments) are scheduled to be completed by the fourth quarter of 2014, which will identify the exact locations for the new facilities. The first of the new plants to be constructed are expected to begin operations between 2017 and 2018.

Project Contacts

Project Sponsor(s)	U.S. Trade and Development Agency	U.S. Commercial Service Mexico
Rafael Narváez Ávila Subdirector of Planning CFE Tel. +52 (55) 29-4400 Ext. 80149 rafael.narvaez01@cfe.gob.mx	Mr. Keith Eischeid Country Manager for Mexico and Central America Tel. +1-703-875-4357 KEischeid@ustda.gov	Ms. Karen Allen Commercial Officer +52 (55) 5080-2195 Karen.Allen@trade.gov Mr. Francisco Ceron Commercial Specialist: Energy & Water +52 (55) 5080-2000, ext. 5211 Francisco.Ceron@trade.gov

Development of the Cerritos Colorados Geothermal Power Facility

Project Type:	Geothermal Electricity Generation and Transmission
State(s):	Jalisco
Projected Investment:	USD $43 million
Timeline:	2014 – 2018
Project Sponsor(s):	CFE

Mexico is a volcanically active country and several regions offer significant geothermal resources that can be tapped for energy. In the 1970's, CFE undertook an extensive national survey to identify viable resources for exploitation. A number of sites were identified, explored and some developed into active electrical generation sites. Generation is currently occurring at four sites: Cerro Prieto in Baja California has an installed capacity of 720 MW and is the third largest geothermal electrical generation facility in the world; Los Azufres in Michoacán has capacity of 188 MW, and; Los Humeros in Puebla and Las Tres Vírgenes in Baja California Sur have capacities of 40 and 10 MW respectively. Geothermal represents just over 2 percent of Mexico's installed electricity generation capacity.

New geothermal projects are identified in the PNI at two locations, at Los Azufres and at Los Cerritos in Jalisco. The first of two planned phases is already underway to expand capacity at Los Azufres by 53 MW. Los Cerritos is not yet begun at the time of this writing, and is located 17 kilometers west of Guadalajara, Mexico's second largest city. This site was first developed in the 1980's, with the intent to meet growing regional demand for power and to diversify the local power mix with a new clean energy source. CFE established access roads and basic infrastructure, conducted geotechnical analyses, and drilled a number of wells. The geothermal fluid reservoirs at Los Cerritos are found between 5,000 and 10,000 feet in depth, with a water to steam ratio of 2 to 1. The area was determined to have the capability to support at least 75 MW of generation capacity, a finding supported by the Japan International Cooperation Agency which participated in aspects of the development studies. The facility was mothballed in 1989 due to budgetary restrictions and environmental impact concerns.

The goal of the government's new project is threefold: 1.) reactivate the facility and conduct further resource exploration and analyses, 2.) provide a connection to the national electrical grid in the vicinity of Guadalajara, and 3.) establish an initial operational generating capacity of 25 MW.

The site has 12 wells drilled and some associated equipment and infrastructure in place. This infrastructure will be evaluated for viability. The project site will be expanded by 50 percent to 7 acres. Exploration and refurbishment works will include drilling of seven exploratory wells, 4 production wells, 3 injection wells, and repair of 3 existing wells. The drilling and infrastructure evaluation activities will be accompanied by various studies of the area's geology and geochemistry of the wells, and measurement of the thermodynamic behavior of the wells and the geothermal activity in the area.

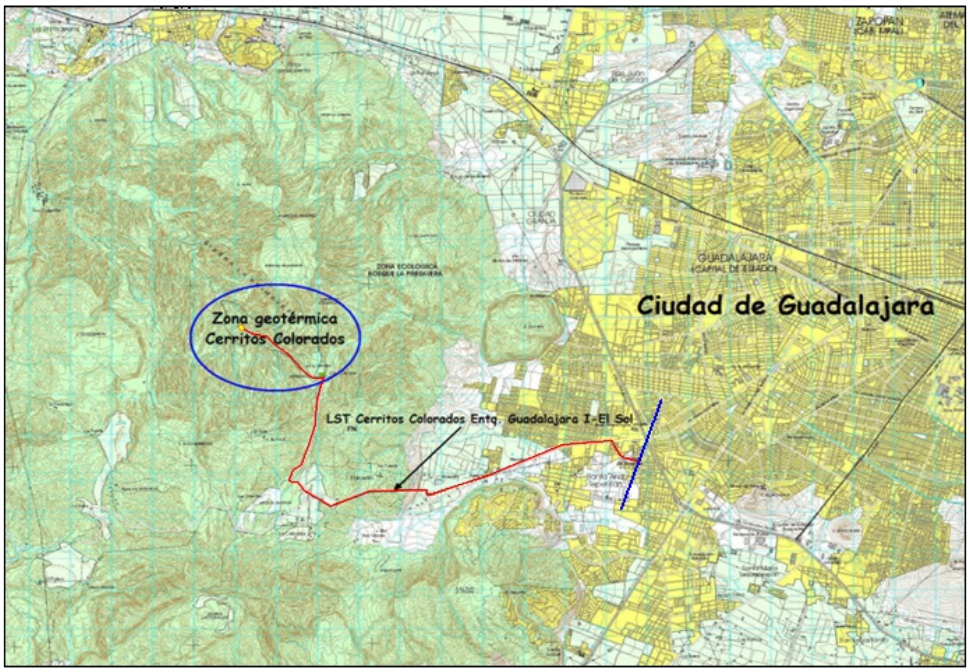


Figure 82: Overview of the Cerritos Colorados Geothermal Energy Project

The 69 kV subtransmission line extending 9 miles from the generation site to connect with the Guadalajara I – El Sol transmission line. This will be a 795 KCM aluminum conductor steel reinforced cable with a fiber optic guard cable. Electricity from this facility would be destined for the public market. The State of Jalisco is currently a heavy net importer of electricity from adjacent states, which imposes a cost in the form of long distance transmission losses. Accordingly, development of this project will support an overall improvement in efficiency for the national system.

Figure 83: Example of a Geothermal Well Cap/Separator Structure

The proposed generation technology is modular condensation units. Approximately 25 MW would be created in the first phase, with a future second phase bringing the facility to its full 75 MW capacity. At this full capacity the facility would have the ability to meet over 6 percent of the present electricity demand in Guadalajara. The phase 1 infrastructure will include 1.5 miles worth of steam piping leading from the wells to the generation equipment, more than 2 miles of polypropylene piping to carry the wastewater for re-injection, pumping equipment, and a wastewater treatment unit.

The 25 MW generation equipment at Los Cerritos is expected to cost USD $36 million and the transmission line another USD $5.5 million. Total investment projected by the PNI is USD $43.2 million.

JICA's involvement in studies for this project indicates potential for Japanese content requirements, particularly if JICA financing is to be used in implementation of the new generation capacity. Some potential could exist for U.S. suppliers in certain aspects of the development of Los Cerritos. France's Alstom and Japan's Mitsubishi are both active, established participants in this market in Mexico, and many experienced local companies provide high quality goods and services suitable for a project of this type. CFE is the entity responsible for development of the Los Cerritos projects.

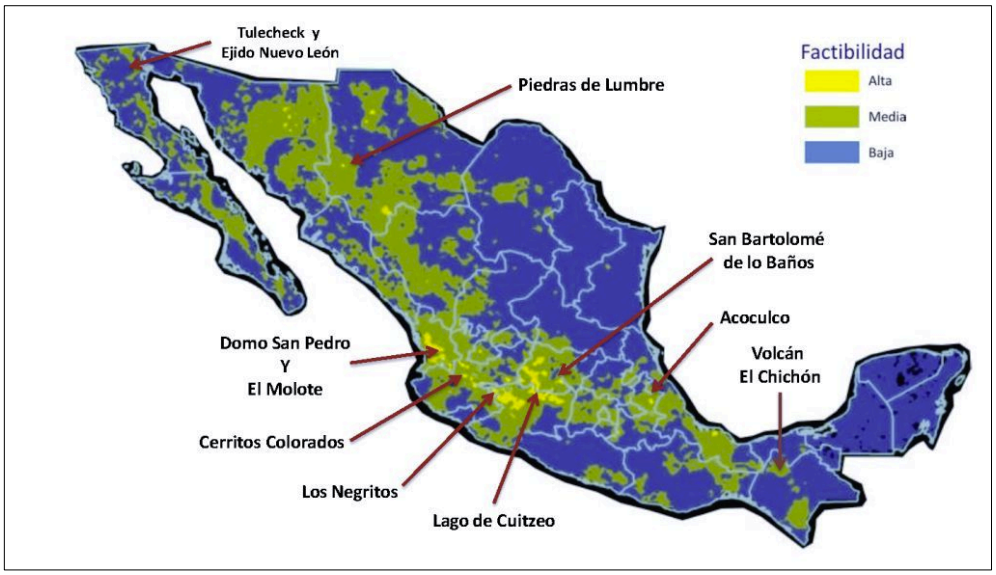


Figure 84: Geothermal Exploration Areas in Mexico

Geothermal energy exploitation continues to be a priority for Mexico and exploration continues at numerous sites around the country. Besides Cerritos Colorados CFE has promising exploration activity underway at the locations of the El Chichonal Volcano in Chiapas, Cuitzeo Lake in Michoacán and Acoculco in Puebla, indicating that substantial future potential exists in this market.

Project Contacts

Project Sponsor(s)	U.S. Trade and Development Agency	U.S. Commercial Service Mexico
Ms. Magaly Flores Armenta CFE Division of Geothermal Projects Tel. +52 (55) 443 322 7089 magaly.flores@cfe.gob.mx	Mr. Keith Eischeid Country Manager for Mexico and Central America Tel. +1-703-875-4357 KEischeid@ustda.gov	Ms. Karen Allen Commercial Officer +52 (55) 5080-2195 Karen.Allen@trade.gov Mr. Francisco Ceron Commercial Spec. Energy & Water +52 (55) 5080-2000, ext. 5211 Francisco.Ceron@trade.gov

Additional Strategic Projects

- **Valley of Mexico City Power Projects:** Two major projects are outlined in the PNI for construction in the Valley of Mexico. A new combined cycle natural gas generation plant, Valle de Mexico II, will be constructed with an installed capacity of 601 MW. This is to be constructed beginning in the fourth quarter of 2014 and enter operations in the second quarter of 2017. Total investment associated with this plant is estimated at USD $739 million. The regional electricity distribution network will also be upgraded. Phase I of this project is nearing completion, having constructed 10 substations and six transmission lines through the State of Mexico for a total investment of USD $176 million. The second phase of this project, to occur between 2014 and 2015, will construct an additional 10 substation and 4 transmission lines, with investment of an additional USD $176 million. Total investment for this program is to exceed **USD $1 billion**.
- **Combined Cycle Norte III:** This project will be built 19 miles south of Ciudad Juarez in Chihuahua at a site called Samalayuca Sur. This will be a combined cycle natural gas burning thermoelectric power plant. It will be developed under an IPP scheme and bidders may offer configurations of one or two modules of gas and steam turbines to achieve the installed net capacity of 788 MW. Bidders will be responsible for providing the engineering, all equipment, materials, replacement parts, and special tools, testing, commissioning and constructing the substation facility. CFE will provide the natural gas supply. Construction is expected to take 35 months. Tenders are underway as of the fourth quarter of 2014, with awards projected for early 2015. The total investment in this facility is expected to exceed **USD $983 million**.
- **Combined Cycle Norte IV:** This project will construct a combined cycle natural gas power plant, with 990 MW of net capacity to be located in the State of Chihuahua between the cities of Delicias and Chihuahua. The pre-investment studies for this project began in 2013 and should conclude in 2015. The scope will include the substation and connections to the natural gas pipeline network. Tenders are expected in late 2015 with operations commencing in 2018. The total projected investment is expected to exceed **USD $943 million**. The supervisor of the study activities is Rafael Narváez Ávila of CFE, tel. +52 (55) 294400 E-80149, or by email at rafael.narvaez01@cfe.gob.mx .
- **Small Photovoltaic Projects:** Mexico has only recently added a small amount of photovoltaic generation to its power mix, accounting for one megawatt each for public service and self-supply as of 2012. CFE budgeted USD $5.7 million for a range of feasibility studies on solar project options around the country, scheduled for completion by the end of 2014. The PNI currently identifies 13 discrete 30MW projects: 1 in Baja California Sur, 2 in Chihuahua, 3 in Durango, 1 each in Guanajuato and Quintana Roo and 5 in Sonora. Each is estimated at USD $46.7 million, for a total projected investment of USD $876 million. Interested parties may contact Roberto Cadenas Tovar of CFE's Renewable Energy Projects Group at roberto.cadenas@cfe.gob.mx or by telephone to +52 (55) 443-322-7006.
- **Las Cruces Hydropower Generation Station:** This project is to be located in Nayarit, 65 miles north of the city of Tepic, east of the municipality of Rosamorada. The project will entail several components.
    - A temporary diversion tunnel will divert the waters of the Rio San Pedro during construction.
    - A 606 foot dam will be constructed to create the new reservoir.
    - The generation station will be constructed on the left bank of the river, to be equipped with three Francis type generation units of 80 MW each.
    - An adjacent substation will be part of the project.

Besides provision of electricity, this structure will also serve to control frequent flooding that impacts local communities and agricultural resources. CFE programmed USD $7.9 million for feasibility and technical studies to be completed by the end of 2014 for this project. Total expected investment is USD $781 million. The pro-forma breakdown into components by cost is provided in the accompanying table. The responsible point of contact at CFE for the technical and feasibility studies is Mr. Rafael Narvaez Avila, Subdirector, telephone: +52 (55) 29-4400 ext. 80149, or by email at rafael.narvaez01@cfe.gob.mx

Component	Cost, USD
Dam	269,365,912
Three hydroelectric generators of 80 MW	112,370,271
River temporary bypass	59,797,645
Hydroelectric station facility	48,887,181
Water gates	35,564,041
Studies	35,295,889
Social, health and welfare activities	33,089,182
Miscellaneous equipment	27,675,676
Access road	27,583,835
Associated works (access roads, construction facilities)	24,940,144
Environmental impact and compensation costs	21,325,250
Impact mitigation projects (social)	10,629,000
Transmission line and substation	5,259,850
Relocation costs	1,615,578
Total	**713,399,456**

Table 45: Las Cruces, Nayarit, Hydropower Generation Station Cost Breakdown

- **Mexicali I Geothermal Plant:** This project will construct a geothermal energy plant with an installed capacity of 27 MW in Baja California for a projected investment of **USD $43 million**. This project is to follow on to findings conducted during feasibility studies and exploration well drilling performed from 2012-2015 in the following areas: Tulecheck, Sierra Cucapah and the ejidos of Nuevo León and Saltillo. The point of contact for the study and exploration activities in the region is Serio Miguel Miranda Vega of CFE, General Resident Cerro Prieto, telephone: +52-686-523-8101, or by email at Sergio.miranda@cfe.gob.mx
- **Chicoasén II Hydroelectric Center:** This project will construct a hydropower generation plant in the State of Chiapas with a capacity of 240 MW at a cost of USD $376 million. The associated transmission assets to be constructed will cost an additional USD $2.2 million, for a total investment of **USD $378.2 million**. This project is expected to enter operations in 2017.

Together, all the electricity sector projects identified to this point in this section 3.4.1 cover USD $17 billion out of the USD $28 billion in projects included in the PNI.

Landfill Biogas

SENER estimates the country has a national potential to generate over 650 megawatts of electricity from landfill biogas in the long term.

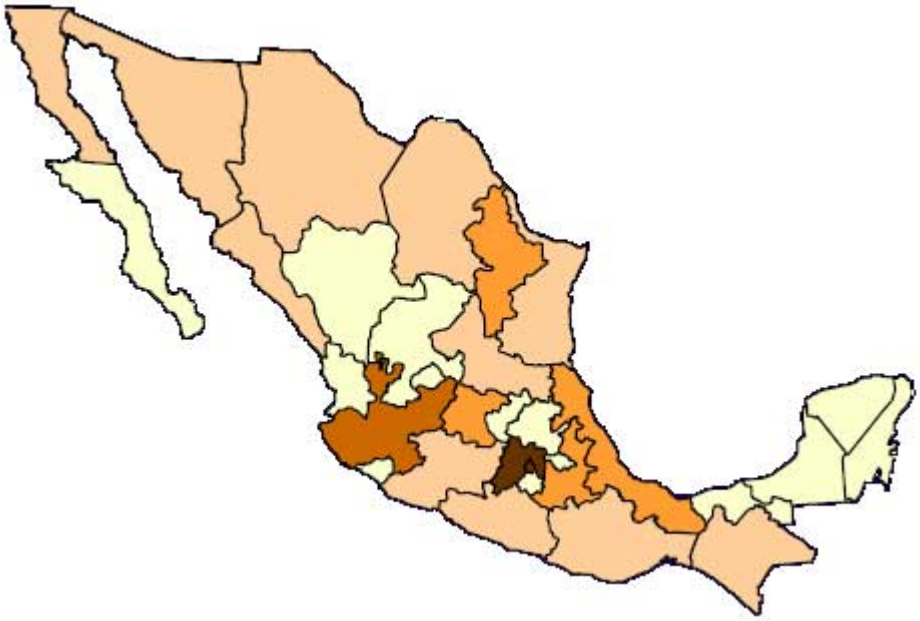


Figure 85: Mexican States with Highest Potential for Landfill Biogas Generation

Currently, Mexico's installed capacity for electricity generation from landfill biogas is 28.2 megawatts through 4 generation sites (out of a national installed generation capacity of 63,745 MW from all sources, public and private). An additional 6 generation sites represent an installed capacity of 15.5 MW produced through sewer sludge, farm waste and industrial wastes. Specific biogas projects included in the national inventory of renewable energy include the following plants (this tally includes multiple types of biogas plants including landfill and industrial plants):

City	State	Installed Capacity (MW)	Operator
Cd. Juarez	Chihuahua	6.40	Private: Energía Eléctrica de Juárez
Delicias	Chihuahua	0.80	Private: Energía Lactea
Saltillo	Coahuila	1.06	Private: Lorean Energy Group
Salinas Victoria	Nuevo Leon	16.96	Private: Bioenergía de Nuevo León
San Nicolas de Los Garza	Nuevo Leon	1.60	Public: Planta Norte
Aguascalientes	Aguascalientes	3.20	Private: Energía Verde de Aguascalientes
León	Guanajuato	1.75	Private: Ecosys III
Querétaro	Querétaro	1.37	Private: TMQ Generación Energía Renovable
Santíago de Querétaro	Querétaro	1.05	Private: Atlatec
Atizapan	Estado de Mexico	0.60	Privado: Relleno Sanitario de Puerto de Chivo
Ecatepec de Morelos	Estado de Mexico	0.97	Privado: La Costeña y Jugomex
Nopalucan	Puebla	0.97	Privado: Empacadora San Marcos
Total		**36.74**	

Table 46: Biogas Generation Facilities and Installed Capacity

Since the passage of the law for the Development of Renewable Energy in 2008 and 2011, only 1.1 percent of the permits granted by CFE have been for biogas projects. The bulk of activity in the renewable electricity sector to date has been for wind (76.1 percent of renewable authorizations), followed by biomass (14.4 percent). It is

important to note that the law sets aggressive objectives for the country as a whole in shifting over time to a higher percentage of renewable generation in its power mix. Fossil fuels will be limited to 65 percent of generation by 2024, 60 percent in 2035 and 50 percent by 2050. A separate law, the General Law on Climate Change, sets a goal of 35 percent of generation from clean energy by 2024. As the current generation mix is only 24.39 percent from renewables, there will be significant pressure to increase the development of renewals. The pressure to develop the solid waste sector also supports the development of biogas components as landfills are modernized and brand new facilities are constructed. The SCT has included a biogas power generation plant in its plan for the Mexico City Airport megaproject, a proposal that would tap into the 60 million tons of trash decomposing in the nearby - now closed - Bordo Poniente Landfill site. This component will support the effort to secure a LEED Platinum certification for the new airport, and SCT estimates resources exist to provide as much as 242 gigawatts of electricity, while reducing the impact of trash decomposition odors on adjacent communities.

The market for environmental technologies in Mexico is competitive, with offerings from European and Asian suppliers in the market for all of the categories of items described. There is a growing, sophisticated group of Mexican companies – solid waste collection and facility contractors and concessionaires - that are interested in integrating overseas technologies into their offerings.

The government has also set specific goals for the production of energy from renewable sources, which include biomass and biogas. For new generation projects the percentage of installed capacity from renewable energy should increase from 25.32 percent in 2012 to 32.8 percent by 2018. For the installed capacity in the system the percentage of electricity generated from renewables should rise from 14.78 percent to 24.9 percent by 2018. Installed capacity from biomass/gas should rise from 357 MW to 785 MW by 2018, with production levels rising from 973.8 GWh/year to 2,142 GWh/year.

Project Contacts

Individual contacts at Mexican agencies have been provided for the projects profiled, when available. Interested parties may also contact the following U.S. agency officials for more information on electricity sector projects in Mexico.

U.S. Trade and Development Agency	U.S. Commercial Service Mexico	
Mr. Keith Eischeid Country Manager for Mexico and Central America Tel. +1-703-875-4357 KEischeid@ustda.gov	Ms. Karen Allen Commercial Officer +52 (55) 5080-2195 Karen.Allen@trade.gov Diego.Gattesco@trade.gov Ms. Claudia Salgado Commercial Specialist, Electricity Infrastructure Systems +52 (55) 5080-2000 ext. 5224 claudia.salgado@trade.gov Mr. Miguel Vazquez Commercial Specialist, Renewable Energy +52 (55) 5140-2643	Ms. Sarah Cook Commercial Officer Tel. +52 (55) 5140-2631 Sarah.Cook@trade.gov Ms. Teresa Verthein Commercial Specialist, Smart Grid and Information Systems +52 (55) 5080-2000 ext. 5228 Teresa.Verthein@trade.gov

	Miguel.Vazquez@trade.gov	

3.4.2 Hydrocarbons

Sector Background

As of 2013, Mexico reported total reserves of 44.5 billion barrels of oil equivalent (b.o.e.). Of this, 31 percent were proven reserves (1P), 28 percent were probable reserves (2P) and 41 percent possible reserves (3P). Within these figures, 69 percent or 30.8 billion barrels were oil and 31 percent consisted of 63.2 billion cubic feet of natural gas. Proven reserves enable the current rates of production of oil for 10 years (placing Mexico among the top twenty exporting countries globally) and for natural gas for 7.3 years.

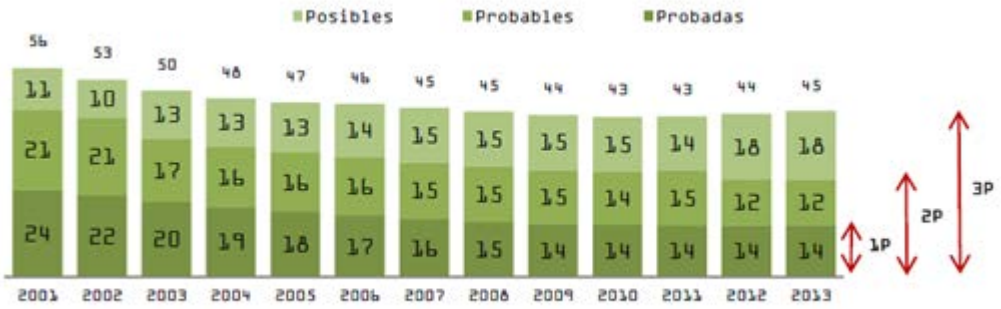
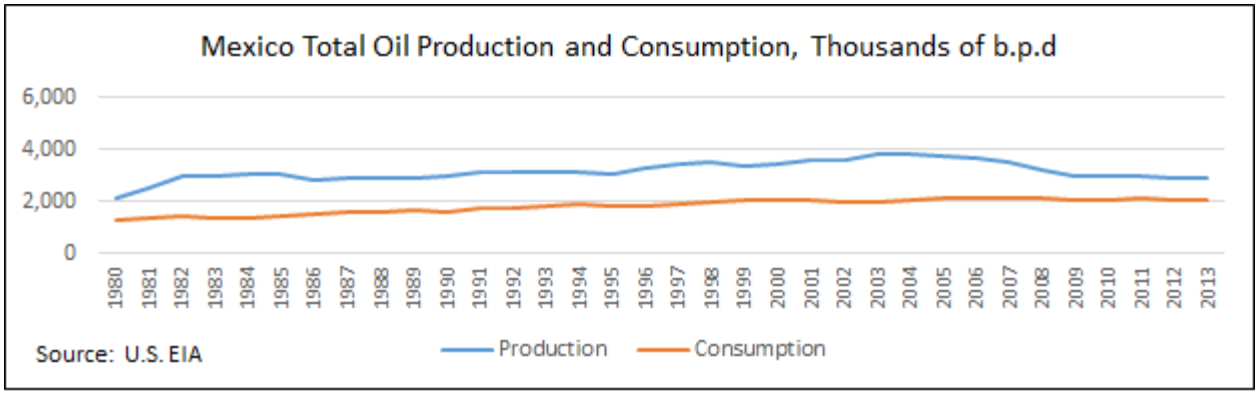
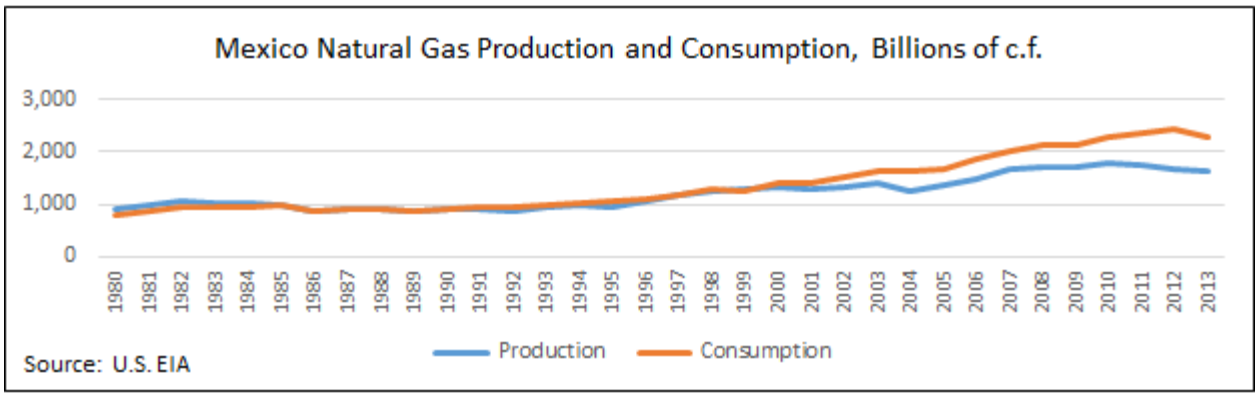


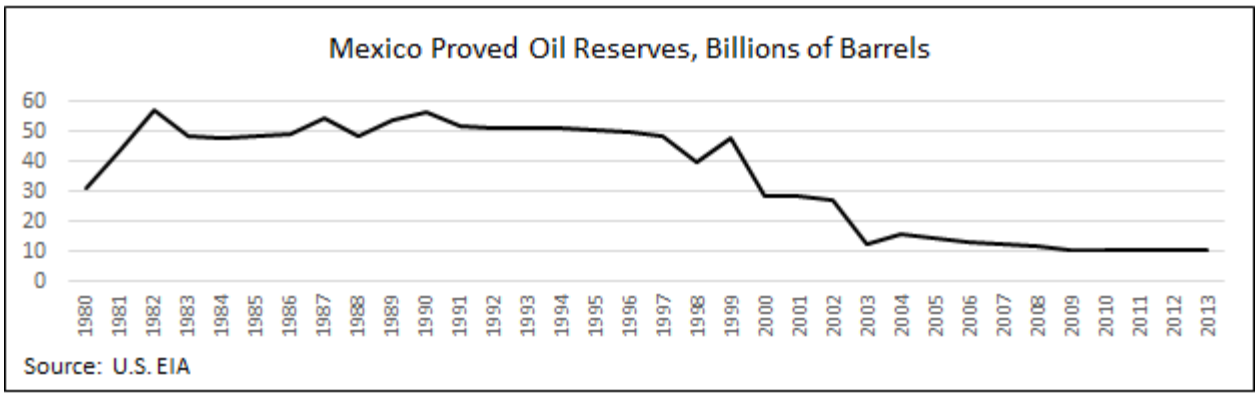
Figure 86: Evolution of Mexico Petroleum Reserves

Most production in Mexico occurs in the states of Campeche, Tabasco and Veracruz, and offshore in the Bay of Campeche. Two major active fields, Ku-Maloob-Zaap (KMZ) and Cantarell, account for more than half of national production at 13 million barrels per day. The bulk of the oil from these fields is heavy crude, much of which is shipped to the United States for processing. A sophisticated refining infrastructure has built up in the Gulf Coast states, with facilities tuned to process the specific characteristics of Mexican oil. Mexico is net exporter of crude oil but a net importer of refined products.

The evolution of production, consumption and reserves of hydrocarbons in Mexico has presented the nation with fundamental challenges over time, as illustrated in the series of charts provided. Oil production peaked in 2003 and natural gas production in 2010. Reserves of both have fallen steadily since the 1980's. Total crude production fell by over 22 percent between 2003 and 2009, and at roughly 1 percent per year after that. Production at Cantarell, begun in 1979, began falling sharply in the 2000's despite various technical efforts to enhance recovery. KMZ production has plateaued in recent years despite technical recovery enhancement efforts. PEMEX has been challenged to maintain production levels and bring new resources into production during this period of decline. Many of the new resources are in areas that are technically difficult to explore and extract, including deepwater and tight oil formations.







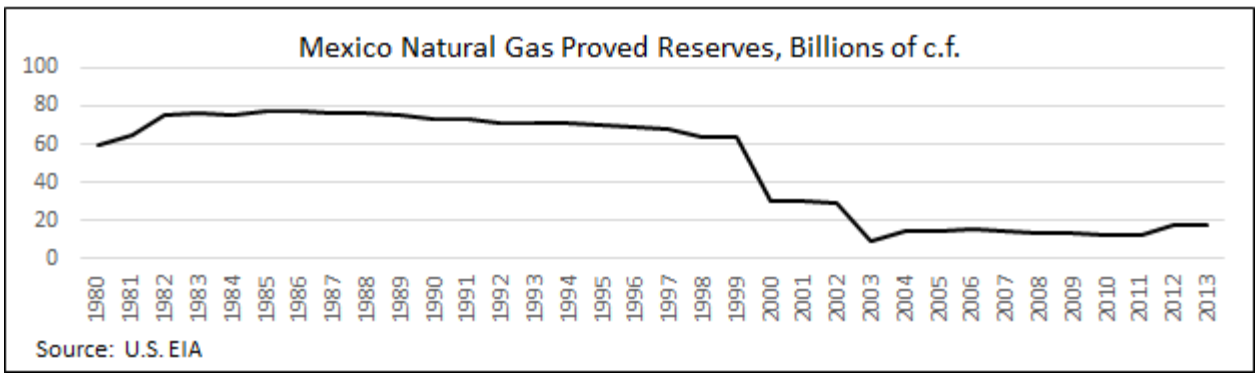


Figure 87: Hydrocarbons Production, Consumption and Reserves Evolution 1980 - 2013

Government Role

SENER

The Secretariat of Energy (SENER) retains its top level role in establishing strategic goals for the hydrocarbons sector in Mexico. SENER has the final say in the allocation of assets to PEMEX versus private actors. SENER establishes the contracts, regulations and standards for the bidding process to conduct exploration and production activities, as well as granting permits for refining activities.

CRE

The Energy Regulatory Commission (CRE) is a body aligned with SENER that is responsible for creating and enforcing the regulatory regime for the gas, refined products, petroleum derivatives and electricity generation industries, including storage, transportation/transmission and distribution. Its objective is to reduce uncertainty, support productive investment, encourage competition and ensure the stability, safety and reliability of provision of the goods and services of the sector to the public at competitive prices. The 2013-14 energy reforms granted this body greater management and budgetary autonomy. In the new market structure, CRE has the responsibility for setting tariffs for use of the national electrical grid.

PEMEX

Petróleos Mexicanos (PEMEX) is Mexico's state-owned integrated oil and gas company. It is the largest company in the country. As of 2013, PEMEX had 154,774 employees and revenues of USD $122.9 billion. The company had strong operating margins of USD $55.6 billion in 2013. PEMEX is a critical source of federal revenue, contributing USD $66 billion to the federal budget in 2013. PEMEX has five major subsidiaries:

- **PEMEX Exploration and Production:** PEMEX E&P performs exploration for, and extraction of, oil and natural gas resources. This division is also responsible for the transportation and storage of these resources, operation of terminals, and operates as a wholesaler in the market. E&P has four operating regions: North, South, Ocean Northeast and Ocean Southeast. This division operates approximately 3,000 miles of pipelines, mostly in the southeastern portion of the country.
- **PEMEX Refining:** PEMEX Refining produces a wide range of products including gasoline, diesel, heavy fuel oil, aviation fuels, petroleum naphtha, petroleum coke, asphalt, and lubricants. They perform the downstream activities of distribution, storage and retail sale. PEMEX Refining operates a network of fuel stations across the country. This group operates six major refineries with an installed capacity of 1.64 million barrels per day of inputs.
- **PEMEX Gas and Basic Petrochemicals (PGBP):** This subsidiary processes, transports and commercializes natural gas, liquid hydrocarbons (such as LP gas); basic petrochemicals such as ethane; propane and butane; and sulfur. They operate natural and liquefied gas pipelines and also offer natural gas hedging services. PGBP operates a national network of pipelines of 7,931 miles divided as follows:
    - 5,805 miles of natural gas pipelines.
    - 1,014 miles of LP gas pipelines.
    - 1,111 miles of product pipelines.
    - 15 compression stations and 5 pumping stations.

- **Petrochemical:** PEMEX Petrochemical produces secondary refined petrochemical products including high, and low lineal density polyethylene, ethylene oxide, glycol, vinyl chloride, ethylene, ammonia, methanol, styrene, benzene, toluene, xylem, paraxylene, propylene, orthoxylene and acrylonitrile. Their primary original feedstock is natural gas.
- **PMI Comercio Internacional:** This subsidiary consists of groups of companies specializing in petroleum products trading, holdings, services and infrastructure projects. It is a small unit of 306 persons, but is a key interface between PEMEX and international markets.

CENEGAS

The Centro Nacional de Control de Gas Natural (CENEGAS) is a quasi-independent agency aligned with SENER, which is responsible for the management of the Integrated National System of Storage and Transportation of Natural Gas. CENEGAS will serve as an independent system operator guaranteeing equal access to the infrastructure. This agency was created by law in August of 2014 and within 90 days CENEGAS will absorb the relevant natural gas pipeline and storage assets and operating responsibilities previously held by PEMEX.

National Hydrocarbons Commission

The National Hydrocarbons Commission (CNH) was created in 2008 as an organization aligned with SENER, but with technical autonomy to regulate and supervise the exploration and production of hydrocarbons in Mexico. CNH's major responsibilities include:

- Increase the recovery rate and maximize the volume of hydrocarbons extracted under economically viable conditions.
- Maintain a steady replacement of hydrocarbon reserves to support the energy security of the nation.
- Utilize the latest and most appropriate technology for exploration and production.
- Protect the environment from the impacts of exploration and production activities and miminize the flaring and venting of gas during production operations.
- Maintain industrial security in the hydrocarbon industry.

The energy reform legislation of 2013-14 has strengthened CNH by granting it further independence from SENER, including management and budgetary independence. CNH is the lead agency for the management and execution of public biddings, signing and administration of E&P contracts under the new legal regime. CNH has a budget of USD $253 million in 2014.

National Hydrocarbons Information System

This database is developed together by SENER, CNH and PEMEX. It is a repository of information on the hydrocarbons industry in Mexico, created to centralize and modernize the presentation of disparate datasets and to comply with the transparency obligations introduced into law, particularly those opening the sector to greater private sector involvement associated with the recent reforms. It includes resource data, maps, inspections, reserve estimates, registers of operators and contractors, geologic information and many other pieces of information.

FEIP

The Petroleum Revenue Stabilization Fund (FEIP) is a public trust fund created within SHCP as part of the energy reforms. This fund's revenues will include royalties charged to PEMEX, oil and non-oil tax revenues, and returns from financial instruments used to hedge hydrocarbon price volatility. This fund, the framework of which was established prior to 2007, is intended to serve a critical stabilizing function for government expenditures in the face of economic shocks, particularly those impacting hydrocarbons revenue such as exchange rate fluctuations or commodity price changes. It will serve to allow Mexico to meet its balanced budget rules in the face of such shifts and shocks. This also has important ramifications for capital spending in the hydrocarbons sector, particularly for PEMEX, which has historically faced volatility in balancing its obligations to meet government revenue targets with its long-term capital needs to maintain or grow production levels.

CFE

CFE is also a major actor in the area of natural gas pipelines in Mexico. Besides PEMEX, CFE is the other major state operator of gas pipelines, growing out of its requirements to fuel its many power plants.

Nota: El CPG Área Coatzacoalcos, comprende los complejos Morelos, Cangrejera y Pajaritos.
Fuente: SENER.

Figure 88: Map of Gas Pipelines in Mexico as of 2013

Energy Reforms and Rounds Zero and One

In the hydrocarbons sector, the recent energy reform process creates a new public and private investment model for the exploration and production of oil and gas resources. PEMEX, along with CFE, are redesignated as "public productive enterprises" receiving more autonomy in decision making, while also facing the opening of previously protected markets for their activities. The government may directly sign contracts with private parties under a number of new commercial structures. The reform also creates the Mexican National Petroleum fund, a sovereign wealth fund that will manage the petroleum income received by the state across the new broader environment of public and private actors. Between them CENACE and CENEGAS will serve as independent system operators for the electrical and pipeline activities, respectively. CNH will oversee the markets for hydrocarbons production and exploration and CRE will oversee downstream activities.

The government has a formal process underway for allocation of the development of existing and potential hydrocarbons resources, designated by "rounds". The first round was Round Zero. In this round, PEMEX was given the opportunity to propose what assets it wished to keep control of. PEMEX requested 83 percent of Mexico's 2P reserves – 20.6 billion b.o.e. - and 31 percent of prospective reserves - 34 billion b.o.e. The government awarded 100 percent of the 2P reserves requested, but only 68 percent - 23.5 billion b.o.e. of prospective reserves, of which 5.2 billion b.o.e are unconventional. The awards to PEMEX were to achieve several strategic goals. First, the government intended to give PEMEX sufficient resources to maintain a production level with replacement of at least 2.5 million b.p.d. for 20.5 years. Second, PEMEX was to be awarded prospective reserves in areas where it was technically proven capable of realizing production. Third, PEMEX was to receive some amount of more challenging deepwater and tight hydrocarbon reserves so that the company could undertake partnerships enabling technology transfer to strengthen its capabilities to exploit these more challenging resources independently in the long-term. Finally, the significant potential reserves remaining will serve to create opportunities attractive enough in terms of scale to bring in major foreign companies with state-of-the-art practices and technology to allow Mexico to unlock the substantial reserves in the most challenging geographies, enabling increases in national production that PEMEX could not achieve.

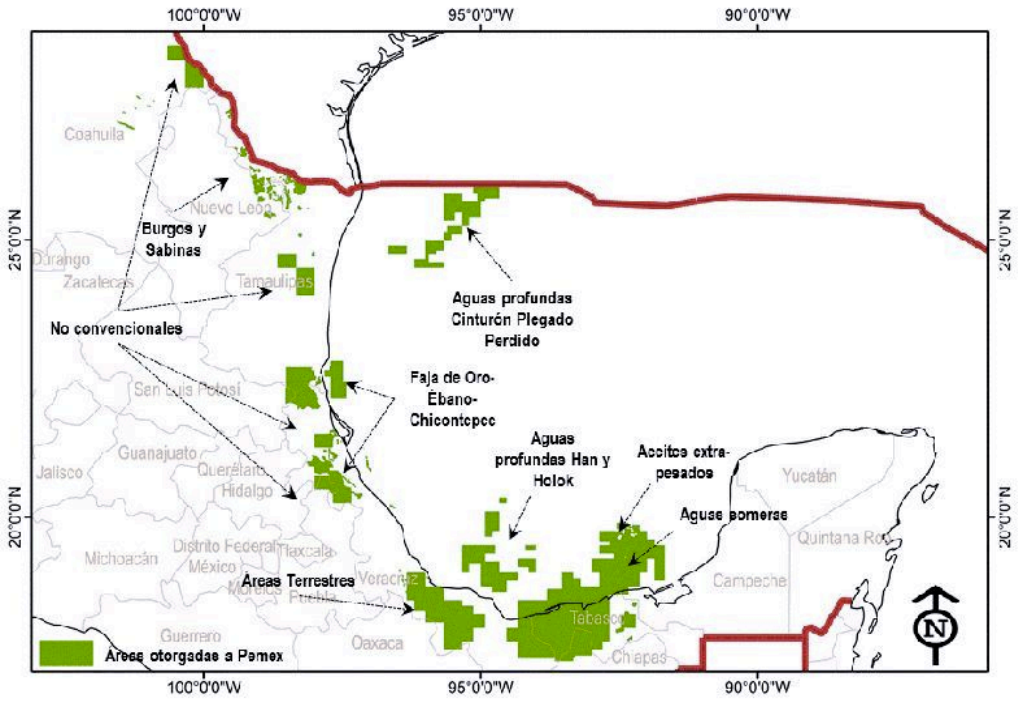


Figure 89: Round Zero Hydrocarbon Asset Awards to PEMEX

While PEMEX is already a major buyer of goods and services from U.S. firms, the Round Zero awards to PEMEX will improve the market for U.S. companies in several ways. The decision gives PEMEX certainty over their long-term assets generally and should free up decision making on capital projects that may have been delayed due to uncertainty. The unconventional assets, now specifically identified for PEMEX exploitation, will allow companies to approach PEMEX to offer goods, services and partnerships unique to these assets.

Round One, which will begin the process of introducing the private sector to develop the uncommitted assets, was initiated by the government on August 13, 2014. Key steps are as follows:

August 13, 2014 through November 2014

- Announcement of Round One
- Feedback on the proposed regions
- Definition of the form, terms, and technical conditions of the contracts (by SENER)
- Definition of the financial conditions and evaluation criteria (by SHCP)

Through January 2015

- Publication of the tender drafts (by CNH)
- Feedback on the terms and conditions (by potential bidders)
- Preparation of the data room (by CNH)
- Social Impact Assessment (by SENER from October)
- Migration of CIEP and COPF to CEE (11 contracts)

February through April 2015

- Initiation of tenders (by CNH)
- Opening of the data room (by CNH)

May through September 2015

- Contract awards (by CNH)

November 2014 through December 2015

- Associations (farmouts) with PEMEX in the areas of mature fields, extra heavy crude and deepwater resources

The assets opened to Round One are illustrated generally in the accompanying map. They show assets classified according to exploration, development/extraction and associations or contracts with PEMEX.

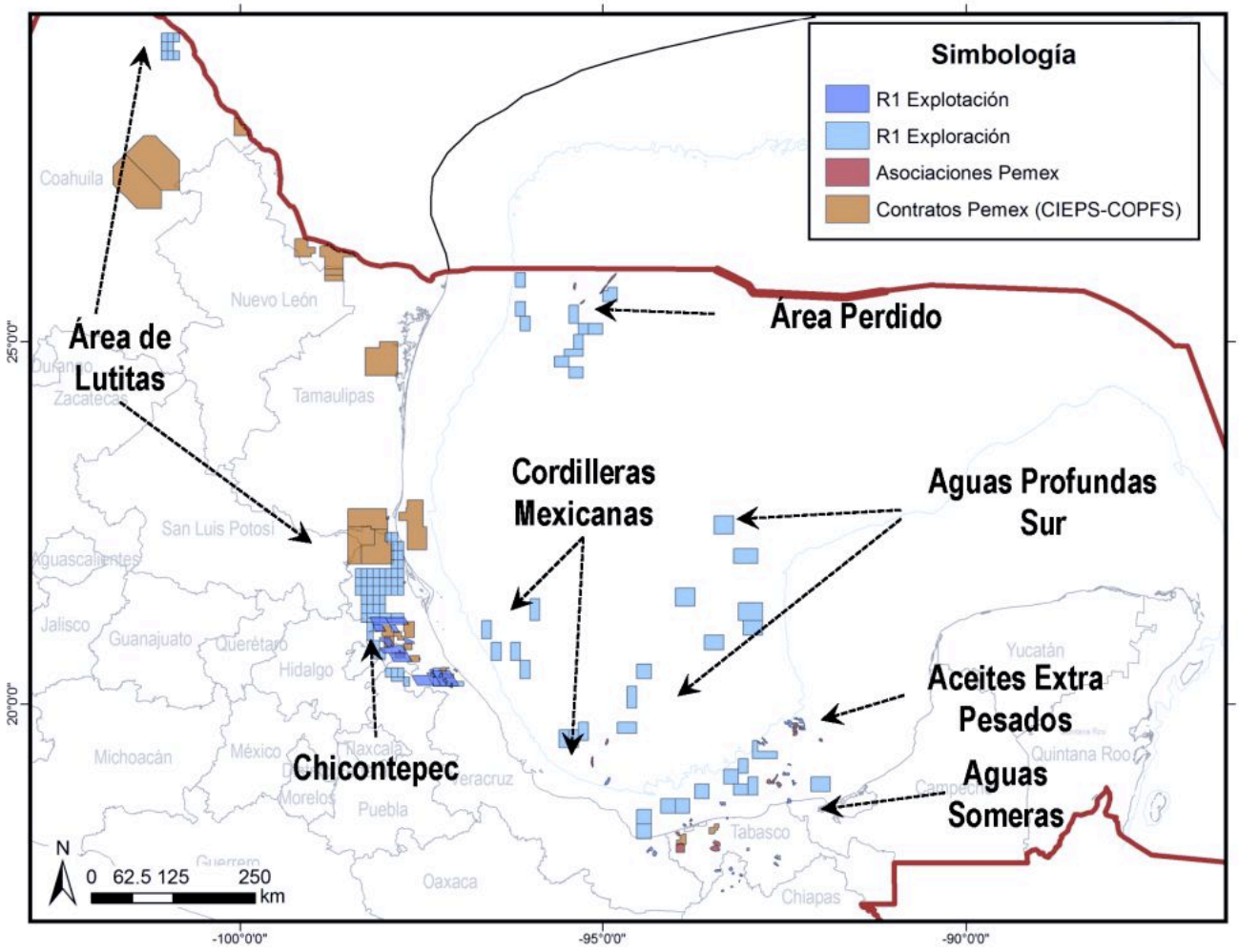


Figure 90: Hydrocarbon Assets in Round One of the Energy Reform Process

The commercial structure for foreign firms operating in the oil and gas sector in Mexico is changed fundamentally by the energy reform. While the reforms are clear that hydrocarbons remain the property and purview of the Mexican state, the structure for private participation is changed fundamentally. Historically, foreign companies participating in Mexico's oil and gas sector would do so through performance-based contracts with PEMEX. Three new contract types have been introduced:

1. Profit-sharing: Companies can receive a percent of profits from oil and gas development, and report projected future revenue as a percent of expected profit.
2. Production-sharing: Companies may have a form of title to a percentage of resource volume as it is produced. This will allow foreign firms to account for reserves as an asset, an important incentive.
3. Licenses: Companies may be paid in the form of the oil and gas resources extracted on a per-project basis, also allowing the claiming of reserves as in production-sharing arrangements.

Profit sharing is the arrangement expected for lower risk projects, and licensing and production-sharing the likely forms used for the riskier and more capital and technology intensive activities.

Figure 91: Shale Gas Regions in Mexico

Sector Objectives

The U.S. Energy Information Administration (EIA) has fundamentally revised its projections for Mexico, taking into account the expected impacts of energy sector reforms. From a decline to 1.8 million barrels per day of production, the forecast is now for 2.9 million barrels per day by 2020, up to 3.7 MMbbl/d by 2040.

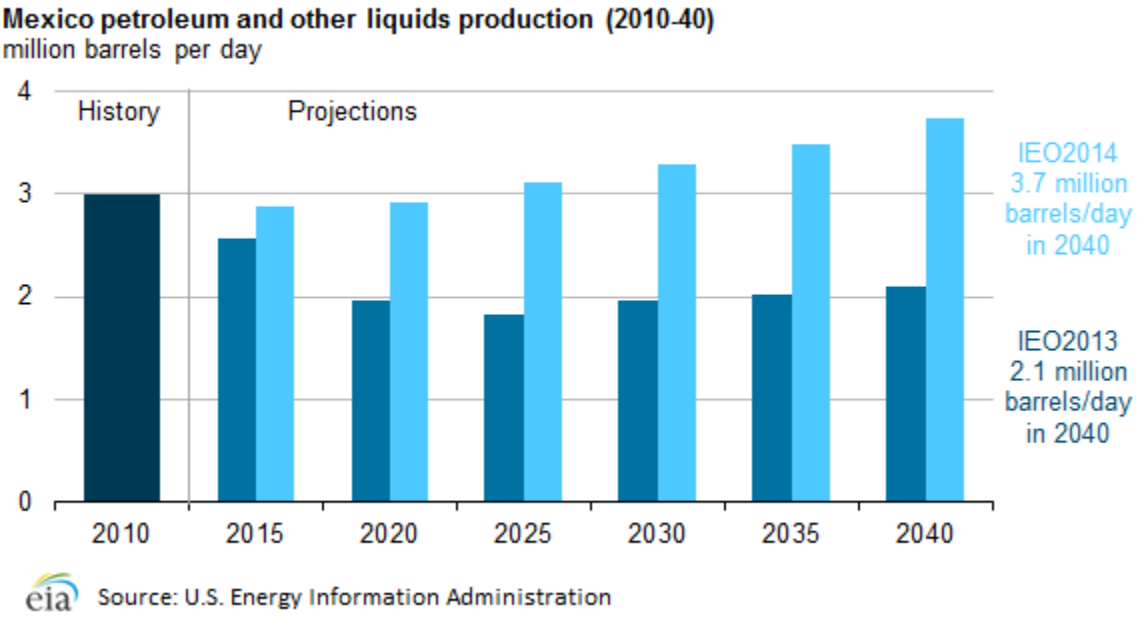


Figure 92: EIA Long-Term Forecasts for Mexico Production of Petroleum and Other Liquids

SENER has established several strategic quantitative goals for the sector through 2018:

- Increase production of crude oil by PEMEX E&P from 2.54 Mbd to 2.68 Mbd.
- Increase production of natural gas by PEMEX E&P from 5.67 million cubic feet per day to 5.42 Mcf/d.
- Increase PEMEX Refining's production of refined gasoline, kerosene, and diesel fuels as a percent of crude processed from 65.7 percent to 73.2 percent.
- Increase the capacity of PEMEX refining's pipeline system from 19,000 barrels per day to 547,000 barrels per day.
- Development by PEMEX Gas and Basic Petrochemicals of capacity additions to the National System of Gas Pipelines of 785,000 cubic meters.
- Increase the recycling of water in PEMEX processes from 36 million cubic meters per year to 62 million cubic meters per year.
- Increase local content of goods and services in PEMEX contracts from 41.5 percent per year to 43.1 percent per year.

Selected Projects

New Natural Gas Pipelines

Project Type:	Natural Gas Pipelines
State(s):	Texas (USA), Multiple
Projected Investment:	USD $
Timeline:	2014 - 2018
Project Sponsor(s):	CFE

Mexico is undertaking a strategic shift in its primary fuel for thermoelectric power generation from fuel oil to natural gas. The development of many new natural gas-fired power plants is paralleled by the construction of a substantial network of new natural gas pipelines that will provide the fuel. This network is oriented towards importing natural gas from the United States, which the EIA projects will see production rise from 24 to 37.5 trillion cubic feet per year by 2040. The new constructions are also designed to provide gas supply to areas of the country that currently do not have pipeline networks.

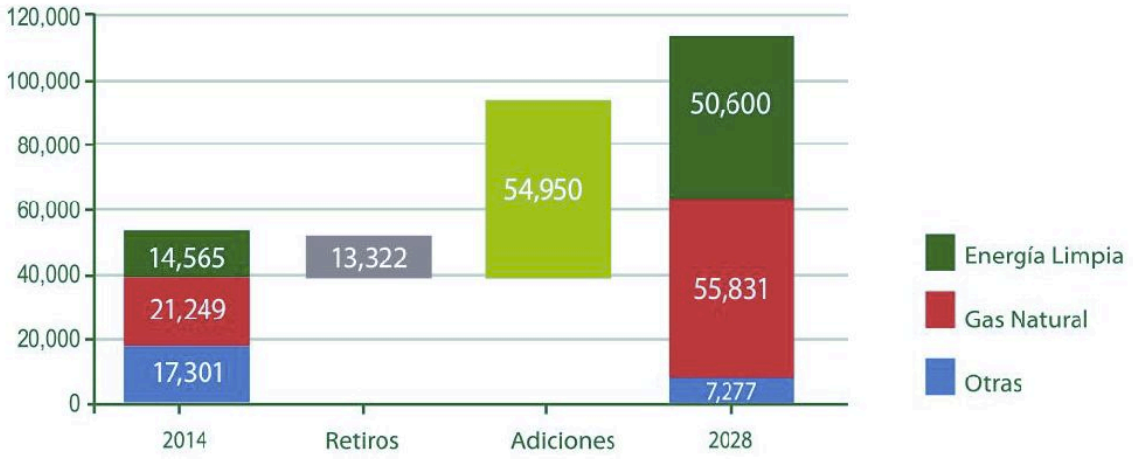


Figure 93: Evolution of Public Service Electricity Generation Capacity by Source (MW)

The current natural gas pipeline infrastructure in Mexico measures over 7,000 miles, with diameters measuring from 16" to 48" and a capacity of 9,000 million cubic feet per day. The energy reform process is expected to create a new National Gas Pipeline System that will be administered by the new system operator and regulator, CENEGAS. Natural gas pipelines in Mexico will fall into one of three categories: economic pipelines, serving a specific customer; strategic pipelines which create a trunk network of natural gas pipeline infrastructure for the country, and; social pipelines that provide natural gas to users in states where the markets for gas are not yet commercially viable, such as in Oaxaca, Chiapas and Guerrero. This will include integration of a number of gas pipelines currently part of the PEMEX system.

Figure 94: Natural Gas Pipelines in Mexico, Present or Under Construction in 2014

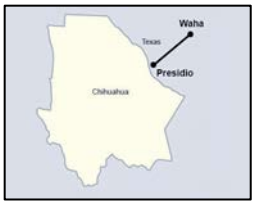
A substantial portion of the new gas pipeline capacity to be built in Mexico is under construction, in tender or in the final stages of preparation for tender as of the fourth quarter of 2014. These segment projects are described below, moving generally north to south across the country.

Waha to San Elizario

This new gas pipeline will be located entirely in the United States, but is a CFE project and a key link in Mexico's gas pipeline strategy. It will originate at the major natural gas pipeline hub and storage facilities at the Waha Basin in Pecos County, West Texas and run approximately 225 miles northwest to San Elizario, Texas, where it will interconnect to the future San Isidro to Samalayuca pipeline that is under construction. It will measure 42" in diameter and have a capacity of 1,475 million cubic feet per day and connect to at least 10 existing pipelines in the vicinity of Waha. The delivery pressure at the border is to be 1,145 psig. The project procurement will include design, engineering, supply of all materials and components, construction, and 25 years of operation and maintenance. At the end of the operating contract term, the transport services contractor will enter into a joint venture agreement in which CFE will own 49 percent of the equity. The alignment will include a fiber optic line to support pipeline operations, including real time metering, performance and security data, which will be part of the contract. Construction is expected to begin in January of 2015 and operations in January of 2017. The RFP process was underway as of October of 2014 with proposals expected November 14, 2014. The total expected

investment in this project is **USD $550 million**. Inquiries about this project may be directed to CFE at waha.pipelines@cfe.gob.mx.

Waha to Presidio/Ojinaga



This new gas pipeline will be located entirely in the United States, but is also a CFE project. It will originate at Waha Basin and run to the border at Presidio, Texas where it will connect with the Ojinaga to El Encino gas pipeline that is under construction. This pipeline will run 145 miles, with a diameter of 42", capacity of 1,350 million cubic feet per day, and delivery pressure at the border of 1,440 psig. The procurement terms, timeline and construction are the same as for the Waha to San Elizario pipeline. The total expected investment in this project is **USD $400 million**. Inquiries about this project may be directed to CFE at waha.pipelines@cfe.gob.mx.

Ojinaga to El Encino

This pipeline will run from the new connection at Ojinaga southwest 186 miles to El Encino, entirely in the State of Chihuahua. This pipeline will be 42" in diameter and will be able to transport up to 1,350 million cubic feet of gas per day. Proposals were due to CFE in October of 2014, awards to be made by the end of 2014, and construction is planned to finish in 2017. Bidding was extremely competitive, with six firms shortlisted on technical proposal merit out of 26 contenders as of October of 2014: Transportadora de Gas Natural del Noroeste (TransCanada); Fermaca Pipeline Ojinaga; Omega Construcciones Industriales; Gasoducto de Aguaprieta; and two consortiums: Enagás and Elecnor (Spanish, affiliated with Abengoa); and Promotora del Desarrollo de América Latina, Energy Transfer Mexicana, Energías de México and Grupo Carso.

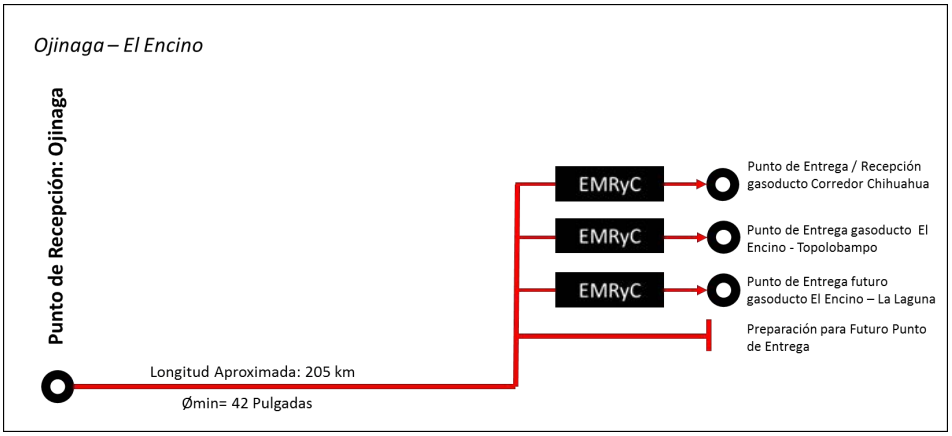


Figure 95: Schematic of the Ojinago - El Encino Natural Gas Pipeline

As with the prior projects, this pipeline is being procured through a design-build-operate structure, with a 25-year operating contract. This project also requires the bidders to bring to the table all necessary financing to support design, construction, and operations. National content requirements apply to the pipeline tubing specifically, with 50 percent of the total length required to be of Mexican origin. This pipeline is to be designed to operate in either direction if required. Cost proposals are to contain a detailed proposal for the tariff

structure the operator will charge for use of the pipeline. The bidders will be responsible for constructing and operating the SCADA systems and primary and alternate control centers, incorporating redundant OLE Process Control Servers that are interoperable with CFE systems. This pipeline will include a fiber optic communications line supporting voice communications and data connections for the SCADA system, with a 500 Kbps capacity and an interconnection through RJ45 cabling enabling connection of the pipeline system to the CFE SCADA system. The total investment in this segment is expected to be **USD $400 million**.

El Encino to La Laguna

This new pipeline will serve to connect the new pipeline terminating at El Encino and will carry gas approximately 250 miles south to the La Laguna region in Durango (La Laguna is the cluster of cities including Torreón, Gómez Palacio and Ciudad Lerdo and it is the ninth largest metropolitan area in the country). This pipeline will have a diameter of 42" with a maximum capacity of 1,500 million cubic feet per day. The technical scope and procurement terms will be similar to the previously described pipeline projects, with a 25-year operating concession. Capacity on the pipeline will initially be used by CFE to support power generation, however it is anticipated that "open season" mechanisms will be used to offer capacity on the pipeline directly to industrial users. This project was open to bid in mid-2014 and proposals are due in the fourth quarter of 2014, with construction to begin in 2015 and conclude in early 2017. The total investment in this new pipeline is expected to be **USD $650 million**.

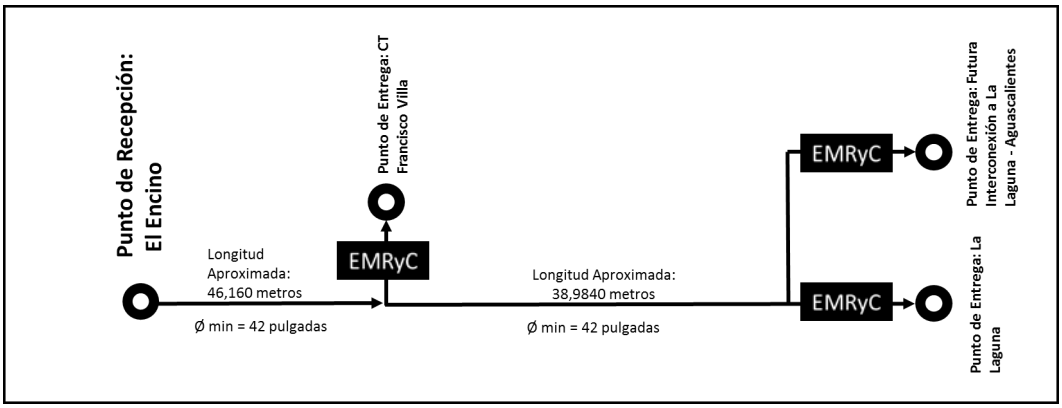
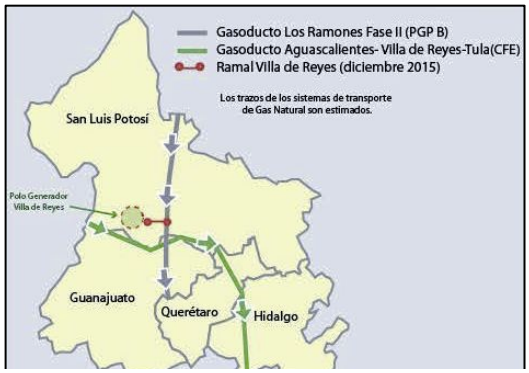


Figure 96: Diagram of the El Encino - La Laguna Pipeline

Waha to Samalayuca

This 186-mile long pipeline, measuring 42" in diameter with a capacity of 1,450 million cubic feet per day, is designed to be a primary source of gas for the Norte III combined cycle natural gas burning thermoelectric power plant to be built 19 miles south of Ciudad Juarez in Chihuahua at a site called Samalayuca Sur. Installed net capacity of this facility will be 788 MW. Tenders are schedule for 2014 and operations by mid-2016. The total investment is projected to be **$541 million**.



Branch Line to Villa de Reyes

This new pipeline will provide natural gas supply to the thermoelectric plant at Villa de Reyes and the combined cycle

plants San Luis Potosí I and II which will enter service in 2020 and 2024, respectively. This line will be 11 miles long, 24" in diameter, with a capacity of 276 million cubic feet per day. This branch will initially connect to the Los Ramones (Phase II) pipeline, and later be connected to the pipeline Aguascalientes – Villa de Reyes – Tula that will enter service in 2017. Bidding will occur in the fourth quarter of 2014, awards are to be made in January of 2015, operations are to begin by the end of 2015. The estimated total investment in this project is **USD $30 million**.

Additional Gas Pipeline Projects

An additional $11 billion of projected investment is identified in the PNI, associated with the following natural gas pipeline projects. Among these is a 99-mile pipeline between Ehrenberg, Arizona and San Luis Río Colorado in Sonora. This pipeline is to be 24" in diameter, it will be designed to carry 130 million cubic feet of gas per day and should enter operations in 2017.

Project	Beneficiary State(s)	Length (Miles)	Millions of USD $	Bidding	Operations
Mérida - Cancún	Quintana Roo, Yucatan	186	461	2014	2016
Ehrenberg - Los Algodones - San Luis Río, Colorado	Sonora	99	248	2014	2017
Supply to Baja California Sur	Baja California Sur, Sinaloa	N/A	595	2014	2017
S. Texas Submarine to Tuxpan	Tamaulipas, Veracruz	388	2,977	2014	2018
Tula - Villa de Reyes	Aguascalientes, Hidalgo, Jalisco, and San Luís Potosí	173	417	2014	2017
Tuxpan - Tula	Hidalgo, Veracruz	147	397	2014	2017
Samalayuca - Sásabe	Chihuahua, Sonora	347	834	2014	2017
Colombia - Escobedo	Nuevo León	158	372	2015	2017
Jáltipan - Salina Cruz	Oaxaca	153	641	2015	2017
Los Ramones - Cempoala	Nuevo León, Tamaulipas, Veracruz	531	2,005	2015	2017
Villa de Reyes - Aguascalientes - Guadalajara	San Luís Potosí, Aguascalientes, Zacatecas, Jalisco	221	551	2015	2018
La Laguna - Centro	Durango	373	893	2015	2018
Lázaro Cárdenas - Acapulco	Michoacán, Guerrero	206	454	2015	2018
Salina Cruz - Tapachula - Central America	Oaxaca, Chiapas	273	441	2015	2018
Total		**3,257**	**$11,287**		

Table 47: Natural Gas Pipeline Projects

Project Contacts

U.S. Trade and Development Agency	U.S. Commercial Service Mexico	
Mr. Keith Eischeid Country Manager for Mexico and Central America Tel. +1-703-875-4357 KEischeid@ustda.gov	Ms. Karen Allen Commercial Officer +52 (55) 5080-2195 Karen.Allen@trade.gov	Mr. Francisco Ceron Commercial Specialist: Energy & Water +52 (55) 5080-2000, ext. 5211 Francisco.Ceron@trade.gov

Diverse Oil and Gas Sector Projects

The PNI identifies over **USD $251 billion** worth of investment activities to be realized in this sector, including exploration, production and refining. Many of these are not discrete projects, but rather broad investment categories that will create a huge range of commercial opportunities for the provision of goods and services by U.S. companies through 2018.

USD $89 billion is expected to be invested in exploration and production activities across wide regions of the country: a national tranche of USD $40.5 billion is to be spent in partnership with state and federal entities. USD $25.5 billion is to be spent in the south-southeastern regions. Another USD $23.3 to be spent in the northern region. The next tranche of USD $80.3 billion involves exploration and production activities at specific major fields. At KMZ USD $18.9 billion is to be spent on operation and maintenance of existing wells, exploration of shallow water resources and associated exploration and development infrastructure. At Cantarell, USD $17.8 billion will be spent in shallow water exploration activities, sustainment and rehabilitation of existing production wells, nitrogen and sour gas injection as a component of enhanced recovery activities, natural gas recovery infrastructure, and dewatering technology. In the fields of Tsimin-Xux in Tabasco and Campeche USD $7.8 billion will be spent on exploration wells, remediation of exploratory wells, and diverse production infrastructure. At Chuc, also in Tabasco and Campeche USD $7.7 billion will be spent on operation and maintenance of existing production wells, new exploratory wells, modernization of infrastructure, and application of enhanced recovery methods. USD $6 billion will be spent on the Aceite Terciaro in the Gulf project in the States of Veracruz and Puebla. This will include investments in maintenance of existing wells and production infrastructure, new exploration wells, and infrastructure for the handling, transport and storage of product. Another USD $6 billion will be spent on the Antonio J. Bermúdez project on operation and maintenance of existing wells, implementation of an electric centrifugal pumping system, new exploration wells, and petroleum transportation infrastructure. In the states of Campeche and Tabasco, USD USD $5.3 billion will be spent on a project focused on shallow water light crude extraction, including operation and maintenance of existing wells, new exploration wells and implementation of enhanced recovery systems. In Tamaulipas $4.9 billion will be invested in the Área Perdido project which will involve exploration activities in deepwater regions. In the Burgos region in Tamaulipas, Nuevo León and Coahuila USD $3.8 billion will be spent to develop natural gas resources through a mix of maintenance and improvement of existing production infrastructure as well as drilling of exploration wells and construction of gas pipelines. At Yaxche in Tabasco and Campeche USD $3.8 billion will be spent on operation and maintenance of existing wells, drilling of new exploratory wells and construction of marine structures and gas and oil pipelines. At Campeche East USD $3.4 billion will be spent on drilling of exploratory wells and 3D seismic studies.

Two major refinery projects will support the conversion of the refineries at Tula in Hidalgo and Salamanca in Guanajuato to process lighter grades of crude and produce higher quality value-added refined products. These projects will create investments worth USD $6.7 billion to occur in the period 2015 – 2018. At Veracruz USD $406 million will be spent to reconfigure existing refinery infrastructure to increase the production of benzene and paraxylene. Another USD $313 million will be invested into the ethylene production infrastructure at the Morelos Petrochemical Complex. The system will be improved to enable production of diverse polyethylene products, ethylene oxide, and glycols. A new polymer laboratory will be built and capacity for storage and distribution will be increased. This project will be completed by 2017.