THE FUTURE OF OIL IN MEXICO

/ *EL FUTURO DEL SECTOR PETROLERO EN MÉXICO*



Energy Trade and Security Issues at the Mexico–U.S. Border

Isidro Morales, Ph.D.

JAMES A. BAKER III INSTITUTE FOR PUBLIC POLICY
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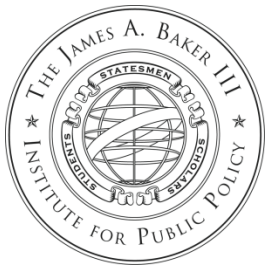

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By

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These papers were written by a researcher (or researchers) who participated in the joint Baker Institute/Oxford University study. Wherever feasible, these papers are reviewed by outside experts before they are released. However, the research and the views expressed within are those of the individual researcher(s) and do not necessarily represent the views of the James A. Baker III Institute for Public Policy or Oxford University.

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About the Study: The Future of Oil in Mexico/ El futuro del sector petrolero en México

The energy industry plays an important role in the Mexican economy, and energy trade is a major component to the U.S.-Mexico relationship. The Mexican government relies on the oil industry for 35 percent of total government revenues, including taxes and direct payments from Petróleos Mexicanos (Pemex), the state oil company. Mexico is the third-largest foreign crude oil supplier to the United States. However, with declining production and rising demand, Mexico could become a net oil importer in the coming decade. President Calderón pushed for energy sector reform in Mexico, but more reforms will be needed for Mexico to reverse its current path toward importer status. This study identifies the dynamics of the political trends in Mexico that will impact future energy policy. The aim of this study is to promote a better understanding of the challenges facing Mexico's oil sector and to enhance the debate among policymakers, the media and industry on these important issues.

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About the Mexican Studies Programme at Nuffield College, Oxford University

Since its establishment in 2002, Oxford's Mexican Studies Programme has conducted research and promoted graduate teaching in Mexico's external relations; democratization and the functioning of democratic institutions in Mexico; and on various Mexican public policy issues, including economic and energy policies.

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I. Introduction

Mexico is a voracious consumer of oil and gas, but is even more addicted to foreign income from crude oil exports. This essay analyzes the consequences of this hydrocarbon dependence, emphasizing what is at stake in terms of cross-border energy trade (oil fuels, gas, and electricity) between the United States and Mexico. Though Mexico's Ministry of Energy considers the decline of Mexican oil reserves, oil production and, hence, oil exports a problem of national security, I contend in this essay that energy policies remain heavily dominated not by a security approach but by the politics of resource nationalism. Under present circumstances, the evolution of crude oil exports remains uncertain, production in nonconventional basins, such as Chicontepec, will remain hampered by technological and financial constraints, and environmental and public security externalities will continue to obscure the investment climate in Mexico's oil industry. Meanwhile, imports of oil fuels (mainly gasoline) and gas will continue to grow, either by pipeline or via LNG cargoes, putting pressure on Petróleos Mexicanos' (Pemex)—Mexico's oil and gas monopoly—income and balance of payments. It is in the electricity sector (mainly in the domain of power generation by independent producers and private utilities), where the most promising opportunities—either for investment, demand expansion, or foreign trade-—currently exist in the country, especially for firms interested in using renewable resources.

II. Mexico's Oil Addiction

Out of the three countries of North America, Mexico is the most dependent on oil and gas consumption as a primary source of energy. At present, oil represents 57% of total primary energy supply (subtracting exports and adding imports) in the country, while gas amounts to 27.4%. This highly contrasts with its North American partners: Oil represents 39% of total primary energy supply in the United States and 35% in Canada; gas represents 23% and 29% of total primary energy supply for the United States and Canada, respectively (IEA 2010). Furthermore, and in spite of the policy efforts of the Felipe Calderón administration (2006-2012), Mexico's energy mix will remain heavily dependent on hydrocarbons in the years to come. However, Mexico's oil (and gas) addiction features not only a great dependence on

hydrocarbons in the energy balance but also, more importantly, oil revenues from exports that have remained, since the end of the 1970s, a major source of fiscal revenues for government. At present, oil taxes and transfers represent around 35% of overall government income. This fabulous oil rent[1] has become crucial ever since Mexico regained international oil markets (1974) for funding not only Pemex upstream and downstream activities, but for backing Mexico's foreign debt, mainly during the 1980s, and social and government expenditures from that time to the present. Figure 1 shows the importance of oil revenues from exports compared to other major sources of foreign income, i.e., remittances, tourism, and the transport sector.

Once the North American Free Trade Agreement (NAFTA) came into force, remittances from Mexican expatriates—illegal or not—tourism, and exports from the transport sector—automobiles, auto parts, etc.—became three major sources of foreign income for the Mexican economy. However, only the latter has represented more than 10% of overall income in Mexico's current account, similar to the amount of oil revenues which, from 2004, have been above that share, as shown in Figure 1. Since oil is not a simple commodity, but a strategic one, its value depends on the cyclical behavior of markets, which are heavily influenced by geological, geopolitical, economic, and political constraints. It is well known that at the turn of the 21st century, oil markets entered a new cycle of "expensive oil," this time marked by the pressures of new net importers such as China and India on the demand side, and geopolitical reconfigurations after the 2003 American invasion of Iraq on the supply side. This explains why the bulk of Mexican oil revenues from exports has been sustained, in spite of the decline of Mexican sales measured by volume.

In other words, Mexico's oil rent in the past five years has increased in spite of the decline in volume, thanks to the new cycle of high oil prices witnessed by international markets. However, Mexico's oil addiction—in both the energy mix and in the balance of payments—has become its major vulnerability. Mexico has become vulnerable to the behavior of oil markets because of two reasons: 1) the unpredictable price fluctuations that may occur in the mid- to long terms; 2) the secular decline in oil exports while imports of refined fuels—mainly gasoline—are growing.

[1] According to the Ministry of Energy, "oil rent" is defined as the income obtained from the value of oil wealth at international market prices minus supply costs (SENER 2008c).

This probably explains why in Calderón's 2010 National Energy Strategy, the concept of "energy security" was introduced for the first time in the country's official jargon.

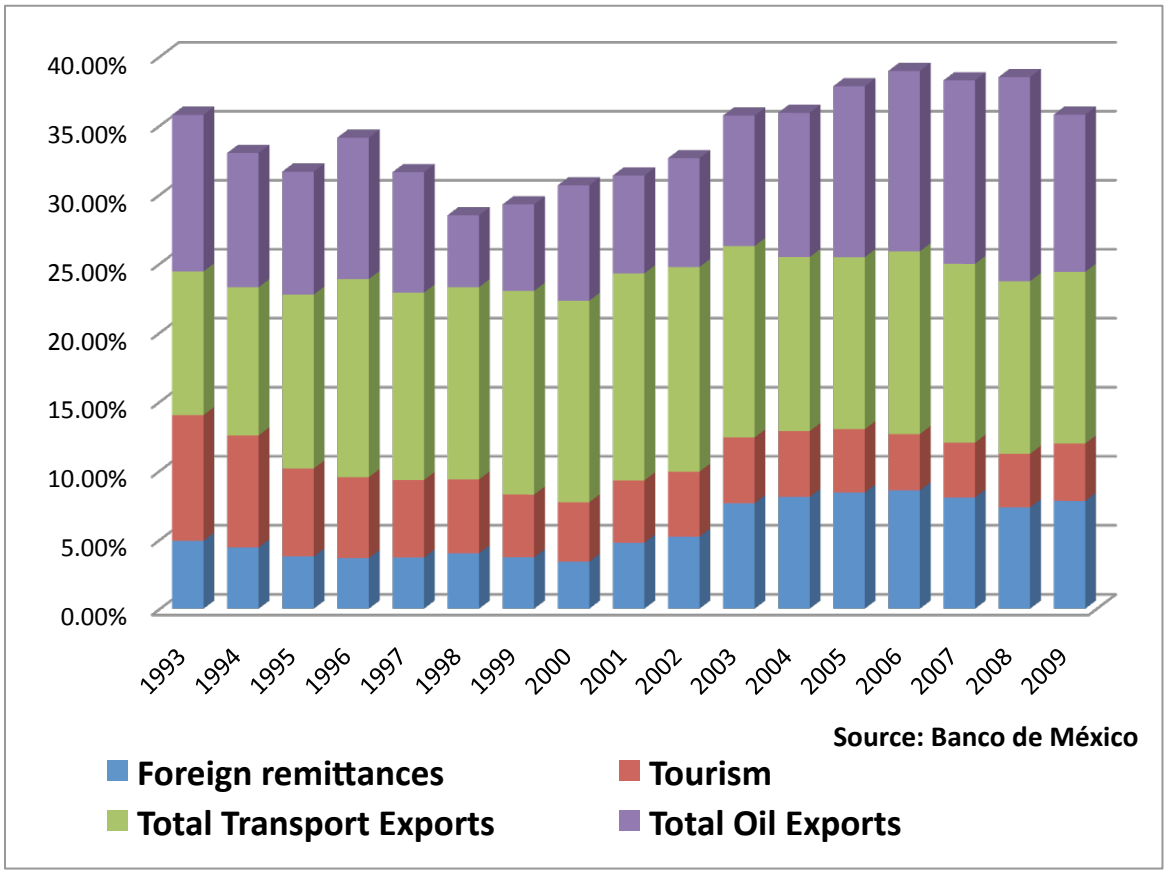
In principle, a strategy of energy security should target the reduction of vulnerabilities—social, economic, or political—vis-à-vis unexpected or critical changes impacting the energy system of a country. In fact, the governance of risk, uncertainty, and adaptation must be at the root of any security policy. In the case of energy, a risk is mainly defined in terms of unexpected shocks affecting the stability of energy supplies (in the case of Mexico, mainly oil and gas), which may be unleashed by natural depletion (the current decline of conventional oil reserves), natural disasters, or geopolitical changes (Morales 2011). These supply shocks may at the same time unleash uncertainties in energy markets and undermine policy options, i.e., the evolution of oil and other energy-related prices, the introduction of alternative fuels, the evolution of new investments and drilling exploration, etc. However, President Calderón's National Energy Strategy has a limited view of energy security for the country, because one of the most important goals to be achieved in the present and forthcoming presidential administrations, i.e. 2024, is the restitution of Pemex oil production to its historical level—3.3 million barrels per day (b/d)—and the ratio of proved reserves replacement to 100%.[2] In 2009 the actual record of these two figures was 2.6 million b/d and 72%, respectively (SENER 2010a, 63). That is, in Calderón's view, the major security goal is to raise oil production to its historical levels and reduce the rate of depletion of nonrenewable resources, all under the aegis of a Pemex monopoly. Under his strategy, it is not clear how a transition to a more diversified energy mix will be accomplished or combined with right price signals for ensuring the participation of private firms (in the domains where this is permitted or in the exploitation of renewable resources) in order to adapt Mexico's energy system to a scenario of growing energy demand while reducing carbon emissions.

Parallel to a rather narrow security perception of Mexico's energy quandary, the current political class is tackling the problem through the lens of "resource nationalism." David Mares makes the distinction between a policy targeting the reduction of vulnerabilities or costs for adapting economies to critical changes in energy systems (a so-called energy security approach), and policies targeting the governance of energy resources as strategic inputs for supplying public

[2] According to most recent estimates, this goal will be achieved in 2012 (SENER 2011, 124).

goods—the so-called "resource-nationalism" approach (Mares 2010). The two approaches are not mutually exclusive and may overlap, causing a different mix of outcomes. In the case of Mexico, however, the root of state-building has been resource nationalism rather than the generation and supply of public goods (Morales 2011).

Figure 1. The Primary Sources of Mexico's Foreign Income in the Current Account, 1993-2009



In recent years, and certainly in October 2008 when "energy reforms" were last enacted in Mexico, the Mexican congress favored a nationalistic rather than security approach, and consequently refused to widen the scope of price competition and private capital participation in the energy sector. This has compromised not only the security goals set by the Calderón administration in his National Energy Strategy but the overall sustainability of energy policies that pursue a public good, regardless how the latter is defined and estimated.

III. The Decline of Crude Oil Production and Exports: Will Mexico Become a Net Importer?

During the past 10 years, most investments in Pemex were channeled to increase production and consequently, exports. While crude oil production peaked in 2004 (with 3.383 million b/d), natural gas production has maintained its own growth. However, overall crude oil reserves have declined. In 1999, Pemex reclassified Mexico's overall stock of proven, probable, and possible reserves. The classifications refer to the actual recovery of crude oil depending on technological and economic conditions prevailing in the industry. Suddenly, Mexicans realized that from a total amount of oil reserves estimated at 40.379 billion barrels (bbls), proven reserves were only 24.7 billion bbls. These are reserves from which current production is being obtained. In 2010, reserves fell to 10.4 billion bbls, which at current levels of production will be depleted in a little more than 10 years. Total oil reserves—including proven, probable, and possible stocks—have thus declined to 30.5 billion bbls, half of them located offshore in the Gulf of Mexico (Pemex 2010a and 2000).

During the Fox administration (2000-2006), investments in exploration and production increased compared to previous years, and this trend has been maintained during the Calderón administration. In 2009, investments in this strategic area of Pemex reached US$16.781 billion,[3] the highest amount witnessed during the past 10 years and the estimated amount that must be invested if Pemex is to attain its previous record production rates. However, since 1997 more and more of those investments are not being made by Pemex; instead, drilling and exploration is outsourced to private companies. These companies finance the work and when their services are rendered, Pemex starts paying them with the additional income it gets from their labors. This formula, labeled in Mexico as infrastructure projects whose payments are re-scheduled for public expense purposes (in Spanish, *pidiregas*),[4] began functioning during the administration of Ernesto Zedillo (1994-2000), but President Fox made it the backbone of the country's plan to finance new investments in the oil and gas sectors.

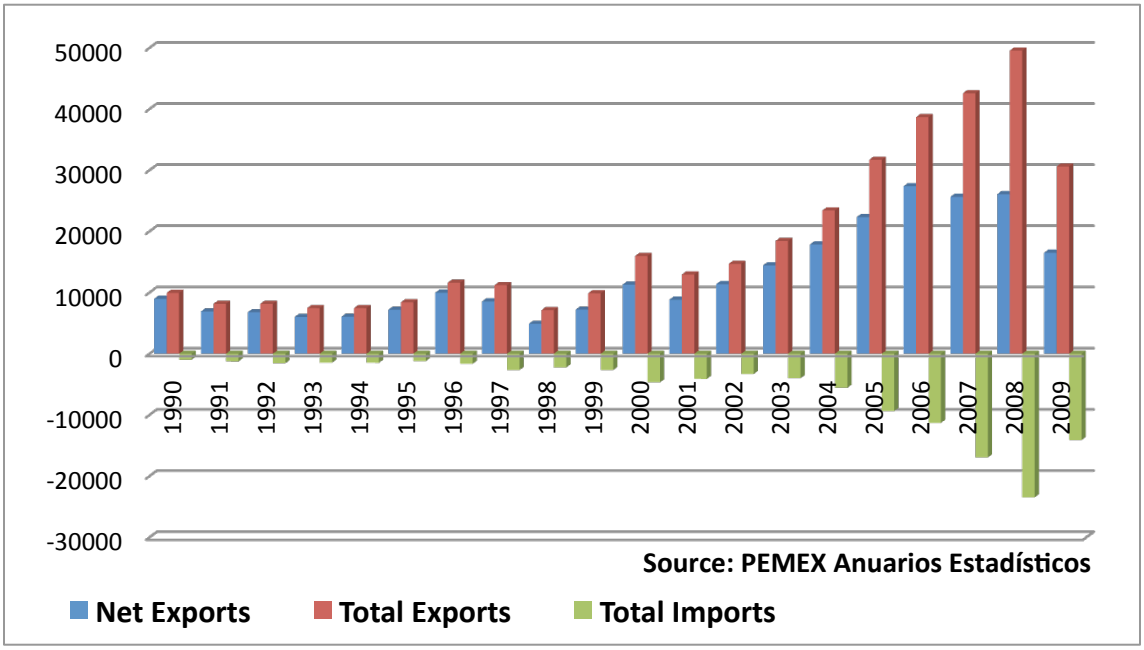
[3] All figures in Mexican pesos were converted to U.S. dollars at the following exchange rate: 1 U.S. dollar=13 pesos.

[4] In Spanish, this formula is called *proyectos de infraestructura diferidos en el registro del gasto*, the acronym of which is *pidiregas.*

In 2008, 88% of Pemex's overall investments were funded by private companies through this mechanism (Pemex 2010b, 10).[5] The Fox administration praised the investment design as the way to go if Pemex wanted to maintain and/or increase its production while maintaining the constitutional ban prohibiting private capital in Mexico's oil and gas industry. At the same time, this formula released the government from using its oil rents to fund the recovery of oil reserves and other energy-related projects.

Nonetheless, in spite of the windfalls of recent years, from 1998 to the present (with the exception of 2006), Pemex has operated in a financial deficit, since the Ministry of Finance levies more than 60% of the company's revenues. At the end of the day, if private investments funded through the pidiregas formula are not paid directly by Pemex (because of the huge transfer of resources), they become a liability for the company or for the Mexican government. This explains why raising production, and hence exports, have become a national security issue for the country.

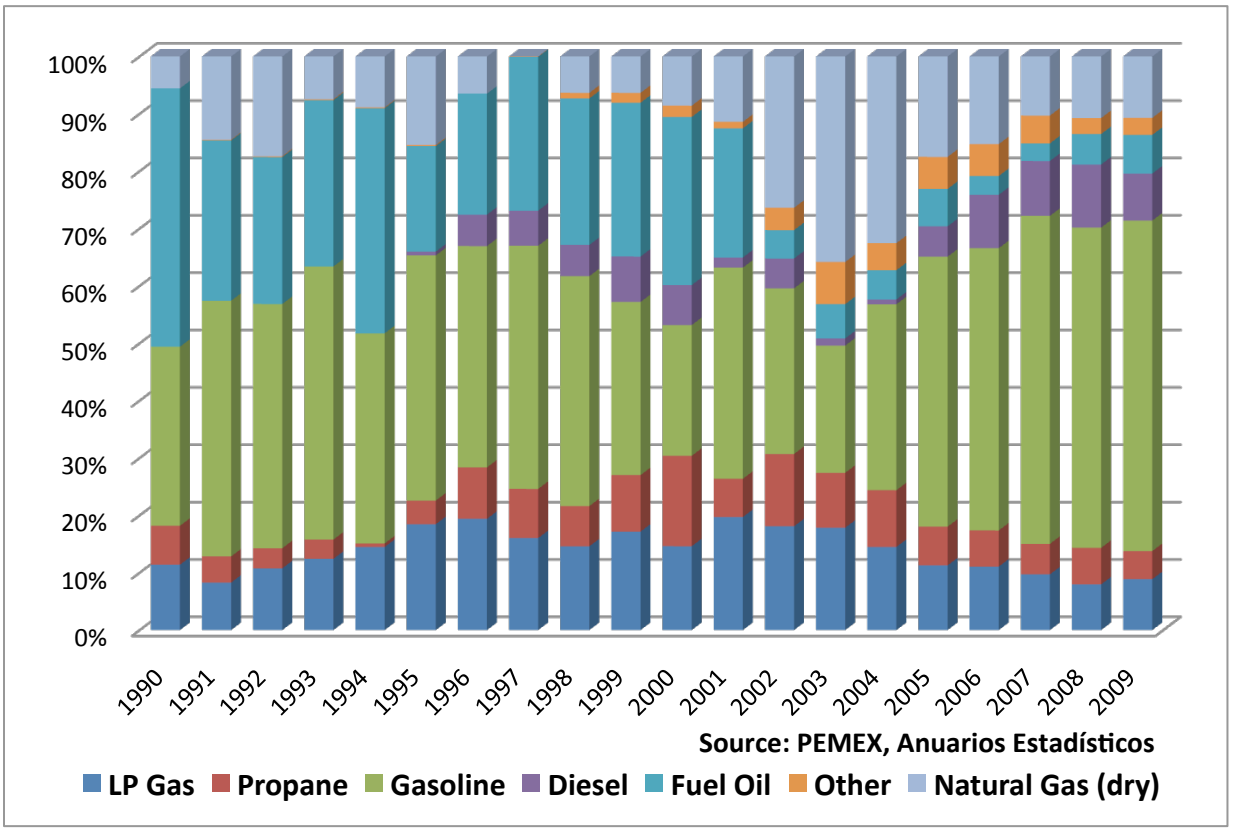
Figure 2. Pemex: Foreign Trade Balance of Hydrocarbon Fuels and Petrochemicals (in millions of dollars)



[5] Pemex did not disclose 2009 *pidiregas* figures.

In 2009 Pemex's net income from its trade balance shrank almost 37% compared to the previous year. This was a major decline in the company's net revenues from foreign trade within the previous 10 years, and was explained by the secular decline in the volume of oil exports, international price fluctuations,[6] and most importantly, growing imports of gasoline—though volumes dropped in the past year due to Mexico's deep recession (see Figure 2). Nonetheless, once the Mexican economy recovers from the impact of the U.S. recession, domestic demand for fuels is expected to grow, as are gasoline imports. Figure 3 shows that from overall imports, gasoline has become the major burden in Pemex's trade balance.

Figure 3. Pemex**: Imports of Oil Products and Natural Gas, Shares of Overall Imports**

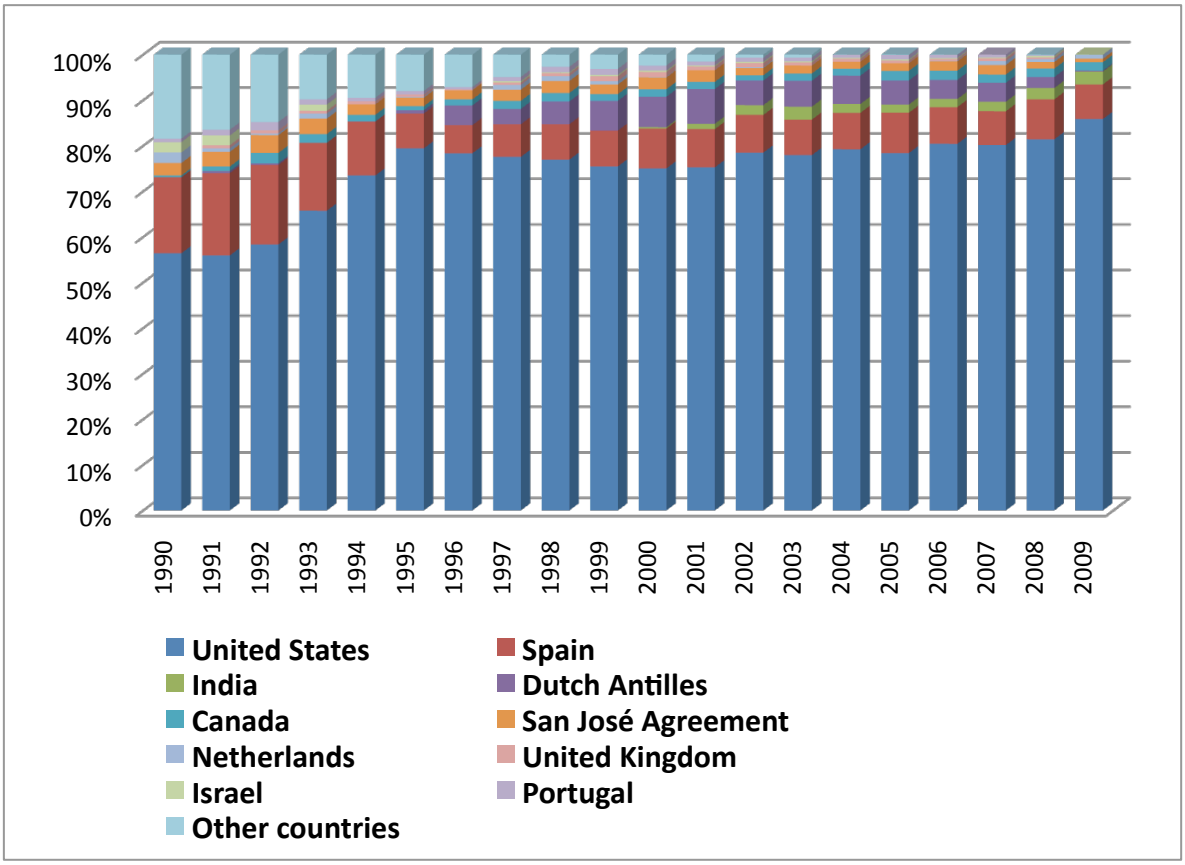


As for oil exports, Figure 4 shows how despite the dominance of oil nationalism in the country's current energy policies, Mexican foreign sales have concentrated more and more in the U.S. market. While in 1990, 56.4% of overall Mexican crude oil exports went to the United States,

[6] In 2009 the average price for the Mexican export mix was $57.44/bbl, while in 2008 it amounted to $84.38/bbl.

this amount rose to 85.8% in 2009. The reason for this growing concentration is not only transport costs, which are lower to the U.S. market, but the fact that most Mexican exports feature heavy oil, or Maya (see Figure 5), whose processing—due to its high content of sulfur and metal—requires the upgraded refineries located mainly in the United States, and not in Europe or Asia.

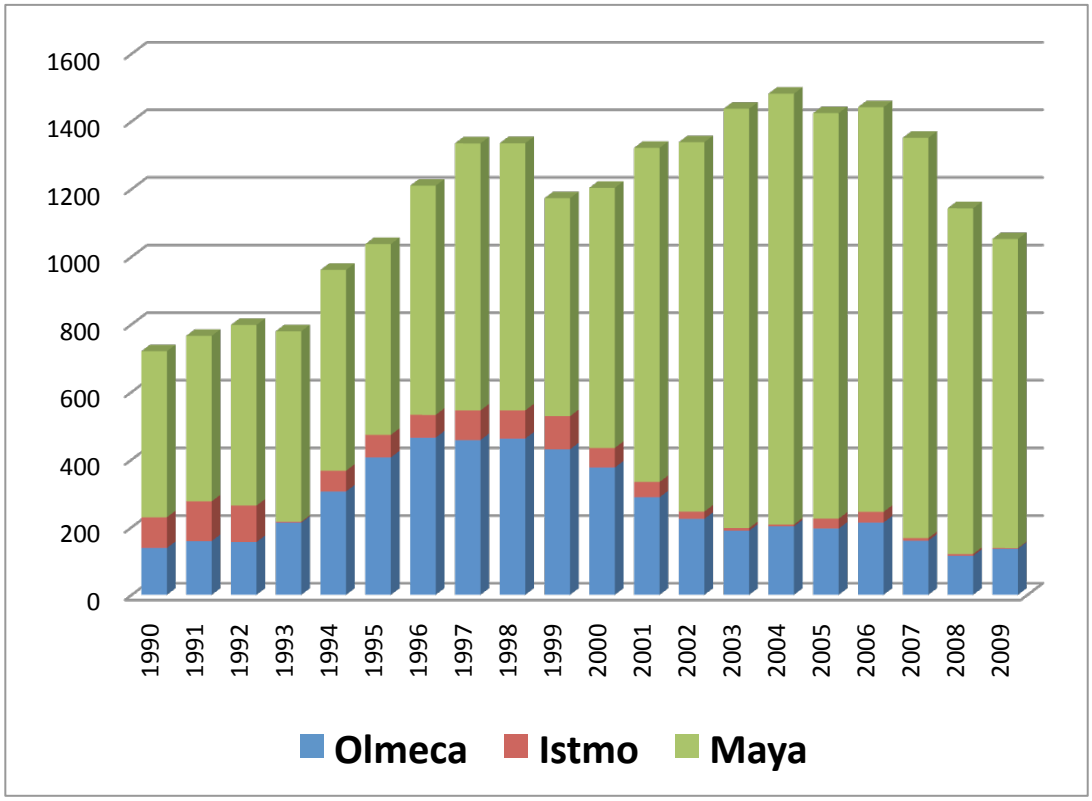
Figure 4. Mexican Crude Oil Exports by Major Countries, 1990-2009



In 2007, before the new energy bills were passed by congress, Mexico's Ministry of Energy (SENER, according to the Spanish acronym), released a pessimistic—though realistic—prospective warning on the possibility that Mexico would start importing light crude oil beginning in 2011 in order to process certain petroleum products demanded domestically (SENER 2007,112). Once the bills were passed, SENER moved to a rather optimistic position and released, at the end of 2008, a new scenario in which Mexico was on the path to increasing

oil production capacity to 3 million b/d in the year 2017 (SENER 2008a). The key for reaching this goal was the aggressive development of probable and possible reserves in Chicontepec,[7] in northern and central onshore Mexico, and which were anticipated to compensate for the rapid decline of Cantarell production. In 2005, Cantarell supplied 61% of overall Mexican crude oil production. It was the last supergiant field discovered in Mexico with a very high productivity. It has abruptly and irreversibly declined and is currently contributing with 26% of overall crude production.[8]

Figure 5. Mexico-U.S. Exports of Crude Oil by Type, 1990-2009 (in thousand b/d)



[7] According to PEMEX classifications, as of January 1, 2010, there were 13.99 billion bbls of oil equivalent (BBOE) of proved reserves, 14.23 BBOE of probable reserves, out of which 60% were in the Chicontepec area, and 14.846 BBOE of possible reserves, out of which 55% were in Chicontepec. This shows the importance of this region for the future evolution of Mexico's oil production. It is important to highlight that offshore resources amount to 52% of probable reserves and 49% of possible reserves. See PEMEX (2010). For definitions of classifications, see PEMEX (2009).

[8] Cantarell peaked with 2.035 million b/d production in 2005, while in 2009 it only produced 684,800 b/d. Part of this abrupt decline has been offset by increasing production of another major field: Ku-Maloob-Zaap, also located in the Northeast Marine region. This field produced 288,700 b/d in 1999, while ten years later was producing 808,000 b/d. (PEMEX 2010a, 20).

By contrast, the Chicontepec fields feature a low level of productivity; an impressive amount of drilling will be necessary to get a small portion of the volume obtained from the Cantarell field in its golden years. Consequently, developing and pumping oil from Chicontepec have proved to be expensive; and there are additional environmental and social costs since the area is highly populated. At the end of 2008, SENER estimated that an average annual investment of US$16 billion was needed to boost production in the years to come. The development of Chicontepec was expected to absorb the majority of those investments in order to ensure the drilling of 19,181 wells and reach an estimated peak of 606,000 b/d—which is lower than the amount Cantarell is currently producing in its declining years.

In spite of the optimistic vision concerning the development of the Chicontepec fields, SENER anticipated a severe decline in exports. While Pemex projected an increase in oil production to 3.021 million b/d in 2017 (or 3.4 million b/d in 2014, according to the National Energy Strategy), Mexico's refinery processing capacity was estimated to increase at an annual average growth rate (AAGR) of 5%, reducing the amount of oil available for export, which was projected to decline to around 875,000 b/d in 2017 (SENER 2008a, 129). That scenario had two major flaws: it was very optimistic about the development of the Chicontepec fields and it made a linear extrapolation regarding the decline of exports.[9]

Since 1978, Chicontepec has been known as one of the most important hydrocarbon reservoirs in the Americas.[10] It is currently estimated to contain 136.763 billion bbls of crude and 54,222 billion cubic feet (cu ft) of natural gas, amounting to a total of 147.211 billion bbls of oil equivalent in situ.[11] Pemex's investments and drilling plans only anticipate recovering 2% of that amount. This is due to the geological characteristics of the fields (which are highly fragmented and with low recovery yields per well), and the technological and economic challenges involved

[9] In fact, the decline of export volumes was calculated by deducing from overall production a growing domestic demand of Mexican refineries. The demand was estimated to grow at an AAGR of 5%; this meant that, for instance, in year 2017 Mexican refineries would be processing more than 2 million b/d. To process such an amount of oil would have required the construction of three additional refineries that year. A more realistic scenario released by SENER at the beginning of 2011 freezes Mexico's refinery capacity to 1.650 million b/d from 2016, with the start of operations of the new Tula refinery. See *infra.*

[10] For an estimation of the reserves and supply costs made at that time see Sordo and López (1988, 110-130).

[11] Information about the so-called Gulf of Mexico Tertiary Oil (Chicontepec fields) comes from CNH (2010), unless otherwise stated.

in the extraction and exploitation of the resources. The investment and drilling costs and the low recovery factor called the attention of Mexico's National Hydrocarbon Commission (CNH, its Spanish acronym), a new watchdog energy agency attached to the Ministry of Energy and whose experts have challenged the poor operational and organizational practices of Pemex during its exploitation of this area.

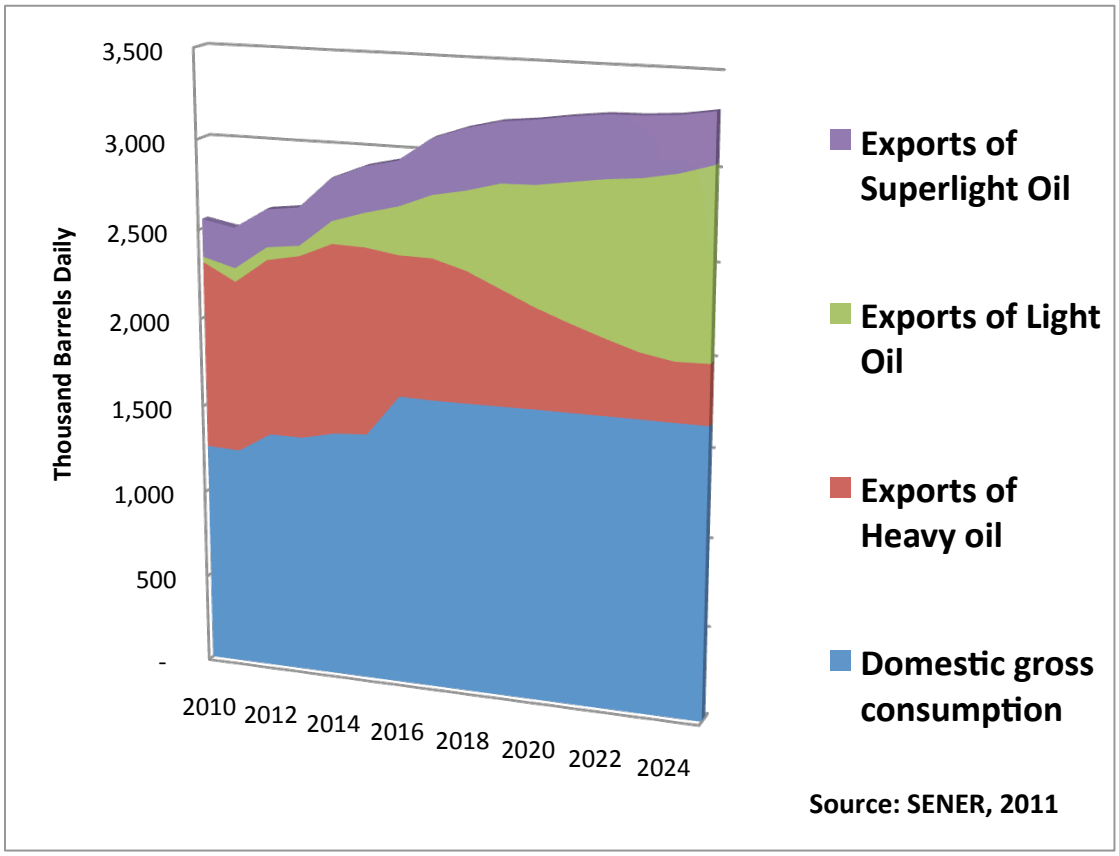
From 2006 to the end of 2009, the oil monopoly invested US$4.04 billion in what technically is called the Gulf of Mexico Tertiary Oil (GMTO). The company originally expected to produce an estimated 116,000 b/d by the end of 2009, but could only extract 29,000 b/d, just a quarter of what was anticipated (CNH 2010a). Costs for drilling and development have skyrocketed in just four years. While in 2006 the supply cost of one bbl coming from the GMTO was US$9, in 2009 it almost doubled to US$17 (CNH 2010, 7). The resources coming from this area have become the most expensive to extract among current operations in the country. The supply cost per bbl might be compared with the production and operational costs of extracting bitumen from tar sands in Canada, which in 2006 ranged from 14 to 24 Canadian dollars[12] (NEB 2006, 3). CNH claimed not to stop the project, but to radically revise it. In order to ensure the feasibility of the GMTO project, supply costs ought to be reduced to a range between 8.6-10.2 U.S. dollars per bbl (depending on the area of extraction), and the development and exploitation of those resources should be realized and administered as if they were nonconventional resources, where economies of scale, horizontal drillings, and a pool of private investors are needed.

At the turn of 2011, SENER released a new scenario to the year 2025, adjusting its previous estimations regarding the development of Chicontepec and the evolution of exports. Under this new scenario the production of crude oil is stabilized in the range of 2.5-2.7 million b/d from 2010 until 2013, that is, during the last years of the Calderón administration. Most of this production will be supported by currently producing fields located in the south and in shallow waters. Production from the GMTO will take more time to come on stream and will make a significant impact until 2022. However, overall domestic production will start to increase in 2014 until reaching a peak of 3.315 million b/d in year 2025 (SENER 2011, 153). A similar trend

[12] Supply costs from the two different basins are not comparable, since the Mexican figure was converted from an estimate made in 2009 pesos, while the Canadian figure was estimated in 2006 Canadian dollars. However, the comparison gives an idea on how expensive the exploitation of the Chicontepec fields have become.

will be followed by exports: They will reach a ceiling during the next three years—at current levels of 1.27-1.29 million b/d on average—and will regain growth in the following years to reach 1.6 million b/d in 2025. Export volumes will grow at an AAGR of 1.6% during the whole period. Figure 6 summarizes all of these trends.

Figure 6. Evolution of Domestic Demand and Crude Oil Exports by Type in Mexico, 2010-2025



In this new scenario, the domestic processing of crude oil reaches a ceiling (1.6 million b/d) in year 2016, once the new refinery of Tula comes on stream. The start of operations at the new refinery reduces crude exports in that same year, which otherwise would have increased along with overall production increases. It is important to highlight that the composition of exports is anticipated to radically change. They are currently dominated by heavy crudes (see Figure 5), but as long as new reserves are being developed, the export mix will be dominated by lighter crudes. The start of operations at the Tula refinery will not eliminate Mexico's need for imported fuels,

mainly gasoline. Though domestic demand of petroleum products will grow at an AAGR of 1.9% from 2010 to 2025, consumption of gasoline in the transport sector will grow at 3.0% AAGR during the same period. Imports of petroleum products will grow at a rate of 1.2% and at the end of the period will amount to 476,900 b/d of oil equivalent. In other words, net oil exports in year 2025 are estimated to amount to 1.267 million b/d, an amount equivalent to current gross exports (SENER 2010b, 176).

This new scenario remains, however, highly optimistic, since production and consequently export targets are to be reached if average annual investments are in the US$24 billion range from 2010 to 2025 (SENER 2010b, 125), that is, a figure that is above the historical record. Pemex optimism is grounded in a positive response from private firms willing to participate in the new cash-incentive contracts, and a scenario in which the price of oil in international markets remains above US$70/bbl.[13]

In addition to the 43.075 billion bbls of oil equivalent of total reserves that Pemex currently acknowledges (see footnote 6), the company estimates the amount of prospective reserves at 52.3 billion bbls of oil equivalent, out of which 56% are located in deep offshore waters of the Gulf of Mexico (500 meters and more below sea level), and 32% in the basins located in the Southeast—either offshore and onshore (SENER 2010a, 17). This has made Mexico's continental shelf a strategic region for present and future oil development. According to Pemex's most recent projections, gas production in deep waters will come on stream from the Lakach project in 2014; crude oil production from the project known as the Gulf of Mexico B, located in the continental shelf, north of Yucatan, is expected to come on stream in 2017 (SENER 2011,126).

Mexico has claimed the oil and gas resources located in the continental shelf beyond the 200 nautical miles of its exclusive economic zone. The country in 1978 signed an agreement with the United States to establish a maritime border in the Gulf of Mexico that recognized Mexico's exclusive economic zone. This border was recently recognized by the U.S. Congress, and deep

[13] Outside of PEMEX, observers and firms maintain a cautious skepticism about the evolution of Mexico's oil production, in spite of the reform (see *Petroleum Economist* [2009] and *Oil Daily* [2010]). $70/bbl was the price used by PEMEX in the scenario to maintain investments below $20 billion (Stratfor 2009). The new investment figures are most probably based on higher international markets.

offshore exploration and development has already started by private companies in the U.S. side of the Gulf. However, in 2000 Mexico signed another agreement with the United States to claim the resources located in the continental shelf beyond Mexico's exclusive economic zone. This agreement recognized for the first time the existence of energy cross-border fields in the redrawn maritime border between the two countries, and called for a moratorium for starting the exploitation of those fields.[14] The agreement thus postponed for 10 years any exploratory activities by companies in the so called western polygon of the maritime border. The moratorium was about to expire in 2011 but the two countries decided to extend it until 2014. However, there are other cross-border fields located to the east of the western polygon, in the so-called Perdido Fold Belt. In this area, not covered by the 2000 agreement, the Trident wells probably contain cross-border fields. This means that sooner or later Mexico will need to reach a shared production agreement with the companies exploiting those fields, unless the country definitively renounces the benefits from the resources located there.[15] However, investments in deep offshore Gulf of Mexico will be subjected more and more to environmental and safety regulations on both sides of the maritime border, especially after the 2010 British Petroleum oil spill.

IV. The Growth of Gas Imports

NAFTA has been the most important energy reform of the past 20 years in Mexico. Although the monopoly of Pemex over upstream and downstream operations remained intact, Chapter 6 of NAFTA, for the first time, continentalized the energy resources of the three signing countries of North America. Without making any significant change to the constitutional laws governing energy activities in the country, Mexico liberalized through NAFTA foreign trade in gas and electricity, and opened to private investment the construction of pipelines and storage facilities for domestic distribution and transportation of natural gas. NAFTA also recognized a new category of private suppliers of power (other than the then-duopoly held by state power companies, Compañía Federal de Electricidad [CFE] and the now-defunct Luz y Fuerza del Centro [LFC]). NAFTA also completed the protracted process of privatizing Mexico's

[14] For the agreement, see INEGI (2010).
[15] According to the last SENER scenario, production from the Perdido Fold Belt will come on stream from 2017. In year 2025, it is anticipated that 784,000 b/d will come from deep water production (SENER 2011, 131).

petrochemical industry, which began in the mid-1980s, maintaining Pemex's monopoly only on basic feedstocks.[16]

The impact of NAFTA on Mexico's oil and gas sectors has been witnessed at the regulatory level rather than in the production fields. NAFTA unveiled the taboo of the participation of private firms in the sector and paved the way to a growing continentalization of energy markets in North America. Since there were no major tariff and nontariff barriers pending on cross-border energy trade between Mexico and the United States prior to NAFTA, bilateral oil and gas trade followed market trends and fed Mexico's addiction to oil revenues from exports, as depicted in previous figures.

Currently, Mexico's proved reserves of natural gas amount to 16.8 trillion cu ft, equivalent to just eight years of production. However, if we add probable and possible reserves to the first figure, the overall figure amounts to 61.2 trillion cu ft (Pemex 2010a). However, 64% of proved gas reserves and 72% of overall reserves are associated with oil, which means that oil production will significantly affect gas production. This has traditionally been a handicap for efficiently recovering gas from associated fields. Since Pemex does not have enough pipelines to effectively transport gas to final users, the company has traditionally vented or flamed the product. In 2009, Pemex burned almost 20% of its overall gas production (SENER 2009a, 97).

During the Fox administration the participation of private investors was crucial for the development of the Burgos Basin, one of the few areas where natural gas is not associated with oil. This gas reservoir, located in northern Mexico, became the target of Fox's energy policies in order to curb growing imports of natural gas for that particular region, which has traditionally imported a marginal amount of this fuel from Texas due to its poor interconnection with Mexico's southern fields. While Mexico exported marginal amounts of gas in the early 1980s, at the turn of the 1990s it started to import growing volumes of this fuel.

[16] For an account of the impact of NAFTA on Mexico's energy sector, see Morales (2011), a study that is part of the major research project on Mexico's oil sector.

In the 1990s, when the country shifted to gas as a substitute for fuel oil to produce electricity, demand for natural gas increased dramatically, increasing imports to 18.2% of current overall supply. So far, natural gas has accounted for 59.3% of electrical power produced by public utilities and 73.3% produced by private firms. Growing imports are perceived in the country as a failure of the state monopoly to ensure energy self-sufficiency and a means for injecting higher international prices into the Mexican economy.

Natural gas imports come either by pipeline from the United States or by ship tanks as liquified natural gas (LNG). So far, most imports come from the United States by pipeline via several border interconnection points that flourished when NAFTA liberalized cross-border trade and allowed private utilities to build transmission lines. The bulk of imports are concentrated in major border cities, such as the urban areas of Tijuana and Mexicali, in Baja California, Ciudad Juárez, and Reynosa. Imports are mainly handled by Pemex and CFE and only minor amounts are carried by private utilities. LNG imports currently pass through two regasification plants, one located in Altamira, Tamaulipas, in the Gulf of Mexico; the second plant, which came on stream in 2008, is located in Ensenada, Baja California. Table 1 of the Annex clearly depicts the evolution of imports during the past 10 years as well as the different points of entry.

The pressure of mounting imports prompted the Fox administration to accelerate the development of the Burgos Basin since, as stated earlier, this reservoir contains nonassociated gas and its production could easily supply additional gas to the Nuevo León region. Under the Fox administration, Pemex invited bids for what were called multiple service contracts (MSCs) for developing Burgos. MSCs continued the Pemex tradition of outsourcing specific services the company could not develop. However, the difference this time was that MSCs encompassed several services assigned to just a few companies that would help develop Burgos in 15 to 20 years. These are long-term clustered contracts. As in the past, the contracts did not allow for any share or participation in Mexico's gas reserves or production. A fixed amount was paid for the services provided by companies on a yearly basis, regardless of the output from the gas fields they developed.

MSCs were criticized, however, for several reasons. They never attracted any of the major oil and gas companies, perhaps because they were not allowed to possess a share of gas reserves. Since a fixed amount was paid to service contractors, the development of some fields could have been more expensive than anticipated if productivity was not high. A major criticism also came from opposition parties, which argued that MSCs breached the Mexican Constitution, since Pemex had let private companies drill for gas and help maintain exploration and production activities—domains which are, in principle, reserved for the oil and gas state monopoly. The fact that MSCs remained controversial in Mexico further discouraged potential investors in the Burgos Basin, and heated the debate regarding the need to change the status quo in the country's energy sector.

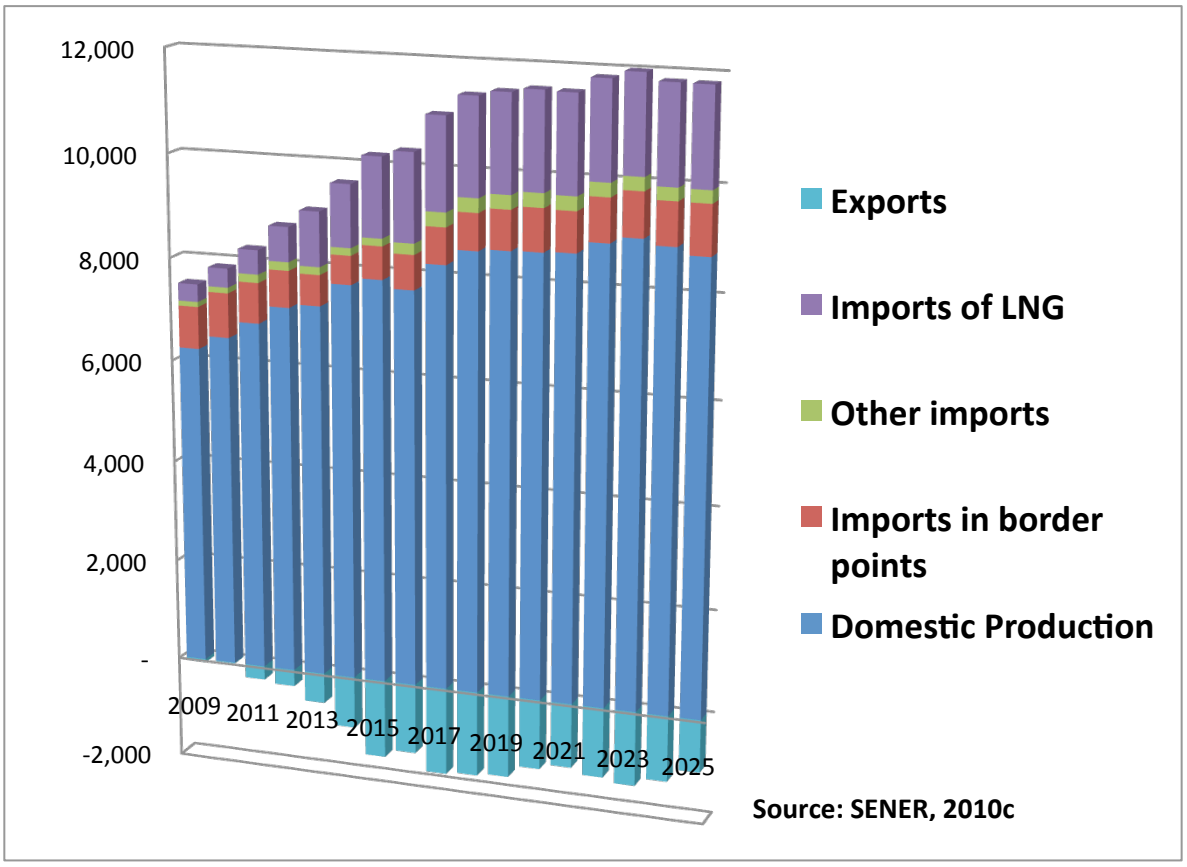
With the enactment of new energy bills during the Calderón administration, the possibility of signing incentive-based contracts with private companies in theory should have allowed further development of natural gas reserves and production. Incentives—which at the end of the day translate to more money for private companies—could in theory be linked to the efficiency and accuracy of companies providing services, or to the recovery of reserves or the amount of reserves added to Pemex's stock. Though the latter possibility was challenged by Mexico's Congress before the Supreme Court of Justice, on December 2, 2010 this judicial body affirmed that financial incentives linked to the addition and/or recovery of hydrocarbon reserves do not breach any constitutional rule (Fuentes 2010). In the next six months, Pemex anticipates inviting bids in an effort to enhance oil recovery in three mature fields under the formula of incentive-based contracts (Hernández 2010).

As for future trends in Mexico's natural gas industry, the Ministry of Energy's most recent scenarios offer two possibilities: 1) low growth and 2) high growth demand with a constant evolution in domestic supply from 2010 to 2025. The AAGR in the "low demand" scenario is 2.3%, while domestic production is estimated to grow at an AAGR of 2.1%. Consequently, gross imports are anticipated to grow at an AAGR of 5.7%. At the end of the period (2025), imports will amount to 26% of overall gas supply. This share remains the same if domestic demand grows at an AAGR of 2.6 %, which is the estimation under the second scenario (SENER 2010c, 171-72). The driving forces of demand growth will be Pemex itself and power generation, either

by CFE or independent producers. Consequently, demand behavior will be sensitive to policies undertaken to reinforce energy savings and efficiency in the overall energy sector.

As for imports, the "planning scenario" (a merger of the two scenarios already depicted) anticipates that the bulk of imports will come from LNG. In year 2025, 61% of overall imports will come from overseas, and not by pipeline from the United States (SENER 2010c, 165). In 2011, an additional regasification plant is expected to come on stream in Manzanillo, located in west Pacific Mexico. The Ministry of Energy anticipates a temporal growth in gross exports, though they will be the by-product of re-exports when importing LNG. The bulk of imports will be regasified at the Ensenada plant, with the goal of re-exporting eventual surpluses to the California market, which until now has refused to build—for environmental reasons—regasification plants in the state. It is important to highlight that Pemex's new regasification plants, in Ensenada and Manzanillo, were built with the supposition that imports of LNG will also increase in the United States, where eight regasification plants are located along the Gulf of Mexico and East coasts. Figure 7 depicts the evolution of domestic production, imports, and exports according to the "planning scenario."

Figure 7. Evolution of Pemex Natural Gas Production, Imports and Exports, 2009-2025 (in million cu ft per day)



However, the current success in the development of shale gas in the United States might change those trends and increase gas exports to Mexico via pipeline. The most recent forecast released by the U.S. Department of Energy (DOE) has more than doubled the estimate of recoverable shale gas reserves in the years to come, from 347 trillion cu ft estimated in a previous outlook, to 827 trillion cu ft anticipated in the most recent outlook (EIA 2011, 8). This will move prices downward, increase domestic supply for the power sector, abate net imports (from 11% of overall net imports in 2009 to 1% in 2035), and increase exports. Currently, some companies are requesting permits from DOE in order to adapt an LNG import site to one that can liquefy exports (Gordon 2010). The fact that one of the most promising shale gas plays is located in southern Texas (Eagleford) lets one suppose that anticipated imports of LNG coming into Mexico could be substituted by cheaper shale gas produced at the border. Though Mexican LNG terminals could be adapted as bidirectional plants (to liquefy for exports and to gasify for

imports), the impact of shale gas surpluses from the United States is currently difficult to assess, since China is already investing in the Eagleford area in order to ensure anticipated growing imports of this fuel (Foster 2010 and Hartke 2010).

Last but not least, there are other externalities affecting the investment climate in both the gas and oil industries, apart from those linked to environmental concerns. Drug dealers and organized crime have already negatively impacted these industries. Abduction of oil workers in the Burgos basin has already been reported by the press. Workers have become hostages of kidnappers who demand money that will fund the activities of drug barons operating under rivalry and pressure (Watkins 2010, 31). If the federal government is unable to curb the activities of these organizations in such a key area, most probably private investors will be discouraged from participating as partners of Pemex, regardless of the incentives they might have in their contracts. Illegal and clandestine seizures of oil and gas have also been reported by Pemex and the Ministry of Defense. While in 2005 Pemex reported 136 illegal pipeline taps, in 2010 the figure grew to 668. Eighty percent of the illegal pipeline taps are located in the states of Veracruz, Estado de México, Nuevo León, Sinaloa, and Tamaulipas, territories dominated by organized crime organizations and drug barons (Jiménez 2011; Soto 2011). Illegal seizures include both crude oil and petroleum products that are sold at clandestine sites or through official outlets via a network of corrupt Pemex employees and retailers (Herrera 2011). Black markets for fuel are not only scattered around the country—illegal sales have also been reported in Guatemala and the United States (Watkins 2010, 31; Jiménez 2011). Oil theft represents around US$2.3 billion in annual losses to Pemex (*El Universal*, August 2, 2010), and in December 2010 provoked a major explosion just 60 kilometers east of Mexico City, killing 29 people (Alfaro 2010). If the U.S. and Mexican governments fail to cooperate in order to keep the illegal activities of organized crime at bay, pipelines and other critical infrastructure will remain vulnerable targets to be exploited by criminal organizations (Morales 2011).

V. The Present and Future of Electricity Generation and Interconnections

Mexico is more addicted to hydrocarbons in power generation compared to its North American partners. Fuel oil and gas are currently used to produce 70% of the electricity generation in the

country, while this share is just 8% for Canada and 23% for the United States. The energy mix is much more balanced in the latter countries, though 50% of electricity in the United States is generated by coal, and almost 60 percent of electricity in Canada is generated by hydro. The natural resources used to produce electricity in Mexico, the United States, and Canada are shown in Figure 8.

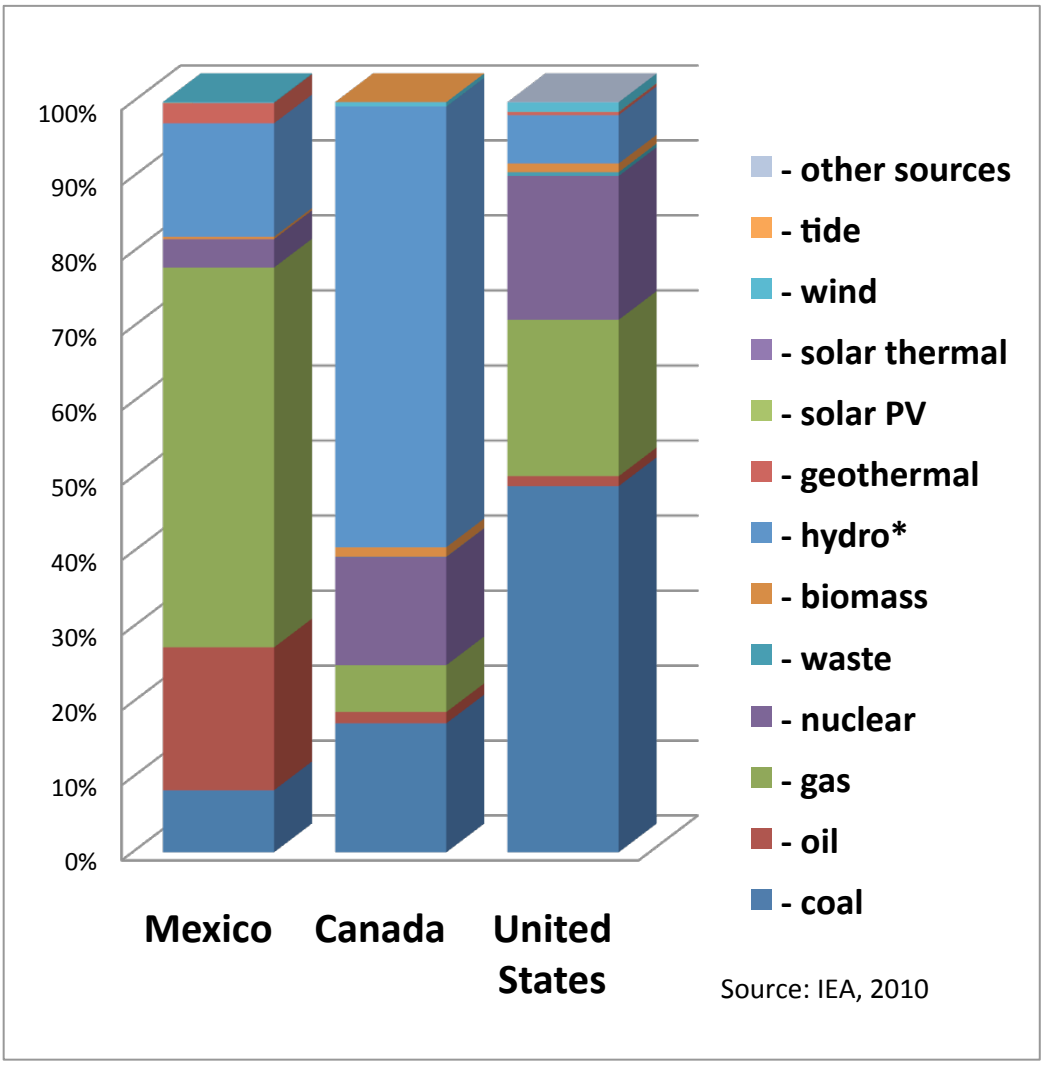
The use of nuclear energy is higher in the United States and Canada than in Mexico, but in all three countries, the increased use of renewable fuels—with the exception of hydroelectricity—is about to begin.

Similar to the impact on natural gas, the negotiation and inception of NAFTA unleashed major regulatory reforms in Mexico's power sector. Domestic legislation was modified to make the distinction between power generation as a public service and electricity production undertaken by private firms and utilities. The first category was reserved for the two state monopolies, CFE and LFC, though the latter was liquidated in 2009. Electricity produced by private firms were classified in the following categories: self-supply, cogeneration, small producers (up to 30 megawatts [mw] of capacity), independent producers (above 30 mw of capacity), and export and import utilities. As of 2009, the total capacity of Mexico's electricity system is 60,440 mw, out of which 66.6% is in the hands of CFE (including 2% that was under the control of LFC); 6.9% is under control of self-supply firms; 4.6% is for cogeneration; and 19.0% is under control of independent producers. Export utilities have 2.2% of overall capacity (SENER 2010d, 102). As these figures show, NAFTA deregulation in this sector made possible what succeeding energy reforms could not accomplish in the oil and gas industries: open upstream activities to the participation of private utilities. Nonetheless, the transmission grid remains in hands of CFE, so all types of private producers must obtain production permits from a state regulator, the Energy Regulatory Commission (CRE in Spanish), and sign transmission contracts with CFE. Most of these permits have been granted to independent producers.

Similar to the situation with natural gas cross-border commerce, electricity trade between Mexico and the United States is highly interconnected along nine exports points. Four of them are located in Baja California and Chihuahua, and are interconnected with the U.S. Western

Electricity Coordinating Council (WECC); five are located in Tamaulipas and Piedras Negras (Chihuahua) and interconnected with the Electric Reliability Council of Texas (ERCT). The main purpose of the interconnections is clear: To reliably supply power on both sides of the border during an emergency. Technical barriers aside, the electricity trade between the two nations has remained marginal and is expected to remain so in the years to come—unless more clear incentives are provided to private producers to explore the potential of renewable resources (wind and geothermal) in the Baja California region. State control of electricity and fuel prices, and the prevalence of pervasive subsidies in almost all ranges of fuels provided by the State play against investment returns for private producers.

Figure 8. Electricity Generation by Fuel in North America, 2008



So far, Mexico has remained a net exporter of electricity to the United States, and 79% of overall exports come from the Baja California interconnections. In the years to come, exports are expected to grow in this region, since in 2009 CFE signed an agreement with Los Angeles authorities to export up to 100 mw of electricity from geothermal sources located in Mexicali (SENER 2009c; SENER 2010d, 101). Table 2 of the Annex clearly depicts the evolution of foreign trade in electricity between the two countries during the past 10 years.

Mexico's Ministry of Energy expects electricity consumption to increase on a historical basis, that is, at rates above gross domestic product (GDP) growth, which means there is plenty of room to improve savings and efficiency. Estimating a GDP AARG of 3.5% to 2025, the ministry estimates electricity consumption to grow at 4.3% annually (SENER 2010d, 126). This means that overall net capacity must be increased by 48% from the present to 2025. Future investments are needed in this sector in order to increase capacity and power supply in the years to come. It is anticipated that approximately US$6.486 billion must be invested annually if the scheduled target is to be achieved (SENER 2010d, 148 and 183). A large portion of these investments is scheduled to come from private utilities, suggesting that most of the attractive opportunities for private businesses are in this sector. However, as long as prices of electricity and fuels, such as natural gas, remain nontransparent and under the control of state monopolies and the Ministry of the Treasury, the prevalence of noncompetitive energy markets will remain a deterrent as private utilities plan future investments.

VI. Conclusion

In 2011, Pemex anticipates investing US$22.9 billion, which is 9% higher than the amount invested in 2010. Eighty-four percent of this investment will go to upstream exploration and development of fields. In spite of the rush to attract new money, crude oil production in 2010 has been reported to be the same as in 2009. Thus, Calderón's administration is absolutely right to frame current Mexico's energy situation as a security issue. Production and reserves need to be increased in order to guarantee domestic supply and to access much needed export income for funding all types of government expenditures. So far, only two factors favor the government's

goal: oil prices in the international market and reforms that affirm the constitutionality of financial incentives for private firms under contract to Pemex.

Only the second factor is the product of a policy decision to redress the current energy conundrum, since the first one is linked to international variables and decisions, and is out of the hands of Mexican policymakers. Since Pemex is a price follower and not a price setter in the international market, any major decline in oil prices, regardless how temporary, will negatively affect its performance. Will the company successfully attract the much- needed funds to reverse the decline in reserves and production?

The answer is elusive. Setting aside the short- to mid-term evolution of oil prices, the major challenge that will confront the company in the remaining years of the current presidential administration is how, on the one hand, to redress the technological and organizational quandaries negatively affecting oil recovery and production in the Chicontepec fields and on the other hand, how to insulate the evolution of the overall energy sector from the mounting activities of organized crime. The closer President Calderón is to the end of his administration, the weaker will he be as he addresses those two major quandaries. Thus, in the years to come, Mexico's energy sector will remain vulnerable to price fluctuations in international markets, to the unpredictable evolution of oil production in the Chicontepec fields, and to the mounting uncertainties unleashed by drug barons in Mexico, mainly in the northern region where nonassociated gas is being extracted. This explains why, for both the United States and Mexico, it is necessary to work out a formula of "shared-governance" and cooperation to insulate, if not resolve, the mutual concerns of the two countries regarding security at the border (violence and drug trafficking for the United States and arms trafficking and drug consumption in the United States for Mexico). Fortunately, Washington has already realized that Mexico's security is linked to U.S. security—a shared concern it calls "intermestic." The recognition of this interdependence either on the origin and outcome of illegal activities of organized crime is crucial in order to build up a new architecture of bilateral cooperation between the two countries.

Those are the major factors that currently shape, and that will continue to shape, the investment climate in Mexico's energy sector. Consequently, an optimistic scenario for the last two years of

the Calderón administration is to maintain the status quo and avert any rapid decline in production and reserves. However, for the mid- and long-term, the status quo is unsustainable. This is so because President Calderón's energy security approach narrowly focuses on the return of oil production to historically high levels, and does not address policy changes and incentives necessary to stimulate the development of nonconventional and renewable fuels. So far, either international prices remain high or go higher (as is currently the case, but due to geopolitical reasons) in order to bring much needed income to Mexico in spite of the decline of its oil production, or the current situation evolves into a major crisis, this time affecting macroeconomic variables (as in the mid-1970s), prompting the country to enact major energy and fiscal reforms that impact the long-term evolution of its natural resources.

Annex 1: Natural Gas Foreign Trade by Interconnection Points

Millions of cubic feet per day												
Interconnecting Points in Mexico	**Importers**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Total Imports		**168**	**281**	**380**	**729**	**996**	**1,124**	**905**	**1,018**	**1,104**	**1,336**	**1,258**
1. Tijuana, B.C.	Electricity public sector (1)	-	26	57	58	-	-	-	-	-	-	-
2. Mexicali, B.C.	Private	11	11	6	10	8	11	11	14	14	15	16
3. Los Algodones, B.C.		-	-	-	33	172	216	237	268	252	278	257
	PGPB (*)	-	-	-	4	21	12	7	14	10	12	10
	Electricity public sector (1)	-	-	-	28	99	115	113	119	119	119	110
	Private	-	-	-	-	52	89	117	135	123	147	136
4. Nogales, Son.	Private	-	-	-	-	-	-	-	-	0	0	1
5. Naco, Son.		7	15	25	43	51	36	37	63	59	74	69
	PGPB (*)	7	15	16	18	19	10	9	31	34	38	32
	Electricity public sector (1)	-	-	10	24	32	26	28	32	25	35	37
6. Naco, Son.	Electricity public sector (1)	-	-	-	-	14	38	38	36	37	40	38
7. Agua Prieta, Son.	Private	6	8	9	11	9	10	10	10	11	10	9
8. Ciudad Juárez, Chih. 2		132	141	124	178	186	201	191	210	236	247	259

Millions of cubic feet per day												
Interconnecting Points in Mexico	**Importers**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
	PGPB (*)	132	141	124	178	167	170	170	184	207	211	225
	Electricity public sector (1)	-	-	-	-	19	31	21	25	30	35	34
9. Ciudad Acuña, Coah.	Private	-	-	-	-	-	-	-	-	1	1	1
10. Piedras Negras, Coah.		7	5	6	6	6	7	6	6	6	5	4
	PGPB (*)	1	-	-	-	-	-	-	-	-	-	-
	Private	5	5	6	6	6	7	6	6	6	5	4
11. Ciudad Mier, Tamps.	PGPB (*)	-	-	-	-	170	172	102	56	62	68	55
12. Argüelles (Gulf Terra), Tamps.	PGPB (*)	-	2	-	13	8	2	-	-	-	-	-
13. Argüelles (Kinder Morgan), Tamps.		-	13	116	206	179	167	72	49	22	98	41
	PGPB (*)	-	13	116	206	179	167	72	49	12	46	29

Millions of cubic feet per day												
Interconnecting Points in Mexico	**Importers**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
	Private	-	-	-	-	-	-	-	-	10	52	12
14. Reynosa (Tetco), Tamps.	PGPB (*)	5	1	4	39	15	2	-	-	-	-	0
15. Reynosa (Tennessee Gas, PMX), Tamps.	PGPB (*)	1	60	33	133	155	172	75	62	4	14	14
16. Reynosa (Tennessee Gas, RB), Tamps.		-	-	-	-	23	92	125	165	149	132	154
	PGPB (*)	-	-	-	-	23	59	45	54	57	62	57
	Electricity public sector (1)	-	-	-	-	-	33	80	111	92	70	97
Imports by gas terminals		**168**	**281**	**380**	**729**	**996**	**1,124**	**905**	**940**	**854**	**980**	**917**
15. Terminal of LNG Altamira, Tamps.	Private	-	-	-	-	-	-	-	79	250	331	334
16. Terminal of L NG Ensenada, B.C.	Private	-	-	-	-	-	-	-	-	-	25	7
Imports of GNL		-	-	-	-	-	-	-	79	250	356	341
Total Exports		**136**	**24**	**25**	**4**	**-**	**-**	**24**	**33**	**139**	**107**	**67**
1. Reynosa (SNG-PGPB)	PGPB (*)	136	24	25	4	-	-	24	33	139	107	67

[1] It includes Comisión Federal de Electricidad and Independent Powwe Production.

[2] It includes imports of San Agustín Valdivia and Ciudad Juárez.

(*)Pemex Gas y Petroquímica Básica

Source: IMP with data collected from CFE, PGPB, Gas del Litoral and other private utilities. Quoted in SENER 2010a, and Prospectiva del mercado de gas natural 2010-2025, México, D.F. page: 127.

Annex 2: Mexican Exports and Imports of Electricity, 1999-2009. Gwh

State	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Exports											
Chiapas[1]	-	-	-	-	-	-	1	2	2	3	22
Baja California[2]	31	66	112	164	765	770	1,037	1,072	1,211	1,197	984
Tamaulipas[3]	-	2	1	-	-	-	-	16	13	4	27
Quintana Roo[4]	100	127	158	180	188	236	253	209	225	248	216
Total	**131**	**195**	**271**	**344**	**953**	**1,006**	**1,291**	**1,299**	**1,451**	**1,452**	**1,249**
Imports											
Baja California[2]	646	927	82	311	45	39	75	514	266	340	280
Sonora[5]	4	4	4	5	5	6	6	6	6	6	6
Chihuahua[6]	7	129	235	189	21	2	6	3	3	3	3
Tamaulipas	2	9	6	26	-	-	-	1	3	3	57
Total	**659**	**1,069**	**327**	**531**	**71**	**47**	**87**	**523**	**277**	**351**	**346**
Net balance Exports-imports	-528	-874	-56	-187	882	959	1,204	776	1,174	1,102	904

[1] Guatemala

[2] San Diego Gas & Electric, Arizona Public Service, Imperial Irrrigation District, Sempra Energy Trading y CAISO (USA).

[3] American Electric Power (AEP) y Sharyland Utilities (SU) (USA).

[4] Belize Electricity Limited

[5] Trico Electric Cooperative Inc. y Unisource Energy Services (USA).

[6] Rio Grande Electric Cooperative Inc. y American Electric Power (USA)

Source: Comisión Federal de Electricidad. Quoted in SENER 2010d: 101.

References

Alfaro, Dora. 2010. "Afirman que explosión fue por ordeñar ductos." *Reforma*, December 23.

Comisión Nacional de Hidrocarburos. 2010. *Proyecto Aceite Terciario del Golfo. Primera revisión y recomendaciones.* México, D.F., Secretaría de Energía, April. www.cnh.gob.mx/ (accessed on August 30th, 2010).

————. 2010. "Seguimiento del Proyecto Aceite Terciario del Golfo." http://www.cnh.gob.mx.

Energy Information Administration. 2011. *Annual Energy Outlook 2011. Early Release Review*. U.S. Department of Energy: Washington D.C.

Foster, Christine. 2010. "China focuses on CBM, shale." *Platts International Gas Report,* October 25.

Fuentes, Víctor. 2010. "Avala la Suprema Corte contratos incentivados." *Reform*a, December 3.

Gordon, Meghan. 2010. "Cheniere asks DOE to allow LNG exports from La." *Gas Daily*, August 20.

Hartke, Samantha. 2010. "China, Norway firms to invest billions in Eagleford." *Gas Daily*, October 12.

Hernández, Alama. 2010. "Aprueba Pemex nuevos contratos." *Reforma*, November 25.

Herrera, Rolando. 2011."Revelan colusión en ordeña a Pemex." *Reforma*, January 16.

International Energy Agency. 2010, 2007. *Energy balances*. Paris: OCDE. http://www.iea.org/.

Instituto Nacional de Estadística y Geografía (INEGI). 2010. *DECRETO Promulgatorio del Tratado entre el Gobierno de los Estados Unidos Mexicanos y el Gobierno de los Estados Unidos de América sobre la Delimitación de la Plataforma Continental en la Región Occidental del Golfo de México más allá de las 200 Millas Náuticas, firmado en la ciudad de Washington, D.C., el nueve de junio de dos mil.* http://www.inegi.org.mx/.

Jiménez, Benito. 2011. "Detecta Sedena red de 'ordeña.'" *Reforma*, January 10.

Mares, David. 2010. "Resource Nationalism and Energy Security in Latin America: Implications for Global Oil Supplies." Working paper, James A. Baker III Institute for Public Policy, Rice University, Houston, Texas.

Morales, Isidro. 2011. "The Energy Factor in Mexico-U.S. Relations." Working paper, James A. Baker III Institute for Public Policy, Rice University, Houston, Texas.

National Energy Board. 2006. *Canada's Oil Sands: Opportunities and Challenges to 2015*. *An Update.* Calgary, AB: Government of Canada.

Oil Daily. 2010. "Economist Says Crude Could Hit $200 by 2012." November 18.

Pemex. 2010a. "Reservas de hidrocarburos al 1 de enero de 2010." March 19. http://www.pemex.com.

————. 2010b. *Anuario Estadístico 2009.*

————. 2009. "Las reservas de hidrocarburos en México." http://www.pemex.com (accessed on April, 21st, 2010).

————. 2000. *Anuario Estadístico 1999*.

Petroleum Economist. 2009. "Mexican energy reforms a start, but not enough to halt a declining output." March.

Secretaría de Energía (SENER). 2011. Prospectiva del mercado de petróleo crudo, 2010-2025." http://www.energia.gob.mx/.

————. 2010a. "Estrategia Nacional de Energía." February. http://www.energia.gob.mx/.

————. 2010b. "Prospectiva de petrolíferos, 2010-2025." http://www.energia.gob.mx/.

————. 2010c. "Prospectiva del mercado de gas natural 2010-2025. " http://www.energia.gob.mx/.

————. 2010d. "Prospectiva del sector eléctrico, 2010-202." http://www.energia.gob.mx/.

————. 2009a. "Prospectiva del mercado de gas natural 2009-2024." http://www.energia.gob.mx/.

————. 2009b. "Balance nacional de energía, 2008." http:// www.energia.gob.mx/.

————. 2009c. "Prospectiva del sector eléctrico, 2009-2024." http:// www.energia.gob.mx/.

————. 2008a. "Diagnóstico: Situación de Pemex." http:// www.energia.gob.mx/.

————. 2008b. "Prospectiva del mercado de petróleo crudo, 2008-2017." http://www.energia.gob.mx/.

————. 2008c. "Iniciativas de Reforma Energética. La renta petrolera." http://www.energia.gob.mx/.

————. 2007. "Prospectiva del mercado de petróleo crudo, 2007-2016." http://www.energia.gob.mx/.

Sordo, Ana María and Carlos Roberto López. 1988. *Exploración, reservas y producción de petróleo en México, 1970-1985*. México, D.F.: El Colegio de México.

Soto, Gonzalo. 2011. "Detecta Pemex otras 2 tomas clandestinas." *Reforma*, January 4.

Stratfor. 2009. "Mexico: Pemex Needs Oil Prices Above $70 A Barrel–Energy Minister." www.stratfor.com.

Watkins, Eric. 2010. "Drug cartels hit Pemex." *Oil and Gas Journal*, June 21.