

Paper #1-12

MEXICO OIL & GAS SUPPLY

Prepared for the
Resource & Supply Task Group

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

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

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

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

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Working Document of the NPC North American Resource Development Study

Made Available September 15, 2011

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Made Available September 15, 2011

National Petroleum Council
North American Resource Development Study

White Paper: Mexico oil and gas production and policy

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INTRODUCTION

Mexico has been a long term supplier of oil to the United States and partner in natural gas trade. Significant two-way trade in oil and gas occurs along the southern border of the US. At times, Mexico was the biggest exporter of crude into the United States. Recent trends in Mexico's oil and gas sector, both on the supply and demand side, indicated that the dynamic between the US and Mexico will be quite different than was historically the case. Increasing demand for natural gas in Mexico, particularly in the electricity sector, is likely to encourage Mexico to import more natural gas for the US and elsewhere. The decreasing production of oil in Mexico will likely restrict Mexico's ability to export oil to the United States in the medium to long term. Additionally, the call on crude products in Mexico will further cut into Mexico's potential exports to the US. Similarly, growing Mexico natural gas demand coupled with slowing growth in Mexico gas production could lead to sustained increases in Mexico's need to import natural gas, with the US clearly well-placed to supply a significant portion of this gas. These market dynamics will take place in a context where the Mexican government will be assessing its framework for hydrocarbons production, which has historically limited foreign investment.

The Structure of Mexico's Hydrocarbons Sector

The Constitution Forbids Private Investment in the Hydrocarbons Sector

Mexico has a highly closed hydrocarbons sector. The nation's constitution forbids any type of private ownership of Mexican hydrocarbons. State oil company Petroleos Mexicanos or Pemex is thus given the sole right to undertake both upstream (exploration and production, or E&P) and downstream (distribution, transport, and refining) activities.

Non-Pemex participation in upstream and downstream oil and natural gas activities is limited to flat fee service contracts undertaken for Pemex. Flat fee contracts remove the link between the amount of hydrocarbons found or produced and the earnings of service provider companies who might be involved in this process. This is designed to remove any semblance of non-governmental "ownership" or privatization of Mexican hydrocarbons. More recently, the Mexican government has begun a gradual shift toward more performance-based incentives in oil and gas service contracts, although without changing the fundamental principle of national hydrocarbon ownership.

Some Consequences of Mexico's Closed Energy Sector

The state's monopoly over its hydrocarbons sector means that it, through Pemex, controls all current and potential hydrocarbons reserves in national territory. This

gives Pemex a privileged position in the nation's oil sector. However, state control has led to two negative outcomes for Pemex. First, it has politicized Pemex internal decision-making. Second, it has undermined company efficiency, technological capacity, and competitiveness. These factors have impeded Pemex's ability to respond to the decline of production at the Cantarell field and shift to more technology-intensive operations such as deepwater and redevelopment of mature fields. Pemex leadership are political appointees who respond to the president and congress. Pemex's annual budget must be approved by the lower chamber of congress each year as a part of the annual budget negotiations. While Pemex now enjoys some budgetary autonomy from the government and can allocate resources across projects as it sees fit, this has only been a recent development as a result of the 2008 Energy Reform.

Given the government's fiscal reliance on oil, both the government as well as the nation's legislators historically have tended to take a short-term, production-oriented view toward Pemex's annual budgetary needs, something that affected the allocation of revenues across projects within Pemex as well. The government relies on Pemex for between 35% and 40% of its annual revenues, depending on the year. Exploration investments would only pay off in the medium to long term, while production investments could pay off now and allow the government and politicians to increase budgetary expenditures.

This dynamic is seen in annual capital expenditure allocations. Pemex's capital expenditure budget remained quite low until only recently, once it became clear to the government that production was going to go into swift decline after 2004. Most of this original increase in capital investment appears to have gone to near-term production activities to help maintain oil output levels (and thus governmental revenues). The resources within the capital expenditure budget allocated to exploration only began to climb after oil production losses became evident despite receiving most of the additional capital..

Graphic: Capital Expenditures

Graphic: CAPEX E&P 1

Graphic: CAPEX E&P 2

Graphic: CAPEX E&P 3

Oil revenues have allowed the government to keep non-oil tax rates in the economy relatively low, while heavily taxing Pemex at rates that have forced the company to indebt itself to cover capital investment costs. However, because Pemex is state owned its debt is equivalent to Mexican governmental debt, reducing the risk to bondholders and making Pemex bonds attractive investments. This has enabled Pemex to become one of the most if not the most indebted oil company in the world,

(Agree that this should be verified) with few limitations on this indebtedness. The company's debt topped \$48 billion in 2009.

State ownership of PEMEX allows the company, like other national oil companies, to pursue investments over longer time horizons with a higher risk profile than would probably be acceptable to many private operators. PEMEX's commitment to increase capital allocations to the Chicontepec project are a case in point. The 2009 budget outlined an investment of \$2.2 billion in this region, up from an average of about \$280 million per year between 2004 and 2007, with Energy Secretary Georgina Kessel repeatedly stating that Chicontepec would continue to receive significant resources in the years after.

However, after years of investing considerable and rising resources in this area but with production hovering around 30,000 bpd, the government and Pemex finally began to reduce its expenditures in this region in 2010. Even then, however, expenditures reached about \$1.5 billion that year.

As a public entity, Pemex has also had to follow detailed and arduous public sector processes for soliciting service contract tenders, acquisitions, and hiring, reducing the capacity of the company to respond to new information in a nimble way. And, the company has increasingly relied on service contract providers to undertake production and exploration, reducing its engineering staff considerably in the process. This has reduced the company's technological expertise, forcing it increasingly to rely on third party analysis rather than in-house experts. The company is also notorious for being overstaffed compared to other state owned oil companies.

The Debate

In a context of falling oil production, reform to the nation's energy sector is seen as necessary by most domestic political and economic actors. However, not all agree on the precise nature of the reforms needed.

At one end of the spectrum, , would be a reform centered on broadly opening the sector to private investment and fully or partially privatizing Pemex in an effort to change the company's behavior (and ties to the state).

A second approach would be to further open the sector to private investment but keep Pemex 100% state owned. A key question under this scenario concerns whether Pemex would be able to purchase the most recent technology on the market from companies who use this technology to retain market edge.

At the other end of the spectrum would be an effort to restructure Pemex to make it more efficient. Proponents of this approach also understand that Pemex lacks adequate technology to address declining production, but argue that the company merely needs financing to purchase it. Better efficiency and technology would then help the company ramp up oil exploration and production.

A centrist approach between these policy positions, such as partial privatization of Pemex or partial liberalization of the sector faces challenges. Opponents of privatization view partial privatization is akin to full privatization and partial opening to complete opening under the current constitution.

Any partial privatization or opening requires the same legislative procedure: a constitutional reform requiring 2/3 support in both chambers of congress and support of 16 out of 31 state legislatures. The policy line or cleavage thus tends to fall between those that want to keep the sector intact and those that want any type of opening.

Generally speaking, the left-leaning Democratic Revolution Party (PRD) opposes energy sector liberalization. The market-friendly National Action Party (PAN) supports liberalization. The Institutional Revolutionary Party (PRI) is divided internally between left-leaning, centrist, and right-leaning members, and is thus highly divided internally on the matter. The PRD and PRI have thus tended to move against any significant energy sector reform efforts, thereby derailing them.

Prior attempts at Energy Sector Reform

The difficulty of undertaking energy sector reform does not mean that no one has tried. President Carlos Salinas de Gortari (1988 – 1994) of the PRI took steps to prepare Pemex for privatization when the government reorganized it into four subsidiaries in 1992. Although Pemex was restructured at this time, privatization was not achieved. The political difficulty of constitutional reform stalled it.

Similarly, upon taking office in December 2000, President Vicente Fox (1994 – 2000) of the PAN expressed interest in opening the hydrocarbons sector to foreign investment but without privatizing Pemex. The government's objective was derailed when no preliminary support could not be built for such measures and no reforms were introduced to congress. However, evidence of Pemex's growing indebtedness gained some traction and in 2005 Congress (?) approved a fiscal reform to reduce Pemex's tax burden, if only minimally.

The 2008 Limited Energy Reform

President Felipe Calderon also tried his hand in 2008. Among other things, the government proposed measures designed to give state oil company Pemex additional budgetary and fiscal autonomy, increased managerial autonomy in executing acquisitions and public projects, new service contract schemes, and a revised corporate governance system.

These proposals were approved, though somewhat diluted, with the help of PRI support. The proposal to open the nation's refining sector to private investment was derailed by the PRI. The reform was thus quite limited in scope and is not expected to greatly change the nation's oil production outlook in the near- or even medium-term.

Although gaining some budgetary and fiscal autonomy from the government in how it directs resources among different projects, the government and thus Pemex is still under pressure to maintain production, and will thus likely continue to favor production investment over exploration. In terms of acquisitions, reducing Public Functions Ministry (SFP) oversight should make Pemex somewhat more nimble in the execution of its projects. However, the greatly anticipated changes to service contract terms were delayed, and their implementation will only begin in early 2011.

The new terms include bonus payments to service providers for bringing projects in early and for the transfer of technology to Pemex. The contract terms are designed to address complaints by Pemex that service providers tend to be inefficient and rely on old equipment, which hurts production efforts. The company has failed to attract the oil majors to conduct contract work under the old fixed fee system, and therefore has lacked access to new technological advances.

While the new contract terms might be lucrative to service providers, large national oil companies such as Brazil's Petrobras have already said that the new terms are not attractive. Moreover, technological transfer is unlikely in the highly competitive oil market when these companies still cannot book reserves.

Indeed, it is also not yet clear whether smaller service providers will find it in their interest to change the way they conduct their activities in Mexico to try to take advantage of the bonus payment scheme; if they do, there is no indication of how long it would take them to adopt and implement new policies to make the most out of the new contract terms. To the extent that the new contracts will help production, **it may be only at the margins and only over a very long period of time.**

Other Factors Affecting the Incentive for Energy Reform

The government's fiscal dependence on oil raises the chances that the next Mexican government will revisit energy reform. This is likely to occur during the next presidential administration (2012 – 2018). Although the level of production has fiscal implications for the government, thereby influencing the nature of energy policy debate, it is not the sole determinant of how much oil revenue Mexico gets; economic factors—oil prices and the value of the peso—are also at play. The effect of oil production on the incentive to reform is thus balanced by the oil price per barrel and the value of the peso.

Indeed, despite falling oil production, rising oil prices gave the current Calderon administration additional fiscal revenues during the first half of the presidential term, while recent peso devaluations have given the government some fiscal cushion for oil price moderations in 2009. High oil prices and a devalued peso thus can bring the government considerable fiscal revenues even in a low oil production context. Low oil prices and a revalued peso could reduce the fiscal returns to high

oil production. In other words, each oil production scenario has an adverse oil price and peso climate, a highly beneficial one, and many possibilities in between.

The worst-case scenario for the prospects for energy reform would be continued stable oil production in a favorable economic context, in which oil is priced high and the peso is valued relatively low. The government would be able to continue high rates of public expenditures. Energy reform would be deemed unnecessary, as high oil revenues would undermine any incentive to change.

The best-case scenario for reform would be that of falling oil production in a negative economic context, in which the price of oil is low and the value of the peso is high. In this instance, government finances would suffer a serious blow, leading to reductions in spending across the board. This scenario would force an opening of the nation's highly closed energy sector.

In between these two extremes lie a host of possible scenarios, ranging from stable oil production and a middle-of-the-road economic climate, to rising oil production in an adverse economic climate, to falling oil production in a strong economic climate. However, the nuances of how these other possible scenarios affect energy policy depend not on the overall fiscal revenues they bring to the government, but on their oil production levels and, to a lesser extent, on the economic context in which they occur.

Politicians in rising oil production scenarios, regardless of the price of oil or value of the peso, face few incentives to undertake energy reforms. Rising production levels mean a huge upside to any oil price rises or peso devaluations and diminish the need for reforms that could be controversial to voters. However, the fiscal pressures on governments rise as oil production moderates and falls, making budgets more vulnerable to price and exchange-rate swings. Positive fiscal contexts—even amid low oil production scenarios—also undercut the sense of urgency for reform, thereby likely diminishing their ultimate scope and reach.

Rising oil production scenarios also provide governments with the structural foundations to run larger deficits compared to more moderate or low oil production scenarios, regardless of the size of fiscal revenues. Investors are less likely to finance deficits in structurally unsound fiscal environments, such as a context with low and/or falling oil production but where the government remains highly dependent on oil revenues for fiscal resources.

Governments in rising oil production scenarios are thus better able to stave off the fiscal effects of falling prices or peso revaluations through running deficits than government facing falling lower oil production scenarios. Governments facing falling oil production are fiscally more vulnerable, in part because they have lower upside when economic conditions improve and in part because they are less desirable credit risks.

Future Reform and Production

Amidst recent high oil prices and peso devaluation, recent oil production stabilization over the course of 2010 (falling steep declines from 2004 to 2009) has reduced the incentive for the government to advocate for any additional energy reforms before the July 2012 presidential elections and the beginning of the next presidential term on 1 December 2012. However, should oil production decline further in the coming years it will likely force the incoming administration (2012 – 2018) to contemplate some type of reform. The sense of urgency, however, will depend heavily on the oil price and value of the peso.

That said, assuming that a consensus for reform emerges, energy reforms could range from Pemex restructuring to full scale sector opening to private investment (?). The precise nature of the reform will depend on which party wins the presidency and on the distribution of seats in congress and party control across state legislatures. The PRD is unlikely to push for any opening of the sector, and rather focus on Pemex restructuring, while a PRI or PAN president are more likely to think about liberalization of the sector.

For the sake of argument, however, let us assume that the next president pushes for and gets some kind of sector opening to private investment, though he does not privatize Pemex. This would probably be the best case (*do you mean most likely case?*) scenario for energy reform in the coming years. (Privatization of Pemex is extremely unlikely, given how few politicians actually advocate for it or support it these days. Comparatively more, though still a distinct minority, support opening the sector to private investment. Indeed, Pemex privatization would probably not have much of an immediate effect on the oil sector, and would instead only matter in the medium to long term.)

Assuming some form of opening where by private companies were allowed to share in exploration and production risk and reward, oil exploration would probably increase quite dramatically and produce results, particularly in the deepwater. However, the timing of these results and their effect on production depends heavily on when this reform would occur. Due to the political effects of the nation's midterm congressional elections occurring three years after the presidential race, most policy making is limited to the first year and a half after presidential or midterm elections.

Assuming that most oil resources are located in offshore regions, an energy reform undertaken in the first year and a half of the president's term could – in the best case -- yield production results from shallower waters by the end of the presidential term in 2018, five years hence. A reform undertaken after the 2015 midterm congressional elections, however, would not yield results until perhaps 2021. Deepwater exploration and development would yield results in only much longer periods of time, probably five years after any other offshore oil is brought online.

In a context where Mexico were averaging, say, about 2.0 million barrels per day around 2018, the best case scenario would be that oil production would rise around this time as a result of new discoveries. Any new oil brought online would be exported. Otherwise, most new oil would be brought online only around or after 2021.

This means that, even in the best case scenario for reform, but assuming the moderate oil production scenario, Mexican oil production and thus exports (to the US) are still likely to dip until 2018 or longer. Assuming a worse-case production scenario, Mexico would become a net oil importer during this time, with any added production starting in 2018 helping it to become self-sufficient. In this case, it would only be after a longer period of time that the nation could continue to export again.

The Oil Sector: Production and Demand

The 1990s was a period of successful expansion for Mexican oil production with much of the new production exported to the United States. The expansion was centered around the massive Cantarell field, which accounted for nearly 50% of Mexican production by 2004. However, the field peaked in 2004 and began a decline from 1.5mm bpd to below 500,000 bpd in 2010. Enhanced oil recovery techniques did not prove successful in maintaining output from the field, although there has been some recent stabilization. Beyond Cantarell, broader Mexican oil production has been in decline since 2004, in large part because of lower productivity of other maturing fields and slow progress on developing offshore fields and the highly complex Chicontepec basin.

Recent Production Declines

Mexican oil production reached its peak in 2004 and then went into steep decline. That year, Pemex produced on average 3.38 million barrels per day (bpd) but by 2009 that average had fallen to 2.60 million bpd. Between January and October 2010, Pemex production averaged 2.58 million bpd. This 800,000 bpd loss represents a decline of 24% in average 2004 production compared to average 2010 production (through October).

Graphic – Average Daily Oil Production by Year

Current President Felipe Calderon has faced considerable oil production losses since the beginning of his term on 1 December 2006. Pemex's average November 2006 production was 3.16 million bpd. During that same month the following year the company produced 2.89 million bpd, a loss of about 270,000 bpd. By November 2008 Pemex has lost another 180,000 bpd, averaging 2.71 million bpd that month. November 2009 production was 2.55 million bpd, 160,000 bpd less than November

the prior year. At the time of this report, November 2010 data was not yet available but October 2010 production averaged 2.57 million bpd, a slight rise from 2009.

Graphic – Average Daily Oil Production by Month

Mexico's recent oil production losses were caused by the steep decline of its principal complex known as Cantarell. Cantarell lies offshore to the north of the Yucatan peninsula in the Gulf of Mexico. The "historic" Cantarell complex—that is, the Akal-Nohoch fields—made up as much as 60% of total oil production in the early 2000s. In 2004, when historic Cantarell was producing at peak levels, it pumped nearly 2.1 million bpd or 61.5% of the nation's 3.38 million bpd total production that year. Historic Cantarell now accounts for about 15% of total oil output.

Graphic – Average Daily Cantarell Production

In the early 2000s, several other nearby fields were added to the Cantarell complex some say to hide losses from the historic Cantarell fields. However, this did little to mask the decline. Pemex had expected that total Cantarell production would stabilize at around 500,000 bpd and remain that way for the long term but recent and ongoing production declines have already caused the complex to dip below this figure in 2010.

Between January and October 2010 total Cantarell output averaged 498,000 bpd, with production first dipping below 500,000 in May 2010. Since then, production has averaged 481,000 bpd (May through October 2010).

Graphic – Average Daily Cantarell and Ku-Maloob-Zaap Production

Although Cantarell production declines have been dramatic, the government has been able to ramp up production from another offshore complex known as Ku-Maloob-Zaap (KMZ) to reduce its overall effect on total oil output. KMZ lies to the northwest of the Cantarell complex in the Gulf of Mexico. Although KMZ has not been historically important to oil production, the complex received considerable investment during President Vicente Fox's term (2000–2006).

KMZ investment, along with the continually growing resources allocated to it under the current Calderon administration, has enabled the government to increase production from about 300,000 bpd in 2004, when Mexican oil production was at its peak, to 830,000 bpd on average so far in 2010 (January through October). Originally, the Energy Secretariat and Pemex expected KMZ's output to peak in 2011, remain largely stable until 2012, and then decline at a very slow rate thereafter. However, revisions to this view are likely, given recent new discoveries near the KMZ complex that will likely be included in its total production figures in the future. If this is the case, then KMZ may not peak for a few more years instead.

Current Production Trends

In early 2010, the government stated that Mexico's total oil production had stabilized. Specifically, Finance Secretary Ernesto Cordero stated in early January 2010 that oil production had leveled off at around 2.6 million bpd, while Pemex's head of exploration and production, Carlos Morales Gil, said in late February 2010 that daily oil production this year would average slightly above 2.5 million bpd.

Most recently, the 2011 budget that was presented by the government to congress in September 2010 forecast average 2011 oil production at 2.55 million bpd. Production data so far this year seems to support the contention that production has stabilized around 2.55 million bpd; average daily production between January and October 2010 was 2.58 million bpd.

Factors Favoring Current Production Trends

Although data appear to show that oil production may have stabilized, it is unclear whether or how long this stabilization will last. There are both factors supporting and well as working against this stabilization. We begin here with the factors that support the government's optimistic view about Mexican production stabilization. First, the decline in proven reserves observed in prior years has abated, with reserve replacement ratios rising dramatically with incremental new discoveries. Second, production from the nation's myriad of smaller, lesser-known fields, has remained constant.

According to Pemex, as of 1 January 2010, Mexico counts on 14 billion barrels proven oil equivalent reserves that are expected to give the nation about 10 years of production. These reserves have been certified by international agencies. About seventy percent of these reserves lie in offshore fields, with most (12.6 billion barrels) found in the southern parts of the Gulf of Mexico along the continental shelf. In other words, near Cantarell and KMZ.

The national also counts on another 14.2 billion barrels—or another 10 years production—of probable reserves, which have also been certified. Most probable reserves lie in the southern part of the Gulf of Mexico (4.9 billion barrels) and in Chicontepec (8.9 billion barrels). Given questions about the viability of producing Chicontepec barrels, questions arise about the real production life of the nation's probable reserves given current technological capacity. Possible reserves reach nearly 15 billion barrels, giving the nation another 11 years of production life. Of these, 5.9 billion lie in the southern part of the Gulf of Mexico and another 8.4 billion lie in onshore Chicontepec.

Graphic: Evolution of Reserves

Graphic: Reserve Replacement Ratios

Since 1982, Pemex has drilled more than 1,000 exploratory wells but made no new major, commercially viable discoveries (*can we define major in this context?*). For this reason, Pemex has pushed over the past few years to increase exploration

spending, with small discoveries and reserve replacement ratios rising as a result. Specifically, exploration spending went from \$1.2 billion in 2006 and 2007 to 2.2 in 2009.

Graphic: Exploration funds

Graphic: Discoveries

As a result, there have been numerous small discoveries in shallower waters in recent years. The most important of which occurred in 2008 when Pemex announced the discovery of two offshore fields in the Gulf of Mexico--Ayatsil and Tsimin--that it confirmed again in 2009. Pemex expects these fields to produce 150,000 bpd each by 2012. But, a myriad of other small discoveries have been made as well. These work to add barrels and compensate for Cantarell decline somewhat.

Risks to Current Production Trends

Four factors, however, put pressure on Pemex's capacity to maintain current production at around 2.5 million bpd in the medium term: 1) production from the Cantarell complex continues to decline; 2) much of the compensation for lost Cantarell production comes from KMZ whose production trends are uncertain; 3) 90% of Mexico's producing fields are already considered mature; 4) the onshore Chicontepec region continues to fail to meet expectations; and 5) deepwater activity is unlikely to play out in the near or medium term, though there is long term potential.

Field level production data show that output from Cantarell has continued to decline, even if the pace of decline has slowed over the past year. In January 2010, Cantarell produced 536,616 bpd; in October it produced 466,558 bpd. The loss of 70,000 bpd may not seem significant in a nation that produced 2.57 million bpd in October 2010 but such losses, however small, have to be replaced with production from other fields.

Although Pemex understood for many years prior to Cantarell's decline that production from this complex would eventually peak and then decline to a much lower level, the company originally estimated that it would decline fairly slowly and that it would stabilize around 500,000 bpd for many years. However, the pace of decline was much more rapid than the company originally thought, while the level of the decline has been greater than original estimates. Cantarell production went from over 2 million bpd to below 500,000 bpd in just six years and looks likely to continue to decline.

Significant water incursions into parts of the field have reduced pressure considerably and made it much more difficult to extract oil. Estimates vary widely about future production levels, with some saying that the complex will soon stabilize around current levels, and others suggesting that production will stabilize at a much

lower production level. Current trends point to somewhere between these two extremes: the complex will probably continue to lose barrels but slowly.

Regardless of when we expect KMZ production to peak, in 2011 or a few years thereafter, the rate of decline could be swifter than the slow decline the government and Pemex currently expect. Production has gone from an average of 301,000 bpd in 2004, to 394,000 bpd in 2006, to more than 800,000 bpd in 2009 and 2010. Some industry observers believe that increasing production at this rate may have done some damage to the fields, particularly in terms of pressure, which could hurt production rates and longevity. Rather than going into only a slow decline, the field's output could drop faster (and sooner) than anticipated, despite the company's best efforts to avoid this.

Graphic – Average Daily Production in Ku-Maloob-Zaap

Individual field level analysis of KMZ also raises concerns. The Ku-Maloob-Zaap complex comprises three separate fields, with Ku lying at the southernmost tip of the complex, Zaap in the middle, and Maloob to the north. Pemex has traditionally relied on Ku for the lion's share of this complex's production. Ku production is now in decline, with increases in Maloob and Zaap production used to maintain overall production figures for this complex. Ku decline could put overall production from this complex at risk. Although it is difficult to say exactly when production from this complex will start to go into decline, it could be sooner than what the government currently suggests.

Maintaining production from the country's other onshore and offshore fields over the past five years has been critical for keeping overall production declines from falling further. However, Pemex categorizes 90% of its fields as mature, implying that they have reached peak production levels and thus will begin to go into decline.

Graphic – Average Daily Production by Major Field and Region

To address concerns about falling oil production, the government and Pemex have highlighted the vast oil resources located in the onshore Chicontepec region. Chicontepec lies mostly in the eastern state of Veracruz but also covers parts of the state of Puebla as well. The Energy Secretariat wrote in its 2008 "Crude Oil Market Outlook, 2008 – 2017" that it expected Chicontepec production to grow from 33,000 bpd in 2008 to 737,000 bpd in 2017. However, Energy Secretary Georgina Kessel touted a revised figure in 2009, stating that the region would produce 600,000 bpd by 2015. In early 2010, this figure was again revised downward to expected production of 500,000 bpd in 2015.

Map: Chicontepec

Actual Chicontepec output, however, is far below these benchmarks. The region produced 32,000 bpd in 2009 and is said to have achieved 37,000 bpd so far this year, even though Pemex has stated that it is trying to raise production to 60,000

bpd by the end of 2010. Yet, the region appears unlikely to reach this level this year or anytime soon in the future.

Chicontepec is comprised of many small oil fields under very low pressure, limiting the lifespan and potential production from any single field. Despite government efforts to increase production in the region through massive drilling efforts—with Pemex stating in early 2009 that it aimed to drill 1,200 wells per year for several years, though this goal was subsequently revised downward—the maximum number of wells drilled and connected to infrastructure networks in any year to date is about 400.

Bureaucratic and legal hurdles (related to right of way and environmental issues), as well as challenges related to infrastructure provision, prevent a massive drilling and thus production ramp-up beyond these figures. Recent revisions to Chicontepec financing in Pemex's budget appear to confirm this view. Allocated federal spending for Chicontepec in 2010 was \$1.5 billion, down from \$2.3 billion in 2009.

PEMEX estimates a “prospective” 29 billion barrels of oil equivalent product in its deepwater areas (below 500 meters). However, these estimates remain speculative at best given the low level of deepwater activity that the company has undertaken over the years. They also estimate that the southwestern regions, located onshore and offshore in the state of Tabasco, could hold as much as 16.7 billion barrels. Most other regions count on far fewer prospects. Pemex estimates that total “prospective” reserves total 52.3 billion barrels of oil equivalent.

Pemex's deepwater activity thus far has not yielded any discoveries. It has been constrained by platform access; the company has only drilled 14 total deepwater exploratory wells to date, with only one of these yielding commercially viable hydrocarbons (natural gas) and none yielding oil. However, Pemex has four new rigs/platforms under contract and plans to drill nine exploratory wells by 2018.

However, Pemex's deepwater exploration plans have been affected by the 2010 gulf oil spill. The company has had to shift some of its planned exploratory drilling away from the deepest parts of the gulf to somewhat shallower areas in an effort to avoid undertaking risky projects in an environment of increasing international scrutiny. The final effects on Pemex's overall plans and estimates of its deepwater potential are as yet unclear but we should expect that them to be rolled back somewhat.

Three possible future oil production scenarios

The gulf between the factors supporting current production levels and those placing downward pressure on Pemex's oil production future has raised speculation about where it will ultimately land. We outline three possible oil production scenarios for the next ten years.

The most optimistic scenario is that of the Energy Secretariat. Energy Secretary Georgina Kessel, testifying to the senate's energy commission in January 2009,

stated that the government believes that production would steadily rise over the years and reach an average of 3 million bpd in the period between 2015 and 2017. The Secretariat of Energy bases this forecast on a combination of improved management of the declining Cantarell complex, continued strong performance at KMZ, rising production from other existing fields (especially the Chicontepec region), and new discoveries in both shallow and deep waters. Under this scenario, Mexico would remain an important oil exporter despite rising domestic demand.

Graphic: Energy Secretariat Oil Production Forecast

The most pessimistic scenario suggests that if Pemex makes no new discoveries and production from existing fields, including KMZ and fields relied on in other regions, goes into decline, production over the next ten years could fall to an average 1.3 of million bpd to 1.5 million bpd if no new discoveries are made and Chicontepec expectations do not play out, total oil production from today's existing fields could end up around 1.3 million bpd by the end of the next presidential term in 2018. By 2020, production from current existing fields approach 1 million bpd. In the case, Mexico would become a major net oil importer. And the US would need to replace Mexican crude oil supplies from other sources over this time frame.

A middle-of-the-road scenario predicts ongoing slow decline at Cantarell and the temporary stabilization and then steady decline in KMZ starting in about three years. In this scenario both Cantarell and KMZ continue to produce important amounts of oil, given that they each count on 3 billion barrels of oil equivalent in proven reserves. Production from the nation's mature fields would remain stable, as well as production in Chicontepec, thanks to increased investment and enhanced oil discovery techniques. And, production in key regions like the areas onshore and offshore of Tabasco would remain high producers with consistent development efforts. Under this scenario incremental oil discoveries would also be made and brought online, enough to cover some of the losses experienced by Cantarell and eventually KMZ.

In this moderate scenario, Mexican oil production would stay at or near its current 2.5 million bpd for two or three more years and then steadily fall to somewhere around 2.0 million bpd by around 2018. It would then hold this rate of production for some years to come. Under this scenario, Mexico would thus continue to produce enough oil to meet rising domestic demand but not enough to remain a major oil exporter, even though it could continue to export for some years to come.

Not all of these forecasts are equally probable. Some version of the middle-case scenario is the most likely, followed by some (more optimistic) version of the worst-case scenario. The least likely is the government's forecast.

The middle road scenario is the most likely for two main reasons: First, although unlikely to maintain production in the near and medium term at current rates, both Cantarell and KMZ count on considerable (and interestingly nearly equal) proven,

probable, and possible oil reserves. Proven reserves are just over 3 billion barrels of oil equivalent each. Even if facing decline for a host of geological and technical reasons in the coming years, fields will continue to produce important numbers of barrels for many years to come. This combined with the strong chances of ongoing, incremental new discoveries that can be used to replace barrels lost from mature fields means that oil production is likely to hover around 2.0 million barrels per day without much threat of collapse.

The absolute worst-case scenario is unlikely, given that Pemex will always engage in exploration and small discoveries will continue to be made in the coming years. Even if Cantarell and KMZ production declined more significantly than our middle-case scenario predicts for geological reasons, the company could avoid a complete collapse in production through its exploration efforts. Indeed, very little of Mexico's offshore and onshore regions have been explored, with it likely that substantial reserves still remain, particularly around the continental shelf near current Cantarell and KMZ.

Even so, a less dramatic version of this worst-case scenario—whereby Pemex finds it difficult to fully compensate for swift Cantarell and KMZ declines—is still more likely than the Energy Secretariat's optimistic production outlook that forecasts significant rises above current production levels. This is only likely in the event of a major new oil discovery.

Domestic Oil Demand

The BP World Review of Energy Statistics puts Mexican oil demand in 2009 at just under 2.0 million bpd. Mexico's Energy Secretariat puts refined oil product demand at 1.48 million bpd oil equivalent that same year. Demand from the transportation sector makes up the lion's share of domestic refined oil product demand.

Graphic: Mexico Domestic Oil Consumption, 1990 – 2009 (British Petroleum figures)

Graphic: Mexico Refined Oil Product Demand

Graphic: Mexico Refined Oil Product Demand by Sector

The Mexican Energy Secretariat expects refined oil product demand to grow by about 400,000 bpd between 2010 and 2020, going from about 1.5 million bpd to nearly 1.9 million bpd oil equivalent in 2020. Domestic refined oil product demand is expected to exceed 2.0 million bpd oil equivalent in the early 2020s. Once again, the transport sector will account for the lion's share of domestic refined oil product demand.

Graphic: Future refined oil product demand

Graphic: Future refined oil product demand by sector

Export Trends

Three main variables affect estimates of future Mexican oil exports: domestic oil production, domestic demand, and domestic refining capacity. Currently, Mexico produces enough oil to export considerable amounts abroad, mostly to the US, but it also imports refined products as a result of insufficient refining capacity.

Graphic: Oil Exports

Gasoline is a case in point. While the nation is capable of producing over 500,000 bpd in gasoline, it imported 332,000 bpd to meet domestic demand. Gasoline only makes up a part of total refined product demand, which is also satisfied with imports.

Graphic: Gasoline Demand

Domestic refining capacity, however, is likely to improve in the future. The Mexican Energy Secretariat has plans for improving capacity at the nation's refineries, which are already underway. It also has the construction of a new refinery planned as well. It all goes to plan, domestic refining would rise fairly significantly in the years to come, although there is some reason to believe that the government may not achieve these plans as demands for funding for exploration lead Pemex to reshuffle capital investment resources.

Assuming that Mexican oil production stabilizes at around 2.0 million barrels per day toward the end of the next presidential term (2012-2018), that the Mexican Energy Secretariat's domestic demand calculations are accurate (that demand will reach about 1.9 million bpd oil equivalent by 2018), and that domestic refining capacity grows substantially according to plan, net oil exports would decline more dramatically than falling oil production figures suggest.

In 2018 net exports could thus be around 100,000 bpd. Mexico would export probably around 300,000 bpd (2.0 million bpd production minus 1.7 million bpd demand) but re-import some of these barrels (200,000 bpd) as refined oil products to meet local demand. Assuming that demand figures are correct, improved oil production rates would raise net export figures. Reduced refining capacity would raise original exports but would not affect net exports in that imports of refined products would rise.

Do you think we can make one graph here showing on the same chart your three cases for oil production, set against oil demand, with the differences being what is available for export or conversely what Mexico might need to import?

The Natural Gas Sector: Production and Demand

The consumption of natural gas in Mexico is on the rise, in large part because of a government push to switch electricity generation and industrial production to natural gas. In tandem, the government has advanced plans to increase the country's ability to import LNG. The dynamic between natural gas imports through pipeline and LNG terminals will be an interesting one to follow in the coming years. A massive glut of natural gas in the United States as a result of recent technological developments in extracting unconventional gas makes the US a likely candidate as a pipeline exporter. However, an oversupply of global LNG could compete with US exported gas in the short term. The transition to natural gas use will be a gradual one, and Mexico's call on natural gas will depend also on production outcomes and domestic supply dynamics.

Production

Unlike with crude oil, natural gas production in Mexico has been growing steadily in recent years. In 2000, natural gas production was just over 4 billion cubic feet per day (bcf/d). In 2009, it was 6,2bcf/d, representing a 50% increase in nine years.

Graphic: Domestic Natural Gas Production

The rise of natural gas production is likely to continue in the coming years. The Energy Secretariat expects production to reach nearly 8bcf/d by the end of the next presidential term in 2018 and that production will continue to rise in the years after that. *Yes, agree that a bit more on MSC impact would be useful*

Graphic: Future Natural Gas Production

Despite ongoing and expected rises in natural gas production, domestic production will consistently fail to meet local demand. This is the case as investment in domestic natural gas exploration and production is unlikely to grow at a rapid rate comparable to 2000-2009. The government prefers to invest in crude oil production development rather than natural gas out of financial concerns. Most natural gas discoveries will thus likely be made as a part of oil exploration efforts, with oil production development given a privileged position.

Outlook for Gas Imports

As a result, we expect natural gas domestic demand to continue to outstrip production. In other words, Mexico has failed to produce enough natural gas to meet domestic demand and this trend will continue and even grow in the future. Natural gas imports have risen alongside rising domestic production as a result of growing demand. In 2000, for example, net natural gas imports were 257mmcf/d. In 2009 they were 1.191bcf/d, representing a rise of about 350% in just nine years.

Graphic: Natural Gas Production, Imports, Exports

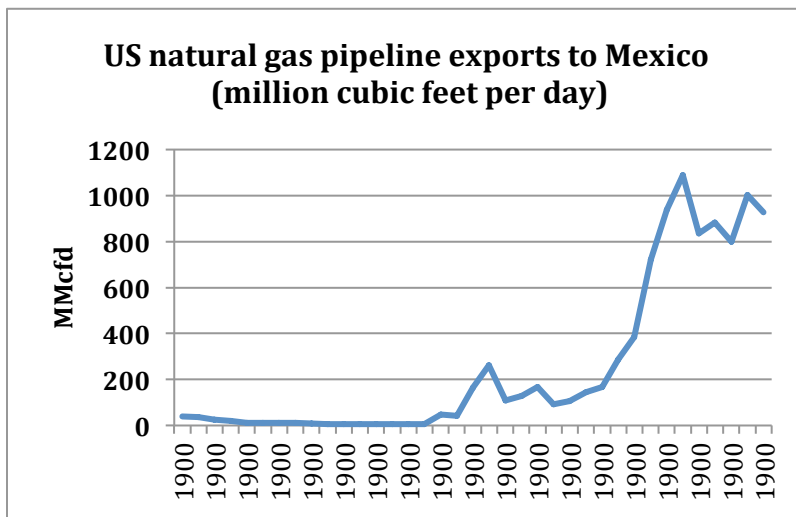
According to the Energy Secretariat, future imports are set to rise as well. In 2018, for example, they are expected to be 1.86bcf/d. In 2024, the end of the subsequent presidential term, they will be about 2.5bcf/d, despite bringing additional domestic gas online.

Graphic: Future Natural Gas Production, Imports, Exports

Much imported natural gas currently comes from the US via pipeline. However, Liquefied Natural Gas (LNG) regasification plant construction has steadily allowed gas imports from other nations, including Trinidad & Tobago, Egypt, Nigeria, Norway, and Qatar.

Graphic: Future Natural Gas Imports by Type

There are approximately 1,800 km of private pipelines. Pipeline network includes ten active import connections with the United States. In 2009, Mexico imported 926mmcf/day of natural gas from the United States, while it also exported 76mmcf/day to the United States. There are 15 pipeline connections across the border with the United States. US exports into Mexico through pipelines have increased dramatically since 2000. In 1999, imports into Mexico from the US through pipeline were at approximately 167mmcf/day. By 2009, the number had jumped to nearly 931mmcf/day.



Source: Energy Information Administration, US Department of Energy

In forecasts released by the Mexican Ministry of Energy and Sener, pipeline imports from 2007 to 2017 stay fairly constant, while LNG imports grow significantly. By 2017, both EIA and Sener predict that more than two-thirds of the increase in imports will be met by LNG. There are currently two LNG terminals in Mexico, the Baja (1 bcf/day) and Altamira (500mmcf/day) terminals. Another west coast terminal is under construction at

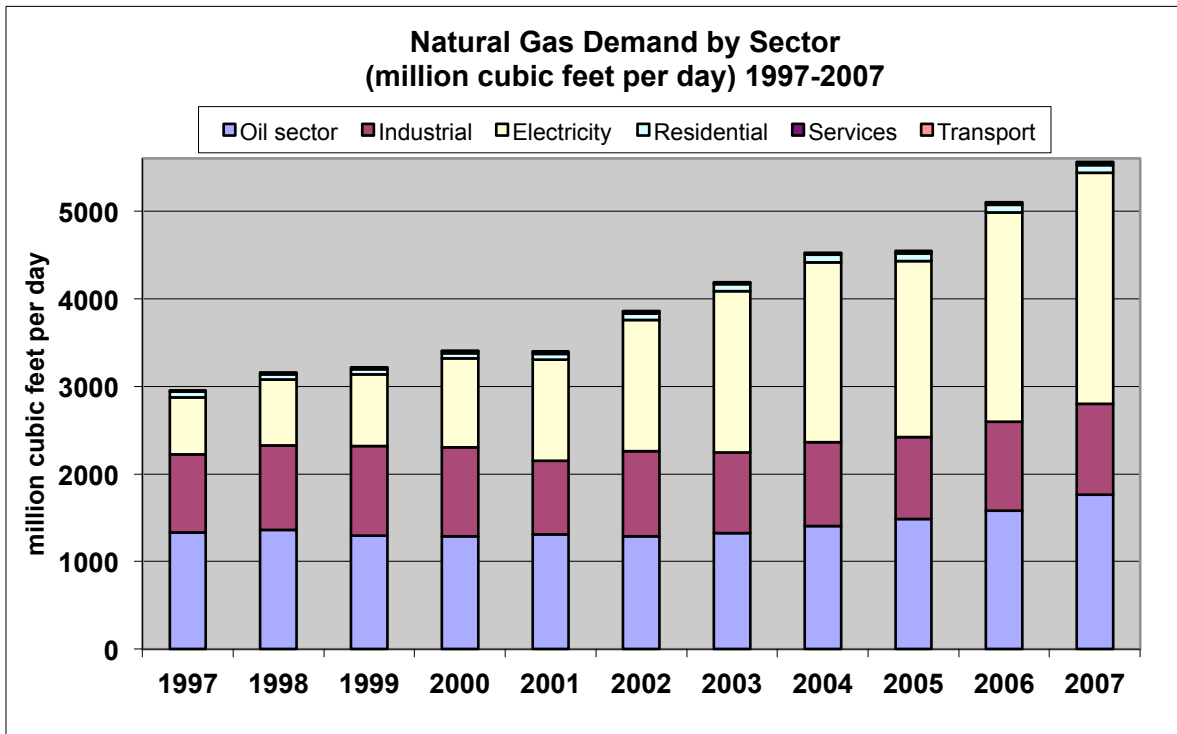
Manzanillo and plans are underway for a few other terminals, all at various stages of planning. The Manzanillo LNG terminal is scheduled to be installed by 2011. The plans for the terminal include an average consumption of 90 mmcf/d in its first year of operation and ramping up to 500 mmcf/d by 2017. Changes in the natural gas profile of the United States and the changing natural gas market may change these forecasts, with pipeline imports from the US to Mexico potentially cutting into LNG imports. Pipeline exports from the US are currently operating below full capacity (particularly from south Texas) and natural gas supply caused by an increase in unconventional gas production could encourage the US to consider increasing exports.

Pipeline imports could grow much faster than LNG imports in the short term. However, the availability of surplus natural gas supply from new shale gas plays in Texas could make expanded imports of pipeline gas from the US more competitive. The US gas will likely have a material price advantage over LNG sourced from markets where long-term contracts are still mostly reflecting oil-linked pricing.

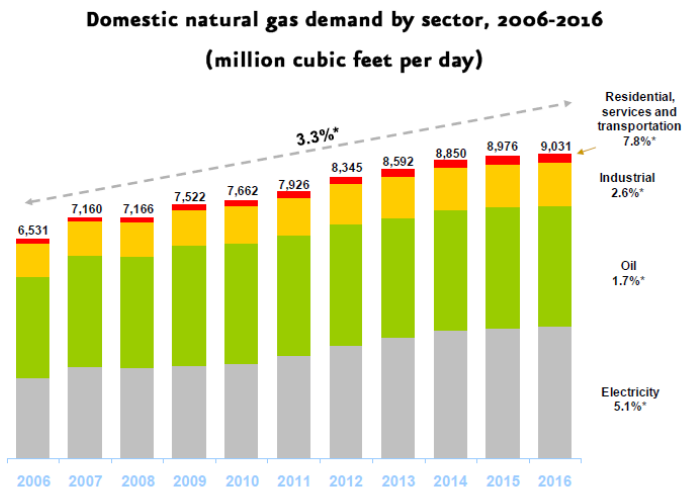
Natural Gas Demand

According to EIA forecasts in the 2010 International Energy Outlook, Mexico accounts for almost 50 percent of the growth in North America's natural gas consumption between the years 2007 and 2035. Strong growth in natural gas consumption is concentrated almost exclusively in the power sector, with some growth in industrial sector. If the Mexican government is able to significantly stabilizing demand, the call on US gas through pipeline imports will be affected.

In Mexico's industrial and electric power sector, natural gas is slated to gain the biggest share in the coming years. Mexico's coal consumption outlook moving forward is relatively flat, with natural gas is taking a bigger share in electricity portfolio. Additionally, while fuel oil has served as an alternative to natural gas in generating electricity, the government has been encouraging switching from fuel oil to natural gas. Between 1997 and 2007, the electricity sector experienced the greatest growth in natural gas demand, rising from 653 to 2,638 million cubic feet per day. Looking out, Sener predicts a 5.1 percent annual average growth rate for natural gas demand in the electricity sector between 2006 and 2016. During the same time period, natural gas demand in the industrial sector rises 2.6 percent. The EIA predicts that share of natural gas in Mexico's total electricity generation will increase from 37 percent in 2007 to 63 percent in 2035, with consumption growing by 2 trillion cubic feet from 2007 to 2035. Industrial sector: Consumption grows by 1.1 trillion cubic feet from 2007 to 2035.



Source: Mexico Ministry of Energy, Electricity Statistics



* Annual average growth rate 2006-2016.
 Source: Sener.

Fuel switching

The Federal Electricity Commission (known as the Comisión Federal de Electricidad, or CFE) plans on converting a number of power plants running on fuel oil to natural gas. The fuel switching program began in 1997. Use of fuel oil in Mexico's electricity sector

has been cut by nearly half between the years 1999 and 2009, while natural gas has filled in most of the difference. Coal use in the electricity sector has stayed fairly constant in the past decade. In 2007, natural gas made up 55 percent of Mexico's electricity production, while fuel oil accounted for 27.10 percent. Coal sourced 15.4 percent of Mexico's electricity.

The CFE has based its strategy moving forward on converting its existing combined-cycle plants from running on fuel oil to running on natural gas. CFE plans on launching a tender in November 2010 for a \$170 million natural gas pipeline intended to run from Tlaxcala state to the Centro I power plant in Morelos state in order to guarantee greater supply of natural gas to Morelos. The plant currently has to rely on fuel oil rather than gas. The pipeline is slated to begin operations in August 2012 and will have the capacity to move 120 million cubic feet per day at first and by 2015 will double its capacity.