MEXICO

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Mexico: Re-awakening An Oil Giant

The two snow-topped peaks of Popocatépetl and Iztacc'huatl stand watch over one of Latin America's most important capitals—Mexico City. On clear days, they can be seen from the city and form a striking contrast to the hustle and bustle of the urban sprawl they survey. The Aztec legend of their creation tells of two star-crossed lovers, separated by death. The Gods took pity on their plight and united them in the same volcanic mountain range for eternity. Today Popocatépetl, the Aztec prince, watches over his sleeping maiden, Iztacc'huatl. The volcanic giant has lain dormant for many years despite the attention of its more active neighbor. The challenge for Mexico today is to find a way of re-awakening the production of its national oil giant, Petróleos Mexicanos (Pemex) and sustaining the recent economic growth that the nation has experienced.

Mexico currently finds itself in the economic spotlight as investors shift their focus away from the BRIC (Brazil, Russia, India, China) countries towards the Spanish-speaking world's most populous nation. Mexico enjoys significant demographic and geographic advantages, with a young and growing population and the major export markets of the U.S. and Latin America conveniently located on either side. The major financial indicators are promising: a low gross domestic product (GDP) to debt ratio of 35%, steady growth rates since the mid-1990s and an increasingly diversified economy that did not suffer as badly as predicted in the global downturn of 2008. The financial sector is fast becoming one of the country's assets with that rarest of modern phenomenon—a stable banking system. Mexican banks have an average capitalization rate of 15%, almost double the minimum regulatory requirement of 8%. Relatively cheap labor costs have resulted in a national manufacturing boom and stimulated the export of goods throughout the world.

Yet for all this diversification, the centerpiece of the economy remains the production of oil and the company that controls it: Pemex.

Declining production

For the past 74 years Pemex has occupied a position of national significance and symbolism that is arguably second only to the national flag. In 1938, President Lázaro Cárdenas ordered the expropriation of all oil reserves and instituted, as a constitutional right, Mexican ownership of the nation's oil and mineral resources. This arrangement saw Mexico become the world's seventh largest oil producer but also led to the fiscal dependence of the state on oil revenues; the national oil company (NOC) accounts for approximately 40% of the country's annual tax revenue.

Such dependence holds dangers. For the past seven years, Mexico has suffered a declining rate of oil production from a peak of close to 3.4 million barrels per day (bbl/d) in 2004 to the current rate of 2.5 million bbl/d. This decrease in production has generated negative media coverage from both national and international sources, many of which blame a lack of private investment and Pemex's inability to break free from the shackles of the tax burden it carries. The fear is that, without greater involvement of foreign technology and capital, Mexico faces the very real threat of becoming a net importer of oil, despite containing 13 billion barrels in proven reserves.

Exciting shale potential

If Mexico and Pemex can awaken from the slumber that has befallen them in the past few years, the potential is huge. In addition to the aforementioned oil reserves, the possibility of shale-gas exploitation in Mexico is generating great excitement across the industry. The U.S. Energy Information Administration estimates the country's shale reserves at 683 trillion cubic feet (Tcf). Even conservative analyses predict levels could place Mexico at the top table of global producers. Questions still surround the availability of the technology required to start production and the ability of the NOC to capitalize on the exciting potential of these reserves.

The lack of investment in gas infrastructure in recent years has seen Mexico fail to take advantage of the vast quantities of natural gas that it contains. Critics argue that the fiscal handcuffs the government has placed on Pemex limit the amount that the company can invest in areas outside of exploration and production. The hope is that shale-gas exploitation will follow a different model to that of natural gas, possibly with the greater involvement of the private sector.

Opening the market

To counter the declining rate of oil production in Mexico, an energy reform was announced in 2008 and, although positive impacts have been felt, many call for wider reforms. The belief is that a greater opening of the market would stimulate sustainable growth in the industry. Any such opening would implicate opportunities for investors and private companies on an unprecedented scale. If successful, it would secure Mexico's future as a major oil producer and sustain the nation's bid to compete with the more garlanded economic might of the BRICS. However, doubts remain as to whether it will be possible for the president-elect and his new government to approve such a reform in congress.

This report will examine the challenges facing the Mexican petroleum industry, discuss the impact of reforms and highlight the opportunities that will exist as the market opens. It includes a special focus on two of the nation's most important oil-producing regions that border the Gulf of Mexico: Tabasco and Campeche. With the increased emphasis that Pemex is placing on deepwater exploration and other offshore activities, both are likely to experience significant growth.

Mexico finds itself at an important moment politically; in December the Institutional Revolutionary Party (PRI) will return to power after an absence of 12 years. Until 2000 the party had held a political hegemony for 71 years, during which period it gained a reputation for corruption and electoral fraud. A strong signal to the Mexican people and to the world that the negative past of this party should be consigned to history would be implementing a successful strategy to ensure the future of the nation's petroleum industry. ▪

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Structural Challenges And Reforms Policy

A 2008 reform aimed to streamline Pemex's function and encourage private-sector involvement.

The declining rate of oil production in Mexico in recent years has generated a fierce debate over the role that Pemex plays in the nation's petroleum industry and the possibility of opening the market to wider participation from private companies and investors. In 2008, Felipe Calderon's government announced an energy reform with the aim of allowing Pemex to function in a more streamlined manner and encouraging the greater involvement of the private sector in Mexican oil production.

Gaining approval for the reform was not a simple matter, as it involves challenging the constitution of 1938 and provokes strong nationalist opposition. Consequently, the final reform was seen by many as a watered-down version that did not go far enough in opening the market to outside participation. Although oil production has now stabilized at 2.5 million bbl/d, further reforms are required if a sustainable increase in production is to be achieved. An opposing view maintains that we have not yet seen the full impact of the 2008 reforms and greater benefits will be seen over the long term if the tools of the 2008 reform are applied more aggressively.

With or without more reforms, Pemex has set the ambitious target of raising production levels to 3 million bbl/d by 2017. If the world's second-largest company by market value is to achieve this goal, it must remedy two major structural challenges: an aging staff population and the budgetary constraints imposed by the state dependence on oil revenues.

Juan Carlos Zepeda Molina, president, National Commission of Hydrocarbons

2008 Reform

The 2008 reform established a new regulatory body to monitor the Mexican upstream petroleum industry; the National Commission of Hydrocarbons (CNH). "Until the Energy Reform of 2008, Pemex had been accountable for the regulation of the petroleum industry, hydrocarbons policy-making and operating as an oil producer," explains Juan Carlos Zepeda Molina, commissioned president of the CNH. "One of the key ideas behind the reform was to remove these first two obligations, so that it would have more freedom to focus on producing oil."

The CNH has assumed responsibility for regulation whilst the creation of energy policy has been reassigned to the Ministry of Energy (SENER). The idea is to enforce greater separation between the government and Pemex to allow it to follow a model that more closely resembles that of other national oil companies. Since its formation, the CNH has already made a tangible impact on the petroleum industry; the establishment in 2009 of legislation to control gas flaring and the February 2012 legal approval of the Chicontepec field's reserves are seen as two important milestones for the organization. However, there are still many hurdles to be overcome, as Zepeda highlights: "We are still working towards convincing all of the major participants that there is a need for the CNH to regulate Pemex and in order to do that we require certain resources. When we consider that the industry has been functioning without a regulator for more than 70 years, it is easy to understand why some are slow to accept change."

The removal of regulatory and policymaking obligations from Pemex is sensible and represents an important break from the past for an industry that has a history of cultural inertia. However, this reform did not attempt to address what is commonly viewed as the most debilitating factor in the relationship between Pemex and the Mexican government; the fiscal reliance of the state on oil revenues. "Around one-third of the Mexican government's income comes from the taxes Pemex Exploration and Production (PEP) pays; this amount can be slightly more or slightly less, it oscillates depending on the year," states José Antonio González Anaya, subsecretary of revenues at the Ministry of Finance and Public Credit.

The tax burden that Pemex carries limits the areas in which it can invest, consequently in the past emphasis has been placed on making profits in the short term rather than creating a sustainable long-term strategy. "If Pemex is to function as a company, it still needs greater independence from the Ministry of Finance and control over its own budget," argues Zepeda.

The 2008 reform was not able to achieve any change in the fiscal relationship between Pemex and the Mexican government but it did provide another mechanism aimed at increasing the national oil company's capabilities: incentivized contracts.

New style of contracts for services companies

One of the principal complaints aimed at the Mexican petroleum industry is that it is a closed shop that does not encourage the participation of the major international oil players. Although the Mexican constitution rules out exploration and production of oil by any company other than Pemex, many international companies have a long term presence in the country's petroleum industry; albeit in a more limited fashion than many of them would prefer. As Pemex explores new sites in technically demanding areas and looks to meet its increased production targets, there is a real need for greater international involvement.

The challenge has been creating a contractual process that presents sufficient incentive for global companies to commit sufficient resources despite the restrictive nature of operating in Mexico. One of the most interesting aspects of the 2008 reform was thus the advent of incentivized contracts for the involvement of service companies in exploration and production. These contracts break the mold of those previously tendered by Pemex; they last for longer terms, allow for greater operational flexibility and most importantly

Humberto Lira Mora, partner, Zenteno-Lira Mora Abogados

Javier Zenteno Barrios, partner, Zenteno-Lira Mora Abogados

give winning bidders a direct stake in the results of oil production from each site. So far there have been two completed rounds of contracts, the first in 2011 and the second in June 2012.

Schlumberger has been one of the beneficiaries of this new process, winning a contract in the first round for the Carrizo block and another, in collaboration with Petrofac, in the second round for the Pánuco block. Juan Manuel Delgado, managing director of Schlumberger Mexico, was initially attracted to participating in a process that rewards performance: "It was not a traditional service contract model but, instead, a model in which you both claim equity on the reservoir or field you manage and provide services to increase production and deliver results."

Beyond being successful in the first round, the fairness of the process and the clearly defined requirements encouraged Schlumberger's continued presence in the second round. "The transparency we saw in the first round was also impressive. In other parts of the world this type of contract can be a more complicated proposition to evaluate, but with Pemex the clearness and transparency of the process encouraged us to continue participating."

Petrofac's country manager for Mexico, Harry Bockmeulen, points out that the collaboration with Schlumberger positions it to deal with the technical challenges that the Pánuco block presents. "Schlumberger is one of the premier oilfield services companies in the world; the partnership capitalizes on its sub-surface expertise and Petrofac's surface engineering capabilities," he says.

The awarded contract also has a great importance to Petrofac: "When the Mexican mature fields were announced in early 2011, the opportunity fit our portfolio perfectly, and given that there were going to be future rounds, it was obviously a place we needed to come and explore. Mexico is now our second-largest center for this division, and has the potential to one day become the biggest; if Pemex continues to offer opportunities, we will certainly go after them."

The only area of Pemex's activities that the first two rounds of contracts concerned was increasing production at mature field sites. This was a move that some industry figures viewed as overly conservative and as not presenting an attractive enough opportunity to tempt the major oil companies to bid in earnest.

"The incentivized contracts represented a step towards a greater opening of the Mexican oil and gas sector but have not yet signaled a significant influx of outside investors and companies," states Humberto Lira Mora, one of the founding partners at Zenteno-Lira Mora Abogados, a law firm that specializes in interpretation of regulation in the energy sector. "After the first round of contracts had been concluded, none of the major international oil production and exploration giants, except for Petrobras, had shown interest in participating."

Zenteno-Lira Mora provided expertise to the Mexican senate when it was determining the terms of the reform in 2008. Javier Zenteno, the firm's co-founding partner, believes that while further reform may be needed, it should focus on defining the internal structure of the energy sector rather than opening the market further. "The 2008 Energy Reform was not a complete one, as it only addresses specific points; however, doing so represented an advance for Mexico's energy sector. Our perspective is that an energy reform should not be centered on opening the sector further to particular national or international companies, but should focus on determining the way that Mexicans manage the national institutions that control energy in Mexico," he said.

There was greater interest in the second round of contracts, with 81 consortiums buying the initial information packages and companies such as Baker Hughes, Halliburton, Chevron and Repsol successfully progressing through the prequalification stage of the process. Ultimately the Petrofac/Schlumberger partnership was the only household name that gained a contract and the suspicion remains that many international companies are yet to seriously consider bidding in the process. Beyond the focus of tendered activities, there are those who maintain that incentivized contracts do not go far enough and the only true solution to increase production sustainably would be a constitutional reform.

"The regime applicable to the incentivized contracts remains very restrictive in terms of compensation to the contractors, and prohibits rights from the contractor over production," explains Ariel Ramos, partner, White and Case law firm. "It would be better to have a constitutional reform so that Pemex can implement international standards and help increase its production. What I would like to see is the eventual implementation of risk-sharing agreements."

It is perhaps unfair to measure the success of the incentivized contracts until some results have been produced by the blocks they concern. Pemex has already seen financial benefit from the first round of contracts but is still waiting for production to go online at the sites before any operational benefit can be measured. As Carlos Morales Gil, director of exploration and production at Pemex, explains: "The two winners, Petrofac and Schlumberger, presented very competitive bids so we have seen excellent cost results. Operationally we are about to see the results; in February we delivered the fields to these two companies, they will start drilling in July and then we expect to start seeing an increase in production."

If the blocks that Pemex allocated for incentivized contracts do show an increase in production then it will represent vindication for the creators of the process. Whatever the critics say, it would seem that the new contracts are here to stay and the breadth of activities they apply to will only grow. According to Morales: "There will be further rounds of incentivized contracts in Chicontepec, in mature fields and in deep water."

This diversification could entice the greater participation of oil majors that Pemex will need to increase production levels. As with the other elements of the 2008 reform, it is too early to judge the success of the new incentivized contractual process, but it has certainly created a new opening for outside participation in the Mexican oil and gas industry. It remains to be seen whether that opening will be enough to sustain growth in oil production levels and secure Mexico's future as a major oil-producing nation.

Through the creation of the CNH and the adoption of incentivized contracts,

Despite *the recent arrival of four new board members, Pemex faces a serious challenge in replacing an aging staff.*

Mexico has demonstrated a will to change the culture of the country's petroleum industry. A larger cultural change that is still required concerns Pemex and how it is structured. The mammoth national oil company employs over 140,000 people and has often been accused of functioning in a highly inefficient manner. To counter this problem, the 2008 reform established four independent directors to sit on the board of Pemex with the mandate of improving the company's strategy. "By law the responsibility of the members of the board of administration is to drive the strategic direction of Pemex," says Fluvio Ruiz, one of the four new directors.

Ruiz believes that Pemex is stronger for the creation of the independent directors. "I believe that we form an advisory group that gives advice that is taken more seriously; one that not only evaluates past decisions, but is also looking to maintain a balance between assuming its legal obligations without interfering in the day to day running of the company."

Ruiz cautions against those who call for large-scale reform without properly considering the consequences: "We have a very fragile state; we do not have the institutional architecture that is designed to control an opening (of the market). A rapid and indiscriminate reform would carry more dangers than benefits. I am in favor of allowing this reform (of 2008) to have the necessary time to achieve all of its goals and if afterwards there is still the need for a further opening, then it can be straightforwardly proposed."

Aging staff

Despite the recent arrival of four new board members, Pemex faces a serious challenge in replacing an aging staff at the highest levels of management. As the organization enters one of the most crucial periods in its history, many of its directors are approaching retirement age. The gap of experience and expertise that they will leave behind will not be easily filled. This problem is compounded by the burden of the company's ever-increasing pension obligations, which totaled $52.4 billion at year-end 2011.

The stagnant structure of Pemex impedes junior level managers from gaining the experience they need to be capable of replacing their superiors when they reach retirement. To make matters worse, in a competitive job market it is becoming increasingly difficult for Pemex to attract the caliber of employee it requires to fill new positions. "Pemex is closely controlled by the Mexican government and so does not have the freedom to offer the bonuses and incentives that private companies can," suggests Jorge Castilla, partner of Human Capital at Deloitte Mexico. "Having pay that is linked to performance can be a motivating factor both for recruiting new staff and for the overall productivity of an organization."

Modifying the way it rewards employees would represent a further rupture from the past for Pemex, but it may be necessary to ensure that it continues to be an appealing proposition for the industry's top talent. Mexico enjoys a demographic advantage with a young, growing population, but this will be lost on Pemex if it does not attract the right people and provide them with the necessary training and exposure to reach top management positions.

Future reforms

If Mexico is serious about achieving a lasting increase in production then more changes are required. One popular opinion is that Pemex should look to emulate Petrobras of Brazil in welcoming private investment to extend its capabilities. This is a view that is shared by Mexico's president-elect, Enrique Peña Nieto, who proposed a wide-ranging energy reform in his electoral campaign. When Peña Nieto officially takes office in December 2012, pushing this reform through the National Congress will be one of his primary objectives. This will present a serious challenge, as he will have to convince not only members of his own Institutional Revolutionary Party (PRI) but also political opponents of its value. To gain the constitutional change that would be required, he would need the support of two-thirds of the National Congress; the alliance led by PRI only accounts for 240 of the 500 seats. Greater private investment in exploration and production activities would free Pemex from the restrictions currently imposed by its fiscal responsibilities. ▪

A worker installs transmitters on equipment in Mexico. (Courtesy Controflux)

An Interview With Mexico's President-elect

Enrique Peña Nieto, of the Institutional Revolutionary Party (PRI), will take office in December of this year. He discusses the reforms that he and his government propose to make in the energy sector

Oil production in Mexico has experienced a slow but steady decline over the past years; pipelines are in desperate need of maintenance and Pemex is facing the important challenge of execution capability. In this context, how important do you think an energy reform would be for Mexico's future?

It is a fact that we will require high levels of investment in both oil production and petroleum infrastructure to fully exploit the potential of our resources. For this reason I have proposed the benefits of carrying out an energy reform that, without renouncing public ownership of hydrocarbons or state control and governance of this commodity, will allow better partnerships with the private sector with the ultimate goal of maximizing the income that the state receives from oil production. It is important to bestow legal certainty on the terms of Pemex's contracting process so that the private sector has more incentives to invest and offer services related to the four areas of the company's operations: exploration, production, refining and petrochemicals.

Through these reforms, Pemex would operate with more transparency and a bigger budget. It would have better management in order to determine the best investment program to ensure the modernization and maintenance of petroleum infrastructure in Mexico.

The balance of power between Pemex, the Ministry of Energy (SENER), the Ministry of Finance (SHCP), and the National Hydrocarbons Commission (CNH) is of key importance for any energy reform. What do you think should be the nature of the relationship between these bodies?

My proposed energy reform focuses on giving Pemex more autonomy over its management and the flexibility to take decisions particularly in the areas of budgeting, contracting and determining future investment programs. However, the state will still maintain in every moment the overall direction of energy policy. I consider it important to increase the independence of the CNH with the objective that it can regulate, judge and supervise the exploration and production of hydrocarbons with greater efficiency. It is absolutely fundamental to define the responsibilities and attributes of the sector's authorities as clearly differentiated from those of Pemex.

How do you plan to open the oil and gas sector to private investment without depriving Mexicans of their control over the country's resources as enshrined in the Constitution?

The energy reform that I have proposed will conserve not only the governance of the state over Pemex, but also the ownership of the Mexican nation over hydrocarbons as established by article 27 of the constitution. The objective is to increase private investment into the petroleum sector in a sustainable manner, above all in the exploration and production of deep water sites. The unique characteristics of these sites coupled with the current regulatory framework do not allow their development, whether that is by Pemex or anyone else. To that end, we will examine the successful mechanisms that have been adopted in other countries, such as Brazil and Colombia.

One point must be made clear; this debate must be centered on the modernization of Pemex and multiplying its execution capacity not in considering the ownership rights of Mexicans over hydrocarbons. This question does not enter into the discussion.

Mexican President-Elect Enrique Peña Nieto

What is your long-term vision for Mexico as an oil and gas producer?

My commitment is to convert Mexico into a major energy power. I have stated the case for an integral reform that will allow us to make the most of the capital, knowledge and technology that third party companies have in order to exploit the full potential of the resources of Mexico. The target is that Pemex returns to its position as the principal driving force of national development; integrating productive chains and generating multiplying effects on the economy.

The reform will represent a step forwards in the progressive transition towards a low carbon economy. Oil revenues, increased by investment and freed from current restrictions, will be used to finance part of the development of renewable energy sources such as solar, wind and geothermal. Mexico has great potential for the use of these energy sources. Currently, one-third of federal government revenues come from the activities of the petroleum sector. These revenues have been used to finance government spending including the financing of social and investment programs.

In the medium term we must be capable of operating a system in which the resources obtained from oil revenues are primarily destined towards infrastructure projects and the creation of capital. In this way economic activity will be incentivized, leading to the creation of jobs and regional development. ▪

Reversing The Declining Trend

Exploiting oil from new sites will require surmounting technical challenges.

Since Mexico reached a peak of oil production in 2004 at a rate close to 3.4 million bbl/d, the news surrounding national production rates has been bleak. Between 2004 and 2008, production rapidly declined and, although in recent years it has stabilized at 2.5 million bbl/d, this is not a level that can be sustained for many years without the discovery and development of new sites. The supply of oil is certainly there (proven reserves stand at 13 billion barrels), the problem is accessing it. Exploiting oil from new sites will, in many cases, require surmounting technical challenges that Pemex is currently not equipped to face; in deepwater areas there is enormous potential but a serious lack of capabilities to exploit it. The company must not only come up with a strategy to deal with this dilemma, but also to balance improving the production efficiency of mature fields with investing in new exploration activities.

Mexico still has great geological potential; the recent excitement surrounding possible shale-gas reserves exemplifies this. In order to achieve a prolonged increase in production levels the national petroleum industry must rapidly adapt the way it operates.

Maximizing efficiency of mature fields

The declining trend in production that Mexico has suffered in recent years came about as a consequence of two things: the decline in production of the Cantarell field and a lack of investment in exploration activities. From its discovery in the 1970s, Cantarell has been the golden goose of the Mexican oil industry. In the 1990s Pemex adopted a strategy of focusing investment on maximizing production at Cantarell and ceased new exploration activities. This left it ill prepared for the decline of the field that began in 2003, instigating a sharp decline in the national oil production rate.

Pemex has since been able to stabilize production but has relied on increasing the efficiency of other mature fields to do so. Ku-Maloob-Zaap is the most productive field today with a rate of 850,000 bbl/d; it, like Cantarell, is located in the offshore Campeche region. Although production at the site continues to increase, it too has a limited shelf life. This has led to fears that when it and other ma-

Stroke and Pipeline Location. Courtesy of Corrosion y Proteccion

ture fields begin to decline, there will be a drastic impact on the oil industry in Mexico.

"Production in Mexico has stabilized but there is a reasonable chance it could fall again, because output has been based on a number of fields that are aging," argues David Shields, a leading industry analyst and editor of the *Energ™a a Debate* magazine, based in Mexico. "If some of them were to decline as sharply as Cantarell did, we would be in trouble."

Although Pemex began investing in exploration activities again in the 2000s, it has so far encountered limited success in discovering new sites, leading to the continued reliance on mature fields. Shields is concerned about the weakness of Pemex's portfolio of producing fields and the lack of exploration success, but he does see reasons for optimism: "They have other fields in shallow water, and big opportunities for enhanced recovery projects using better technology in existing fields."

As demonstrated by the first two rounds of incentivized contracts, the focus on increasing the efficiency of mature field sites has created new openings for services companies that can offer technology and expertise that Pemex would not otherwise have access to. To gain maximum value from these contracts the NOC is looking for integrated service providers. The Schlumberger/Petrofac collaboration is a top-end example of this inclination.

Comesa is a drilling and oilfield services company that in recent years has followed a strategy of restructuring and improving efficiencies to consolidate its position in the market. From this platform the managing director, Adán Oviedo, is now targeting a diversification of its service offering. "Comesa is looking for more partnerships as we look to develop our capabilities and competencies so that we can offer an integrated oilfield services solution to Pemex. Many of the large service providers such as Schlumberger and Haliburton sub-contract for their Pemex projects. The opportunity I spot is to incorporate these small service providers into Comesa, so that Comesa can offer these solutions direct, streamlined, and at a fair cost.

The final goal is to win a contract to become a field operator. "We hope to begin offering a wider range of services to Pemex with the ultimate target of demonstrating that we will be capable of operating a small mature field site."

Comesa is jointly owned by Pemex and Schlumberger and, although these two entities are not involved in the day-to-day running of the company, they represent a strong knowledge base through their expertise and many years of experience operating in the petroleum industry.

Adán Oviedo, managing director, Comesa

The availability of service contracts for operating mature fields has not only created interest for companies long established in the market, entrepreneurs have also noticed the opportunities. Juan Pablo Ballestas Juliao, founder and current chief executive officer of Blastinaval, has created a number of enterprises that provide services to the oil and gas sector. Although he started working in Colombia, he relocated to Mexico in 2001 after spotting the potential of the country's petroleum industry. Blastinaval began life in the Mexican market with a contract to provide anticorrosive maintenance to Pemex's naval vessels. Operations have since diversified and the company participated in the second round of incentivized contracts. Although his company was not a winning bidder, Ballestas Juliao had a positive impression of the process: "I thought that it was a success for Pemex. I believe the organization gained a lot from the process and so did the country."

He suggests that although more reforms may be needed in the future, we should not rush into making them: "I think that there is still a lot of room for making changes, but that at the moment they (the Mexican government) are going about reforming the industry gradually which is the correct way to proceed."

Blastinaval is targeting winning a contract in the future and Ballestas Juliao is optimistic about prospects in Mexico. "For service providers new doors of opportunity are opening; the dynamic these companies offer will teach Pemex a new way of doing things."

Deepwater prospects and new exploration

One of the primary criticisms leveled at Pemex is the lack of a strategic investment program for exploration. The freezing of exploration activities in the 1990s betrayed a short-term approach that exacerbated the impact of Cantarell's decline on Mexico's overall production rate. Carlos Morales Gil has over 30 years' experience of the inner workings of Pemex and has long been a critic of halting investment in exploration. Under his stewardship of Pemex's exploration and production division, this approach has changed and he suggests that we have already seen fruits of this labor. "From 2011 we have been able to replace 100% of our oil reserves through new exploration activities."

Morales states that Mexico's proven oil reserves are already increasing due to the greater number of ongoing exploration projects. Pemex recognizes the huge potential that exists in deep water (defined in Mexico as deeper than meters) areas, but conquering this technically challenging terrain is no easy task. Properly exploring an area that encompasses around 500,000 kilometers requires resources that Pemex does not currently have access to. Once a deepwater site has been successfully identified, exploiting the oil from it will require the use of technology and expertise of the type that Pemex does not currently possess.

"Currently the reserves we are talking about in deep water are prospective, so we must also confirm their existence," explains Morales. "Once we start discovering oil the primary challenge becomes a technological

one. To develop deep water sites at a rapid rate we will need to increase our technological capabilities through greater investment into equipment and the training of our people."

Morales is optimistic that Pemex will be able to overcome these obstacles and begin production from deepwater sites in the near future. Yet David Shields is critical of the recent investments Pemex has made in exploration: "It has spent a lot of money on two non-conventional projects: Chicontepec and deep-water exploration, which have had very limited results, in spite of what Pemex officially says."

Shields highlights the fact that the NOC has drilled 18 deep-water wells but discovered no oil. He adds that Pemex does not have the monetary reserves of other major oil companies, leaving it ill suited to deep water drilling. The successful development of Mexico's deepwater sector may well depend on leveraging the capabilities of foreign oil majors who have global experience in this area. With the advent of incentivized contracts this could be possible and Morales predicts that a future round will focus solely on deepwater activities.

Chicontepec

As Shields mentions, Pemex has directed a substantial portion of its exploration investment towards the exploration of the Chicontepec basin. This is an onshore area located in the states of Veracruz, Hidalgo and Puebla. The first oil fields were found in the area 86 years ago, but it is only in recent years that it has become an investment priority for Pemex. The basin holds proven reserves of 650 billion barrels of oil; however converting this potential into a reality has so far proven difficult and production from the site currently stands at 70,000 bbl/d.

At Chicontepec, as with deepwater sites, a lack of technology and expertise has so far hindered the development of oil exploitation. The basin contains challenging geological characteristics that impede drilling operations. With the background of the decline of oil production nationally, Pemex has invested significant resources into Mexico's largest certified hydrocarbon reserve but has yet to see true return on this investment. Consequently critics have questioned whether it represents an appropriate use of the limited funds Pemex has at its disposal.

A recent study conducted by the National Commission of Hydrocarbons concludes that Chicontepec occupies a large proportion of Pemex's exploration budget but offers little profitability and is high risk. "When Chicontepec is described as receiving high levels of investment this is a relative statement," counters Morales. "Pemex invests 20 billion pesos ($1.5 billion) per year into Chicontepec out of an annual exploration investment total of 35 billion pesos ($2.6 billion). Our yearly production budget stands at 215 billion pesos ($16.1 billion) and we invest 10% of that money into Chicontepec."

His argument is that the reserves the site holds are such that investment into developing the capabilities needed to raise production will pay off in the long term. The potential of Chicontepec is undoubted; 3P reserves from the basin account for 40% of Mexico's total potential. In order to exploit these resources Pemex and its partners must

Grupo TMM's fast supply ship operation (2009), carrying materials, equipment and personnel from offshore platforms in the Bay of Campeche.

Aside from *offshore oil reserves, there is considerable enthusiasm surrounding the possible shale-gas reserves that Mexico holds.*

crack the code of its unique characteristics. The immediate need for boosting oil production suggests that an injection of technology and capital from the private sector could be necessary.

Undoubted geological potential

As the case of the Chicontepec basin demonstrates, Mexico maintains huge potential for hydrocarbon exploitation. The nation occupies 15th position in global rankings of proven oil reserves with 13 billion barrels and potential reserves would dwarf this figure. In 2010, the then Secretary of Energy, Georgina Kessel, estimated that the Gulf of Mexico alone could contain 50 billion barrels of oil.

Excitement still surrounds the offshore sector in Mexico and while deepwater exploration remains an unconquered frontier, moves are already being made to construct new rigs in shallow water areas. The growth of offshore activities in Mexico is likely to be supported by a future round of incentivized contracts focused purely on offshore. At the Offshore Technology Conference in Houston this year, Sergio Guaso Montoya, vice president for business development at Pemex, announced plans to publicly tender offshore blocks before year-end 2012. Two offshore blocks were tendered in the recently concluded second round of incentivized contracts; however, no bids were received for these blocks. Any future round that focuses solely on offshore will have to increase the incentives for any bidders to encourage participation.

Involving expertise from outside of Mexico is not the only way of building capabilities in offshore projects. In July 2012, the board of Pemex announced plans to participate in overseas exploration projects and to buy some U.S. refining assets. This is part of a wider business strategy to increase the international presence of the company. If these plans are successful, Pemex would gain direct experience of working in deep-water exploration and production projects alongside oil majors. This would provide undoubted benefits, not only building the NOC's own capabilities, but also providing it with a better understanding of the conditions that would encourage oil majors to participate in similar projects in Mexican waters.

Aside from offshore oil reserves, there is considerable enthusiasm surrounding the possible shale-gas reserves that Mexico holds. The U.S. Energy Information Authority has estimated Mexican shale-gas reserves at 683 trillion cubic feet. Pemex offers a more conservative estimate of 150- to 490 trillion cubic feet, but, as Adán Oviedo of Comesa explains, this would still represent reserves of global importance. "Even following the conservative estimation of 150 trillion cubic feet, that is still six times what Mexico has in natural gas reserves, which is a huge amount of gas."

Although the technology for extracting shale gas has yet to mature, Morales believes that the capabilities developed in the U.S. can be applied to Mexico and can make its exploitation viable for Pemex. As he details, the company is already putting a serious focus on shale gas: "Pemex has just begun exploring shale-gas areas in the north of Mexico; we are trying to assess the width of the bands of wet gas, dry gas and oil in these sites. This year we will drill 17 new wells looking for shale oil in Veracruz and an area south of the Burgos field."

As with the offshore sector, a round of contracts specifically targeting shale exploitation is seen as the logical next step.

Avoiding the pitfalls of the past

The test will be to see whether Mexico can avoid repeating the mistakes of natural gas exploitation in the country. Despite enjoying plentiful reserves of natural gas and a comparative global price advantage, a lack of investment in gas infrastructure has left Mexico unable to exploit its own resources. Natural gas production falls under the remit of Pemex, but with its current budgetary constraints it is difficult to make a financial case for investment in gas infrastructure, as no financial benefit will be seen for many years.

Jose Luis Uriegas, managing director of Grupo IDESA, a petrochemicals company with over 50 years' experience, argues that Pemex is never going to seriously invest in natural gas production if it has to choose between that or further investment in crude oil exploitation. The profit margins are far greater in the production of oil, so, according to Uriegas, the answer could be greater private sector involvement. "In my opinion, if we had more room in the private sector to produce more gas and ethane we would have a good chance to significantly boost production."

Although production of natural gas is still exclusive to Pemex, construction of pipelines is open to private companies and investors. With some large-scale projects announced, there are reasons to believe that the future of natural gas production in Mexico could be brighter. However, if the nation is to maximize the possibilities that shale-gas reserves present, then following a different model from that applied to natural gas will be important. To achieve this reform may be demanded, as Adán Oviedo says: "There is not enough investment to move towards monetizing this potential (of shale-gas production). Mexico needs to change the rules of the market to make these big opportunities available to the country."

Media portrayals of the oil industry in Mexico focus on the declining rate of production and limits imposed on Pemex by its ties to the government. Despite this, the nation enjoys a wealth of untapped oil reserves. If Pemex is to meet the production targets it has set, there is a strong case for further reforms that will permit greater private sector involvement in all areas of production and exploration. Similarly, it is difficult to see how Pemex will monetize the potential of natural and shale-gas reserves without outside investment. The opportunities remain great for the future of one of the world's historic oil producers but action must be taken now or its decline will become terminal. □

Production Forecast: Where will Pemex achieve increases in oil production?

Pemex has set the target of raising oil production to 3 million barrels per day by 2017. Below Carlos Morales, director of Exploration and Production at the NOC, details the areas in which increases in production are being targeted to achieve that goal.

CM: In order to achieve that target there are certain areas that we project will increase in production and others that will continue with their current rates. We expect that production will remain stable in the south onshore region at 500-600,000 bbl/d, in the Ku-Maloob-Zaap field at 850,000 bbl/d and in the light oil offshore region at 600,000 bbl/d. We are counting on increasing the production of the Cantarell field slightly to around 500,000 bbl/d and bringing Chicontepec up to 200,000 bbl/d, which we believe is a very reasonable target.

There are two new projects, Ayatsin and Ximin, that will go online and account for 250,000 bbl/d. The final part of the equation comes from mature fields; with the advent of incentivized contracts we expect to bring production to 400,000 bbl/d.

Special Regional Focus: The Gulf of Mexico

The importance of the Gulf of Mexico has increased with Pemex's announcement that it is expanding to deepwater exploration.

The Gulf of Mexico, covering an area of approximately 575 square kilometers, is undoubtedly one of the most important regions for the oil and gas industry in Mexico. Of this territory, two of the most productive regions are located in the Northwestern Marine Region and the Southwestern Marine Region, and production has increased by an annual rate of as much as 38.9% in some areas, such as Aceite Terciario del Golfo.

The importance of the Gulf of Mexico has increased over the last years with Pemex's announcements to start expanding into deepwater exploration. According to Pemex, the potential for such projects in the Gulf of Mexico is enormous: 55% of the 54 billion barrels of prospective (potential) resources of crude oil are located within this area.

World-class prospects in the Mexican gulf are nonetheless still uncertain; the particular geological and technical challenges involved, such as the deep underwater drilling and impaired visibility due to thick salt deposits on the sea bed, mean that to make the most of the Gulf's potential, more time, and crucially more investment, is needed in order to recover the ground lost since Mexico's oil production started a steady decline in 2004.

Ongoing geological surveys will take at least three to four years, and Pemex will need to make rapid advances in its technological capacity in order to cope with the demands of operating in the Gulf. Pemex would do well from looking at how well exploited the American Gulf is; large multi-nationals with world-class equipment and systems at their fingertips would be able to make the most of the Mexican Gulf's potential within a much shorter time-frame than Pemex.

No risky investment by Pemex would be needed, nor rapid or extensive modernization; letting the Shells and Chevrons of the industry to tackle the obstacles whilst reaping the benefits would seem an ideal way forward for a country so dependent on its natural resources for its economic well-being.

If Pemex is able to reverse the decline with the reserves in the Gulf, it is estimated that Mexico's oil demands will be met for the next 30 years.

Tabasco: The Energy State

The State of Tabasco is located in the southernmost part of the Gulf of Mexico, bordering the states of Campeche, Chiapas and Veracruz, as well as the country of Guatemala. Because of its importance to the oil and gas industry and the electric power generation, Tabasco has been dubbed "The Energy State." The state contributes 20% of domestic oil production and 42% of gas production. Today, Villahermosa, the capital city of Tabasco, is the axis of the Mexican oil and gas industry, for its proximity to Tabasco's onshore and offshore fields, the presence of several of Pemex's administrative and operational offices, as well as the easy access to Dos Bocas, one of the country's most important sea terminals.

Fluvio Ruiz, independent board director, Pemex

Pemex placed the administrative offices of Exploration and Production (PEP), Gas and Petrochemicals as well as the Administration of the South Region in Villahermosa. Jaime Patiño Ruíz, President of the Asociación Mexicana de Geólogos Petroleros (AMGP), explains: "The decision to place some of Pemex's key offices in Villahermosa, Tabasco, reflects a desire that decision-making on operational issues is decentralized and close to production areas."

He also highlights the importance of Tabasco in creating the perfect oil blend for export: "There is also a significant production of light oil that we use to mix Pemex's ready mixture of offshore heavy oil and the very light onshore oil, which helps us to produce a better final product with higher commercial value."---

Tabasco's location is strategic also when it comes to oil and gas exports as Villahermosa is very close to the seaports that handle 95% of Mexico's crude oil. The most important of these is Puerto Dos Bocas, which is just 80 kilometres away from Villahermosa and is in charge of more than 50% of the crude oil exports in Mexico. The port was constructed by Pemex between 1979 and 1982 and because of its location and accessibility, Puerto Dos Bocas has been the heart of Tabasco's economy. It has become a major trading hub. An example is , which distributes foreign brands equipment in Mexico. Operations manager Hugo Priego Reyna says: "We needed to offer products that cannot be found in Mexico and so we look for products from companies outside of Mexico. Whether our clients ask us or not, we look for new products constantly."

Jose Mercedes Garcia Priego, from Corporativo INASA, a Mexican company specialized in offering environmental services to the petroleum industry, believes that there are many benefits related to being located at Puerto Dos Bocas. "We have a five-year plan regarding the development of a regional center close to Dos Bocas where we could receive water, contaminated material, etc. We want to have all the possible permits and machinery in order to offer a better service. We also want to have portable platforms which we can use to solve problems in different locations."

Onshore and offshore fields

Production from Tabasco comes from both onshore fields, classified by Pemex within the Region Sur or southern region, as well as offshore fields, administered under Pemex Southwestern Marine Region. The southern region encompasses eight states; Guerrero, Oaxaca, Veracruz, Tabasco, Campeche, Chiapas, Yucatán, and Quintana Roo; and consists of five integral business units: Bellota Jujo, Cinco Presidentes, Macuspana, Muspac, and Samaria-Luna. The State of Tabasco includes parts of Bellota Jujo and Samaria-Luna, some of the most important fields of the Southern region.

The most important onshore fields include the Samaria-Luna, which produces over 200,000 bbl/d. Mature fields also include those recently awarded to Petrofac: Santuario, Magallanes, and Carrizo. The region also hosts Delta del Grijalva, whose 10 separate oilfields, of which Caparroso, Sen, and Luna are the most important, produce Olmeca light crude oil, the highest-value crude oil Pemex exports to international markets. Miguel Angel Mendez Garcia, temporarily replacing José Luis Fong Aguilar as Pemex sub-director for Region Sur, explains that the most important project in Region Sur is the Delta del Grijalva, "which provides for around 130,000 barrels per day out of the total 500,000 produced by Region Sur."

The offshore fields in the State of Tabasco are classified within the Southwestern offshore region, an area in the continental shelf and slope waters of the Gulf of Mexico covering over 500,000 square kilometers. The region includes the fields of Abkatún-Pol-Chuc and Holok-Temoa (both of which exceed 500 meters, and encompass the Lakach, Lalail, and Noxal fields) and Litoral de Tabasco. The Litoral de Tabasco fields include May, Yum, Sinan, Citan, Yaxche, Tsimin, Xanab and Tecoalli.

One of the key companies working in the region is Petrofac, which has been awarded the contracts for developing the mature Santuario, Panuco and Magallanes fields. Harry Bockmeulen, country manager of Petrofac in Mexico shares the strategy of the company for the development of the Santuario and Megallanes fields. "Our aim in Santuario is to double production by the end of the first year; in Magallanes we hope to be about 50% above what we first had, and we will eventually more than double it. Maintaining exist-

ing levels was the challenge in the first three months until our rigs arrived; we now have four drilling rigs and two workover rigs. The facilities themselves are getting our attention; they are old, so we have to make investments. Our first three wells have been vertical, but we will be drilling one or two horizontally. Although this is not high-tech, it will be new to the blocks.

"We will also investigate whether fracing can increase productivity. Part of the Magallanes field tends to get waxing up of production, but we will need to greatly increase our knowledge of the chemistry to eliminate these bottlenecks. Overall, our challenge will be to do simple things well. We already use nitrogen to gas lift wells at Santuario and Magallanes. There is an art to getting the pressure right, enabling optimized production. We are open to all new ideas, but by this time next year we have to deliver the field development plan for the next 23 years to Pemex," says Bockmeulen.

As Pemex emphasizes the importance of developing and reactivating many other mature fields in the future, another company has chosen its basis in Villahermosa; the Ecuadorian Sertecpet, which provides technology for the development of mature fields. The general manager of the company in Mexico, Bolivar Araujo, comments: "Our company is able to provide technological solutions for reservoir stimulation especially in mature fields. Our pump 'Jet Claw' is used in hydraulic-lift and has great advantages saving over other conventional artificial lift systems, such as electrical submersible pump, mechanical or progressive cavity; we can obtain different productions and draw a graph to determine the reservoir pressure, the background fluid and the productivity index, obtaining information in real time."

Bolivar Araujo, general manager, Sertecpet

Natural gas production

Tabasco's role is crucial in the production of natural gas as 90% of the country's reserves lie within a 200-kilometer radius of Tabasco. Until relatively recently, Mexico had not given high priority to the development and use of its natural gas reserves as a major constraint remains the lack of investment in pipeline infrastructure for transporting gas over long distances. However, as the production of natural gas becomes more important to the country and as natural gas demand is climbing rapidly, due to greater reliance on gas-fired power generation and privatization of natural gas distribution systems in the nation's largest cities, many companies start to offer services and products focused on this resource.

One of them is Nuvoil, a local company with 25 years of experience in gas management and operation, currently working with Pemex on the "Tres Hermanos" project and developing solutions for air injection to increase pressure. According to the general manager of Nuvoil, Mariano Hernández Palmeros: "Our gas pipeline network has not kept pace with the demand for gas in the country. Mexico's economy must open up to investments in the gas transportation infrastructure in order to have an efficient distribution network- just as it is everywhere else. The most productive gas fields are lo-

cated in the south of Tabasco and combined should produce approximately 1.2 billion cubic feet. However, the need to produce more oil as fuel necessary for Pemex, the consumption of gas does not increase on national level."

A wealth of knowledge

Villahermosa's strategic location has attracted a wealth of both Mexican and international companies, many of which congregate within the Torre Empresarial in Villahermosa.

Something that connects all of them is the opinion that Tabasco is where the opportunity lies. As Arturo Cadena Hernández, general manager of Cahdez, S.A. de C, a Mexican company representing international surface and subsurface valves manufacturers in Mexico, says: "Tabasco has traditionally been quite important in the industry. Currently the region is growing in hydrocarbon production and there are still areas that have not been exploited. In our opinion Tabasco is the area that has greater oil potential in Mexico. The company sees positive growth not only in the region but also in the country as a whole and hopes to see in the near future "adequate technological conditions that allow us to do our own manufacturing in Mexico."

Cahdez represents some of the leading valves manufacturers for surface and subsurface facilities.

Campeche: home to Mexico's most productive fields

The discovery of oil fields off the coast turned Campeche into an extremely important area for the rest of Mexico—over half of Mexico's oil and over one-fourth of the country's natural gas are produced by the wells off the coast of Campeche. The state is located on the continental shelf of the southern part of the Gulf of Mexico and is part of the Sureste basin, which includes the Saline-Comalcalco basin, the Campeche-Sigsbee salt basin and the Villahermosa uplift. This has been by far the most important Mexican hydrocarbon basin, containing two of the most productive fields: Cantarell and the neighboring heavy-crude field Ku-Maloob Zaap.

Félix Cobos Rojas, general manager of IPS Mexico, a company focused on providing integrated technological solutions in the south of Mexico, comments on the advantages and disadvantages that the State of Campeche has and how local companies deal with them: "The South Region is now the second largest in the country in terms of

production. Campeche's infrastructure is favorable for the oil industry. An advantage that we have is our knowledge of the geography and topography of the area; we learned to live with the environment. This is what helps us overcome challenges such as the inherent nature of the state, floods and lack of terrestrial communications."

Although some significant improvement in the state's economy came in the late 1950s when the fishing and timbering industries developed, Campeche's main economic change came with the discovery of its offshore oil reserves in a shallow water region called Sonda de Campeche. When the Cantarell field was discovered it made the state the top oil producer in Mexico, accounting for 70% of total petroleum production in the country. Ever since then, the oil industry has had an increasing impact on Campeche with more than 45% of the state's economy being related to the offshore oil fields located within its territory.

Cantarell

By far the most famous Mexican oil field is the enormous mature field Cantarell, once one of the largest oil fields in the world, it has faced dramatically declining production over the past several years. First discovered in 1971 by a fisherman called Rudesindo Cantarell, by 1979 the field had been operating for four years and the first set of offshore platforms was completed.

As the current administrator of the Cantarell field for Pemex, Miguel Angel Lozada Aguilar explains, the development of Cantarell has been characterized by three stages. "For 14 years, from 1982 to 1996, production was in the range of one million barrels. In 1987, because wells ceased to flow naturally, we introduced an artificial production system called 'gas lift' to boost pressure. The second stage took place between 1997 and 2005 and aimed to maximize the economic viability of exploiting the field, doubling the wells productivity. We have drilled 250 additional wells and constructed a pressure maintenance plant at the field. The last stage occurred between 2006 and 2012 with the start of production decline, characterized by a strong decrease from 1.8 million bbl/d to 600,000 bbl/d. It is worth mentioning that this decline was foreseen and expected. In 2012, we have been close to 500,000 bbl/d, currently collecting 460,000 bbl/d."

In short, the 558,000 bbl/d produced in 2010 represent a 19% decline compared to the levels from 2009 and a 74% decline from the peak production level of 2.14 million bbl/d in 2004.

Pemex maintains that the decline in production did not come as a surprise. In fact, the company has taken various actions to recover a significant volume of oil. Some of the factors that contributed to maintain production rate at 1 million bbl/d include building new platforms and drilling new wells, as well as increasing pipeline and gas treatment capacity to handle greater volumes. One of the most important factors in the company's attempt to maintain production levels was the introduction of nitrogen injection in 1994, when Cantarell lost 40% of its original pressure. This consisted of a $6-billion injection system that was required to maintain the field's reservoir pressure.

Despite all these efforts, the field's decline is inevitable, and the relative importance of Cantarell to Mexico's oil sector has decreased too: Cantarell contributed 22% of Mexico's crude oil production in 2010 compared with 63% in 2004. Since the effectiveness of nitrogen injection diminishes as the concentration of oil in the formation decreases, the excess of nitrogen from the Cantarell field can be invested in the neighboring offshore field, which is currently Mexico's most productive oil field: Ku-Maloob-Zaap.

Ku-Maloob-Zaap

Ku-Maloob-Zaap (KMZ) covers an area of 149 square kilometers off the coast of Tabasco and Campeche, 105 kilometers northeast

of Ciudad del Carmen, Campeche, lying in 100 meters of water. The field comprises five fields: Ku, Maloob, Zaap, Bacab and Lum. As Mexico's most productive oil field, KMZ produces 850,000 barrels of crude oil per day. A key strategy to increase production has been to provide an enhanced recovery drive injecting natural gas and nitrogen into the wells.

The first of the three largest and most productive fields of KMZ, Ku, was discovered in 1979. Together with Maloob and Zaap, the fields produce from the Kimmeridgian, Lower Paleocene-Upper Crataceous and Middle Eocene reservoirs, with total reserves being estimated at 4.9 billion barrels.

KMZ contains 18% of Mexico's non-Cantarell proven reserves and is expected to offset much of Cantarell's decline in production. What makes the field challenging, however, is the nature of KMZ's oil, which is often twice as heavy as Cantarell's.

The current administrator of the field, Félix Alvarado Arellano, comments on how Pemex dealt with this: "The exploitation of KMZ started with the Ku field, which is very similar to Cantarell. The problem, however, came with the Maloob field, where the first heavy oil came from. Thanks to the gradual increase in production, the workers at the field, the people working on the design and the engineering, we could plan and implement changes in a timely manner. However, the problem still persists and two of our main projects are aimed to facilitate handling. Right now we count on the supply of the light oil from the Southwest Marine Region in order to mix our blend and we also continue to sell a commercial mixture through FPSO."

In fact, the FPSO that was installed in KMZ in 2007 has given a boost to the field's production and has become the first-ever ship-shape production floater in the Gulf of Mexico. The owner-operator is the Oslo-based company Bergesen Worldwide. The general manager for Mexico, Johnny Torp, comments on the advantages of the FPSO: "The main advantages are time and capacity. We can build an FPSO in 18 months while the construction of a platform takes much longer. In addition, even in bad meteorological conditions, FPSOs can keep the production going while platforms often have to be abandoned in extreme weather. Our FPSO, Yuum Ka K Naab, has produced around 220 million barrels of oil for Pemex, and has offloaded 720 million so far and its daily separating capacity is 200,000 barrels. The success of our FPSO is tremendous and the fact that Pemex uses it as a show piece, in many situations, we take as an indication that they agree with us. We operate well and have great uptime."

According to Pemex's estimations, the output from KMZ should peak at 933,000 bbl/d in 2016 due to the start-up of the adjacent Ayatsil and Pit satellite fields.

Currently, the Cantarell and KMZ fields together, which are part of the Northeast Marine Region, bring 52% of the total national production. José Serrano, sub-director of the Northeast Marine Region, shares the future strategy for the development of the area: "Our objective is to maintain Ku-Maloob-Zaap between 850,000 and 860,000 barrels and foster a revival of the Cantarell fields, Akal, Sihil, Ixtoc, Ek-Balam, among others in order to reach 1.4 million bbl/d. The idea is that with the implementation of enhanced recovery processes in the Chac Akal field, with the reactivation of surrounding fields and also with a very strict management strategy as in the areas of Ku-Maloob-Zaap, we should keep this platform for the next six years," he says with regard to Pemex's future strategy for the development of the region.

In search of new technologies

New technologies are crucial not only to the future of Cantarell and KMZ but, according to Aguilar, also to the development of the Mexican oil and gas industry as a whole: "The Instituto Mexicano de Petróleo's function is to provide Pemex with new technologies to help us make an optimal use of our sites."

Jaime Gallegos Rosado, chief executive officer of Share Oil & Services

Innovation and the ability to offer new technologies has certainly been the focus of many companies. For service providers such as Share Oil & Services, innovation gives the company an edge in a competitive market. Since there is an increasing need to optimize and increase the efficiency of the current activities in the industry, the company has been investing in research and development to come up with various solutions to support its clients and maximize productivity.

Jaime Rosado, chief executive officer of Share Oil & Services, shares the company's new innovations: "We have 18 new technologies and a research center that handles four different business lines. We have developed a system network that can determine what happens if a well is closed, which one should close, which should open and can make decisions about possible actions. This system reports daily production and can recommend to the person in charge what to do in order to increase production; if for example, there is a well with decreasing production.

"In addition, this network can be used to provide risk analysis or cost-benefit analysis and suggestions for improvement. What makes our technology important is that it can preserve the knowledge generated and ensure it stays within the company. Our technology can make intelligent decisions allowing the company to have a lower dependence on its employees."

This focus on innovation spreads throughout all aspects of the service chain. DTK Group (Drilltec), for example, use a very untraditional approach that aims to save considerable costs to the client through digital rock analysis. John D. Lawrence, chief executive officer of DTK Mexico, explains how the technology works: "This is a brand new technology, developed over the last 15 years or so at Stanford University, the Australian National University and the research center of Statoil in Norway. DTK has done two large pilot studies on offshore fields, which we are now analyzing with Pemex specialists. In contrast to conventional methods of taking measurements on rock cylinders, digital rock analysis makes microscopic images of the internal structure of minute samples, which are then converted into mathematical models and scaled up to normal size for measurements to be made.

"Today, the reliability of this method is just as good as using the rock itself, without requiring the costly process of obtaining substantial samples. Companies do not tend to take these samples very frequently, but our well-site teams can continuously collect minute rock fragments without causing disruption."

With Pemex's strategy to reactivate and develop mature fields, cutting-edge technologies do not just offer a competitive edge, but are crucial to allow the extraction of oil at all. John Bilsland, director general of Regent Steam de Mexico, a Canadian company, leader in sand control solutions and enhanced oil recovery (EOR) solutions that entered the Mexican market in 2009, explains why this change in Pemex's strategy is crucial for the oil and gas industry in the country: "In many places in Mexico,

SHARE OIL & SERVICES
CONSULTING GROUP

-POSL (Production Optimization Services Line)

Studies to ensure stream flow

Traditionally, the analysis of production systems has been split into:

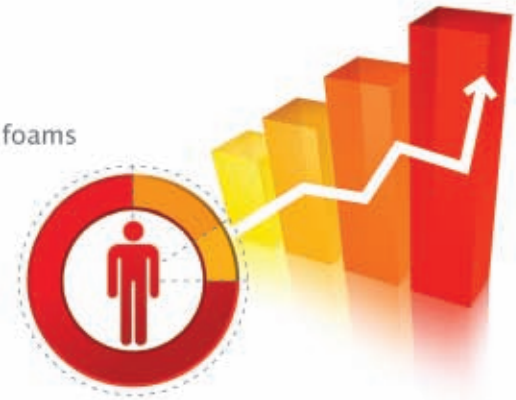
Basin
Basin characterization and simulation.

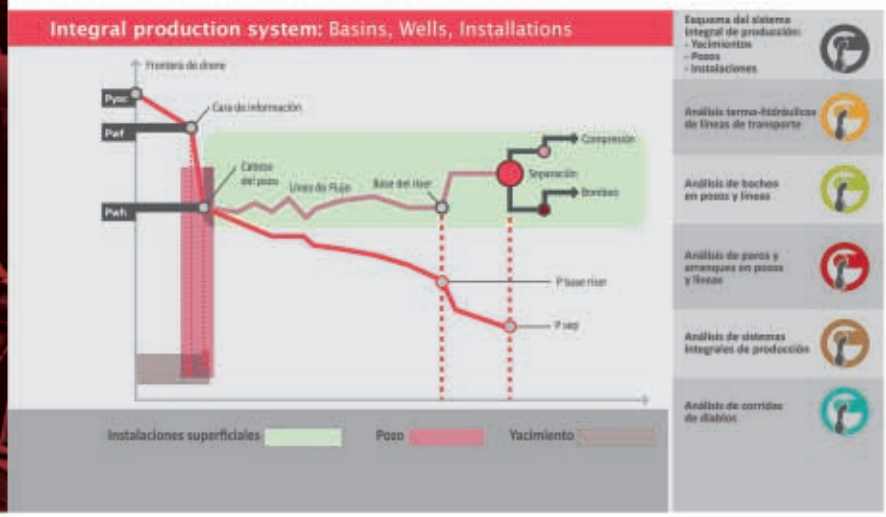
Wells
Evaluation, design and optimization of stationary wells

Installations
Evaluation, design and optimization of stationary processes (Aspen Hysys, Pro/II, Pipephase, GAP, Reo, Pipesim, etc) and transport networks (OLGA)

The evaluation, design and optimization of production systems requires an integral analysis that ensures the challenges of securing stream flow are met.

A) Gas hydrates
B) Paraffin and Alphastenes
C) Sands
D) Incrustations
E) Corrosion
F) Emulsions and foams
G) Batch





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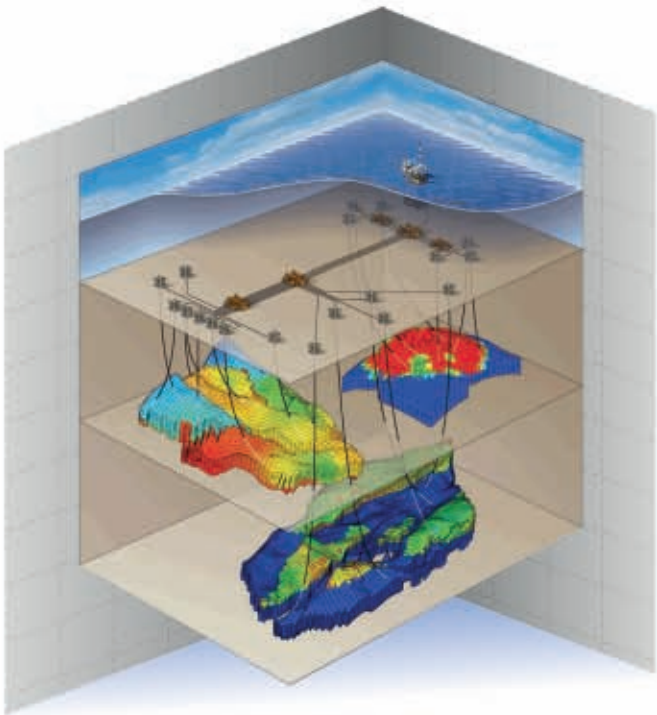
The problems associated with securing stream flow are mainly due to:

- Pressure drop in wells and pipelines
- Marine or land soil characteristics
- Temperature patterns of the seabed and environment
- Terrain characteristics of the seabed or soil
- Flow changes in pipelines
- Changes in fluid properties (RGA - residual gas analyzer, water cuts, static pressure, etc.)
- Compatibility of the chemicals introduced into the product stream

A proper analysis of the problems requires:

- Understanding of the behavior of the produced fluids
- Modelling the flow of hydrocarbons from the basin to the processing facilities



Technical assistance in the operation of production facilities

Characterization of hydrocarbon mix
The characterization allows us to obtain a representative composition of the hydrocarbon flows analyzed with the help of process simulators such as Hysys®, Pro/II® o PVTsi®.

Their main aims are to:
Adjust the properties of the analyzed fluid to the real properties as reported by the PVT (pressure volume temperature) analysis. Reduce the number of heavy pseudo-components to a practical minimum.

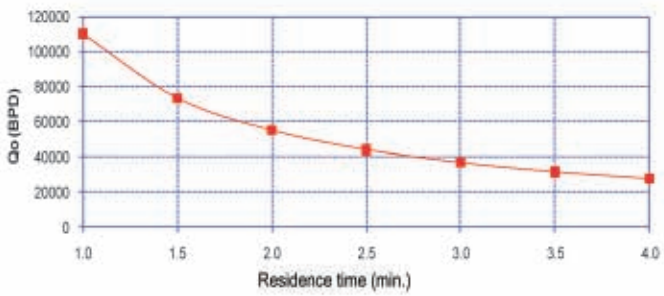
Process simulations in stationary mode

The process simulations through simulators like... allow us to determine the physio-chemical properties of any streams involved in recollection, separation, pumping, compression, treatment and transport of hydrocarbons.

Provided we have process simulation models that are representative of our system, we can predict, anticipate or eliminate problems linked with production handling.

Once the characterization and the process simulation have been carried out, the development of hydraulic analysis, the selecting and sizing of optimal production lines and equipment such as separators, pumps, compressors and valves becomes possible.

- Sizing of production separators, slug-catchers and rectifiers, etc.



- Hydraulic analysis of mixing, oil and gas process systems
- Selecting and sizing of pumps, compressors and valves

Well affluence behavior

$$Q_o = J\left(P_{ws} - P_{wf}\right)$$ ← Productivity index

$$\frac{Q_o}{Q_{o,max}} = 1 - 0.2\left[\frac{P_{wf}}{P_{ws}}\right] - 0.8\left[\frac{P_{wf}}{P_{ws}}\right]^2$$ ← Vogel model

$$F_I = P_{ws} - P_{wf}$$ ← Driving force

John Bilsland, managing director, Regent Energy Group

Pemex has exhausted much of the supply of deeper and older oil, and is now looking at the younger alternatives higher up, which are in sand. It is said that one sixth of the oil in the world has been produced to date; that was the easy stuff, and now we have to go after the more challenging resources, which is where our technology really starts to shine."

Implementing new technologies, however, is not always easy. This is especially true when working with national oil companies like Pemex that have traditionally used more conventional methods in their operations. Pablo Perez, general manager for Petrolink in Mexico, shares his view with this regard: "Big organizations are often reluctant to accept new technologies and this has also been the case in Mexico. It has taken Petrolink four years to break into the Mexican market. It is a time-consuming process but once the companies see the value that new technology offer in terms of time saving and cost and process optimization they become very responsive towards our services."

Petrolink is a British company, pioneer in data management solutions for the oil and gas industry. The company has been in Mexico since 2004 and is currently developing a platform "which enables all kind of data sharing; from operation reports to day-to-day administrative documents," explains Perez.

As Campeche contains the geologically complex Cantarell and KMZ fields, there is a market of both intense competition and significant technical challenges for all companies involved. According to Rosado of Share Oil & Services, however, "every innovative company that offers technology solutions to optimize production and business costs will always have opportunities for success." ▪

A Safer And Environmentally Sustainable Future

Pemex's and the public's attitudes toward safety are changing, and there is a new focus on the environment.

The 2010 *Deepwater Horizon* oil spill focused the world's attention on the Gulf of Mexico for all the wrong reasons. Eleven people died in the explosion and many others were injured. The ecological impact continues to be felt two years later, with deaths occurring among local marine mammals at twice the normal rate. The oil continued to leak for three months and some seepage is potentially still occurring today.

Although this disaster happened in U.S. territorial waters, the reverberations of the incident were felt keenly in neighboring Mexico. Oil and gas has the potential to be dangerous, and to ensure the safety of the wider environment and of the people working at the sites, there is a sub-set of thinkers and workers servicing Pemex whose sole purpose it is to make oil and gas safer and more sustainable.

Changing attitudes towards safety

Pemex historically has been accused of cutting corners and under investment, with an inevitable impact on safety and sustainability. "As a state-owned company, Pemex has always enjoyed a high degree of flexibility and a low degree of control, which resulted in its failure to establish the correct procedures to avoid risks and damages, both onshore and offshore. Still, in a way Pemex is far more protected than any private company, because on top of the typical insurance programs, being a national company it can count on the coverage provided by the state. If something like the 2010 BP spill happened to Pemex, the company might be able to recover more easily than any private company," said Mauricio Llamas, senior partner, Environment Law Mexico, a law firm with expertise in advising on environmental matters.

Mauricio Llamas, founding partner, Environment Law Mexico

The issue at the heart of the problem is an incapacitating bureaucracy. "Since 2001,

the regulations and bureaucracy of Pemex have evolved into a monster that is restricting the government's ability to make active decisions for the benefit of the economy. Worryingly, lack of sufficient investment means that the budget assigned to Pemex projects is less than is required for the project to be safe and world-class. The fact of the matter is that Pemex cannot continue with its current investment program; it is simply not a sustainable model for Mexico's long term economic health," warned Jesus Reyes Heroles of Structura.

However, this is perhaps a somewhat unfair assessment of Pemex; many areas of its operations are indeed world class. "We have found that Pemex has very capable people with very high levels of knowledge about what they are doing. Its technicians are world class. Pemex is working hard to improve what it is doing. Relatively recently it has begun to change in terms of increasing efficiency in operations, and there was a change of mentality in the people of Pemex; they are eager to improve and get on with their work," said Carlos Hoyos, sales manager at Solutions for the Control of Resources, a company that specializes in technology to reduce the environmental impact of industrial activities.

Pemex's recent investments in safety speak volumes; Kidde México, a leading supplier of safety and detection systems, has recently signed the largest ever blanket order for detection systems with Pemex. Horacio Fájer Cardona, director of Kidde México, passionately believes in the vital role of safety detection systems, "Pemex has set up safety policy very well and have just released a new version of Annex S, the document that details safety procedures for the industry. We were involved in the drafting of the document along with other industry players. One of the absolutes at Kidde is to enforce strict environmental and health and safety best practices; we have zero tolerance for someone who does not adhere to those standards. We try to share our best practices within Pemex, who use us as a benchmark for others," said Cardona.

Horacio Fajer Cardona, director, Kidde México

An increasing *emphasis is being placed on operating in an environmentally friendly manner throughout the industry.*

The process of gaining wide acceptance for improved safety standards has at times been symbiotic. "The way Pemex perceives Bureau Veritas depends on the people and the area we are dealing with. We are working with these people to change their mind and to disprove the opinion that we are merely bureaucrats; the certifications we offer are much more than that. Our mission is not to sell a framed certificate to be hung on a wall; we sell a concept and an asset, the reduction of risk," explained Rafael Parrilha, country manager at Bureau Veritas, a company, founded in France in 1828, that today offers safety certification and advice on reducing risk to companies throughout the world.

Reducing the environmental impact

If anything demonstrates the passion of the public for environmental concerns, it is the hijacking of Shell's recent online PR campaign. The public was invited to design and post Shell adverts on the company's website, but this quickly became a space for the expression of sentiment against the oil and gas industry and the environmental impact it is perceived to have. Public pressure aside, the need to develop sustainable business models has increasingly become a necessity; the global population hit 7 billion in October and will continue to increase apace along with demand for food, water and other natural resources. The reality is that businesses must do more with less. Mexico's short-term future cannot come at the cost of Mexico's long-term future. Just how green are Pemex and the Mexican oil and gas industry?

"Mexico has developed its environmental legislation over the past 25 to 30 years, and it has happened very slowly. Many environmental practices were established in the country as a result of international companies who had to comply with global regulations, and thus were ahead of local legislation and enforcement. For instance, we worked on site abandonment processes, which was an issue not covered by Mexican legislation until 10 years ago. Working with international clients, we created the processes and practices that have now been integrated into law. Today, Mexico has a comprehensive legislation, although it still retains a situation very different from that, for instance, of Chile, when it comes to energy and oil," says Llamas of Environmental Law. "Furthermore, when contracting a private company, Pemex now passes on its obligations, so that contractors have to comply as well."

One such contractor is Corporativo INASA, which was established in 2009 with the main objective of providing environmental management services to Pemex. "The most important factor for our development has been the demand for our services, which is constantly rising due to increasing government regulations. Our main area of operation is water treatment. The technology we use allows us to install our platforms and at the same time ensures that, while installing and operating, we are not actually contaminating the water ourselves. It is important for us to achieve our business goals, but doing it in a clean way is our main priority," said Jose Mercedes Garcia Priego.

An increasing emphasis is being placed on operating in an environmentally friendly manner throughout the industry. "Respecting environmental norms is intrinsic to our culture, our values, and our business model. We currently have three researchers studying environmental technologies, so that we will be able to provide products that, in turn, would allow clients to sensibly reduce their greenhouse gas emissions," explains Octavio Figueroa, projects manager at Bombas Internacionales Mexicanas (BIMSA), a proudly Mexican company that supply pumps to the oil and gas industry.

He emphasizes that an important part of the research and development that the company does is targeted at increasing sustainability. "We are always ready to work on the most recent technologies, which are also the more sustainable ones. Without such a focus on research, we would not be able to offer products of high quality and sustainability."

Figueroa was critical of past government policy changes that have limited the capacity of Pemex to invest in research: "Over three decades ago, Mexico adopted an energy policy that resulted in a dramatic downsizing of the research and development function of both Pemex and the Comision Federal de Electricidad (National Commission of Electricity); those policies sacrificed Mexico's most valuable resource: its human capital."

Attitudes seem to have changed in recent years and a renewed focus on research and development across the oil and gas sector will hopefully lead to a future for the industry in Mexico that is not only economically viable but also environmen-

Foreign Companies And Investment

Questions remain regarding the potential risks and restrictions imposed on foreign companies.

The Energy Reform of 2008 created provision for the greater involvement of private companies in the exploration and production of oil in Mexico through the introduction of incentivized contracts. Much emphasis was placed on involving the expertise and technology of international companies. President elect Enrique Peña Nieto has spoken about the need for opening the energy sector further to welcome foreign companies and investors. For many considering entering the Mexican market, questions remain regarding the potential risks and the restrictions that will be imposed on their activities.

Law firms have seen a surge in business in the energy sector in recent years and they are well equipped to explain the risks of operating in Mexico and the intricacies of the country's regulatory frameworks. As with many Latin American countries, Mexico suffers from an image problem regarding the transparency of its business culture.

The problem for foreign entrants can be a failure to understand local business norms rather than anything more sinister. "Transparency is about what you know about a country and a business," argues Hunt Buckley, partner at Haynes and Boone law firm. "If you present a Mexican businesses man with a morass of U.S. business law he will think that there is no greater opacity. The lack of transparency is perhaps more a consequence of lack of local understanding; you do not hear Mexicans talking about lack of transparency, it is always foreigners."

The difficulty is not so much the regulatory framework itself, but a lack of information about the regulatory framework. Héctor Jesús Dagdug Rangel, from the Villahermosa-based law firm Dagdug & Rangel, shares his view: "We need to provide foreigners with information; we provide services to assist foreigners when setting up new business here; we help them to channel and make an informed decision on which is the best way to come and invest in Mexico. The bureaucratic procedures have been simplified now; the new law helped for the opening, which has been the desired effect."

Pemex was praised for the clarity of its new incentivized contractual process and the general trend in Mexico seems to be towards greater transparency in business practice. The 2012 World Bank rankings for "ease of doing business" place Mexico at 53 out of 183

Ander Cortazar, managing director, Rotork

economies measured.

These rankings are based on the analysis of quantitative data to compare business regulation environments. Mexico occupies a respectable position, one which is enhanced, when it is considered that Brazil, India and China are ranked 126, 132 and 91 respectively. However there is still room for improvement as demonstrated by Transparency International's Corruption Perception Index which awards Mexico a score of 3.0 on a scale of 0 (highly corrupt) to 10 (very clean).

The other major concern in Mexico is security. The nation has been plagued with drugs-related violence in recent years. President Felipe Calderon's war against drugs cartels has been positively received by the majority of Mexicans, but has coincided with a surge in violent deaths in a nation.

FTI Consulting is an international consultancy with global expertise in providing security intelligence. "We provide our clients with real-time information and preventative tools so that they are both aware of any potential threats and able to act on this information to prevent there being any impact on their operations," explains Aldebarán Melgarejo, managing director of the firm's Mexico office.

Melgarejo believes that there will be a shift towards greater foreign investment from emerging market countries, such as China and Brazil, where investors are more risk tolerant. That is not to say that traditional global investment centers should avert their gaze from Mexico; although investors must be aware that there is a risk, the potential gains outweigh the cost of mitigating this risk.

Entering the market

The necessities of increasing production from mature fields and operating in demanding environments have created an opening in the market for companies that offer advanced technological capabilities. Working with local partners can be a solution for foreign companies looking to penetrate the market. K-Tronix is a Mexican company that provides Pemex with power generation systems. It enjoys collaboration with a Swiss company, New Wave. The products K-Tronix sells are manufactured in Switzerland, meeting with international standards, but built to the specifications of the Mexican market. "Foreign companies sometimes have directors in Mexico but they often do not have the power to make quick decisions," asserts Salvador Aguilar, managing director of the technology company. "There are corporate politics that restrict them. The advantage of being a Mexican company is that we meet with all Mexican laws and are more agile."

Aguilar is constantly on the look-out for new technologies that could improve his company's capabilities, "I demand to my team of

engineers that we are both present at many technology expositions and are attending others. It is of the utmost importance to find new sources of power, electrical components, manufacturers of transformers and relevant laboratories. Technology and the rules of the game are developing rapidly and we have to be quick to adapt by adopting new innovations that will improve our product offering."

He sees combining a local understanding of the specifications that are needed in the Mexican market with an international standard of cutting-edge technology as a model for success.

Another solution for foreign product manufacturers can be to acquire a local distributor and gain an instant local sales network. Rotork is an international manufacturer of actuators and flow control systems with headquarters in the UK; in 2011 it bought its local distribution office in Mexico, Rotork Servo Controles. "We are seen in the industry as Mexican, rather than as British or American," states Ander Cortazar, managing director of the company's operations in Mexico. "This perception was certainly helped by the fact that we were present here first through a local distributor; more recently, the industry has appreciated our strategic decision to commit to Mexico."

Building a reputation in Mexico through establishing a relationship with a local distributor can be the foundation for a more prominent entrance into the market at a later stage. Cortazar affirms that Rotork are in Mexico for the great prospects in the country's oil and gas industry. "We want to follow the trend of growth set by the company globally, and this is the ultimate reason why we are investing into Mexico: we see the country's potential. Rotork will keep working with Pemex, but also look at other clients, always maintaining quality as our biggest advantage."

Local companies remain important

The Mexican oil and gas market is opening to foreign companies and this greater international involvement is trumpeted by many as the solution to the problems the industry currently faces. Yet it is important not to forget that local companies have

Héctor Cuellár Sanchez, president, Válvulas Worcester de Mexico

been the foundation of the industry throughout its history. The introduction of high-end technology from global companies will not be worth much without the backing of the Mexican companies that have worked in the industry for decades.

Gabriel Moreno is the managing director of Flow Control, a company based in Mexico City that has been supplying equipment to the oil and gas industry since its creation in 2000. Moreno would welcome greater levels of private investment into the sector as long as it is carefully monitored. "I do not think that we can be closed to investment, but I do believe that we must ensure the quality of each investment."

He sees collaborations between companies that are established in the market and private investment as a sustainable way forward that would support growth. Flow Control has a partnership with Cameron, the American equipment supplier and Moreno recognizes the benefit of specific experience and expertise that foreign companies can bring to the market. "Cameron has a specialized deep water division that is developing projects in the Gulf of Mexico with Petrobras and some American companies. Our strategy will be to work with companies like them that have specialized expertise so

The introduction *of high-end technology from global companies will not be worth much without the backing of the Mexican companies that have worked in the industry for decades.*

Grupo TMM's harbor tugs provide towing service in Manzanillo, Colima.

that when it is required in Mexico we can also participate."

Moreno emphasizes that, for any company looking to provide products to Pemex, meeting with its particular technical specifications is a key criterion. This a view that is supported by Héctor Cuellár, president of Válvulas Worcester de Mexico, a valve manufacturer with 50 years' experience in the Mexican market and a long established relationship with Pemex. "The products we manufacture for Pemex are tailor-made to its exact specifications. This is something that applies to all of its contractors; in order to win a contract with Pemex, you must comply with its technical requirements."

In the past Pemex has been accused of choosing the supplier with the most economic offer and not rewarding companies for the quality of their products. Cuellár has seen this attitude change: "Pemex now chooses its partners using the discretion that its experience affords; companies that offer a cheap quote but supply low quality goods will not last long." He believes this attitude has created a stronger market, "The market evolves in this way and becomes more competitive as the weaker providers are forced out."

Cuellár believes that reducing restrictions on investment in the oil and gas sector may be necessary to reverse the recent declines in production. However he also recognizes that anyone who proposes such changes will have to overcome the weight of historical opposition, "The history of oil production in Mexico is tied to the widely-held belief that unless our natural resources were protected and kept in Mexican hands it would only be foreign companies that would benefit from their extraction."

There are strong arguments in favor of a greater opening of the Mexican petroleum industry to foreign companies and investment. To achieve a sustainable increase in oil production will demand greater resources and capabilities than Pemex can currently offer. Pemex must also function in a more commercial manner to increase efficiencies across the board. Greater involvement from the private sector could have a significant positive impact on both these issues, but that is not exclusive to foreign private companies. Mexican companies will also play a critical role whether as partners or leaders in their own right.

Any opening of the market must be supported by Mexicans for it to succeed. The challenge for Enrique Peña Nieto and his new government will be re-awakening the national oil colossus, Pemex in a manner that does not disturb the pride that Mexicans have in maintaining the sovereignty of their national resources. ▪