

Mexico's Petroleum Future

Understanding the
Economic Value of the
New Energy Model

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ABOUT THIS REPORT

Mexico is an essential piece of the North American petroleum production platform. The energy reform measures implemented in Mexico over the last few years, also known as the New Energy Model, offer considerable potential to lift oil and gas production, increase employment and deliver technological advances, and crucially additional revenues for federal, state, and local governments. The New Energy Model, if implemented, will also enhance long-term energy security for Mexico and North America. Energy reform in Mexico is contributing to the likelihood that North America will become a sustained net exporter to world markets in both petroleum (crude oil and refined products) and natural gas in the coming years.

The New Energy Model has brought new investment into Mexico's petroleum provinces, and today 107 licenses have been awarded for investment to 73 companies. There has been significant investment in seismic surveys and commitments for new wells. This expanded activity in the petroleum sector, entirely from private investment, has led to new discoveries. Crude oil production, on a long decline in Mexico, is now set to rise substantially starting in 2020. By any standard, the Mexican energy reform represents a remarkable achievement, but many Mexicans remain suspicious of the reforms given the history of corruption in the country and within Pemex.

Mexico's recently inaugurated new president, Andrés Manuel López Obrador (often referred to as AMLO), has expressed skepticism towards the energy reforms and in particular the speed of implementation. His policy proposals include broad and extensive programs to address income inequality and an initiative to increase investment in essential infrastructure, with an emphasis on rescuing Mexico's energy sector. Some of these policy initiatives include a major rethinking of the New Energy Model, including more state control over the energy sector, and increasing the authority and funding for Pemex. On December 5th, 2018, AMLO publicly stated that more investment is needed from private firms that have been awarded concessionary exploration contracts under the New Energy Model. He is also seeking a three-year halt to new oil and gas bid rounds to make an assessment of whether the foreign firms will deliver adequate investment and new production, although he has remained committed to not interrupting existing concessions.

Although Mexico has not had a full public debate on all aspects of AMLO's criticism of the New Energy Model, this EPRINC assessment demonstrates that the reforms offer considerable potential to provide new revenue to meet the funding requirements for many of AMLO's proposed social programs. Any decision to substantially alter the New Energy Model should also include a full debate on the merits and demerits of substantial retrenchment to the energy reform program. In order to begin the discussion over the future of the New Energy Model, this report addresses some of the central concerns in Mexico's petroleum future, including an estimate of the economic value of the energy reforms. The report is separated into three sections. It begins with the role of petroleum in the Mexican economy, including an estimate of direct and indirect economic benefits. This section is followed by an evaluation of the New Energy Model and its likely implications for the Mexican petroleum industry and the national economy. A concluding section provides an evaluation of how other petroleum-rich oil provinces, with government managed petroleum sectors, have dealt with oil and gas production decisions and management of the industry.

ABOUT EPRINC

The Energy Policy Research Foundation, Inc. (EPRINC) was founded in 1944 and is a not-for-profit, non-partisan organization that studies energy economics and government policy initiatives with special emphasis on oil, natural gas, and petroleum product markets. EPRINC is routinely called upon to testify before Congress as well as providing briefings for government officials and legislators. Its research and presentations are circulated widely without charge through posts on its website. EPRINC's popular Embassy Series convenes periodic meetings and discussions with the Washington diplomatic community, industry experts, and policy makers on topical issues in energy policy.

EPRINC has been a source of expertise for numerous government studies, and both its chairman and president have participated in major assessments undertaken by the National Petroleum Council. In recent years, EPRINC has undertaken long-term assessments of the economic and strategic implications of the North American petroleum renaissance, reviews of the role of renewable fuels in the transportation sector, and evaluations of the economic contribution of petroleum infrastructure to the national economy. Most recently, EPRINC has been engaged on an assessment of the future of U.S. LNG exports to Asia and the growing importance of Mexico in sustaining the productivity and growth of the North American petroleum production platform.

EPRINC receives undirected research support from the private sector and foundations, and it has undertaken directed research from the U.S. government from both the U.S. Department of Energy and the U.S. Department of Defense. EPRINC publications can be found on its website: www.eprinc.org.

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EXECUTIVE SUMMARY

The petroleum industry has long played a major role in the Mexican economy and, with the recent reforms, should continue to make a significant contribution to economic growth, employment, the federal budget and the country's trade balance. Because it represents only about 10% of the economy, the negative effects associated with the "resource curse" are not significant.

Even with the recent decline in oil prices and production, the petroleum sector comprises 8% of the Mexican economy and directly employs 130,000 workers and about 500,000 jobs more indirectly. Payments to the federal budget in 2017 were \$46 billion, and the trade balance was improved by approximately \$35 billion, three times the 2017 deficit. This occurred despite the current low level of prices and production.

The New Energy Model has already brought in roughly \$1 billion in bonuses from companies bidding on leases and commitments of \$161 billion in capital expenditure. Even including only the early discoveries offshore and expected onshore production, a peak production of 400 tb/d (thousand barrels per day) is likely. Revenue to the government should be as much as \$7 billion per year, including land rentals, and would be much more if the government continues to offer blocks for lease.



KEY FINDINGS

- ▶ The petroleum industry doesn't dominate the Mexican economy, but it makes a significant contribution.
- ▶ It accounts for up to 10% of Mexican GDP, and directly or indirectly accounts for about 400 thousand jobs.
- ▶ Without the petroleum industry, Mexico's trade deficit would be four or five times the current level.
- ▶ Under the New Energy Model, the government has already received \$1 billion USD in bonus payments and production from planned developments should peak at nearly 400 tb/d, yielding \$6 billion in royalties per year or more, depending on world oil prices.
- ▶ The additional gas production already planned should reduce SO₂ emissions by 700,000 pounds and 200 pounds of mercury per year at the peak, if the additional gas produced substitutes for coal consumption.
- ▶ Private sector companies are generally more efficient than state mineral enterprises, with costs at half or less those of Pemex, freeing up more revenue for the government.
- ▶ The additional work force employed for these developments will typically be skilled labor, earning higher wages than most workers, and helping to upgrade the work force.



THE ROLE OF PETROLEUM IN THE MEXICAN ECONOMY

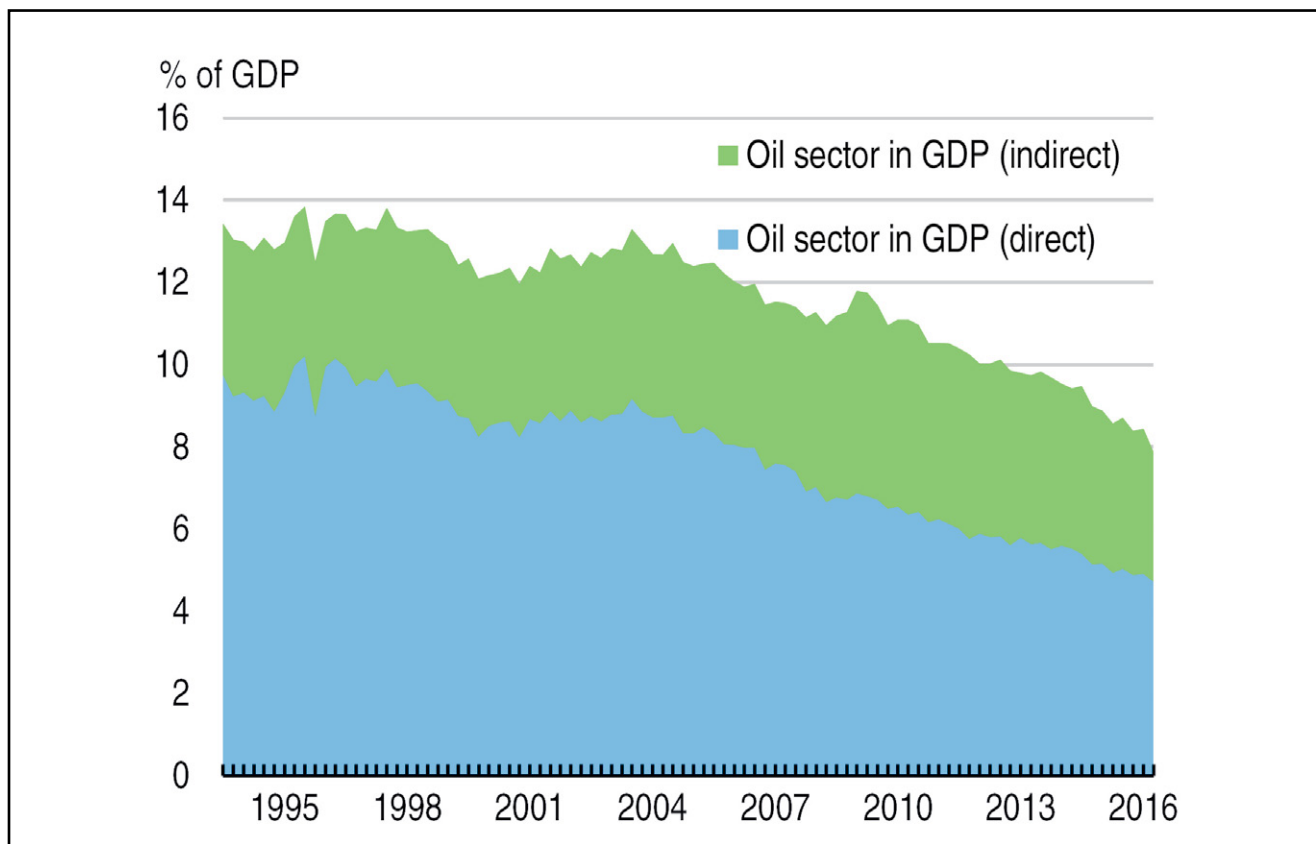
The Current Industry

Oil has a number of effects on the Mexican economy, some direct (i.e. cash payments) and others indirect (i.e. employment of skilled labor). The former are particularly easy to quantify, although care must be taken to avoid assuming a high degree of precision; the latter are important and should not be ignored because they are less quantifiable.

The petroleum industry represents roughly 8% of Mexico's GDP, according to the OECD,

including indirect benefits (Figure 1). The number has decreased significantly in recent years with lower oil prices, as well as lower oil production and exports, which could of course be reversed. The direct contribution reflects revenue from petroleum and investment by the national oil company, while indirect contributions are primarily due to the multiplier effect, as the petroleum industry spending and income pass through other sectors of the economy, such as the steel industry.

Figure 1
Petroleum Sector as Share of GDP
Declining Contribution of the Oil Sector

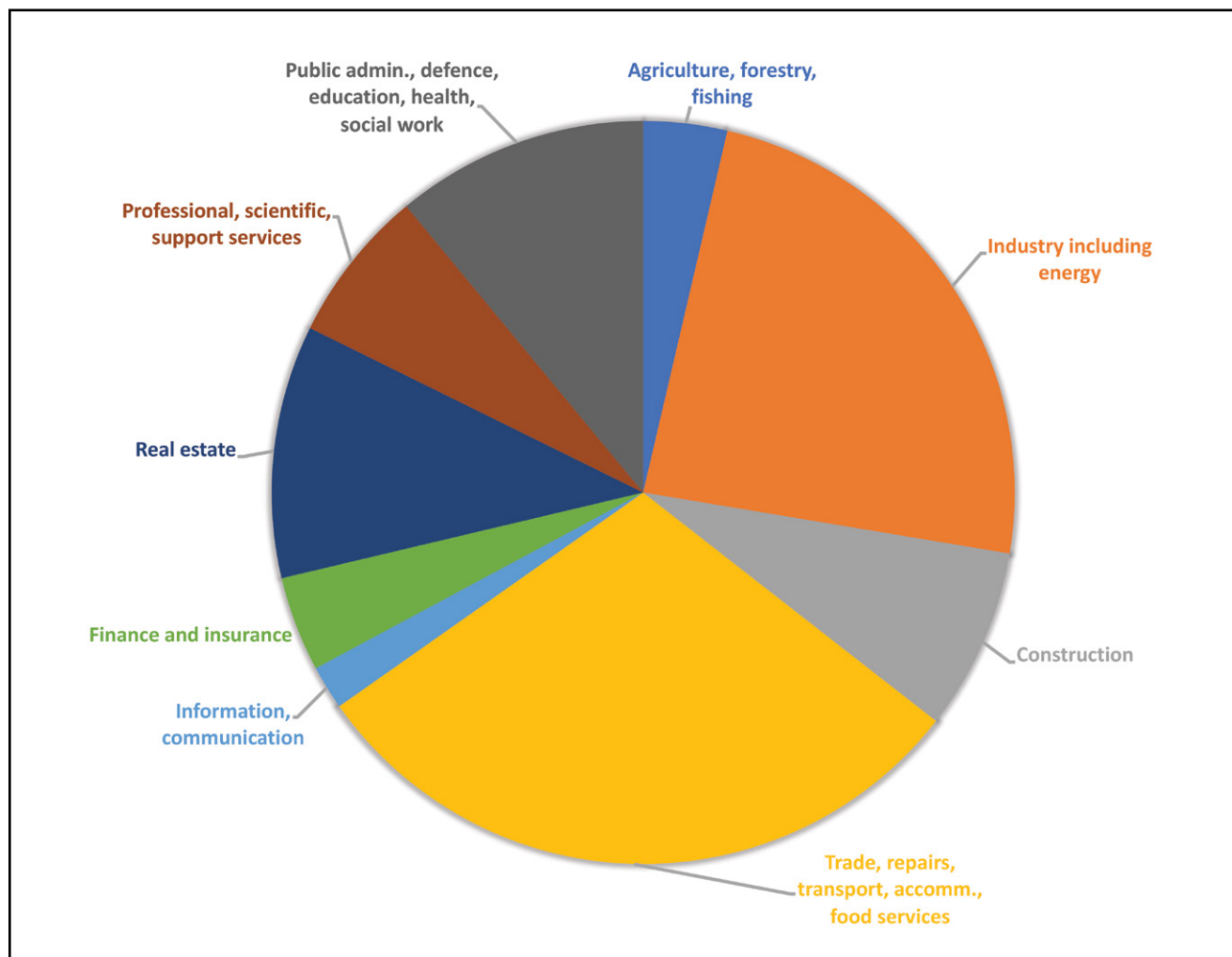


Source: OECD *Economic Surveys: Mexico*, January 2017, p. 19

The Mexican petroleum industry is roughly the size of the public, construction, and real estate

sectors, as shown in Figure 2.

Figure 2
Sectors in the Mexican Economy



Source: OECD Country Statistical Profiles

Additionally, the petroleum sector, through its spending and salary payments, creates indirect economic activity in Mexico. Estimates for this “multiplier effect” vary, but Table 1 shows the result of research by two consulting firms, Price Waterhouse and IHS, for the United States. The former estimate refers to the oil and gas sector, the

latter only the gas industry. The implication of the table is that the total contribution of the oil sector to the economy is more than twice that of the sector alone; and for every employee in the petroleum industry, there are more than three working in jobs that support the industry.

Table I
Multiplier Effect: Indirect Jobs Created by Oil Industry

	Direct	Indirect	Total	Multiplier
PWC Value added (\$billion)	465	617	1082	2.33
(oil and gas) Employment (000s)	2192	6968	9160	4.18
Labor Income (\$billion)	176	357	533	3.03
IHS Value added (\$billion)	172	213	385	2.24
(gas) Employment (000s)	622	2206	2828	4.55
Labor Income (\$billion)	70	111	181	2.59

Source: "Macroeconomic Impacts of the Domestic Oil & Gas Industry," prepared for the Macroeconomic Subgroup, September 2011. Working paper 5-1, National Petroleum Council, Washington, D.C. p. 3

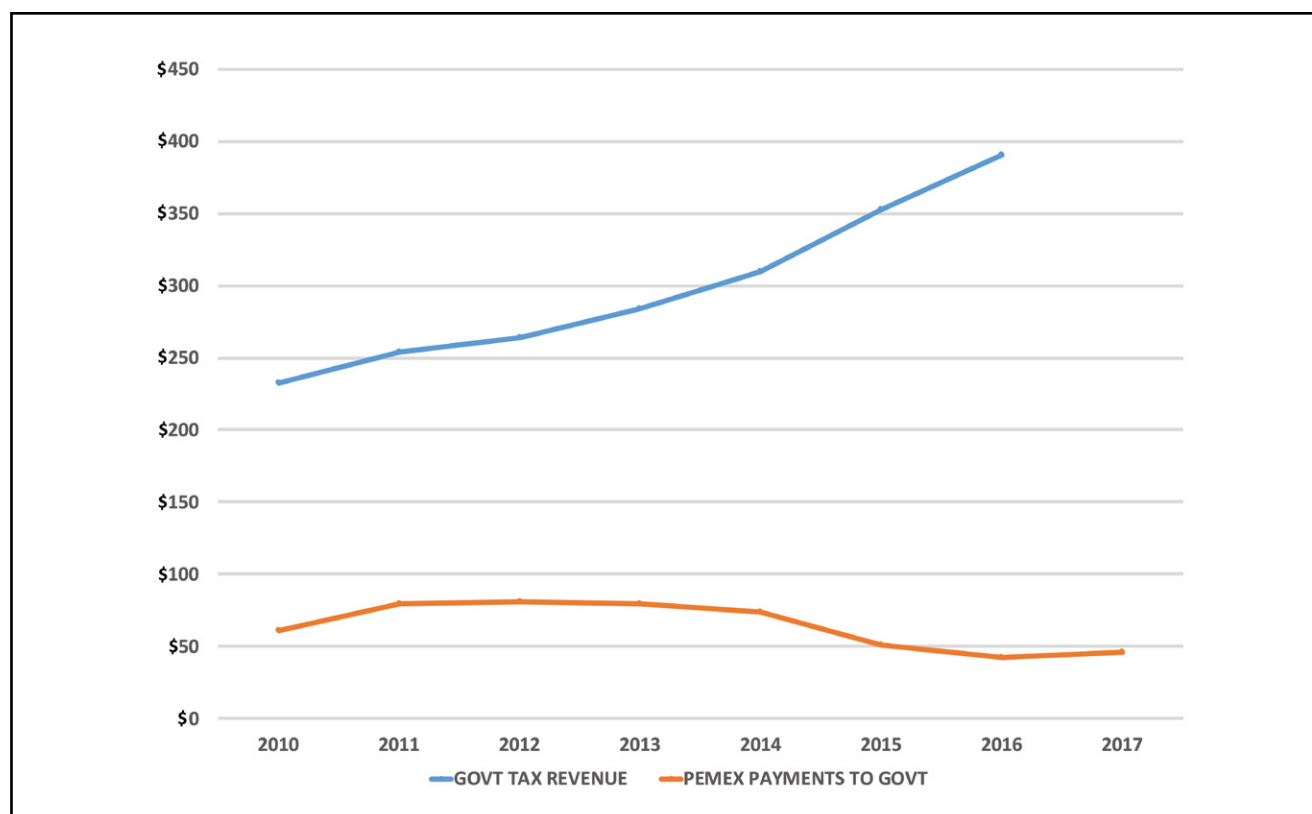
Direct Benefits: Government Revenue

The most clear-cut benefit to the country of Mexico is the revenue which flows to the government from the petroleum industry, whether originating in Pemex or the private companies. Historically, of course, most of the money has come from Pemex, but in the future an increasing amount

will come from bonus payments, royalties, and/or taxes paid by private operators.

Figure 3 shows payments over time related to government revenue; until the 2015 price collapse, they were roughly 25 percent. They remained at 10% of government revenue in 2015, but prices have recently declined.

Figure 3
Pemex Payments to Government (Billion USD)

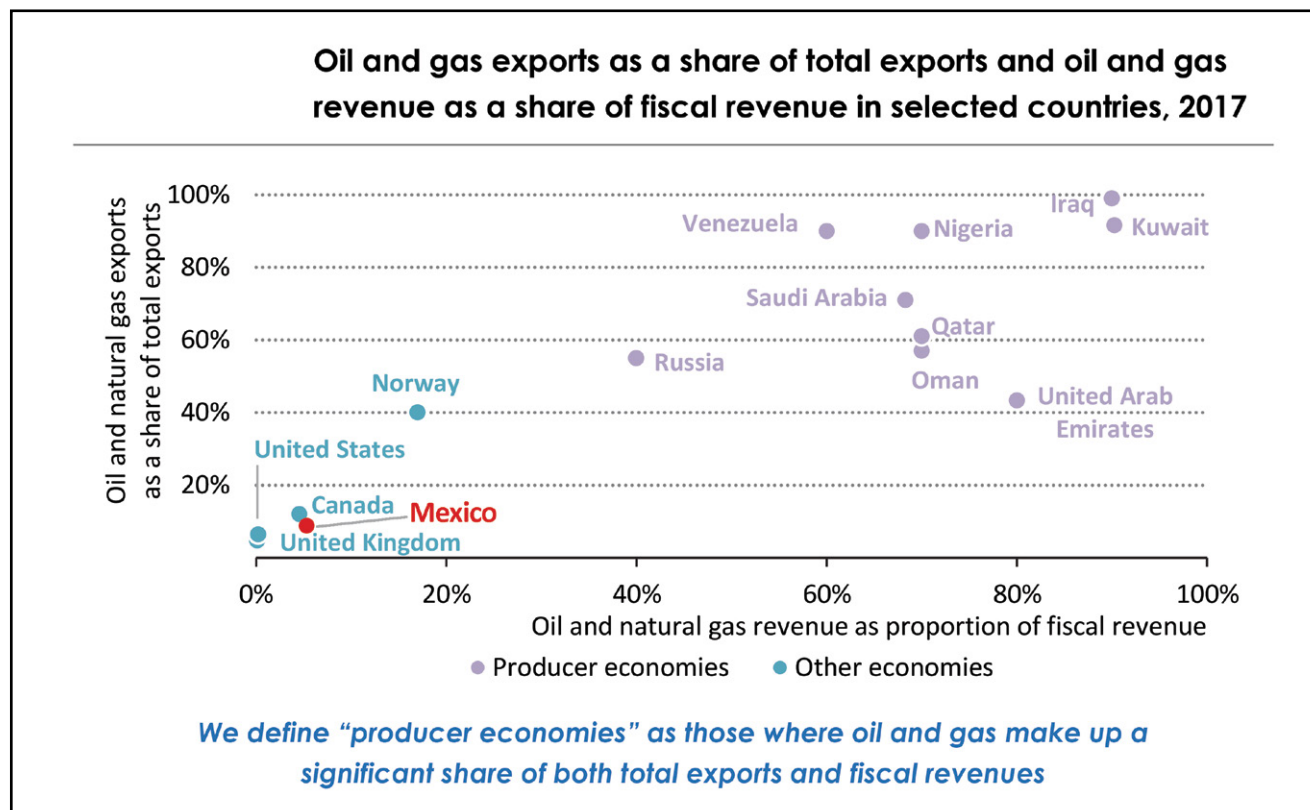


Source: OECD, Pemex

For a country that is not heavily dependent on oil for the bulk of its GDP (like most OPEC nations as Figure 4 shows), this is a large amount and has been very beneficial in supporting government

finances and programs. A reduction in revenue from the petroleum sector would severely crimp the government's ability to undertake investment in new programs.

Figure 4
Petroleum Revenue in Various Nations



Notes: For Russia, the oil and natural gas revenue as a share of fiscal revenue refers to the federal budget, which we have considered for the sake of consistency with other countries covered in this report. Revenues from oil and natural gas account for around 20% of Russia's consolidated budget, which includes revenues and expenditures in the Russian regions. Sources: Extractive Industries Transparency Initiative submissions; national accounts; World Bank

Employment

At present, an estimated 130,000 work directly in the petroleum sector,¹ while it is generally assumed that there are many more who are supported by the sector such as in the steel industry housing providers, medical care, and so forth. As Table 1 above shows, indirect employment resulting from the sectors is usually more than three people

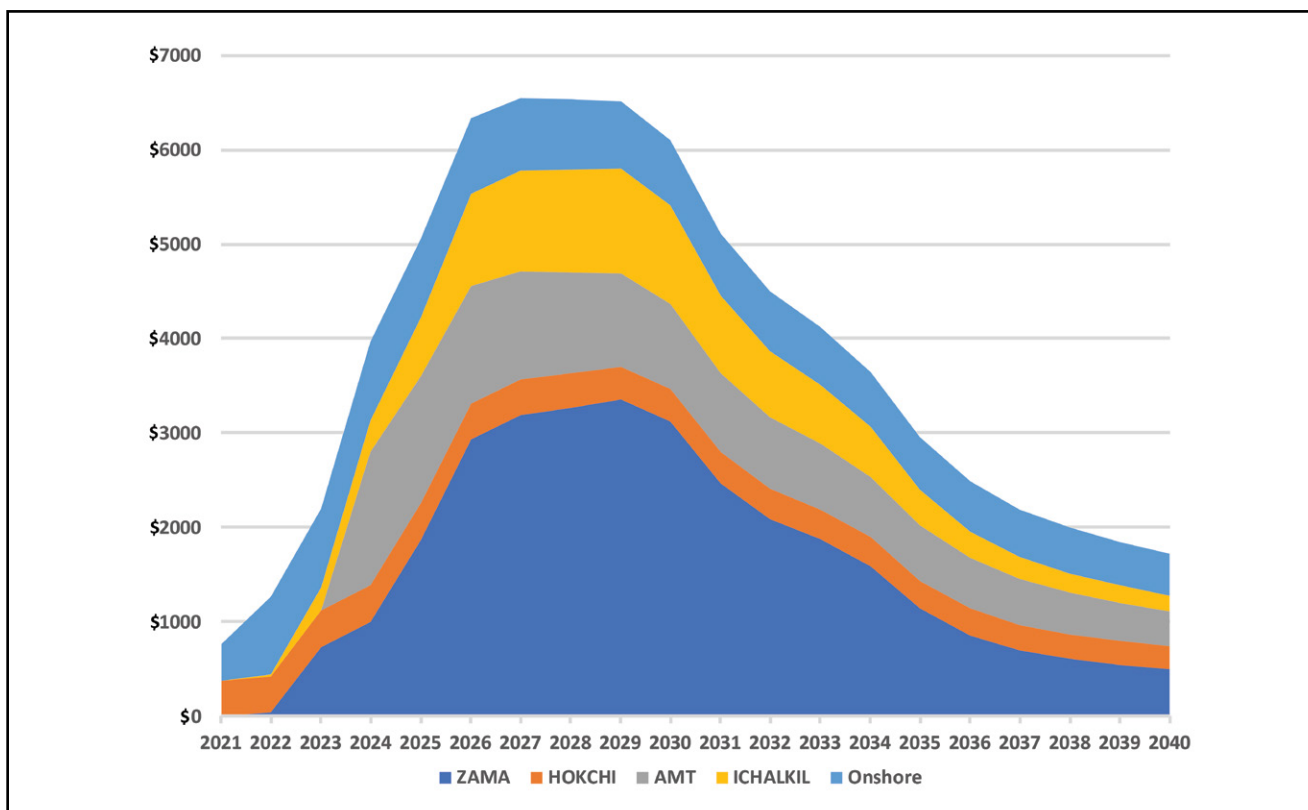
for every one employed in the industry, implying that perhaps an additional 400,000 workers owe their jobs to the petroleum sector in Mexico out of a national labor force of over 55 million. This means that petroleum-related employment is roughly 10%, or close to the share of the petroleum sector in the economy demonstrated in Figure 1.

New Revenue Streams

With the New Energy Model, there have already been payments to the government of \$1.4 billion in bonuses from companies bidding for oil leases, and an anticipated \$151 million annually in fees for surface rental.² Royalties on projected production are shown in Figure 5, based on rough

assumptions of production profiles and a 55% royalty, using the IEA New Policies price scenario. Precise amounts will vary according to a variety of engineering decisions and the actual price path which occurs, but just these four projects — plus new onshore production — should contribute, at a peak, over \$6 billion to the Mexican budget.

Figure 5
Royalties from Planned Oil Projects (Million USD)



Source: Calculated by the author³

Production Timing:

Cost of Leaving Petroleum in the Ground

One constant in energy policy making has been the debate over the timing of production, with the private sector typically seeking to produce as fast as possible while some analysts and academics suggest it is better to delay production. This debate has largely occurred following the large oil and gas price increases in the 1970s and the accompanying fears of future resource scarcity, although some of the arguments seem to have a scientific rationale behind them.

In truth, a number of countries have adopted

the approach of limiting production for a variety of reasons, some of which are quite logical. Most obviously, the large reserve holders in the Middle East would cause a severe drop in the prices they receive if they produced without restraint. Additionally, some countries such as Norway have worried that they would cause damage to their economies because of either inflation in the manufacturing sector or distortions to their currency. However, Mexico has such a large manufacturing sector and skilled labor force that this should not be a concern.

Field Level Analysis

The losses from a revenue stream caused by delaying a project can be easily calculated. In Table 2, the net present value of the anticipated revenue stream for the proposed Zama field development is shown, using three discount rates and comparing no delay, a one-year delay, and a three-year delay.

This represents the current value of expected revenue, and clearly depicts that even a modest delay can cause significant economic losses. Governments often do not take this into account in their planning, in part because they ignore the losses or perceive them to be imposed on the private sector.

Table 2
Cumulative Present Value of Oil Revenue (Million USD) to 2040
in the Zama Field

Direct	Indirect	Total	Multiplier
465	617	1082	2.33
2192	6968	9160	4.18
176	357	533	3.03

Note: Revenue (not profits) from present to 2040

Source: Price forecast from IEA New Policies Scenario

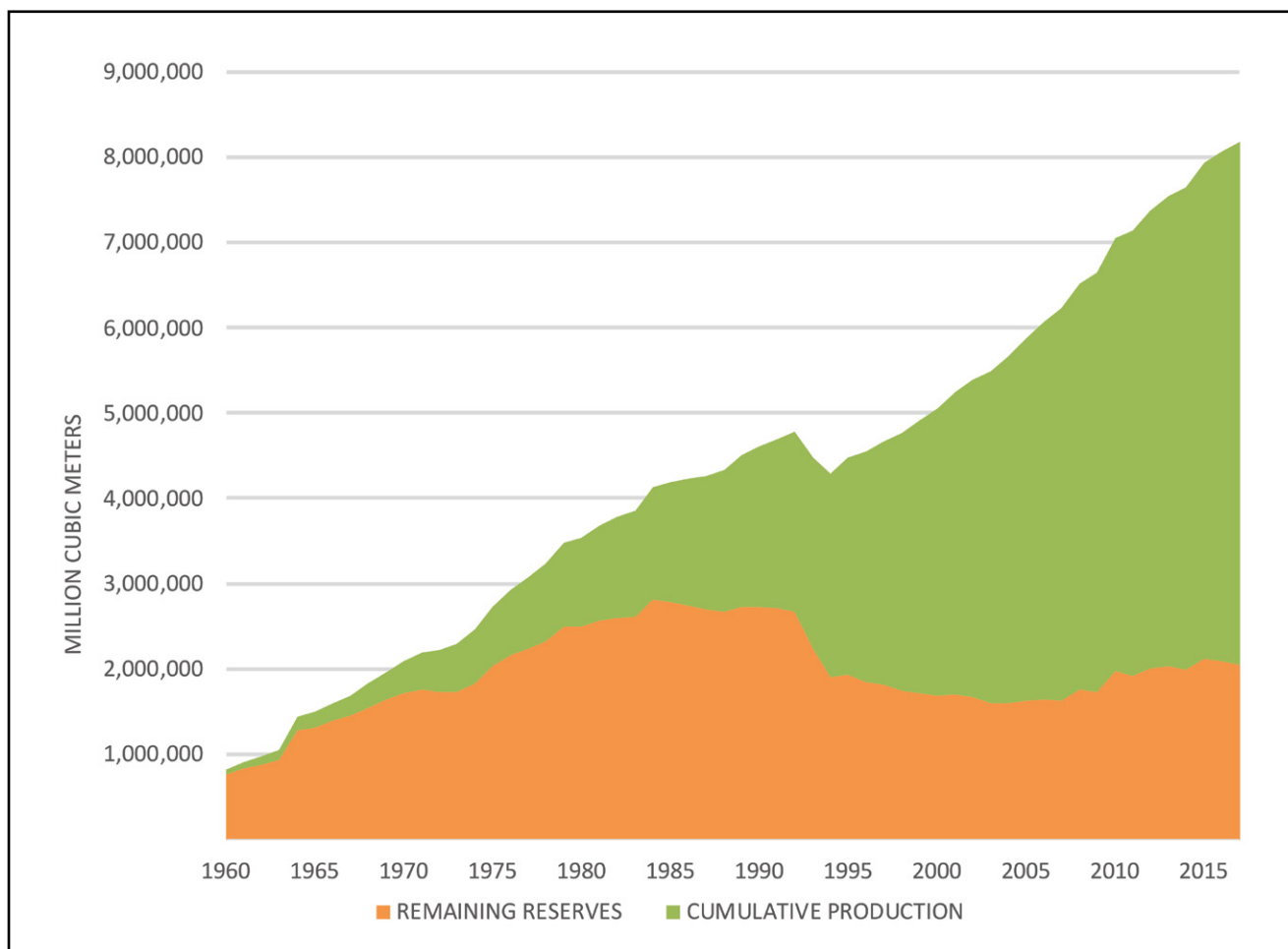
Future Scarcity

Concern about the lack of resources in the future and the negative effect this would have on a nation's economy (or a given economic sector) has caused a number of countries to restrain production and/or exports of petroleum, whether oil or natural gas. This was particularly true in the 1970s during the first and second Oil Crises, when governments around the world worried about the availability of resources in the future. This included the U.S., where the government sought to encourage the usage of coal in power plants to conserve natural gas resources, and Canada, where the government-imposed restrictions on natural gas exports that

explicitly required a reserve base of 25 years of domestic needs.

The fears proved costly. Canada has produced 5 trillion cubic meters of natural gas since the government decision to preserve 1.75 trillion cubic meters for future use. There remain 2 trillion cubic meters of natural gas in reserves in Canada. Indeed, as Figure 6 shows, reserves have changed only slightly in the past four decades, mostly due to changes in definition. Once shale gas is developed, the resource base will be considerably expanded, as technically recoverable resources have been estimated at 14 trillion cubic meters.⁶

Figure 6
Canadian Natural Gas Production and Estimated Remaining Reserves



Source: Canadian Association of Petroleum Producers

The policy problem stems from a poor understanding of resources and resource estimates. Many politicians do not realize that reserve numbers simply represent an inventory of the resource which is available to be produced. The industry generally avoids having a surplus of reserves, especially in places where production is constrained for some reason, such as price supports in the Middle East. Thus, companies in Canada would typically not want to have reserves far in excess of domestic consumption and export

demand, especially for natural gas which cannot easily be shipped to distant markets.

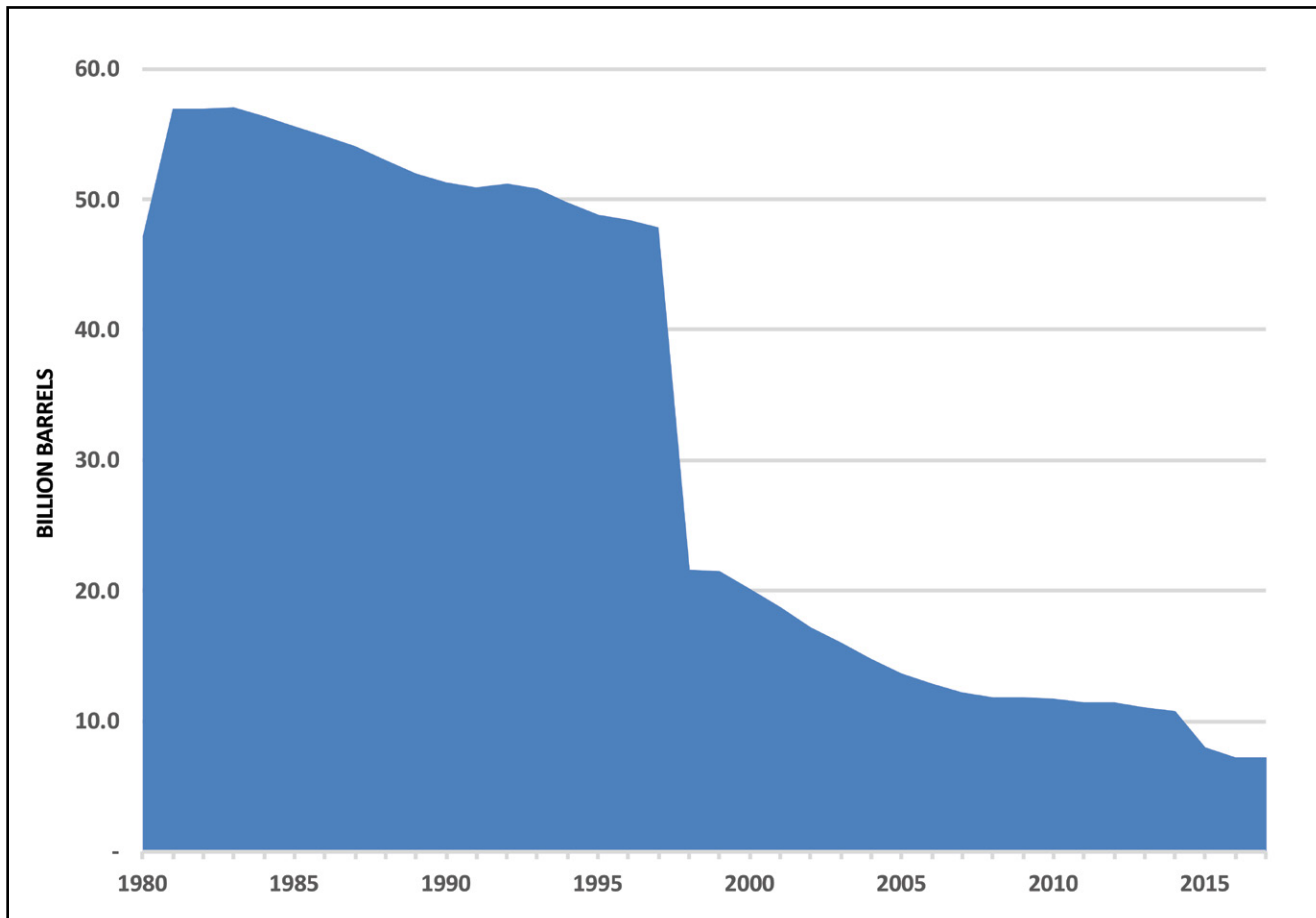
The Mexican case is more complicated. As Figure 7 below shows, proved oil reserves have declined sharply in recent years, but this is primarily the result of reassessment in the mid-1990s. Pemex was very aggressive in booking reserves, including reporting “proved plus probable” reserves, a broader definition than used in most other countries.

Mexican Oil Reserves

Additionally, low levels of investment over the past two decades have been responsible for sliding reserve levels, as demonstrated by the discovery of a shallow-water field called Zama approximately 60km off the coast of Tabasco, thought to hold about

1 billion barrels. This is one of the largest finds in recent years and perhaps 100 times the size of recent shallow-water discoveries in the U.S. Gulf of Mexico. If such a large field has already been found, then many more discoveries can be expected.

Figure 7
Mexican Oil Reserves



Source: BP Statistical Review

Indirect Benefits

Aside from the cash flows to the Mexican government, the petroleum industry provides a number of indirect benefits to the country. Not all are easily quantifiable, but there is wide agreement on the contribution.

Trade Balance

Table 3 shows the Mexican trade balance along with its oil and gas trade, as well as the degree

to which consumption of domestic oil and gas reduces the trade deficit. The drop in the value of petroleum exports in 2014 had a significant impact on the nation's trade balance, moving it notably into deficit. More important, the value of oil and gas produced and consumed domestically (the two right-hand columns) helped the country avoid tens of billions of dollars in imports.

Table 3
Petroleum and the Mexican Trade Balance (Billion USD)

	Total Exports	Total Imports	Trade Balance	Oil Exports	Petroleum Imports	Petroleum Balance	Imports Avoided Oil	Imports Avoided Gas
2013	\$380	\$381	-\$1	\$48.6	\$28.3	\$20.3	\$73.1	\$7.2
2014	\$397	\$400	-\$3	\$41.2	\$28.4	\$12.8	\$61.9	\$8.5
2015	\$381	\$395	-\$14	\$21.1	\$20.9	\$0.2	\$31.8	\$4.8
2016	\$374	\$387	-\$13	\$17.5	\$19.9	-\$2.4	\$26.1	\$4.0
2017	\$409	\$420	-\$11	\$22.4	\$26.4	-\$4	\$32.5	\$4.7

Source: Pemex "Monthly Petroleum Statistics"

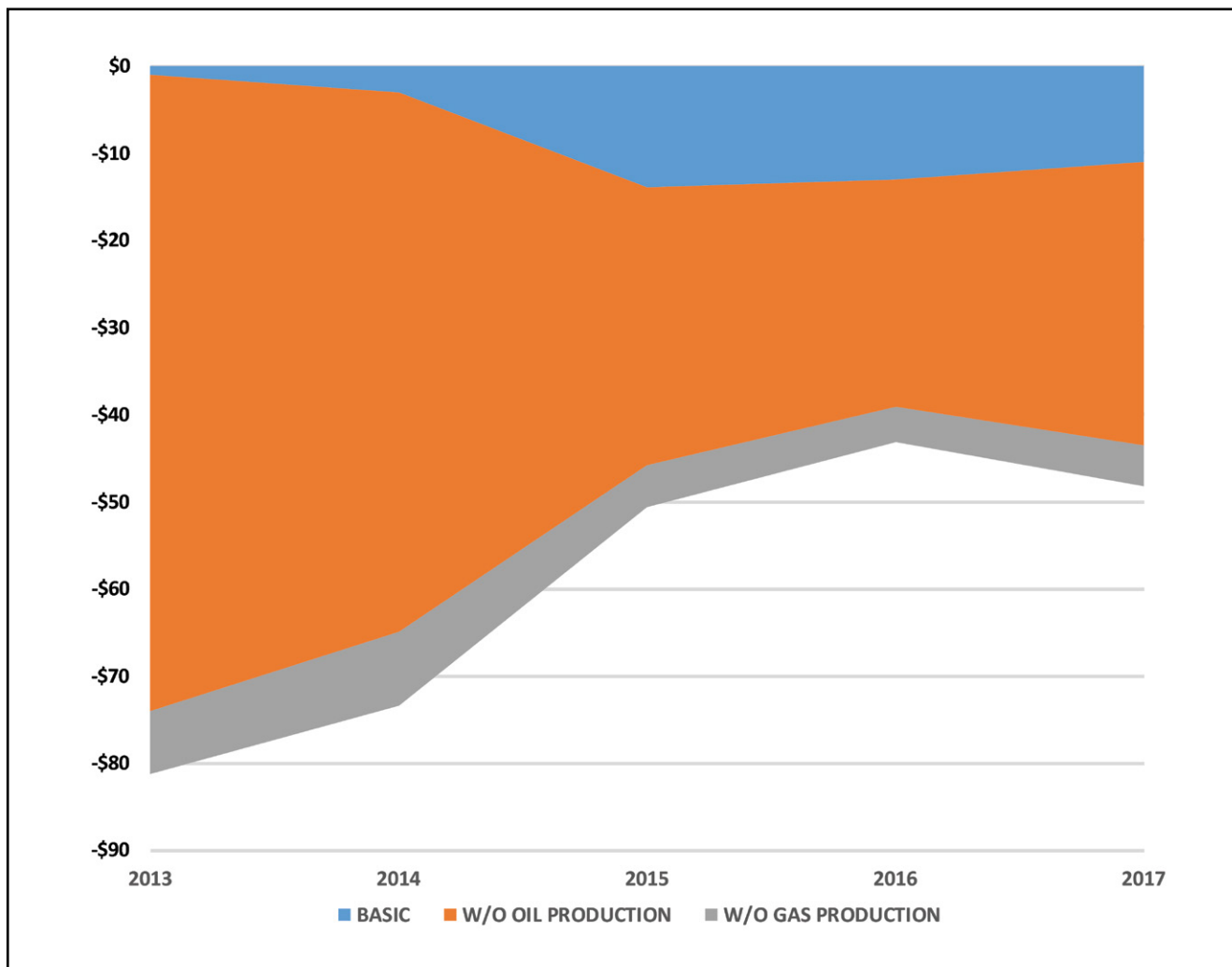


THE ROLE OF PETROLEUM IN THE MEXICAN ECONOMY continued

Figure 8 demonstrates this graphically: if Mexico did not produce oil and gas, its trade balance would be much worse: tens of billions of dollars into the red. (The lesser contribution in recent years reflects lower oil production, not

higher production.) The blue area represents the actual trade deficit, the orange area is the amount that would have been spent on oil imports if Mexico didn't produce oil, and the gray area is the same calculation for Mexico's gas production.

Figure 8
Effect of Oil Production on Trade Balance (Billion USD)

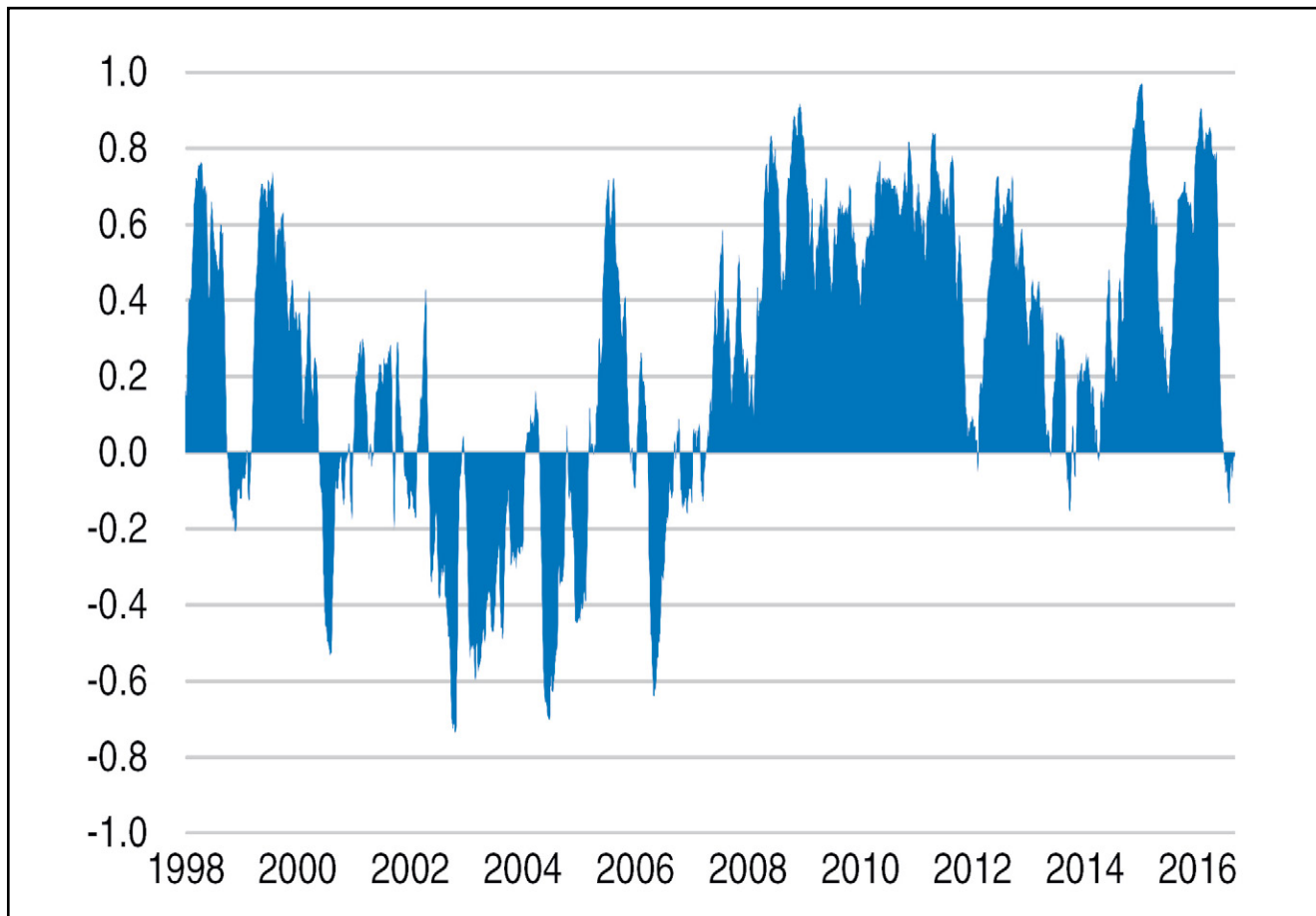


Source: PEMEX "Monthly Petroleum Statistics" and EIA data

Although it is hard to quantify, the reduction in the trade deficit (real and implicit) has meant that the Mexican peso is relatively stronger, lowering domestic interest rates and thus increasing

economic activity. In Figure 9, the OECD shows that the correlation between the Mexican peso and the price of Mexican crude has increased in recent years, supporting this argument.

Figure 9
Historical Correlation Between Oil Prices and Exchange Rates



Source: OECD *Economic Surveys Mexico*, 2017

Employment Upgrading

Generally speaking, the petroleum industry requires a skilled workforce and higher compensation than many other professions. Although some workers are highly educated including scientists and engineers, there are many field workers with secondary educations but who gather experience during employment. Table 4

compares annual salaries in the U.S. for workers in the extraction industry and a number of specialties within that industry, including roustabouts who typically perform manual labor. Compared to many other sectors, such as farming or retail, these workers earn significantly more than their compatriots.

Table 4
Comparable Salaries in Petroleum and Other Sectors in the U.S.
Annual Compensation, USD

EXTRACTION	\$47,480
Gas Plant Operators	\$69,600
Derrick Operators	\$47,510
Rotary Drill Operators	\$56,180
Roustabouts, Oil & Gas	\$39,850
OTHER MISCELLANEOUS	
Farming, Fishing and Forestry	\$28,840
Preschool and Kindergarten	\$39,600
Secondary School Teachers	\$62,730
Retail Sales Workers	\$25,560
Food Preparation	\$24,710
Transportation and Material Moving	\$37,070

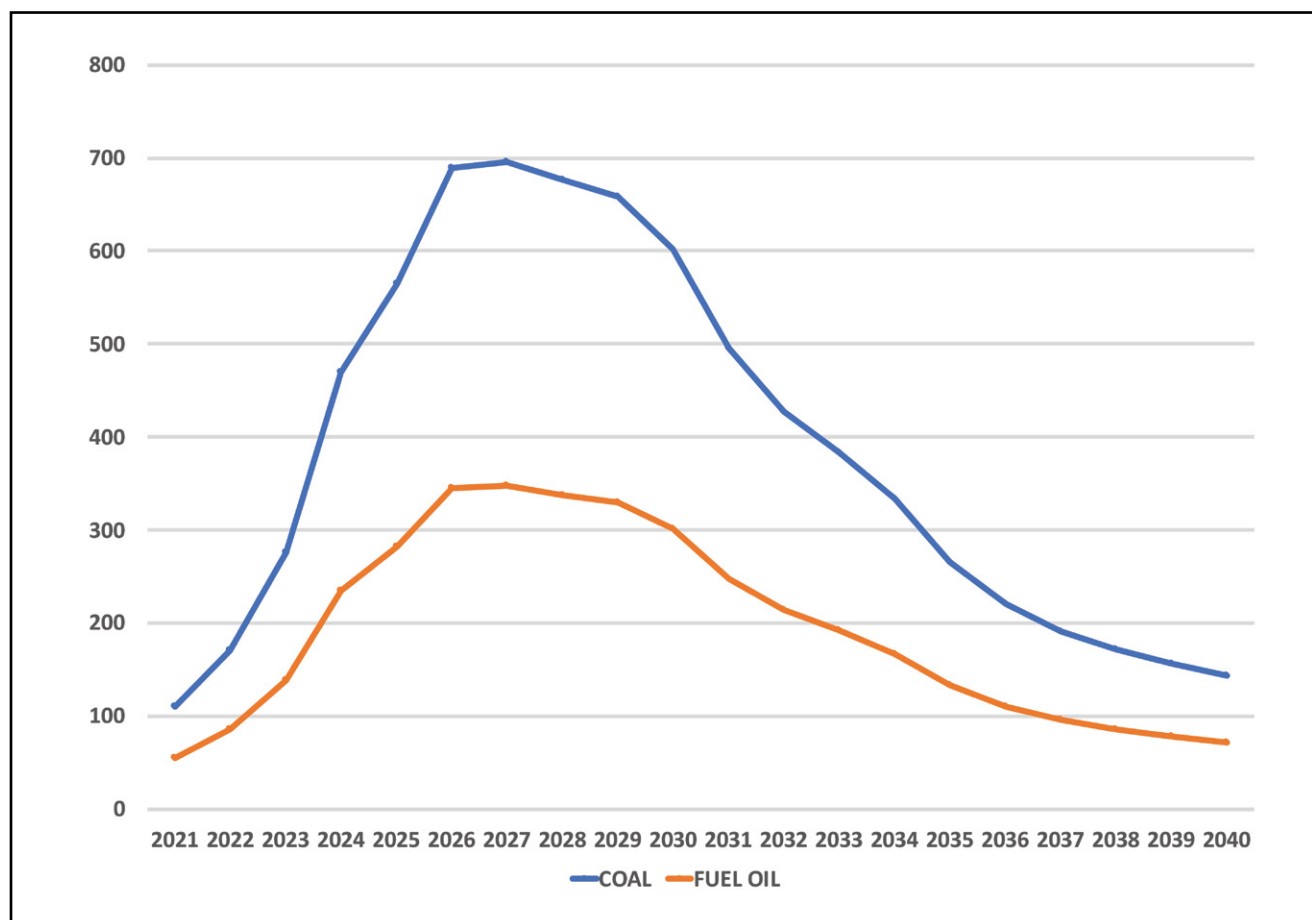
Source: U.S. Bureau of Labor Statistics"

Pollution

A side effect of the New Energy Model involves the potential for higher production of natural gas to replace dirtier fuels, notably coal and residual fuel oil used in power generation and industrial boilers. Coal emits from 0.67-6.43 lbs/MMBtu (pounds per million British Thermal Units) of sulfur dioxide and 1.82-34.71 lbs/TBtu (pounds per thousand British Thermal Units) of mercury, while residual fuel oil emits 0.3-2.65 lbs/MMBtu of sulfur dioxide and 0.48 lbs/TBtu of mercury, depending on the quality. Natural gas emits no sulfur dioxide and only trace amounts of mercury.

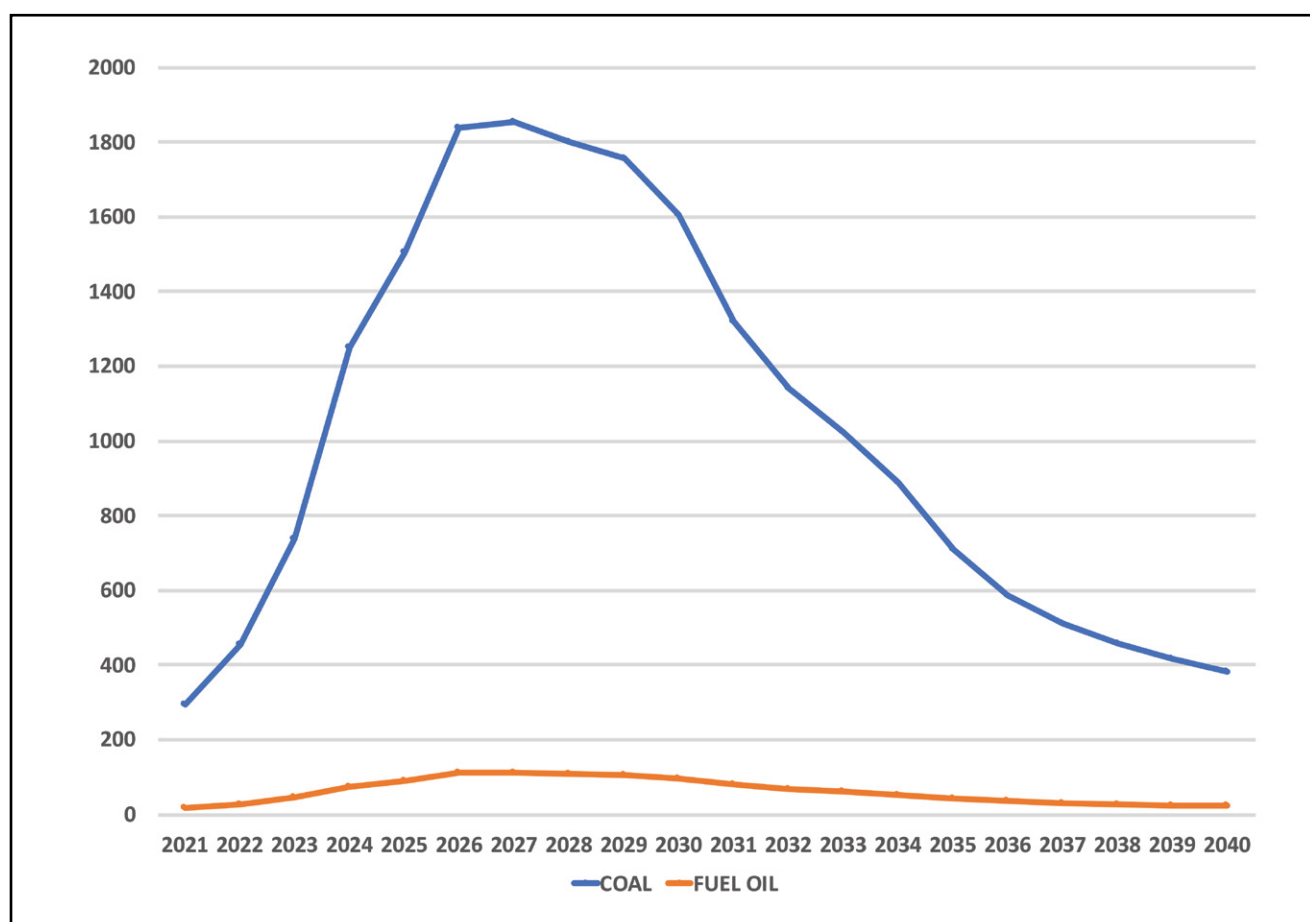
Figures 10 and 11 show roughly how much of these two pollutants would be avoided if the natural gas produced from the four planned offshore developments and expected onshore production were used to displace either coal or residual fuel oil, using moderate estimates of the quality of Mexican fuels. (3 lbs/MMBtu SO₂ for coal and 1.5 for RFO, and 8 and 0.48 lbs/TBtu for mercury.) The savings are clearly significant and would be even greater if Mexico could increase natural gas production beyond these initial levels by offering more blocks for sale.

Figure 10
Mexican SO₂ Emissions Saved by
Expected Natural Gas Production (Millions of pounds)



Source: The author's calculations based on submitted development plans

Figure 11
Expected Mexican Mercury Emissions Saved by
Expected Natural Gas Production (Pounds)



Source: The author's calculations based on submitted development plans

Capital Flows

The commitments made by the many private operators bidding in the first rounds of auctions

account for a total of \$161 billion, most of which is devoted to deepwater operations (Table 5).

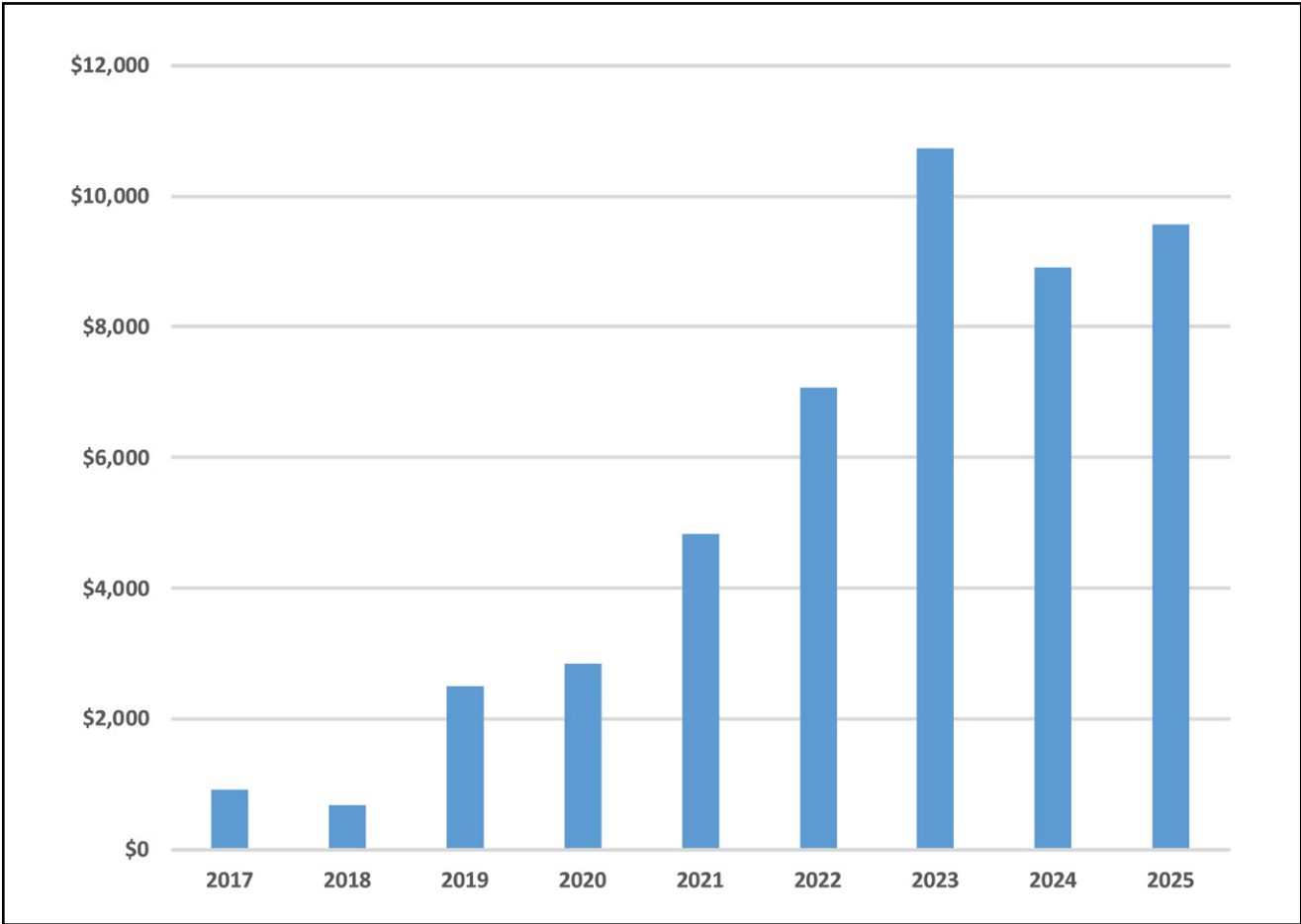
Table 5
Share of Commitments Made in First Rounds of Auctions

	Share			Billion USD		
	Deepwater	Shallow	Onshore	Deepwater	Shallow	Onshore
International	43%	22%	25%	\$57.6	\$5.1	\$0.8
National	42%	18%		\$56.3	\$4.1	\$0.0
Large Cap	10%	14%		\$13.4	\$3.2	\$0.0
Small/Mid Cap	3%	10%		\$4.0	\$2.3	\$0.0
Newly Created	2%	36%	75%	\$2.7	\$8.3	\$2.3
Total	100%	100%	100%	\$134	\$23	\$3

Source: Secretaria de Energia⁵

Perhaps more important, Figure 12 shows the annual projected upstream investment for current projects, expected to surpass \$10 billion in 2023, which represents an increase of approximately 40% over the total foreign direct investment in Mexico in 2017.

Figure 12
Current Projections for Upstream Capital Expenditures
by the Private Sector (Million USD)



Source: Secretaria de Energia

EVALUATION OF THE NEW ENERGY MODEL

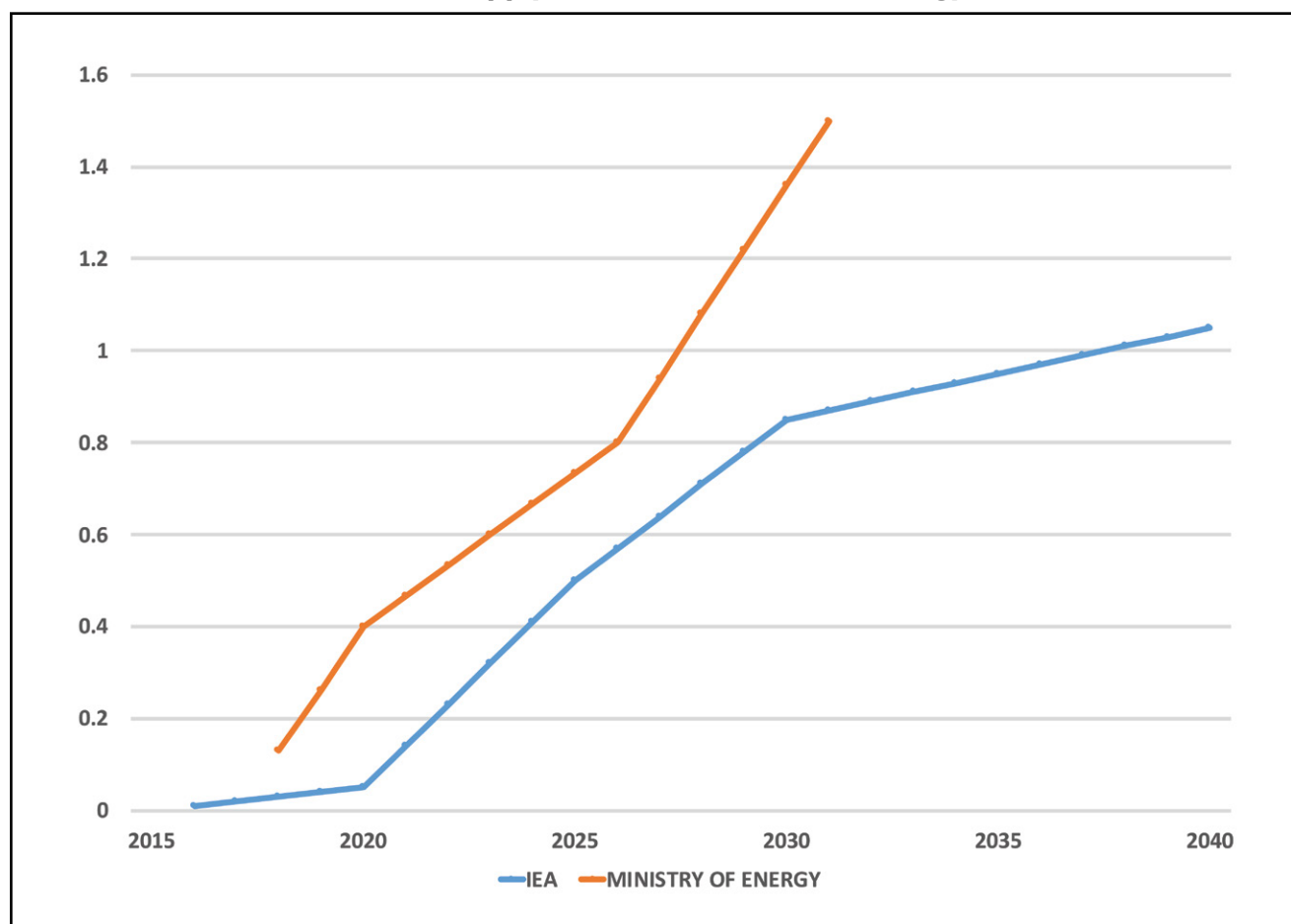
New Energy Model Benefits

The path forward for the new administration in Mexico should take into account the many accomplishments of the New Energy Model, which have only just begun to be realized. Some, such as the increased revenue from higher petroleum production, are relatively easy to quantify, albeit with an element of uncertainty. Others, such as technology transfer, are harder to quantify but nonetheless real and widely accepted.

Increased Revenue

There have been two estimates in particular of the difference in oil production resulting from the reforms in Mexico, from the Ministry of Energy and the International Energy Agency. Figure 13 shows the increased production they predict in millions of barrels per day, and while they diverge notably in the end-years, estimates that far into the future are never highly reliable. In the first decade or so, both show similar growth patterns although the IEA shows growth starting three years later.

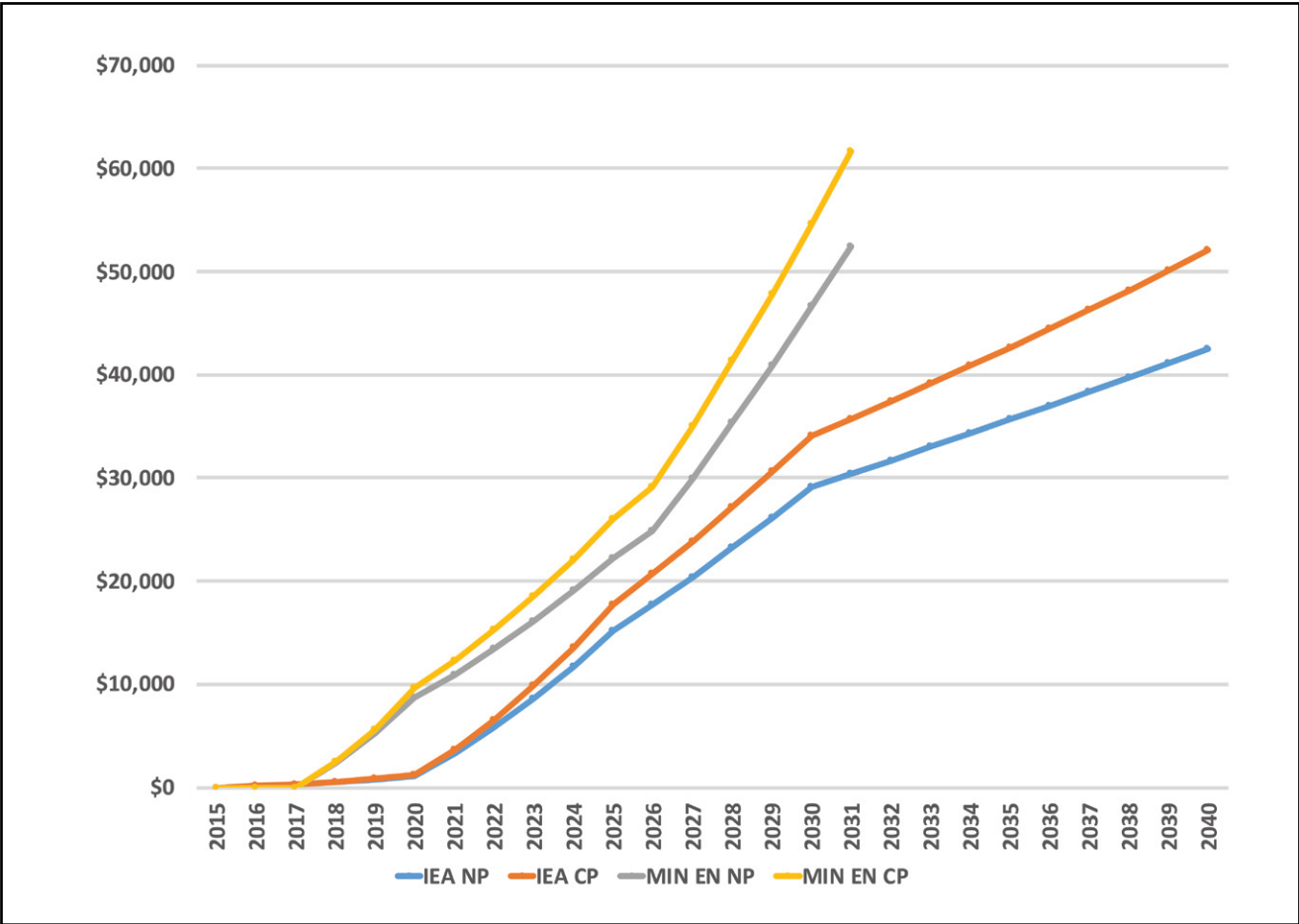
Figure 13
Increased Mexican Oil Supply Forecasts from New Energy Model Reforms



Sources: Mexico Energy Outlook, IEA, 2016 and Flores-Quiroga op. cit.

Given these oil supply forecasts and using the current IEA price forecasts from the New Policies and Current Policies scenarios, the additional revenue projected is shown in Figure 14. By 2025, the range of extra oil revenue is \$20-30 billion per year, representing a significant fraction of current revenues, and with minimal investment inputs from the government.

Figure 14
Forecasts of Additional Oil Revenue in Mexico (Million USD)

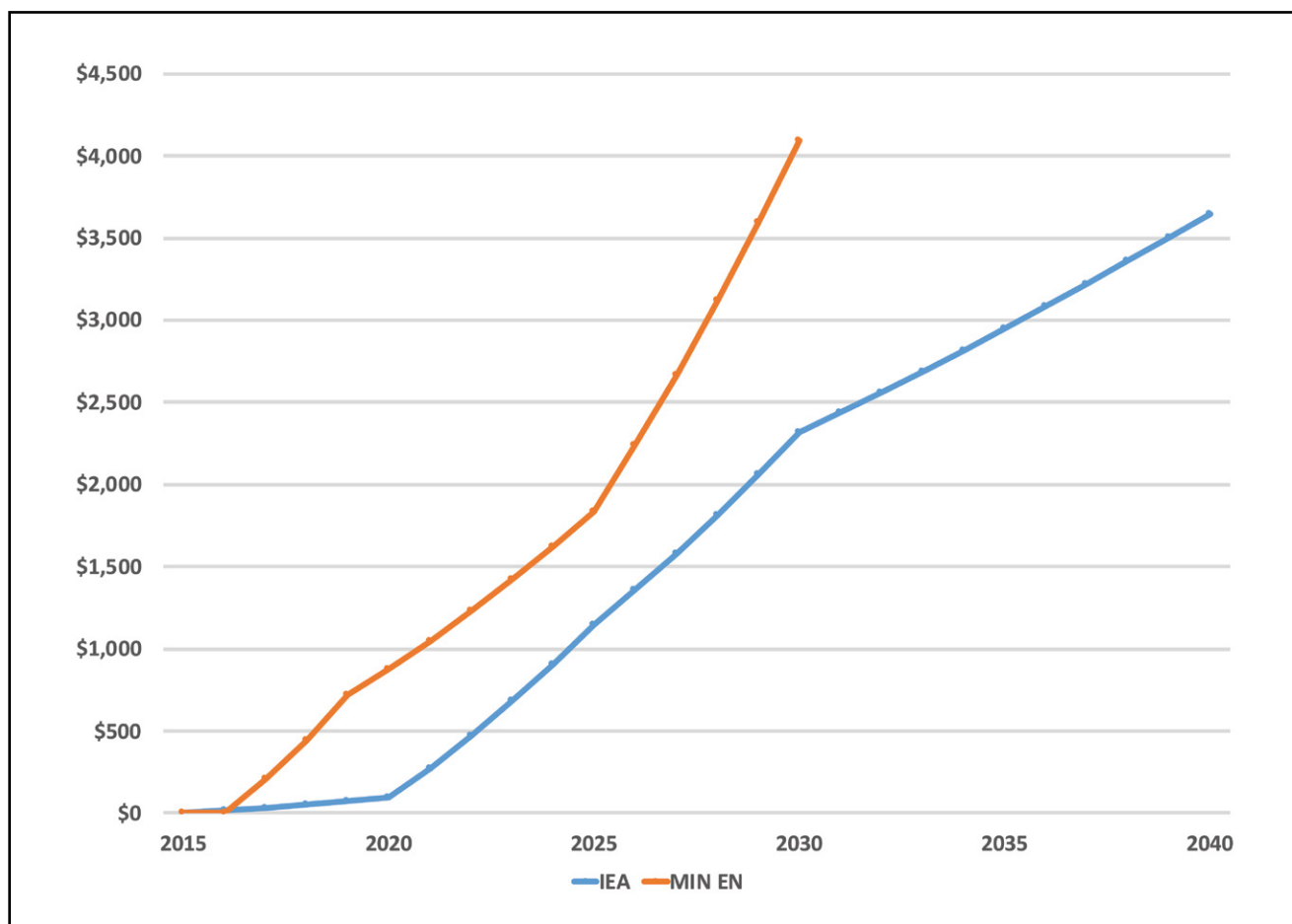


Sources: Mexico Energy Outlook, IEA, 2016 and Flores-Quiroga op. cit.

Taking those same oil production forecasts and using the IEA's forecast of the natural gas price at Henry Hub yields an increase in natural gas revenues as shown in Figure 15. (It is assumed that the gas/oil ratio in the new oil production remains

the same as the current ratio.) Because natural gas sells for much less than oil on a Btu basis, the revenue gain is much smaller, but it still represents a reduction in Mexico's import bill for natural gas, currently running at \$3.5 billion per year.

Figure 15
Revenue from Increased Mexican Natural Gas Production (Million USD)



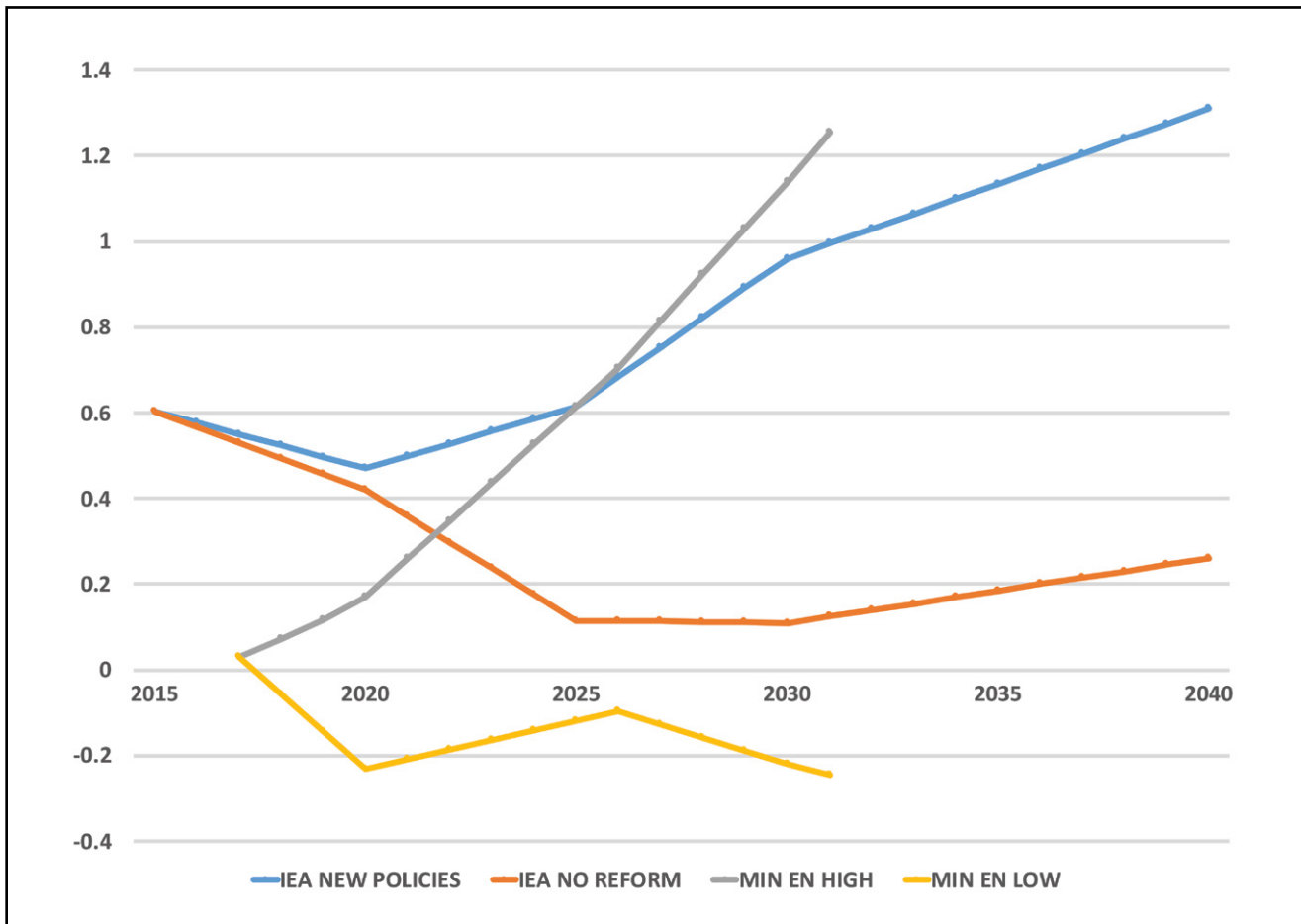
Sources: Mexico Energy Outlook, IEA, 2016 and Flores-Quiroga op. cit.

Improved Trade Balance

As noted earlier, not only do petroleum exports play a major part in Mexico's trade balance, but natural gas imports are similar in size to the recent trade deficit. The New Energy Model is expected to boost production of both oil and gas, as the previous two figures showed. Figure 16 shows

the difference in oil exports given the IEA's forecast of domestic oil consumption and production under the IEA New Policies and No Reform Scenarios and the Ministry of Energy's High and Low forecasts. Without the reforms, Mexico would be expected to see minimal oil exports or even imports.

Figure 16
Mexican Oil Trade Balance Scenarios (Million barrels per day)

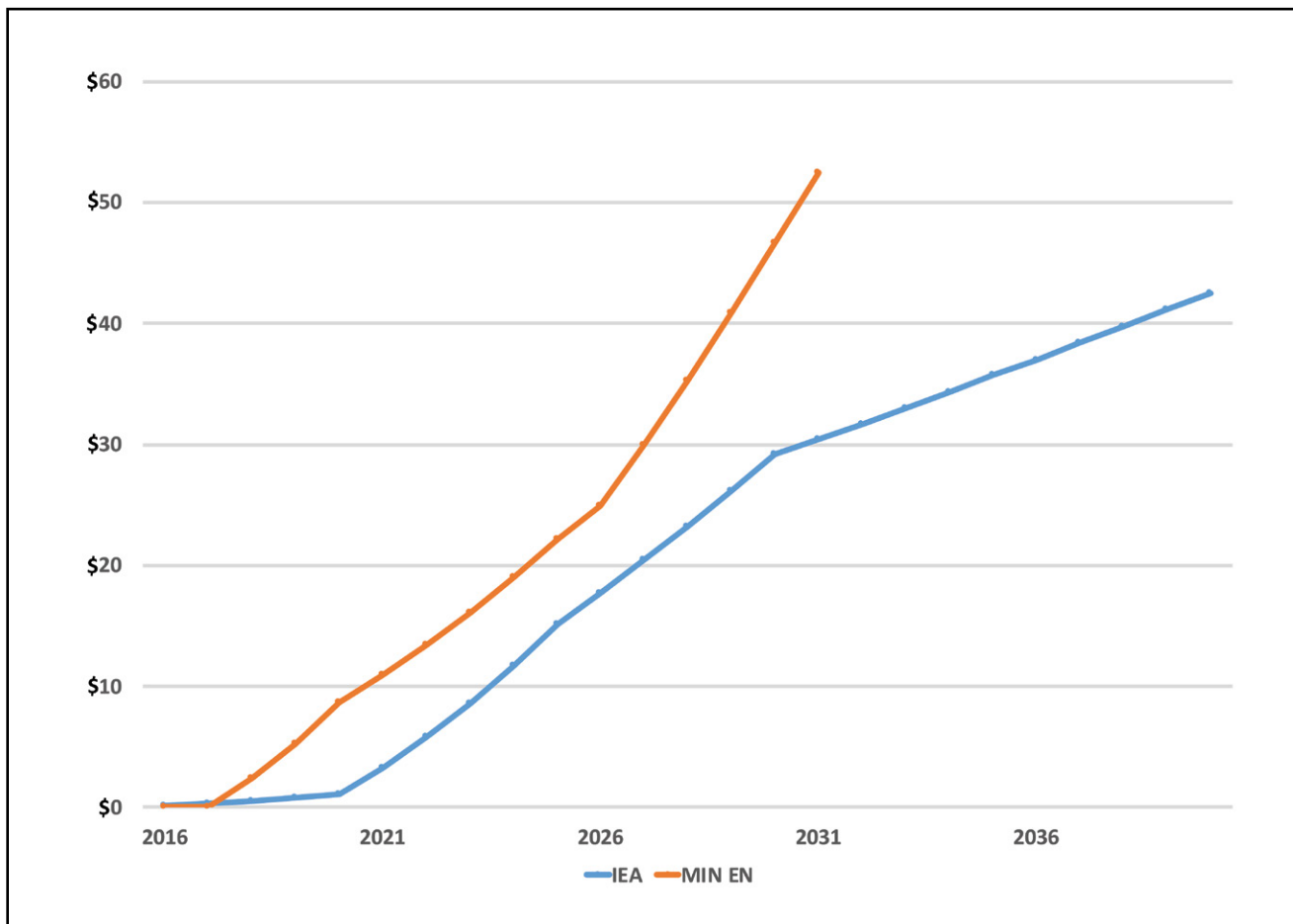


Sources: Mexico Energy Outlook, IEA, 2016 and Flores-Quiroga op. cit.

Using the IEA's oil price forecast (New Policies Scenario), the difference in oil exports revenue as the result of the New Energy Model can be seen in Figure 17. Within a few years, the additional

amounts are greater than the 2017 national trade deficit (\$11 billion) and increase in the future with higher prices and production, which is expected to outpace consumption growth.

Figure 17
Mexican Oil Export Gains from New Energy Model (Billion USD)



Sources: Mexico Energy Outlook, IEA, 2016 and Flores-Quiroga op. cit.

Benefits from the Presence of Private Corporations

There is a long-standing debate on the relative merits of privately held oil companies versus state mineral enterprises (SMEs). Most state mineral enterprises have existed where the state feared it didn't have the capacity to deal on an equal basis with large multinational corporations, where the state had political goals (British coal in the postwar era, current Bolivian oil operations), and/or the state was heavily dependent on the petroleum industry for its revenue.

Economic thinking during the postwar boom years sometimes emphasized the value of having a state mineral enterprise that could access capital at low-risk government borrowing rates, dealing with intangibles such as upgrading the labor force or providing superior delivery of common goods like environmental protection.

However, the debate has increasingly shifted in favor of regulated private corporations or a mix of state and private enterprise. (Britain and

Canada, among others, privatized their national oil companies; Argentina privatized YPF but later renationalized it.) The lower efficiency in SMEs has been perceived to be a major economic cost. Countries from Argentina to Russia have seen how political interference in hiring and investment can prove wasteful, and the less flexible decision-making behavior of governments reduces investment efficiency. Economists have also argued that Pemex borrowing costs are increased because of political uncertainty related to the budgeting process.

Also, while employees and/or local residents might receive improved services such as health and education from an SME, it is not clear that a national oil company can provide them more efficiently than dedicated governmental departments. Certainly, a number of SMEs have been found to be less attentive to health, safety, and environmental issues than private companies that are closely regulated.

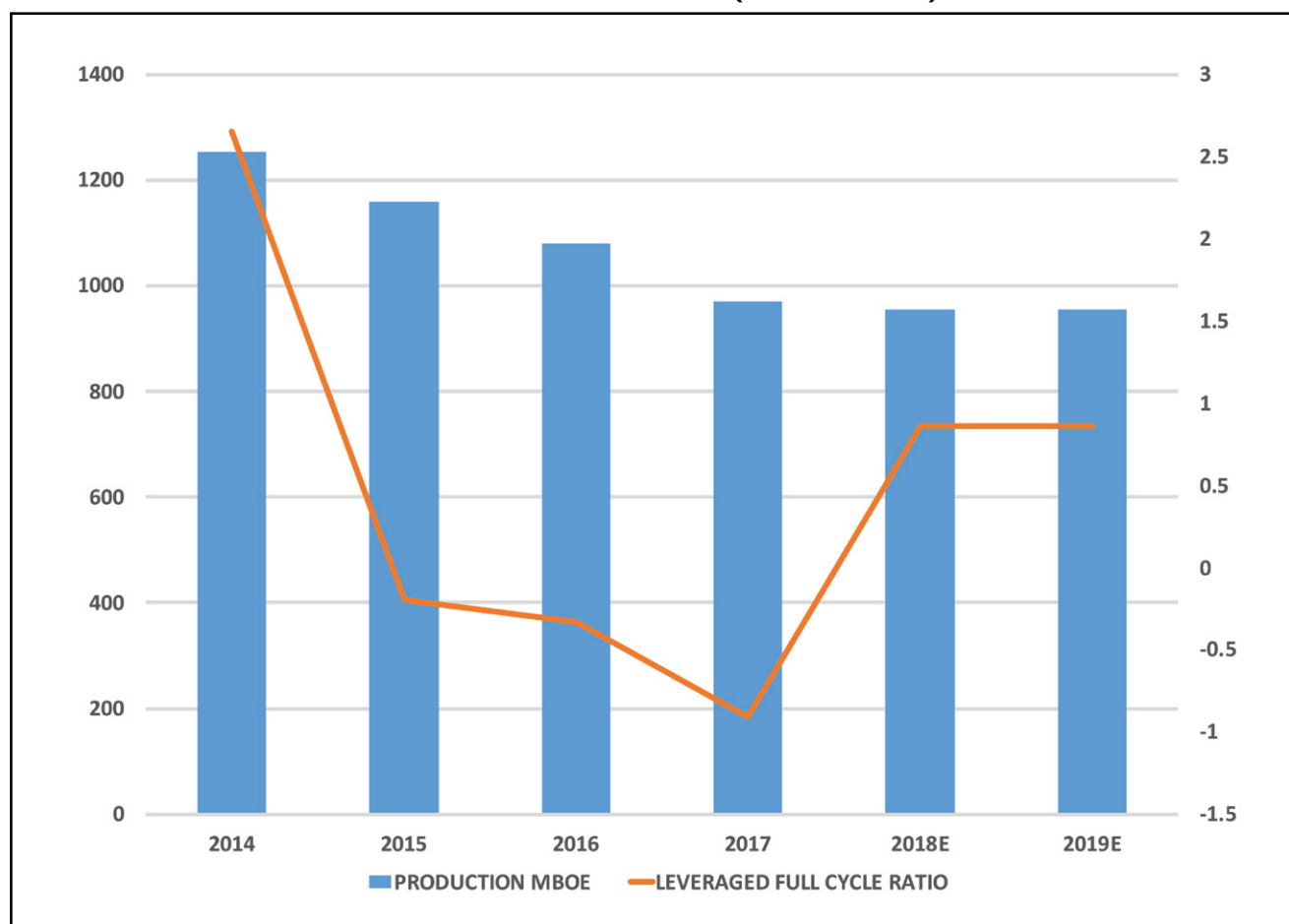


Efficiency

Needless to say, every company and every oil field is different, but it can generally be seen that private sector companies in the oil industry have tended to be much more efficient than public sector companies. As Figure 18 shows, Pemex has approximately the same share of government

expenditures as revenue, although that is an imprecise measure. But Pemex figures for 2016 and 2017 show that operating costs and expenses were 62% and 93% of sales revenue, while Moody's calculations show that the company has had costs below breakeven since the oil price dropped in 2014. (Figure 18)

Figure 18
Pemex Breakeven Costs (I=breakeven)

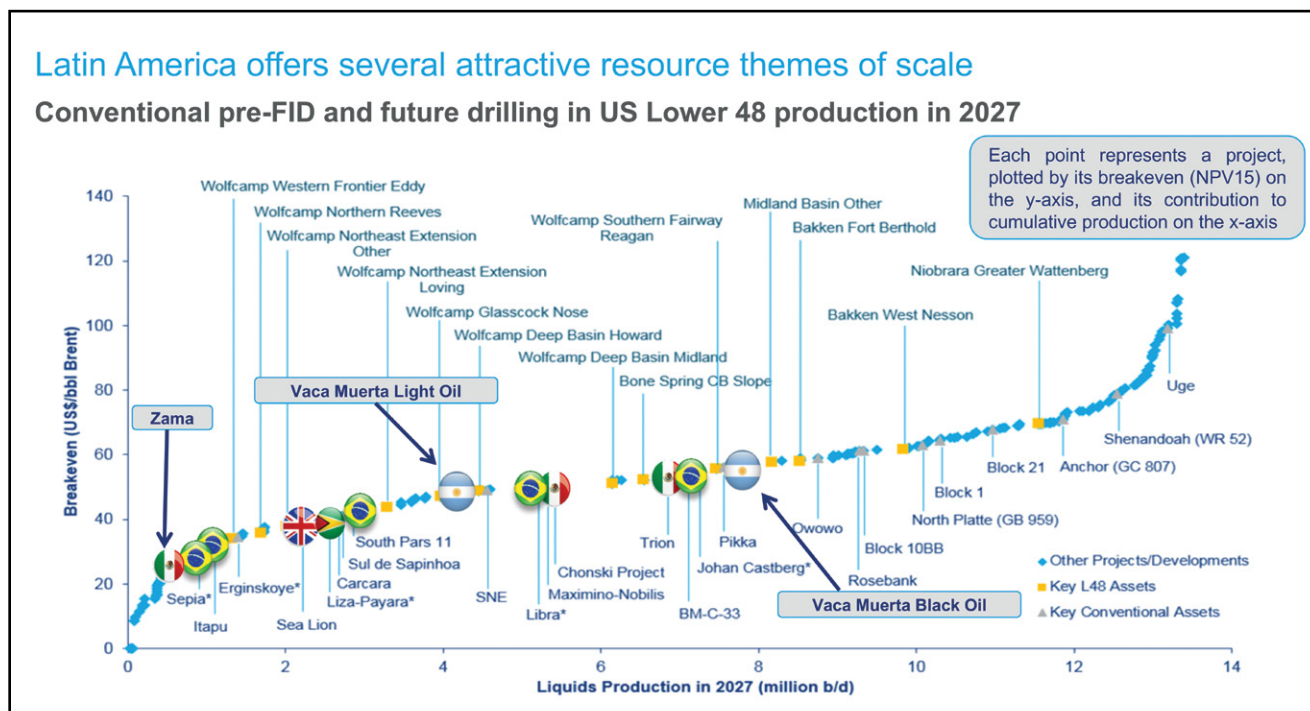


Source: Moody's Investor Service "Issues in Brief: Petroleos Mexicanos" July 24, 2018, p. 3

Similarly, Wood MacKenzie's analysis of global oil projects' economics shows that the estimated cost of the Zama oil field development is far below what Pemex has experienced (Figure 19).

This is further confirmed by projected development costs of \$25.50 (Round 2.1), \$21.76 (Round 2.3) and \$32.95 (Round 1.4).¹¹

Figure 19
Oil Cost Supply Curve



Source: WoodMac and Talos

Pemex in 2017 paid roughly 13% of its income in profit-sharing taxes.¹² Compare that with the offerings of private companies which have agreed to production sharing taxes of roughly 55%, aside from bonuses and other fees. Again, the measure is not highly precise, but nonetheless demonstrates that development by private sector companies is more efficient and yields higher tax revenue for the government.

Access to Technology

The reforms enacted have made it much easier for the Mexican petroleum industry, including Pemex, to gain greater access to industry technology. This reflects two factors: specific technologies employed outside Mexico that could prove applicable inside the country, and general technologies that different companies have developed at different times, but which will be more

easily disseminated with the presence of numerous operators.

In two areas, technology developed outside Mexico should be very applicable to domestic resources. Mexico has, to date, undertaken relatively small efforts in its deepwater sections of the Gulf of Mexico, whereas operations have been pioneered in Brazil and then become widespread in the U.S., North Sea, West Africa and Southeast Asia. The heavy involvement of outside companies with lengthy experience in deepwater production should make those operations more efficient, as well as helping Pemex improve its proficiency in that area.

Hydraulic fracturing of oil wells has a long history, but only recently in shale deposits, primarily in the United States, but increasingly in Argentina, Australia and Canada, among other places. Knowledge of optimal production techniques is widespread in the industry, again concentrated

in the United States, but Pemex has relatively little experience with the production technique.

In general, the industry has large amounts of research ongoing constantly, and a combination of professional organizations and informal contacts allow for the spread of advances in petroleum engineering as well as geology, and having more companies operate within Mexico will allow for greater spread of this knowledge, not just between private companies but with Pemex as well. In particular, smaller operators are known for constant efforts to refine production techniques, which was a major reason why they pioneered hydraulic fracturing of shales.¹³

Diversification

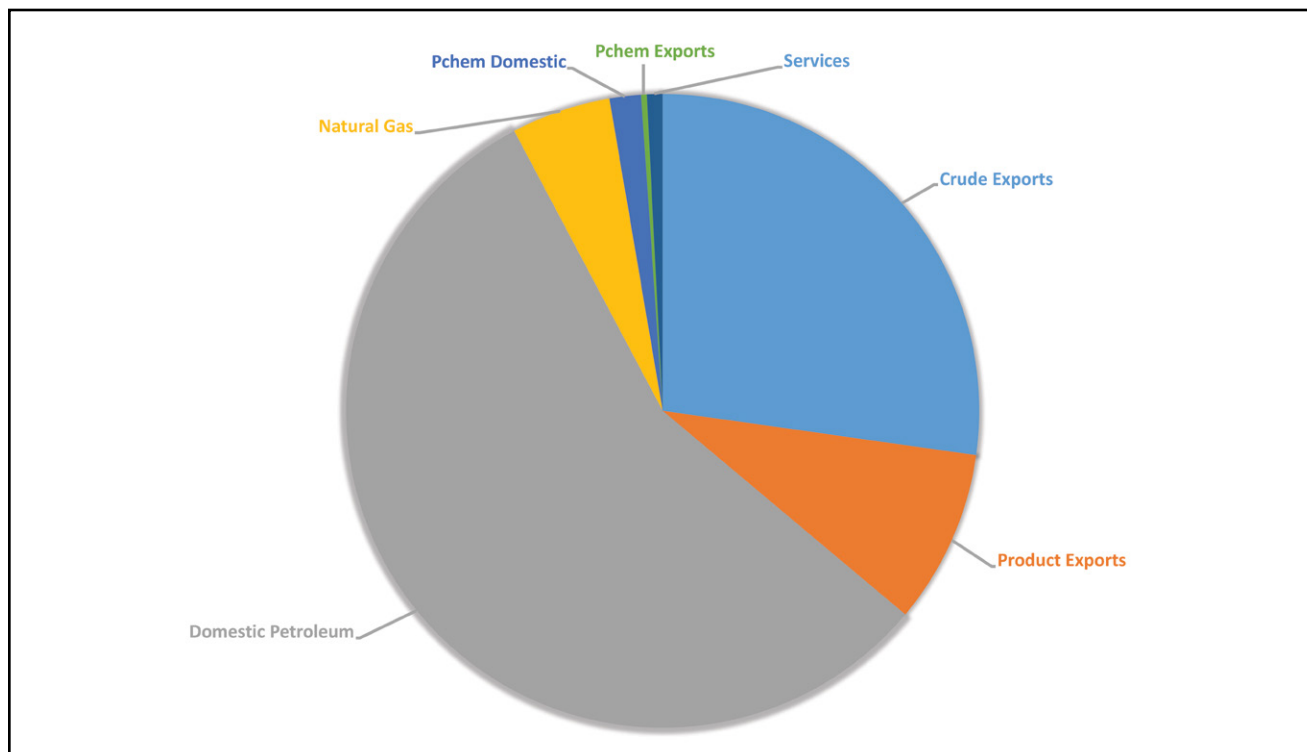
Pemex is a vertically integrated oil corporation but with its operations restricted to Mexico which means both the company and the country suffer

from a lack of diversification. All large oil companies are geographically diversified with the exception of some national oil companies (NOCs). (Most NOCs do not make upstream investments of any significance outside their own countries, but a number have downstream operations around the world.)

As Figure 20 shows, Pemex gets the vast bulk of its revenue from petroleum, mostly domestic product sales and crude and product exports. Petrochemicals, natural gas, and services are all minor parts of its business. This is not too unusual for a large oil company, although many of them have a greater presence in natural gas production.

(In the 1980s, there was a movement by large oil companies to diversify out of their primary businesses, believing that petroleum was a mature, if not dying, industry. However, this proved to be a mistake and nearly all retrenched to focus on their “core competencies.”¹⁴)

Figure 20
Pemex Revenue by Sector



Source: PEMEX¹⁵

For Mexico, without considering the optimal strategy for Pemex, the country clearly will benefit from having more of the capital investment coming from overseas and a variety of companies. This will

mean that investment flows will be less vulnerable to Mexico’s business cycle and more flexible in responding to changing market conditions.

LESSONS FROM OTHER NATIONS

A large number of countries produce petroleum, many exporting it, and with wildly differing experiences, usually reflecting differences in their overall economic situation as well as the nature of their petroleum resources. Yet some common themes occur throughout the literature.

Fear of the resource curse is common, but not always well understood. As writers like Mikesell and Kaznacheev have pointed out, the presence of petroleum (or similar) resources is not the cause of most of the problems associated with it (corruption, hollowing out of manufacturing, overvalued currency) but rather poor economic management.¹⁶ As just one piece of evidence, although the resource curse is sometimes called the “Dutch disease,” the Dutch economy remains robust and it continues to host a strong manufacturing base (18% of the labor force) and maintains healthy agricultural exports.

The biggest failing seems to have occurred where nations with large mineral resources could

not cope with the volatile nature of revenues, given the cyclical nature of mineral (and energy) prices. Most especially, they have often overestimated future revenues and as a result, undertook overly ambitious spending plans. The classic case is perhaps Venezuela in the 1970s, described in detail in Terry Lynn Karl’s book, *The Paradox of Plenty: Oil Booms and Petro-States*, where the former president of Venezuela, Carlos Andres Perez, admits that his enthusiastic economic strategy based on expectations of ever-increasing revenues, proved disastrous when oil prices fell.

In many countries, the petroleum sector has been an important part of the national economy, essentially as an adjunct to the manufacturing sector. Table 6 shows a breakdown of both Alberta and Norway compared to Mexico, and it is clear that Mexico resembles those economies much more than, for example, the petroleum rich countries like Kuwait and Saudi Arabia.

Table 6
Economic Sectors in Oil Producing Nations

	Alberta	Mexico	Norway
Oil & Gas & Mining	17.0%	23.5%	20.2%
Manufacturing	6.5%		7.0%
Construction	10.7%	7.8%	5.2%
Transportation & Utilities	6.2%	29.1%	6.0%
Business & Commercial Services	11.7%	6.6%	9.1%
Real Estate	12.0%	10.8%	3.5%
Tourism and Consumer Services	5.0%		1.2%
Retail & Wholesale	9.0%		6.4%
Public Administration	5.4%	10.8%	17.0%
Financial Insurance	4.7%	4.1%	4.6%
Education	4.1%		
Health Care	6.2%		
Agriculture & Forestry	1.6%	3.6%	0.6%

Source: Respective government data

Note: Not all data available.

Volatile Prices

The volatility and unpredictability of oil prices has created significant problems for many oil-exporting countries and various policies have been employed in response. Mexico is unusual in that it has been relying on hedges in the future market to reduce uncertainty, although that has only reduced not eliminated the problem. Countries like the U.K., the U.S., and Canada treat oil price volatility as being similar to that of agricultural commodities but have provided little or no effort to shield producers from the problem.

In some instances such as Kuwait and Norway, a portion of oil income is set aside in some form of investment account, often called a Sovereign Wealth Fund, which can offset the fluctuations in oil revenues. Obviously, this works best where the country has a large surplus of revenue which can be devoted to such a fund, and many oil and commodity producers find this type of approach difficult to implement.

Ownership

The range of upstream policies is wide, with nations like Saudi Arabia retaining complete ownership and control of the resource through a national oil company (the approach Mexico followed until recently), to the United States, where all oil production is done by private companies and a large portion of the resource is owned by private citizens. No other country allows private ownership of petroleum resources and even in the United States, a large fraction is on government lands. More commonly, a number of governments have total ownership of the resource but no state mineral enterprise, that is, development by private companies, while many have private operators but partial ownership of upstream operations.

Operations

Canada, the United States, and Great Britain are the primary nations that do not now have national oil companies but rely entirely on the private sector for the development of production. (None, however, preclude foreign national oil companies from carrying out operations on their soil, but they are treated equally with the private corporations.) Although some countries like Kuwait and Saudi Arabia operate their own oil companies, nonetheless they regularly contract work out to international companies in the service sector just as private companies do. Others like Libya and Nigeria take a mixed approach, where private companies operate the oil fields but with the national oil company as a partner. Some countries have national oil companies, such as Sonatrach in Algeria, that operate some of their fields, while still allowing private, mostly foreign, companies their own operations. Norway's Equinor (formerly Statoil) is operator for a fraction of that country's oil fields.

Fiscal Systems

At present, the primary fiscal system used in countries with outside investment is the production (or profit) sharing contract, whereby the explorationist bids for a block, agrees to a certain amount of exploration wells, and, if a find is made and declared commercial, undertakes to pay a certain portion of the production (or alternatively, profits) to the government, an amount negotiated during the bidding process.

A few nations such as Iraq have adopted a service contract approach, whereby the operator is paid a set fee per barrel produced. This is usually disliked by the operators but is more acceptable when there are known resources and costs can be estimated with a degree of accuracy.

CONCLUSION

Setting energy policy for an oil producing country can be very challenging, not least because of uncertainty about future markets and exploration outcomes as well as the many competing interests in society that produce conflicting demands on the government and the sector. But it is largely unquestioned that a robust petroleum sector can make many positive contributions, including providing revenue for government and well-paid jobs for the population in addition to reducing the need for commodity imports.

The reforms introduced by the New Energy Model have already brought in revenues in the form of bonuses and promise payments of royalties that will benefit the government, while improving the trade balance. The greater efficiency of operations among private companies, who are much less

subject to political demands, should mean that the government maximizes the financial benefits from its petroleum resources, and private competition will spur the national oil company, Pemex, to improve its operations.

Continuing the practice of providing leases for auction can help the government achieve many of its economic and social goals, especially where outside technology can enhance production opportunities, such as in Mexico's shale basins and its Chicontepec field. The development of a world-class petroleum industry, with companies based in Mexico but increasingly operating abroad, would help diversify the economy. As with countries like Canada and Norway, a vibrant petroleum sector can play a major role in transforming the economy.



¹“Resumen Impacto Sector Upstream en la Actividad Económica,” September 2018

²Ibid

³Royalties based on approximate rate of 55% from bds to date, the announced production plans and projected prices from the International Energy Agency

⁴<https://www.reuters.com/article/us-canada-oil-shale-insight/why-canada-is-the-next-frontier-for-shale-oil-idUSKBN1FI0G7>

⁵Flores-Quiroga, Aldo, “Achievements of the Energy Reform,” August 24, 2018

⁶Ibid

⁷Ibid

⁸International Energy Agency, Mexico Energy Outlook: World Energy Outlook Special Report,” 2016

⁹Radetzki, Marian, State Mineral Enterprises: An Investigation into their Impact on International Mineral Markets,” Resources for the Future, 1985

¹⁰<http://www.pemex.com/en/investors/financial-information/Paginas/results.aspx>

¹¹“Análisis Government Take, Aguas someras, Aguas profundas, Áreas terrestres, Comité Financiero AMEXHI

¹²<http://www.pemex.com/en/investors/financial-information/Paginas/results.aspx>

¹³See Olsen, Bradley and Rebecca Elliott, “Oil Giants Start to dominate U.S. Shale Boom,” Wall Street Journal, 11/15/18

¹⁴Lynch, Michael C., *The Peak Oil Scare and the Coming Oil Flood*, chapter 3, describes many of these

¹⁵<http://www.pemex.com/en/investors/financial-information/Paginas/results.aspx>

¹⁶Mikesell, Raymond, “Explaining the Resource Curse, with Special Reference to Mineral Exporting Countries,” Resources Policy 1997; and Kaznacheev, Peter, “Curse or Blessing? How Institutions

