

THE FUTURE OF PEMEX: RETURN TO THE RENTIER-STATE MODEL OR STRENGTHEN ENERGY RESILIENCY IN MEXICO?

Isidro Morales, Ph.D.

Nonresident Scholar, Center for the United States and Mexico, Baker Institute;
Senior Professor and Researcher, Tecnológico de Monterrey

March 2020

© 2020 by Rice University's Baker Institute for Public Policy

This material may be quoted or reproduced without prior permission, provided appropriate credit is given to the author and Rice University's Baker Institute for Public Policy.

Wherever feasible, papers are reviewed by outside experts before they are released. However, the research and views expressed in this paper are those of the individual researcher(s) and do not necessarily represent the views of the Baker Institute.

Isidro Morales, Ph.D

“The Future of Pemex: Return to the Rentier-State Model or Strengthen Energy Resiliency in Mexico?”

<https://doi.org/10.25613/y7qc-ga18>

Introduction

Mexico's 2013-2014 energy reform not only opened all chains of the energy sector to private, national, and international stakeholders, but also set the stage for Petróleos Mexicanos (Pemex) to possibly become a state productive enterprise. We are barely beginning to discern the fruits and limits of the energy reform, and it will be precisely during Andrés Manuel López Obrador's administration that these reforms will either be enhanced or curbed. Most analysts who have justified the reforms have highlighted the amount of private investment captured through the nine auctions held so far. Critics of the reform note the drop in crude oil production and the accelerated growth of natural gas imports and oil products. Another way to consider the course and success of the reforms is through the new profile that Pemex may take on if it indeed becomes an efficient enterprise able to generate profit in the different value chains it still owns, thus helping to mitigate the country's current vulnerable energy situation.

Meanwhile, the new administration would seem to be once again focusing its hydrocarbon policy goals on reactivating state-run business investments to reach crude oil and gasoline production goals for 2024, when the administration will end. This type of strategy would mean going back to the López Portillo years (1976–1982), or even the Vicente Fox years (2000–2006), when the then state-run monopoly was forced to maximize its crude oil and oil-refined production without taking into account financial, geological, technological, or other types of restrictions. Today, the administration is correct in prioritizing the development of Pemex as a leading hydrocarbons company, but it must understand that to do so, the enterprise must become part of the new competitive context brought about by the reforms so that it can reduce risks and bolster its strengths. This article looks at these risks and strengths and highlights the potential danger if Pemex's management and board of directors remains subordinate to one administration's political priorities. This article also considers the significant difference between basing an energy policy on hydrocarbon and oil-product self-sufficiency versus basing it on progressively decarbonizing the nation's energy matrix with the goal of improving its resiliency and sustainability. The first plan (hydrocarbon self-sufficiency) is more a project to legitimize the government's political priorities and implies questionable results and possible high costs. However, the second plan (progressive decarbonization) might mean a true state policy that would allow the country to make an energy transition over this century, with economic, political, and social opportunities that could be unleashed. Pemex would have to play an essential role on either path, but it certainly cannot go back to the leading role it had during the state-run monopoly stage. The enterprise must first and foremost specialize in the chains where it is the most competitive and fight for financial and corporate autonomy, meaning it must stop being an income collector for the state, something that the energy reform did not modify.

This article is divided into five sections. The first one analyzes the limits and risks of basing the nation's new energy policy on self-sufficiency, without taking into account farther-reaching, long-term goals such as securing decarbonization and the country's energy transition. The second section reviews the severe restrictions imposed on the company over the last few years and the challenges it faces in obtaining fresh capital to be used for

the myriad goals mandated by the president instead of by its board of directors, such as increasing oil and gas production, modernizing refineries, building a new refinery, and fighting against imports of gas and oil products. The final three sections focus on explaining the challenges the company faces in meeting such diverse goals, highlighting that the current challenges and vulnerabilities in each of the chains (crude oil and gas extraction and building refineries) are different in nature. Comprehending the different nature of each challenge will help Pemex to prioritize its goals.

Self-sufficiency or Energy Resiliency?

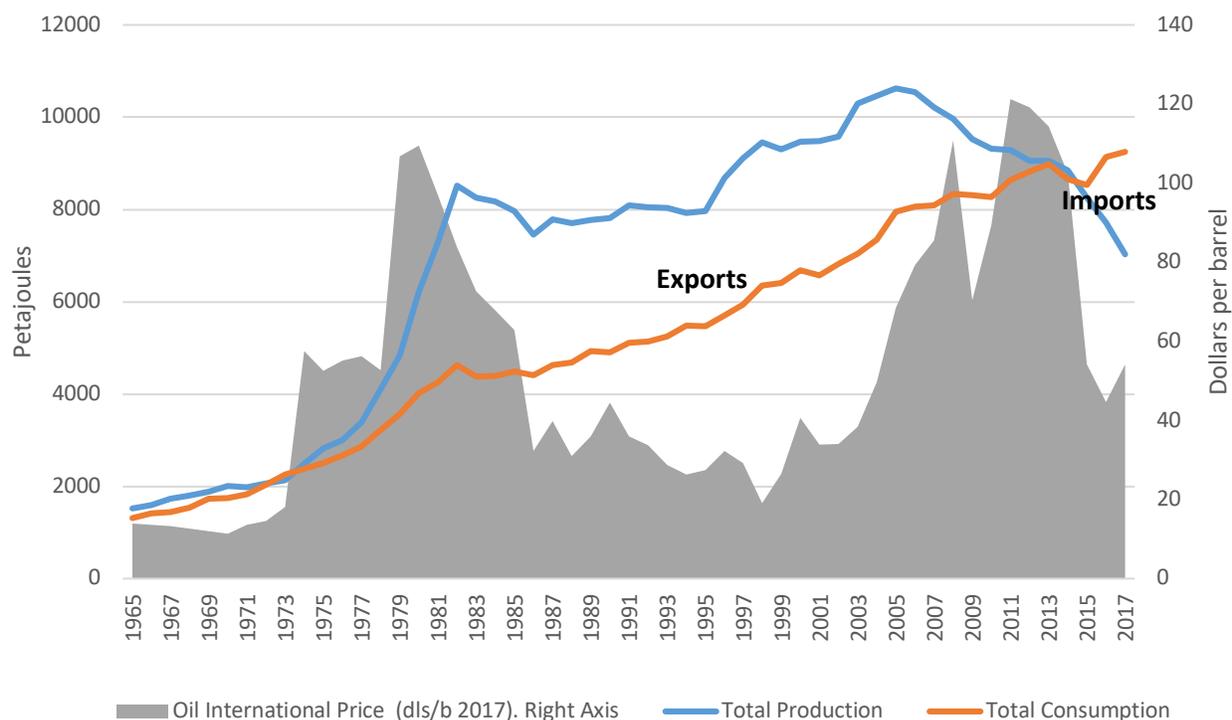
Pemex, which until 2014 was run as a public monopoly to explore, extract, process, and distribute hydrocarbons in Mexico, has historically been more than a simple state-run company. Since 1938, when it was founded after the oil expropriation, the company has become the champion of the recovery and defense of the sovereignty of the Mexican state over the nation's underground resources. Even though article 27 of the 1917 Constitution decreed that the nation would take over these resources, it was not until 1938 that Lázaro Cárdenas' government made good on that takeover by decreeing the expropriation.¹ From then until 1975, the company's main goal was to assure the nation's fossil fuel supply at prices subsidized by the state, making it a very powerful instrument in the push for industrial policies and social management.

Figure 1 shows the evolution of Mexico's total energy balance over the last 50 years. Three company cycles can clearly be seen, if we consider that today 85% of energy consumption is from fossil fuels.² The first cycle runs from 1965 to 1975, when total energy production (measured in petajoules) was still close to the levels of consumption. In fact, this cycle is much longer, since it began approximately at the end of the 1950s, when the Mexican state made energy self-sufficiency another banner of Pemex. Beginning in 1976, during the last year of the Luis Echeverría administration (1970–1976) and during practically all of José López Portillo's administration (1976–1982), a new cycle began called the rentier-state period. During this cycle, we can clearly see how total energy production significantly exceeded domestic consumption needs, which had an average annual growth rate of 3.9% during the entire period covered by the figure. The surplus during this entire cycle can be explained by the growth in the national supply of crude oil, which allowed the country to become one of the world's main exporters. The country's energy production reached a record high in 2005 at 10,624.5 petajoules and then began falling at 3.35% annually beginning in 2006.

¹ For a history of the country's energy policy from expropriation until after the so-called "oil boom" in López Portillo's administration, see Meyer and Morales 1990.

² This number is for primary energy use. If we add coal (7%), fossil fuel use grows to 92%, which shows the high carbonization of Mexico's economy.

Figure 1. Mexico Production and Consumption of Gross Energy 1965-2017



Source: SENER, n.d.; BP 2018.

Figure 1 also shows the evolution of international crude oil prices in real terms, contrasted with the evolution of Mexico's energy balance. The country's insertion in the international oil market took place in 1973, at the same time that the cycle of high prices began. Indeed, simply from 1973 to 1974, prices went up in real terms from US\$18.15 per barrel (dls/b) to US\$58 dls/b, a hike of 300%. In 1980, the price reached a record of US\$109.56 dls/b, the largest increase since the oil industry began to develop.³ After this, prices tended downward, although never at the levels seen from the post-war period to 1973. Since 2000, prices began a new upward cycle, reaching a record high of US\$121.24 dls/b in 2011 and experiencing a new plunge since mid-2014, settling at approximately US\$50 dls/b. Current prices in real terms are still above the average price of US\$16 dls/b that prevailed from 1946 to 1974, so we can say that the industry has settled in an "expensive oil" cycle.

There are basically two types of factors that account for the "high" cycle of oil: economic-geological factors, on the one hand, and geopolitical factors, on the other. Some of the former include pressure from the constantly increasing consumption of crude oil and oil products from traditional producer countries, located mainly in the Persian Gulf and

³ According to records kept by British Petroleum (BP) since 1861, only in 1864, at the dawn of the industry, did the international price of crude oil reach US\$125.81 in adjusted 2017 dollars. International price references quoted here are from BP 2018.

whose exploration and production costs are some of the lowest. As global demand began to outpace the production capacity of these basins, prices started to rise, which led to new investments in new oil fields. Regarding geopolitics, the regional conflicts and rivalries in the Middle East and the formation of the Organization of the Petroleum Exporting Countries (OPEC) in 1960, whose main goal was to defend the fall in oil prices until the beginning of the 1970s and then to keep prices rising through a system of quotas, have made oil a strategic good that can be used as a negotiating weapon. This has led to significant price volatility. Figure 1 shows this volatility; even though prices after 1974 remain on average higher than they were in the post-war period, the peaks reached throughout this period are more the result of geopolitical factors: intra-regional wars (such as on October 6, 1973 and the Iran–Iraq War from 1980 to 1988), the fall of pro-Western governments (such as the Shah of Iran in 1979), and the ability of Saudi Arabia to impose discipline within OPEC or to punish—with geostrategic calculations—those who misbehaved (Yergin 1991).

In any case, since 1976—when at the end of Echeverría’s administration the decision was taken to develop the fields in southeastern Mexico in Tabasco–Reforma—the goal of Mexico’s insertion in the oil market has been to optimize the profits generated from volatile oil prices. If we understand the oil rent as earnings above the costs of exploration and production of a barrel of oil plus reasonable profit margins in competitive conditions and market equilibrium, Figure 1 shows the windfalls, which eventually acted as incentives to increase the supply of crude oil. These margins continue today, even though prices are considered moderate. Today, Pemex estimates US\$25 dls/b as the cost of shallow water discovery and production, compared to an export price of the Mexican mix that has varied between US\$35 and US\$45 dls/b (infra). We can assume that costs for Pemex until 2004 were lower, before the Cantarell fields began their accelerated decline. The high productivity of these fields—which reduced costs to scale—contributed that year to 63% of the total crude oil supply.

Therefore, the period beginning in 1976 can be considered as “rentier state-led,” since from then until the 2013–2014 energy reform, the goal of the Mexican government was to maximize oil export income through Pemex. This was done in order to collect extraordinary resources to increase government spending and investment. This action, in turn, led to a government “addiction” to oil earnings, with amounts varying between 30% and 40% of total public earnings, until recently. This has also historically discouraged the government from putting into action a progressive fiscal policy that would create greater financial autonomy.

The rentier policy at first was triumphalist⁴ and was later justified and legitimized by the country's importance on the international oil market, which has at times allowed it to have margins of maneuver with the United States, the main recipient of Mexico's crude oil supply (Morales 2011). Mexico's insertion in the international market was also built as a projection of Pemex into export markets, which prolonged and consolidated the narratives of sovereignty and self-sufficiency that had been under construction earlier.

It was not until Felipe Calderon's administration (2006–2012) that the sovereignty and self-sufficiency discourse, which had legitimized the company's activities, shifted toward the goal of strengthening energy security, understood in its traditional sense as a way to assure the timely supply of the country's energy needs at reasonable prices (SENER 2014). In fact, the fall in crude oil production, beginning in 2005, and later the fall in gas production in 2009, led the Calderón administration to seek to increase the production of hydrocarbons to their historic levels through the development of the Chicontepec fields and to halt the accelerated decline at Cantarell. In 2008, the president managed to pass a reform, without modifying the Constitution, that allowed for the participation of citizen members on the board of Pemex. It also established the National Hydrocarbon Commission (CNH), linked to the Secretariat of Energy (SENER), which has acted as a technical-inspector watchdog of Pemex's exploration and production activities ever since.

With the government unsuccessfully halting the drop in production, and with the decrease in exports and the growth in gas and oil product imports, a coalition of the country's main political parties was successfully convened at the beginning of the Peña administration. This coalition was led by the Institutional Revolutionary Party (PRI), which returned to power after a 12-year interregnum with the National Action Party (PAN) in the presidency. The cross-party alliance, known as the "Pact for Mexico," agreed upon a government project made up of a series of priorities, including the need to carry out a radical reform of the energy sector that would allow for the injection of private capital in all its value chains. Since the end of 2013 and throughout 2014, Mexico's Congress voted on a series of laws and rules that, without giving up state ownership of all underground resources, put an end to the energy duopoly regime that had reigned in Mexico (at least since 1960) and opened the industry to national and international foreign investment. These changes together are known as the "Energy Reform." Several articles of Mexico's Constitution were modified, but especially article 27, where the participation of private contractors in hydrocarbon exploration and production activities was explicitly legalized through a system that called for public auctions to be held in three rounds. Thanks to these reforms, new stakeholders were able to sign licenses and production or profit-sharing contracts with the CNH and SENER. From 2014 to December 2018, the end of Peña's administration, the government managed to sign 110 contracts auctioned in the three rounds, including a total of nine bids for production and exploration, and managed to bring in US\$7.568 billion for different

⁴ During the first four years of the López Portillo administration (1976-1982) Mexico witnessed an "oil boom," a rapid increase of oil output combined with high international prices. The government optimistically coined the phrase "manage the abundance," referring to its policy goal of managing all of the oil wealth. However, in 1981 and 1982, international oil prices dwindled, and Mexico defaulted its foreign public debt.

types of payments and investments (Pemex 2019b). The public auction system and the signing of contracts between SENER and private participants began a new cycle for Mexico's oil and energy industry—one of extraction and management of oil profits through market mechanisms.

Even though López Obrador's administration has respected all these contracts, it has suspended the auctions that were scheduled in the previous government's Five-Year Plan (SENER 2017a) and has rejected the possibility of developing the shale oil and gas fields. Since the beginning of his government, López Obrador has considered the oil reform as part of a privatization project that would weaken both Pemex and the Federal Electricity Commission (CFE). According to the president and to officials in his government, the reform did not comply with its mission—to increase oil and gas production and to attract private investment for amounts above those it has indeed captured. Still, thus far there has been no interest in reversing the legislation from the Peña administration. At least for now, the new administration has decided not to continue with the rounds and auctions and has preferred, as the following sections will show, to assign the contracts directly or to recur to the system of “restricted auctions,” where the government decides beforehand who will be able to bid (as was the case with the Dos Bocas Refinery).

It is important to note that even though the modification to article 27 of the Constitution allowed openly for the participation of private companies in the energy sector, articles 25 and 28 retain hydrocarbon exploration and production activities as strategic areas and therefore under “exclusive” state control. In other words, article 27 allows for private participation in primary activities, under conditions always limited by the state through contracts or licenses. Yet in both plans, rights and benefits could be suspended by state authorities if the investors do not adjust to the goals and requirements of the signed contracts. If there is litigation, disputes with private companies can be handled by international courts (as long as they are not administrative-type suspensions), and those with Pemex can be handled by Mexico's courts.

The new legislation also gave more independence to the CNH and to the Energy Regulation Commission (CRE), which is in charge of managing sales and access conditions of the new investors, and eliminated oil union representatives from the business's board of directors. Meanwhile, Pemex stopped being a parastate entity and became a state productive enterprise, like the CFE, whose main purpose is value creation.

The original spirit of the reform was to strengthen and increase the country's hydrocarbon supply. In other words, like the changes during the Calderón administration, it was meant to bolster energy security. According to the reform's program principles, it sought to halt the fall in crude oil production and to raise it to three million barrels per day (mbpd) in 2018 (and 3.5 mbpd in 2025) and to raise natural gas production to 8,000 million cubic feet (MCF) a day (10,400 MCF a day in 2025) (*Reforma Energética* 2014, 3). Peña's government also envisioned the opening of a new refinery—one that would not necessarily be run by Pemex—by 2026. However, as the spirit of reform moved ahead in Congress, and after several debates and discussions, the legislators also approved a new electricity law and a law

that mandated the country's energy transition. The importance of the 2014 Electricity Law is that the members of Congress finally decided that natural gas would no longer be considered as a "clean" energy source. Until then, SENER had treated it as such, since it had lower carbon emissions than fuel oil, and natural gas had become the transitional fuel to feed the growing demand of combined-cycle plants. The 2014 law considers gas as a clean energy source only if the so-called "carbon sequestration" is being carried out. When the Energy Transition Law went into effect in December 2015, the use of clean fuels—renewable and nuclear energy—for generating electricity became mandatory. The law establishes that in 2024, 35% of electricity generation must come from these sources, and it set up a carbon market for buying and exchanging "green certificates."

These two bills made clear the idea behind the reform, at least for several legislators who at that time were in political opposition. It went beyond simple support for energy security through state-led market mechanisms. The reform also paved the way to launch a decarbonization of Mexico's economy with the goal of not only fighting climate change and honoring Mexico's commitments to the Paris Agreement, but also improving its energy resiliency, considering its huge dependence on the production and consumption of fossil fuels.

If energy resiliency is understood as the ability to respond and adapt to unforeseen shifts or shocks that alter one or more energy systems considered as vital (Cherp and Jewell 2014; Jewell, Cherp, and Riahi 2014; Rutherford and Coutard 2014), decarbonization processes are considered today as one of the strategies to reduce the vulnerabilities caused by the extreme dependence on hydrocarbons. The decarbonization of economic and productive processes in favor of green energy such as solar or wind entails the advantage of renovating inputs permanently. Still, energy systems fed by renewable resources also have limitations and vulnerabilities. One is their still-limited storage capacity, which will certainly improve through stronger advances in technology and more efficient batteries. Another is the fact that they are intermittent generation sources, which means there will be a continued dependence on fossil fuels to assure an uninterrupted energy supply.

These issues show that energy resiliency does not refer to the response capability of only one vital energy system but rather to a combination of them and to the way they interconnect to assure a country, region, or even a cross-border region's total energy supply. In other words, they are systems that interlink different energy sources, with differentiated technology and distribution systems, and that have a specific geographic localization. Seen in this way, even though Mexico is a country that in practice produces and consumes fossil fuels, it has several energy systems that, interlinked, assure its supply and consumption. There are at least three hydrocarbon systems: one for crude oil exploration and extraction, with its own geology, storage, and collection logistics; one for natural gas, which may or may not be linked to crude oil or may occur through unconventional extraction, with its own particular logistics and technology (for example, fracking); and one for refining and industrial transformation, also with its own refining, storage, and distribution logistics. Parallel to these three systems are others for generating secondary energy, such as electricity. There are carbo-electrics and thermo-electrics that

require fossil fuels for their generation. In Mexico, 76% of all electric fluid is generated with these fuels. The rest is generated with so-called “clean energy,” which includes hydraulic, nuclear, wind, and solar. Each of these energy sources is itself a system, because it is not the same thing to run a hydroelectric plant as a nuclear one. Each source demands different technologies and processes, with different operations and transmission infrastructures.

Even though the energy reform paved the way for Mexico to take on the energy transition decisively, it does not guarantee that the country can improve its energy “security,” or much less, its resiliency. As has been noted, during Calderón’s administration, the country’s traditional sovereignty narrative regarding its energy resources was replaced by an energy-security discourse. Yet this concept continues to be understood in its traditional sense, as the ability to assure the energy supply at affordable prices. The first question that arises is, which “supply” is to be assured? In Mexico, it is of course hydrocarbons, but if we see them as vital interlinked systems, the next question is, which system? Is it crude oil, natural gas, refined products, or all of them at once? Are the vulnerabilities all the same in the different chains that make up these three energy systems? If this is the case, why not develop another type of energy supply, just as the decarbonization discourse and practice propose? For some countries, the answer has been nuclear energy, while for others it has been renewables. So, what decarbonization options should the country follow, taking into account the resources it has and its access to technology? Next come the questions about energy consumption.

While energy security has focused on supply and the cost of energy resources, energy resiliency also includes the problem of consumption and of operating infrastructure. How should the use of fossil fuels be punished because of the greenhouse gases produced? How can the use of renewable energy be encouraged? Which operations and transmission infrastructure should be bolstered—pipelines or distributed generation; cable or accumulators and batteries? After one year in office, López Obrador has clearly shown the path the country’s energy policy might follow. He has openly distanced himself from the energy reform agreed upon and launched by his predecessor, but without yet annulling its legal and regulatory framework, which has simply been suspended. At the level of discourse, the new team has returned to a rhetoric of sovereignty and self-sufficiency that reminds us of the final years of the rentier state-centered model. This type of discourse has once again placed the CFE and Pemex at the center of Mexico’s energy systems, where private capital would participate as a contractor who shares risks and services with one of the two companies. The new government’s energy policy is currently trying to account for the fact that oil profits are in danger of disappearing, due to both the fall in crude oil production and the accelerated increase in gas and oil product imports, as Figure 1 shows. This is why the current administration also talks about recovering the notions of national security and geopolitics regarding energy topics (Pemex 2019b).

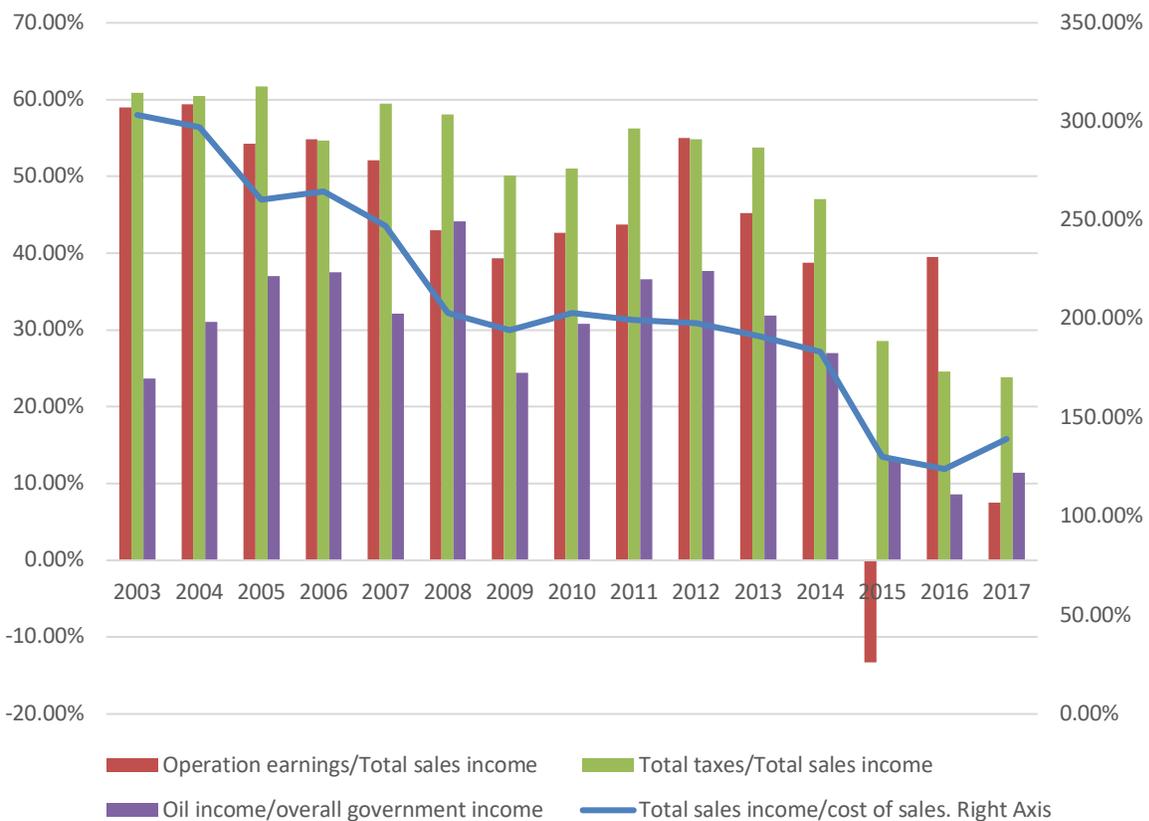
In other words, for the current administration, to return to self-sufficiency and to increase the production of crude oil means to improve the state’s ability for action and autonomy, as a result of both the additional profit that will be created and the strengthening of the two most important public companies that still exist. In the following sections, we shall analyze

how Pemex, in its current situation, will be able to comply with the mandate set by the new administration. Will it be able to raise crude oil production to an average of 2.4 mbpd by 2024? Will it be able to increase natural gas production to 6,933 MCF per day by the end of this year? Will it also be able to build a refinery with the capacity to process 340,000 barrels of crude oil a day in 2021? Will these self-sufficiency goals be met? What will be the cost of this self-sufficiency? Will it perhaps cancel the energy transition that the 2013 and 2014 reform had promised? Is self-sufficiency a goal to strengthen the resiliency of the country’s energy systems?

Avatars of a Company that Collects Income for the Public Coffers

Since the beginning of the rentier-state oil cycle, Pemex has acted as an income-collection agency for Mexico’s government. Figure 2 shows the company’s key financial indicators before and after the energy reform. As late as 2014, the year in which international crude oil prices plummeted, total income for oil sales outpaced the costs significantly and still doubled them the year of the plunge. Beginning in 2015, income from sales outpaced costs by less than 50%.

Figure 2. Pemex: Financial Indicators 2003-2017



Source: Pemex 2003-2017, *Estados Financieros Consolidados Dictaminados*; SHCP 2019.

Figure 2 also shows operational performance as a percentage of total sales. This income reflects the remaining amount once costs for total sales and other expenditures are deducted, including for distribution, transport, sales, administration, and even certain benefits for pension plans, or practically all direct and indirect costs except financial ones (including debt, service, and exchange losses). The figure is also eloquent in that it shows clearly how operational performance, which tended downward with respect to 2003, contracts significantly—except in 2016—after the oil market plunge. In 2015, for the first time Pemex had net operating losses, and in 2017, the meager profits represented only 7.5% of total sales income, far from the 60% seen in the early years of this century.

The figure further shows that oil has continued to collect income for the government coffers, which has created an “addiction” to this income. Traditionally, Pemex has transferred 50-60% of its sales income to the government, especially for so-called “hydrocarbon rights,” and has done so at these levels until very recently. Beginning in 2014, the income bleed was reduced, making up only 24% of sales in 2017. Likewise, the ratio of oil income to total government income remained at historic levels, more than 40% in 2008. From 2014 on, the ratio of this income contracted, making up only 11% of total fiscal income in 2017.

The contraction in transfers from Pemex, and therefore in oil income, in the government coffers should not be seen as a change in the role played by the company in Mexico’s public policies. Rather, it shows the crisis of the country’s energy sector shortly after the energy reform went into effect. Even though Pemex’s transfers to the treasury have been adjusted in recent years to allow it to keep more resources, the energy reform did not substantially modify the subordination of its board of directors to SENER, which still leads it, and to the secretary of the treasury, which still has the last word regarding the company’s budget, spending, and fiscal obligations. This is one of Pemex’s main corporate-limiting factors, since its lack of independence from the executive branch and its inability to procure and manage its own resources leave it with no autonomy to set its own goals and challenges.

Indeed, Pemex has worked with net losses over the last few years, except in 2006 and 2012, because its transfers to the treasury have been equal to or even greater than its operational performance. The company is then dependent on income from exports and is vulnerable because of its transfers to the treasury. On the one hand, oil income depends on the amount of crude oil output and its value, linked to the fluctuation in international prices. On the other hand, the company’s subordination to the treasury’s annual taxes—which vary according to government requirements from oil income and are not based on agreed-upon transfers (as the government did with the companies that took part in the nine auctions after the reform)—has imposed a type of embargo on Pemex’s income.

Figure 3 shows how the fluctuation in total sales income oscillates according to the behavior of the average price of the Mexican export mix on the international market. It explains why, since Calderon’s administration, the most important goal of the government, including López Obrador’s, has been to increase the production of crude oil once again to its historic levels. The figure also shows that despite the decrease in sales income, sales costs

(estimated in real terms) did not decrease. In other words, the company has not been flexible in adjusting its internal costs when the international market contracts and production falls.

Figure 3. Pemex: Total Sales Income and Total Sales Costs



Source: Pemex 2003-2017, *Estados Financieros Consolidados Dictaminados*; Pemex 2006 and 2017, *Anuarios Estadísticos*.

According to Pemex’s official numbers, production and exploration costs have gone up in the past few years. The former has increased from US\$6.80 dls/b in 2012, to US\$10.50 dls/b in 2017, while in 2015 the company estimated the costs of discovery and development to be US\$14.35 dls/b (Pemex 2017a, Pemex 2015). This amount gives an approximate average of US\$25 to discover and produce one barrel of crude oil in shallow waters, an area that the company has focused on in the past few years. All things considered, this cost is still attractive for the company, even after the price drop in 2014, because the average of the export mix has oscillated between US\$35 and US\$45 dls/b (Figure 3). The opportunity to reduce costs and to increase company efficiency could be on the labor side. Hartley and Medlock have already mentioned that Pemex, when compared to other state-run companies such as PDVSA (Venezuela), ARAMCO (Saudi Arabia), or Statoil (Norway), had the highest number of employees with respect to total assets (Hartley and Medlock 2011). At

the end of 1990, Pemex had fewer than 130,000 full-time employees, while in 2015 the number had gone up to 153,085 (Pemex 2006, 2017b). We must also add the innumerable part-time employees who have traditionally worked for the company and whose numbers are not reported. This observation can be seen in Figure 4, which shows the profitability of the company's total investment related to the accumulation of assets. At the end of 1990, for every peso invested, the oil company obtained nine pesos in assets, in 2015, the ratio had fallen to one to five. The situation has flipped quickly, more as a result of the contraction in investment in recent years than from improved efficiency in investment.

Even though the company has cut its personnel over the last few years,⁵ the main problem in adjusting the work load is the rigid structure of the oil union. In adverse times, personnel reduction is carried out mostly among non-union workers. The unionized employees also enjoy a series of benefits, including a very hefty pension plan, which has increased the company's worker liabilities and has led to a negative balance in total equity. Like the subordination of the company's board of directors to Mexico's executive office, the employee burden is another corporate-limiting factor for the company. When the labor legislation approved by Congress in April 2019 goes into effect, it will allow workers more freedom to unionize, and it is likely that the labor adjustment the company needs will be easier to achieve.

Besides the labor costs and liabilities, the company has also dealt with the accelerated growth of its external debt in recent years. In absolute terms, the company's long-term debt (both internal and external) grew from 56.339 billion pesos in 1997, to 1.9 trillion pesos in 2018, equivalent to US\$95.086 billion dollars.⁶ It is important to note that the volume of this debt practically tripled in Enrique Peña's term (2012–2018), going from 672.618 billion pesos in 2012, to almost two trillion pesos in 2018. Estimated as part of the company's total assets, the growth of the external debt grew from 16.6% to 89% of total assets in 2018. In other words, the company's debt is practically equivalent to the total of its assets. This situation has led to pressures in terms of financial costs (payment of the principal plus accrued interests) and credit ratings, which have very recently lowered the company's performance outlook. For example, Fitch Ratings lowered Pemex's credit rating from BBB+ to BBB-, which places it one step away from losing the investment grade (see Pemex's website).

⁵ In 2017, the number of full-time employees fell to 124,660.

⁶ In June 2018, the amount of Pemex's long-term external debt was 1.66 trillion pesos, while internal debt was 242.158 billion pesos (SEC 2018). Eighty-five percent of the debt has fixed interest, while 15% is at variable rates. Seventy-five percent is in international bonds, 6% in international banking, and the rest is in other financial instruments. Sixty-five percent is in USD, 17% in euros, 11% in pesos, and the rest is in other currencies (Pemex 2018a).

Figure 4. Pemex: External Debt and Investment/ Total Assets 1997-2018



Source: SEC 1997-2018; Pemex 2006 and 2014, *Anuario Estadístico*; Pemex 2017b; Pemex 2020.

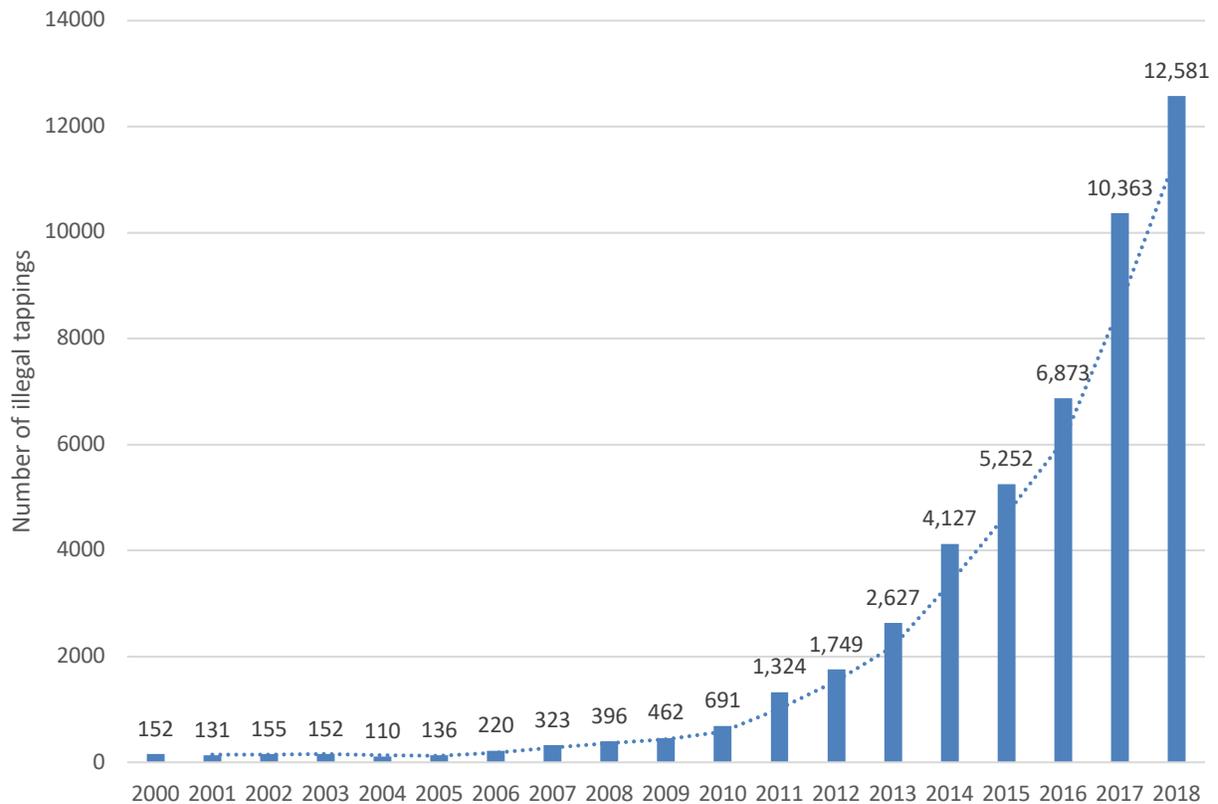
Since his government took over, López Obrador has made it clear that the new resources to be injected into the company would not mean an increase in its debt, at least during the first year of his administration. Facing pressure from the company's credit ratings and the need to improve its credit profile, the Ministry of Finance and Public Credit (SHCP) announced the possibility of using 100 billion pesos from the Budgetary Income Stabilization Fund (which has approximately 300 billion pesos) to liquidate part of the company's debt ("México prevé aumentar su producción" 2019). This measure would have meant liquidating only 5% of the debt, using a third of a fund that was set up as part of the energy reform to guarantee a macroeconomic balance of public finances during difficult times.⁷ Fortunately, this measure was rejected, and in May 2019, the SHCP turned to a severe public spending cut—which affected public universities and all government dependencies, including the health sector—to transfer fresh resources to the company.

Besides the austerity measures, in December 2018, López Obrador's administration began to fight against the illegal tapping of oil, gasoline, and gas pipelines, which had grown exponentially under the Peña administration, as Figure 5 shows. With assistance from the armed forces, and in the middle of a debate over the need to create a National Guard, López Obrador managed to significantly reduce the illegal tapping of gasoline in three months. Illegal tapping decreased from 56,000 barrels per day (bpd) in 2018, to 8,000 bpd by the end of March 2019 (Guerrero 2019b).

This reduction not only involved the state takeover of the Salamanca refinery, but also the launch of inquiries about who was involved. For example, General Eduardo León Trauwitz, the former subdirector of Pemex's Safeguard Strategy under Peña's administration, is suspected of having been an important player in the illegal tapping of fuel (Barajas 2019). Corruption within Pemex is nothing new, but everything seems to indicate that during the past administration, it reached unprecedented levels. Besides the accelerated illegal tapping of fuel, there is evidence that the bribery and contract-buying carried out by the Odebrecht company—which caused scandals in Brazil, Peru, Argentina, and other countries—also involved Pemex and its former director, Emilio Lozoya, on whom the attorney general has opened an inquiry.

⁷ Indeed, the reform planned for the creation of an oil fund fed by taxes, royalties, and surpluses from the new exploitation of oil wealth, to be managed not by the secretary of the treasury but by the Bank of Mexico. This fund is in fact made up of a variety of funds, such as the compensation fund, with a total of 4.7% of the country's annual GDP. The compensation fund's function will be to make the necessary transfers to the treasury, with the goal of managing public spending. There is also a reserve fund, with an amount equal to 3% of the country's GDP, whose goal is to preserve the wealth for future generations. Although the new tax provisions maintain Pemex's transfers to the fund (up to 71.5% of income from operations), the goal of the fund was to make transparent the extraction and management of oil rent while lessening the fiscal pressure on Pemex, a situation which thus far has not been realized, as was noted earlier.

Figure 5. Illegal Pipeline Tapping in Mexico



Source: Senado de la República 2015; Pemex 2018b.

Fighting corruption in Pemex and the energy sector would seem to be one of the flagships of López Obrador’s administration. The goal is to close the illegal leaks that have bled the company and thus to restore part of its income and assets. For example, the current administration has estimated that 40 billion pesos worth of stolen fuel was recovered at the end of March 2019, of which 80% was returned to Pemex.

The Challenge of Increasing Oil Production: How Much and For What Purpose?

In February 2019, Mexico produced 1.720 mbpd of liquid hydrocarbons,⁸ a number far below the 2.129 mbpd extracted in 1980, slightly before the country entered the oil “boom” of the first half of the 1980s. At that time, the country set off on a race against time to quickly raise its production platform, which two years later reached three mbpd. This number was a record high, since the country had never managed to produce such an amount before or after the oil expropriation. In 2004, Mexican production reached an

⁸ Including crude and condensed forms.

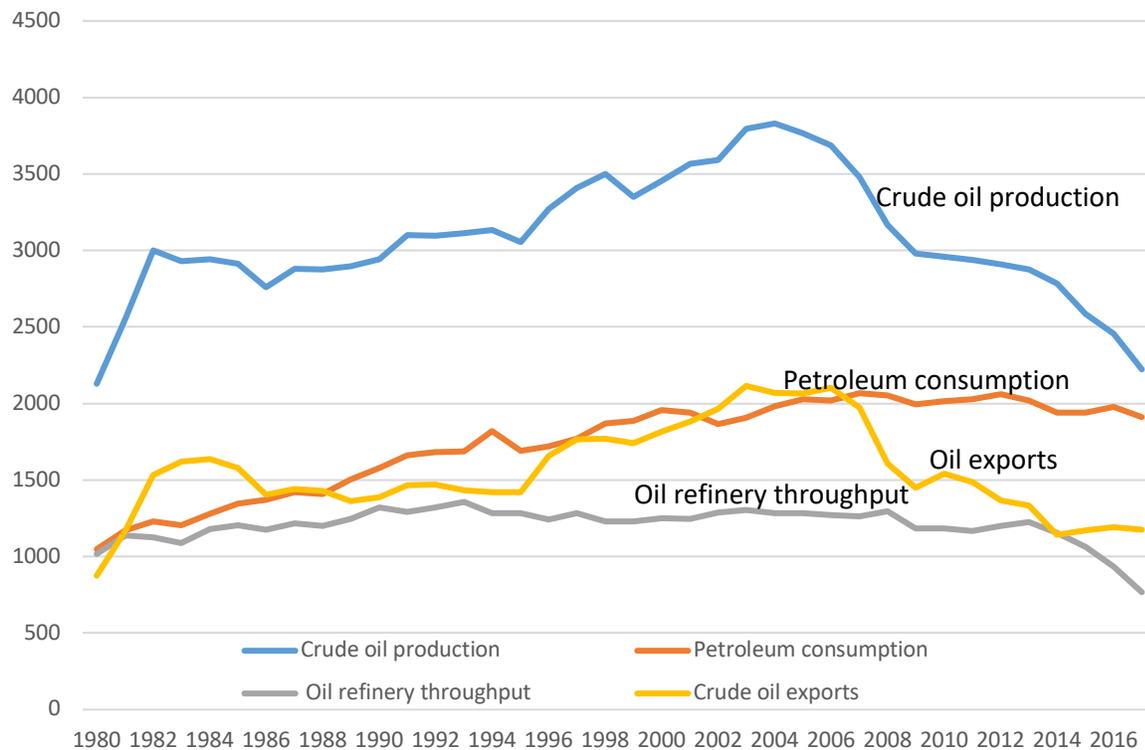
average of 3.830 mbpd, a record, only to begin a progressive decline until today, due mainly to the plunge in production in the Cantarell fields (located in the Bay of Campeche). As is known, the last super giant field found in the country reached its maximum production in 2004 during Vicente Fox's administration, and it began to decline quickly beginning the following year. In 2004, Cantarell contributed 63% of total crude oil production, whereas in February 2019, it was barely 5.6% (CNIH 2019). The speed of the decline and the inability to stop it have made it clear that the field suffered from overexploitation due to political pressure to maximize Pemex's production with no thought to the technical and geological limiting factors of any oil field (Lajous 2014, 75-82). The fields developed by Pemex to compensate for the decline in Cantarell, such as Ku and Maloob-Zaap, have not reached that level.

Figure 6 shows the decline in exports. Beginning in 2014, the drop in exports seemed to stop, even though total production continued the downward trend. It can be explained by the lower volumes of crude oil sent to the six Mexican refineries. In fact, the decrease in refinery throughputs began in 2008 and accelerated in 2013, which shows that the Mexican refineries were working far below their capacity. There are several reasons. The greater extraction of heavy crude over light crude is one of them, because the refineries were not reconverted enough to process heavy crude (which characterizes the Mexican mix).⁹ A lack of maintenance of the refineries is another reason, because Mexico's state-centered extraction policy has favored investment and development of primary activities over refining, especially over the last 15 years. This is when extraction reached its historic high and international prices surpassed early 1980s levels. A third reason might be that since the refineries have not been modernized, the performance of light distillates such as gasoline have not been able to increase when compared to residuals, such as fuel oil.

This situation might explain the priority of maintaining the "floor" of crude oil exports, which apparently the managers of Pemex have fixed since 2013. This means that the fall in production has reduced the crude oil sent for refining. After all, profit for the state-run company is found more in crude oil exports than in making oil products, which were subsidized until 2017 when the energy reform liberalized internal sales prices (infra).

⁹ In 2017, 54% of Mexican production was in Maya crude (21.81° API).

Figure 6. Mexico: Major Trends in the Crude Oil Industry 1980-2017, Thousand Barrels per Day



Source: BP 2018; Pemex 1988-2017, *Anuario Estadístico*.

In the end, Mexico’s oil exports have gone down from 1.870 mbpd in 2004 (the high point) to 1.184 mbpd in 2018, a decline of 686,000 bpd.¹⁰ Exports to the United States, Pemex’s main client, fell from 1.590 mbpd in 2004 to 674,000 bpd in 2018 (Pemex 2019a).

Since the Calderón administration, and especially during Enrique Peña’s, reversing the fall in crude oil became a priority. In fact, the goal of the energy reform was to open the exploration and production chains to foreign investment so as to inject fresh capital and to share the financial risk in an attempt to increase crude oil production. With the changes introduced through the reform, Pemex stopped being a monopoly company and became a state productive company, which means that its main goal is to optimize its resources to obtain benefits. To achieve it, the company board would have autonomy to prepare its annual operations plan and would be reduced to 10 members, of which five were chosen by the president and five were citizen consultants proposed by the president and endorsed by the Senate. The five representatives from the oil union, who had until then made up part

¹⁰ By the last date, exports of Maya crude represented 91% of the total, while Istmo crude (33.7° API) made up 7%, and the remaining were Olmecca crude (39° API), the lightest Mexican oil (Pemex 2018a).

of the board, have been excluded since then. Even though the board of directors was granted faculties to make decisions about investment and resource allocation priorities, the company's fiscal regime was still subject to the criteria of the SHCP, especially in designing the country's income and expense budget.

According to the new legislation, Pemex or any other public Mexican company has the right to operate under an allocation scheme, meaning blocks and fields of hydrocarbons are leased directly by Mexico's government to the state company. These leases were awarded through the so-called "Round Zero." Meanwhile, private operators can only participate through contracts (production or shared-agreement) or licenses. Even though the law does not define distinctions between the leases, contracts, and licenses, the rights and benefits derived from each of these formats are significantly different.

The Ministry of Energy can award leases, taking into account the technical and financial capabilities of the public companies and strategic and political criteria on energy security. This process explains why Pemex was able to hold on to most of the deposits with proven and probable reserves, whether underground or in shallow waters, through "Round Zero." In the leases, the private operators can participate through service contracts, although the new law allows Pemex to migrate its leases to contracts or to externalize part of its operations with private companies (farmouts). The leases awarded to Pemex represent 86% of the 3P reserves traditionally estimated by the company (a total of 65 billion barrels of oil equivalent—BBOE), 39.4% of conventional prospective resources, located mainly in shallow waters (a total of 20,700 million barrels of oil equivalent—MBOE), and 0.8% of unconventional prospective resources (a total of 5,200 MBOE). The leases were awarded for five years and can be renewed by SENER, or returned to it if Pemex cannot run them efficiently, and they can eventually be bid on under the contract and license scheme.¹¹ Besides the lease awards, the different auctions organized by the CNH over three rounds that took place between 2015 and 2018 allowed Pemex to obtain additional blocks of prospective reserves, especially in shallow and deep waters, by participating individually or in consortium/partnership with private foreign companies. Likewise, the state-run oil company managed to partner under a farmout with three international companies to develop reserves in both shallow waters and onshore. It has also managed to migrate some of its leases to contracts with the goal of stimulating the participation of foreign capital (Pemex 2018a).

¹¹ The new legislative body also permits SENER to require 30% participation by Pemex in private contracts if SENER judges that it is appropriate due to the similarity of the blocks run by the public company to the private ones, or if it is possible to transfer technology to benefit the public company. Regarding cross-border fields, which are still regulated by an agreement signed with the United States, Pemex could participate with at least 20% of the investment with private contractors. Finally, the law foresees the establishment of "reserved zones" by presidential decree if the country's national interests and energy security considerations require it. The new legislation also requires on average 35% of "national content" for any operator who participates in exploration and production activities, except in deep waters. Initially, 25% was requested, to increase by 10 points.

In this way, the company has retained enough blocks and fields, as well as additional resources, to lead the increase in production of crude oil over the next few years. According to the latest crude and oil product outlook published by SENER during Enrique Peña's administration, it was expected that Pemex's production could increase to over 2 mbpd in 2023, and remain at above 1.8 mbpd through 2031. In that year, production could reach 3.5 mbpd (SENER 2017b), but practically half would come from the auctions carried out or still to be held, according to the previous government's Five-Year Auction Plan (SENER 2017a). Yet according to calculations done by the CNH, and taking into account only the auctions that were held through the end of the previous administration, it has been estimated that production from these auctions would reach 305,400 bpd in 2024 (the end of López Obrador's administration) and 734,00 bpd in 2032.¹² According to these latest calculations, the country's total production could reach 2.5 mbpd at the beginning of the third decade of the century.

Faced with these scenarios, López Obrador's new team has envisioned a new goal: reach 2.6 mbpd by the end of his administration in 2024, of which Pemex would produce 2.480 mbpd on average, approximately 700,000 bpd more than what the company is currently producing. The growth would come from a substantial increase in investment in upstream activities, which would allow the company to boost its traditional and cutting-edge exploration, its new development, and its secondary recovery activities. It would also allow the company to reduce the field rate of decline and increase production in the exploitation fields (Pemex 2019a). It is expected that this growth would come from 20 new fields whose development began in 2019, 16 located in shallow waters in the Gulf of Mexico and four in onshore fields. It will be necessary to drill 116 new wells, build 16 drilling platforms (most of them offshore), construct 27 pipelines, and improve the existing infrastructure (Pemex 2019b).

Even though the contracts auctioned during Peña's administration have been respected, the oil company has remained as the engine in charge of raising the production of fossil fuels (crude oil and gas) and refined products. Under the new model, participation by private contractors continues, but as material and service providers to the company, under the "integral service contracts for exploration and production" scheme. This allows for incentives to be provided to the contractors depending on their operational risk. In other words, López Obrador's administration has suspended, for now, the auctions for new fields according to the Five-Year Plan followed during Peña's administration, by which private companies participated to obtain licenses and production or shared-profits contracts. Under López Obrador's administration, the contractors take part to develop and increase the fields leased to Pemex under "Round Zero."

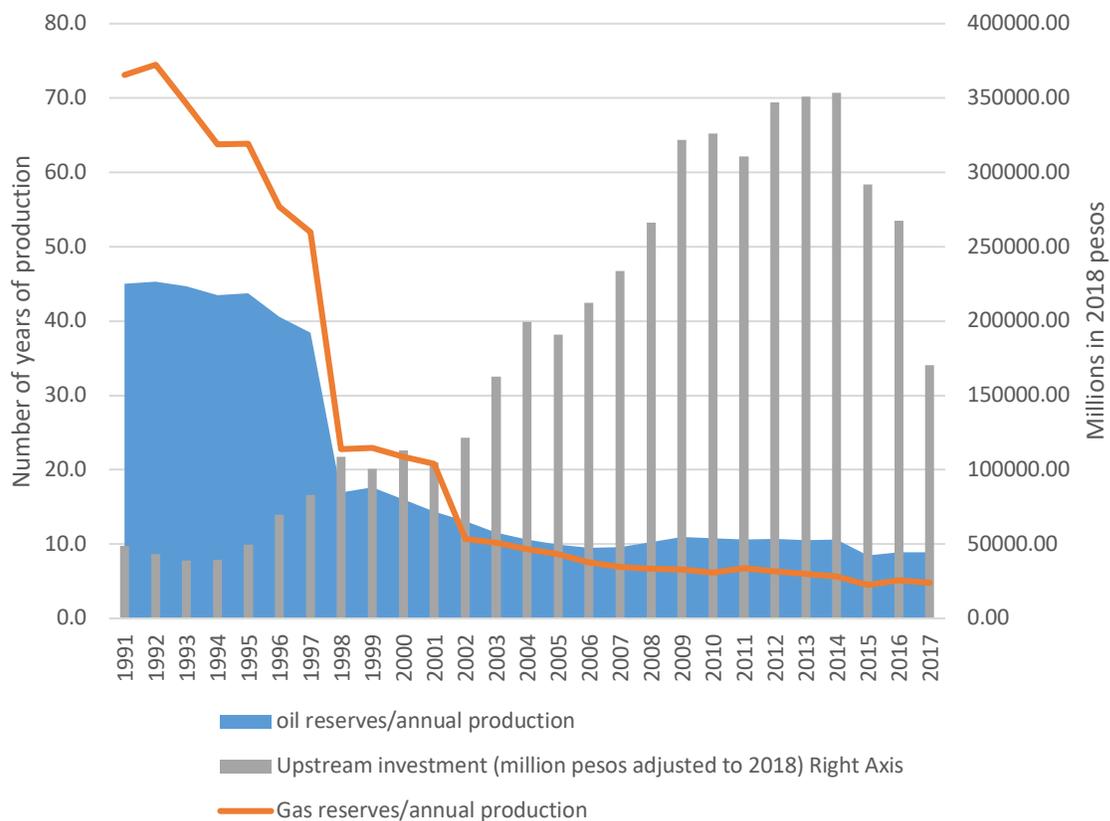
The auctions for contracts have to be public, but the current administration has favored what it has called "restricted auctions" and direct leases. The former means selecting a

¹² This information was not available on the CNH public website, but López Obrador presented it at a public appearance where for the first time he mentioned his goals regarding hydrocarbons, just before he took over the presidency ("Evolución de la industria petrolera en México" 2018).

limited number of companies that can bid for the contracts, such as has been the case for increasing the recovery of mature fields, or the construction of the Dos Bocas refinery, which finally was declared as abandoned (infra). In the second case, the contracts are awarded directly to companies chosen by Pemex, as has been the case for developing seismic engineering and construction work (Omaña 2019).

All this seems to indicate that raising the amount of investment in the company’s upstream activities will be crucial to develop the potential reserves and to increase the production of crude oil and gas in the short and medium term. Yet given Pemex’s financial pressures, analyzed in the previous section—fiscal bleeding, little flexibility to reduce costs, a fall in operating income, high debt, and a lowered credit rating—the injection of fresh money to elevate its productive investments will not be easy. Moreover, the company will have to optimize its use of scarce resources to efficiently reach its ambitious goals. Until 2014, Pemex put the bulk of its investment in upstream activities without necessarily obtaining the results it had proposed.

Figure 7. Mexico: Oil and Gas Reserves in Production Years and Upstream Investments



Source: BP 2018; Pemex 1988-2017, *Anuario Estadístico*; Pemex 2017b.

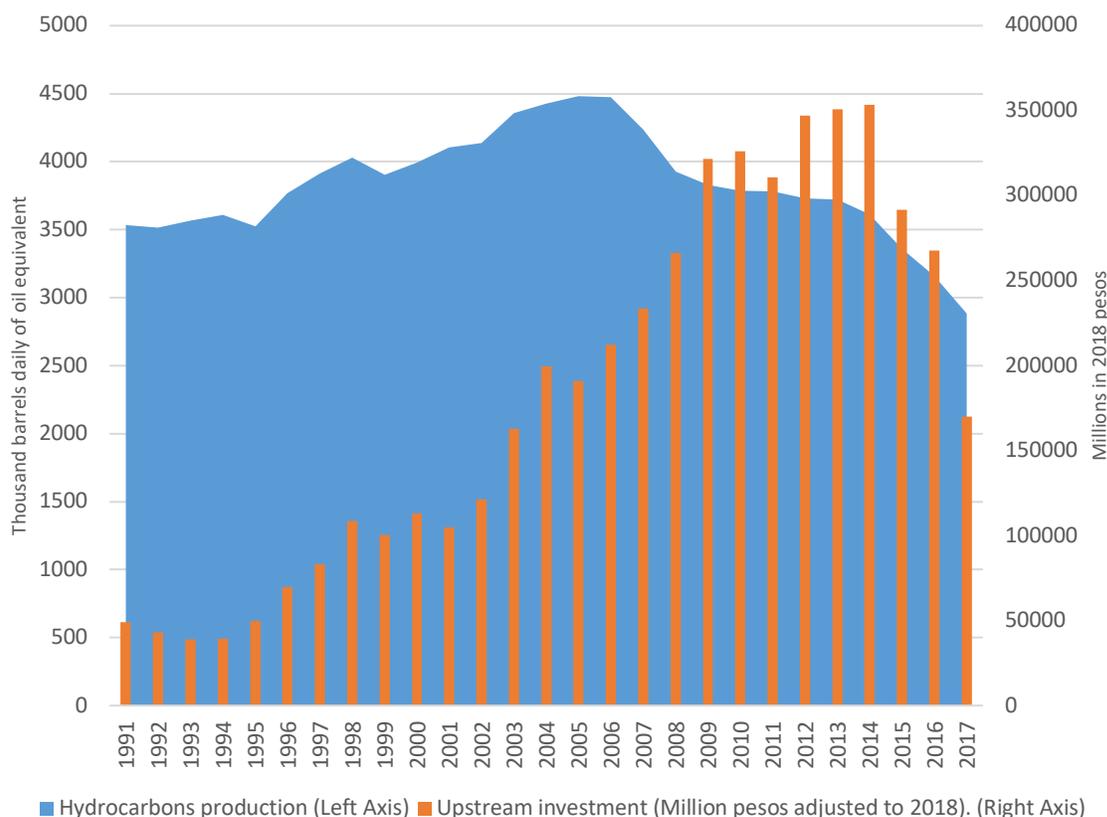
Figure 7 shows the evolution of company's upstream investments over the last 26 years, compared to the stock of reserves of both crude oil and gas calculated in production years. The comparison is valid because even though part of the investment has been used to increase crude oil and gas production, at least during the administrations of Ernesto Zedillo (1994–2000) and Vicente Fox (2000–2006), beginning with the Calderón administration the goal was to stop the fall in reserves, or, as was mentioned earlier, to increase the depletion rate to 100%. Figure 7 shows clearly a plunge in hydrocarbon reserves—measured in terms of production years—in 1998. The drop was due more to technical than geological reasons, since Pemex had to adjust its reserves that year to meet international standards, required by the New York Stock Exchange, if the company wanted to continue issuing debt bonds. In other words, until then the company had “inflated” its reserves, and it had to adjust them to stricter geological and technical criteria to maintain trust and transparency with international investors. The figure shows a downward trend in the inventory of reserves before and after the adjustment. The situation became pressing when Cantarell began its accelerated decline in 2005.

Figure 8 shows the same evolution of Pemex's upstream investments—adjusted to 2018 pesos—this time compared to the evolution in the company's production of total hydrocarbons, meaning both crude oil and gas expressed in thousands of crude oil equivalent. As we can see, total production started to decrease in 2007, a decrease that continues today. Yet investment in real terms did not stop growing until it reached a record high of 353.566 billion pesos (adjusted to 2018 pesos) in 2014, the same year in which the price of the Mexican export mix plummeted with the drop in international prices. If we compare this figure to Figure 3, we can see that in 2010 and 2011, the Mexican mix surpassed US\$100 dls/b, while in 2015 the average price was US\$43.12, and one year later it was US\$35.60. Increasing investment to stop the fall in reserves and production made sense because the international market conditions assured a healthy profit for crude oil extraction. Still, Pemex did not reverse the fall in the amount of reserves, at least throughout that period, nor did it halt the fall in the production of hydrocarbons. Might it mean that the bulk of investments the company made were unproductive?

Since the information that the company makes public does not display investments in primary production by area or activity, it is difficult to answer this question. However, the Cantarell and Chicontepec cases show that the company's investments do not always achieve their goal. According to the CNH, the attempts to halt the accelerated fall in Cantarell production led to an uncontrolled venting of natural gas that was brought under control in 2010. However, in Chicontepec, the amount of investment that Pemex put into developing and boosting the production of more than 19,000 drilled wells was not compensated by their low productivity,¹³ so the CNH suggested halting production (CNH 2013, 92; CNH 2010).

¹³ From 2006 to 2009, Pemex invested 52.520 billion pesos (equivalent to 74.521 billion pesos in 2018) to develop the Chicontepec wells, with less than satisfactory results (CNH 2010, 7).

Figure 8. Pemex: Upstream Investment and Total Production of Hydrocarbons



Source: BP 2018; Pemex 1988-2017, *Anuario Estadístico*; Pemex 2017b.

During the years analyzed, the bulk of Pemex’s investment has gone into exploration and production. Under Peña’s administration, 85% of investment went toward these areas, while 11% went to refining, and the rest went to other chains, including petrochemicals (Pemex 2017a). López Obrador’s administration has announced that the amount of investment will go up, at least when compared to 2018. Pemex will increase its total investment by 288 billion pesos, equivalent to US\$14 billion,¹⁴ an amount 14% higher than the one from last year (Pemex 2019a). This amount will be covered by extraordinary income that Pemex will receive from the SHCP, as a product of the transfers and budget cuts the SHCP has announced to boost the state-run company (supra). Of this amount, 226 billion pesos (78%) will be used for upstream production chains and 58 billion pesos (20%) for downstream. The first amount, although higher than during the last two years of the Peña administration, is lower than the amount invested in 2016, which in 2018 pesos was 267.620 billion pesos, and much lower than the amounts spent between 2009 and 2014, which were higher than 300 billion in real terms (Figure 7). It is clear that over the next few years, the amount of money that the company will get from the treasury (even with its many

¹⁴ At an exchange rate of 20 pesos per dollar.

restrictions) or from the fight against corruption, will have to be invested very productively if the company truly wishes to optimize its resources and increase upstream production, as President López Obrador has mandated.

The Cantarell and Chicontepec cases show that when the company is subject to political pressure, the odds of making poor decisions increase. The creation of the CNH as an independent body to oversee Pemex became useful and valuable to reduce the burning of gas when Cantarell was out of control and to halt the development of Chicontepec when it showed low well productivity. As was mentioned, the energy reform gave this body more independence, as well as the CRE. As long as these two bodies remain independent from the decisions and preferences of Pemex, SENER, and even the president, they will be able to act as counterweights to measures that could damage the company's assets or finances. However, Guillermo García Alocer, who was the director of the CRE since 2016 and should have remained until 2023, has resigned, and the way in which four of the board members were renewed¹⁵ raises doubts about the continuity and survival of these counterweights.

The Natural Gas Dilemma

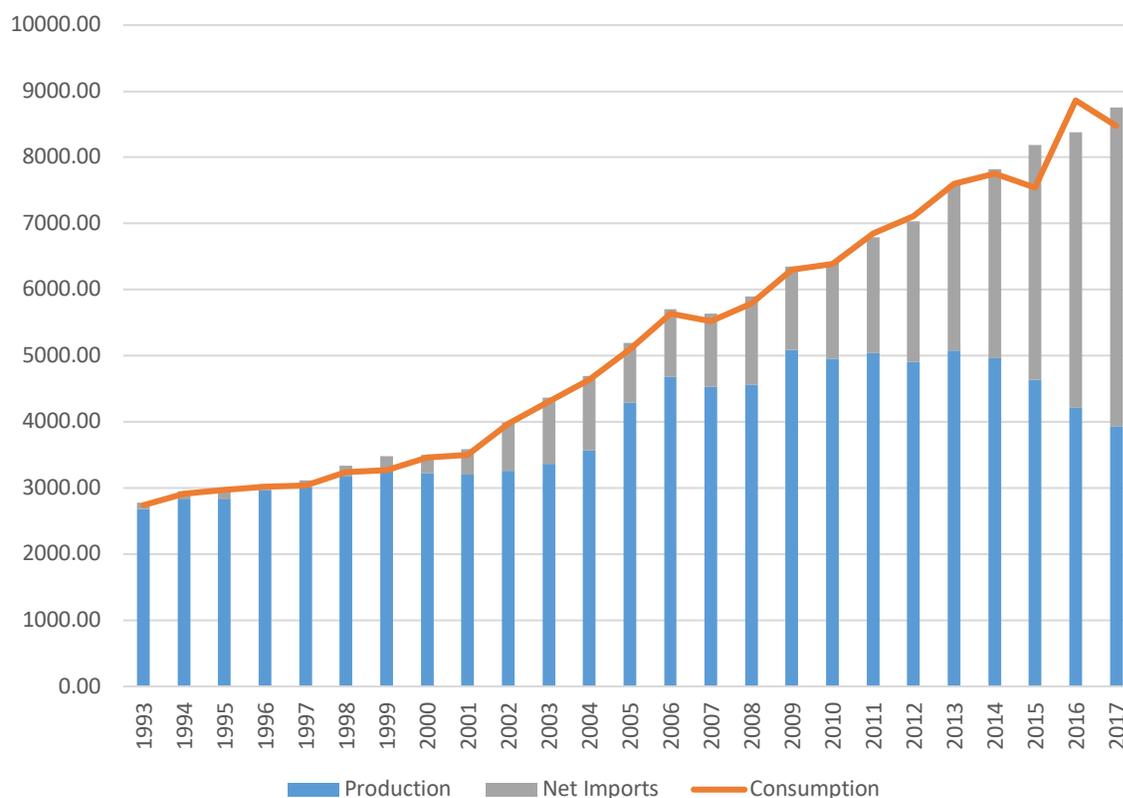
Pemex has been and continues to be a significant natural gas producer. This fuel is a vital energy system on its own, even though 76% of national production is associated with crude oil extraction. Because of the geological concentration of the reserves and the collection and transmission infrastructure in the country, there are three main gas markets. The first is made up of six northern states that border the United States. The main reserves in that region can be found in the basins of the northeast in the Sabinas-Burro-Picacho and Burgos fields, where 76.5% of the country's non-associated gas production is concentrated. Since there is only one gas pipeline linking the northeast with the southeast of the country, where the bulk of associated gas reserves and production is located, Mexicans in the northeast and northwest have traditionally depended on imports from Texas. There are several connection points along the entire Mexico–U.S. border, although 97% of imports come through Monterrey, Reynosa, and Camargo. The northwest has traditionally imported through El Paso and Naco, where gas pipelines were recently built for supplying that region. This market is supplied more and more by imports from Texas, which boasts the lowest natural gas prices in North America because of the gas boom in that state and in the United States in general, thanks to shale gas exploitation. This has meant an increase in total gas imports over the last few years, with imports making up 57% of consumption in 2017 (Figure 9). This market also has two regasification terminals to import liquified natural gas (LNG) in Altamira on the Gulf Coast and in Ensenada on the Pacific.

The second market is located in the center and southeast of the country, where most of the population lives and the traditional basins for associated gas production are found. There,

¹⁵ During the first semester of 2019, President López Obrador sent his proposals of candidates to renew the CRE to Mexico's Senate, but they were rejected twice and considered inept for the position. In the end, and according to the legislation, the president chose the four new consultants from the list of rejected candidates, without taking into account the senators' observations and criticism (López 2019).

we find seven of the nine fuel-processing plants. The supply infrastructure for this market is the vastest and has been bolstered by the regasification plant in Manzanillo, the new private pipelines and those under construction that connect the center of the country with the center–west, and the completion of the submerged pipeline that connects Tuxpan to Brownsville, from where Texan gas will also be able to be imported. The third market is the Yucatán peninsula and can be considered as emerging, since it has recently been linked to the transport and distribution infrastructure in the center by a private pipeline that supplies the needs of the CFE’s thermoelectric plants on the peninsula.

Figure 9. Mexico: Production, Consumption, and Net Imports of Natural Gas 1993-2017 (millions of cubic feet per day)



Source: BP 2018; SENER, n.d.

Even though Mexico has probable reserves of 11.543 trillion cubic feet (TCF), prospective conventional resources estimated to be 76.4 TCF (of which 13.1 TCF are in Burgos and most of the rest in the Deep Gulf), and 141.5 TCF of unconventional (shale gas), of which 85% is in the land basins of the northeast (CNIH 2019),¹⁶ the country has increased its natural gas imports, especially from the United States (although Mexico

¹⁶ According to the U.S. Energy Information Agency, Mexico has a potential of 545 TCF in technically recoverable shale gas resources (USEIA 2013).

still imports LNG from other countries). Natural gas imports especially increased since the second half of this century, which is when national production started to decline (as is mentioned in the previous section). The reason for the fall in national production is intimately linked to the decline in crude oil extraction, because, as has been noted, three-fourths of gas production is linked to it.

All things considered, the fall in national production and the accelerated increase in imports of this product in a country with ample prospective reserves, both conventional and unconventional, clearly shows that the problems and dilemmas Pemex faces in the gas industry are not the same, and at times are not comparable, to those it faces in the crude oil chains. Whereas in the crude oil industry what is at stake is to defend and, in some cases, to increase a profit that international crude oil markets still offer, in the case of natural gas chains, what is at stake is to supply the growing consumption of the CFE's combined-cycle terminals and of independent producers to generate electricity. The natural gas system is linked to the crude oil chains in the extraction phase (associated gas) and to the electricity system as a main fuel for generation. It is as strategic and vital a system as the ones for crude oil and electricity, but it fills different roles. It is in the ability or inability to fulfill these roles that we can weigh the resiliency or vulnerability of a system, as is suggested in the first section of this article. In Mexico, the gas system is more vulnerable than the crude oil or refined ones, and it is not yet clear how Pemex will handle this vulnerability.

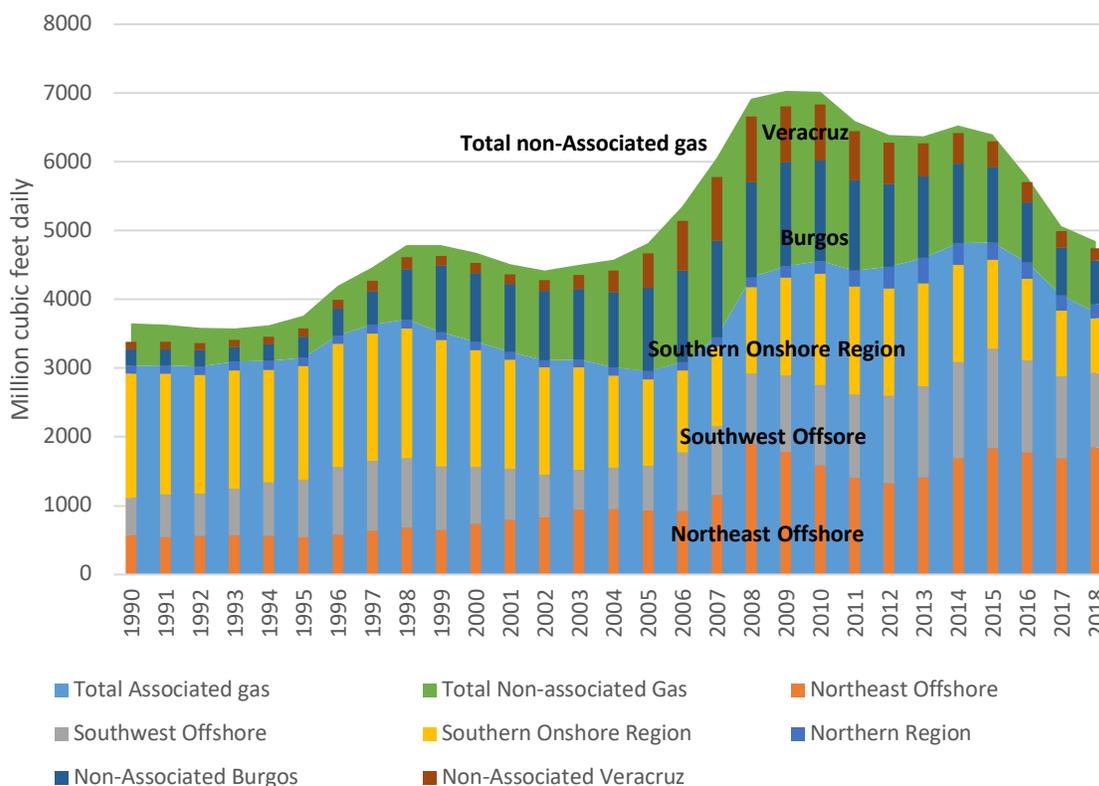
There are several reasons for this situation. Throughout the state-centered cycle launched at the end of the 1970s, the extraction of natural gas was not a priority for Pemex, because crude oil extraction and exports produced more profit. Unlike for crude oil, the international gas market has historically been regionalized, since thus far the most economical transport cost is still by pipeline and not by boat. As technology innovation has reduced the costs of freezing and regasifying LNG, a global market for natural gas has begun to emerge, but with prices that are still much higher than those at cross-border markets connected by pipelines. Moreover, Pemex has favored the development of collection, storage, and distribution infrastructure for crude oil rather than for gas, which has generated little surplus for exportation. This has also created bottlenecks for tapping into national production, leading to the burning and venting of fuel.

Unlike crude oil, where the crash in production can be explained by the collapse of Cantarell, with natural gas, it can be better explained by the fall in associated gas located in the land wells in the south and by the non-associated gas assets of the northeast, especially in the Burgos Basin. Indeed, as Figure 10 shows, gas production reached its historic high in 2019, when Pemex produced 7.03 billion cubic feet (BCF) a day.¹⁷ It was achieved thanks to the increases in the southwest marine region and the northern onshore wells, especially in the Burgos Basin. Production from the southwest reached its peak in 2015, compensating for the historic decline of the onshore wells in the south of the country. In 1990, production in these wells accounted for 49% of total gas production, while in 2018 it was only 16.4%. Meanwhile, the northeast marine region in those same years accounted for 15.6% and 38%, respectively.

¹⁷ Gross natural gas production in Mexico includes nitrogen and other gases.

Paradoxically, in that region, as the Cantarell fields produced less and less oil, they produced more associated gas. Therefore, there was a switch from onshore to offshore wells (located in shallow waters) for extracting this crude oil-associated fuel.

Figure 10. Mexico: Natural Gas Production by Region and Geological Features



Source: SENER, n.d.

It is important to note the evolution of non-associated gas production, located mainly in basins in Coahuila, Nuevo León, and Tamaulipas, and to a lesser degree in Veracruz. As Figure 10 shows, their share of total production grew in both absolute and relative terms. In 2007, 43% of total production came from non-associated gas sources, while in 1990, it was only 17%. The largest producing basin was Burgos, as the figure shows. What should be noted is its decline, since by 2018, non-associated gas made up barely 21.5% of total production, an amount closer to 1990 numbers. The fall in production at Burgos and in non-associated gas in general has not been the result of geologic restrictions but rather of investments. Since Pemex has traditionally placed more importance on exploration, development, and production of crude oil, since Zedillo’s administration, and especially under Fox (2000–2006), the government has been interested in attracting private investment to develop the non-associated resources of the basins in the northeast. In 1995, at a time of severe restrictions on public spending caused by the financial crisis at the end

of 1994, the Zedillo government launched the “Long-term Productive Infrastructure Projects,” better known as PIDIREGAS. This initiative sought to attract investments financed with private capital for projects concerning the exploration and the development of oil and gas fields that, once completed, would be passed on to Pemex, and the government would repay the investment with the products generated. It gave a definitive boost to the production of non-associated gas in northeast Mexico, which continued under the so-called “multiple service” contracts pushed by Fox’s government.

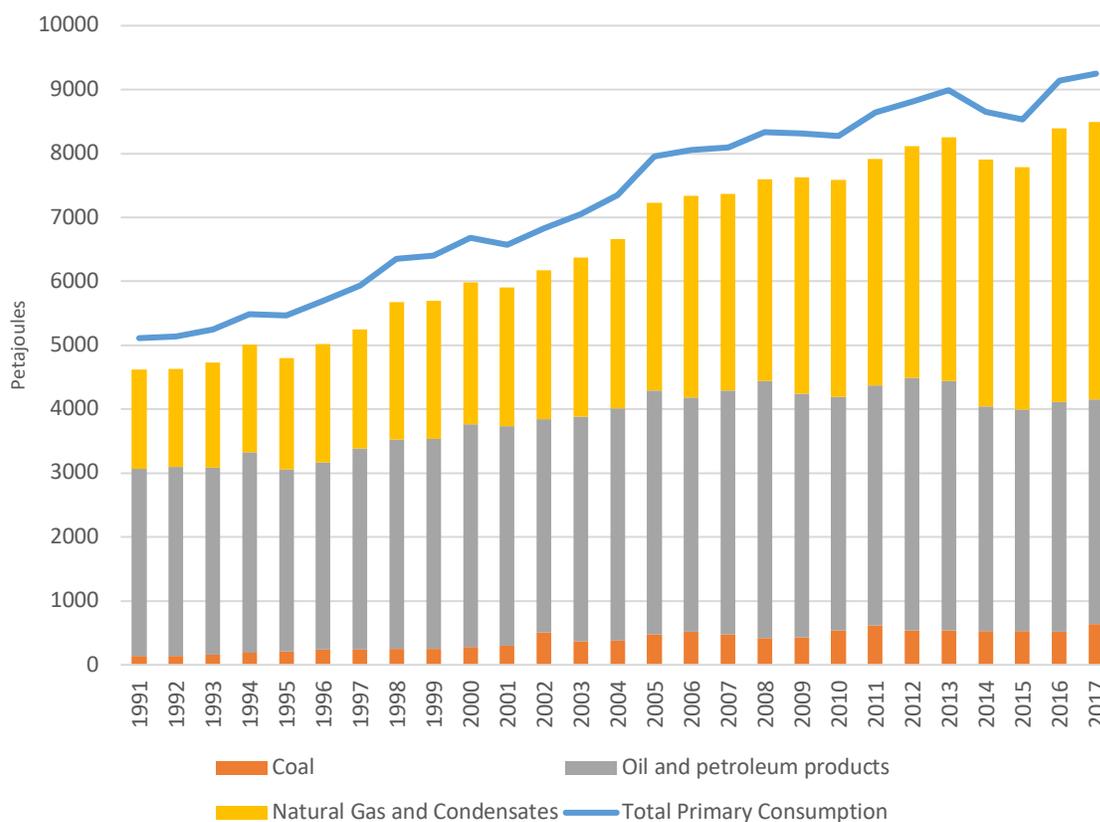
Even though this plan is still in use today, it has caused controversy because the investment undertaken has turned into an increase in the company’s external debt. Investment to develop these gas basins stopped flowing and was geared more toward developing the Chicontepec fields and the shallow water basins, giving preference to crude oil extraction. The same can be said of collection, transport, and distribution infrastructure, even though they were privatized in 1995. This situation explains the decline in production of the Burgos Basin, even though it is a region with ample prospective conventional and shale gas resources.

The consumption of natural gas as an energy input is different than that of crude oil and oil products. Crude oil is the main throughput for Pemex’s own refineries. On the international market, the state company has had several different clients around the world, but its market has been concentrated in recent years on the U.S. Gulf Coast. Meanwhile, the oil product market includes a series of products used mostly for national consumption, with segmented, differentiated markets including gasolines, diesel, liquid petroleum gas (LPG), and jet fuels. By contrast, the consumption of natural gas is concentrated in two sectors: electricity generation (51%), where the CFE dominates, and the oil sector (26.4%). The industrial manufacturing sector uses 21.1%, and the residential and auto transport sectors are marginal (SENER 2018a, 35-36).

Given this complex market and product differentiation, natural gas consumption has seen the highest rates over the last 30 years, as Figure 11 shows. During the Carlos Salinas years, the consumption of crude oil made up 57% of total primary consumption, and gas, 31%. In 2017, the amounts flipped, and natural gas made up 47% of consumption and crude oil, 38%. Indeed, it was during this period, especially since the Zedillo government, that natural gas started to take the place of fuel oil as the most efficient and least polluting source of electricity generation. Later, during the Felipe Calderón Hinojosa and the Enrique Peña Nieto governments, natural gas became the “transition fuel” to eliminate fuel oil in electricity generation.

At the same time, natural gas became a strategic source for the cement, ceramic, steel, chemical, and petrochemical industries. During this period, the gross use of crude oil grew at an average rate of 1%, below the 2.4% average annual growth of the total consumption of primary energy. On the contrary, consumption of natural gas grew at 4% annual rates, which explains the pressure on Pemex to provide for this fuel since the end of the 1990s.

Figure 11. Mexico: Total Consumption of Primary Energy and Fossil Fuels 1991-2017

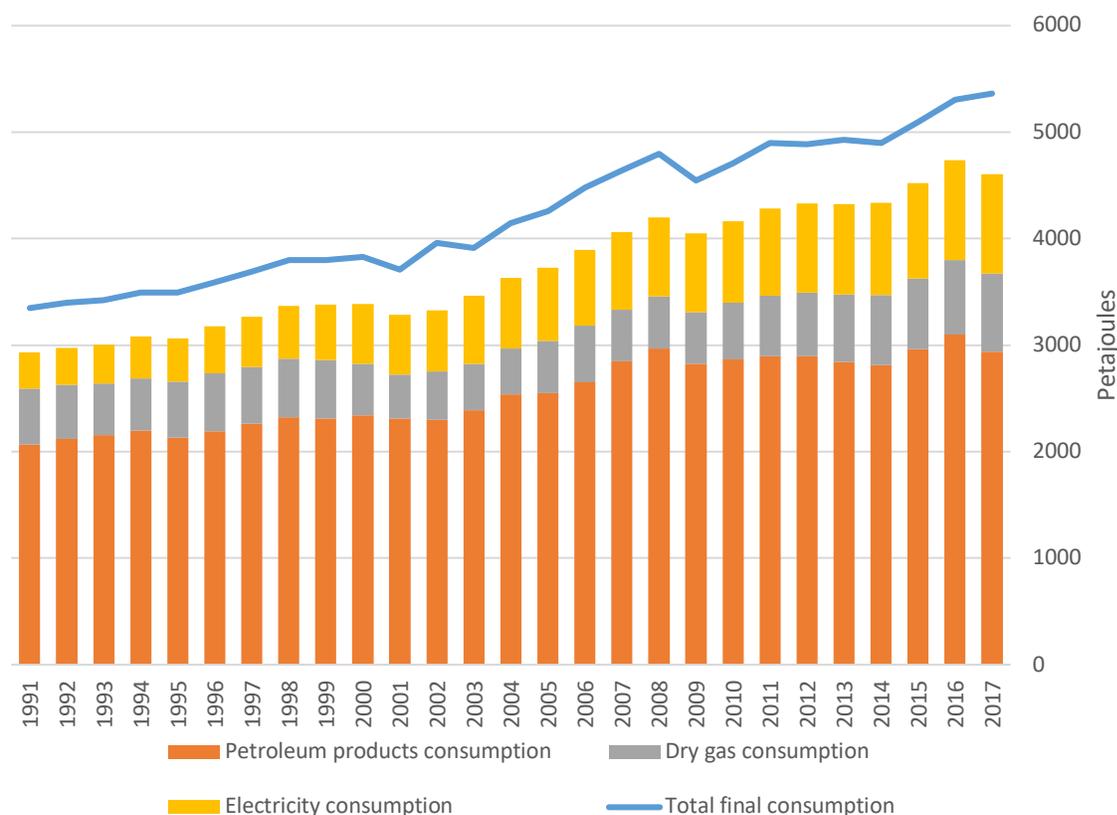


Source: SENER, n.d.

While today electricity generation uses 8% fuel oil and 11% coal, the latest projections made at the end of the Peña administration pointed to the elimination of these fuels, to be replaced by natural gas and by the obligatory arrival of clean energy, as the Energy Transition Law dictates (SENER 2018b, 74). If this trend continues, pressure on natural gas requirements will remain, since, as Figure 12 shows, of the final consumption of secondary energy, electricity consumption has the highest rates during the period discussed (1991–2017), making up an average of 4% of the annual consumption with respect to 2% of the total.

The most significant factors to explain Pemex’s decline in the supply of natural gas beginning in 2009 include a rentier-state priority that favors the production of crude oil over gas, a drop in the production of associated gas, a halt to investment in non-associated gas fields, and the accelerated growth in the primary consumption of gas to supply the growing demands of the thermoelectric plants.

Figure 12. Mexico: Final Fuel Consumption 1991-2017



Source: SENER, n.d.

One of the objectives mandated by López Obrador's new administration is to reverse this decline and make Pemex produce, by the last month of 2024, 6.9 BCF of natural gas a day, an amount very close to that reached by the company in 2008. The way to achieve it is similar to what was done regarding crude oil extraction—halting the decline as much as possible, speeding up new developments, and increasing exploration (Pemex 2019b). Thus far, neither the president nor the new director of Pemex, Octavio Romero, have announced a more specific plan for the development of gas fields, which presupposes that the increases will mainly come from the 20 new fields announced to increase crude oil production. In other words, the recovery of gas production will fall on Pemex as it explores and develops the fields that have associated gas in the shallow waters of the Gulf of Mexico.

Since the beginning of the current administration, López Obrador has made it public that neither Pemex nor private entities will develop the vast unconventional gas potential located in the northeast of the country. Before that, Pemex had already drilled 18 unconventional gas and oil wells, of which only 11 had commercial value, although with very low productivity (CNH 2019). Even though the current administration has not explained the reasons behind its decision, it is understood that it does not wish to arouse controversy with environmental

groups that have warned about the social, infrastructure, water, and chemical resource costs that the exploration and production of unconventional fossil fuels would incur.

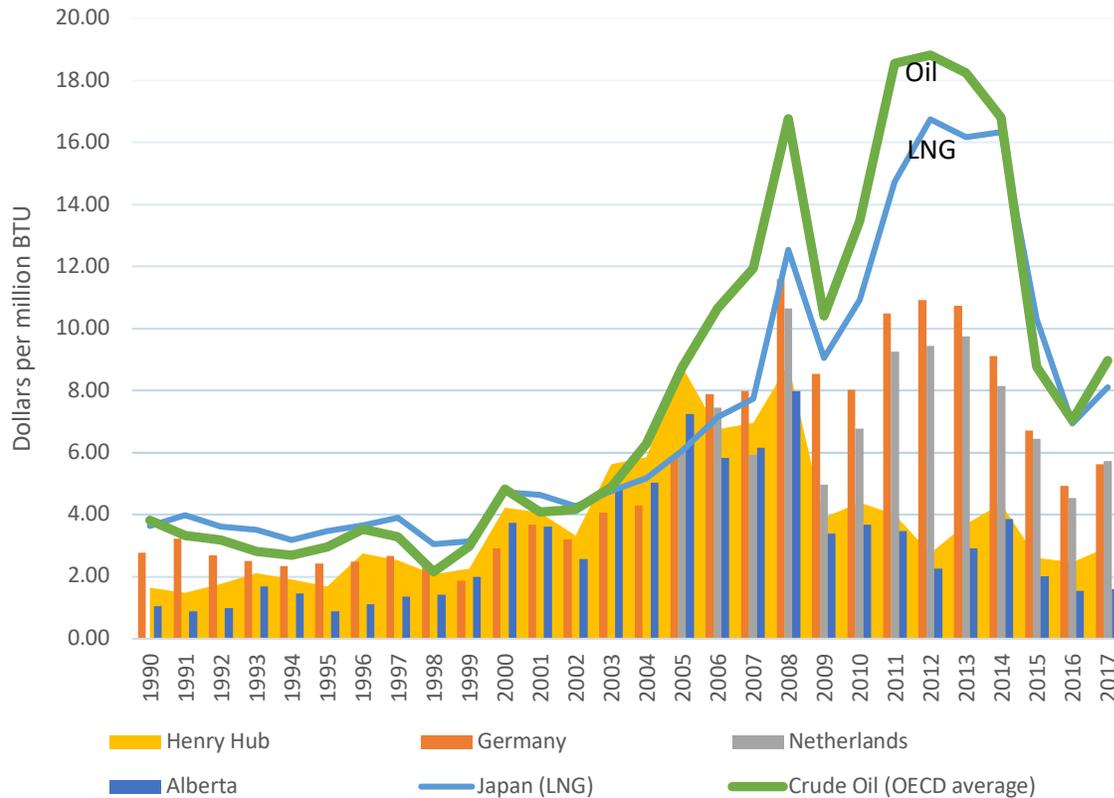
These conditions show that throughout the current administration, natural gas imports, especially from the United States, will continue and might even increase in both absolute and relative terms. The number of imports will depend on the recovery factor of national production, which will still fall on Pemex and will apparently continue to be linked to the evolution of crude oil production. A more aggressive way of facing the problem, without having to turn to the development of unconventional resources, would certainly be to increase investment in non-associated gas fields located in northeast Mexico, either by auctioning them to private producers or by partnering Pemex with private producers through the farmout system (although the current government has discarded the latter).

Continuing to import gas from the United States is for now the most economical way to assure supply. In 2017, Mexico imported 57% of its natural gas consumption from the United States, while in 2009, the peak year for domestic production, it imported 20% (see Figure 9). That is how Mexico has become the United States' main client. Imports from Texas are attractive because of the proximity and the price. Since 2006, U.S. natural gas prices have no longer been linked to crude oil prices, even though oil prices started a new upward trend at that time. This was due to the revolution in shale gas and oil extraction, using a system of injecting chemicals dissolved in sand and water to cause a hydraulic fracture and drilling horizontally to keep from using vertical wells. While in 2007 the United States produced less than two TCF a year of shale gas (8% of the total), in 2017, it produced 19.018 TCF a year on average, or 57% of total production (according to USEIA's website). The revolution in shale gas production more than compensated for the decline in natural gas extraction, and has made the United States a net exporter today, with the likelihood of soon becoming a global LNG exporter.

The bulk of U.S. unconventional production comes from the Permian, Eagle Ford, and other basins located in Texas, New Mexico, and other Gulf Coast states, as well as from fields in the Marcellus Basin in the Appalachian range. These fields will continue to feed the growth in natural gas production over the next few years, and the surplus will be exported either by pipeline or by sea. According to the latest estimates from the U.S. Department of Energy, Mexico will continue to be the United States' main importer by pipeline, but LNG exports will increase quickly (USEIA 2019).

The U.S. export boom has meant not only that gas prices have become unlinked with oil prices, but also that for now they are the cheapest in the world. Indeed, Figure 13 clearly shows this evolution and compares the Henry Hub prices (the shaded part on the figure) to the main markers in the rest of the world. The prevailing price of gas in North America (if we also include Alberta) is lower than prices in Europe and Asia. LNG prices are slightly lower than crude oil's (by equivalent calorific value). In fact, the LNG sold in Asia costs more than double what is sold in North America, where it is one-third of the price of crude oil. With such competitive prices, it is not surprising that gas-intensive industries, especially for electricity generation, have been boosted in the United States. Mexico, as we have noted, is no exception.

Figure 13. Evolution of Natural Gas Prices vs. Crude Oil Prices 1991-2017



Source: BP 2018.

Mexico’s inability to import everything from the United States has been more of an infrastructure problem, not an availability problem. The abundance of natural gas in Texas has also been emphasized by the production of associated gas from unconventional oil fields, which has meant that gas prices in Waha, close to El Paso, are even lower than prices at Henry Hub. The Peña administration bet on increasing connection infrastructure, especially with the state of Texas, to increase the country’s import capability. Some of the pipelines are already working, and others will be soon. Of course, this situation has discouraged Pemex and others even more from extracting non-associated gas in the north of the country, since the import contracts are long-term. In other words, the infrastructure developed during the previous administration (which will be completed during this one) has tied the Mexican gas system to the Texan one in the long term, betting on import prices continuing to be low when compared to oil and other gas markets.

Although this type of bet solves the problem of gas-supply security, the same cannot be said of the country’s energy resiliency systems. The integration of the gas supply network to the Texas production and transmission network has made the fuel provisions vulnerable to any type of external shock that might affect the network. This shock might be climatic, such as natural disasters that halt or alter gas production in the risk zones. It could be market-related,

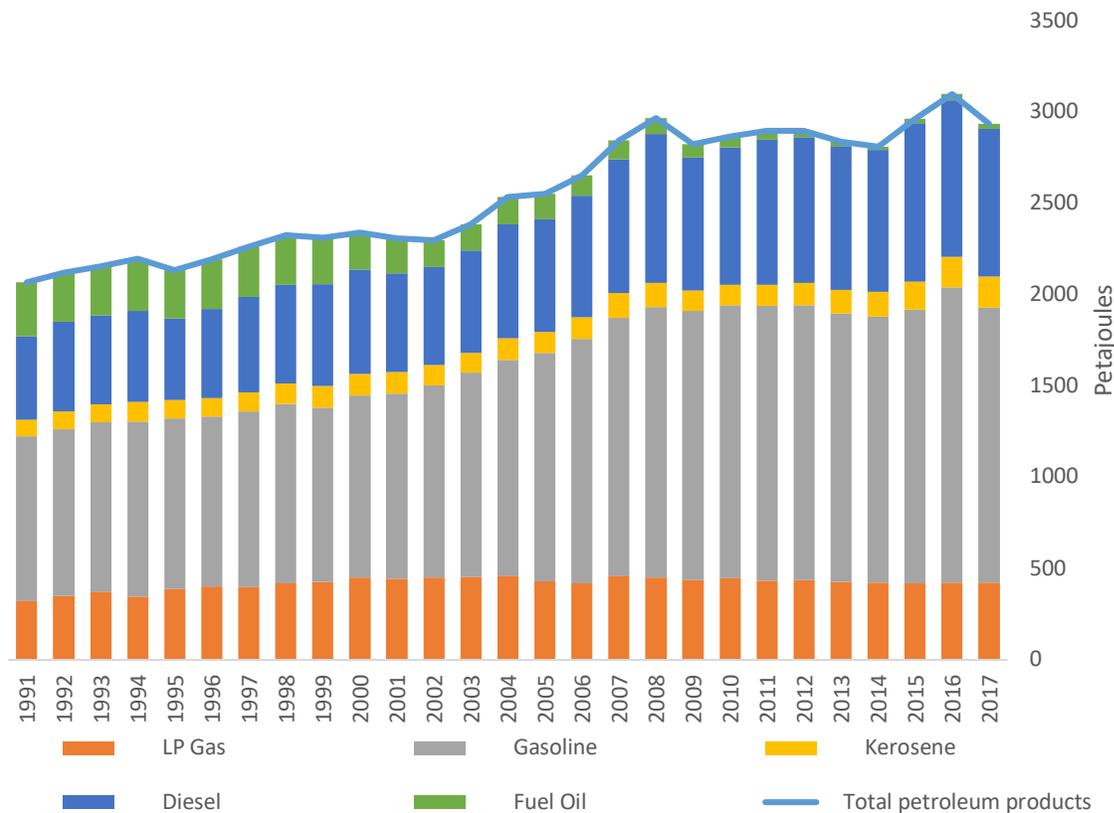
if for example pressure or incentives to increase LNG exports put upward pressure on pipeline exports. It could be geological, if well productivity of unconventional resources turns downward, a scenario that the Department of Energy always considers in its annual projections. It could be a diplomatic–geopolitical shock, if the White House decides to tax Texan exports for “national security” or other reasons. We must not downplay the recent pressure from President Trump to apply a 5% tax on all Mexican imports if Mexico did not substantially halt illegal immigration by Central Americans through the southern border (regardless of the United States-Mexico-Canada Agreement (USMCA) negotiations). The Trump administration has often used trade and access to the U.S. market as a pressure mechanism, which at any moment could affect the flow of gas from Texas to Mexico. A shock that alters supply for any reason would affect not only gas-consuming industries in Mexico, but also electricity generation and prices, since as we have seen, gas has become and will continue to be the main fuel in the production of electric fluid.

Finally, but no less important, affixing Mexico’s supply to U.S. provisions, although cheap for now, could also slow the arrival of clean energy sources, especially for electricity generation. The decarbonization of Mexico’s economy is one way of reducing its vulnerability to the environmental, social, economic, and geopolitical costs derived from its high level of dependence on fossil fuels, whether produced domestically or supplied through cross-border networks. From this perspective, natural gas should be seen as a transition fuel, while renewable energy sources mature and become consolidated as the most important source of energy. Mexico’s solar energy potential is much more encouraging than its prospective fossil fuel resources, both conventional and unconventional. Discouraging the development of renewable energy, either by canceling new “green” auctions as the administration has done or by betting on a long-term cheap supply of natural gas, will severely slow investment in infrastructure, technology, development, and production of energy systems fed by clean or renewable resources.

The Gasoline and Refined Products Dilemma

Over the last 30 years, petroleum products have undergone significant changes in final fuel consumption. At the beginning of 1990, gasoline and diesel consumption made up 43% and 23%, respectively, of the final consumption of oil products. However, in 2017 they made up 51% and 28%, respectively. Meanwhile, the final consumption of fuel oil, a fuel that will be completely replaced as a source of electricity generation but is still used as a sea transport fuel, decreased from 14% to 1% of end consumption. It is clear that the bulk of Mexico’s consumption lies in gasoline and diesel, while fuel oil will be removed from Mexico’s oil product purchases. In fact, from 1991 to 2017, the consumption of gasoline and diesel grew to annual average rates of 2.25% and 2.55%, respectively, above the 1.5% annual rate of all oil products, while the consumption of fuel oil decreased by an annual average of 7%. Meanwhile, LPG, still used by the residential sector, grew by 1.32% a year on average and makes up 14% of all oil product consumption. Figure 14 shows this evolution in final consumption.

Figure 14. Mexico: Final Consumption of Oil Products 1991-2017



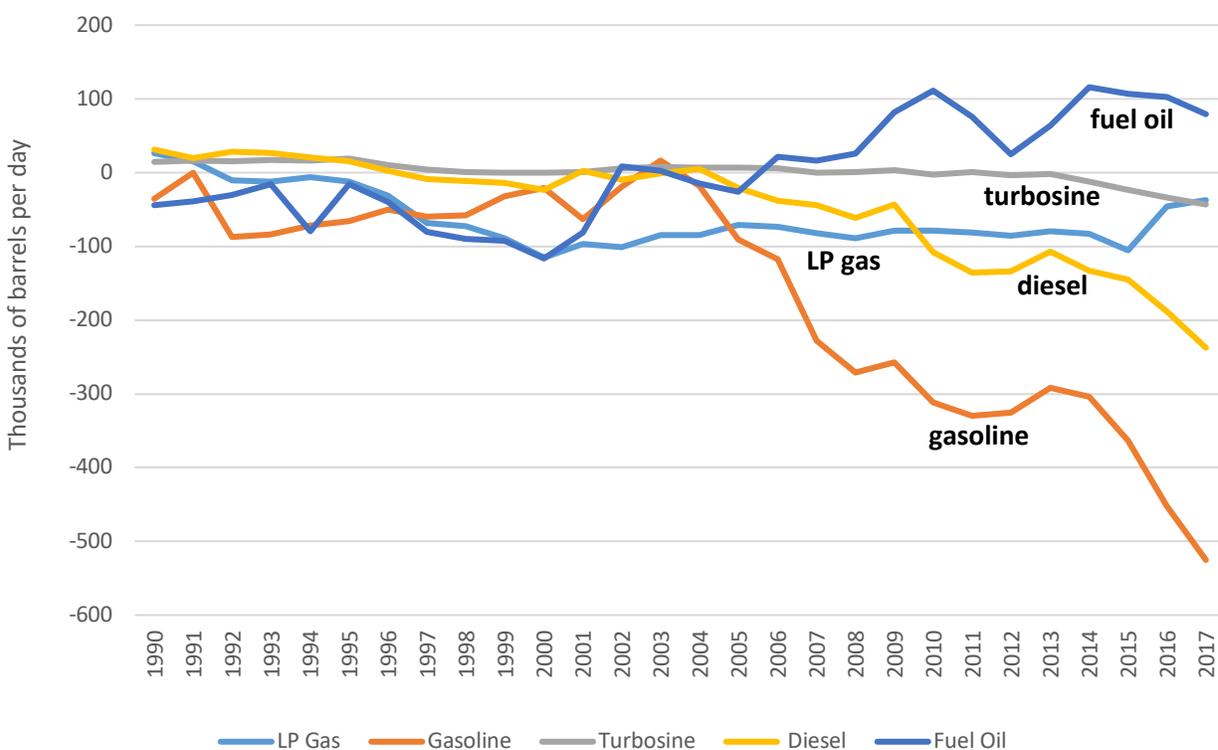
Source: SENER, n.d.

While the consumption of oil products is still concentrated in gasoline, diesel, and LPG, a trend that will continue if past growth rates are any indication, such is not the case for their elaboration. In 1992, when the Azcapotzalco refinery was no longer in operation, the six remaining refineries in the country that are still active today (Cadereyta, Madero, Minatitlán, Salamanca, Salina Cruz, and Tula) produced 4.1% of LPG, 30.4% of gasoline, 21% of diesel, 4.8% of aircraft fuel, and 30.7% of fuel oil. However, in 2017, these numbers changed to 2%, 33%, 20%, 5% and 28%, respectively. In other words, over a 27-year span, Pemex did not adjust the elaboration of its oil products according to changes in national consumption, where gasoline and diesel have become more predominant compared to fuel oil. Furthermore, the elaboration of oil products decreased. While in 1992, a total of 1.325 mbpd of refined products was produced, in 2014, this amount was only 787,000 bpd, a decrease of 538,200 bpd.

The fall in the elaboration of oil products can be attributed to several factors. As Figure 6 shows, since 2014, Pemex began to reduce volumes of crude oil for processing. While in 2013, 1.224 mbpd of crude were refined, in 2018, this volume decreased to 612,000 bpd, practically half of what was processed five years ago. Besides the technical shutdowns, the obsolescence of most of the refineries, and Pemex’s priority in maintaining crude oil

exports, the company also processed less crude oil because of the chemical composition of the material. Traditionally, Pemex prefers to refine light crude over heavy crude, because the former allows for higher yields in gasoline and diesel and lower yields in fuel oil. As has been noted, the elaboration of fuel oil is still very high (currently 28% of all oil products), compared to consumption trends. It is due both to the quality of the crude oil processed and to the technology in the refining plants. Fuel oil yields are higher if heavy crudes are processed, but also if there are no modern coker units to increase the production of light distillates when compared to heavy ones. The drop in light crude extraction and the technological lag in Mexico’s refineries also explain the deterioration in the ability to make more gasolines and distillates to satisfy national consumption.

Figure 15. Mexico: Trade Balance of Main Petroleum Products



Source: SENER, n.d.

This situation has meant that the refineries run below their capacity¹⁸ and that domestic demand is satisfied through imports. Today, Pemex imports 70% of its domestic supply of gasoline and diesel, while paradoxically it has increased its fuel oil exports. If consumer trends continue, it is very likely that imports of these and other products will continue to grow.

¹⁸ Forty percent of idle capacity in 2018, according to data published by the new administration (Pemex 2019a).

López Obrador's administration has been more explicit about refined products compared to natural gas extraction and processing. From the beginning it was decided that 49 billion pesos would be invested over the next three years to rehabilitate the country's six refineries, and 160 billion pesos, to construct a new refinery in Dos Bocas, Tabasco (El Universal 2018), able to process 400,000 bpd ("Nueva refinera" 2018).¹⁹ The new government states that it seeks to recover self-sufficiency in generating gasoline and other refined products. Moreover, since his campaign, López Obrador has been explicit in rejecting what he has called another "gas price hike." He states that price increases will only be used to adjust prices to inflation. Self-sufficiency and price stability in gasoline soon became the new government's two main energy goals. The construction of the Dos Bocas refinery became the government's most pressing act to reinforce the new energy policy.

From the beginning, it was stated that the new refinery would cost 160 billion pesos (US\$8 billion in June 2019), and it would begin operations in 2022. Despite the government's optimism, the launching of construction of the new refinery has faced serious setbacks. From the beginning, both the Mexican Petroleum Institute (IMP)—the center for engineering and government technical research that supports both Pemex and the SENER—and the Mexican Institute for Competitiveness (IMCO)—a private research center that prepares economic and social reports—believe that Dos Bocas is nonviable in terms of time and costs. The IMCO study ran 30,000 financial scenarios and came to the conclusion that the project was 2% likely to be profitable, so it proposed investing the money allotted for the refinery in more productive activities for Pemex (IMCO 2019). After discrediting the IMP opinion (Guerreo 2019a), López Obrador hurried to carry out a "restricted auction" of proposals to build the new refinery, whose distillation capacity was reduced to 340,000 bpd. Four construction companies were chosen, that, according to the president, were internationally renowned for their ability and professionalism in building complex refineries.²⁰ Still, soon after, the president annulled the results, since none of the construction companies were committed to completing the project in the time frame or for the costs the government wanted. According to the bids, costs ranged from US\$10 billion to US\$14.740 billion, and the refinery would not be online until 2025, after the current administration had ended. It was decided that the government would build the refinery together with SENER, completing it in May 2022 (Guerrero 2019c).

As a project whose technical and financial aspects were not made public and that did not undergo an environmental or social-impact study, construction on the Dos Bocas refinery was launched in June 2019.²¹ The way that this decision was taken and handled clearly shows that technical and financial considerations for projects as sensitive as the construction of a refinery have taken a backseat to the government's policy priorities.

¹⁹ The same source noted that although López Obrador mentioned that the total amount referred to the production of gasoline, the then-president elect actually meant the new refinery's total distillation capacity.

²⁰ The four main bidders were Bechtel (U.S.) in consortium with Techint (Argentina), Worley Parsons in partnership with Jacobs, the French company Technip, and the U.S. company KBR.

²¹ It was not until August 11 that the Security, Energy, and Environmental Agency gave its "conditioned" environmental authorization of compliance with environmental and safety mitigation measures for the communities close by (Cervantes 2019).

Indeed, the decision to build a refinery is more a question of political legitimacy than one of techno-economic rationale or public policy that might attempt to increase the country's energy resiliency. The construction of the refinery has been justified to recover "self-sufficiency" in gasoline through Pemex, something that the new refinery will manage to do, regardless of the cost and time required for its construction. A refinery able to produce 340,000 bpd of oil products would have an average yield production, speaking optimistically, of 170,000 bpd of gasoline or 50% of the refinery throughput, much higher than the current average output of the six refineries (33%). Such an increase in gasoline production, plus expected improvements in the modernization of the other six, might reduce imports of this fuel, but it would not put an end to them, especially if their consumption continues to increase at the current rate, as we have seen. More than self-sufficiency, the impact would be felt in the decrease in gasoline and other oil product imports, but it might be at a high cost.

If the current government based its energy policies more on the idea of improving energy resiliency than on achieving self-sufficiency, the most convenient response would be to curb the high consumption of gasoline and other liquid fuel, such as diesel and jet fuel. In other words, more than increasing domestic supply, it would attempt to moderate and reduce consumption levels. As we know, the government has traditionally subsidized final energy consumption, both oil products and electricity. In line with the 2013–2014 reform, the subsidies for gasoline were eliminated in 2017 in order to maintain a market open to imports where the final price would reflect not only the refining margins of the distillers, but also the transport and distribution costs. The subsidy policy—which is still in place on LPG and electricity consumption—has been onerous for the government²² and has benefitted the wasteful spending of the country's most privileged sectors. According to the consulting company CIDAC (2012), 75% of gasoline subsidies still in place in 2011 benefitted 40% of the population with the country's highest incomes. Only 12.5% of the subsidies helped the 40% of people with the lowest incomes. In the rural sector, 60% of electricity subsidies helped 10% of the country's richest agriculture producers (CIDAC 2012, 22 and 25).

The subsidies not only promote high rates of consumption, which have continued, but also have a harmful effect on the environment. The current administration is revising practices to fight against the environmental contingencies that are increasingly more common in the country's main metropolitan areas. Basing a refined-products policy on price freezing ("no more gas price hikes") is regressive from a social standpoint, harmful for the environment, and adverse to mitigating global warming, besides being contrary to strengthening energy resiliency.

Unlike with natural gas, where Mexico has become tied to a cross-border market pivoted in Texas production, for gasoline and other refined products, even though most imports still come from the United States, they can be diversified with relative ease. Refined products operate under a global market logic, similar to the one for crude oil, so an external shock might be more easily assimilated by a network of providers than in the case of natural gas.

²² For an estimation of the cost of subsidies in Mexico throughout history, see OECD/IEA 2012.

It is true that prices might become volatile, not only because of the changing margins of the refineries, but also because of the behavior of the crude oil market, which, as we have noted, is uncertain. However, final prices would be transferred to the final consumer, who, as we have seen, is found in the most privileged sectors of society. In this way, the consumption of refined products in Mexico could evolve toward the prevailing practices in most of the countries who are members of the Organization for Economic Co-operation and Development (OECD). In these countries, the price of fossil fuels tends to punish consumption by private drivers in order to promote saving, efficiency, and a transition to more decarbonized economies.

To protect the income of the most underprivileged sectors, the government could maintain the subsidies on public transportation, as well as foster and improve it, as is done in most European Union countries. An unexpected cut in the natural gas supply or a sudden spike in import prices could affect the gas system in general and transfer this vulnerability to the electricity system, as we saw recently with the shortage in the Yucatán Peninsula. It is not the case for the network of distillates, where supply can be met with global imports, and a price increase can temper the consumption of the privileged sectors with positive results for the environment and health.

It is troubling that the new government's determination to keep gasoline prices stable is its flagship goal in the new energy policy. As we have argued, neither the new refinery—if it is completed in the time proposed—nor the modernization of the national refining system will bring about energy self-sufficiency in oil products. Price stability will not bring it either, since, if they are to remain competitive, prices should oscillate according to the price of crude oil exports. When the new government launched its campaign against fuel theft, as is mentioned in the second section of this article, there was a shortage in Mexico City and other cities located close to the Salamanca Refinery, one of the focal points of the plundering. Since the shortage put pressure on gas prices, President López Obrador even suggested creating a state-run distributor to hold back price hikes (Vázquez 2019). This situation shows the importance that the new government has given to maintaining prices and reducing gasoline imports as a way to bolster the success of an energy policy destined to reach self-sufficiency and a stronger state measure. All things considered, both the director of Pemex and the staff at the treasury should be aware of what the country agreed to with the USMCA, a trade agreement that, if approved by the Canadian Parliament and the respective U.S. and Mexican Congresses, will prohibit anti-competitive practices by state-run companies in matters of gas, oil, oil products, and electricity. In other words, it will not be so easy for the government of the “Fourth Transformation”²³ to go back to the policy of subsidies and price freezing in energy issues, which were so useful during the golden age of PRI hegemony.

²³ This is how López Obrador's has dubbed his plans for Mexico. According to López Obrador, the previous three “historic transformations” were achieved by Mexico's War of Independence (1810-1821), the “War of Reform” (1858-1861), and the so-called “Mexican Revolution” (1910-1917).

Conclusion

Pemex could become an efficient, competitive, leading company to underpin a new industrial policy capable of triggering the regional and national growth that the current government desires. Yet with its current limitations and the ambitious goals that imply criteria more political than corporate and that point in several directions, the company is not in the best position to do so. Even with the energy reform, the company does not have the corporate autonomy to set its own goals and priorities that would allow it to fully develop its most competitive value chains, without question located in exploration and the extraction of hydrocarbons. Even though the treasury department has announced a more flexible, generous regime for the company, the main mandate for the state-run company is to increase the production of hydrocarbons, crude oil, and gas, in order to take back energy sufficiency and hold on to the state-centered model employed since the end of the 1970s. Furthermore, despite overwhelming evidence against the idea, Pemex is being pressured and obligated to build a new refinery with the goal of reducing the importation of gasoline and other refined products. Pemex also faces an excess of personnel and high labor liabilities that keeps its operating costs high, worsened by the reduction in its income from sales.

Meanwhile, the sovereignty and energy self-sufficiency discourses remind us of the ideological framework that guided the energy policy from post-Cárdenas times until the end of the 1970s, but with the intention of holding on to the rentier-state model that began at the end of that period. For the current government, it is as though increasing oil rents and assuring self-sufficiency are synonymous with strength and geopolitical autonomy. This article argues the contrary: the best way to improve the country's energy autonomy, with political clout for the state, is to back the resiliency of its energy systems, in both fossil and non-fossil fuels. In this sense, Mexico's energy policy must be framed not in principles of self-sufficiency, nor of sovereignty, nor of security (if understood solely in terms of assuring energy supply), but rather in long-term principles that encourage and foster the transition and energy resiliency of its resources.

This type of strategy is not at odds with sovereignty, nor with security, nor with the market, because progressive decarbonization of the Mexican economy and a push for renewable energies, where the private sector has much more to bring to the table in terms of technology and capital, would reduce the vulnerabilities of the country's vital energy systems and increase the government's fiscal margin to finance its public policies. From this angle, what then should Pemex's priorities be, if it is to hold on as a competitive public company? The company's strength and assets are certainly underground, with resources located mostly in onshore fields and in shallow waters leased to it by the state in the "Round Zero." In fact, part of the new production that the current government expects will come from these fields. Yet it would be dangerous to impose on Pemex a platform production to be achieved during a presidential term, similar to what happened during López Portillo's government. It could lead to overexploitation of fields and to all types of errors, like those we saw in Cantarell and Chicontepec. In any case, if the current government must increase oil profits because of the accelerated drop in production, it will have to reconsider private capital participation, which is a way to share the risk (geological

and financial) and the technology. Pemex's experience with Trión²⁴ could be the role model if the company is to move toward cutting-edge technology for the development of deep-water fields.

By developing its fields on land and in shallow waters, Pemex could optimize the collection of associated gas in order to increase domestic supply of this vital fuel, which has become the transition source for the electricity sector. To do so, Pemex would have to dedicate part of its resources to develop infrastructure for collecting and processing associated natural gas. It would certainly not be enough to significantly reduce gas imports, which, for now, are very attractive from Texas. As long as gas prices remain low in North America, Pemex will have no economic incentives to develop the non-associated reserves located in northeastern Mexico, which favors imports. Since the current government has decided not to support the development of unconventional gas (for different reasons), it could stimulate the production of non-associated gas, either by auctioning new fields in the northeast (as it had planned) or allowing Pemex to partner with private companies to do so. Increasing the extraction of this fuel is a higher priority than increasing the extraction of crude oil, due to the increasing vulnerability of the country's gas system.

From a transition and resiliency angle, building a refinery with Pemex's scarce resources to develop crude oil and gas would be counterproductive for the company, as could be seen when the private consortiums that were going to take part in the project confirmed that it did not adjust to the timeline or budget the government had proposed. Regarding refined products, especially gasoline, the current government should make it clear that the country must speed up its transition to clean energy, for environmental, sustainability, public health, and geostrategic reasons. The government should respect the price liberalization of gasoline that came about with the reform and reduce consumption even if it means raising taxes on carbon emissions and channeling public resources to speed up the arrival of renewables. The idea is not incompatible with maintaining subsidies and support for the use and development of public transportation. Gasoline consumption will also slow down and eventually decrease with the arrival of hybrid and electric vehicles, whose technological advances have sped up in recent years. The entrance into force of the USMCA might hasten these changes, since it is expected that assembled vehicles in Mexico will include the technological advances of the multinational automakers.

Finally, transparency and accountability are indispensable if the country wishes to bolster its energy industries and the margin of autonomy of all stakeholders, including the state. It took years to create autonomous, highly professional bodies such as the CRE and the CNH. The National Agency for Safety, Energy, and Environment and other similar organizations, whose purpose is to watch over public policies and make sure they work well, must evolve in a similar way. It is therefore disturbing that the current administration is seeking to weaken these organizations or renovate them with personnel who are not trained or suitable for the positions. A desire to look to the past without recognizing the errors made

²⁴ This is the name of the oil block, located in the Gulf of Mexico, that is being developed and exploited by PEMEX in association with the Australian company BHP Billiton.

in energy policy, especially by imposing more goals with short-term political objectives rather than following a long-term state strategy, might compromise Pemex's technical-financial viability even more, leaving the country's sustainability and energy resiliency even more fragile.

References

- Barajas, Abel. 2019. "Comparece General acusado de huachicol." *Reforma*, April 10, 2019. <https://www.reforma.com/libre/acceso/accesofb.htm?urlredirect=/aplicaciones/articulo/default.aspx?id=1652029>.
- BP (British Petroleum). 2018. *BP Statistical Review of World Energy*. no. 67, June 2018. <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2018-full-report.pdf>.
- Cervantes, Evlyn. 2019. "Dan autorización ambiental a Dos Bocas." *Reforma*, August 12, 2019. <https://www.reforma.com/libre/acceso/accesofb.htm?urlredirect=/dan-autorizacion-ambiental-a-dos-bocas/ar1744278>.
- Cherp, Aleh, and Jessica Jewell. 2014. "The Concept of Energy Security: Beyond the Four As." *Energy Policy* 75 (December): 415–42. <https://doi.org/10.1016/j.enpol.2014.09.005>.
- CIDAC (Centro de Investigación para el Desarrollo A.C.). 2012. "No más subsidios injustos." June 6, 2012. <http://cidac.org/no-mas-subsidios-injustos/>.
- CNIH (Centro Nacional de Información de Hidrocarburos). n.d. "Sistema de información de hidrocarburos." Gobierno de México. Accessed April 23, 2019. <https://hidrocarburos.gob.mx/estad%C3%ADsticas/>.
- CNH (Comisión Nacional de Hidrocarburos). 2010. *Proyecto Aceite Terciario del Golfo. Primera Revisión y Recomendaciones*. Mexico City: Secretaría de Energía, April 2010. https://www.gob.mx/cms/uploads/attachment/file/109350/Proy_aceite_terciario_del_golfo_Primer_rev_y_recomendaciones.pdf.
- . 2013. *Dictamen Técnico del Proyecto de Explotación Cantarell (Modificación Sustantiva)*. Mexico City: Secretaría de Energía, July 2013. https://www.gob.mx/cms/uploads/attachment/file/109202/Cantarell_Modificacion_Sustantiva.pdf.
- . 2018. "Producción de contratos." Gobierno de México, Accessed May 8, 2019. https://portal.cnih.cnh.gob.mx/downloads/es_MX/estadisticas/Producción%20de%20contratos.pdf.
- . 2019. *Exploración y extracción de petróleo y gas en lutitas*. Mexico City: Secretaría de Energía, June 2019. <https://hidrocarburos.gob.mx/media/2773/exploraci%C3%B3n-y-extracci%C3%B3n-de-petr%C3%B3leo-y-gas-en-lutitas.pdf>.
- El Universal [pseud.]. 2018. "AMLO anuncia que se invertirán 175 mmdp para comenzar el rescate energético." *El Imparcial*, July 27, 2018. <https://www.elimparcial.com/sonora/mexico/AMLO-anuncia-que-se-invertiran-175-mmdp-para-comenzar-el-rescate-energetico-20180727-0064.html>.

- “Evolución de la industria petrolera en México.” Lopezobrador.org, September 2018. <https://lopezobrador.org.mx/wp-content/uploads/2018/09/Evolucio%CC%81n-de-la-industria-petrolera-en-Me%CC%81xico.pdf>.
- Guerrero, Claudia. 2019a. “No tiene fundamento estudio de IMP.-AMLO.” *Reforma*, January 30, 2019. <https://www.reforma.com/libre/acceso/accesofb.htm?urlredirect=/no-tiene-fundamento-estudio-de-imp-amlo/ar1596848>.
- . 2019b. “Presumen menos huachicol y ahorro de 12 mmdp.” *Reforma*, April 23, 2019. <https://www.reforma.com/libre/acceso/accesofb.htm?urlredirect=/aplicaciones/articulo/default.aspx?id=1660668>.
- . 2019c. “Hará Pemex refinería de Dos Bocas.” *Reforma*, May 9, 2019. <https://www.reforma.com/libre/acceso/accesofb.htm?urlredirect=/aplicaciones/articulo/default.aspx?id=1673121>.
- Hartley, Peter R., and Kenneth B. Medlock. 2011. “The Revenue Efficiency of Pemex: A Comparative Approach.” *The Future of Oil in Mexico*. Houston, Texas: James A. Baker III Institute for Public Policy. <https://hdl.handle.net/1911/92505>.
- IMCO (Instituto Mexicano para la Competitividad). 2019. “Diagnóstico IMCO. Refinería Dos Bocas.” April 9, 2019. <https://imco.org.mx/temas/diagnostico-imco-refineria-dos-bocas/>.
- Jewell, Jessica, Aleh Cherp, and Keywan Riahi. 2014. “Energy Security under Decarbonization Scenarios: An Assessment Framework and Evaluation under Different Technology and Policy Choices.” *Energy Policy* 65 (February): 743–760. <https://doi.org/10.1016/j.enpol.2013.10.051>.
- Lajous, Adrián. 2014. *La industria petrolera mexicana. Estrategias, gobierno y reformas*. Mexico City: Fondo de Cultura Económica.
- López, Mayolo. 2019. “Tunde oposición a propuestos para CRE.” *Reforma*, April 2, 2019. <https://www.reforma.com/aplicacioneslibre/articulo/default.aspx?id=1645549&md5=66032e95b6c4e2e076e9c2898e9c8489&ta=0dfdbac11765226904c16cb9ad1b2efe>.
- “México prevé aumentar su producción petrolera desarrollando 20 campos nuevos.” *EFE*. April 13, 2019. <https://www.efe.com/efe/america/mexico/mexico-preve-aumentar-su-produccion-petrolera-desarrollando-20-campos-nuevos/50000545-3952259>.
- Meyer, Lorenzo and Isidro Morales. 1990. *Petróleo y Nación (1900–1987): La Política Petrolera en México*. Mexico City: Fondo de Cultura Económica.
- Morales, Isidro. 2011. “The Energy Factor in Mexico–U.S. Relations.” *The Future of Oil in Mexico*. Houston, Texas: James A. Baker III Institute for Public Policy, April 29, 2011. <https://www.bakerinstitute.org/media/files/Research/f30f5dc0/EF-pub-MoralesFactor-04292011.pdf>.
- “Nueva refinería producirá 400,000 barriles por día, según AMLO.” *Forbes*, September 4, 2018. <https://www.forbes.com.mx/nueva-refineria-producira-400000-barriles-por-dia-segun-amlo/>.

- OECD/IEA (Organization for Economic Cooperation and Development/ International Energy Agency). n.d. “OECD-IEA analysis of fossil fuels and other support.” Accessed September 12, 2012. <http://www.oecd.org/environment/fossilfuelsubsidies.htm>.
- Omaña, Karla. 2019. “Da Pemex contratos sin concurso.” *Reforma*, April 23, 2019. <https://www.reforma.com/libre/acceso/accesofb.htm?urlredirect=/aplicaciones/articulo/default.aspx?Id=1660499&v=3>.
- Pemex. 1988-2017. *Anuario Estadístico*. <https://www.pemex.com/ri/Publicaciones/Paginas/AnuarioEstadistico.aspx>
- . 2003-2017. *Estados Financieros Consolidados Dictaminados*. <https://www.pemex.com/ri/finanzas/Paginas/resultados.aspx>.
- . 2006. *Anuario Estadístico 2006*. http://www.ri.pemex.com/files/content/Anuario_2.pdf.
- . 2015. “Presentación a Inversionistas.”
- . 2017a. *Anuario Estadístico 2017*. https://www.pemex.com/ri/Publicaciones/Anuario%20Estadistico%20Archivos/anuario-estadistico_2017_es.pdf.
- . 2017b. “Pemex Fact Sheet.” Ciudad de México: Pemex, 2017. https://www.pemex.com/ri/herramientas/Documents/PEMEX_Factsheet_e.pdf.
- . 2018a. “Presentación a Inversionistas.” November, 2018.
- . 2018b. “Reportes de tomas clandestinas.” https://www.pemex.com/acerca/informes_publicaciones/Paginas/tomas-clandestinas.aspx.
- . 2019a. “Presentación a Inversionistas.”
- . 2019b. “Petróleos Mexicanos Presentación a Inversionistas.” February 18, 2019. <http://www.pemex.com/ri/herramientas/Presentaciones%20Archivos/Presentaci%C3%B3n%20Inversionistas%2018%20Febrero%202019.pdf>.
- . 2020. “Inversión en cifras.” <https://www.pemex.com/ri/finanzas/Paginas/InversionCifras.aspx>.
- Reforma Energética*. 2014. Gobierno de México. [https://www.gob.mx/cms/uploads/attachment/file/10233/Explicacion ampliada de la Reforma Energetical.pdf](https://www.gob.mx/cms/uploads/attachment/file/10233/Explicacion_ampliada_de_la_Reforma_Energetical.pdf).
- Rutherford, Jonathan and Olivier Coutard. 2014. “Urban Energy Transitions: Places, Processes and Politics of Socio-technical Change.” *Urban Studies* 51, no. 7 (May):1353–1377. <https://doi.org/10.1177/0042098013500090>.
- SEC (United States Securities and Exchange Commission). PEMEX Project Funding Master Trust. Form F-4, Registration Statement, years 1997-2018. <https://www.sec.gov/cgi-bin/browse-edgar?action=getcompany&CIK=0001648418&owner=exclude&count=40&hidefilings=0>.

- Senado de la República. 2015. “Robo de hidrocarburos en México,” *Mirada Legislativa*, LXII Legislatura, no. 81, June 2015. <http://bibliodigitalibd.senado.gob.mx/bitstream/handle/123456789/2023/ML81.pdf?sequence=1&isAllowed=y>.
- SENER (Secretaría Nacional de Energía). n.d. “Sistema de Información Energética (SIE).” Accessed May 25, 2019. <http://sie.energia.gob.mx/>.
- . 2014. “Estrategia Nacional de Energía, 2013–2027.” SENER, 2014. Accessed May 17, 2014. <https://www.gob.mx/cms/uploads/attachment/file/214/ENE.pdf>.
- . 2017a. *Plan Quinquenal de Licitaciones para la Exploración y Extracción de Hidrocarburos 2015-2019*. Mexico City: SENER, March 2, 2017. <https://www.gob.mx/sener/acciones-y-programas/plan-quinquenal-de-licitaciones-para-la-exploracion-y-extraccion-de-hidrocarburos-2015-2019-98261>.
- . 2017b. *Prospectiva de Petróleo Crudo y Petrolíferos, 2017–2031*. Mexico City: SENER, 2017. [https://www.gob.mx/cms/uploads/attachment/file/284344/Prospectiva de Pret leo C rudo y Petrol iferos 2017.pdf](https://www.gob.mx/cms/uploads/attachment/file/284344/Prospectiva_de_Petroleo_Crudo_y_Petroliferos_2017.pdf).
- . 2018a. *Prospectiva de Gas Natural, 2018–2031*. Mexico City: SENER, 2018. [https://www.gob.mx/cms/uploads/attachment/file/284343/Prospectiva de Gas Natur al 2017.pdf](https://www.gob.mx/cms/uploads/attachment/file/284343/Prospectiva_de_Gas_Natural_2017.pdf).
- . 2018b. *Prospectiva del Sector Eléctrico, 2018–2031*. Mexico City: SENER, 2018. https://base.energia.gob.mx/Prospectivas18-32/PSE_18_32_F.pdf.
- SHCP (Secretaría de Hacienda y Crédito Público). 2019. Ingresos Presupuestarios del Gobierno Federal, Petroleros y No petroleros Pesos corrientes multianual (1990-2018). <http://presto.hacienda.gob.mx/EstoporLayout/estadisticas.jsp>.
- USEIA (United States Energy Information Administration). 2013. *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*. Washington, D.C.: U.S. Department of Energy, June 2013. <https://www.eia.gov/analysis/studies/worldshalegas/pdf/overview.pdf>.
- . 2019. *Annual Energy Outlook 2019 with projection to 2050*. Washington. D.C.: U.S. Department of Energy, January 24, 2019. <https://www.eia.gov/outlooks/aeo/pdf/aeo2019.pdf>.
- Vásquez, Azucena. 2019. “Ve COFECE riesgos con gasolineras de Estado.” *Reforma*, April 10, 2019. <https://www.reforma.com/libre/acceso/accesofb.htm?urlredirect=/ve-cofece-riesgos-con-gasolineras-de-estado/ar1651770>.
- Yergin, Daniel. 1991. *The Prize. The Epic Quest for Oil, Money and Power*. New York, NY: Free Press.