Mexico's New Energy Reform

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Introduction: A reform years in the making

By Duncan Wood, Director, Mexico Institute, Wilson Center

In 2003, two years into the Vicente Fox administration, Mexican oil production hit its historic peak, at 3.4 million barrels a day. The government reaped a massive windfall in oil revenue and it became clear that oil now represented a critical component of government finances, responsible for over 33 percent of total revenue. Only two years later, in late 2005 as the administration was beginning to wind down, then energy minister Fernando Elizondo Barragan began to make a series of public presentations about the forecast for Mexican oil production. I was party to one of these presentations, at the Instituto Tecnológico Autónomo de México (ITAM) in Mexico City. That day, the Secretary made a clear and concise argument that, from its recent peak, Mexican oil production had entered an unavoidable and inexorable decline. Unless the national oil company, Petroleos Mexicanos or Pemex, could acquire new technologies and know how from private and foreign companies, it would be unable to exploit the country's remaining oil reserves, the vast majority of which lay in the deep waters of the Gulf of Mexico, or in unconventional onshore fields such as the Chicontepec field in eastern Mexico. However, due to the prevailing interpretation of the 1938 oil nationalization, Pemex was prevented from entering into meaningful partnerships with private actors, and was unable to acquire the necessary technology on the open market.

As a young academic barely entering the field of energy policy, I was stunned by what I saw. Mexico, a nation that depended heavily on its naturally endowed hydrocarbon reserves was about to leave hundreds of billions of stranded subsoil and subocean assets because of a failure to modernize its laws and attitudes. The answer to the conundrum was so obvious and simple to me that I simply could not understand why the country's political elites did not unite to change that reality. I naively thought that if only people became aware of the problem, then they would see what was needed. My older and wiser colleagues explained to me that this was not news, that many already knew the stark reality. Mexico did not change because it was not ready to change. And thus began my education in Mexican energy politics.

Thirteen years later, the much-debated reform has come and gone and Mexico has a new energy model. This new model has been controversial in Mexico's polity, but widely celebrated around the world. Between August and December 2013, the Mexican Congress debated and then approved a Constitutional Reform that allowed private and foreign investment across the energy values chain for the first time in 75 years. In August of 2014, the Congress approved secondary or implementing legislation and a new legislative and regulatory framework was created that has allowed for a level playing field for all actors in the sector. Since then, Mexico has witnessed a profound and rapid opening of its oil, gas and electricity sectors, as well as attempts to reform the national oil company, Pemex, and the national electricity utility, the Comision Federal de Electricidad or CFE.

The reform happened. It happened even though many doubted it was possible. It happened despite the huge weight of history and political opposition. It happened despite the entrenched vested interests that saw the reform as an existential threat. It happened despite the political risk, the financial risk and reputational risk that it involved. A reform that had seemed politically impossible for decades came together in the matter of a few months of political negotiation, and in a little over a year of legislative deliberation both a constitutional reform and secondary or implementing legislation had been passed.

The reform was undertaken at an inauspicious moment – oil and gas prices were severely depressed, reducing investor enthusiasm and prices have only recently begun to stage a comeback. Pemex was mired deep in debt, faced enormous labor and pensions liabilities and a fiscal regime that seemed to be critically weakening the company to the point of no return. The CFE loomed large over the electricity sector as a monopolistic actor that would inhibit the development of a truly competitive market.

And yet the reforms have brought about an extraordinary, rapid and profound liberalization. In the oil sector, we have witnessed the signing of more than 100 contracts for E&P, with a total future investment value of more than $160bn. In mid-2018, the rig count in Mexico began to rise for the first time in years. Pemex is now partnering with private and foreign firms in oil exploration and production, and has been allowed to farm out certain blocks entirely to private firms for a share of the profits. In the electricity sector, there has also been massive interest from international investors, who have offered to generate electricity at record low prices that will be passed on to the Mexican consumer. Again this has involved billions of dollars of new money coming into Mexico that would not otherwise have been committed.

But the reform is far from complete, and important adjustments should be made to fully realize the benefits of an open and competitive Mexican energy sector. A 2018 paper by IPD Latin America and the Wilson Center's Mexico Institute[1] highlighted the concerns expressed by a broad cross-section of industry players in Mexico and argued that, despite the impressive achievements of the reform, there still remains much work to be done. Of critical importance are modifications to regulations and to one of the key regulators, to ensure that Mexico's market remains competitive and that the independence of the regulatory institutions is strengthened.

What's more, many of the promises that were made in 2013 and 2014 during the legislative negotiations have failed to materialize yet. Pemex is now producing less than 1.9 million barrels a day and still faces a precarious financial and business future and the company has been the subject of major corruption scandals. The CFE still dominates the Mexican electricity market, although moves to disaggregate the firm have begun. Lastly, although there has indeed been the commitment of massive amounts of investment in the oil sector, the true benefits in terms of oil produced, fiscal revenue and employment will only really begin to be seen after 2020. There has been disappointment and outright anger from the Mexican public over gasoline prices, and this issue has been seized upon in electoral campaigns to undermine support for the reforms.

This contrast between stunning success and disappointing results requires us to engage in a complete and comprehensive analysis of the reform in all of its dimensions. The volume that has been assembled here is an attempt by foreign-based analysts, experts in their respective fields, to provide an unbiased evaluation of the reform. After this introduction and a history of the reform process, each of the chapters asks the following questions:

- What has been successful in the reform process?
- What is still incomplete in the implementation of the reform?
- What needs to be changed or modified to take full advantage of the reform?
- What will take more time to develop into a success?

1 Duncan Wood and John Padilla, *Mexico's New Hydrocarbons Model: A Critical Assessment Four Years Later, Wilson Center,* https://www.wilsoncenter.org/publication/mexicos-new-hydrocarbons-model-critical-assessment-four-years-later.

The first chapter in this volume, by Sarah Ladislaw and Jesse Barnett, describes the drivers of change in the global energy system and summarizes the major issue areas that are topmost in the minds of analysts and planners in that system. This chapter is critical to understanding why Mexico's reform was so urgent in 2013 and why it remains pertinent today. In many ways, the 2013 reform brought Mexico into line with the dominant policy ideas of the 21st century, and has helped prepare the country for the challenges and transformations that will come in the near future. Most important among these are rising energy demand, peak oil demand, the rise of electric vehicles (EVs), the growth of renewable energy and the increasingly worrying prospects for climate change.

Chapter 2, by Wood and Martin, offers a history of the reform process. It is important to emphasize that the 2013 reform was not the first attempt to modernize Mexico's energy model; in fact there have been multiple attempts to do just that, generally in piecemeal fashion, since the early 1990s. These attempts to increase opportunities for private participation in the energy sector focused on both electricity generation and on oil and gas exploration and production, but at each stage a more comprehensive opening of the sector was frustrated by political realities.

Until 2013, that is. The unique confluence of political factors that year made possible a daring and far-reaching reform package that opened the entire energy value chain in Mexico to private investment and participation. The ambition of the new administration of Enrique Peña Nieto, a political deal between Mexico's major political parties called the *Pacto por Mexico,* and a growing realization of the urgency of opening the oil industry to private investment combined to bring about a dramatic shift in thinking about the sector, and comprehensive Constitutional reform. That, in turn, paved the way for secondary or implementing legislation to be passed in August of 2014, and the eventual launch of bidding rounds for oil exploration and production in 2015. What is described in this chapter is a both a change in the governing paradigm of Mexican energy policy, as well as a stunning pace of reform that both impressed investors and put huge stress on bureaucrats and institutions as they struggled to prepare for the new energy model. Overall, this was an impressive achievement.

Guillermo Garcia Sanchez analyzes the "fine print" of the reform legislation in Chapter 3 and focuses on three main issues: the need to enshrine some concepts in the Constitution itself rather than just the transitory articles; the need to provide greater certainty in the form of investor protections; and the specific issue of providing a clearer definition of the word "concession". Garcia Sanchez also argues clearly that there is still too much freedom left to the executive branch to determine the way in which the new energy model will be implemented, allowing for political preferences to determine outcomes.

In chapter 4, Jeremy Martin analyzes the oil and gas reform process, focusing in on the multiple and dramatic changes that were made to the hydrocarbons sector because of the reforms. Martin emphasizes the importance of the institutional and regulatory restructuring that took place as well as the rapid pace of executing the bidding rounds. Martin also argues that there is now renewed investment in research toward innovation and technology. At the same time as he lauds the progress made by the reform, Martin makes the case that the government of Enrique Peña Nieto made a critical error in overselling the reform to the Mexican public and stresses the need for a new communication strategy to convince Mexicans of the reform's benefits. Given the tone of the new administration in Mexico, this is unlikely to transpire.

Chapter 5 focuses on the challenges faced by Pemex before, and because of, the reform process. Abad and Maurer expertly explain the constraints faced by Pemex prior to the reform: access to capital, an overwhelming tax burden and insurmountable inefficiencies. They argue that financial constraints have been partially overcome by the use of farmouts but are still considerable. As for the fiscal challenge, Pemex has seen its burden lightened by lower levels of taxation but those taxes are still very high by comparison with other Latin American national oil companies. On the question of inefficiencies, changes to the Pemex refining business and over 30,000 layoffs of Pemex staff have resulted in cost savings but there are still major internal problems that need to be resolved by the NOC.

Mexico's new electricity model is addressed by the Peter Nance in Chapter 6. In what is the most lengthy and detailed chapter of the volume, Nance explains five main elements of electric sector reform: the building of a market-based structure, the division of the national utility (CFE) into different entities, the regulatory framework, power auctions and the construction of transportation infrastructure for both electricity and for natural gas. The list of achievements due to the reform is impressive and the speed of implementation is remarkable, especially when compared to similar changes in neighboring countries.

However, the author also points out that there remain some serious challenges and weaknesses in the reform process. Of particular concern is that projects are taking longer to develop in Mexico for a variety of reasons. What's more, the formerly monopolistic CFE retains a dominant market position that threatens the interests of competing firms. Nonetheless, the main takeaway from the analysis of the reform and its implementation is that Mexico has come a long way in a relatively short period of time. Nance recognizes that this part of the reform is far from perfect, but that the achievements to date have been impressive.

Chapter 7 of this volume is dedicated to the development of renewable energy sources in Mexico as a result of the reform. Lisa Viscidi offers analysis and insight into the potential for renewable energy in the country, the development of the legal and regulatory framework, progress thus far under the reform, and the challenges that continue to hold back the development of Mexico's renewable potential. Principal among these challenges are lack of investment in the national grid, the competitive pricing of natural gas as a generation fuel, and social license issues.

Chapter 8 offers a view of the future of the energy sector in Mexico under the administration of Andrés Manuel López Obrador, elected president of Mexico on July 1st 2018. The incoming government has made clear that it does not agree with the reform of 2013, but that the law will be respected. Nonetheless, it is clear that attempts will be made to modify the legal framework of the reform, if only in the secondary or implementing legislation and perhaps with regards to regulation. What remains to be seen is how investors will react to the potential modifications of Mexico's energy model, and whether the changes will prove to be helpful or damaging to the achievement of the new administration's energy goals.

Mexico's energy reform continues to be a bone of contention between analysts and politicians, between international investors and those who seek greater national control of the country's energy wealth. But few would deny that the reforms were truly historic, profound and highly ambitious. In passing them, and then seeking their rapid and effective implementation, the Mexican government has shown what is possible when crisis threatens and when political stars align. Now we must evaluate what the political future holds for the reform and those who have invested so heavily in it.

The Evolving Global Energy System

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Introduction

No industry is as essential to the human condition as energy. It fuels our cars, lights our homes, and powers our businesses. The enterprise of creating and maintaining a durable energy system—the collective means by which society generates and distributes vital energy resources—has been around for generations. But longevity is not the same as constancy, and energy analysts have taken on the dual task of defining the status quo of the energy system as well as projecting its potential evolution. By proclaiming the dawn (or twilight) of various paradigms, periods, and ages, countless writers have attempted to make sense of this colossal and intensely global industry. Although no attempt to reduce the history of the energy industry into distinct sequential strata will ever capture its true complexity, these efforts are a useful means of assembling a coherent narrative to inform public and private sector decision-making processes. One of the more important lessons instilled by even a cursory reading of this literature is that the energy system tends to move slowly, but changes to it can be swift and irrevocable, meaning that it is all the more valuable to reflect on and analyze the system.

The goals of this chapter are threefold. First, it seeks to explain the various drivers of and constraints to changes in the energy system, whether technological, market-based, or political. Second, it provides a broad summary of our current understanding of the energy system, not through a fuel-by-fuel breakdown of supply and demand but by a survey of the major issues that most energy analysts consider crucial. Finally, it aims to combine the insights found in the outlooks of the industry's major forecasters with a more speculative look at the less tangible forces that could shape the future of energy.

Today's Energy System

Before considering what the highly uncertain future of energy might look like, it is useful to take stock of how we understand its present status. The current energy system remains dependent on fossil fuels such as oil, coal, and natural gas, which together provide just over 85 percent of the world's energy[2]—though in recent years oil has overtaken coal as the largest single source. Although coal continues to provide the largest share of power globally, renewables are rapidly gaining ground, with some countries relying on solar, wind, bioenergy, and hydro to generate more than 25 percent of their electricity. Oil has almost entirely been worked out of the mix save for a handful of remote countries where diesel is still used for power generation. Nonetheless, oil continues to dominate the transportation sector, where more than 90 percent of demand is met by oil-derived products[3]. For its part, nuclear power has seen its center of gravity shift. Although most nuclear plants continue to be

2 BP, "BP Statistical Review of World Energy 2017," June 2017, 9.

3 U.S. Energy Information Administration (EIA), *International Energy Outlook 2017*, DOE/EIA-0484(2017), September 2017, ch. 8, www.eia.gov/outlooks/ieo/pdf/0484(2017).pdf.

operated by an exclusive club of highly developed economies, the sector's growth increasingly has been driven by new builds in China, India, and other developing economies. This is a stark contrast to the sector's performance in the traditional North American, European, and Japanese markets, where it has struggled in recent years to compete against other fuels, restart operations in the wake of post-Fukushima security concerns, and build new plants on budget and on time.

The geopolitics of energy has also experienced remarkable change. Just a few years ago, economies outside the Organization for Economic Cooperation and Development (OECD) surpassed their more developed peers as the largest users of primary energy; today, these countries consume more than 58 percent of the world's total primary energy production.[4] China, which has added the largest increment of energy demand growth each year for the past 14 years and is now the world's largest energy consumer, has finally begun to see demand growth decline owing to a more general slowing of economic growth, energy efficiency improvements, and structural economic reforms. Across the Pacific, the United States, once most recognized for its role as the world's largest energy consumer, is now the world's largest oil, natural gas, and hydrocarbon gas liquid producer. The rapid rise in U.S. oil and gas production, along with other factors, helped bring about a collapse in oil and natural gas prices in 2014, causing financial stress for the world's oil- and gas-exporting economies and ultimately to an alliance between the Organization of the Petroleum Exporting Countries (OPEC) and Russia to manage production in an effort to stabilize world oil prices.

All of these shifting market and geopolitical dynamics are taking place in the context of important technological and societal change. The declining cost of renewable energy means that energy systems are becoming not only more diversified but also more distributed, flexible, and responsive, incorporating innovations like two-way power flow, demand-response, and distributed storage options. The energy system is also gradually becoming more digitally enabled both inside and outside the electric power sector, with digital applications for drilling operations, pipeline functioning and maintenance, refinery optimization, and transportation technologies.

From a policy perspective, countries and companies must craft new strategies to survive and compete in this market environment while simultaneously meeting a broader suite of societal goals and commitments. Among those commitments promulgated by the various multilateral fora, none have achieved the same recognition—symbolic or otherwise—as the United Nations (UN) Sustainable Development Goals (SDGs). Several SDGs speak to the provision of energy services in order to alleviate energy poverty and meet other development needs such as education, health care, and basic nutrition. The specific goals include:

- By 2030, ensure universal access to affordable, reliable, and modern energy services;
- By 2030, increase substantially the share of renewable energy in the global energy mix;
- By 2030, double the global rate of improvement in energy efficiency;
- By 2030, enhance international cooperation to facilitate access to clean energy research and technology; and
- By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries.

In 2015, another major UN accord also entered into force under the auspices of the UN Framework Convention on Climate Change: the Paris Climate Agreement. By creating a new framework for global

4 "BP Statistical Review of World Energy 2017," 9.

cooperation on emissions reductions, the signatories to the agreement made commitments—albeit nonbinding ones—to establish plans for climate adaptation, financial mobilization, and technology sharing. Similarly, global leadership organizations, such as the G-20, G-7, Asia-Pacific Economic Cooperation (APEC), Summit of the Americas, and the Association of South East Asian Nations (ASEAN), have introduced energy-related targets and goals to foster cooperation. Many of these goals are designed to enhance coordination on issues where countries see collective gains to be had from collective action (such as infrastructure integration) or to mobilize action in areas where domestic action alone is difficult to pursue (such as subsidy reform). Although many of these global efforts catalyze initial action, at present the world is not on track to meet many of these international goals. This is particularly true of the SDGs and the Paris Climate Agreement, where most observers consider that progress has been inadequate.

Current Energy Challenges

This snapshot of the global energy system presents a complex landscape in which policymakers, corporate leaders, and investors must make decisions about the short- and long-term outlooks for energy supply, demand, trade, and investment. Before examining forecasters' consensus about the longer-range outlook, it is helpful to explore some of the near-term issues shaping current energy markets and energy-related investment and policy decisions. The main issues include the emergence of new macroeconomic headwinds, the rebalancing of global oil markets, the next wave of natural gas investment, changes to the mix of fuels used to generate electricity, geopolitical developments in both major consumer and major producer states, the intensification of climate change concerns, and the increasing financialization of energy markets.

The day-to-day movement of oil prices often captures more headlines within energy circles than changes to the global economic outlook, but no single factor is more important to the energy system than the rate and pace of economic growth and the energy intensity of that growth. This is especially true in today's context, where the 2008 economic downturn is still fresh in people's minds and the systemic risk uncovered in that downturn is still being dissected and debated. Since the Great Recession, most of the world's economies have returned to business-as-usual growth paths, and in 2017 global economic growth was even greater than expected at 3.7 percent, compared to an initial International Monetary Fund (IMF) forecast of just 3.1 percent.[5] This is particularly important for energy markets as economic growth—usually expressed as the change in either gross domestic product (GDP) or GDP per capita—is the primary driver of energy demand. Nonetheless, the IMF has noted that the global economy faces real risks, with its 2017 *World Economic Outlook* warning that "[i]f financial conditions remain easy . . . with a protracted period of very low interest rates and low expected volatility in asset prices" it could lead "to a buildup of financial vulnerabilities in advanced and emerging market economies alike."[6] In other words, although low interest rates have helped many economies right themselves in the wake of the Great Recession, they have also increased the likelihood of a financial correction. In addition, the longer-term productivity gains that are all but required to set countries on a path to more sustainable growth still require politically contentious fiscal and structural reforms. Several countries are working to make such reforms, many of which will affect the energy sector. For instance, Saudi Arabia's Vision 2030, a domestic reform package seeking to wean the economy off of its reliance on government spending and diversify its oil-dominated

5 International Monetary Fund (IMF), *World Economic Outlook, October 2017: Seeking Sustainable Growth: Short-Term Recovery, Long-Term Challenges* (Washington, DC: IMF, October 2017), www.imf.org/en/Publications/WEO/Issues/2017/09/19/world-economic-outlook-october-2017.

6 Ibid.

energy sector, has instituted measures to reduce the role of energy subsidies and change the country's energy and investment outlook. The reforms have been greeted with enthusiasm both in and outside of Saudi Arabia, but the details of their implementation have been met with some concern among investors who see the plan as perhaps overly ambitious.

Developed economies are also taking steps to enhance their competitiveness. In North America, for instance, companies are adjusting to recent changes in U.S. tax policy with mixed results. On the one hand, the reforms contained in the Tax Cuts and Jobs Act of 2017 are expected to provide several tangible benefits across the oil and gas industry, such as a reduction in the corporate tax rate and the implementation of a participation exemption system. On the other hand, the reforms also impose several burdens, including new rules designed to stop U.S. companies from transferring certain assets to foreign subsidiaries to avoid U.S. taxes, and significantly reducing the applicability of various tax provisions that allow companies to use net operating losses to lower their tax bill.[7] Overall, however, the oil and gas industry's reaction has been one of tempered enthusiasm—with domestic-oriented companies coming out ahead of their more internationally-focused peers—and even alternative energy companies have welcomed most of the changes.[8] Such measures have provided a near-term stimulus to the U.S. economy and seem likely to improve the competitiveness of U.S. domiciled corporations in the long run.

Yet new headwinds have emerged as well. The most prominent is the prospect of a trade war between the United States and China, who together account for $648 billion of globally traded goods and nearly 40 percent of global GDP.[9] As discussed later in this chapter, the drag on global growth and the return of protectionist economic measures undoubtedly will affect the intensely global energy industry and may create undue pressure on a global economy seeking to emerge from a postrecovery period on a more sustainable path.

Second, the rebalancing of oil markets is likely the matter of greatest near-term focus for energy companies, given the impact of oil price changes on the competitiveness of other fuels and the economy as a whole. At the time of writing, energy prices have returned to a level that most economists view as healthy—low enough to prevent "demand destruction" whereby consumers switch to alternatives, but high enough to allow most producers to earn a reasonable return on investment. More than three years after the 2014 collapse in global energy prices, the consensus view seems to be that, absent a supply disruption, prices are unlikely to return to their pre-recession highs, even in light of the December 2016 OPEC agreement to cut production by 1.8 million barrels per day (bpd) and subsequent agreements to extend those cuts.[10] Nonetheless, and despite the gradual progress toward a more sustainably balanced oil market, the near-term market outlook remains uncertain. The first and perhaps most significant area of uncertainty is the volume of oil production coming online from U.S. tight oil production. Market observers are split on the near- to medium-term production outlook for tight oil,

7 Clark Sackschewsky, "Tax Reform's Impact on the Oil & Gas Industry," BDO, December 31, 2017, www.bdo.com/insights/industries/natural-resources/how-tax-reform-will-impact-oil-gas.

8 Jon Nelsen et al., *Tax Reform Act - Impact on Renewable Energy*, Baker Botts, December 20 2017, www.bakerbotts.com/ideas/publications/2017/12/tax-reform-act---renewable-energy.

9 World Trade Organization (WTO), *World Trade Statistical Review 2017* (Geneva: WTO, May 2018), www.wto.org/english/res_e/statis_e/wts2017_e/wts17_toc_e.htm.

10 Adam Sieminski, Frank A. Verrastro, and Andrew J. Stanley, "OPEC's Moving Target" Center for Strategic and International Studies, December 13, 2017, www.csis.org/analysis/opecs-moving-target.

with some forecasts differing by more than 500,000 bpd. A second area of uncertainty is the breakeven costs for non-tight oil production projects around the world. Several years of extended capital investment cuts of up to 25 percent or more across the industry has led many to speculate that a "gap" in production will materialize once those missed capital investments show up in lower than necessary oil production. The key question is when that gap emerges and how much current exploration and production expenditures are bridging or widening it—a difficult challenge for any analyst given the cost declines being claimed by oil producers. Finally, whether and how OPEC decides to manage its post-2018 production is a key factor in the oil market rebalance outlook.

Despite the rise of unconventional production, OPEC production continues to play a pivotal role. Its member states hold almost 81 percent of the world's proven oil reserves[11] and 55 percent of its proven natural gas reserves, much of which can be produced using conventional extraction technologies at a lower-than-average cost.[12] But for much of 2015 and 2016, OPEC's ability to engage in strategic price-setting behavior seemed questionable given internal frictions among its members and surging U.S. production. Since then, however, OPEC has worked to hasten the rebalance, starting with its November 2016 decision to cut production—the first such agreement in eight years. Crucially, the agreement was able to secure the cooperation of not only its more hesitant members—Iraq and Iran—but also Russia, which currently is the world's third largest petroleum producer but is not a member of OPEC. These efforts were further reinforced by the organization's November 2017 agreement to extend production cuts until the end of 2018 and its success in convincing Nigeria and Libya, both of whom previously had been exempted from the cuts, to participate. Nonetheless, the agreement still faces a number of challenges. As a cartel of individual members, OPEC is not monolithic in its thinking, and already disagreements have emerged concerning when and how quickly its members should relax production restraints. Saudi Arabia, for instance, has suggested that the current OPEC/non-OPEC alliance could last for decades, a claim meant to reinforce the credibility of the alliance's actions but one that will need to be further developed in order to gauge any real and lasting impact.

Third, natural gas demand is expected to grow over the next several decades as the regional markets on which gas is sold become increasingly liquid and interconnected, not least because of the burgeoning liquefied natural gas (LNG) trade. When coupled with the desire to monetize increasingly gas-rich reserves, this anticipated growth has led many countries and companies to seek investment opportunities throughout the gas value chain. The problem is that, at present, most natural gas markets—with northern China as a notable exception—are oversupplied, which has depressed prices and enthusiasm for further projects. LNG infrastructure is still expensive to build and most investors continue to view such projects as prohibitively risky unless secured by long-term offtake agreements, which many project sponsors are loath to enter into given the prevailing low-price environment. On the demand side, gas faces several challenges as it competes for market share in the electric power sector, including domestic pricing restrictions, insufficient infrastructure, and economic competitiveness with regard to other fuels that receive direct and indirect government subsidies. Gas faces the additional hurdle of objections from environmental communities that see gas development as a distraction for lower-carbon sources of power generation, such as wind and solar. This dynamic, in addition to local opposition to hydraulic fracturing in many locations where gas resources are abundant, further complicates the outlook for gas.

11 "OPEC Share of World Crude Oil Reserves." OPEC, Web.

12 Central Intelligence Agency, "Country Comparison: Natural Gas - Proved Reserves," *World Factbook.*

Fourth, electric utilities the world over are continuing to grapple with how to optimize their oil, gas, coal, nuclear, and renewable assets portfolios to achieve diverse objectives. Although the overall share of electricity generated from renewables has risen from 18.3 percent in 2000 to 22.3 percent in 2014,[13] there is no universal pattern to how utilities are adjusting their fuel mixes. They have done so in ways that fit their individual circumstances. For instance, in India and several other Southeast Asian economies, the relative share of electricity generated from renewables has actually fallen even though the absolute quantity of renewables has increased. In these cases, price remains paramount, which in turn has engendered a further reliance on lower-cost options, usually coal and natural gas—even though renewable sources like solar are increasingly competitive in these countries. But other developing economies have chosen different paths: China's renewables share has grown from 16.6 percent to 22.6 percent largely on account of its efforts to address air quality and energy security concerns, while the renewable energy shares of many African countries' mixes have skyrocketed as solar technology has proliferated. And just as India and China have pursued different energy mixes in response to different circumstances, so too have more developed economies chosen various generation options reflecting their needs. Although Saudi Arabia and several other Middle Eastern countries have begun investing in solar, wind, and even nuclear power in order to free up valuable oil and natural gas resources for export, European states such as Germany, France, and Spain have done so in order to achieve ambitious climate objectives. What unites these utilities then is neither the kinds of fuels they are adopting nor their reasons for doing so, but rather the fact that they are increasingly willing to change the composition of their fuel portfolios.

Fifth, today's energy landscape is still regularly shaped by nonmarket forces: wars, terrorism, civil strife, and shifting alliances continue to affect the price and disposition of energy resources. Unsurprisingly, the Middle East remains the backdrop for many of these forces. In addition to the almost perpetual strategic disagreements within OPEC, the strained and increasingly hostile relationship between Iran and Saudi Arabia has exacerbated geopolitical divisions. Although both nations nominally share a common interest in preserving OPEC's price-setting power, disputes over religion, the conflict in Yemen, the fate of their respective proxies in postwar Iraq, and Iran's nuclear program continue to taint the relationship between the region's two biggest producers. Globally, tension and proxy wars in places like Kurdistan, North Korea, Syria, Venezuela, and Yemen make for an increasingly precarious geopolitical horizon.

Sixth, it is now no longer possible for most parts of the energy value chain to ignore climate change and the growing policy apparatus that surrounds it. On the one hand, the sense of the threat posed by climate change is nothing new, particularly within the scientific community. Though there are academic disputes over exactly how fossil fuels contribute to global warming, its existence is no longer seriously disputed, with Cook and colleagues' study showing that "among abstracts that expressed a position on AGW [Anthropogenic Global Warming], 97.1 percent endorsed the scientific consensus"[14] and the Intergovernmental Panel on Climate Change stating in its 2013 report that the body was "95 percent certain that humans are the main cause of current global

13 World Bank, "Data Bank: Renewable Electricity Output (% of Total Electricity Output)," accessed March 20, 2018, https://data.worldbank.org/indicator/EG.ELC.RNEW.ZS?view=chart.

14 Benjamin John Floyd Dean, "Comment on 'Quantifying the Consensus on Anthropogenic Global Warming in the Scientific Literature,'" *Environmental Research Letters* 10, no. 3 (2015): 3.

warming."[15] What is more novel is the increasing acceptance of climate concerns within the boardrooms of traditional energy firms. Although many oil, gas, and coal companies welcomed the victory of President Donald Trump in the 2016 elections, it did not fundamentally alter their investment outlooks. Although these firms are more than happy to avail themselves of looser environmental regulations, few expect this reprieve to be anything more than temporary, and are preparing accordingly as calls for carbon taxes, cap-and-trade regimes, and even outright boycotts have continued to grow louder in most countries. When coupled with the potential of greener technologies to disrupt the prevailing energy system, climate change is likely to increasingly shape the way that energy markets develop.

Finally, energy markets have grown more interconnected with financial markets, changing not only how energy is bought and sold but also how energy investments are assessed, financed, and developed. Financialization typically has occurred as a result of two related phenomena: (1) the development of new financial instruments, such as futures and options, derived from the physical trade of commodities; and (2) the investment of energy-derived earnings into financial assets.[16] By either of these metrics, financialization has intensified since the Great Recession, with the total number of open interest contracts—namely, options and futures—on light sweet crude oil traded on the New York Mercantile Exchange growing from an average of just over 61 million bpd in 2006 to around 98 million bpd in 2017, dwarfing the number of physical barrels actually produced in the United States by a factor of almost 10 to 1.[17] But although this shift has been significant, there is little consensus on what it actually means for prices and companies. On the one hand, the proliferation of energy-based derivatives and other financial instruments is believed to have "deepened" the markets for oil and (to a lesser extent) natural gas by providing increased liquidity for holders of energy-linked financial assets and by expanding the pool of potential counterparties for companies to engage in hedging and other risk management practices.[18] On the other hand, some have suggested that the incorporation of commodity markets into the wider financial ecosystem could increase the probability of a larger systematic failure in the market, as the performance of energy assets would be increasingly linked to the performance of nonenergy assets.[19] In other words, just as the creation and spread of mortgage-backed securities linked the performance of a small section of the housing market to otherwise unrelated classes of assets, so too could the expansion of commodity-linked financial products subject energy markets to fluctuations in markets only tangentially related to energy.

15 Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2013: The Physical Science Basis* (Geneva, IPCC, 2013), www.ipcc.ch/report/ar5/wg1/.

16 Franco Ruzzenenti, "Changes in the Relationship between the Financial and Real Sector and the Present Economic Financial Crisis: Study of Energy Sector and Market," Working Paper 105, Financialisation, Economy, Society & Sustainable Development (FESSUD) Project, April 2015, http://fessud.eu/wp-content/uploads/2015/03/FESSUD_Working-Paper-Series-D-3-08-final-working-paper-105.v2.pdf.

17 Computed as the change in "CRUDE OIL, LIGHT SWEET – NEW YORK MERCANTILE EXCHANGE" Open interest all. Assumes a 10 million bpd production statistic for 2017. Data from the U.S. Commodity Futures Trading Commission's Disaggregated Futures-and-Options Combined Reports.

18 Brian J. Henderson, Neil D. Pearson, and Li Wang, "New Evidence on the Financialization of Commodity Markets," *The Review of Financial Studies* 28, no. 5 (May 2015): 1285–1311.

19 Daniel P. Ahn, "Improving Energy Market Regulation: Domestic and International Issues" working paper, Council on Foreign Relations, February 2011, www.cfr.org/sites/default/files/book_pdf/CGS-IIGG_WorkingPaper12_EnergyMarkets.pdf.

Energy Systems of the Future: Insights from the Outlooks

What then can be said about their future? A favorite starting point for many energy analysts are the flagship publications of the major energy forecasters, namely the International Energy Agency's (IEA) *World Energy Outlook*, the U.S. Energy Information Administration's (EIA) *International Energy Outlook*, and BP's *Energy Outlook.* Crucially, none of these organizations offer predictions about the future; rather, they provide projections. This difference may seem pedantic, but it is essential to keep in mind that their projections are what could happen given a set of specific circumstances under different scenarios, and that a change to any one assumption may dramatically alter their results. As the first EIA administrator Lincoln Moses explained when pressed by a senator to dispense with the caveats and hypotheticals and skip to the facts, "Senator, there are no facts about the future."[20]

Yet even if there are no facts about the future, comparing the various outlooks reveals recurring themes that inform today's consensus view of the future development of energy systems. First and foremost is the question of future energy demand. On this, the three organizations seem to agree on baseline projections between now and 2040, with the IEA projecting a 30 percent increase in total global energy demand in its New Policies Scenario, the EIA a 28 percent increase in its Reference Case, and BP around a 33 percent increase in its Evolving Transitions case. As the IEA points out, although this growth is slower than in previous decades, it still represents a tremendous amount of new energy—equivalent to "adding another China and India to today's global demand."[21] The assessments also generally align on the likely changes to the geographic composition of this growth, namely the rising importance of developing economies. According to both BP and the IEA, around two-thirds of the projected growth in energy demand by 2040 is expected to be driven by India, China, and other Asian developing economies, with the EIA projecting a 41 percent increase in non-OECD energy demand, compared to just a 9 percent increase in OECD countries.

The three assessments do disagree on the key issue of "peak oil demand"—essentially, the question of if and when global oil consumption will begin to decline. Neither the IEA nor the EIA forecast a peak in oil demand by 2040, but BP suggests that oil demand should plateau by 2030 before beginning to decline somewhere in the mid-2030s. This divergence partially reflects their varying assessments of the future of renewables, particularly the ability of electric vehicles to replace gasoline- and diesel-powered competitors. Although the EIA's outlook does not contain projections for the number of electric vehicles, the BP and IEA outlooks do, with BP estimating 323 million electric vehicles on the road by 2040 compared to the IEA's 277 million.

BP is similarly more bullish than its peers, particularly the EIA, on the speed of renewables growth. According to the company, renewables should grow at an annual rate of around 7.0 percent between 2016 and 2040, compared to the IEA's estimate of 6.5 percent and the EIA's 4.5 percent. These views on the speed of renewables deployment also feed into their perspectives on the future of the world's fuel mix. Notably, all three agree that more and more of the world's energy will be provided in the form of electricity, though they disagree on the speed of the transition, with the IEA forecasting 2.0 percent annual growth in electricity demand, the EIA 1.3 percent, and BP 2.01 percent. This growth reflects several underlying dynamics. First, and as previously

20 John Dingell, "Plug-In Electric Vehicles 2008: What Role for Washington?," Brookings Institution, June 11 2008, www.brookings.edu/events/plug-in-electric-vehicles-2008-what-role-for-washington/.

21 International Energy Agency (IEA), *World Energy Outlook 2017: A World in Transformation* (Paris: IEA, 2017), 23, www.iea.org/weo2017/.

intimated, most forecasters expect petroleum-powered transportation to become a relatively less important driver of energy demand, owing largely to improvements in the fuel efficiencies of internal combustion engines and the increasing competitiveness of electric vehicles. Second, developing economies generally tend to transition away from energy-intensive industries like manufacturing and toward less-intensive service-based industries. As a result, the relative decline of demand in the transportation sector is expected to be more than offset by an increase in commercial and residential demand, both of which rely more on electricity than on other forms of energy. The source of this electricity is also expected to change. Although coal-fired plants historically have provided the largest source of generation, coal demand is expected to stagnate or plateau in all three of the major forecasts, with the EIA forecasting peak coal demand between 2020 and 2025, and BP somewhere between 2020 and 2030. Even in the IEA's estimate, which forecasts slow but positive growth in coal demand through at least 2040, coal fares the poorest of the various fuel types, with its share of electricity production falling from 44.2 percent in 2016 to 33.1 percent in 2040. The likely fate of coal, however, stands in stark contrast to that of natural gas. Bolstered by surging U.S. unconventional production, increasingly attractive contract structures, and intensifying environmental concerns, natural gas is expected to maintain its relative position in the electric power sector even as other fossil fuels are phased out in favor of renewables. Natural gas demand is also expected to grow significantly in absolute terms, with BP forecasting 51 percent growth in total consumption between 2016 and 2040, compared to an estimated growth of 43 percent by the EIA and 45 percent by IEA.

Finally, and despite the relative declines of both coal and oil, all three projections share a relatively pessimistic view of the world's ability to combat climate change. According to the EIA, by 2040 annual carbon dioxide (CO_2) emissions are forecasted to reach 39,318 million metric tons (MMmt), an estimate comparable to the IEA's 35,642 MMmt and BP's 36,776 MMmt. All of these figures are far in excess of the roughly 18,000 MMmt level that the IEA calculates will be necessary to remain on track to achieve the climate objectives set forth in the Paris Agreement and the UN SDGs.[22] Crucially, even though all three estimates expect that emissions from the developed world will decline—largely because of increased energy efficiency and the abandonment of coal-fired electricity—these declines are widely projected to be more than offset by growing emissions from the world's rapidly industrializing economies.

Energy Systems of the Future: Competition, Consumers, and Crises

Examining the areas of relative consensus among the major energy forecasts has provided insights about the internal and external drivers shaping our view of the future of energy. But perhaps of even more value are the areas of relative uncertainty—the known unknowns. Beyond the core economic fundamentals are less-tangible factors that also will shape the energy landscape in the coming decades. Of these factors, three seem most worthy of special attention: changes in the nature of competition, the evolving preferences and identities of energy consumers, and crises.

It may seem strange to include competition in this list. Competition, of course, is by no means a stranger to the energy world. But what could be new is the means by which firms and countries compete for specific fuels, markets, and technologies. Energy producers are facing more abundant supply conditions and, by extension, lower prices. As BP chief economist Spencer Dale noted in the BP Energy Outlook, competition in a world of

22 Ibid., 33 and 651.

abundant supply and technological change means that competition for market share within a given fuel category will be as stiff as it will be between fuels. The disruptive threat posed by new technologies and new business models will further intensify competition.

One area where this competition is likely to prove fiercest is in the oil market. Although the primacy of oil is likely to decline into the future, oil will remain a vital resource for many oil-producing countries and economic sectors. With the advent of U.S. tight oil production and looming economic headwinds, oil markets are entering a new cycle with structural elements that are fundamentally different from those in years past. Although oil price projections and scenarios for the next decade vary, many cluster around a basic "lower for longer" scenario defined by a lower price trajectory ($50–$60 per barrel)[23] interrupted by occasional bouts of volatility—a price environment similar to that of the 1980s. Should this occur, financing will grow tighter for oil firms, particularly for state-owned national oil companies (NOCs) that could be forced to adopt new strategies to attract capital from privately owned international oil companies (IOCs) or other NOCs. NOCs themselves are diverse—from cutting-edge champions like Norway's Statoil to severely challenged organizations such as Venezuela's PDVSA—but many are poorly positioned for a lower for longer scenario. They may have failed to reinvest earnings, and many home governments increasingly have commandeered NOC earnings to address fiscal shortfalls.

IOCs face a similarly uncertain future. Although they are less encumbered by the political vagaries of home governments, they hold only a modest share of global reserves, with the IEA finding that "[o]verall, nearly 80% of the world's proved-plus-probable reserves, including both conventional and unconventional oil, are controlled by national oil companies . . . or their host governments" and that these NOC-controlled assets are generally "those with the lowest average development and production costs."[24] As a result, IOCs likely will either go deeper into U.S. tight oil—thereby displacing independents—or invest more in assets held by NOCs or OPEC members. In the long run, this option to go abroad in search of lower production costs could coincide with the likely decline in NOC reinvestment, potentially allowing IOCs to seize market share from incumbent NOCs in some resource-rich countries.

Reserves will not, however, be the only thing over which companies compete, and IOCs and NOCs alike are likely to fight to not only maintain their position in relatively stagnant developed markets but also seize market share in the developing world's expanding markets. With fast growth, rising incomes, and booming populations, developing markets are attractive to NOCs and IOCs. Looking for an edge, these companies may forge new relationships with governments in these areas, in many cases likely with the backing of their respective home nations. New commercial ties between companies (particularly NOCs) and governments could intensify nonenergy geopolitical relations in the region, as evidenced by the increasing pace of dealmaking between Asian and Middle Eastern NOCs to secure supply and demand relationships through midstream and downstream investment. Examples of such partnering include Saudi Arabia's forward positioning of stocks and purchasing of refineries in China and Southeast Asia but also Russia's recent spate of downstream Indian asset purchases. This collective "pivot East" may simply seem to be business as usual for many in the energy sector, but the potential geopolitical implications could be profound in a time of Asian regional economic integration and the awakening of a new era of Chinese soft power.

23 Ibid.

24 IEA, *World Energy Outlook 2013* (Paris: IEA, 2013), 432, www.iea.org/publications/freepublications/publication/WEO2013.pdf.

But the explanatory power of competition has limits. Even the most competitive NOCs and IOCs could be caught flat-footed by a sudden change in the demand for their products. Although the determinants of demand vary with the commodity in question, a key common element is consumers, and energy consumers likely will have significantly different future demands. As evidence, one needs only to look at China to see how quickly the demand profile of a country can change. Although the country is both the world's largest consumer of coal and its largest emitter of CO2, it is also the single largest investor in renewable energy, and today it leads the world in the production of lithium ion batteries, wind turbines, and solar photovoltaic cells.[25] A discussion of the exact forces motivating Chinese energy policy is beyond the scope of this chapter, but many—perhaps most—of them have their roots in Chinese consumer demands. Though price and reliability remain the dominant concerns for many developing economies, including China, the Chinese example shows how mutable these priorities can be and how quickly social and environmental considerations can assert themselves.

Consumer desires are not the only variable, however. It is clear that the geographic locations of the consumers themselves will also be different. Although the developed world still consumes around 40 percent of the world's energy despite accounting for just over 17 percent of its population,[26] its energy demand is slated to shrink by 0.1 percent per year on average between now and 2040, compared to growth of over 1.6 percent per year in developing economies. To put this in perspective, developing country energy demand is forecasted to grow by an amount equal to all of the energy consumed by the United States—times two. Consequently, energy companies are placing their bets in the developing world, and in 2016 energy investment in developing economies exceeded investment in developed economies by more than $263 billion. It is clear that this shift represents a departure from the present, but it also raises a key question: will consumers in developing countries consume energy in the same ways as their counterparts in the developed world? Even if one controls for the time component—the fact that consumer tastes inevitably evolve as a result of technology or other forces—it is not clear that consumption will look the same. It is not unreasonable, for instance, to imagine that consumers in these countries could have different expectations for energy: they are, for instance, likely to have different needs for heating or cooling, different preferences for transportation (two- or three-wheeled vehicles, for instance), or different tolerances for energy-related externalities.

The final factor is that of crises. As discussed earlier, the energy sector is often shaped by difficult-to-predict accidents, incidents, or conflicts that change the ways countries produce, trade, and consume energy. Recent examples include the 2010 Deepwater Horizon oil spill, the 2011 nuclear disaster in Japan, Russia's 2014 annexation of Crimea, and the battery of sanctions against Iran to facilitate negotiation on their nuclear weapons program. Although forecasting geopolitical crises is even more error-prone than auguring the future roles of competition and consumers, crises are bound to happen. On the geopolitical stage, it is highly likely that international relations will continue to be shaped by the "rise of the rest,"[27] with the United States forced to increasingly seek like-minded coalitions to accomplish its global objectives. This should provide ample opportunity for other powers to assert their interests. Russia, for instance, probably will continue to advance its

25 Tim Buckley and Simon Nicholas, *China's Global Renewable Energy Expansion: How the World's Second-Biggest National Economy is Positioned to Lead the World in Clean-Power Investment* (Cleveland: Institute for Energy Economics and Financial Analysis, 2017); and Michael Liebreich. "Bloomberg New Energy Finance Summit" presentation, New York, April 25, 2017.

26 World Bank. Measured as OECD share of final energy consumption and total population.

27 See Fareed Zakaria, *The Post-American World* (New York: Norton and Co., 2008).

revanchist foreign policy while remaining fundamentally weak at home, with a struggling economy, factionalized political environment, and increasing resistance to its authoritarian tendencies. China, for its part, will continue its ascent, while struggling to reconcile its rise with the competing claims of its neighbors—particularly those of an increasingly potent India—and the mounting expectations of its citizens.

These potential fault lines in big-power geopolitics would be bad enough were it not for the internal challenges that governments increasingly face. Governments around the world are challenged by domestic opposition to immigration and free trade, threats from radicalization and terrorism, graying populations, and skyrocketing spending on entitlements. These forces often seem to be separate from geopolitics, but they strain government capacity and capability. Managing these challenges at home while dealing with a complex global environment is already a treacherous proposition, and it is unlikely that the future will be any different. It is hard to say with any degree of certainty which domestic issues will affect future energy systems, but two are particularly worth monitoring. The first is the future of trade. Although most of today's trade disputes concern manufactured goods and intellectual property, energy remains the world's most traded resource, and adjustments to the trade regimes of even seemingly unrelated products can have significant implications for energy markets. It remains to be seen whether the current backlash against trade will persist, but the increasing sophistication and efficacy of sanctions suggests that politically motivated disruptions to international trade are unlikely to disappear. Second, governments will have to contend with the damages caused by natural disasters and climate change, anthropogenic or otherwise. As these trends are likely to continue, the need to more adequately protect communities and assets will only grow.

These less-tangible factors of competition, consumers, and crises offer a natural complement to the more tangible prognoses of the major forecasters. They suggest that even though our ability to correctly predict the future of energy markets will continue to be fallible, certain forces are likely to be present. The increasing importance of non-OECD consumers is all but assured, and an energy-abundant but CO2-constrained future seems more realistic than not. Changes to the energy landscape are, and will continue to be, driven by complex economic, technological, political, and geopolitical factors. No one driver will dominate and the next few years will likely see increased competition, the prerogatives of new consumers, and the actions of governments and companies that seek to avoid and respond to potential crises. As a result, no one country or energy source is destined to win out; at this stage, agility, flexibility and risk management will be key.

Of Paradigm Shifts and Political Conflict: The History of Mexico's Second Energy Revolution

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Introduction

The story of Mexico's paradigm shift in energy policy is nothing short of extraordinary. The breadth and depth of the reform, the dramatic break with the past, and the positive long-term impact on Mexico's economy are of course remarkable, but the story of the political process is also worthy of recognition. An issue that had long seemed intractable, one on which the only consensus appeared to be that change was impossible, suddenly moved forward at breakneck speed in 2013, resulting in a constitutional reform in December of that year and secondary or implementing legislation by August 2014. The audacity and pace of the reform process naturally meant that the final legislation was far from perfect. But the reform is astounding as an example of what can happen when political forces and economic imperatives align. For that reason, 2013 will long stand as a watershed in Mexican history.

Yet the year or so of reform debates and decisions do not tell the whole story. Mexico had been struggling with energy reform for decades, and prior to 2013 there had been several abortive or partial attempts to modernize the system. What follows in this chapter is the story of those efforts and how they contributed to the modifications to Mexico's legal framework that came to be known as the "mother of all reforms."

Approval

The expectation had been building for days, ever since President Enrique Peña Nieto and his administration had submitted to Congress the final version of the long-thought impossible proposal to amend the Mexican Constitution to allow private participation in the energy sector. Though it was called an energy reform proposal, the public largely obsessed over the elements aimed at opening the country's oil sector. Indeed, the question of how the constitutional amendments would affect Pemex (Petróleos Mexicanos), the state-owned petroleum company, soon dominated most if not all of the analysis and debate over the proposed reforms.

Early in the morning of December 16, 2013, all eyes were on the legislature in the state of San Luis Potosí. By that point, 16 of the 32 Mexican states had voted in favor of the constitutional amendments, and one more approval would secure the required majority. After an overnight session that extended from Sunday into early Monday, the San Luis Potosí legislature resoundingly voted in favor of the constitutional amendments and reform measures. The state-level legislative approval was the final hurdle for what many were calling an audacious move by Enrique Peña Nieto's government at its one-year mark.[28] Eventually, 24 of Mexico's 32 states and federal district would ratify the reform.

The Peña Nieto administration had spent the previous weeks successfully shepherding the reform proposal and constitutional amendments through the Federal Congress. Despite the expected protests, recriminations,

28 "SLP también aprueba la Reforma Energética" [SLP also approves the energy reform], SIPSE, December 16, 2013, https://sipse.com/mexico/san-luis-potosi-tambien-aprueba-la-reforma-energetica-66434.html.

accusations of *vendepatria* (traitor), and legislator theatrics—including chained and padlocked doors and an infuriated congressman who went so far as to strip off his clothes at the rostrum—Peña Nieto and his team had proved far more politically adept than earlier administrations. The energy reform won final approval in Mexico's lower house, or Chamber of Deputies, 353 to 134, having gained overwhelming approval in the Senate 95 to 28 two days prior.[29] The final vote affirmed the convenient coalition of the country's center-right party, the PAN (Partido Acción Nacional; National Action Party), and Peña Nieto's own PRI (Partido Revolucionario Institucional; Institutional Revolutionary Party).[30] Leaders from both parties had been negotiating the final terms and extent of the reform since Peña Nieto had taken office in December 2012, but the discussions reached a more expeditious and serious level when the PAN unveiled its own outlines for energy reform in late July 2013 and the PRI and Peña Nieto presented their reform proposal in August. On December 20, 2013, Peña Nieto signed the bill into law and forcefully declared, "We, Mexicans, have decided to overcome myths and taboos in order to take a great step toward the future."[31] But what were these myths and taboos of which Peña Nieto spoke?

Myths and Taboos: The Past is Prologue

There is no mistaking the fact that the energy sector—specifically, oil—has been center stage in various chapters of the modern history of Mexico. For the better part of the past two decades, Mexico's political landscape has been dominated by three major political parties: the PRI, the PAN, and the PRD (Partido de la Revolución Democrática; Party of the Democratic Revolution). Only recently has the MORENA (Movimiento de Regeneración Nacional; National Regeneration Movement), a breakaway party formed by longtime PRD stalwart Andrés Manuel López Obrador in 2012, emerged as a key political actor. The fragmented and predominantly tripartite nature of politics in Mexico has had important legislative ramifications. Since 1997, no president has had a congressional majority, and consequently major reform measures were either blocked or diluted. For decades, nowhere was this deadlock more evident than the nation's energy sector and efforts to reform the nationally owned Pemex.[32]

Expropriation and the Creation of Pemex

March 18, 2018, marked the 80th anniversary of the expropriation of foreign private oil company operations in Mexico, and the origins of the creation of Pemex. President Lázaro Cárdenas's decision to nationalize Mexico's petroleum sector in 1938 came to represent the country's break with foreign oil companies, most of which were American and British. Pemex, the new national oil company created by President Cárdenas, emerged as a clear

29 "This Is How You're Stripping the Nation! Mexican Congressman Takes off His Clothes in Angry Protest at Historic Energy Privatization Bill as Scuffles Break Out and Doors Barricaded," *Daily Mail,* December 12, 2013, www.dailymail.co.uk/news/article-2522868/Mexican-congressman-takes-clothes-angry-protest-historic-energy-privatization-scuffles-break-doors-barricaded.html; Richard Fausset and Tracy Wilkinson, "Mexico's Congress Passes Energy Reform Bill," *Los Angeles Times*, December 12, 2013, www.latimes.com/world/la-fg-mexico-chamber-oil-20131213-story.html; and Miguel Gutierrez and Dave Graham, "Mexico Senate Passes Energy Bill; Leftists Seek to Derail," Reuters, December 11, 2013, www.reuters.com/article/us-mexico-reforms/mexico-senate-passes-energy-bill-leftists-seek-to-derail-idUSBRE9BA11120131211.

30 "Mexican Senate Passes Electoral Bill, Clearing Way for Energy Debate," Reuters, December 3, 2013, www.reuters.com/article/us-mexico-reforms-approval/mexican-senate-passes-electoral-bill-clearing-way-for-energy-debate-idUSBRE9B304Y20131204.

31 "Mexican President Signs Controversial Oil and Gas Law," BBC News, December 21, 2013, www.bbc.com/news/world-latin-america-25471212.

32 Alejandro Chanona Burguete and Alberto Lozano Vazquez, "Mexico: Situation and Challenges of Energy Security and Environmental Sustainability at the Beginning of the Twenty-First Century," in *Energy Security and Environmental Sustainability in the Western Hemisphere,* edited by Remi B. Piet, Bruce M. Bagley, and Marcelo R. S. Zorovich (Lanham, MD: Lexington Books, 2017), 81–111.

sign of Mexican sovereignty, and for many years it was touted as a model for how a nation could take greater control of its natural resources. It also provided a strong sense of Mexican independence.

The historic and political weight given to the nationalization of Mexico's oil industry cannot be understated. March 18 is one of the most important historical dates in 20th-century Mexican history: the day is a Mexican federal holiday, and schoolbooks include dissertations on its importance to the country's political history. It is not uncommon to hear tales in Mexico of how families responded to President Cárdenas's effort by donating family heirlooms, livestock, and savings as contributions to help fund the early days of Pemex. Further constitutional reforms of 1938 and 1940, and particular amendments in 1960 and 1983, solidified both the core nationalist vision set in motion by Cárdenas and the political desire to reserve for Pemex the exclusive right to manage all oil activities in Mexico.[33]

Indeed, Pemex has become the literal embodiment of that nationalistic fervor. Oil, Pemex and national sovereignty are intricately connected. It has been said that in Mexico, oil is not merely a chemical compound, but rather a fundamental element of sovereignty with "quasi-religious significance." Simply put, in Mexico, oil is part of the national DNA. This fundamental political truism continues to affect the development of the nation's huge oil resource potential and Pemex by restricting private (particularly foreign) investment in the most important aspects of the nation's oil industry.[34] President Cárdenas's historic decision imbued citizens of Mexico with a sense of ownership of the nation's oil and a fervent shared desire to keep Pemex in state hands. For years, oil—and specifically, the constitutional elements associated with it—was a third-rail political issue. No politician dared touch it, and the arrangement had developed quite favorably for the federal coffers.

For years, the legacy of nationalism and constitutional prohibition denied Pemex partnership opportunities with foreign and international firms and prevented it from benefiting from greater access to technology, know-how, and fiscal and management efficiencies. As the shale revolution boomed, unconventional hydrocarbon production flourished in the United States, and new developments sought to exploit the resources available in the deep waters of the Gulf of Mexico, the hindrances of this self-imposed isolation increasingly became apparent. Multinational partnerships from across the world, including several national oil companies, have drilled and discovered significant oil reserves just across the land and maritime border in the United States—and Mexico has been left out.

Given the increasing importance of oil for Mexico in the 1930s, particularly in light of important resource discoveries in the years leading up to the nationalization, historians have pointed out that President Cárdenas's expropriation actions were nationalistic but quite rational. Nationalization was an understandable response to various disagreements with the foreign companies operating in Mexico at the time and the language of Mexico's 1917 constitution with regard to oil. Perhaps just as important, the expropriation also directly linked Pemex to the PRI, solidifying the party's connections with the oil workers' unions and oil-rich states along the Gulf of Mexico. For the better part of the next 75 years, successive PRI governments would place Pemex squarely at the core of their economic development and budget. Though the direct Pemex and PRI linkage can be viewed through a historical lens for its outsized influence in avoiding changes or reform, at the same time it provided

33 Diana Villiers Negroponte, "Mexico's Most Critical Challenge: Energy Reform," Brookings, November 20, 2013, www.brookings.edu/opinions/questions-about-energy-reform-in-mexico/.

34 Ibid.

PRI candidate Enrique Peña Nieto with a great talking point: only he, the leader of the new and forward-looking PRI, could confront the ghosts of the past and overcome the opposition to reforming the energy sector and overhauling Pemex.

The Easy Oil is Gone: Falling Oil Production and the Cantarell Curse

According to the International Energy Agency (IEA), Mexico is the world's eleventh largest oil producer. However, its market fundamentals have been changing rapidly. Production declines and demand growth have led to major imbalances, driving much of the past decade's reform debates and policy efforts.[35] Furthermore, data released by National Hydrocarbons Commission (Comisión Nacional de Hidrocarburos; CNH) in early 2018 note that the country's oil reserves fell by more than 7 percent over the previous year.[36] Indeed, one of the central promises posited by the Peña reform government is that energy sector reforms aimed at Pemex and allowing private investment would translate to an uptick in oil production of 500,000 barrels per day (bpd) by the end of the administration's six-year term (*sexenio)* in 2018.

What is the reason for this imbalance? In a word, Cantarell. In the early 1970s, a fisherman named Rudesindo Cantarell, operating in the Bay of Campeche in the southern part of the Gulf of Mexico, reported to the local Pemex office that his fishing nets were being ruined by oil. After further investigation in the 1970s, Pemex's Cantarell oil field proved to be the world's third largest oil field, and on the back of the Cantarell output Pemex became one of the world's largest oil exporters. Production at Cantarell boomed until 2004 when it peaked at a remarkable 2.136 million bpd.[37]

The significance of Cantarell's historical impact and legacy is evident in the Mexican petroleum sector even today. Along with the bonanza that the field provided, it served as an important cover for myriad inefficiencies at the state oil giant. Given how prolific the Cantarell field became, for a time Pemex and Mexico were spared the larger questions of their own inadequacies, particularly for Pemex's development of fiscal management and access to know-how and technology that were commonplace in the oil industry. When Cantarell began its decline, it was nothing short of precipitous. By 2008, Cantarell's production had dropped to just over 1 million bpd, and by the time of the energy reform the field's output had fallen to less than 400,000 bpd. The loss of over 1.7 million bpd from one field is a chilling statistic when one considers the implications for overall production and for Pemex and government revenues.

As the IEA's recent assessment of Mexican oil confirms, the problem is not one of resource availability.[38] There is no questioning Mexico's geological potential, particularly in its underexplored deepwater and unconventional oil and gas plays. But the question of accessing those reserves—that is, exploring for, discovering, and producing

35 International Energy Agency (IEA), *Mexico Energy Outlook*, World Energy Outlook Special Report (Paris: Organization for Economic Cooperation and Development [OECD]/IEA, 2016), www.iea.org/publications/freepublications/publication/MexicoEnergyOutlook.pdf.

36 David Alire Garcia, "Mexico Oil Reserves Dip Again as Private Firms Begin to Contribute," Reuters, March 23, 2018, www.reuters.com/article/us-mexico-oil-reserves/mexico-oil-reserves-dip-again-as-private-firms-begin-to-contribute-idUSKBN1GZ2UY.

37 Daniel Romo, "The Cantarell Oil Field and the Mexican Economy," *Problemas del Desarrollo: Revista Latinoamerica de Economía* 46, no. 183 (October-December 2015), https://probdes.iiec.unam.mx/en/revistas/v46n183/body/v46n183a6_1.php.

38 IEA, *Mexico Energy Outlook*.

them commercially—has long been at the heart of the national debate in Mexico over the role of Pemex and the option of opening the oil industry to private and foreign participation.

Oil, Pemex, and the Federal Budget

Thankfully, despite being a major oil exporter, Mexico has not suffered from the prototypical effects of the resource curse.[39] Oil as a share of exports peaked in 1982 at 77 percent and has declined steadily since, falling below 40 percent by 1988 and below 15 percent by 1993; today, oil accounts for around 4 percent of Mexico's total exports.[40] Mexico's aggressive trade and market liberalization has led to important growth in manufacturing and diversification of export earnings. However, these figures do not properly relate the other real effect that oil has had in Mexico—what may be called the "Cantarell curse." Since production began in 1979, the Cantarell field alone is estimated to have generated over half a trillion dollars in revenue for Pemex and Mexico. Mexico's dependency on oil and its state oil company Pemex for the federal budget is quite real; in many ways, oil has been an economic lifeline for the national treasury, allowing successive governments to avoid needed tax and fiscal reform. This dependency extends to states and municipalities, which count on federal transfers to cover their budget. According to one analysis, 89 percent of state income currently comes from the federal government. As Mexico's oil industry boomed, particularly with the enormous discovery of the Cantarell oil field, the federal budget grew dependent on oil; today, roughly 30 percent of federal budget revenues come from Pemex.

Interpretations of the economic impact and the "curse" that Cantarell has had, both for Mexico's structural development and Pemex, have varied greatly. Those analyses will not be revisited. What is important to note is how the resource dependency wrought by Cantarell in turn led to mismanagement in the field, as well as inefficiencies and ultimately to a stifling fiscal straightjacket placed on Pemex by the federal government.[41] Seeking to maximize what was at first the highly pressurized field at Cantarell, Pemex drilled hundreds of wells, creating a gusher-like production. Cantarell's development ultimately suffered from an almost perfect storm of mismanagement caused by ineffective technology, insufficient capital budgets, and intense pressure to produce as much oil as possible and maximize its rent for the federal treasury.[42]

With the benefit of hindsight, Cantarell seems to have allowed Pemex and Mexico to skirt the challenging issues that other nations faced in their petroleum sectors. These problems include such concerns as attracting and managing international investment and collaborate with international oil companies, dealing with bloated work forces, redressing severe managerial and fiscal inefficiencies, and tackling the most difficult to discuss issue: corruption. A possibly apocryphal story circulating in Mexico for several years concerns a question posed to a

39 Charles McPherson, "Governance, Transparency, and Sustainable Development," in *Energy and Security: Strategies for a World in Transition*, edited by David L. Goldwyn and Jan H. Kalicki (Washington, DC; Baltimore: Woodrow Wilson Center Press; Johns Hopkins University Press, 2013), 444–65.

40 "Mexico Exports, Imports, and Trade Partners," Observatory of Economic Complexity, MIT, 2018, https://atlas.media.mit.edu/en/profile/country/mex/.

41 Jeremy Martin, "Oil in Mexico & United States Energy Security: A Tale of Symbiosis," *Journal of Energy Security*, January 12, 2010, www.ensec.org/index.php?option=com_content&view=article&id=224:oil-mexico-us-energy-security&catid=102:issuecontent&Itemid=355.

42 Romo, "The Cantarell Oil Field and the Mexican Economy."

senior Mexican government official about the megafield: What if Mexico had never discovered Cantarell? His answer: "Mexico would probably be one of the most developed countries in the world."

For a series of PRI governments, oil emerged as a significant form of hard currency, and in some cases oil earnings were instrumental in efforts to stave off financial crisis, such as the 1994 peso crisis. After the Banco de México devalued the peso in late 1994 in response to a series of political and financial shocks that had left the country's markets in turmoil, Mexico was on the brink of sovereign default. In January 1995, the United States orchestrated an international bailout of roughly $50 billion. Mexican oil sales were used, quite successfully, as collateral for the roughly $20 billion in U.S. credit extended to Mexico, which was actually paid off some three years early.[43]

The brunt of the fiscal dependency has been borne—or perhaps more accurately, has been ascribed—to Pemex. Indeed, because of the onerous fiscal demands placed on it, Pemex has not been able to successfully manage its several years of pretax profits and has not turned a profit since 2006. Through onerous taxes and royalties, for years the federal government has milked the Pemex cash cow; the company is taxed at roughly 60 percent, though in some cases the effective rate can jump to 100 percent.[44] A review of statistics from the 2008 oil price spike underscores the extent of Mexico's fiscal dependency on Pemex. Despite the year's record oil prices, in 2008 Pemex lost $8.1 billion on revenues of $98 billion, and paid the federal government $57 billion in taxes and royalties. As a result of its tax burden, Pemex has been unable to direct adequate investment until only recently, and has borrowed heavily to meet requirements. There may be no more succinct summary of the legacy of the Mexican government and its national oil company than that set forth by the joint ITAM/Wilson Center report *A New Beginning for Mexican Oil,* which noted that "Pemex does not operate under a logic of value generation, but rent extraction."[45]

Beyond oil, the recent broader evolution of the Mexican economy bears discussion. Since a sovereign default in 1982, Mexico has made great strides to open its economy and has pursued an aggressive free trade agenda. It has reduced the role of the state in the economy and embraced global markets. Mexico, Canada and the United States implemented the North American Free Trade Agreement (NAFTA) in 1994. Mexico also has signed free trade agreements with more than 40 other countries, and because of its aggressive trade policies, 90 percent of trade is under free trade agreements.

For many, Mexico's economic reforms over the past two-plus decades have made it an exemplar of the Washington Consensus. Mexico greatly succeeded in lowering inflation, privatized a slew of inefficient state enterprises, increased its fiscal discipline, and reduced the nation's external debt burden as a percentage of gross domestic product (GDP). Nevertheless, economic growth in Mexico has been lagging, if not lackluster. One analysis of per capita GDP growth highlights the challenge facing Mexico: within Latin America, it has kept pace with Argentina but not with Chile or Brazil, and its growth is far below that of Southeast Asia and Eastern and Central Europe. Despite its economic reforms, it has underachieved in terms of growth for a variety of

43 David E. Sanger, "Mexico Repays Bailout by U.S. Ahead of Time," *New York Times*, January 16, 1997, www.nytimes.com/1997/01/16/business/mexico-repays-bailout-by-us-ahead-of-time.html.

44 ITAM and Mexico Institute, *A New Beginning for Mexican Oil: Principles and Recommendations for a Reform in Mexico's National Interest* (Washington, DC: ITAM/Wilson Center, November 2012), www.wilsoncenter.org/sites/default/files/wood_new_beginning_mexico.pdf.

45 Ibid.

reasons, specifically faulty provision of credit, persistence of informality, control of key input markets by elites, continued ineffectiveness of public education, the role of China as an export goods competitor, and vulnerability to adverse external shocks.

Part of the reason for this lagging competitiveness and productivity is because the revolution in Mexico's trade relations and its manufacturing industry stands in stark contrast to the long-term refusal to do the same for the energy sector. Many in Mexico have commented that until the 2013–14 reforms, Mexico's economy had been only partly modernized, and that the energy sector's failings, both in terms of declining oil production and uncompetitive electricity prices for industrial consumers, were one of the most important handicaps limiting Mexican prosperity. The problem was that consensus on how to resolve these issues was impossible to reach.

Prior Reform Attempts

The Peña Nieto administration was not the first to attempt to reform the Mexican energy sector. Going back to the administration of President Carlos Salinas de Gortari (1988 to 1994), there have been attempts to modernize the sector and to inject higher levels of private participation. Although Salinas failed to open the hydrocarbons sector, he was successful in securing a partial opening of the electricity sector through the 1992 Electric Energy Public Service Law (Ley del Servicio Público de Energía Eléctrica). That legislation made five exemptions to the monopoly position of public power generators, allowing private power generators for the following reasons:

1. For self-supply contracts
2. By cogeneration
3. For sale to the Federal Electricity Commission (Comisión Federal de Electricidad; CFE)
4. As small power producers (less than 30 megawatt (MW) capacity)
5. For import or export.

These five exceptions, in particular the first and the third, later proved to be of critical importance in helping Mexico meet growing electricity demand and provide access to cheaper electricity and green power for private businesses. Just as important, they highlighted the difference in the level of political sensitivity to electricity versus oil in Mexico.

On February 2, 1999, President Ernesto Zedillo attempted to take the reform further. He proposed a reform of Articles 27 and 28 of the Constitution to allow greater opportunities for private investment in the electricity sector and, critically, private participation in oil exploration, production, and processing. That proposal, which came at a time of deep divisions in Mexican politics, was so roundly rejected by both the PRD and the PAN that Zedillo gave up on his plans.

The PAN administration of Vicente Fox (2000 to 2006) also attempted to open the sector to private investment. Although some in the PRI supported his proposals, Fox similarly backed off from presenting more ambitious proposals for oil and gas liberalization after the PRD and many PRI legislators rejected his attempts to open the electricity sector.

What these three earlier efforts show is that Mexican governments traditionally have regarded attempts to open the electricity sector as a possible back door into the seemingly intractable conversation about opening the

hydrocarbons industry to private investment. However, the deep divisions of Mexican party politics and ideology prevented those attempts from moving any further.

Paving the Way: The 2008 Energy Reform

In December 2006, Felipe Calderón, who had served a stint as secretary of energy under his predecessor Vicente Fox, assumed the presidency with a clear understanding of the problems and challenges of Mexico's oil-driven fiscal dependency and the burdensome political legacy at Pemex. He was well aware of the ominous signs surrounding the national oil company's production and budget figures. By the end of the Fox administration, Pemex's deep-running problems, ranging from technological to financial and from deeply rooted corruption to labor issues, were becoming a matter of national urgency. Energy secretaries Elizondo and Canales both spoke eloquently about the looming crisis facing Pemex and Mexico's oil production. By 2005, there was strong evidence to suggest that if nothing was done to arrest the halt in Mexico's oil production, then Mexico would become a net oil importer by the end of the second decade of the 21st century.

Recognizing these problems, in 2008 President Calderón and his energy team worked with the congressional leadership to formulate both a legislative package and a coalition to pass it. From the beginning, the left-wing PRD party staged spectacular protests, created "resistance brigades" to oppose the reform, and blockaded Congress to prevent a vote. The deep-seated opposition from the PRD, as well as reluctance from the more nationalist elements of the PRI, meant that a constitutional reform vote—requiring a two-thirds majority in both chambers of Congress and a majority of the state-level legislatures—was out of the question. Instead, Calderón and his team decided to put forward a legislative package that focused on reforming Pemex, along with two new laws promoting the use of renewable and sustainable energy. By March, Energy Secretary Georgina Kessel and Pemex CEO Jesús Reyes Heroles had released a 130-page diagnosis of the problems facing the national oil company, and on April 8, 2008, President Calderón presented the legislative package to Congress.

Securing the support of the PRI legislators was critical, and that came thanks to the support of PRI senator Manlio Fabio Beltrones, long considered the intermediary between Calderón and the PRI. Once that support was in place, even massive demonstrations and a nonbinding referendum organized by leftist forces could not stop the legislation from moving forward. However, between the staunch opposition of the PRD and the modifications that the PRI introduced in Congress, the legislation that emerged was a watered-down reform of the energy sector. In the original proposal, Calderón had sought a framework that would have gone much further in opening the country's hydrocarbons to private participation. The proposal included measures that would have allowed Pemex to enter into joint ventures with foreign companies in exploration and production, and permitted private companies to build and operate refineries, pipelines, and storage facilities in Mexico.[46] The proposal also included a twist on opening new sources of capital for Pemex: Citizen Bonds, which were bonds open only to Mexican investors.

46 Clare Ribando Seelke, Michael Ratner, M. Angeles Villarreal, and Curry L. Hagerty, "Mexico's Oil and Gas Sector: Background, Reform Efforts, and Implications for the United States," Congressional Research Service R43313, January 6, 2014, http://usmex2024.uscmediacurator.com/wp-content/uploads/2013/08/Energy-Reform-Analysis-Congress-Report.pdf.

In October 2008, Mexico's Congress finally approved a set of measures aimed at reforming the sector, particularly Pemex. A central part of the legislative package focused on the need to create a more modern, agile Pemex, one that would have enhanced and increased autonomy through a major rewrite of many of the statutes governing the company, including revised contractual mechanisms that would allow it to hire outside firms to help produce oil though service contracts—the so-called incentive contracts. The new laws provided transparency measures, and also reorganized Pemex management and allowed for "independent" members of the board of directors in an effort to include industry experts on the board. In typical negotiated Mexican political fashion, these new members took their places in May 2009: two were nominated by the PAN, one by the PRI, and the fourth by the PRD.

As part of the efforts aimed at the oil industry and Pemex, the reform also stipulated increased oversight of the national oil company by a new upstream regulator, CNH. CNH's effort to exert its oversight authority initially led to a critical assessment and debate over the development of the Chicontepec oil field, as well as increased scrutiny and mandates for Pemex to reduce gas flaring and for deep water regulation. Its commissioners were appointed for renewable five-year terms, and the commission's first president, Juan Carlos Zepeda, has had his term renewed since then.

A key element of the 2008 energy reform was the provision to allow Pemex to develop and bid incentive-based contracts, what Pemex has called "Integrated E&P [Exploration and Production] Contracts." In accordance with the reform measures, the new contract model allowed Pemex to make its service contracts more flexible, with higher payments for increased performance. Ultimately, the oil industry inside and outside of Mexico had little interest in this form of contract. Only a few contracts of this nature were signed, largely with service companies and not with traditional upstream market participants. Three particular mature onshore blocks—Magallanes, Santuario, and Carranza—came online in relatively short order, and production from these projects began to increase. However, the investment totals and impact on national oil production have been negligible to date.

The other two parts of the 2008 reform focused on renewable and sustainable energy, creating Mexico's first framework for the renewable energy industry and establishing the bases for a long-term reduction of the country's carbon footprint. Calderón's administration saw an impressive growth in renewables, especially in wind energy investments, and the April 2012 General Climate Change Law committed Mexico to reducing emissions growth by 30 percent by 2030 (50 percent by 2050), obtaining 35 percent of its energy from renewable sources by 2024, and establishing a national mechanism for reporting emissions.[47]

Consensus, Conflict, and Reform

In his book *México, la gran esperanza* (*Mexico, the Great Hope*), prepared in classic U.S. politicking style for his 2012 presidential run, Enrique Peña Nieto set forth a host of economic reform proposals. Among the many notable policy positions was his argument of the need for energy reform, and specifically for reforms aimed at the national oil company, the behemoth state within a state that is Petróleos Mexicanos.[48] In his campaign

47 Duncan Wood, "Energy Challenges for the Peña Nieto Administration," in *The End of Nostalgia: Mexico Confronts the Challenges of Global Competition*, edited by Diana Villiers Negroponte (Washington, DC: Brookings Institution Press, 2013), 57–72.

48 Shannon K. O'Neil, "Enrique Peña Nieto's Campaign Book," Council on Foreign Relations (CFR), November 22, 2011, www.cfr.org/blog/enrique-Peña-nietos-campaign-book.

tome, Peña Nieto pressed for "the transformation of Pemex so that, while maintaining the state ownership of the company, it is allowed greater flexibility to seek partnerships with private investors, make the public finances less dependent on it, invest part of the oil rent in renewable energy so that oil is the source of financing for the 'inevitable energy transition that Mexico and the world will experience.'"[49]

As president, Peña Nieto added another signpost to the long, winding road of the narrative of Mexico's oil sector and Pemex. During the campaign, when it came to the energy sector he was even more emphatic than he had been in his book. He asserted in several interviews that he would stake his administration's success on attracting private investment to Mexico's oil patch, which could include selling shares in Pemex. Peña Nieto called the theme of Pemex reform as possibly the "signature issue" of his *sexenio*. In a cleverly crafted line, he stressed that it was exactly because of the PRI's nationalistic legacy with regard to Mexican oil that he would succeed; to reporters, he frequently likened it to the idea of staunch anticommunist President Richard Nixon going to China in the 1970s.[50] Many embraced this supposition, and added that along with the PRI's historical legacy, its relationship and support within the mighty oil workers' union was perhaps even more important for the reform efforts. [51]

By the time Peña Nieto took office, Mexico faced a triple threat to its energy sector. First, oil production was declining rapidly because of the inefficiencies and restrictions of a monopolistic oil sector. Second, the high electricity prices being charged to industry were severely compromising the country's economic competitiveness. Third, the nation's two national energy companies, CFE and Pemex, were hamstrung by restrictions placed on their activities and finances. Nothing short of a revolution would be sufficient to drag the national's energy industry belatedly into the 21st century.

The Pacto por México

Between his election in July 2012 and his assumption of office on December 1, President-elect Peña Nieto, his incoming administration, and the PRI leadership worked closely with Mexico's other two major parties, the PAN and the PRD, to create a broad economic agenda to reinvigorate the nation's economy.[52] The Pacto por México (Pact for Mexico) was formalized on December 2, 2012, and in addition to signatories from the PRI, PAN, and PRD, the mayor of Mexico City, the governors of Mexico's 31 states, and the leaders of the Mexican Senate and Chamber of Deputies also participated in the signing ceremony.[53] The pact, which included 95 initiatives, was designed to gain consensus around a series of structural adjustments that would help Mexico to shake off its sluggish growth of the past several years.

To boost employment opportunities for its citizens, the country had to address its competitiveness and

49 Enrique Peña Nieto, *México, la gran esperanza: Un Estado Eficaz para una democracia de resultados* [Mexico, the great hope: An efficient state for a democracy with results] (Mexico City: Grijalbo, 2012).

50 Mary Anastasia O'Grady, "Mexico Talks Monopoly Reform," *Wall Street Journal,* November 28, 2011, www.wsj.com/articles/SB10001424052970204452104577060772222754302.

51 Shannon K. O'Neil, "Peña Nieto and Energy Reform," CFR, July 12, 2012, www.cfr.org/blog/Peña-nieto-and-energy-reform.

52 http://pactopormexico.org/

53 Andres Sada, "Explainer: What Is the *Pacto por México?*," Americas Society/Council of the Americas, March 11, 2013, www.as-coa.org/articles/explainer-what-pacto-por-m%C3%A9xico.

understand why it was falling behind economies such as South Africa, India, and China. During the campaign, Peña Nieto had highlighted many of the reasons he and his economic team blamed for the country's lackluster economic performance. Most notable were the drags on productivity and competitiveness derived from the remnants of the state-led growth strategies and market distortions caused by state monopolies in the energy sector. Juan Pardinas, director of Mexican think tank IMCO, described Mexico's energy sector as "hermetically sealed" and on par with that of North Korea—obviously not a corporate structure that would boost a country's global competitiveness.[54] When it came to energy reform, the pact spelled out the need to "[c]arry out an energy reform to serve as the engine of investment and development . . . that will turn the sector into one of the most powerful engines of economic growth through the attraction of investment, technological development, and the formation of value chains."[55]

Signed the day after Peña Nieto was sworn in as president, the Pacto por México offered the new administration an immediate political and strategic roadmap complete with timelines and goals for translating to policy and delivering fiscal, education, political, and, of course, energy sector reforms. But even with the pact's consensus-building approach and important successes on education, legal and telecom reforms, the energy question proved too divisive. The PRD left the pact in November 2013, effectively rendering it with little to no future.[56] Energy reform thus moved ahead outside the structure of the pact, becoming a PRI-PAN collaborative reform effort in the legislature.

Nonetheless, the agreement provided the political environment in which progress in negotiations could be made and a sufficiently broad coalition constructed to allow ambitious reforms to take place. But the pact was not the only political agreement that was needed to move forward with energy reform. The PRI party constitution itself had a restriction on allowing private participation in the hydrocarbons sector, and so early in 2013, the PRI party congress approved changes to its constitution, permitting the party to support constitutional reforms that would allow private investment.

The PAN Proposal

On July 31, 2013, the PAN submitted its energy reform proposal to the Mexican Senate in an effort to formally begin the debate over the future of the nation's energy sector. This effort, which preceded a formal proposal from the Peña Nieto administration, ramped up the national debate and caused the PRI and Peña Nieto team to advance their efforts as well. But most important, as would become evident as the final reform bill was negotiated, the PAN proposal pushed the potential reform measures beyond what the PRI had been privately discussing and intimating that it was comfortable pursuing.

The PAN proposal called for amending the Mexican Constitution, specifically Articles 25, 27, and 28, with implementing legislation enacted thereafter. It set forth measures to open the country's oil and gas sector (and

54 "Monetizing Mexico's Oil: An Interview with Juan Pardinas, IMCO" (podcast), Institute of the Americas, November 21, 2013, www.iamericas.org/media/com_podcastmanager/files/energy/Interview_Juan_Pardinas.mp3.

55 http://pactopormexico.org/acuerdos/

56 Pablo de Llano, "La aprobación de la reforma energética fulmina el Pacto por México" [The approval of the energy reform fulminates the Pacto por México], *El País*, December 12, 2013, https://elpais.com/internacional/2013/12/12/actualidad/1386874561_675888.html.

electricity markets) to private investment and competition. The proposal also outlined the creation of a Mexico Oil Fund to administer oil profits and in so doing redress the country's fiscal dependence on oil revenue. In addition, the PAN set forth a plan to provide Pemex (and Mexico's state-owned power monopoly CFE) with more autonomy, making changes to their corporate governance policies and corporate boards of directors—specifically, eliminating the five union seats on the Pemex board. The proposal also included a focus on sustainability and climate change.[57]

Most notably, the PAN proposal set forth a structure to imbue the CNH, the upstream regulator created during the 2008 reform, with the ability to offer concessions and contracts with private market participants for exploration and production of Mexico's hydrocarbons. In international petroleum contracting terms, a concession was a major departure not only from Mexico's historical legacy, but also from what the country's leaders had previous discussed as possible in energy reform. Some called it a radical departure from the status quo, and it certainly was beyond what the PRI had indicated that they intended to pursue in the legislature.

When it comes to international petroleum contracts, essentially there are two structures. The first is a concessionary system. As David Johnston describes it in his chapter of *Escaping the Resource Curse*, in a concessionary system "the government grants the company the right to take control of the entire process—from exploration to marketing—within a fixed area for a specific amount of time." The second is a contractual-based system that typically falls into one of two subsets: production-sharing contracts and service agreements. Hugely important for Mexico, given its historical legacy and outright prohibition on private ownership of hydrocarbons, was what Johnston calls "the distinguishing characteristic" of each contract modality. The key distinction comes down to where, when, and if hydrocarbons ownership can be transferred to a private company.[58] The PAN proposal presented a clear marker that outlined a contract structure to allow for a form of private ownership of Mexico's hydrocarbon resources.

By setting forth a reform that included a concession-type contract, the PAN proposal diverged strongly from the 2008 measures and directly confronted Mexico's legacy of its complete and entire ownership over its subsoil resources and the wealth those resources could generate. In addition, the measures aimed at Mexico's state-owned energy sector enterprises were a massive shift in how the country managed the sector and the role of the government within that sector.[59]

PRI Proposal

On August 12, 2013, barely two weeks after the PAN had unveiled its ambitious proposal to reform Mexico's energy sector—a proposal that went further and diverged more from the country's nationalistic oil legacy than had been expected—the PRI and the Peña Nieto administration set forth their party's energy reform outline. In a televised announcement from Los Pinos, the presidential palace, the president declared that his party's

57 Mayer Brown, "Sweeping Mexico Energy Reform Proposal," August 2, 2013, www.mayerbrown.com/files/Publication/9eeecff5-e629-40ab-90ea-24bdd938498d/Presentation/PublicationAttachment/d021ea0d-1171-40ca-847e-3827cdf1b473/PAN_Energy_Reform_Proposal_0813_V4.pdf; and Negroponte, "Mexico's Most Critical Challenge."

58 David Johnston, "How to Evaluate the Fiscal Terms of Oil Contracts," in *Escaping the Resource Curse,* edited by Macartan Humphreys, Jeffrey D. Sachs, and Joseph E. Stigliz (New York: Columbia University Press, 2007), 56.

59 Negroponte, "Mexico's Most Critical Challenge."

and administration's proposal would "make the energy sector one of the most powerful motors of the national economy." He further argued that the reform was the first step toward a 21st-century energy sector for Mexico.[60]

Invoking the spirit of Lázaro Cárdenas, Peña Nieto tiptoed through a political minefield by proposing to restore a clause that had been written into the constitution in 1940 but later had been removed. The clause allowed the government and Pemex to enter into both production- and profit-sharing contracts with foreign firms and private Mexican companies. Peña Nieto cautiously specified that he would only seek legislative approval for profit-sharing deals, thereby preventing private and firms from physically possessing Mexican oil. However, this proposed arrangement also meant that companies would have significantly less incentive to invest in the Mexican energy sector.

Similar to the PAN proposal, the PRI outlined a proposal for the oil and gas sector that had at its center constitutional amendments that would end the Pemex monopoly in the country's upstream and expose the national oil company to competition by allowing it and other new private market participants to enter into profit-sharing contracts with the Mexican federal government. The PRI proposal included measures aimed at reforming Pemex and restructuring it into a commercially oriented entity; the host of proposed structural and fiscal changes for the firm would enable it, for instance, to enter into partnerships and joint ventures with private firms. Secondary, or implementing, legislation would be enacted after the constitutional amendments were approved and utilized to add further detail to the reform.

Distinct from the PAN proposal, the PRI's measures did not include the possibility for concession contracts but instead specifically noted that it would maintain Mexico's historical and constitutional ownership and control of its subsoil and hydrocarbon reserves and the prohibition on private ownership. In an effort to preclude debate over the proposal's relevance for the international oil sector, Enrique Ochoa Reza, then deputy secretary for hydrocarbons, hosted a press conference to discuss the proposal and went to great lengths to reassure potential investors as to the structure of oil contracts under the Peña Nieto reform. He stressed that the model that the government would pursue for the profit-sharing contracts would allow for the critical element and heavily debated concept of booking of reserves in accordance with the relevant regulations of the U.S. Securities and Exchange Commission.[61]

Other Proposals

Although the PRD, through its participation in the Pacto por Mexico, had agreed to the basic outlines for structural energy reform, the party was fractured with regard to the contours for the reform it would support. Indeed, the PRD's presidential candidate, Andrés Manuel López Obrador (often known as "AMLO," from his initials), had resigned from the party in objection to the pact and specifically opposed the efforts aimed at opening Mexico's energy sector to private participation. After leaving the PRD, López Obrador formed a new political movement, MORENA, that ultimately became a political party authorized by Mexican electoral authorities.

60 Dudley Althaus, "The Great Mexican Gamble: Can Big Oil Save the Country's Economy?," PRI, August 13, 2013, www.pri.org/stories/2013-08-13/great-mexican-gamble-can-big-oil-save-countrys-economy.

61 Hugh Tucker, James A. DeMent Jr., Pamela M. Giblin, and Carlos A. Solé III,"Mexico's President Enrique Peña Nieto Proposes Historic Energy Reforms," Baker Botts LLP, August 13, 2013, www.lexology.com/library/detail.aspx?g=f8891013-5980-459e-bbcb-7ac067eb7679.

Overall, PRD party leaders opposed the market opening that was at the core of both the PAN and PRI proposals, while the MORENA posture was that of pure opposition and outright rejection of any form or opening of Mexico's energy sector to private participation. The most notable element of the López Obrador and MORENA position was the call for a national plebiscite or referendum on energy reform.[62]

Upon seeing the government's proposals, Cuauhtémoc Cárdenas—the son of former president Lázaro, the founder of the PRD, and the party's leading thinker on energy issues—immediately denounced what he saw as the hijacking of his father's name and called on fellow nationalists to protest against the "privatization" of Pemex. Followers of López Obrador joined this faction, and planned and projected massive demonstrations against the proposals. But in Mexico City, where antigovernment protesters regularly take to the streets, the protests against energy reform were overshadowed by those of the national teachers' union, which similarly was opposing the government's education reform. An initial protest called by López Obrador attracted only 25,000 people. A second march along Mexico City's Reforma Avenue in conjunction with the PRD likewise managed to draw only 25,000, and a third attempt by López Obrador a few weeks later saw the numbers drop to 12,500.

The PRD on the whole instead sought to reform Pemex, particularly regarding its fiscal and tax burden, and though the party argued for enhanced budget autonomy and a stronger national oil company to reinvigorate the energy sector, it also emphasized the need to confront the massive corruption within the firm. Cuauhtémoc Cárdenas argued for reform centered on three pillars: (1) no need to amend the Constitution's Article 27; (2) a new management autonomy and governance structure for Pemex; and (3) tax reform to redress Pemex's insolvency.[63]

The Push for Energy Reform, 2013–14

Mexican public opinion has long been opposed to opening the energy sector. Perhaps the most stunning manifestation of this opposition came in the contrast of public responses to two questions in a 2006 study conducted by the Mexican think tank CIDE (Centro de Investigación y Docencia Económicas; Center for Economic Research and Teaching). The poll, titled *Mexico and the World 2006*, asked Mexicans about their attitudes to international affairs and foreign countries. The first of the two key questions asked Mexicans if they would agree to "Mexico and the United States becoming a single country if this would mean a better standard of living for you." To the surprise of most analysts, 54 percent of Mexicans agreed with the proposal. Later in the study, another question asked "should the Mexican government permit or not permit foreigners to invest in oil production, exploration, or distribution?" In this case, 76 percent of respondents nationwide answered "No.".[64] When contrasting the response to these two questions, it appears that Mexicans were more likely to sell their country than their oil!

This overwhelming opposition to foreign participation in the oil sector reflects decades of nationalistic rhetoric; the celebration of the oil expropriation; and the close links between the symbols of the flag, Pemex, and sovereignty. Opinion polls consistently showed that Mexicans rejected the option of opening the energy sector to

62 Negroponte, "Mexico's Most Critical Challenge."

63 Burguete and Vazquez, "Mexico."; and Seelke et al., "Mexico's Oil and Gas Sector."

64 Guadalupe González and Susan Minushkin, *Public Opinion and Foreign Policy in Mexico* (Mexico City: Centro de Investigación y Docencia Económicas, June 2007), http://libreriacide.com/librospdf/DTEI-156.pdf.

foreign and private investment as had happened in the rest of the economy. This rejection was in part a result of the perception that the privatization of the banking and telecommunications sectors in the 1990s had resulted in an unjust concentration of economic power in the hands of a few individuals and groups.

But the situation in 2013 offered some hope. Although the 2008 reform efforts had been stifled by political realities and had done little to improve the sector's prospects, Mexican public opinion increasingly seemed to be accepting the notion that Pemex and national oil production were in trouble. This was greatly helped by the fact that the PRI was driving the reform efforts and that the initial proposal had been modest. In September 2013, the American firm ViaNovo released a poll that showed some surprising movement on the issue.[65] The poll found that 53 percent of Mexicans supported the government's proposal with only 38 percent opposing. In part this reflected the honeymoon period that the Peña Nieto government was experiencing at the time, and in part it indicated something of Mexicans' ignorance about the content of the reforms. Nonetheless, it showed that the concerns about Pemex had reached a broad section of the public.

This was because there were multiple diagnoses of the problems facing the national oil company. In addition to the studies presented during the 2008 reform attempt, newspapers and television news were full of stories about declining oil production and Pemex's financial and labor problems, along with articles about the success of modernization efforts in other countries.

Civil society played its part, too. The Mexican think tank IMCO (Instituto Mexicano para la Competitividad; Mexican Institute on Competitiveness) dedicated its 2013 international competitiveness report to the oil industry, titled *Nos cambiaron el mapa: México ante la revolución energética del siglo XXI (They Changed the Map on Us: Mexico and the 21st-Century Energy Revolution).*[66] In that report, IMCO highlighted the many failings of the Mexican system, including the lack of investment in research and development, the scale of inefficient investment in Pemex, and the astonishing fact that both Cuba and North Korea allowed more foreign investment in their oil industries than Mexico did. At the same time, the IMCO report emphasized Mexico's huge oil and gas potential and argued that the only way to fully exploit that natural endowment was to open the sector to private and foreign investment.

Another report, this time from the Wilson Center's Mexico Institute and ITAM (Instituto Tecnológico Autonomo de México; Autonomous Technological Institute of Mexico), made a different argument. Rather than focus on the diagnostic, *A New Beginning for Mexican Oil* established terms of reference for a successful energy reform process in Mexico, explaining basic terminology and proposing guiding principles. Based on a 2012 series of meetings with energy experts in Mexico City, the report argued for a reform in which "the twin principles of economic pragmatism and operational flexibility should be given a central position," one that is "as simple and straightforward as possible and should open rather than close policy options for the Mexican state." It also stated, "Third party participation is needed in areas where Pemex cannot satisfy the nation's energy needs."[67]

65 "Vianovo Releases New Poll on Mexico Energy Reform," Vianovo, September 20, 2013, https://vianovo.com/news/vianovo-releases-new-poll-on-mexico-energy-reforms.

66 Instituto Mexicano para la Competitividad (IMCO), *Nos cambiaron el mapa: México ante la revolución energética del siglo XXI* [They changed the map on us: Mexico and the 21st-century energy revolution] (Mexico City: IMCO, 2013), https://imco.org.mx/indices/documentos/2013_ICI_Libro_Nos_cambiaron_el_mapa_Mexico_ante_la_revolucion_energetica.pdf.

67 ITAM and Mexico Institute, *A New Beginning for Mexican Oil.*

These ideas and many others became part of the policy dialogue surrounding the reform process. Between September and October, the Mexican Senate held forums on the energy reform, inviting expert testimonies from national and international analysts. The forums reinforced the notion that the current status quo was untenable. On October 31, 2013, Secretary of Energy Pedro Joaquín Coldwell, CFE chief executive officer (CEO) Francisco Rojas Gutiérrez, and Pemex CEO Emilio Lozoya gave testimony in the Senate.

Momentum was building, but consensus was difficult to reach. On November 28, interparty negotiations broke down and the PRD left the bargaining table and the pact. From this point on, the negotiations would be dominated by the PRI and the PAN, resulting in a definite shift toward more rather than less liberalization in the new energy model.

Approval

After months of political horse-trading, as well as efforts to build consensus for the final reform measures and constitutional amendments, the Peña Nieto administration submitted its proposal to Congress in early December 2013. As discussed above, the debate in Congress and public response led to protests, recriminations, and accusations of treason. But the administration's ability to take advantage of converging political factors and to navigate and strike an appropriate balance between its desired proposal and that of the PAN—along with the PRD's begrudging acknowledgment of the desperate need to address a faltering Pemex—allowed for a fairly quick final approval. Mexico's lower house, the Chamber of Deputies, passed the energy overhaul 353 to 134, after an earlier Senate approval of 95 to 28.[68]

As required for the reform's constitutional amendments, 24 of Mexico's 32 states and federal district carried them over the final hurdle by a majority approval in the state legislatures to ratify the reform. Although the final vote reflected an affirmation of the convenient coalition of the center-right PAN and Peña Nieto's own PRI, the final measures have proved to more fully reflect the PAN proposal on oil, particularly for contractual modalities—not least because the PAN withheld its support until the government agreed to adopt a more ambitious approach.

Constitutional Amendments

The cornerstone of the Peña Nieto energy reform, and an element he had discussed since his campaign for president, was the need to amend the Mexican Constitution and overturn the seemingly immutable prohibition of private sector participation and investment in the country's energy sector. Nowhere was this more relevant than for oil and the national icon of Pemex. As Peña Nieto prepared the reform measures and ushered them through Congress, he was able to draw upon important lessons learned from earlier PAN administrations. His predecessors had spoken forcefully about reform, but had proved politically incapable of realizing anything more than marginal and incremental changes in the nation's energy sector, and thus had been ineffective in reversing the ominous trends of plunging oil production, deepening inefficiencies, and a faltering Pemex. As Peña Nieto noted during the signing ceremony on December 20, 2013, to much applause across the global energy business, he had succeeded in confronting an enormous historical legacy of "myths and taboos" about Mexico's energy sector.

68 "This Is How You're Stripping the Nation!"; Fausset and Wilkinson, "Mexico's Congress Passes Energy Reform Bill"; and Gutierrez and Graham, "Mexico Senate Passes Energy Bill."

The Peña Nieto reform successfully included amendments to Articles 25, 27, and 28 of the Mexican Constitution. These amendments effectively threw open the country's oil sector to private participation and new contractual opportunities for pursuing hydrocarbon development, though the reform measures carefully maintained that the state would maintain ownership of the nation's subsoil.

In selling its reform, the Peña Nieto government established six founding principles for the constitutional reforms. Although these principles have been only partially met at the time of this writing, it is important to note them here:

1. Hydrocarbons continue to be the property of the nation.
2. More competition in the energy sector will bring higher productivity, more competitiveness and better prices.
3. Strong regulatory agencies.
4. Transparency.
5. Clean energy.
6. Strengthening Pemex and CFE.

Although the hydrocarbons reforms attracted almost all of the media and political attention, the reform package went far beyond just oil and gas. In the electricity sector, the CFE's legal status was modified, with structural changes that essentially unbundled the company into smaller units. As with Pemex, CFE would become a state-owned productive company; likewise, the CFE board would be reworked to include independent members. In electricity generation, the reform removed all limitations to private participation remaining after the 1992 Electric Energy Public Service Law. For the first time in decades, generation would become a fully competitive activity in Mexico, and private investment would be allowed throughout the value chain. The transmission network was taken out of the hands of CFE and transferred to a new agency known as CENACE (Centro Nacional de Control de Energia; National Energy Control Center). Adequate access to natural gas supplies for generation was made possible by building out cross-border pipelines to the United States and creating a national gas transportation regulatory agency, CENAGAS (Centro Nacional de Control de Gas Natural; National Natural Gas Control Center). Lastly, the renewables industry was promoted by allowing private investment in geothermal generation and through new laws promoting clean energy.

Secondary Legislation

Although the constitutional amendments were an essential cornerstone of the energy reform process in Mexico, they were crafted to be intentionally broad and expansive. Implementing or secondary legislation was required to complement and provide specificity for most aspects of the energy reform and its implementation. This was particularly the case with regard to the structure and parameters for private investment in Mexico's oil sector, as well as the manner in which the reforms sought to transform Pemex. Therefore, soon after the constitutional amendments were signed in December 2013, the Peña Nieto administration began to work with Congress to craft the requisite secondary legislation that would need only a simple majority for approval.

The details of the secondary legislation were debated throughout the first half of 2014. Although there was significant agreement about the overall goal of the reform, the secondary legislation became highly contentious.

Industry representatives lobbied hard for legislation that would both expand their freedom of action and strengthen the regulatory framework to give greater certainty. President Peña Nieto submitted a package of 21 laws—9 new laws and 12 amended laws across the entire scope of Mexico's energy sector—implementing the constitutional reforms for review and debate by Congress in April 2014. Although the laws represented literally dozens of changes that would impact the future of the country's energy outlook, they can be summarized in two critical elements: fiscal and governance. Even then, there was drama. In June, for example, the PAN left the Senate negotiations for three weeks following a breakdown in talks with the PRI. However, on August 6, in an astonishingly short period since the constitutional reform in December, Congress approved the secondary legislation and sent it to the executive to be signed. Peña Nieto signed the new laws on August 11, 2014.

Final Results

Beyond simply confronting historical ghosts in the sector and opening the possibility of private investment, the constitutional amendments and secondary legislation significantly reordered the country's energy governance and institutional structure. Specifically, the reform ended Pemex's monopoly on oil and gas production and set forth a process by which the national oil company would become a "state productive enterprise" (discussed below). The critical fiscal and governance elements in the amendments and secondary legislation pertained to the changes to the Hydrocarbons Law and Hydrocarbons Revenue Law. Modifications in these laws effectively codified and authorized private investment and participation in Mexico's upstream. They further spelled out the possible contractual modalities by which the government would allow and seek private participation in the development of the country's hydrocarbon resources. They involved four contract types: licenses, production-sharing contracts, profit-sharing contracts, and service agreements. (The last of these had been the less-than-successful key element in the 2008 reform measures.)

Further, the laws assigned the authority and responsibility for regulation of the country's upstream to the CNH, perhaps the most successful outcome of the 2008 reform effort. The other existing regulatory body, the CRE (Energy Regulatory Commission; Comisión Reguladora de Energía) was further strengthened and, like the CNH, saw its autonomy guaranteed by law. A new regulator, the ASEA (Security, Energy, and Environment Agency; Agencia de Seguridad, Energía y Ambiente) was created, with responsibility for industrial safety and environmental protection across the oil value chain. Unfortunately, however, the ASEA lacked the institutional independence of either the CNH or the CRE, operating as a dependency of the environment ministry. This arrangement would be severely criticized in later years as it left the door open for potential political interference in the regulatory environment.

The laws also created CENAGAS, the new independent operator of the nation's natural gas pipeline network. Additionally, the Hydrocarbons Law also stipulated that the energy ministry (Secretaria de Energia, or SENER) would retain the authority to grant permits for petroleum treatment and refining; processing of natural gas; import and export of crude oil, natural gas, and petroleum products; and activities that previously were held exclusively by Pemex.[69]

In the electricity sector, the unbundling of the CFE was the most serious challenge to be overcome to achieve a fully competitive sector. Market participants and analysts continued to express doubts and concerns about the

69 IEA, *Mexico Energy Outlook.*

CFE's willingness to give up its monopolistic position. However, the subsequent bidding rounds for generating capacity saw huge interest on the part of foreign and national companies, with record low prices for renewable electricity that will benefit Mexico for years to come (see chapters by Peter Nance and Lisa Viscidi).

Importantly, on top of all of the major changes to the country's energy sector, the broader intent of the energy reforms and the subsequent Energy Transition Law, both underscore the Mexican government's desire to build an energy sector that meets the need to shift to a low-carbon growth model. Indeed, Mexico has made a strong commitment to boosting clean energy deployment and set forth ambitious emissions reduction targets and goals as part of its agreement as a signatory to the Paris Agreement on Climate Change.

The drama and intrigue of decades of discussion and debate in Mexico over the need to modernize the energy sector ultimately came to head in a period of less than 13 months. The blistering pace of the reform process was extraordinary when compared with the speed at which energy reform advanced in other countries, and it was testament to the political bargaining skills, expertise, and dedication of the SENER staff. Of all Mexico's reforms, the changes to the energy sector remain the most significant and far-reaching and will be the most impactful in the long run, if they are allowed to take their course. Politics and the electoral fortunes of the country will determine whether that is indeed the case.

The Fine Print of the Mexican Energy Reform

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Five years ago, when Mexico transformed its energy sector, most commentators were worried about the government's capacity to implement the reform. What would the upstream contracts look like? Would the auctions be transparent? How would international companies react? After two successful auction rounds, 107 signed contracts, and the creation of viable regulatory agencies to manage and monitor the reform agenda, the questions have changed. Today, Mexico's capacity to implement energy reforms and attract foreign investment is no longer in doubt. Today, the most pressing questions about the reform concern its long-term sustainability. Can it survive Mexican electoral cycles? Will Mexico continue down the same road that fosters private participation in the development of new fields? How safe are the current investments in Mexico from the rise of populism and nationalism in the Mexican political narrative?[70] In other words, moving forward, are the necessary legal pillars cemented in place firmly enough to survive any political hurricane?

The legal response to these questions, as with many legal issues, is unclear. The reform included not only the oil and gas sectors but also the production and distribution of energy around the Mexican territory.[71] This chapter cannot fully address all of the sectors covered by the reform; rather, it will focus on why the legal architecture of the energy reform for upstream activities is not as "bulletproof" and "irreversible" as some Mexican officials claim.[72] Two weak points may prevent the reform from achieving its desired long-term stability. First, the heart of the energy reform is located not in the text of the constitution, but in the transitory articles of the reform. The president's legal team decided to insert the substantial terms of the reform—especially the type of contracts that the state could sign—as "transitory" articles rather than choosing to fight the political battles needed to make them constitutional provisions. The second and perhaps the biggest weakness of the reform was the designers' inability to surpass the legal culture that surrounds Mexico's tradition of hyper-presidentialism. Mexican presidentialism tends to consolidate state power in the president as the central figure in determining public policy, as opposed to relying on independent agencies to control the key policy decisions in their assigned areas of oversight.

This second point deserves greater attention. For political and strategic reasons, the "founding fathers" of the reforms made sure that the president ultimately has control of the future of the energy sector. He or she might

70 See the special "Latin America First?" edition of *Americas Quarterly,* www.americasquarterly.org/content/latin-america-first. According to the March 2018 Goldman Sachs report on Mexico, "AMLO [Andrés Manuel López Obrador] could change the oil sector *status quo* by slowing down the implementation of the energy sector reform, making it less predictable and market friendly, and by intervening more in the sector directly, and indirectly by giving more money, power, and influence to the inefficient state-oil concern, Pemex." See Alberto Ramos, Paulo Mateus, and Gabriel Fritsch, "Mexico: Facing 100 Days of Uncertainty and Potential Drama," Goldman Sachs Economics Research, March 23, 2018, www.lapoliticaonline.com.mx/files/content/110/110415/Mexico_Facing_100_days_of_Uncertainty_and_Potential_Drama.pdf.

71 "Decreto por el que se reforman y adicionan diversas disposiciones de la Constitución Política de los Estados Unidos Mexicanos, en Materia de Energía, DOF (Edición Vespertina), 2 (20 de diciembre de 2013)," December 20, 2013, http://dof.gob.mx/nota_detalle.php?codigo=5327463&fecha=20/12/2013 (hereafter, Constitutional Reform).

72 According to Mexican energy minister Pedro Joaquin Codwell, who is also the chair of Pemex's board of directors, the energy reform is "'irreversible' as its major tenets are enshrined in the constitution, and would require a super-majority in Congress to reverse." See Ana Isabel Martinez, "Mexico Energy Minister Says Election No Obstacle to 2018 Oil Auctions," *Reuters,* February 9, 2018, www.reuters.com/article/us-mexico-energy/mexico-energy-minister-says-election-no-obstacle-to-2018-oil-auctions-idUSKBN1FT2N2.

be constrained in the ability to modify existing contracts, but a new president surely can put the brakes on future projects, planned bidding processes, and the participation of private actors in the next stages of the reform. When it comes to the oil and gas sector, private actors might be constitutionally authorized to sign contracts with the state, but the president is still the one in control of the terms of the agreements, the tax regime attached to them, and even the possibility that new fields may be open for exploration. The new agencies, notably the National Hydrocarbons Commission (Comisión Nacional de Hidrocarburos; CNH), do not have the complete independence to choose the partners of the Mexican state or ensure that the decisionmaking process will be transparent. The executive power holds the paper, the pen, and even the key to the room where the contract will be signed. From a policy standpoint, Mexico might not be open for business in the next exploration and production (E&P) development stages. It will all depend on whether the next president decides if it is in Mexico's national interest to invite private actors or to assign the new fields to Pemex.

Transitional Constitutional "Safeguards"

The energy reform proposal of 2013 sparked a debate among legal scholars on whether the reform was modifying the constitutional order substantially.[73] President Peña Nieto and his team of experts were keen to point out that the reform was in fact following the vision of the last president of the Mexican revolution, President Lázaro Cárdenas.[74] Peña Nieto's team proposed to reinsert the wording in the constitution that Cárdenas had employed to constitutionalize the expropriation of the oil industry back in 1938.[75] The Cárdenas reform textually prohibited the state from giving concessions to private parties for the production of hydrocarbons but retained the possibility for the government to sign other types of contracts with them.[76] In other words, it would be constitutionally permissible to contract with private parties, but not to give concessions to them. "It wasn't until the beginning of the 1960s when an amendment was enacted that the constitution prohibited the signing of any contracts with private parties and reserved all of the hydrocarbon-related activities to Pemex," Peña Nieto explained in his 2013 speech introducing the reform.[77] Ironically, in the view of the Peña Nieto administration, the reform reestablished the 1938 legal regime to introduce Mexico to the 21st-century energy revolution.

In the view of the administration, this unusual way of amending the constitution disarmed any argument from the congressional opposition that the administration had violated the spirit of the 1938 expropriation and the values of the national revolutionary identity.[78] However, it was a strategic mistake. The Peña Nieto administration did not specify in the constitutional text what type of contracts could be signed by the state. The

73 See, for example, George Baker, "Concesión 'vs' licencia" [Concession vs. license], *Milenio Diario*, June 29, 2015, www.milenio.com/firmas/george_baker/Concesion-vs-licencia_18_545525470.html.

74 "Palabras del Presidente Enrique Peña Nieto, durante la Presentación de la Iniciativa de Reforma Energética" [Speech of President Peña Nieto introducing the energy reform initiative], August 12, 2013, www.gob.mx/presidencia/prensa/palabras-del-presidente-enrique-pena-nieto-durante-la-presentacion-de-la-iniciativa-de-reforma-energetica.

75 Ibid.

76 Ibid.

77 Ibid.

78 Ibid.

amendment did not define what a concession is, nor did it state the terms of the other types of contracts.[79] The administration left it to the transitory articles to establish the type of contracts that the constitution did not define. Legally, this left open the possibility for contradictions among the constitutional text, the transitional provisions, and the secondary regulation. Ultimately, these contracts in the transitory regime are the most important element that defines the legal relationship between the state and the private actor and they become the main source of investors' rights.[80]

Are they Concessions or Licenses?

Upstream activities have changed radically since the 1910s when the Mexican revolutionaries were drafting the Mexican Constitution. In those days, the most common (and one could argue almost the only) contractual relationship between states and companies was the classic concession arrangement.[81] These concessions allocated E&P rights over vast areas for long periods of time to one single company and granted title to the resources in situ (in the ground).[82] These concessions contracts typically reserved few rights to the state "except for the right to receive a payment based upon production," usually in the form of income tax and royalties.[83] The essential characteristic of the early concession agreement was that the "concessionaire enjoy[ed] a nearly total freedom" and control over the resources in all facets of the petroleum operations.[84] For example, before the 1938 nationalization, the British-controlled Mexican Eagle Oil Company had a concession over all federally owned lands along the Gulf of Mexico.[85]

79 The constitution does not specify what a concession is. Neither the transitory articles nor the Hydrocarbons Law passed after the reform specify it. The Hydrocarbons Law defines only E&P assignment and contract ("Assignments: the legal administrative act in which the Federal Executive gives exclusive rights to the assignment recipient to engage in Exploration and Exploitation of hydrocarbons in a Contractual Area for a specific time") (Exploration and Extraction Contract: a legal act in which the Mexican State, through the National Hydrocarbons Commission, agrees to the Exploration and Extraction of hydrocarbons in a contractual area for a specific period of time.").

80 As stated by F. Rouhani in the context of the Iranian legislation, "The Petroleum Act lays down the general principles under which agreements may be made, and described the varieties of authorized relationships, but once an agreement is made and is ratified by the Legislature, the Petroleum Act virtually fades away because the agreement itself is the appropriate and sufficient law." See F. Rouhani, International Agreements and Contracts in the Field of Petroleum 9 (United Nations Inter-Regional Seminar on Techniques of Petroleum Development, January 23–February 21, 1962).

81 Ernst E. Smith et al, *International Petroleum Transactions*, 3rd ed., (Westminster, CO: Rocky Mountain Mineral Law Foundation, 2010), 429 ("Early grants of mineral rights were made through classic concession agreements. The characteristics of this agreement were: (1) a grant of rights to mineral development over vast acreage; (2) for a relatively long period; (3) providing to the IOC extensive control over the schedule and manner in which the mineral reserves were developed, and (4) reserving few rights to the sovereign, except the right to receive a payment based upon production.")

82 Ibid, 429.

83 Ibid.

84 *Saudi Arabia v. Arabian American Oil Co.* Award, 27 I.L.R. 117, 161 (August 23, 1985) ("The concessionaire enjoys a nearly total freedom, and is neither bound by clauses concerning maximum tariffs for sales nor prohibitions of preferential tariffs, which are the usual features of the cahiers des charges in public service concessions. Mining concessions are not public works concessions either, because the mineral deposits become the property of the concessionaire who, at the end of his concession, will have to return them to the State with their exploitable substance diminished and sometimes even exhausted."). See also Zhiguo Gao, *International Petroleum Contracts, Current Trends and New Directions* (London: Graham & Trotman, 1994), 12–13.

85 George Philip, *Oil and Politics in Latin America: Nationalist Movements and State Companies* (Cambridge, UK: Cambridge University Press, 1982); and Jesús Silva Herzog, *Historia de la expropiación de las empresas petroleras* [History of the expropriation of oil companies] (Mexico City: Instituto Méxicano de Investigaciones Económicas, 1964), 18–32.

In contemporary E&P agreements signed between states and private companies, the terms *concessions, licenses,* and even *E&P agreements* are "often used interchangeably."[86] In the words of Gordon Barrow, "there are a number of synonyms for this instrument [concession], such as permit, license and lease."[87] Modern concessions around the globe minimize or eliminate the broad terms of the classic concessions and expand the government's control over the private companies' operations.[88] Worldwide, one could easily find contracts that are called "concessions" but that no longer give the private company total control of the resource. These contracts will have, among others things, various levels of government control, different initial terms of operation, different minimum exploratory work obligations, different work plans approved by the ministries in charge of supervision, and differing commitments to specific plans for developing the resources, including terms for the relinquishment of the area.[89] Moreover, contemporary concessions "include bonuses payable on signature of the agreement, on discovery of a petroleum field or on reaching certain levels of production."[90] In other words, today the term *concession* is vague. Without a proper legal definition, as in the Mexican energy reform constitutional text, the term leaves unclear the type of contractual relationship that will emerge between the state and the private party. This is where the transitory articles come into play.

The fourth transitory article specifies that the Mexican Congress must regulate the type of contracts that the government can sign with private companies that would exploit the national resources on behalf of the nation. Moreover, the transitional provision ties the hands of Congress by stating that these contracts "should be, among others: service agreements, profit or production sharing, or licenses."[91] In terms of the state considerations, the transitory article states that these should be: "I) cash for the services contracts; II) a percentage of the profit, for the profit-sharing agreements; III) a percentage of the production, for the production-sharing agreements; IV) with the onerous transfer of hydrocarbons after being extracted from the underground, in the case of licenses, or V) any combination of the above."[92] Instead of giving temporary instructions to Congress on regulating the constitutional reform, the transitional provisions gave specific instructions on the substance of the legislation that Congress had to adopt.

86 Smith et al., *International Petroleum Transactions*, 443; another example of how they are used interchangeably can be found in Carmen Otero García-Castrillón, "Reflection on the Law Applicable to International Oil Contracts," *Journal of World Energy Law & Business* 6, no. 2 (2012) 133.

87 Gordon Barrows, "A Survey of Incentives in Recent Petroleum Contracts," in *Petroleum Investment Policies in Developing Countries*, edited by Nicky Beredjick and Thomas Wälde (London: Graham & Trotman, 1998), 226.

88 Smith et al., *International Petroleum Transactions*, 443.

89 Carol Nakhle, "Petroleum Fiscal Regimes: Evolution and Challenges," in *Taxation of Petroleum and Minerals: Principles, Problems and Practice,* edited by Philip Daniel, Michael Keen, and Charles McPherson (London, Routledge, 2010), 89 and 95.

90 Ibid. For instance, in the case of the United States, the current leasing regime is a form of concession ("generally, federal offshore leases, a form of concession, include the following terms and provisions: a leasehold consisting of a compact area not exceeding 5,760 acres; a lease primary terms of five years (up to ten years for certain deep water leases) and a habendum clause providing for a secondary term for so long as oil or has is produced in paying quantities or approved drilling or well reworking operations are being conducted; payment of the amount or value specified by the bidding system; the right to explore, develop, and produce oil and gas conditioned upon due diligence requirements and upon approval of a plan of payment of royalties; and offers of production to small or independent refiners."). See Owen L. Anderson and Christopher Kulander, The Offshore Petroleum Licensing Regime in the United States, in *Regulation of the Upstream Petroleum Sector: A Comparative Study of Licensing and Concession Systems*, edited by Tina Hunter (Cheltenham, UK: Edward Elgar, 2015), 167.

91 Transitory Article 4.

92 Ibid.

Regarding the type of contracts that must be included in the secondary legislation, the transitional provisions look similar to modern concessions or licenses elsewhere in the world. Moreover, transitory article 5 gives the substantive right to international companies to report or book expected benefits for accounting and financial purposes from these contracts. In other words, the so-called licenses authorized by the transitory article look like contemporary concession agreements.[93] The only fundamental difference being that the hydrocarbons are transferred to the company once they are extracted, as opposed to in situ, and upon payment of the royalties.[94] However, just like the modern concession, in the Mexican license the private operator bears all the costs and risks and retains the exclusive right to explore and extract the hydrocarbons located in a specified area.[95] As stated by the renowned legal scholar Diego Valadés, "in one section of the Constitution, contracts with the name concession will be denied, and then in another section, they will be allowed under an equivalent denomination."[96]

One reading of these provisions is that President Peña Nieto and his team were unable to include the modern type of concessions in the constitution. Put differently, they did not fix the most critical source of substantive rights to private companies in the text of the constitution; rather, they did it in its transitional provisions. Perhaps the Peña Nieto administration feared the political turmoil that the term could generate. Instead, they enacted them in the transitory articles hoping that they would be less controversial. They treated the constitution not as the supreme law of the land, but rather as an adhesion contract that hid the most important terms in the fine print, hoping that the other party would not realize it until it was too late.

Transitory Articles as a Fine Print

Is hiding the substantive rights of important constitutional reforms in the transitory articles a regular parliamentary practice in Mexico? No. Good legislative practice dictates that it is not the nature of transitory articles to be the heart of a constitutional amendment. In civil law, a transitional section has the purpose of determining the enforcement of the approved legislation.[97] Transitional provisions, for example, explain which laws are being revoked and substituted by the new law; they define who the enforcing authority will be, instruct agencies or Congress that they must pass specific legislation or allocate budget to give life to the reforms, and the like. They make sure that there is no legal "anarchy" between the time that the new law takes force and the old law is repealed.[98] In other words, they give the necessary details for the legislation to become a reality, they are temporary and auxiliary in nature, and hence they are not deemed to be the heart or central part of the

93 See comments from José Antonio Prado of Holland and Knight in Alejandra López, "Confunden términos licencia y concesión" [Confusing terms of license and concession], *Reforma,* June 8, 2015, www.reforma.com/aplicacioneslibre/articulo/default.aspx?id=560100&md5=8651197a2972748724fcac21ebf63411&ta=0dfdbac11765226904c16cb9ad1b2efe&po=4; and Alejandro Guzmán Rodríguez, "¿Contratos o Concesiones?" [Contracts or concessions?], Energía a Debate, n.d., www.energiaadebate.com/¿contratos-o-concesiones/.

94 Ibid.

95 See, for example, Contract No. CNH-R01-L04-A1.CPP/2016 with China Offshore Oil Corporation E&P Mexico, S.A.P.I. de C.V., Section 2.1, www.gob.mx/cms/uploads/attachment/file/198308/Contrato_Area_1_Cinturon_Plegado_Perdido.pdf.

96 Diego Valadés, "La Constitución desfigurada" [The disfigured constitution], *Reforma*, December 12, 2013.

97 Ibid.

98 "Artículos Transitorios. Formas Parte del ordenamiento Jurídico Respectivo y su Observancia es Obligatoria", Segundo Tribunal Colegiado en Materia Administrativa del Sexto Circuito, Tesis Aislada, VI.2o.A.1 K, Num. De Registro: 188686, Novena Época, Semanario Judicial de la Federación y su gaceta, Tomo XIV, Octubre de 2001.

legislation.[99] Some commentators argue that "once the transitory article serves its function it loses its efficacy, that is the reason why it cannot establish general provisions that are binding upon private individuals."[100] This is not the case of the transitional articles of the energy reform.

As mentioned above, the transitional provisions are the center of the reform. Out of the 6,900 words that make up the Mexican energy reform, 6,000 are located in the transitory articles.[101] The core of the reform is not regulated in the constitution, but in these "provisional" articles.[102] In a study by Diego Valadés, "out of the 21 transitory articles, eleven have important provisions that should be part of the constitutional text."[103] It is here where the reader can find the type of E&P contracts that the government can sign with private parties: license, production- and profit-sharing agreements, and service contracts. Moreover, it is in these "temporary" articles where companies are given the right to book the reserves awarded by the contracts. In other words, the heart and soul of the Mexican upstream energy reform is not in the constitution, but in these transitional provisions. In the words of Diego Valadés, "[i]n Mexico no one had ever used the transitory articles to mislead and conceal, like they did in the case of this reform."[104] It is left to the Supreme Court of Mexico to determine the possible impact of modifying the nature of such transitional articles that potentially could contradict the constitutional text.[105]

In the past, the Mexican Supreme Court has stated that the transitional provisions are part of the constitutional amendment in so far as they help to give life to it.[106] Yet these rulings were mostly in the context of determining the obligations of certain authorities to pass secondary legislation or the timing of the legislation's entry into

99 Francisco Berlin Valenzuela, *Diccionario de Términos Parlamentarios* [Dictionary of parliamentary terms] (1997). ("Articulo transitorio. Disposición numerada en forma consecutiva de un tratado, leyo reglamento que tiene una vigencia momentánea o temporal. Su carácter es secundario, en la medida que actúa como auxiliar de los artículos principales, para precisar el momento de la entrada en vigor del nuevo texto legal o para determinar otras especificaciones sobre las condiciones en que la nueva legislación comenzará a surtir efectos legales."). See also Sergio Nudelstejer, "Articulo Transitorio en México" [Transitory articles in Mexico], *Enciclopedia Legal,* http://mexico.leyderecho.org/articulo-transitorio/#Recursos ("En México, el término 'artículo transitorio' hace referencia a una disposición que se agrega después de que la materia a legislar ha sido tratada en su propio articulado y su efecto jurídico está limitado en el tiempo.")

100 Carla Huerta Ochoa, "Artículos Transitorios y Derogación" [Transitory articles and repeal], *Boletín Mexicano de Derecho Comparado* 102, https://revistas.juridicas.unam.mx/index.php/derecho-comparado/article/view/3693/4524. (Para conocer la naturaleza de los artículos transitorios no es necesario realizar un análisis semántico, pues el término transitorio es elocuente, de su denominación se infiere que la función de estos artículos es, en principio, temporal y sirve para regular los procesos de cambio en el sistema jurídico. Su naturaleza jurídica se define por su función que se refiere a la aplicabilidad de otras normas, ya sea al señalar la entrada en vigor de una disposición o al derogarla. El artículo transitorio pierde su eficacia una vez que ha cumplido su cometido, por ello es que no puede establecer prescripciones genéricas con carácter vinculante a los particulares.)

101 Valadés, "La Constitución desfigurada."

102 Ron Snipeliski Nischli calls the transitory articles "a new modality" of the constitutional legislator to "detail certain aspects of the constitutional text" in the "transitory" articles "which are not transitory at all, because they share the same nature and characteristics of other constitutional provisions" Ron Snipeliski Nischli, "Artículo 27," *Constitución Política de los Estados Unidos Mexicanos Comentada*, Vol. 1, edited by Jose Ramón Cossio Días (Mexico: Tirant lo Blanch, 2017), 558.

103 Valadés, "La Constitución desfigurada."

104 Ibid.

105 This is one of the consequences of including substantive rights in the constitution. See Snipeliski Nischli, "Artículo 27," 558.

106 Amparo en Revisión 1106/2015, resuelto 02/03/2016, Segunda Sala de la Suprema Corte de Justicia de la Nacional; see also Acción de Inconstitucionalidad 99/2016 y acumulada 104/2016 (regarding the electoral judges); Acción de Inconstitucionalidad 58/2016 (anticorruption law in Chihuahua); Acción de Inconstitucionalidad 56/2006 (anticorruption law in Veracruz).

force.[107] The Supreme Court has never resolved the possible result of a contradiction of substantive rights directly given to individuals in transitory articles—such as rights to private parties to book reserves—and the text of the constitution. A new government could argue in court that the constitutional text limits the rights of private parties to providing services to the state, contradicting the terms of the transitory articles that provide for licenses that give exclusive rights to exploit and extract hydrocarbon resources. We do not know how the Supreme Court will react if it is asked to determine whether the constitution contradicts substantive rights located in the transitory articles. But what we do know is that by "disfiguring the constitution," the legal engineers of the reform gave ammunition to the detractors to fight it out in courts.[108] If the Peña Nieto administration had included everything in the text of the constitution, the available alternative for the detractors would be to fight for a constitutional amendment. However, with the adopted legal architecture, a new president could argue that the existing contracts violate the spirit of the constitution because, as he or she understands it, the terms are closer to the ones of a concession. Hence, the new president would not need to amend the constitution to challenge the existing contractual architecture of the reform.

The President at the Helm of the Energy Reform

Yet it is the structure of the decision-making process, not the transitional provisions, that may be the biggest challenge to the implementation of the new energy model. The designers of the reform ensured that the executive power played an important role in defining the direction, pace, and content of the energy sector in Mexico.[109] At least three executive prerogatives hold the key to the future of the reform in the upstream sector: the power to determine the energy policy of the state, the prerogative to determine the areas and the contracts that will be open for auctions, and the authority to determine the financial and fiscal terms of the contracts.[110] All three fall into the hands of ministries that are directly in control of the sitting president.

SENER as the Master Key

According to the constitutional design, the minister of energy, who is directly appointed by the president, has the power to "establish, conduct and coordinate the energy policy" in Mexico.[111] When it comes to hydrocarbon-related activities and the transition and distribution of energy, these are considered state "strategic" activities "of social interest and public order, and as a consequence will have preference over any other activity that benefits from the development of the surface or underground."[112]

As a consequence, the minister of energy can decide which areas will be adjudicated by assignments to state production entities (mainly Pemex) and which will be contracted through auctions where private and state entities can participate (figure 3.1). The risk of the future of the energy reform lies in this division of tasks. Regardless of the existing contracts, the next government will have to decide whether new areas will be

107 Ibid.

108 Valadés, "La Constitución desfigurada."

109 See Snipeliski Nischli, "Artículo 27," 557.

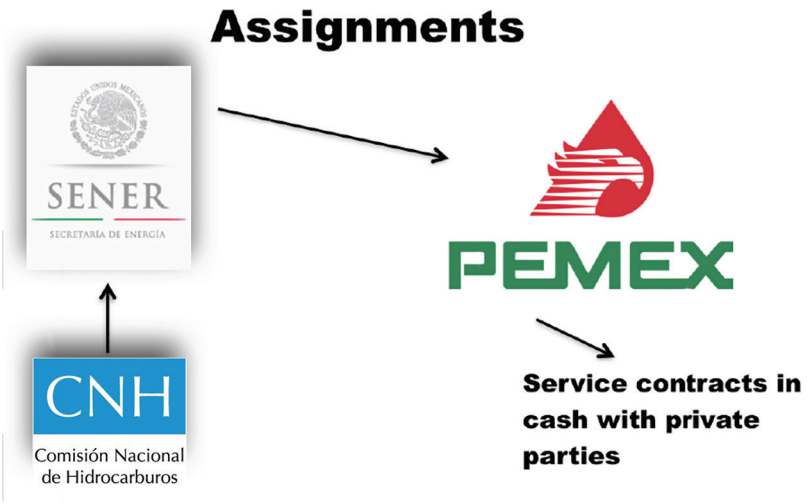
110 Constitutional Reform, Article 6 Transitory and Article 10 Transitory.

111 Ibid., Article 10 Transitory.

112 Ibid., Article 18 Transitory.

adjudicated to Pemex or be open for competition. The secondary legislation, the Hydrocarbons Law, tries to narrow the grounds in which the ministry can give assignments to Pemex by forcing it to justify its decision "as the most adequate mechanism for the interest of the State in terms of production and that guarantees the supply of hydrocarbons and that the recipient of the assignment has the technical, financial and execution capacity to extract the hydrocarbons in the most efficient and competitive way."[113] In this adjudicative process, the National Hydrocarbons Commission (CNH) must give its option by issuing a technical report.[114] However, constitutionally, nothing prevents the new minister of energy from modifying the next rounds and the development plan set up by the previous administration in the name of "national interest." In case of inconsistency between the constitution and the secondary legislation, the federal courts could easily declare the secondary law as unconstitutional for limiting the powers of the executive contrary to the text and spirit of the reform.

Figure 3.1. Assignments



The energy ministry's second power lies in its ability to design the content of the contracts and the technical guidelines of the bidding processes. The CNH can "technically assist" the minister of energy in defining these provisions, but the ultimate design is the ministry's responsibility. Once a new area is found, the ministry determines which type of contractual relationship will govern its development: assignments, production- or profit-sharing agreements, or licensees. The CNH is in charge of the auctions, the signing of the contract on behalf of the state, and most important of supervising and enforcing the terms of the agreement.

Perhaps the most important power of the CNH regarding long-term reform implementation lies here. If the companies fail to perform their duties under the contracts or in accordance with the law, only the CNH can cancel the contractual relationship under a set of preestablished grounds.[115] Such grounds might include the possibility that the companies do not start operations in a particular period, do not invest in the field as agreed in the contracts, transfer contractual rights without authorization, have an accident that affects production and

113 Decreto por el que se expide la Ley de Hidrocarburos y se reforman diversas disposiciones de la Ley de Inversión Extranjera, Ley Minera, y Ley de Asociaciones Público Privadas), DOF: 11/08/2014 (hereafter, Hydrocarbons Law), Article 6.

114 Ibid.

115 Ibid., Article 20.

is caused by negligence or fraudulent conduct, fail to report the appropriate information regarding production and costs to the authorities, or fail to produce payment to the state in accordance with the contract terms.[116] According to the Hydrocarbons Law, these are the only grounds (*únicamente* is the term used in Spanish) to cancel an E&P contract and relinquish the area without compensation.[117] The procedure to determine a rescission of these contracts is considered an administrative act and is not subject to arbitration. In sum, the ministry of energy cannot cancel the existing 107 contracts; instead the CNH is the only body that can make this determination under the narrow circumstances established in the Hydrocarbons Law.[118]

Since the CNH is the one enforcing the contractual terms, it does have the duty of providing comments to the ministry of energy regarding a future contract. However, ultimately the contractual design is determined by the minister of energy. The only provisions of the agreements that do not fall under its powers are the ones related to finances and taxes. Here is where another office dependent on the president—the treasury—comes into play.

The Power of the Executive Purse: A Shadow from the Old Regime

It is well known that Pemex's terrible finances before the energy reform were not only the result of mishandling of resources inside the organization but also a consequence of the extreme control that the Mexican finance ministry exercised over the company's books. The government's primary sources of revenue came from taxes on Pemex. Hence, the ministry of energy had enormous influence over how the state-owned company's finances were administered. With the energy reform, the finance ministry's authority over the operation of hydrocarbons companies did not disappear. The reform gives exclusive powers to the ministry of finance to establish the "economic conditions for the bids and contracts [of the energy reform] in connection to the fiscal regime that will allow the Nation to obtain in time the profits that will contribute to long-term development."[119] As such, for each contractual arrangement the finance ministry is in charge of determining the standard royalties, corporate tax and costs deduction, and adjustable rates for royalties. This provision gives a robust control of the economics of the contracts to a single government office (figure 3.2). The treasury could make a particular project attractive to foreign investors or economically inefficient.

For example, the Hydrocarbons Income Law sets up a sliding-scale royalty with varying rates depending on the type of fields, their production rates, and the price of oil and gas.[120] Some projects with narrower profits, such as shale gas, will have a royalty discount.[121] The possible rise of royalty rates if production or prices increase will depend on each contractual arrangement.[122] The finance ministry determines those rates after the ministry of energy designs the contract. Another example, found in Article 13 of the Hydrocarbons Income Law, states that

116 Ibid.

117 Ibid. (El Ejecutivo Federal, a través de la Comisión Nacional de Hidrocarburos, podrá rescindir administrativamente los Contratos para la Exploración y Extracción y recuperar el Área Contractual únicamente cuando se presente alguna de las siguientes causas graves)

118 Ibid.

119 Constitutional Reform, Article 10 Transitory.

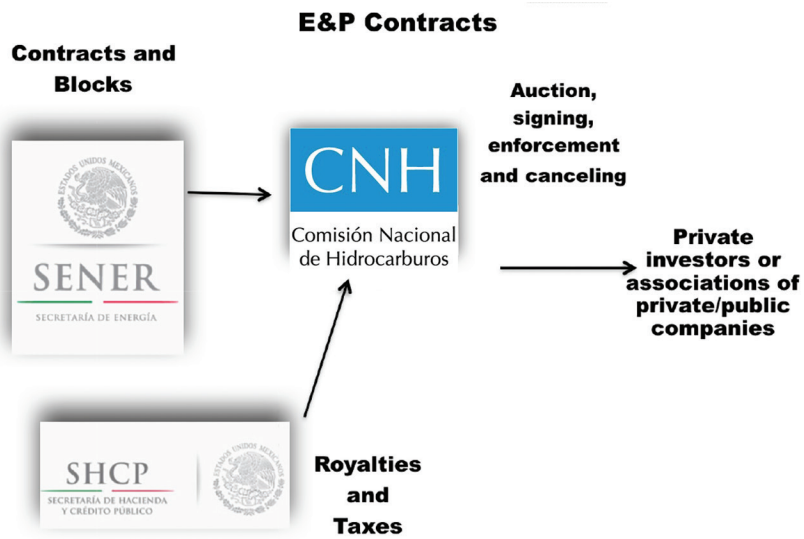
120 Decreto por el que se expide la Ley de Ingresos sobre Hidrocarburos, se reforman, adicionan y derogan diversas disposiciones de la Ley Federal de Derechos y de la Ley de Coordinación Fiscal y se expide la Ley del Fondo Mexicano del Petróleo para la Estabilización y el Desarrollo, DOF: 11/08/2014. (Hereafter, Hydrocarbons Income Law.)

121 Ibid.

122 Ibid.

in the case of the production-sharing contracts, the finance ministry will determine whether to include the cost recovery consideration in the agreement.[123] In sum, even assuming that the ministry of energy decides to go forward with the bidding processes after hearing the CNH's opinion, the finance ministry could set up a fiscal regime that makes the whole project unviable for the private operators. In this case, the CNH does not have the power to convince the finance ministry to modify the economic terms of the contracts. One could easily imagine a scenario where, after a failed bidding process, the incoming president instructs the ministry of energy to assign a field to Pemex. The incoming president could argue that it is in the national interest to develop the resources after the private companies rejected the "fair" economic terms from the state and insisted on trying to get "more" of the nation's riches. Whether Pemex is in a financial and technical condition to develop the particular field, is a different story. However, the legal architecture is there and could readily be deployed for a political cover-up.

Figure 3.2. E&P Contracts



The finance ministry's executive control over the financial terms of the contracts is effectively unlimited, and could derail the economic feasibility of E&P projects if the new president decides to self-boycott the reform. This policy would not require any constitutional amendment since it is well within the powers of the executive as envisioned in the energy reform.

International Protection of Existing Investments

As stated above, the CNH has limited grounds to rescind the contracts without an obligation to compensate the private companies.[124] The Hydrocarbons Law establishes a procedure in which the private company can challenge the CNH decision and try to resolve the breach of contractual obligations before it becomes final.[125] Once the CNH confirms its decision, the only available legal mean to challenge the rescission is to file an

123 Ibid., Article 13.

124 Hydrocarbons Law, Article 20. The private company has 30 days after receiving the CNH decision to provide evidence and challenge the rescission. After receiving arguments and evidence from the company, the CNH has 90 days to confirm its decision. If the private company solves the inconsistency, the CNH can leave without effecting the rescission.

125 Ibid.

administrative action in Mexican federal tribunals.[126] According to the Hydrocarbons Law, "as a consequence of an administrative rescission, the Contractor will transfer back to the State the area without any charge, payment, or compensation."[127] For any other contractual dispute, the E&P contracts can include alternative dispute resolution mechanisms, including arbitration provisions under international treaties signed by the Mexican state.[128] For example, if the Mexican government decides to modify the Hydrocarbons Law or the Hydrocarbons Income Law in a way that affects the contractual relationship or the business plans of the companies, the latter could bring a legal action internationally for a breach of International Bilateral Investment Treaties.[129] The international treaties provide for an arbitral mechanism in neutral forums where the investor could obtain higher amounts of compensation than if they had disputed the issues domestically.[130]

Some of the license contracts signed by Mexico, particular for the deepwater fields, provide additional safeguards to foreign investors.[131] Although the license agreement specifies that any dispute regarding the administrative rescission determined by the CNH will be resolved in federal tribunals, it gives investors a right to bring the dispute to an international tribunal for quantifying compensation. For example, the contract with China Offshore Oil Corporation E&P Mexico provides that "the contract may initiate a proceeding before an international tribunal . . . exclusively to determine the existence of compensatory damages and lost profits and, depending on the case, its monetary quantification, that emerges as a consequence of an administrative rescission that is ruled as groundless by the Federal Tribunals."[132] Moreover, according to the contract, the company "will enjoy all of the rights recognized in international treaties signed by the State."[133] This would include the China-Mexico Bilateral Investment Treaty (China-Mexico BIT) in force since June 6, 2009.[134] According to Article 1 of this treaty, contracts signed with Mexico cannot be affected by government actions because they fall under the

126 Ibid.

127 Ibid. ("Como consecuencia de la rescisión administrativa, el Contratista transferirá al Estado sin cargo, ni pago, ni indemnización alguna, el Área Contractual. Asimismo, se procederá a realizar el finiquito correspondiente en términos de las disposiciones jurídicas aplicables y de las previsiones contractuales.")

128 Ibid., Article 21 ("Tratándose de controversias referidas a los Contratos para la Exploración y Extracción, con excepción de lo mencionado en el artículo anterior, se podrán prever mecanismos alternativos para su solución, incluyendo acuerdos arbitrales en términos de lo dispuesto en el Titulo Cuarto del Libro Quinto del Código de Comercio y los tratados internacionales en materia de arbitraje y solución de controversias de los que México sea parte.")

129 Guillermo J. García Sanchez, "The Hydrocarbons Industry's Challenge to International Investment Law: A Critical Approach," *Harvard International Law Journal* 57, no. 2 (2016): 475–528, https://ssrn.com/abstract=2820729.

130 Ibid.

131 China Offshore Oil Corporation E&P Mexico, S.A.P.I. de C.V.; see also note 26.

132 Ibid. at Section 26.4 ("El contratista podrá iniciar un procedimiento ante un tribunal arbitral, en términos de la Clausula 26.5, únicamente parta que se determine la existencia de daños y perjuicios y en su caso, su cuantificación, que resulten de una causal o causales de rescisión administrativa consideradas infundadas por los Tribunales Federales de forma definitiva.")

133 Ibid. at Section 26.9.

134 "Agreement Between the Government of the United Mexican States and the Government of the People's Republic of China on the Promotion and Reciprocal Protection of Investments," http://investmentpolicyhub.unctad.org/Download/TreatyFile/759.

definition of a protected investment.[135] These are "contracts where remunerations depends substantially on the production, revenues or profits of an enterprise" and the deepwater fields are located in the Mexican continental shelf, which according to the treaty and international law is considered Mexican territory.[136]

In sum, the international companies can challenge a rescission from the CNH before federal tribunals. If they win the case, they can bring the claim to an international arbitral tribunal to quantify the compensatory damages and loss of profits. These mechanisms are additional layers of protection that are not specified in the constitution nor the transitory articles or the secondary legislation. In addition to this "domestic" proceeding with an international recourse for quantification, the companies also have access to international arbitral tribunals to resolve any other disputes related to the contract.[137] International BITs or investment chapters in free trade agreements, such as Chapter 11 of the North American Free Trade Agreement (NAFTA), force Mexico to provide foreign investors with "fair and equitable treatment" (NAFTA Article 1105, or China-Mexico BIT Article 5) and to receive prompt and adequate compensation in the case of expropriation (NAFTA Article 1110, or China-Mexico BIT Article 7).[138] For example, if a new government decides to cancel existing contracts by enacting new legislation that forces the companies to renegotiate the existing deals with more state-centered legislation, then the companies could bring claims to international investment tribunals. In these international fora, they could allege that they were being treated unfairly and that the government violated their investment "legitimate expectations."[139] They could even argue that by forcing them to renegotiate the deal, the new government's actions are an unlawful expropriation.[140]

Governments in Mexico are aware of the importance of letting international investors know that the state will fulfill its promises to arbitrate these types of disputes in international forums, regardless of who is in power.[141] Evidence of that is the fact that Mexico recently signed the Convention on the Settlement of Investment Disputes between States and Nationals of Other States (ICSID Convention). This convention created the

135 Ibid., Article 1 ("investment" means the asset owned or controlled by investors of a Contracting Party and acquired in accordance with the laws and regulations of the other contracting Party, listed below: . . . interest arising from the commitment of capital or other resources in the territory of a Contracting party to economic activity in such territory, such as under (i) contracts involving the presence of an investor's property in the territory of the other Contracting Party, including turnkey or construction contracts, or concessions, or (ii) contracts where remunerations depends substantially on the production, revenues or profits of an enterprise").

136 Ibid. ("in respect of the United Mexican States, the territory of the United Mexican States including the maritime areas adjacent to its coast, i.e. territorial sea, the exclusive economic zone and the continental shelf, to the extent to which the United Mexican States may exercise sovereign rights or jurisdiction in those areas according to international law."). For a deeper study of investments in the Gulf of Mexico, particularly near the maritime border with the United States, see Guillermo J. García Sanchez and Richard McLaughlin, "The 2012 Agreement on the Exploitation of Transboundary Hydrocarbon Resources in the Gulf of Mexico: Confirmation of the Rule or Emergence of a New Practice?," *Houston Journal of International Law* 37, no. 3 (2015): 681–792, https://ssrn.com/abstract=2652563.

137 For an extensive review of the mechanisms in the context of NAFTA, see Bradly J. Condon, "Mexican Energy Reform and NAFTA Chapter 11: Articles 20 and 21 of the Hydrocarbons Law and Access to Investment Arbitration," *Journal of World Energy Law and Business* 9, no. 3 (2016): 203–19; for the rights of companies in the Mexican legal system, see Guillermo J. García Sanchez, "Las empresas y sus derechos humanos según la Corte" [The human rights of companies according to the Supreme Court of Mexico], NEXOS, *El Juego de la Corte*, April 14, 2014, https://eljuegodelacorte.nexos.com.*mx/?p=3737*.

138 Ibid.

139 García Sanchez, supra note 55.

140 Ibid.

141 See Carlos Vejar's comments on the ratification, "Consequences for Mexico After Subscribing to the ICSID Convention," Holland and Knight Newsletter, January 11, 2019, www.hklaw.com/publications/Consequences-for-Mexico-After-Subscribing-to-the-ICSID-Convention-01-11-2018/.

International Centre for Settlement of Investment Disputes (ICSID) to provide investors and states with services and procedural rules for the conciliation and arbitration of their investment differences.[142] Most important, for investors' rights, the ICSID Convention has a stronger enforcement mechanism than the BITs because it forces states to recognize the pecuniary obligations in the awards "as if it were a final judgment of a court in that State."[143] There is no need to go through the regular judicial enforcement proceedings prescribed by the New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards.[144] Even though Mexico was in the top 10 recipient countries of foreign direct investment and had used the ICSID Additional Facilities before, Mexico had been reluctant to sign the ICSID Convention.[145]

Can the New Agencies Control Gulliver?

In his novel *Gulliver's Travels*, Jonathan Swift describes how the tiny people of the island of Lilliput subdued a giant who washed up on their shore. Imprisoning Gulliver was only possible after the Lilliputians worked together and left their fights over trivial matters aside. The new agencies created by the energy reform cannot subdue the will of the executive power to further implement the reform, but if they work together, they still hold vital competencies to keep the reform afloat or at least mitigate the pace of radical changes. The example mentioned above of the NHC and its power to enforce and supervise the existing contracts is just one of many.

The reform also created the following agencies that mostly regulate the technical and economical operation of the energy market in Mexico: the National Agency for Industrial Security and Environmental Protection of the Hydrocarbon Sector (ASEA), the National Center for Natural Gas Control (CENEGAS), the National Energy Control Center (CENACE), and the Mexican Oil Fund for Stabilization and Development. Both CENACE and CENEGAS are agencies in charge of ensuring technical operation of the energy market. CENACE has "the operative control of the national electric system," must supervise the operation of the "wholesale electricity market," and most importantly has to ensure that there is a "nondiscriminatory and open access to the national grid and the general distribution lines."[146]

With respect to CENEGAS, the agency has the duty to control the "operation of the national pipeline system for the storage and transportation" of natural gas.[147] CENACE basically takes control of the national grid away from the previous state-owned entity, Comision Federal de Electricidad (CFE). Instead of a state monopoly controlled by CFE, now private actors can compete with the state productive company for the generation and

142 The ICSID Convention has been ratified by 153 states and entered into force on October 14, 1966. For the text of the convention, see https://icsid.worldbank.org/en/Documents/icsiddocs/ICSID%20Convention%20English.pdf. For information on the ICSID, https://icsid.worldbank.org/en/.

143 Article 54 ("(1) Each Contracting State shall recognize an award rendered pursuant to this Convention as binding and enforce the pecuniary obligations imposed by that award within its territories as if it were a final judgment of a court in that State. A Contracting State with a federal constitution may enforce such an award in or through its federal courts and may provide that such courts shall treat the award as if it were a final judgment of the courts of a constituent state.")

144 The New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards is one of the oldest international instruments that gives the right to the winning party of an arbitral process to go through a judicial process to have the award recognized in any jurisdiction where the Convention is in force. For more information, see the convention's website at www.newyorkconvention.org.

145 Vejar, "Consequences for Mexico after Subscribing to the ICSID Convention."

146 Article 16 Transitory, ("encargado del control operativo del sistema eléctrico nacional; de operar el mercado eléctrico mayorista; del acceso abierto y no indebidamente discriminatorio a la red nacional de transmisión y a las redes generales de distribución.")

147 Article 16, b) Transitory.

marketing of electricity. CFE is left only with the transmission and distribution of power, which is considered a public service, but private parties, to a limited extent, may also participate in transmission and distribution activities by contracting with the State. The reform also strengthened the role of the Energy Regulatory Commission (CRE) in its role of granting electricity generation permits, permits in the hydrocarbon industry activities (transportation, storage, distribution, compression, liquefaction, decompression, regasification, marketing, and sale of hydrocarbon products to the public), and permits for the management of integrated systems. In the regulation of the market, these agencies can have an impact on the way the new administration perceives the importance of implementing the reform. For example, for the electricity market, CENACE, the CRE, and the Ministry of Energy regulate the sale of electricity produced in small scale near consumption sites, and that are connected directly to a distribution network ("distributed generation"), such as microgenerators of renewable energy.

Of the new agencies, those with a higher level of autonomy are the CRE and the NHC. These administrative entities are considered decentralized organs ("organos desconcentrados") of the federal government that are recognized by Article 28 of the Constitution as "coordinated regulatory organs" of the energy sector and have autonomy in their functions from the Ministry of Energy.[148] As such, they have regulatory powers recognized in the Constitution, and although they are constitutionally part of the federal executive power, they do have technical, operative, and budgetary autonomy.[149] Moreover, the Mexican Senate is involved in the designation of the commissioners of both regulatory agencies.[150] The president must submit three candidates for each commissioner's seat, and two-thirds of the Senate must choose one among the three. If the Senate fails to select a commissioner after thirty days, then the Executive can designate him/her from the list.[151] The commissioners can be reelected for the same position once and can only be removed for "grave" causes.[152] The ASEA is also a decentralized organ but it does have a direct hierarchical dependency from the Ministry of Environment (SEMNARNAT), and it is not recognized in Article 28 of the Constitution as a coordinated regulatory organ in the energy sector.[153] Moreover, the head of ASEA can be designated and removed directly by the president.[154]

People who are committed to the institutions where they work make a difference when there are changes in the political arena. Thus far, the officers at CRE and NHC have technical profiles, with years of experience, and a deep understanding of their duties to their agencies. Civil servants can hold "Gulliver" accountable if they place themselves above politics and place their trust in institutions. They can make it harder for politicians to implement profound policy changes; they can advise the incoming party against backtracking specific policies that could hurt the institutions or the country; they can become the resistance inside the administration that

148 Article 28 of the Constitution ("El poder Ejecutivo contara con los órganos reguladores coordinados en materia energética denominados Comisión Nacional de Hidrocarburos y Comisión Reguladora de Energía") http://www.diputados.gob.mx/LeyesBiblio/pdf/1_150917.pdf

149 Article 10 Transitory, b) and c); Article 12 Transitory; for an explanation of the difference between decentralized and de-concentrated organs see, Josefina Cortes Campos, La administración pública: una categoría normativa en construcción, in CIEN ENSAYOS PARA EL CENTENARIO. CONSTITUCIÓN POLÍTICA DE LOS ESTADOS UNIDOS MEXICANOS, Tomo 2 (2017), p. 77

150 Article 13 Transitory.

151 Ibid.

152 Ibid.

153 Articles 24 and 27, Ley de la Agencia Nacional de Seguridad Industrial y de Protección al Medio Ambiente del Sector Hidrocarburos.

154 Ibid.

makes it hard for the incoming giant to stir the helm too quickly away from the set curse. Mexico has had such profiles in ministries such as the Ministry of Treasury and the Ministry of Foreign Affairs. These two have the lowest turnover rates of high-level officers in the Mexican administration. Particularly the latter one has a deeply rooted culture of institutional loyalty, backed by legislation that fosters meritocracy above politics, and ensures that the diplomatic core follows the pre-established principles and traditions of Mexican diplomacy even when facing new presidents and politically appointed ministers of foreign affairs. The new energy agencies do not have similar laws that protects them from political interference, and the officers are just starting to create an institutional culture, but there is hope that in the long run they will be able to survive any changes and be a pillar of stability. Ultimately, any new administration needs to fill the positions in these organisms and Mexico has few professionals with the expertise in the open energy market.

As part of the energy reform, the national council for scientific and technological activities (CONACYT) and the Ministry of Energy control a public trust in charge of financing research related to the implementation of the energy sector and for creating human capital specialized in the area.[155] As such, the government has the money available to build a new brand of energy government officials trained by the best institutions in Mexico and abroad. These resources must be protected and employed adequately. Mexico recently faced corruption scandals related to the misuse of research related funds that ended up financing political campaigns using contracts with public universities.[156] The public fund for the creation of technology and human capital for the implementation of the energy reform is essential for staffing the newly created agencies. The potential for adequate leadership in the energy sector is there, and it is up to the current administration to make sure that it is not lost in another scandal.

The leadership of public officials has been fundamental in the implementation of the reform. Existing leadership at both the CRE and NHC is praised for their transparency, professionalism, and openness to dialogue with the industry. If a new party comes into power, the existing energy officers could peer up and resist broad changes within the administration. Moreover, they should recommend the continuation of the programs that finance research, technologies, and human capital that ensures that the reform is here to stay. A common front can hold Gulliver to the ground, but division and tribalism can open up the gates for him/her to flood the island.

Conclusion

When it comes to the transitional provisions of the reform, the drafters of the constitutional amendment seemed to have forgotten a common Mexican folk expression: *no hagas cosas buenas que parecen malas,* or "don't do good things that give the impression of being bad things." Instead of providing for the reform's most important elements (the rights of the private companies) in the text of the constitution, they drafted them in the transitory articles with the expectation that doing so would be less controversial. This effort to avoid controversy while still paying lip service to the Mexican revolutionary spirit only gave ammunition to the reform's detractors to fight the transitional articles and the secondary legislation in courts. Hence, it is a false idea that the reform is

155 CONACYT - SENER / Hidrocarburos, https://www.conacyt.gob.mx/index.php/fondos-sectoriales-constituidos2/item/conacyt-sener-hidrocarburos

156 Albison Linares, "El dinero se iba a un agujero negro': el esquema de corrupción que compromete al gobierno de México, The New York Times, Sept 5, 2017, https://www.nytimes.com/es/2017/09/05/el-dinero-se-iba-a-un-agujero-negro-el-esquema-de-corrupcion-que-compromete-al-gobierno-de-mexico/

"bulletproof" because it is constitutional. There is no need to amend the constitution to fight the nature of the contracts in federal courts, because the term *concession*—which is prohibited by the constitution—is not defined. In fact, the existing licenses look very similar to modern-day concessions around the globe.

The drafters of the Mexican energy reform assumed that they would remain in power for long enough to continue to implement the reform, or at least assumed that future administrations would agree with their energy policies. They suffered from a political arrogance reflected in the legal architecture of the reform. Instead of isolating the future of the energy sector from political transitions, they concentrated the power of long-term implementation in the hands of the executive. The new bodies, like the CNH, have limited powers to influence how the state will develop this strategic sector. They are there to assist in the implementation and provide opinions. But ultimately, the man or woman sitting in Los Pinos has the last word on whether the country will adhere to the vision of the current administration or whether he or she will choose to halt the reform. The current administration somehow missed one of the crucial lessons of the modern constitutional order: if a long-standing implementation is what you seek, make sure you isolate the institutions from political cycles. Do not concentrate power with elected officials. In the short run, this might mean that you will lose some levels of control, but in the long run, you will have ensured that the changes will survive the political transitions.

If the existing hydrocarbon developments were already in the production stage; if the flow of oil was helping Mexico to reduce its national debt, lowering the price of gas and electricity; if the new private companies were already hiring nationals in a substantial number and helping to reduce unemployment in specific regions—if all of these were true, then the energy reform would have the most critical insurance policy against political changes. It would already be yielding the benefits envisioned by its designers. Unfortunately, these benefits are not yet visible to the general population, and except for the bonus payments, the revenues are not flowing in levels that would isolate the new "golden hen" from interference.

However, this does not mean that the existing contracts will be renegotiated or canceled. There are many reasons for the new president to maintain them and wait for the projects to yield positive economic results. After all, Pemex production has been in decline for the past 13 years, and the government needs the additional flows of revenue that the E&P contracts are projected to yield. Canceling them without any justification established in the contractual terms and the law would mean that the state would have to compensate the investors for their losses and that it would not benefit from the much-needed investment in the upstream sector. Only the CNH, according to the preestablished set of causations, can cancel the contracts on behalf of the government without violating investors' rights. However, this fact in no way means that the government will have to open new projects to private participation or call new auctions. Consequently, the following key policy recommendations should be kept in mind:

- **Protect CNH independence.** Even though the commission cannot determine whether a future auction will take place, it does control the existing agreements. It is fundamental to ensure that it is as isolated from the political process as possible.

- **Transparency.** The CNH and the ministries that participate in the implementation of the energy reform must be extremely cautious in maintaining a good public perception; in that process, transparency is essential. If financial and production indicators are unclear or contradicted by other data, or if the auctions are tainted by accusations of corruption, it will become easier for the next president to halt the reform's implementation. The best defenders of the reform are numbers to prove that it is generating revenue and benefiting the population.
- **People matter.** It will be up to the incoming Congress to ratify the new members of the CNH. The few controls that the CNH has over the development of the contracts and the determination of assignments must be exercised by people who have a technical background in the industry and are less subject to political influence. Moreover, the government must continue to invest in human capital that fills agency vacancies. The new generation of government energy experts should not be primarily former Pemex or CFE officials as they are today; they should be a new generation, trained in depoliticized environments and in the logic of technical independence from the electoral cycles.
- **Open dialogue.** The existing administration has a responsibility to the industry to engage in a dialogue with whoever ends up being the new president. As opposed to trying to advance as many auctions as possible before December 1, when the new president takes office, the current administration should sit down with the existing candidates, the business community, and the agencies to go over the implementation of the reform. The worst scenario is to give additional political weapons to any new government by accelerating the implementation and risking the chance that the bidding process appears corrupt or fraudulent.
- **Coordinating decisions.** Any decision taken by the CNH or the ministries that could affect the existing contracts should be taken in coordination with the ministry of economy's office in charge of international negotiations and litigation. Mexico has one of the most renowned team of public officials that specialize in the negotiation of bilateral investment treaties and the litigation of investor-state disputes. If Mexico wants to avoid facing international claims, the team at the ministry of economy should be involved in the decisionmaking process to advise the other agencies on plausible litigation risks.
- **Ratification of the ICSID Convention.** Even though Mexico has an excellent international reputation for paying investors after losing an international investment claim, now that the government has decided to sign the convention, it is necessary to ratify it before the next government takes office. Considering the political climate in Mexico today, a failure to ratify the convention would send the wrong signal to investors regarding the state's commitment to help enforce arbitral investment awards.

The Politics of Oil in Mexico: Consolidating the Reforms

Jeremy Martin, Vice President, Energy & Sustainability, Institute of the Americas

To date, no one appears to have ever attempted to assemble a quantitative analysis of the number of diagnostics and policy prescriptions that have been written for the Mexican energy sector, or the oil industry and the national oil company Pemex more precisely. All the same, the amount of ink spilled and breath dedicated to the subject has been immense. Countless bottles of tequila have been consumed as fiery debates raged over the best path forward for Mexico's national patrimony (oil) and national icon (Pemex). Anyone who has worked in or followed the Mexican oil sector over the past two or three decades surely has been privy to conversations and debates over what ails the country—and how to solve it.

This Time, It's Different

The energy reform efforts that began in earnest in the early 2000s during the Vicente Fox administration, followed by those initiated by Felipe Calderón in 2008, were important in the context of moving the debate forward but not in terms of ultimately effecting change. Resistance and opposition to overhauling the sector had not entirely disappeared by Enrique Peña Nieto's election in 2012, but sufficient political will emerged to move forward in modernizing and setting a new path for the sector. Moreover, as candidate Peña Nieto had been emphatic about his desire to seek major energy reforms and had won a clear-cut electoral victory. Indeed, he asserted in several interviews that he would stake his administration's success on attracting private investment to Mexico's oil patch. After his election, he quickly translated that reform mantra to a coalition and agenda called the Pacto por México.[157] That this pact fell apart was less important than the fact that it had catalyzed the energy reform process and allowed the PRI (Partido Revolucionario Institucional; Institutional Revolutionary Party) and the PAN (Partido Acción Nacional; National Action Party) to collaborate and negotiate an ever-more ambitious reform agenda. As Peña Nieto noted during the December 2013 signing ceremony for the energy reform measures—to much applause across the global energy business—he had succeeded in confronting an enormous amount of historical legacy in Mexico, what he called the country's "myths and taboos." Phrased a bit differently: *this time, it's different.* But what exactly, as of early 2018, have those differences resulted in for Mexico?

The cornerstone of the Peña Nieto energy reform, as he had discussed in his presidential campaign, was the need to amend the Mexican Constitution and overturn the seemingly iron-clad prohibition of private sector participation and investment in the country's energy sector. Nowhere was this more relevant than with regard to oil and the national icon of Pemex. The Peña Nieto reform successfully amended Articles 25, 27, and 28 of the Mexican Constitution to open the country's oil sector to private participation and new contractual opportunities for Mexican hydrocarbons, though the measures nonetheless ensured that the state would retain ownership of the nation's subsoil. The nature of the constitutional change was key to institutionalizing and securing the reform's intent and longevity, and it remains the defining element.

157 http://pactopormexico.org/

Additionally, Mexico has moved extremely quickly to implement a major institutional and regulatory restructuring of its entire energy value chain, most critically for private investment in the oil sector. The pace at which the reform has been implemented is particularly impressive when compared with other reforms undertaken in Brazil and Colombia, which took considerably longer. A key part of that pace has been executing the Round Zero process with Pemex and proceeding to prepare terms and contracts, and host a series of auctions that have offered investors a range of opportunities from onshore to deep-water to mature fields. To date, Mexico has hosted eight auctions as part of three bid rounds. Perhaps most important, the auctions have forced Mexican government and industry to work together to ensure that the process not only is competitive globally, but also adheres to industry standards and best practices and exhibits the highest levels of transparency.

Many of the ills afflicting Mexico, Pemex, and the national oil sector stemmed from the lack of technology transfer and insufficient innovation. The reform measures directly and indirectly confronted the need to foster innovation, and contained legal and other elements that would direct and incentivize embracing technology and innovation across the industry—especially at Pemex. Indeed, provisions in the newly created contractual environment pushed Pemex to maximize innovation and technology transfers. But in more concrete terms, the government has also sought to directly support investment in technology and innovation. For example, early 2018 saw the inauguration of a major research and development center in Veracruz aimed at Mexican-made innovative solutions to the challenges of the oil sector, particularly in the deepwater. Overlooked but also important is the fact that Mexico has inserted itself into the global energy governance system, and has formally joined institutions such as the International Energy Agency (IEA) and the Extractive Industries Transparency Initiative (EITI) that will enhance the institutional overhaul and transparency of Mexico's oil sector.

On top of all of the major changes to the country's hydrocarbons sector, the broader intent of the energy reforms, and subsequent Energy Transition Law, underscore the Mexican government's desire to build an energy sector that is commensurate with the need to shift to a low-carbon growth model in the country. Mexico has made a strong commitment to boosting clean energy deployment and set forth ambitious emissions reduction targets and goals as part of its agreement as a signatory to the Paris Agreement on Climate Change.

The path to fully consolidating the reforms and creating a truly competitive, liberalized Mexican oil market is a long one. It is not very useful to set a timetable or projection for when that will or should occur. Yet it is clear that the first critical tests have been passed and the country's path forward to a modern oil sector is far clearer today than before the reform was implemented. There will be challenges, and the rapidly changing global energy outlook is particularly critical for Mexico and where its oil sector fits. But this time, it is indeed different.

The Reform's Moving Pieces

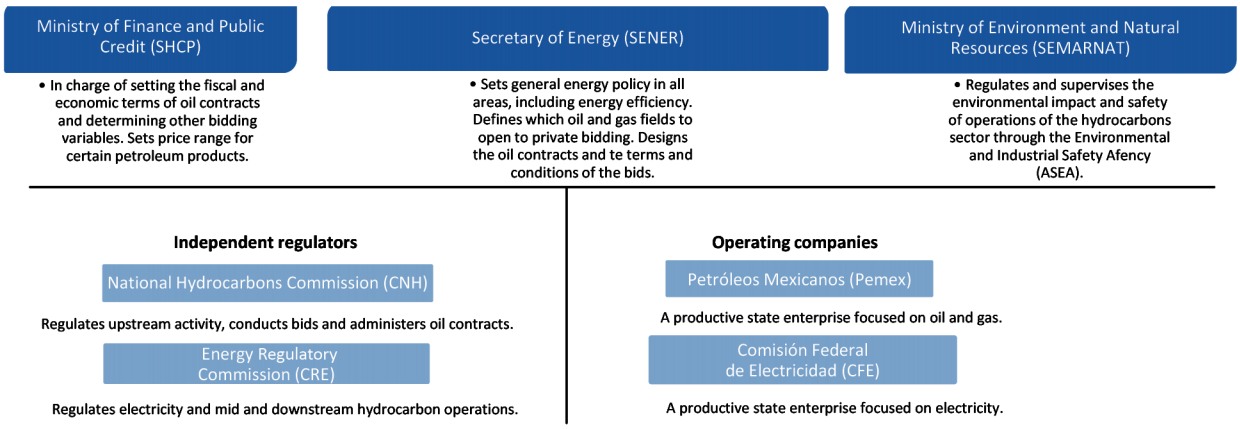
To complement and attain the overarching goal of increased competition and attracting private investment, the Peña Nieto administration sought to thoroughly reorganize and restructure the nation's institutional framework for the energy sector. An overhaul of the sector's governance was critical to enhancing transparency and providing the institutional authority and independence for managing the sector's opening. Defining the roles and oversight responsibilities was set forth in the reforms and secondary legislation, but not surprisingly remains a critical challenge for the long-term viability and in order to create a truly competitive energy market in Mexico.

Government institutions

The reform's overhaul of Mexico's energy governance primarily affected the National Hydrocarbons Commission (Comisión Nacional de Hidrocarburos; CNH) and the Energy Regulatory Commission (Comisión Reguladora de Energía; CRE), with measures to transition each from government entities to fully independent regulators. Meanwhile, the role of the energy ministry (Secretaría de Energía; SENER) and Secretariat of Finance and Public Credit (Secretaría de Hacienda y Crédito Público; SHCP) would be further defined in terms of the energy policymaking and fiscal elements of the new governance structure. The environment ministry (Secretaría de Medio Ambiente y Recursos Naturales; SEMARNAT) was chosen to support a newly created regulatory body, the Agencia de Seguridad, Energía y Ambiente (Agency for Security, Energy, and the Environment; ASEA), that would oversee environmental and safety issues in all segments of hydrocarbon development. ASEA, was not however, granted the level of independence that the reform afforded the CRE and CNH. Included in the restructuring was the transition of the nation's two state-owned enterprises in the energy sector, Pemex and the Federal Electricity Commission (Comisión Federal de Electricidad; CFE), to what the reform denoted as a new quasigovernmental structure called a productive state enterprise.

According to a succinct analysis prepared by the IEA (figure 4.1), SENER is the principal energy policymaking body in the government, charged with setting general energy policy in all areas. Moreover, in the oil and gas sector, SENER is responsible for defining which oil and gas fields would be auctioned, and for designing oil contracts and the terms and conditions of the bids. SHCP is responsible for setting the fiscal and economic terms of oil contracts and determining other bidding variables, as well as determining pricing for a certain range of petroleum products. SEMARNAT hosts the regulatory ASEA, which is charged with supervising the environmental impact and safety of operations across the entire hydrocarbons value chain.

Figure 4.1. Restructuring of the Mexican Energy Sector



Source: IEA, *Mexico Energy Outlook* (2016).

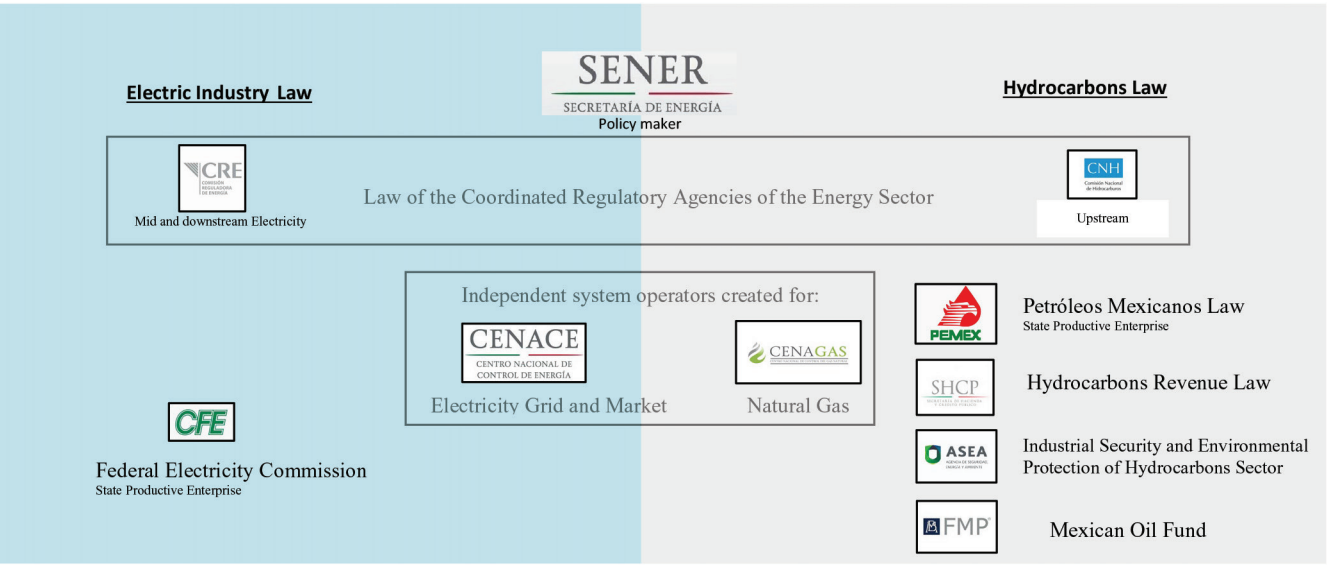
Meanwhile, the CNH as a newly constituted independent regulator is responsible for regulating all upstream activity in the country's oil and gas sector, as well as conducting public auctions and bid rounds and administering and overseeing upstream oil and gas contracts. The CRE, the most mature regulator—having been created more than 20 years ago during electric sector market reforms—is charged with regulating the electric sector and overseeing midstream and downstream operations and segments of the hydrocarbons value

chain. Notably, these reforms provided both CNH and CRE with autonomy and independence from the federal government and created a new institutional structure that allotted each agency seven Senate-approved commissioners, with staggered terms to provide continuity and minimize political interference.[158] (For more details on regulatory agencies, see figure 4.2.)

Another institutional change was derived as part of the process and transformation of Pemex and the reduction of its monopoly in Mexico's oil and gas sector. As part of that effort, the reforms forced Pemex to hand over to the newly created CENAGAS (Centro Nacional de Control del Gas Natural; National Natural Gas Control Center) control of its 87 natural gas pipelines across almost 9,000 kilometers. Pemex was thus limited to providing system maintenance and operational assistance.[159] Meanwhile, privately developed and operated pipelines were permitted to integrate into the national system in adherence to open-access principles.[160]

CENAGAS was created to manage, administer, and oversee the nationwide operations, transportation, and storage of natural gas. It is charged with coordinating the country's natural gas supply and distribution network in the most secure, efficient, and reliable way possible, including authority and responsibility for overseeing the bidding process by which private enterprises can invest in Mexico's natural gas pipeline network. Beyond taking over the administration and maintenance of the existing pipeline system, a key element of its mandate is to expand the pipeline network in Mexico. Plans point to an ambitious expansion of Mexico's natural gas pipeline network with projections indicating more than doubling the network to more than 20,000 kilometers by 2019.

Figure 4.2. Energy Sector Regulatory Agencies and Legal Structures



Source: CRE.

158 Women in Energy/Mujeres in Energía, "The Future of Mexico's Energy Sector," Institute of the Americas, October 2017, www.iamericas.org/documents/energy/reports/Future_Mexico_Energy_Sector.pdf.

159 "Pemex and Cenagas Signed an Assets Transfer Contract of the National Pipeline System" (press release), Pemex, October 29, 2015, www.pemex.com/en/press_room/press_releases/Paginas/2015-099-national.aspx.

160 Richard H. K. Vietor and Haviland Sheldahl-Thomason, *Mexico's Energy Reform* (Harvard Business School, January 2017), www.hbs.edu/faculty/Pages/item.aspx?num=52187.

Productive state enterprises

The reforms focused on restructuring Mexico's state-owned enterprises and sought to convert Pemex and CFE into "state productive enterprises" whose portfolios of responsibilities (which previously included issues such as the country's energy security) were revised to focus on value creation.[161]

As part of the transition for Pemex to become a productive state enterprise with a focus on efficiency and competition, the reform spelled out major changes to the company's structure, particularly the composition and size of the board of directors. The total number of members was cut from 15 to 10, and the five board members representing the oil workers' union were removed and replaced with five public members. The number of government representatives likewise was reduced to five seats to be held by the energy secretary (the chair of the board), the finance secretary, the economy secretary, the environment secretary, and the deputy secretary for hydrocarbons. Further structural adjustments aimed at reducing costs and boosting efficiency at Pemex included reducing the company's subsidies from four to two, and enacting overarching managerial reforms of the company's legal, financial, and human resource functions. One of the new subsidies focuses on upstream activities while the other manages industrial transformation, essentially the downstream segments and aspects of the company's portfolio. In a further effort to enhance productivity, Pemex created five new subsidiaries focused on drilling, logistics, cogeneration and services, fertilizers, and ethanol.[162]

As discussed above, the Pacto por México had included major structural adjustments intended to boost economic growth and competitiveness in Mexico. Fiscal reform and enhanced tax collection were seen as key pieces to complement the energy reform measures. For years, Mexico held the notorious distinction of topping the Organization for Economic Cooperation and Development (OECD) ranking for lowest tax revenue of its member countries.[163]

To complement the energy reform, and in an acknowledgment of the fiscal straightjacket that decades of Mexican governments had placed on Pemex, the Peña Nieto administration pursued a major overhaul of the federal tax system largely focused on reducing tax breaks, boosting income taxes, and improving collection. As part of the fiscal reform, Pemex would see reduced tax rates, specifically in the number of taxes the company would be required to pay the federal treasury. Pemex was set to pay on the order of 36 percent in taxes and royalties per year, a major reduction in its burden that routinely had been three times greater than the new figure.[164]

Mexico's sovereign oil fund

Formally known as the Mexican Petroleum Fund for Stabilization and Development (Fondo Mexicano del Petróleo para la Estabilización y el Desarrollo), the Mexican sovereign oil fund was created as part of the reform measures to bring increased transparency and fiscal discipline to the management of the economic rents derived

161 International Energy Agency (IEA), *Mexico Energy Outlook,* World Energy Outlook Special Report (Paris: Organization for Economic Cooperation and Development [OECD]/IEA, 2016), www.iea.org/publications/freepublications/publication/MexicoEnergyOutlook.pdf.

162 Vietor and Sheldahl-Thomason, *Mexico's Energy Reform*.

163 Krista Hughes, "Analysis: Mexico Aims to Overhaul Tax System, Raise Revenue," Reuters, May 6, 2013, www.reuters.com/article/us-mexico-tax/analysis-mexico-aims-to-overhaul-tax-system-raise-revenue-idUSBRE9450A520130506.

164 Vietor and Sheldahl-Thomason, *Mexico's Energy Reform.*

from the development of the country's hydrocarbons. Specifically, the fund was established and placed under the management of the central bank and a board comprising the ministers of finance and energy, the chairman of the central bank, and four independent members nominated by the president and ratified by the Senate. The fund will hold all royalties and resource rents from the oil and gas sector. The parameters for usage spell out clear limitations and note that the right to withdraw from this fund to finance the government budget is capped at 4.3 percent of gross domestic product (GDP).[165]

The fund draws from the lessons of other countries where the management of the oil sector and its fiscal impacts offered mechanisms to improve fiscal stability and management and allay concerns over the so-called resource curse. These financial structures, often referred to as sovereign wealth funds, are deemed critical to effectively diversifying and allowing for the investment of wealth derived from resource production—petroleum, in the case of Mexico. In the oil sector, Norway has the most relevant and largest fund, having built up a tremendous financial portfolio in excess of $1 trillion with the express purpose of providing a countercyclical fund and reserve "for when the oil and gas reserves run out."[166]

Clearly, international references greatly informed this element of Mexico's energy governance restructuring and enabled the creation of a well-conceived plan for managing natural resource wealth. But executing and implementing the objectives of the fund requires continued evaluation and attention. Indeed, Norway has continually reevaluated its fund's mechanism and structure for ensuring that its citizens reap the greatest financial benefit from its finite natural resources. This is particularly relevant not just for the fund but for the related aspects of the management and role of the national oil company, an area where Mexico's reform is subject to ongoing debate.

Round Zero

Called by some the first concrete step toward breaking up Pemex's monopoly in Mexico's oil and gas upstream, Round Zero was the process by which the national oil company submitted to SENER and CNH the assets it wished to keep under its control.[167] Prior to the first public auction held by the government (Round One), the reform spelled out a process that granted Pemex an opportunity to request from the government an initial allocation of exploration and production rights and assets to maintain its participation in the market. Unique as it sounds, Round Zero was not invented for Mexico's energy reform; Brazil and Colombia had held similar rounds as they revamped their petroleum sectors in 1997 and 2003, respectively.

Through the process, Pemex was required to justify its request in terms of financial and technical capabilities to develop the assets and projects it sought to retain. Ultimately, SENER (with CNH input and advice) granted Pemex 21 percent of Mexico's prospective resources, versus the 31 percent the company had sought.[168]

165 IEA, *Mexico Energy Outlook.*

166 Briony Harris, "What Is a Sovereign Wealth Fund?" World Economic Forum, October 13, 2017, www.weforum.org/agenda/2017/10/what-you-need-to-know-about-sovereign-wealth-funds/

167 "Pemex Wish List Signals Start of Mexican Energy reform," *Financial Times,* March 20, 2014, www.ft.com/content/e0a5c578-b019-11e3-b0d0-00144feab7de.

168 "FACTBOX—Mexico's Round Zero and Round One Oil Projects," Reuters, August 13, 2014, https://in.reuters.com/article/mexico-reforms-energy/factbox-mexicos-round-zero-and-round-one-oil-projects-idINL2N0QJ2Z620140813.

Overall, Pemex received rights to assets and projects that represented 85 percent of Mexico's proved reserves and 20.6 billion barrels of oil equivalent (billion boe) of proved and probable reserves (2P) covering 90,000 square kilometers. Furthermore, the government agreed to reserve the right to assign, on an exceptional basis, additional exploration and production areas to Pemex.[169]

Oil and gas auctions

One of the most critical elements of the reform process and its goal of opening Mexico's upstream to competition and private participation was public bidding and auctions. As a byproduct of the framework established in the reforms, and the clear mandate for SENER as the policymaker and CNH as the upstream regulator and administrator of the auction process, the government created an ambitious program as part of its five-year plan for four bid rounds between 2015 and 2019 that will open a rich, diverse portfolio of exploration and development blocks across the country, both onshore and offshore.[170]

To date, Mexico has carried out eight auctions as part of three bid rounds. Round Three contemplates two more auctions before the end of 2018, with discussion underway to add another auction and bidding aimed specifically at heavy oil projects.[171] The auctions have resulted in important financial commitments, and as of late March 2018 Mexico had received pledges in excess of $173 billion to develop the projects.[172]

Round One

The initial results in the first phase of Mexico's Round One were highly criticized for the lack of competition and participation. The results of the country's first private oil bidding in July 2015 was not the start that the Mexican government had sought, nor did it pan out the way those eager to invest had hoped. Some observers argued that in addition to the profit-sharing and investment requirements, the $6 billion corporate guarantee was too onerous.

By most metrics, including those established by the government, awarding merely 2 out of 14 blocks on offer was subpar. Yet there is more to the story than just the letdown in terms of the number of bids. The lackluster first auction also increased the burden on the government to improve competition and the fiscal and contractual attractiveness for future tenders, in particular the highly anticipated deepwater bidding. Given the volatility in international oil markets, there was much speculation over what might have happened in a more favorable oil price environment. But the July 15 results point more toward the minimum bid requirements and the floor established by the Mexican government, and specifically the SHCP, that was the real game-changer for

169 Adrián Lajous, *Mexican Oil Reform: The First Two Bidding Rounds, Farmouts and Contractual Conversions in a Lower Oil Price Environment* (New York: Center on Global Energy Policy, School of Public and International Affairs, Columbia University, October 2015), http://energypolicy.columbia.edu/sites/default/files/Mexian%20Oil%20Reform_October%202015.pdf.

170 Sener, "Plan Quinquenal de Licitaciones para la Exploración y Extracción de Hidrocarburos: 2015–2019," Government of Mexico, http://sener. gob.mx/res/index/plan/Plan Quinquenal.pdf; and Lajous, *Mexican Oil Reform.*

171 David Alire Garcia and Marianna Parraga, "Mexico's Pemex Raises Hand in Final Oil Auction before Election," Reuters, March 27, 2018, https://in.reuters.com/article/mexico-oil/mexicos-pemex-raises-hand-in-final-oil-auction-before-election-idINKBN1H32LY.

172 David Alire Garcia and Marianna Parraga, "Shell Sweeps Nine of 19 Blocks Awarded in Mexico Oil Auction," Reuters, January 31, 2018, www.reuters.com/article/us-mexico-oil/shell-sweeps-nine-of-19-blocks-awarded-in-mexico-oil-auction-idUSKBN1FK278.

the tender.[173] These were valuable lessons to learn, and to their credit, both the Mexican government and the industry seeking to participate in future auctions implemented important adjustments and modifications in the following rounds.

Yet despite the handwringing following the first auction, it immediately bore some fruit. One of the main goals of the energy reform measures was to boost competition and open Mexico's oil industry to new entrants. Nine international and Mexican firms participated in the first bid round, and two blocks were awarded to Mexico-based Sierra Oil & Gas in a consortium with Talos Energy from the United States and Premier Oil from the United Kingdom. The big winner in the first auction, therefore, was a consortium that included British and U.S. companies, led by a company established in Mexico specifically to pursue such new opportunities. Hindsight also has revised some of the more pessimistic views of the so-called failure of Round One's first auction, as the Talos/Premier/Sierra oil discovery at a block won in the first-ever auction greatly buoyed the reform's architects and proponents and affirmed the importance of unleashing private investment to search for and exploit Mexico's hydrocarbons.

As the rounds proceeded, the government actively sought to adjust to the market realities the future bidding opportunities with increasing success. The changes produced improved results during the second auction of Round One as the government awarded three out of five shallow-water blocks on offer to a wide range of international companies including Eni of Italy; Pan American Energy of Argentina (partially owned by BP); Fieldwood Energy from the United States; and PetroBAL of Mexico, a private firm with solely Mexican capital that was created expressly to pursue the market opening in Mexico.[174] Moreover, the block that Eni won at the second auction of Round One also proved to be an important investment and led to a major discovery announced in mid-2017, with oil production slated to begin in early 2019. Interestingly, Eni reportedly is in talks with Qatar Petroleum to farm in—that is acquire a stake—in their project and discovery, further affirming the increasing maturity of the Mexican oil sector and the global interest in it.[175]

Mexican authorities adroitly developed the third auction of Round One to boost participation by Mexican firms and operators. Indeed, the auction came to be known informally as the "Mexico Round," and was a key piece of the government's efforts to incentivize and stimulate participation and market access for Mexican firms in the evolving market by offering less onerous financial requirements and bidding terms. Twenty-five on-shore blocks were offered as part of Round One's third auction and all were successfully tendered, with 18 won by Mexican firms.[176]

The fourth and final auction of Round One had been purposely placed at the end of the round. Mexico was finally starting to open the so-called jewels in the crown: the highly touted opportunities for private exploration and production in its offshore deepwater in the Gulf of Mexico. The most anticipated and lucrative of the

173 Jeremy Martin and Alexis Arthur, "Why Mexico's Historic Oil Bid Wasn't a Complete Flop," *Christan Science Monitor,* July 17, 2015, www.csmonitor.com/Environment/Energy-Voices/2015/0717/Why-Mexico-s-historic-oil-bid-wasn-t-a-complete-flop.

174 Vietor and Sheldahl-Thomason, *Mexico's Energy Reform.*

175 Amy Stillman and Chiara Albanese, "Eni, Qatar Hold Talks for Deal on Giant Mexico Field," *Bloomberg,* April 5, 2018, www.bloomberg.com/news/articles/2018-04-05/eni-qatar-are-said-to-hold-talks-for-deal-on-giant-mexico-field.

176 "L03 Seguimiento y Transparencia: Resultados" [L03 Monitoring and transparency: Results], Rondas Mexico, Government of Mexico, 2016, https://rondasmexico.gob.mx/l03-seguimiento-y-transparencia/#resultado.

Round One auctions, it included 10 blocks; late in the planning stages, a deepwater joint venture project known as Trion was added in parallel to the bidding process and public auction set for December 2016. Trion was added in July, seven months after the auction and terms had been formally launched.

The Trion project was the first of the farmouts permitted under the reform to allow Pemex to seek a partner for developing major deepwater opportunities. The structure of the reform required Pemex to conduct a public process for its partner through CNH modality and management. By placing the deepwater auction at the end of Round One, the Mexican government assiduously worked to enhance the fiscal and contractual terms throughout the preceding year and a half in order to prepare for the hugely important offer for private investment in the country's deepwater—projects and investments that typically run into the several billions of dollars and can take up to a decade to produce their first barrel of oil.

The government had received an enormous amount of information and feedback from earlier auctions, and all involved had developed a keener understanding of how to structure the bid process for competitive data rooms for qualification and participation, but most important in terms of the fiscal and contractual elements that would dictate investors' final bidding and auction offering decisions. Though there had been some debate about the offering structure early in the development of the Round One bid process, Mexican authorities ultimately decided to offer the deepwater blocks using so-called license contracts that are similar to standard international oil and gas concessions.

On December 5, 2016, the Mexican authorities gathered at a massive conference facility in Mexico City, which ironically abutted the city's horse racing track. The government hoped that the deepwater bids would spur enthusiastic competition among international oil companies seeking to enter the Mexican market and further develop the country's deepsea oil riches. As the deepwater oil and gas auction came to a close, words such as *momentous, significant,* and *historical* were flying around Mexico City and the broader global energy world. As the final block was adjudicated just before the Mexican lunch hour, the success in terms of winning bids, competition, and diversity of bidders was clear for all at Mexico City's Centro Banamex and those watching the livestream to see. Although Secretary of Energy Pedro Joaquin Coldwell had indicated that SENER would be happy if four of the ten blocks were awarded, a full eight of the ten blocks on auction, and the farmout and partnership with Pemex, were successfully tendered, exceeding the government's expectations. The first-ever Pemex farmout was awarded to the Australian firm BHP Billiton, based on a winning payment of $624 million. It had tied with BP in terms of additional royalty commitments—each had bid 4 percent.

Given the diversity and size of the bids tendered, oil prices difficulties and capital constraints did not have as much of a depressing effect as anticipated. The success of the auction offered a strong argument that even in a capital-constrained global energy market, large projects could still be successful when the investment terms and conditions are right. Likewise, fears of Pemex's ongoing troubles seemed to be greatly exaggerated. As the forthcoming projects with BHP Billiton and Chevron & Inpex underscored, Pemex was in a position to work as part of major international consortiums to learn firsthand the best practices and operational excellence of the oil and gas industry. Sierra Oil & Gas—a Mexican firm that was created to pursue opportunities in the Mexican oil sector—also was able to carve out an important role in Mexico's postreform upstream landscape, participating in two more blocks to bring its total to four. It was the most aggressive and committed bidder with bids that far

exceeded the minimum additional royalty terms established by the government. Yet without the energy reform measures, Sierra Oil & Gas would not have existed in the first place.

CNH and the Mexican government conducted the deepwater auction with sufficient transparency, as well as a highly rigorous qualification and adjudication process that left few doubts as to the validity and objectivity of the bids. The terms and process produced an important level of competition, particularly for Salina Basin opportunities. The deepwater auction attracted a number of major upstream oil and gas firms, with BP, ExxonMobil, Chevron, Total, Statoil, CNOOC, and Petronas all emerging as winners (figure 4.3).[177]

Figure 4.3. Mexico's Deepwater Auction: Winners

Block	Winner	Country
	TRION	
Farmout	bhpbilliton	Australia
	PERDIDO	
Block 1	CNOOC	China
Block 2	ExxonMobil, TOTAL	France/US
Block 3	Chevron, PEMEX, INPEX	US, Mexico, Japan
Block 4	CNOOC	
	CUENCA SALINA	
Block 1	Statoil, bp, TOTAL	Norway, UK, France
Block 2	- - - - - - - - - - - - - - - - - - - -	- - - - - - - -
Block 3	Statoil, bp, TOTAL	Norway, UK, France
Block 4	PETRONAS, SIERRA OILGAS	Malaysia, Mexico
Block 5	MURPHY, ophir, PETRONAS, SIERRA OILGAS	US, UK, Malaysia, Mexico
Block 6	- - - - - - - - - - - - - - - - - - - -	- - - - - - - -

Source: "Webinar: Long-Term Regulatory Certainty in Mexico," Institute of the Americas (March 15, 2018).

Round Two

Similar to the structure of Round One, the Mexican authorities placed the most lucrative opportunities and blocks as the final auction for the round. Just as Round One concluded with deepwater blocks on offer, Round Two concluded with an even greater number of deepwater blocks for bidding. In the end, 19 of the auction's 29 blocks were successfully tendered, far outpacing the estimates of many in the government and industry.[178] Winning bidders paid the government $525 million as part of their offers to acquire blocks in the auction. Moreover, the government again was quick to highlight the investment pledges and potential of the round: an estimated $93

177 Jeremy Martin, "Mexico Celebrates Oil Auction Bidding Bonanza," Institute of the Americas, n.d., https://www.iamericas.org/en/archives/latest-articles/2264-mexico-celebrates-oil-auction-bidding-bonanza

178 "Ronda 2. Aguas Profundas Cuarta Convocatoria" [Round 2: Deep water fourth call], Rondas Mexico, Government of Mexico, January 31, 2018, https://rondasmexico.gob.mx/r02-l04-seguimiento-y-transparencia/#resultados.

billion over the life of the projects adjudicated. Authorities also noted that the blocks ultimately could lead to oil production of approximately 1.5 million barrels per day. Most important, perhaps, was the commitment displayed by Shell, which was by far the most aggressive bidder and won 9 of the 19 blocks adjudicated by the Mexican government.[179]

Earlier in the round, the first auction focused on shallow-water opportunities and counted 15 blocks on offer. The government was pleased with the results, as 10 of the 15 were adjudicated and the previous winner increased its participation in the Mexican market by winning three bids. Major players Total and Shell also acquired blocks. In addition, Colombia's Ecopetrol acquired its first block and investment in the Mexican market.[180]

Round Three

On March 27, 2018, Mexico's historic energy reform reached another milestone. With the clock ticking and the July 1 elections looming, the Mexican government showed no signs of slowing its pace. By most accounts, the first offer of the Round Three auctions exceeded expectations, highlighting what several industry analysts insisted is the most critical factor supporting Mexico's opening: the potential and prospectivity of below-ground resources. All told, 16 of the 35 blocks on offer were awarded. Most blocks featured competition among several possible investors, and led to some aggressive bids and fiscal upside for the Mexican government. Cash bonuses offered to the Mexican government by winning bidders surpassed $124 million. Total investments in the projects were posed to exceed $8.5 billion over the life of the contracts.[181]

Before March 27, the Mexican government had been gaining confidence with increasingly competitive bid rounds and growing investment commitments and market participants. CNH and SENER officials promoted the fact that the first- and second-round auctions led to more than 90 contracts signed, hundreds of millions of dollars in cash bonuses offered by winning bidders, and long-term investment plans that could reach as high as $150 billion over the course of the contracts. These early bid rounds produced important lessons for the government on the mechanics of the auction process and, most important, on how to prepare and finalize the contract and fiscal terms for the blocks on offer. Moreover, important oil discoveries by new market participants in the months leading up to the auctions greatly undergirded further bidding efforts and in many ways were able to lower the risk of some of the elements of the nascent market for new entrants in Mexico.

Farmouts

José Antonio González Anaya, the second director-general of Pemex under President Peña Nieto, assumed control of the company in early 2016. In many of his initial interviews, speeches and public appearances, he went to great lengths to emphasize the need and opportunity for Pemex to seek partners. Partnerships, he argued, are a way for Pemex to address some of its fiscal constraints but also provide lessons and support for more efficient and technologically savvy development of its assets, especially the more challenging ones in its

179 Garcia and Parraga, "Shell Sweeps Nine of 19 Blocks."

180 http://www.oedigital.com/component/k2/item/15617-mexico-s-round-2-1-begins

181 "Ronda 3, Licitación 01. Aguas Someras: Seguimiento y Transparencia" [Round 3 Bid 01. Shallow waters: Monitoring and transparency], Rondas Mexico, Government of Mexico, https://rondasmexico.gob.mx/r03-l01-seguimiento-y-transparencia/#resultados.

portfolio. "If we can get efficiency gains through operation, through technology, it's even more profitable for Pemex," he argued in terms of the differences between outright sale of an asset and joint ventures.[182]

As part of the process of asset allocation undertaken during Round Zero, certain projects that remained under Pemex's control, particularly those that required more capital and technology, were viewed with an eye toward utilizing one of the reform's key elements: private sector partnerships with Pemex. As had been argued during years of energy reform debate, such partnerships would give Pemex not only new possibilities for access to capital but also other key elements for developing large, challenging oil projects, including technology transfer, know-how, and managerial skills. The company desperately needed the exposure and experiences from these partnerships and joint ventures with international and private firms with global reach and experience. Fortunately, the energy reform had given Pemex a method to attract partners.

A key modality for this new ability was the farmout process, by which Pemex could formally invite companies to partner on the development of specific projects. Specifically, the government developed a process by which Pemex would be allowed to seek partners through a practice known in the oil industry as a farmout, a process whereby the national oil company could bring on a private partner that would then commit to future contribution of capital and operational expenses. Most important, the government expected Pemex to seek partners and farm out a number of fields which it had started to develop. As Adrian Lajous, a former director-general of Pemex, has noted, the farmout process recognized Pemex's investment in past exploration and production efforts and enabled it to partially monetize those assets.[183]

Interestingly, however, the format for Pemex to proceed with the farmouts was to be closely managed and directed by the government, with SENER, SHCP, and CNH input. One of the most unusual parts was that the Pemex farmout opportunities would be managed through the government's auction and public bidding modality, though Pemex did retain the ability to provide technical input as part of the preparation of the bidding documents. Adrian Lajous called the structure an "awkward arrangement."[184]

Plaudits

The energy reforms have received their fair share of both praise and criticism. It is worth looking in greater depth at some of the highlights of the reform for Mexico's energy future.

Pace

As with most highly politicized issues, Mexico's energy reform has had its dissents, with one possible exception: the speed and pace at which the reforms and significant steps have unfolded. As discussed previously, the opening of the sector based on constitutional amendments to Articles 25, 27, and 28 required developing a strong new legal and regulatory framework to allow new participants in the sector, to strengthen existing

182 Robert Grattan, "Pemex Looks for Outside Partners," *Houston Chronicle,* February 23, 2016, www.houstonchronicle.com/business/energy/article/Pemex-looks-for-outside-partners-6850503.php.

183 Lajous, *Mexican Oil Reform*.

184 Ibid.

regulators, and to create new agencies. This process took less than three years—a stark contrast with other countries where similar market overhauls took four to six years to be in a position to hold their first public bid round.

The reform, secondary legislation, and key steps were all swiftly approved and initiated for a number of reasons. As an example, it is worth looking at the previously discussed process known as Round Zero, one of the most critical phases to delineating the role and asset ownership of Pemex, the government, and possible private market participants. Brazil and Colombia underwent similar structural changes intended to reshape the ownership of their oil between nation and national oil company. The international context is important. Not only have Colombia and Brazil embarked on similar paths to opening their oil sectors in terms of verbiage, but compared with Mexico, in both countries the Round Zero process was managed comparably over a more extended period. Brazil took the better part of two years to define Petrobras's Round Zero assignments; for Colombia's Ecopetrol, the process lasted over a year. Mexico completed the Round Zero process in less than one year.

Beyond that concrete example, when it comes to the oil sector opening, Mexico has proceeded to implement secondary legislation and a redefined energy governance structure that created several new agencies and reconfigured others. Additionally, as the government is keen to emphasize, Mexico has hosted eight auctions that have garnered over 100 contracts with new, private market participants with major investment commitments.

Constitutional amendments

As Mexico hurtles toward elections in July 2018, the steps taken by the Peña Nieto government to gain energy reform through a constitutional amendment are of increasing importance. A two-thirds majority vote in Congress is needed to amend, or in the case of the energy reform, overturn, the constitution. Given the fractured state of politics and the likelihood of a fairly divided legislative body, it is unlikely that whoever wins the presidency will be able to cobble together sufficient support for a new constitutional change. Therefore, as the political rhetoric of the 2018 electoral cycle ramps up, it is evident that enshrining the reform tenets in the constitution provides important sustainability and greatly reduces the potential for political interference, or at least demands a political majority to reverse the constitutional changes.

Transparency

Regrettably, the Peña Nieto administration has suffered greatly from a series of scandals that called into question the integrity of his government. Indeed, much of the aforementioned 2012 campaign rhetoric—particularly that of a new PRI, one above scandal and not tainted by the party's legacy of corruption—have all but disappeared. But with regard to the energy reform, there have been important strides and progress to ensure the uprightness of the measures and their implementation across the government. Three key indicators point to the gains made during the energy reform.

First, during the entire development and execution of the upstream auctions held by the government and specifically the CNH, the process has been conducted in an open, well-defined, and transparent manner. The qualification process, in fact, has been criticized for its bureaucratic hurdles, which surely have been done with an eye to full openness. Moreover, the actual auctions and selection process have all had live transmissions, with fully open and transparent solicitation and bid opening ceremonies, and have been applauded by experts and practitioners across the globe.

Second, the previously discussed farmout process at Pemex has been conducted with true openness. As awkward and unusual as the process may be for a company to acquire a partner through a public bidding process, the reform clearly spelled out the procedures as a critical part of the effort to render the highest level of transparency to the entire upstream auction and bidding process. Government officials and all stakeholders involved in the reform understood and recognized that any doubts (or worse, scandals) could greatly impinge the reputation of the entire reform and jeopardize its future.[185]

Finally, in late 2017, the EITI board approved Mexico's membership application, enabling it to join what has been called the global standard for the good governance of oil, gas, and mineral resources. Acceding to the EITI is an important step of the energy reform process in Mexico and its efforts to not only increase transparency but also bring to bear international best practices and further decentralize and socialize the access to critical information about the development of Mexico's natural resources, particularly its oil reserves. According to the press release coinciding with Mexico's accession, "the EITI addresses a range of issues relevant to the outlook for the oil, gas and mining sectors, including license allocation, production data, tax transparency, the role of state owned enterprises, and the allocation of the revenues, including to the recently created Mexico National Oil Fund."[186] Mexico will now proceed to gain implementing country status with the EITI, a process that will require it to adopt EITI reporting standards within 18 months. Further, the process requires validation within two-and-a-half years from the acceptance of its candidacy. The validation process could prove to be the most relevant. Attention derived from adherence to EITI standards typically focuses on boosting governance and transparency in revenue management. In Mexico's case, the focus is on the EITI's multiple-stakeholder group and its efforts to promote dialogue. The validation process will assess how Mexico has fared with the adoption of the EITI standard, along with the critical lessons learned and evidence of addressing stakeholder concerns and recommendations. Indeed, as Shell's Mexico country chair, Alberto de la Fuente, noted, "The EITI is a fundamental standard in our industry . . . this tool will contribute to an informed, transparent and accountable public discussion for the benefit of Mexicans."[187]

In addition to joining a large group of like-minded countries and the agreement to standards, protocols, and procedures for managing natural resource development, the EITI is also an important mechanism for the involvement of civil society and nongovernment organizations in a forum for open, transparent dialogue with government and industry. Beyond the obvious elements of increased transparency and improved management of the natural resource value chain, a key EITI element is the multistakeholder group involved in all implementing member countries. Each country develops its strategy for adherence to EITI standards through its multi-stakeholder group composed of government, industry, and civil society representatives.

Naturally, the need to further imbue Pemex with a sense of this goal and end-game remains a huge element going forward, one that should be addressed as part of the effort to consolidate the reform. Suffice to say that the recent scandals, including the transgressions of President Peña Nieto's first Pemex director-general, are significant knocks against what has indeed been a transparent and honest market sector opening.

185 Ibid.

186 "Mexico Embraces Oil, Gas and Mining Transparency," EITI, October 25, 2017, https://eiti.org/news/mexico-embraces-oil-gas-mining-transparency.

187 Ibid.

Investments

The results from the reforms in terms of investment commitments have increased as the market opening and auction process has been refined. Recent investment commitments have begun to underscore a key factor supporting Mexico's opening: the potential and prospectivity of the below-ground resource. The auctions and bidding have demonstrated that the reforms have been successful in designing an internationally competitive legal and regulatory framework and significantly incorporating the global oil industry's best practices. The Mexican government proudly touts the running total of contracts, the number and geographic diversity of companies, and the level of investment commitments attained as part of the upstream auctions and bidding process. As of late March 2018, Mexico had received commitments greater than $173 billion to develop the projects.[188]

An 2016 IEA analysis assessed the investment impact of the reform measures on investment and private participation, and speculated on what might have transpired had the reforms not been implemented. The study found that if Mexico had not implemented the 2013–14 reforms, its oil production would barely recover to 2.3 million barrels per day and it would receive 45 percent less revenue from the oil sector. Specifically, the IEA "No Reform Case" indicates that by 2040, the value caused by the lost oil output could have reached $650 billion, while upstream investment would be around $260 billion lower.[189]

Discoveries

As discussed, one of the strongest challenges that had built up over time for Mexico and its national oil company was declining production, worsened by an inability to replace the oil reserves it was producing. Even as Pemex produced less and less oil, it also found less and less of it, and could not achieve the standard for future sustainability of at least 100 percent of reserve replacement.[190] This challenge remains at Pemex, but Mexico's national oil sector outlook has seen important developments directly related to the entrance of private participants and stemming from the auction process and investments flowing into the sector.

In January 2018, for the first time since the expropriation of foreign oil companies in 1938, Mexico certified oil reserves of private and foreign market participants. According to the CNH, the discoveries made in two projects amount to some 251 million boe from two shallow water blocks auctioned in late 2015 to Italy's Eni and Argentina's Pan American Energy. CNH president Juan Carlos Zepeda announced to the media that "what we see here is the first certification of reserves that are being presented by two companies that received contracts at auction." He added that the reserves from the two blocks have tripled since the companies took them over from Pemex.[191] The latter point should require little explanation in terms of its importance for the reform's implementation and as a diagnostic of the ills afflicting Pemex.

188 Garcia and Parraga, "Shell Sweeps Nine of 19 Blocks."

189 IEA, *Mexico Energy Outlook.*

190 According to the U.S. Energy Information Administration (EIA), the reserve replacement ratio measures the amount of reserves a company added compared to the amount it produced that year. A reserve replacement ratio above 100 percent means that it discovered more reserves that year than it produced, adding to its resource base and future potential production. See EIA, *Financial Review of the Global Oil and Natural Gas Industry 2015*, May 2016, www.eia.gov/finance/review/pdf/financial_2015.pdf.

191 David Alire Garcia, "Mexico Oil Reserves Dip Again as Private Firms Begin to Contribute," Reuters, March 23 2018, www.reuters.com/article/us-mexico-oil-reserves/mexico-oil-reserves-dip-again-as-private-firms-begin-to-contribute-idUSKBN1GZ2UY.

But in terms of plaudits reinforcing the structure and necessity of the reform, as well as potential material impact for Mexico's oil future, there may be no better example than the discovery announced in July 2017 by the consortium of private firms Talos Energy, Premier Oil, and Mexico's own native Sierra Oil & Gas. Though yet to be fully appraised, the discovery—known as the Zama well—could reach as high as 2 billion barrels. It has been called one of the top 20 largest oil discoveries of the past 20 years.[192] Unlike the discovery made by Eni, the Zama well was in a previously unexplored area in close proximity to where a dry hole had been drilled. It was literally the first purely private oil discovery in Mexico in more than 80 years. In an interview with the *Financial Times*, Talos CEO Tim Duncan noted that "what really makes this unique is that this is truly an exploration project." The discovery in many ways also highlighted Mexico's prospectivity in its shallow waters, an area that Pemex had plied successfully for years, particularly the Cantarell field.[193]

Innovation

For years, the legacy of nationalism and constitutional prohibition denied Pemex partnership opportunities with foreign and international firms and curtailed its ability to innovate. Given these constraints, Juan Pardinas, director of Mexican think tank IMCO, described Mexico's energy sector as "hermetically sealed" in a manner on par with that of North Korea.[194] The major transformation of the industry evident in other countries—in many ways the digitalization of the oil sector—would have been virtually impossible through a monopolistic state-run system.[195]

The lack of innovation was particularly acute with regard to the touted potential that Pemex and Mexico failed to monetize off its coast. With the shale revolution and the growth of unconventional hydrocarbon production in the United States, as well as continued developments in the deep waters of the Gulf of Mexico, the hindrances have become more apparent as multinational partnerships (including several national oil companies) took advantage of innovations in the oil industry. The benefits of such major innovations and technological advances were nowhere more evident for Mexico than in the discovery of significant oil and natural gas reserves just across the land and maritime border in the United States. Likewise, beyond the northern neighbor, much time was spent studying the innovation that propelled Brazil and its national oil company to be the world's leading deepwater driller. These developments provided important elements to build broader arguments for the reform measures. Thus, a key goal of reform was to modernize the oil sector, in particular to provide avenues for Pemex to innovate and embrace opportunities.

In many cases, the aim to foster innovation was more implicit than explicit. However, specific language was aimed at what is known as technology transfers. The reforms contained elements of the overhaul at Pemex that would direct and incentivize the use of new technology and innovation. Indeed, certain provisions gave Pemex a chance to use the newly created realm and opportunities of contracts and joint ventures to maximize innovation

192 "Talos and Premier in 'Significant' Mexico Oil Discovery," *Financial Times,* July 12, 2017, www.ft.com/content/79969c16-66bb-11e7-8526-7b38dcaef614.

193 Ibid.

194 "Monetizing Mexico's Oil: An Interview with Juan Pardinas, IMCO" (podcast), Institute of the Americas, November 21, 2013, www.iamericas.org/media/com_podcastmanager/files/energy/Interview_Juan_Pardinas.mp3.

195 "Mexican Energy Reforms," *Forum: A Quarterly Journal for Debating Energy Issues and Policies* 109 (June 2017), Oxford Institute for Energy Studies, http://eprinc.org/wp-content/uploads/2017/07/OEF-Mexico-Issue.pdf.

and technology transfers. Reforms of the public works law and guidelines also granted Pemex the ability in some cases to use direct contracts if they or the joint ventures involved technology transfer. Such an approach is a clear display of how the reform measures have come together to boost private sector participation and partnerships at Pemex at the same time as leveraging technology and know-how for corporate innovation.[196]

Just after the historic date of March 18, President Peña Nieto inaugurated a new phase in Mexico's oil innovation and the launch of the Deepwater Technology Center located in Veracruz. The center, a collection of five laboratories, will be spread across 21 hectares and will seek to place Mexico's oil sector at the cutting edge of innovation and technology. Specifically, it will look for innovative solutions to three primary challenges: drilling of wells; environmental risks and qualification; and the design and development of tools, equipment, and systems.[197] The launch of the center is a major milestone on the path to incubating innovation in Mexico, directly aimed at its need to innovate its deepwater capabilities. It will leverage Mexico's existing National Council for Science and Technology (Consejo Nacional de Ciencia y Tecnología; CONACYT) and the Mexican Petroleum Institute to further spur research and development to meet the reform's innovation goals and focus on deepwater hydrocarbon exploration and production. Energy Secretary Pedro Joaquin Coldwell indicated that the new research center will develop talent and generate applied knowledge and solutions. It also will provide Mexican scientists with the opportunity to research and develop made-in-Mexico advances in equipment, processes, and materials for deepwater hydrocarbon development in the safest, most efficient, and most environmentally sustainable manner.[198]

With the maturation of the Mexican oil and gas sector and the increasing deployment of private companies and capital in the country's upstream, the Mexican Petroleum Institute can play a much more strategic role in supporting and boosting innovation and research and development. Instead of merely existing to satisfy the needs and requirements of Pemex, the institute can pursue medium- and longer-term strategic objectives, and perhaps collaborate with some of the recent arrivals in Mexico's oil sector. This new outlook, as evidenced by the center in Veracruz, should greatly help to avoid a clear flaw and an inhibiting factor for innovation: the institute's nationalistic perspective, one that favored short-term political goals.[199]

IEA membership

Similar to the importance for the broader economic performance and benchmarking that OECD membership affords Mexico, as well as the international best practice frameworks, the Mexican Senate's acceptance and approval of Mexico's IEA membership is another milestone. It complements the reform intentions to open the country's energy sector to not just private participation but to the world. IEA membership also provides Mexico with an opportunity to integrate into the global energy governance structure. Of course, it is also important for

196 Javier Martínez-Romero, *Innovation as an Imperative for the Mexican Oil Industry Post Energy Reform* (Houston: Mexico Center, Baker Institute for Public Policy, Rice University, April 2017), www.bakerinstitute.org/media/files/files/6c27d420/MEX-pub-EnergyInnovation-033117.pdf.

197 Adoración Araiza, "Inaugura EPN Centro de Tecnología para Aguas Profundas" [EPN opens Deepwater Technology Center], *MiMorelia,* March 23, 2018, www.mimorelia.com/inaugura-epn-centro-tecnologia-aguas-profundas/.

198 Eduardo Vázquez Reyes, "Centro de Tecnología para Aguas Profundas, nuevo espacio para la investigación científica" [Deepwater Technology Center, a new space for scientific investigation], *Conacyt,* March 28, 2018, http://conacytprensa.mx/index.php/sociedad/politica-cientifica/21001-centro-tecnologia-aguas-profundas.

199 Martínez-Romero, *Innovation as an Imperative for the Mexican Oil Industry.*

the IEA in its effort to go beyond its traditional membership to include its first member from Latin America, a nation that straddles the line between the traditional divisions of oil producer and consumer nations.

With the formal announcement of Mexico's IEA membership, Secretary Coldwell noted that "with this final step, Mexico enters the most important energy forum in the world . . . we will take our part in setting the world's energy policies, receive experienced advisory in best international practices, and participate in emergency response exercises." The official IEA press release added that it "is delighted to continue supporting implementation of Mexico's energy reform with technical expertise, and further intensifying the fruitful bilateral dialogue of energy policy best practice exchange."[200]

Consolidating the Reform: The Path Forward

Just as Mexico found itself at a crucial juncture for the future of its economic competitiveness after Enrique Peña Nieto took office, with a corresponding need to modernize its anachronistic energy sector, the country again finds itself at critical moment. Thanks to the 2013–14 energy reform measures, its energy sector has seen monumental change. But, as cases from across the globe have shown, it is even more essential to move beyond the initial overhaul and first phase of the reform process and consolidate the gains. It is at that point that Mexico finds itself as 2018 unfolds.

One point of note is that of oil prices. Significant attention has been paid to the questions of the reform's implementation against the backdrop of a major collapse in global oil prices. No assessment can ignore the impact upon the government's plans for auctions and even the transformation of Pemex as part of the prescriptions set forth in its mandate to become a productive state enterprise. At the same time, global commodities markets, none more than the international oil market, are impossible to predict and are notoriously volatile. Therefore, any discussion on the path forward and steps for consolidating the reform must consider a lower price environment and continued oil price volatility as a constant, transversal element, not a factor to address in and of itself. If anything, the reform's visible successes in the face of the persistently strong headwinds of a global oil price downturn should be praised as a vital achievement. Those strides support the premise that Mexico's oil prospectivity can attract investment even under the most challenging circumstances.

As would be expected with the implementation of measures intended to throw off almost 80 years of history and entrenched power, a wide range of areas demand further attention. But it is worth stressing five areas that, if attended to in the coming months and years by the Mexican government and its citizens, could be critical in consolidating the reforms and ensuring their sustainability:

- Revising and refining the vision for reform of the oil sector
- Whither Pemex and defining further reform of the national oil company
- Balancing regulation, oversight, and investment
- Improving security and reducing fuel theft
- Translating and highlighting benefits.

200 "IEA Marks Historic Day in Global Energy Governance with First Member Country in Latin America," IEA, February 18, 2018, www.iea.org/newsroom/news/2018/february/mexico-officially-joins-iea-as-30th-member-country.html.

What is the vision?

Despite the well-deserved plaudits and historical legacy overcome by the 2013–14 reform measures, the question of the vision remains. Even if Mexico has greatly advanced the national conversation to overcome its myths and taboos, it has not fully defined what the vision is for its oil sector. (Nor has it done so in terms of translating benefits, as discussed below.)

To date, the government and architects of the reform have posited a vision based upon structural adjustment aimed at eliminating the state monopoly and allowing private participation in the oil sector, all with the goal of greater economic competitiveness and GDP growth which should translate to jobs and upward economic mobility. For decades in Mexico, the oil status quo and what it represented for Mexicans could be understood in terms of economic, social, political, and environmental security.[201] But if one steps back and considers the litany of economic, political, and energy indicators discussed throughout this analysis, they provide further questions and fewer answers. To properly define Mexico's vision for the oil sector, it may also now be more appropriate to understand what role oil will play in the country's development scenarios and plans in a postreform environment.

Is oil a pillar of economic development? Or rather, is it a key geopolitical tool to support Mexico's energy security, one that guarantees access to secure and affordable supplies at reasonable prices for its citizens? This question is particularly important to define as the oil and fuels markets in Mexico become increasingly unbalanced and the need to turn to imports grows, with all of its attendant economic and geopolitical concerns. The country's elected officials must address these questions with input derived from the experiences of implementing the reform. Further citizen participation and a deeper understanding of the fundamental question at the heart of the debate is necessary.

Perhaps part of the problem with the defining the exact vision is that Mexico does have a relative consensus as to how oil and national sovereignty are related. There is no doubt that said sovereignty allows the nation to determine and dictate how it manages its natural resources, principally its oil. But defining a vision that can rally enough support to ensure the certainty and continuity of the reforms beyond their basic enshrinement in the constitution is how to truly incorporate private investment to further manage and develop the country's oil prospects, yet at the same time transform the national icon of Pemex into the modernized, efficient, and transparent market participant needed for the near- and midterm success of the oil sector. Which leads us to the most perplexing element: What must be done to guarantee this pillar of a revised vision and to ensure the viability of a company that former President Vicente Fox once described as a symbol in Mexico as revered as the Virgin of Guadalupe?[202]

Whither Pemex?: Reform 2.0

Deputy Secretary of Finance Miguel Messmacher, a senior treasury official, posed a question that helps to frame the debate around transforming Pemex: can Mexico "make national champions into competitive firms" while

201 Alejandro Chanona Burguete and Alberto Lozano Vazquez, "Mexico: Situation and Challenges of Energy Security and Environmental Sustainability at the Beginning of the Twenty-First Century," in *Energy Security and Environmental Sustainability in the Western Hemisphere*, edited by Remi B. Piet, Bruce M. Bagley, and Marcelo R. S. Zorovich (Lanham, MD: Lexington Books, 2017), 81–111.

202 Ibid.

"generating market incentives and increasing corporate governance?"[203] Clearly, Messmacher, who became one of the one most public faces associated with the oil reform measures, new contracts, and investment promotion, knew what he was talking about when it came to Pemex, which explains why his questions seem rhetorical.

Messmacher also spoke of governance issues, which were clear targets of the Pemex reform. Regrettably, one of the most ballyhooed changes—the removal of oil workers' union members from the Pemex board of directors and their replacement with private and independent directors—has proven feckless. This may have been the fault of the appointments, but more likely it was the lack of commitment within the government and the company to fully implement those pieces of this corporate governance restructuring. This demands attention in Reform 2.0. But managerial excellence, innovation, and fiscal prudence were never part of the equation of a national champion, at least as it evolved over the decades in Mexico. Thus the idea of making a national champion into a competitive firm may have been the wrong trajectory, particularly if cutting-edge innovation, technologies, and business practices were part of that end goal.

The Round Zero process may have underscored the national champion's potential ability to avoid or delay major change. Its process was a direct counter to any reasonable suggestion that the reform would make Pemex would disappear from the sector altogether. Indeed, at the end of the process, Pemex retained the rights to 85 percent of Mexico's proved reserves and 20.6 billion boe. A series of requirements were placed upon the firm to enable it to keep these rights, but the intervening years have proved that Pemex has the leverage to dictate how those terms and requirements are enacted and enforced.

One proposition being publicly circulated by the CNH head is that a further reform of Pemex would include an initial public offering and minority stock offering, thereby inserting the firm into the market and raising capital but also requiring management practices and governance similar to other publicly traded companies.[204] The focus on this idea has tended to be more on the fiscal side, on Pemex's need to raise capital to support its development plans for the massive oil resources still under its control. Although a stock offering could be useful—examples abound from Colombia to Brazil regarding national oil companies that suffered many of the same afflictions as Pemex—it must be done in conjunction with the aforementioned three organizing principles of boosting profitability, efficiency, and competitiveness. To that end, a useful complement of any Pemex stock offering would be another version of Round Zero. Such a review and exercise would determine the parameters for the reserves and assets that Pemex is allowed to maintain in its portfolio. The process would dictate more precise terms for capital, technical capability, and timelines for executing and developing the assets it controls. If one result from the Peña Nieto reforms has been crystal clear, it is that the auction process is working and gaining in functionality and in terms of return on investment with regard to adding barrels of oil to Mexico's reserves and potential barrels of oil to the market in Mexico and beyond.

A final important step toward Pemex's autonomy would be to adjust the farmout process as stipulated in the reform. At first glance, this might seem counterintuitive, but it would be a significant step to provide Pemex with the ability to directly contract and form joint ventures and associations with other companies and market participants. This is the industry standard across the globe and has been a key element of the international

203 Vietor and Sheldahl-Thomason, *Mexico's Energy Reform.*

204 Shadia Nasralla, "Mexico Regulator Wants Minority Stake Floated in State Oil Firm Pemex," Reuters, March 21, 2018, www.reuters.com/article/us-mexico-pemex-ipo/mexico-regulator-wants-minority-stake-floated-in-state-oil-firm-pemex-idUSKBN1GX295.

oil industry for many years. For the first phase of the reform, it made sense to manage possible partnerships for Pemex through the auction process and under CNH management. However, as the oil market matures, and with the number of successful bid rounds and demonstration of transparency in the farmout process, an appropriate next step would be to proceed to a phase whereby SENER, SCHP, CNH, and Pemex would develop a mechanism for transitioning the company to allow for direct association and partnering.

Balancing regulation, oversight, and investment

As discussed in a recent report by the Mexican Hydrocarbons Association (Asociación Mexicana de Empresas de Hidrocarburos; AMEXHI), beyond the noted constraints on the country's upstream competitiveness rendered by the rule of law and security issues, a barrier within the oil sector—albeit one that can be managed by stakeholders within the sector itself—is the inconsistency and duplication of regulatory processes. AMEXHI further noted that these issues are known and that SENER, the CNH, and the SHCP have recently worked on this issue and have tools that can contribute to competitiveness, but they must strive to offer greater commercial certainty with more competitive fiscal terms and greater access.[205] Industry representatives contend that they continue to face and manage excessive bureaucracy; the existence of multiple regulators and regulatory overlap often means that partners must obtain a variety of permits and approvals, in some cases including almost identical requirements from different agencies. As the sector opening has progressed, and with the arrival of dozens of new participants in all segments of the oil and gas value chain in Mexico, the pressure on the nascent regulatory structure has greatly increased in terms of both its ability to assert its independence and specific roles and its drive to ensure that the level of so-called red tape and processes does not stifle investment.

As ASEA executive director Carlos De Regules has conceded, a newly organized regulatory body tends to overregulate at first given the enormity of the challenges and desire to properly dispense its duties.[206] At the same time, he has argued for a framework for long-term regulatory certainty that improves social well-being and achieves the intended goal at the lowest possible social cost while minimizing unwanted side-effects. Specifically, he is interested in a model of risk-based regulation that provides an objective tool to strike an appropriate balance between risks and benefits. In Carlos' estimation, such an approach requires two key mechanisms: first, efforts to minimize inhibiting bureaucracy, such as expert reports and verifications by authorized third parties; and second, mechanisms to make accountability undiluted and unequivocal, such as self-declarations.[207] These objectives are vital to the continued implementation of the reform's restructured regulatory model and institutions in Mexico.

Lessons from Colombia highlight the need to strike the appropriate balance between attracting investment at auction, in concessions, and granting contracts, and facilitating actual project execution. Colombia was lauded for its major oil and gas overhaul for years but then quickly fell victim to its own success; projects and investments became constrained by severe regulatory, environmental, and institutional bottlenecks. These are

205 AMEXHI (Asociación mexicana de empresas de hidrocarburos), *Agenda 2040: Transformando a México* [Agency 2040: Transforming Mexico], AMEXHI, March 2018, http://amexhi.org/2040/VISION2040AMEXHI.pdf.

206 "Webinar: Long-Term Regulatory Certainty In Mexico," Institute of the Americas, March 15, 2018 www.iamericas.org/en/events/past-events/2318-webinar-long-term-regulatory-certainty-in-mexico.

207 "Risk-Based Regulatory Alignment: An Enabling Strategy for Oil and Gas Competitiveness in North America," Institute of the Americas, January 2017, www.iamericas.org/documents/energy/reports/Risk_based_Regulatory_Alignment.pdf.

early days in the Mexican market opening, but worrisome signs have begun to emerge as to similar constraints in the country. Indeed, the permitting process at the state level and the social and environmental liabilities with local communities must also be evaluated and addressed so as not to cause unneeded delays or interruptions in critical project development.

Availing themselves of Mexico's OECD membership, the three primary energy regulatory bodies sought and developed a holistic assessment of the status of energy regulation in the postreform milieu. The 2017 report, *Driving Performance of Mexico's Energy Regulators*, laid out clear recommendations for enhanced governance. Most dovetail nicely with the AMEXHI assessment. Specifically, the OECD called for the regulators to build more regular and formal relations with Congress to discuss activities and results, which in turn could support improved governance by making regulator operations more effective through increased flexibility in financial and human resource management, ultimately empowering all three regulators with fully autonomous and financially sustainable futures devoid of political interference. In addition, the OECD spelled out the need to create a one-stop shop for licensing and permits, a so-called ventanilla única (one-stop window) to alleviate some of the charges of excessive red tape.[208]

With regard to reform's investment goals, Mexico's investment framework and five-year plans give signals to investors about the upcoming launches of rounds—information that in turn can generate both knowledge and certainty in the industry. Government and industry understand that it is indispensable that the rounds must be frequent, high-quality, and competitive, and with efficient regulations based on transparency and reduced transaction costs. The CNH has made strides to create a predictable auction process in which the varying opportunities—onshore, mature fields, shallow water, deepwater—are all scheduled consistently in terms of timing, bid qualification requirements, and fiscal and contractual terms.[209] CNH chairman Juan Carlos Zepeda has spoken often of these challenges and is directing his agency to standardize the bidding process within the realm of what is feasible.[210]

Security issues and oil theft

Mexico's broader security situation has been the subject of extensive analysis. The elements that comprise the perilous environment in many parts of the country will not all be considered here. But what does bear discussion and attention as part of any path to consolidating the reform measures is to understand the impact of the security challenges on the energy sector, particularly on the oil industry and Pemex. Indeed, oil theft from Pemex pipelines; money laundering by way of service stations; and, worst of all, provocative kidnappings of the company's executives and service companies working with the state firm, are all on the rise.

According to a Reuters analysis based on reports and data obtained from the Mexican government, between 2011 and 2016 the number of unauthorized taps discovered on Mexico's fuel lines nearly quintupled. Further data obtained from a CNH report commissioned in 2017 indicated that between 2009 and 2016, there had

208 OECD, *Driving Performance of Mexico's Energy Regulators* (Paris: OECD, January 13, 2017), www.oecd.org/mexico/driving-performance-of-mexico-s-energy-regulators-9789264267848-en.htm.

209 "Mexican Energy Reforms."

210 Audrey Leon, "The Fruits of Mexico's Labor," *Offshore Engineer,* August 1, 2017, www.oedigital.com/technology/software/item/15936-the-fruits-of-mexico-s-labor.

been illegal pipeline taps roughly every 1.4 kilometers along Pemex's approximately 14,000-kilometer pipeline network.[211] The spike in fuel thefts and illegal trading, as well as kidnappings, presents serious questions as to whether Pemex is fully in charge of all its facilities across the nation. Indeed, many analysts indicate that the physical security and monitoring of pipelines belonging to Pemex are severely lacking. Pemex has taken steps to install systems and measures to detect declines in pressure in some oil product pipelines but the project is expected to take years to complete. Unofficial figures place thefts from the Pemex network at roughly $1 billion annually. Thefts from the Pemex network are not new, but their increase and the strain they place on the already-taxed company are important. Security experts also point to these thefts as an important source of revenue for drug cartels, especially as the Mexican government continues to crack down on them. The illegal tapping has grown significantly in the areas where conflict with cartels is the most pervasive.[212]

Worse yet, the security situation and related corruption have exacerbated challenges and problems derived from years of poor upkeep and management at the Pemex refining system. Fatal accidents, including fires and explosions, have become almost commonplace. Despite the opportunity provided for Pemex by way of the reform and ability to create joint ventures and private partners, Pemex has found few takers on the refining and downstream side. Indeed, one executive from a global refining consulting firm indicated that "there is no incentive to invest in the Mexican refining system," specifically citing "organized crime and corruption." The aforementioned 2017 CNH report noted that blame can be assigned inside and outside the sector: "The problem is corruption, not just in security and judicial services, but also inside Pemex."[213]

Translating benefits

In selling the reform measures, the Peña Nieto administration and its political allies made a compelling case for the economic necessity of the reforms as well as their upside for the average Mexican citizen. The government persuasively argued that when it came to oil, the nation's patrimony would remain just that: 100 percent owned by the Mexican people. Leaving aside the technicalities and the elements of oil contracts, regulatory models, and partnership modalities for Pemex, the government sought to ensure that citizens understood the benefits of the reform. Naturally, most of the attention was focused on lowering prices for consumers, but the creation of a modern, competitive market that would spur job creation and support Mexico's broader macroeconomic goals also was one of the selling points.[214]

By passing the reform measures, the government set in motion the path to many of these objectives, which were supported by citizens through their votes for the Peña Nieto administration and congressional leaders. However, for the average citizen the reform is not about providing the best petroleum contract to attract private investment or the most appropriate form of innovation and technology transfer. Instead, for the Mexican

211 Gabriel Stargardter, "The Refinery Racket: Mexico's Drug Cartels, Now Hooked on Fuel, Cripple the Country's Refineries," Reuters Investigates, January 24, 2018, www.reuters.com/investigates/special-report/mexico-violence-oil/.

212 Jeremy Martin and Sylvia Longmire, "The Perilous Intersection of Mexico's Drug War & Pemex," *Journal of Energy Security,* March 15, 2011, www.ensec.org/index.php?option=com_content&view=article&id=283:the-perilous-intersection-of-mexicos-drug-war-aamp-pemex&catid=114:content0211&Itemid=374.

213 Stargardter, "The Refinery Racket."

214 Tracy Wilkinson and Richard Fausset, "Mexico's Officials Wage PR Battle to Sell Energy Reform Plan," *Los Angeles Times,* August 13, 2013, http://articles.latimes.com/2013/aug/13/world/la-fg-mexico-pemex-pr-20130814.

populace the reform means translating what has occurred to date, why it is important and relevant, and how it positively impacts the economy and workforce. For the broader society, these benefits must not only be delivered but also be fully comprehended.

To do so, the oil sector must do more than just highlight the number of blocks adjudicated, the number of firms participating, and the potential investment commitments. Even the hugely important news of major oil discoveries demand a more down-to-earth translation and messaging. Indeed, there must be a concerted effort across the government and industry to begin to share, both literally and figuratively, the benefits of the reform measures. What do the large amounts of monies committed by companies mean for employment? How is the government directing the signing bonuses gathered at auction? What about the Mexican oil fund? Has the importance of that mechanism for the average citizen been communicated? And beyond the fund, how will the government manage taxes and royalties from increased participation in the oil sector, particularly so that it benefits the majority and not only elites?

Beyond the need to strike the right balance between regulation and investment, a proper dialogue among the full range of relevant actors in the country must be held. Mexico clearly needs adequate dissemination and communication strategies for reaching society as a whole and reporting on the results. Communication efforts underscoring greater transparency regarding the reform measures, decisions, and actions being taken by the regulators, government, and Pemex are of utmost importance.

In the oil sector, perhaps nowhere is this improved communication strategy more feasible than in the gasoline market. The liberalization of the fuels market has seen an explosion of competition from international and Mexican private enterprises. More than 40 companies have entered the market. Mexican consumers now have choices, and can select where to purchase their fuel based on price, service, convenience, and other factors. For the average Mexican citizen, the market today is far more competitive. Unfortunately, the subsequent rise in gas prices in early 2017—the *gasolinazo*—and its impact on the population was an important lesson for the government. Many factors, most prominently poor planning, supply bottlenecks, and infrastructure challenges, created a major crisis when the government began to remove subsidies from fuel prices and adjust the prices to the market. In particular, it provided ammunition to opponents of the reform who sought to highlight the woes of its implementation.[215] But since that mishap, the market liberalization has proceeded apace. That the *gasolinazo* has been squarely placed in the rearview mirror is important, but its messaging and rollout lessons—not only for the fuels market but for all segments of the sector—are important to recall in future efforts to consolidate the reform.

As noted, the CNH has made great strides to create a predictable upstream auction process with varying opportunities that are scheduled consistently in terms of timing, bid qualification requirements, and fiscal and contractual terms. This is important for generating results and communicating with industry. In the same way, convincing society of results is a process that requires patience while the results of the rounds unfold. Even though energy is a highly technical industry, for continuity's sake it is essential to show society the benefits of the reform and see that predictable institutions, beyond sexennial plans, reduces uncertainty.

215 Rob Nikolewski, "Boiling Over on the Border: The Reasons behind the Gasoline Protests in Mexico," *Los Angeles Times,* January 31, 2017, www.latimes.com/business/la-fi-mexico-gasoline-20170131-story.html.

Finally, just as the Peña Nieto administration and its allies in Congress created and executed a public relations strategy to sell the reform and set the country on its new energy path, the effort must be continued but also deepened to convey to both citizens and incoming politicians the depth of what has been achieved. To fully consolidate the reform beyond technical and industry-specific challenges, its benefits must be translated to and understood by the wider population; the results must be tangible and understandable. To continue to support it, they must feel it, if not see its benefits in their daily lives.

A Crude Reform: Pemex in Mexico's New Energy Landscape

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Mexico is coming out of one of the most dramatic reform periods since the creation of the North American Free Trade Agreement (NAFTA). Following the presidential election in July 2012, the new Peña Nieto administration shepherded through Congress a series of radical reforms—the most radical removed the national oil company Pemex (Petróleos Mexicanos) from its position as the monopoly supplier of all hydrocarbons in Mexico and guardian of the nation's subsoil resources.

The reform did not privatize or radically change Pemex's nature. What it did was expose Pemex to competition while at the same time remove some of the constraints that previously had held it back. By 2012, Pemex's production had been in decline for eight years, and there was widespread agreement that something needed to be done, even if there was little agreement on what. Yet the compromised nature of the reforms meant that they failed to remove the constraints the company faced. Pemex gained some freedom and flexibility, but not enough, and it remains shackled by high taxes and high debt.

Starting with a historical overview of how Pemex gained its iconic status as the defender of Mexico's national sovereignty against predatory foreign companies, this chapter explains the roots of Pemex's production decline after 2004 and shows how the Peña administration managed to overcome that iconic status and pass energy reform—but in process preserved many of the features that held the company back. It then shows how even though the energy reform was supposed to ease these constraints in theory, the reforms were incomplete in practice. Consequently, it takes a slightly more pessimistic view of the future of energy reform than the current conventional wisdom.

A History of Pemex

How did the Mexican oil industry come to be dominated by one giant state-owned producer and why did that company hold such iconic status in Mexico for so long? To understand this question, one must go back to the beginnings of the Mexican oil industry.

The Mexican oil industry before Pemex

In 1884, during the long dictatorship of Porfirio Díaz (1876–1910), the government gave the owner of the land legal right over any oil that was found underneath.[216] The law overturned the Spanish colonial tradition that had granted the state ownership over subsoil resources.[217] When the first oil companies began to explore for

216 Lorenzo Meyer and Isidro Morales, *Petróleo y nación: La política petrolera en México (1900–1987)* [Oil and the nation: Oil policy in Mexico (1900–1987)] (Mexico City: Fondo de Cultura Económica, 1990).

217 Stephen Haber, Noel Maurer, and Armando Razo, "When the Law Does Not Matter: The Rise and Decline of the Mexican Oil Industry," *Journal of Economic History* 63, no. 1 (2003): 1–31.

petroleum around 1900, they did so under this law. American and British firms controlled the majority of the known reserves. Díaz, it should be noted, had enacted his law in order to promote oil and mining production as a domestic revenue source, not as a giveaway to foreign capitalists. Once the industry's tax exemptions began to expire in 1910, he responded to the oil companies' successes by starting to raise taxes.

Unfortunately for the oil magnates, they soon faced far larger headaches than the small tax hikes levied by President Díaz: a full-blown revolution, Mexican style. One out of every 15 Mexicans would either die or flee to the United States, and full stability would not be restored until 1929.[218] In 1917, while the fighting was still in full swing, some of the revolutionary factions convened a constitutional convention. Article 27 of the resulting constitution—which still governs Mexico 101 years and 227 constitutional amendments later—declared that all oil and gas reserves belonged to the nation. In the view of the revolutionaries, a small, unaccountable elite had used the 1884 law to surrender wealth to foreign companies in order to line their own pockets. In their view, the new constitution returned to the country's historical tradition and took back for the people of Mexico what had always been theirs.[219] (It is important to note, particularly for American readers, that this putatively radical change simply gave Mexico the same subsoil regime that prevails everywhere on Earth outside of 47 of the 50 United States, including such radical jurisdictions as Canada, Australia, and Alaska.)

The oil industry resisted the violence and institutional change. Oil taxes rose dramatically as every faction looked to the wells for income, and the oil zone was not free from violence. Nonetheless, Mexico's output skyrocketed after 1917 despite the taxes, threats, and military mobilizations. Petroleum output then fell precipitously after 1921, but politics was not the reason. Rather, Mexico simply ran out of oil that could be produced competitively using existing technology. The companies kept looking for oil; they just stopped finding it.[220] Some new discoveries (notably Poza Rica in 1937) prevented production from falling below 100,000 barrels per day (bpd), but the first golden age of Mexican oil was over.

The Creation of Pemex

If oil was no longer particularly important for the Mexican economy, how did it come to occupy such an important space in Mexico's political mythology? The short answer is the dramatic expropriation of March 18, 1938. President Lázaro Cárdenas' confrontation with the foreign companies became the stuff of political legend and a great nationalist triumph, a way of legitimating the Revolution and the dictatorial rule of the PRI (Partido Revolucionario Institucional; Institutional Revolutionary Party). This mythology concealed two great ironies: (1) President Cárdenas nationalized the companies in order to ensure that the industry *kept* producing in the face of labor strife, not to take back resources or seize (nearly nonexistent) profits; and (2) the Mexican government quietly acquiesced to American pressure and paid the oil companies more than the market value of their properties.

218 For a history of the Mexican Revolution, see Stephen Haber, Noel Maurer, and Armando Razo, *The Politics of Property Rights* (Cambridge, UK: Cambridge University Press, 2003), particularly chapter 3.

219 Ibid.

220 Exploratory wells increasingly came up dry, and the average initial capacity of a successful well dropped from a peak of 24,800 barrels per day (bpd) in 1920 to only 3,600 bpd by 1929. See Haber, Maurer, and Razo, "When the Law Does Not Matter."

A wave of strikes started in 1934 and quickly escalated; that same year saw Mexico's various company unions unite into the Oil Workers' Syndicate of the Mexican Republic (Sindicato de Trabajadores Petroleros de la República Mexicana; STPRM). More strikes hit in 1935 and 1936. On November 3, 1936, the STPRM demanded an $8.3 million wage hike, 18 paid holidays, 20 to 60 days' paid vacation, health insurance, 25 days of severance pay for each year of service in the case of voluntary separation and 90 days of severance in the case of involuntary separation, and—most seriously—control over all hiring decisions save for 110 positions across the entire *industry*.[221] The oil companies refused to meet union demands.[222]

The Cárdenas administration attempted to mediate. Talks dragged on for years. Finally, on March 2, 1938, the Federal Labor Board announced that it would grant the STPRM a $7.3 million wage hike and increased control over personnel decisions. The Supreme Court upheld the decision the next day.

The result was chaos. Mexican Petroleum reacted by closing 23 wells, moving oil stored in the fields to the Tampico port (presumably for quick export), shutting down the Mata Redonda refinery and sending a letter to every employee stating that it would be unable to comply with the board's order.[223] The March 7 deadline fixed by the Federal Labor Board came and went. The board responded by suspending all labor contracts.[224] With their pay contracts suspended and a strike deadline looming, workers began to seize loading terminals and shut down pipelines. President Cárdenas faced the imminent collapse of the oil industry.[225] The problem was not that the industry loomed particularly large as a share of tax revenues or gross domestic product (GDP) in 1938, but rather that Mexico's road transportation and a key part of its electrical capacity ran on domestic oil. Shut them down, and you shut down the economy.[226]

On March 18, 1938, Cárdenas announced the nationalization in order to keep the goods moving and the lights on. The government moved quickly to seize the assets of the foreign companies operating in the country and created Pemex as a state-owned monopoly charged with the exploration, production, refining, and distribution of crude oil and petroleum products in Mexico. U.S. president Franklin D. Roosevelt had little enthusiasm for helping oil magnates, but lobbying by the companies convinced him to pressure Mexico for a settlement. In 1942, the U.S. government imposed a settlement, and Mexico paid market value for the U.S. oil companies' operations (which in any case had been losing money for years). A separate agreement with the Mexican Eagle Oil Company, the largest in Mexico, gave its shareholders compensation in excess of *three times the company's 1936 market capitalization.*[227]

221 "Proyecto aprobado en la primera Gran Convención Extraordinaria del Sindicato de Trabajadores Petroleros de la República Mexicana" [Project approved in the first Extraordinary Grand Convention of the Petroleum Workers Union of the Mexican Republic], AGN, Archivo Histórico de Hacienda, n.d., C1857–117.

222 Brown, "Labor and State," 19.

223 Ibid., 24.

224 Gordon, *Expropriation,* 117.

225 Brown, "Labor and State," 27.

226 By 1938, 11 percent of the country's electricity generation ran on oil. See Victor Carreón, Armando Jiménez, and Juan Rosellón, "The Mexican Electricity Sector: Economic, Legal, and Political Issues," CIDE Documento de Trabajo no. 342 (Mexico City: Centro de Investigación y Docencia Económicas [CIDE], November 2005), 10.

227 All compensation figures are given in net present value terms at the time of the expropriation. See Noel Maurer, "The Empire Struck Back: Sanctions and Compensation in the Mexican Oil Expropriation of 1938," *Journal of Economic History* 71, no. 3 (2011), 608.

In short, the Mexican government seized a marginally profitable industry in order to keep the domestic oil flowing and wound up paying more than market value to its foreign owners. A nationalist triumph this was not. Nonetheless, Lázaro Cárdenas was an excellent politician. He turned the expropriation into a symbol of national sovereignty. Mexicans had control of not only their natural resources, but also the capacity to produce and process them without foreign assistance. For decades thereafter, Mexican children learned in public school history textbooks about the courage of President Lázaro Cárdenas in standing up to the powerful international oil companies. A national mythology arose surrounding the event. Many Mexican politicians felt a patriotic duty to preserve the legacy of President Cárdenas; others feared a nationalistic backlash if they made their views public.[228]

Organizing the oil industry

Pemex's monopoly did not spring forth fully formed in 1938. The Petroleum Affairs Enabling Act of 1938 gave Pemex the task of conducting all petroleum-related activities on behalf of the nation, but Article 6 of the Enabling Act authorized Pemex to contract third parties to perform services. This applied to all activities in the value chain: exploration, production, transport, storage, distribution, and wholesale commercialization of crude oil and refined products. In 1940, the government allowed Pemex to enter into production agreements with private companies, as long as they were domestically owned. A year later, in 1941, an amendment to the Enabling Act allowed partially foreign-owned companies into oil production, as long as Mexican nationals held the majority of the shares. In 1949, Mexico further loosened the restrictions on foreign participation, signing "risk agreements" with foreign companies, allowing them to explore and drill in particular areas. If oil was found, Pemex would take care of production, but it would pay back a percentage of oil revenues in exchange.[229]

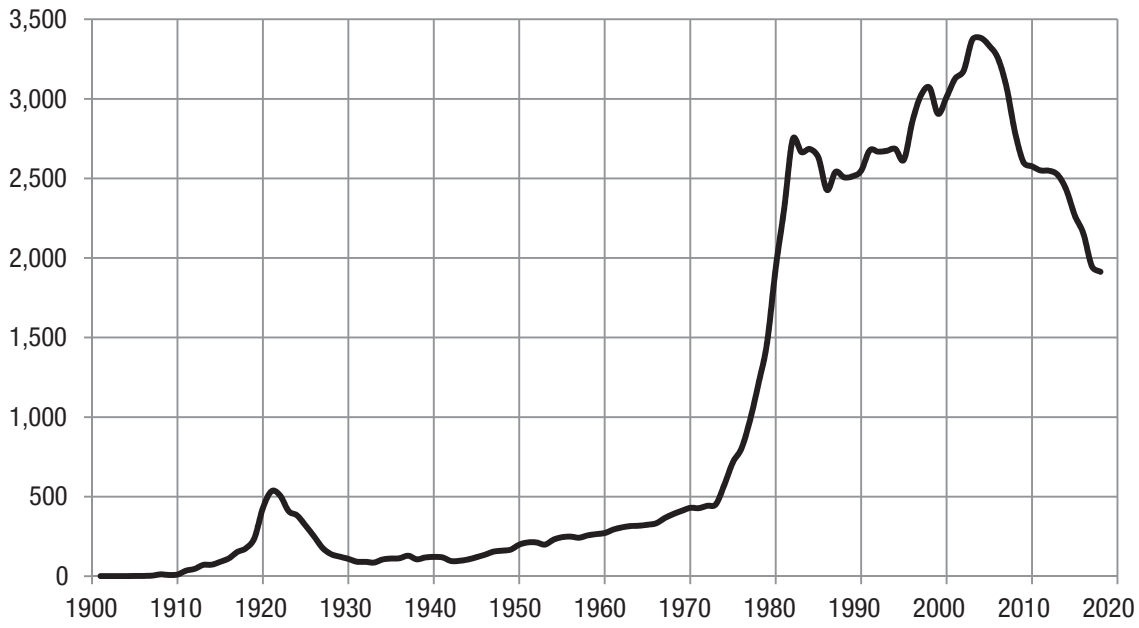
New discoveries and Pemex's ability to master new technology kept Mexico's oil production from stagnating, but production rose only slowly after 1938. In 1956, increasing domestic demand meant that Mexico became a net oil importer.[230] As late as 1970, production averaged only 80 percent of its 1921 peak (see figure 5.1).

228 Thelma Gómez Durán, "Nacionalismo recobra bríos por debate petrolero" [Nationalism recovers vigor for oil debate], *El Universal,* June 8, 2008, 1.

229 Isidro Morales, "Pemex During the 1960s and the Crisis of Self-sufficiency," in *The Mexican Petroleum Industry in the Twentieth Century*, edited by J. C. Brown and A. Knight (Austin: University of Texas Press, 1992): 233–55.

230 Antonio Bermúdez, *The Mexican National Petroleum Industry* (Palo Alto: Institute of Hispanic-American and Luso-Brazilian Studies, Stanford University, 1963), 243.

Figure 5.1. Mexican Oil Production, 1900–2017 (thousand bpd)



By the late 1960s, the Mexican government could take the symbolic act of banning foreign participation in the industry at little practical cost.[231] Pemex did, however, continue to hire foreign service companies.[232] One of these companies, Brown & Root, became the primary contractor in the development of the massive oil fields developed offshore in southeastern Mexico in the late 1970s.[233] Later on, Pemex became the single largest client for another American oil services company, Schlumberger.

In 1992, the government divided Pemex into four subsidiaries: Exploration and Production, Refining, Gas and Basic Petrochemicals, and Petrochemicals. Additionally, Pemex owned a trading affiliate and a real estate company, and along with Schlumberger it co-owned an exploration company that operated inside Mexico. The different subsidiaries operated at arm's length from each other, and each one had its own finance, human resources, and legal divisions. The goal of the breakup had been to increase internal control by forcing the newly separated units to conduct measurable transactions whenever a product crossed their border from another subsidiary. The problem, of course, was that the center lost direct control over the newly defined units.

The 1992 restructuring also sought to combat the high level of corruption in Pemex by eliminating its construction subdivision. Since the 1970s oil boom, Pemex had been tarnished by scandals involving large-scale theft at all levels of the company. The epicenter of corruption was the construction subdivision, since it controlled many of the procurement decisions. Yet, while highly wasteful, the subdivision also housed whatever little expertise Pemex had in the management of large engineering projects. Raúl Muñoz—Pemex's chief

231 Morales, "Pemex During the 1960s and the Crisis of Self-sufficiency."

232 "Foreign Legion Underpins Mexico's Oil Nationalism," *Petroleum Intelligence Weekly*, January 5, 2009.

233 Joseph A. Pratt, Tyler Priest, and Christopher J. Castaneda, *Offshore Pioneers: Brown & Root and the History of Offshore Oil and Gas* (Houston: Gulf Publishing Company, 1997).

executive officer (CEO) from 2000 to 2004 and previously CEO of DuPont Mexico—would later lament that no other branch of Pemex arose to close the gap in project management expertise.[234]

Mexican law sought to prevent collusion between Pemex managers and contractors by requiring that a large percentage of purchases and contracts be assigned to the lowest bidder in a public auction. The goal was to decrease rent-seeking opportunities. The regulations, however, had a negative impact on the company's flexibility to respond to challenges on the ground. Pemex managers constantly complained that projects were delayed because minor procurement changes had to be approved by Mexico City.[235] In addition, the staff feared prosecution on corruption charges, and thus refused to make even minor decisions without explicit authorization. International industry experts commented that Pemex managers constantly seemed to be occupied dealing with regulatory paperwork and audits, rather than on strategic and technical decision-making.[236]

The rise and decline of Cantarell

Unbeknownst to Pemex's managers, by 1971 the company was on the verge of a great leap forward. Ten years earlier, in 1961, a fisherman named Rudesindo Cantarell had noticed that his shrimp nets kept on getting coated with sludge in Campeche Bay, off the Yucatán Peninsula. For seven years, Cantarell unsuccessfully tried to interest the authorities in his discovery, until, in his own words:

> One day, I said to myself, "I'm a Mexican and I believe that there is wealth in the sea here that could benefit the country." In 1968, I went to Veracruz to sell a load of red snapper, and a friend who worked for the oil company suggested that I tell them directly about my discovery. So I went to Coatzacoalcos, to the La Ganadera Pemex office, and I told them about the floating oil stains and bubbles. They didn't believe me at first, but they said that they'd send some people to investigate. Three years later, on March 12, 1971, they looked for me and we went down to where the oil stains were . . . A little bit later they discovered that this place was the biggest oilfield in the country. I didn't believe them, but various people who worked for Pemex started looking for me, to give me some gifts, to tell me that I was a national hero.[237]

Other discoveries soon followed. Mexican oil production skyrocketed. Offshore Gulf production soon made up 80 percent of Mexico's production. In the middle of the 1990s, when it seemed as if Cantarell was on the brink of decline, Pemex developed a plan to inject nitrogen into the reservoir to maintain pressure. Injections began in 2000, and Cantarell's output leaped from 1.6 million bpd in 1999 to 2.1 million bpd by 2004. By that point, Cantarell produced 63 percent of Mexico's oil.[238]

Unfortunately, as Mexico had learned before in the 1920s, one can only fight geology for so long. Even the most

234 Francisco Flores-Macías, "Explaining the Behavior of State-Owned Enterprises: Mexico's Pemex in Comparative Perspective," Ph.D. diss., Massachusetts Institute of Technology, Department of Political Science, 2010.

235 Ibid.

236 Pemex A case.

237 Martín Morita, "En la miseria y olvidado por Pemex, murió Rudesindo Cantarell, descubridor de la zona petrolera más importante de México" [Rudesindo Cantarell, discoverer of the most important oil area in Mexico, died in misery and forgotten by Pemex], *Proceso*, May 11, 1997, 36.

238 Scott Weeden, "Meteoric History of Cantarell Field Continues for Pemex," *E&P Magazine,* May 1, 2015, www.epmag.com/meteoric-history-cantarell-field-continues-pemex-792716#p=full.

productive oilfield has limits. Once the amount of oil in a given formation declines past a critical point, injecting more nitrogen serves only to fill the formation with gas and split the reservoir into smaller unrecoverable pockets. That meant that Pemex had to cut injections, but cutting injections dropped the reservoir pressure and caused production to resume its decline. Moreover, declining pressure meant that saltwater began invading the reservoir, further reducing output. To give Pemex credit, by 2013 it had squeezed out more than 36 percent of the estimated total reserves in the field, whereas most oilfields around the world produced only 35 percent of their estimated reserves before exhaustion.[239] Nonetheless, Cantarell went into rapid decline. By the eve of the energy reform, in 2013, output was down to 439,800 bpd and falling. Production at the neighboring offshore Ku-Maloob-Zaap fields (discovered in 1979, but not commercialized until 2002) made up some of the slack.

Pemex believed that new onshore fields around Chicontepec would replace Cantarell, a project known as the Aceite Terciario del Golfo. Unfortunately, Pemex proved incapable of developing Chicontepec. Pemex projected that the field would reach 550,000 to 700,000 bpd by 2017 and 1 million bpd by 2021.[240] The development of Chicontepec, however, did not run smoothly. The rock was relatively low porosity and impermeable, the reservoir highly fractured, and the field's internal pressure extraordinarily low. Drilling delays were pervasive. Pemex accused service companies of not meeting deadlines; services companies countered that Pemex did not provide drilling sites on time.[241] In addition, the field sprawled over 1,500 densely populated square miles. The area lacked infrastructure and the prevalence of towns and farms increased the barriers to construction.[242] By 2016, Chicontepec produced only 40,000 bpd and falling, where just a year before it had been hoped to produce 700,000.[243] Pemex had spent more than $11 billion on the venture.[244] To be fair to Pemex, the field was insanely complex and it was far from clear that any oil company could have made a go of it. That said, failure meant that by the time 2013 arrived, Pemex had no immediate replacement for Cantarell.

The role of labor in Pemex

Pemex's unions wielded extensive power from the beginning. In fact, as related above, the company had been born in the wake of a paralyzing oil strike. The dictatorial PRI recognized the power of the union and sought to bring it under control. In return for loyalty, the PRI allowed oil labor leaders to run their unions as personal fiefdoms, utilizing workers' dues for personal enrichment. Oil union members accepted corruption because their leaders delivered the goods. Over time, agreements granted increasingly favorable terms. Layoffs were near impossible. Moreover, union jobs became effectively hereditary; when a worker retired, one of his or her children

239 Tayfun Babadagli, "Development of Mature Oil Fields –A Review," *Journal of Petroleum Science and Engineering* 57, no. 3–4 (2007): 222.

240 For the 2017 projection, see Pemex internal documents, http://www.pemex.com/index.cfm?action=content&sectionID=143, accessed 19 September 2009. For the 2021 projection, see International Energy Agency (IEA), *Mexico Energy Outlook*, World Energy Outlook Special Report (Paris: Organization for Economic Cooperation and Development [OECD]/IEA, 2016), 90, www.iea.org/publications/freepublications/publication/MexicoEnergyOutlook.pdf.

241 Peter Millard, "Mexico's Pemex to Fine Weatherford for Oil Drilling Delays," *Rigzone,* January 16, 2009, www.rigzone.com/news/oil_gas/a/71772/mexicos_pemex_to_fine_weatherford_for_oil_drilling_delays/.

242 "Gov't strives to save oil field," *El Universal,* April 6, 2007, http://www2.eluniversal.com.mx/pls/impreso/noticia.html?id_nota=24064&tabla=miami.

243 U.S. Energy Information Administration (EIA), "Country Brief: Mexico," EIA, December 8, 2016, 6, www.iberglobal.com/files/2016-2/mexico_eia.pdf.

244 Jeremy Martin, "Oil in Mexico & United States Energy Security: A Tale of Symbiosis," *Journal of Energy Security, January 12, 2010*, www.ensec.org/index.php?option=com_content&view=article&id=224:oil-mexico-us-energy-security&catid=102:issuecontent&Itemid=355.

gained first dibs on new jobs at the firm. Pemex avoided strikes, but the end result was a combination of high wages and severe overmanning.

Pemex had further difficulty optimizing its operations because the labor agreements effectively prevented the firm from relocating personnel. The union was divided into geographic sections, and the relative strength of each section leader was a function of the number of employees he or she represented. The union therefore strongly resisted the transfer of workers from declining to booming areas.

Only once had Pemex managed to lay off a substantial number of unionized workers. In 1989, the government initiated an operation that led to the imprisonment of "La Quina"—the nickname of Joaquín Hernández, the powerful STPRM leader—on murder charges. In the aftermath, Pemex slashed its workforce by approximately 25 percent. The number of employees, however, soon resumed its upward march. By 2013, the company employed a record 154,774 workers at an average annual wage of US$40,748, at a time when the average Mexican wage was only US$10,477.[245] Payroll costs ate up 5.0 percent of the firm's revenue at a time when its after-tax margin was *negative* 10.6 percent.[246]

The Politics of Pemex in the Early 21st Century

By 2012, a presidential election year, it was obvious to all observers that the Mexican oil industry was in serious decline. In another country, the government might have been able to ignore the problem, but Mexico did not have that luxury. The Mexican federal government relied upon oil revenues to sustain government spending. Oil taxes provided 26 percent of federal revenues, amounting to 6 percent of Mexico's GDP. Despite significant tax increases on the non-oil economy during the Calderón administration, Mexican politicians were unwilling to raise non-oil taxes enough to sustain the country's low level of public spending, let alone increase it to the levels of countries like Argentina and Chile.[247]

The fields in Cantarell and Chicontepec may have been declining, but Mexico did not lack for promising oil and gas resources. The problem was money. Pemex did not have the money needed to develop the country's deepwater reserves or unconventional onshore plays. (It also lacked the expertise, but expertise can be gained with sufficient money.) The reason why Pemex did not have the money was that the federal government imposed a crushing tax burden on the company. The federal government could have eased up on the tax burden, but then it would have had to find another way to finance Mexico's already insufficient public spending.

In 2012, the PRI under Enrique Peña Nieto won the presidency but failed to win a congressional majority; it was expected that his administration would follow the previous two into reformist mediocrity. Instead, the PRI managed to pass a comprehensive series of radical changes, including the energy reform. How did *that* happen? The roots of the accomplishment were threefold. The first was that while the PRI did not hold a majority in

245 Pemex employment and wages from Pemex, *Anuario Estadístico 2016,* 10, Table 1.3. Mexican average wages from the Organization for Economic Cooperation and Development (OECD). All figures are in nominal dollars using a 2013 exchange rate of 12.77 pesos per dollar.

246 Calculated from data in Pemex's 2013 20-F filing.

247 Before 2006, the federal government claimed 60.8 percent of Pemex's gross revenues. (Additional levies increased the effective burden to roughly 63 percent.) The government feared that corruption within Pemex would allow its management to game a more complicated system. In 2006, the government reduced Pemex's tax burden, as part of a general tax reform that imposed the first corporate income tax in Mexican history at a flat rate of 19 percent. The law replaced Pemex's gross receipts tax with a complex set of new duties. The effect was to reduce the tax burden on the company to 57 percent of income, but this was not enough to consistently lift the company out of the red.

Congress, it held a majority of the state legislatures. This was vital because a Mexican constitutional amendment requires a majority of state legislatures to approve. Mexican political parties, unlike American ones, are highly centralized—if party leadership approves of an amendment reported out of Congress, then the state legislatures controlled by that party will immediately vote "yes."

The second was that the opposition PAN (Partido Acción Nacional; National Action Party) had no clear candidate for the 2018 election and thus no one with an incentive to hold up reforms for their own electoral advantage. Moreover, the PAN had long approved of opening the energy sector. The PRI could change its positions on a dime for political advantage; it was harder for the more ideological PAN to do the same. The PRI also agreed to give into PAN desires in a separate political reform. In addition, the PRI found it easy to buy votes from two smaller parties: the Greens and the New Alliance. The Greens, despite their name, were not particularly concerned about the environment. Rather, the party functioned as a family enterprise, winning seats in order to collect federal subsidies which it used to maintain its seats, parceling out votes to the highest bidder. The New Alliance began as a vehicle for the head of the powerful national teachers' union and morphed into a vaguely center-right party. These highly centralized parties could be bought and would stay bought in what one prominent Mexican political scientist and commentator called "legalized corruption."[248]

The third was a split in the left. Andrés Manuel López Obrador—better known by his initials as AMLO—had abandoned the center-left PRD (Partido de la Revolución Democrática; Party of the Democratic Revolution), frustrated with his second unsuccessful run at the presidency. The "New Left" faction took over the party and decided to distance itself from AMLO's perceived radicalism. It therefore reached out to the PRI and PAN to negotiate a series of economic and political reforms that it hoped would reignite economic growth, positioning itself as the sensible left alternative in 2018.[249]

The resulting "Pacto de México" did not include the energy reform, but President Peña used the spirit of cooperation engendered by the agreement to speed the reform through Congress with PAN support (see table 5.1). A July 2013 poll showed that only 39 percent had a "good" or "very good" impression of Pemex, against 32 percent whose opinion was "bad" or "very bad." Only 44 percent were "proud" or "very proud" of the company, against 54 percent who were "slightly" or "not at all" proud. Eighty-eight percent considered the company to be riddled with corruption. Fifty-nine percent supported allowing Pemex to act as if it were a private company. Strangely, of those who claimed to be familiar with the PRI's proposed reforms, 55 percent supported the legislation but 54 percent also opposed private investment in the industry.[250]

248 Carlos Elizondo Mayer-Serra, "Reforma de la Constitución: la economía politica del Pacto por México" [Constitutional reform: The political economy of the Pacto por Mexico], *Revista Mexicana de Ciencias Políticas y Sociales* 62, no. 230 (2017), 30.

249 Ibid., p. 27.

250 Fernando Barrientos del Monte and Daniel Añorve, "México 2013: Acuerdos, reformas y descontento" [Mexico 2013: Agreements, reforms, and discontent], *Revista de Ciencia Política* 34, no. 1 (2014), 239–40.

Table 5.1. Congressional Votes on Energy Reform by Party

	Senate		House	
	For	Against	For	Against
PRI	53	0	209	1
PAN	35	2	107	3
Greens	7	0	28	0
New Alliance	–	–	10	0
PRD	0	20	0	95
Labor	0	5	0	13
Citizens' Movement	–	–	0	19
Independent	0	1	–	–
TOTAL	95	28	354	131

Source: Barrientos del Monte and Añorve (2014).

The Peña administration also needed to overcome opposition from the oil workers' union. After all, the PRI had no desire to provoke a crippling oil strike or mass demonstrations and it certainly had no desire to threaten its position in the 2015 midterms or 2018 presidential election. The oil unions had one center of gravity: the leadership of Carlos Romero Deschamps. Deschamps also happened to be a sitting PRI senator and "enjoyed" second place on the *Forbes list of the 10 most corrupt Mexicans.*[251] On a monthly salary of US$1,864, Deschamps managed to accumulate a $1.5 million "cottage" in Cancún, a son who drives a $2 million Ferrari, and a daughter who likes to post Facebook images of her jet-setting around the world with her three English bulldogs. In other words, a serious corruption investigation would toss him and his children into jail. President Peña made it clear to Deschamps that he had no choice but to go along with the reform in the most obvious way: in February 2013, Peña took the powerful leader of the teachers' union, Elba Esther Gordillo—number one on the *Forbes* corruption list and head of the aforementioned New Alliance Party—and had her arrested on corruption charges. Gordillo was fortunate enough to be over 70 years old and therefore eligible for house arrest instead of prison— she owned a nice apartment in Polanco—but the message was clear.[252] Deschamps brought the union on board with the reform.

The reform went through the Senate in a little less than two months; in a last-minute change, the Senate added a clause removing the oil workers' union's five seats on Pemex's board.[253] The Chamber of Deputies approved the Senate version two days later. In another country, requiring half the state legislators to ratify the amendments would have slowed the process. In Mexico, however, state legislators were beholden to their parties' national leadership: the reform took only 83 hours after passage to garner a majority of state legislatures.[254]

251 Dolia Estevez, "The 10 Most Corrupt Mexicans of 2013," *Forbes*, December 16, 2013, www.forbes.com/sites/doliaestevez/2013/12/16/the-10-most-corrupt-mexicans-of-2013/.

252 The judge in Gordillo's case putatively agreed to house arrest out of fear that Gordillo might lose her mind in prison. Luis Pablo Beauregard, "El Gobierno mexicano pide restringir la comunicación de Elba Esther Gordillo" [The Mexican government asks to restrict the communication of Elba Esther Gordillo], El País, February 15, 2018, https://elpais.com/internacional/2018/02/15/actualidad/1518660623_657439.html.

253 "Senado echa al sindicato del consejo de Pemex" [Senate dismisses the Pemex council union], *El Economista* December 10, 2013, www.eleconomista.com.mx/empresas/Senado-echa-al-sindicato-del-consejo-de-Pemex-20131210-0036.html.

254 Mayer-Serra, "Reforma de la Constitución," 34.

The energy reform was radical in the sense that it opened Mexico's hydrocarbon industry to foreign investment, but where Pemex was concerned it was remarkably conservative. Pemex was given the right to retain a swathe of self-chosen hydrocarbon plays in what the reform called "Round Zero." The union lost its five board seats, replaced by outside directors, but Pemex remained an organ of the federal government, its budget subject to congressional and treasury review. The company now faced competition in the retail sector, but it was not forced to divest any of its extensive network of service stations. Pemex could invite foreign companies to participate in its plays (known as "farmouts"), but only when advantageous to it and only with government approval. In other words, President Peña's reforms did not strike at the heart of Pemex's special position; rather, they skirted it, preserving enough of Pemex's status to defuse the most intense opposition while still opening the hydrocarbon industry. That is not to say that the reforms did nothing to change Pemex, because they preserved as much of Pemex's status as was possible given the goal of attracting enough foreign capital to reverse the output decline.

Energy Reform in Theory

How did the energy reform specifically affect Pemex? Pemex faced three interrelated constraints. The first was that the firm had no access to outside capital in order to finance new ventures or improve existing ones other than by issuing debt. It could neither issue equity nor engage in joint ventures. The second constraint was the massive tax burden imposed by the federal government. Taxes regularly drove the company into the red, leaving few resources for reinvestment or expansion. The third was management's inability to squeeze out efficiencies. The labor union controlled a third of the seats on the board and the four-division split made decisionmaking cumbersome at best. In addition, the federal government micromanaged all budget decisions, since Pemex was considered an integral part of the federal bureaucracy. The reforms, therefore, intended to ease these three constraints.

To address the first constraint, the energy reform first allowed Pemex to choose which potential oil plays it wished to retain. Pemex would present a list of desired plays to the oil ministry—both existing fields and potential ones—which would make the final determination in "Round Zero." Pemex could then choose to "farm out" some of these plays; that is, to attract foreign partners that eventually would receive a share in the play in return for physical investment and the use of their technology. To address the second constraint, the reform once again changed the tax system to lower the burden on the company if production went up but raise it if prices increased. Finally, to address the third constraint, the union lost its privileged position on Pemex's board and was required to accept a change to the pension system. In addition, the reform reorganized Pemex from four divisions to two. These changes are worth examining in greater detail.

Easing financial constraints

In theory, the reforms were designed to ease the financing constraints Pemex faced. Round Zero allowed the company to choose which existing blocks it wished to keep. Pemex management did not make the decision independently. Rather, the Pemex board voted (by a bare majority) to outsource the selection to a committee of four government officials and one independent board member.[255] The committee requested only 82 percent of all the proved or provable (also known as 2P) reserves and 31 percent of all possible (3P) reserves in the country, amid suspicion that the government wanted to reserve promising blocks for the state to auction off in later

255 Fluvio Ruíz Alarcón, "The Mexican State and Pemex," *Forum,* June 2017, 10.

rounds.[256] Why this would benefit the state more than allowing a fully state-owned and highly taxed enterprise to develop them was left unexplained.

The energy minister approved all of Pemex's 2P requests and 68 percent of its 3P requests.[257] Pemex's director-general reacted with indignation to the loss of a third of its 3P requests, but 3P reserves are by their nature speculative. The energy ministry likely believed that it would require the resources of major international oil companies to develop them. Pemex could still bid on those reserves in later auction rounds.

For the fields Pemex retained in Round Zero, the energy reform gave it the ability to "farm out" some of those blocks to private companies. In a standard farmout agreement, the owner of the lands (or "farmor") brings in a partner (the "farmee"). The farmee agrees to invest a certain amount in the play. Once production starts, the farmee pays a fixed royalty on any production to the farmor. Any returns above the royalty pay back the farmee for their investment. Once the farmee has earned back their investment, they have the option to either continue making royalty payments or switch to a percentage interest in the proceeds from the play.

For a cash-strapped Pemex, a development model where the bulk of new investment comes from the farmee was obviously attractive. Most of the areas considered for farming out would be already discovered or producing fields, some of which might even have infrastructure in place.[258] Pemex was quite optimistic about the model.

Easing fiscal constraints

The tax burden on Pemex regularly drove the company into the red. Before 2006, the federal government claimed 60.8 percent of Pemex's gross revenues. The government feared that corruption within Pemex would allow its management to game a more complicated system. The problem was twofold. First, it took no account of oil prices. Second, it taxed marginal production at the same rate as existing fields. In 2006, the government attempted to address the problem. First, it raised taxes on the non-oil economy, including the first corporate income tax in Mexican history. Second, it replaced Pemex's gross receipts tax with a complex set of new duties designed to increase the rate on existing fields while reducing taxes on newer operations. The reform reduced Pemex's tax burden, but not enough to lift the company into the black.

The 2013 energy reform therefore took another bite at the apple, slashing the number of taxes Pemex had to pay on its crude oil and gas production while raising allowed deductions. In addition, the new system was made more sensitive to costs. Whereas before Pemex could deduct costs only at a fixed rate of 6.50 per barrel at most fields—well below the company's average 2013 production cost of $7.91 per barrel—the company could now choose to deduct 10.6 percent of the value of production.[259] It also was allowed to offset losses against its total

256 The SEC defines "proved" (1P) reserves as hydrocarbons with a 90 percent probability of being extracted at current prices. "Probable" reserves have a 50 to 90 percent probability of being extracted at current prices. "Possible" reserves have a less than 50 percent probability of being extracted. The higher the hydrocarbon price, the more resources the firm can profitability devote to extraction. Because the probability of extraction changes with the price of hydrocarbons, reserves rise with prices even if the firm conducts no exploration. Conversely, if prices fall, then the decline in reserves will exceed the amount of hydrocarbons actually extracted by the firm.

257 Secretaría de Energía (SENER), *Programa quinquenal de licitaciones para la exploración y extracción de hidrocarburos, 2015–2019* [Five-year tender program for hydrocarbon exploration and extraction, 2015–2019] (Mexico City: SENER, 2018), 6, www.gob.mx/cms/uploads/attachment/file/298799/Programa_Quinquenal_ene_2018.pdf.

258 Adrian Lara, "The Evolving Role of Pemex and Its Future Position in the Upstream Sector," *Forum* (June 2017), 17.

259 2013 production costs from Pemex's 2015 20-F filing, p. 41.

tax bill.[260] Finally, hydrocarbon tax rates were reformed to operate on a sliding scale, rising and falling with oil prices.[261] Yet all legal formulas aside, Pemex remained under pressure to continue contributing roughly what it had before the reform.[262] Former Pemex CEO José Antonio González Anaya acknowledged as much when he told a pair of Harvard investigators, "Pemex is the largest tax contributor, about 15 percent. If Pemex's taxes deviate, I get a call."[263] That call could be serious, since the law granted the executive branch the authority to alter tax rates in the future.[264]

Easing managerial and labor constraints

If Pemex were to act as a "normal" oil company focused on production and revenue, it would have to increase efficiencies and stop behaving as an employment machine. The reform recognized this problem. First, it reorganized Pemex into two main divisions: Exploration and Production (E&P) in the upstream and Industrial Transformation in the downstream. Second, it reorganized procurement, legal, and human resources. Third, it removed the union's five seats on the Pemex board. The new board would consist of the energy and finance ministers, three other members appointed by the president of Mexico, and five outsiders appointed by the president and confirmed by the Senate.[265]

The Peña administration also proposed that it would help Pemex with its current pension burden. The government said that if Pemex and the unions could agree to cut pensions, it would assume from Pemex a portion of the remaining burden equal to half the agreed-upon savings.[266] Pemex's employees were able to retire at 55 years of age, 10 years lower than other Mexican government employees, and they were guaranteed half of their salary, life insurance, and free medical coverage for themselves and their spouses. The administration told Pemex that it should persuade the union to raise the retirement age to 65 and agree to liberalize labor practices.[267] The reform did not, however, alter Pemex's legal status as a branch of the federal government. Despite the energy ministry's seat on the board, Pemex was effectively independent from it. However, the treasury and Congress retained the right to review all its expenditure items line by line.

260 For an example of how this offsetting worked, see page F-119 of the company's 2017 20-F filing with the U.S. Securities and Exchange Commission (SEC).

261 Lucas Aristizabal and Alberto de los Santos, "Petróleos Mexicanos Sensitivity Analysis," *FitchRatings,* October 21, 2016, 3.

262 Mayer-Serra, "Reforma de la Constitución," 37.

263 Richard H. K. Vietor and Haviland Sheldahl-Thomason, *Mexico's Energy Reform* (Harvard Business School, January 2017), 7, www.hbs.edu/faculty/Pages/item.aspx?num=52187.

264 Diana Villiers Negroponte, "Mexico's Energy Reforms Become Law," Brookings, August 14, 2014, www.brookings.edu/articles/mexicos-energy-reforms-become-law/.

265 Lara, "The Evolving Role of Pemex," 16.

266 Juan Montes, "Pemex, Union Agree to Overhaul Pension Benefits," *Wall Street Journal,* November 11, 2015, www.wsj.com/articles/pemex-union-agree-to-overhaul-pension-benefits-1447287357.

267 Negroponte, "Mexico's Energy Reforms Become Law."

Energy Reform in Practice

With the reforms in place, it was hoped that Pemex's would be able to acquire capital, enjoy a more relaxed taxation policy, and sort out its internal issues in order to become profitable. Yet in practice, the financial, fiscal, and management and labor constraints remained.

Easing financial constraints

Pemex lacked both the cash and the technology to develop its resources. These facts made farmouts attractive, sweetened further by the fact that farmout production fell under the new, more lenient tax regime that the energy reform had established for private companies. Pemex's biggest farmout to date (auctioned in December 2016) involved the Trión deepwater field. The project required $1.9 billion in capital expenditure from the Australian firm BHP Billiton and $600 million from Pemex before production; ultimately, investment will total $7.4 billion.[268] Comparatively, the other farmouts have been small change: in October, Pemex farmed out for Cárdenas-Mora, a $127 million expected investment in partnership with Cheiron Holdings Limited; and Ogarrio, a $95 million expected investment in partnership with Deutsche Erodel AG.[269] An attempt to auction the Ayín-Batsil play attracted no bidders. The company also planned to farm out the Nobilis-Maximino field in 2018, but investors expressed little interest and Pemex cancelled the tender. (See table 5.2.)

268 Data provided by SENER officials.

269 The verb in Mexican Spanish for "farm out" is *farmoutear.*

Table 5.2. Pemex Joint Ventures and Farmouts

Block	Round	Partner(s)	Hydrocarbon	Expected peak production (bpd)	Investment (US$m)	Auction date
Perdido Block 3	1.4	Chevron and Inpex	Light oil		$2,017	May 12, 2016
Trión farm-out		BHP Billiton	Light oil and gas	108,448	$8,839	Dec 5, 2016
Tampico-Misantla Block 2	2.1	Deustche Erdoel	Light oil and dry gas		$578	Jun 19, 2017
Southeastern Basins Block 8	2.1	Ecopetrol	Light oil		$804	Jun 19, 2017
Cárdenas-Mora farmout		Cheiron	Light oil	13,253	$192	Oct 4, 2017
Ogarrio farmout		Deustche Erdoel	Light oil	16,346	$162	Oct 4, 2017
Ek-Balam		none	Heavy oil	109,440	$6,600	May 2, 2017
Santuario and El Golpe		Petrofac	Light oil and gas		$1,590	Dec 18, 2017
Perdido Block 2	2.4	Shell	Light oil		$6,131	Jan 31, 2018
Perdido Block 5	2.4	none	Light oil		$6,131	Jan 31, 2018
Perdido Block 18	2.4	none	Dry and wet gas		$3,318	Jan 31, 2018
Perdido Block 22	2.4	Chevron and Inpex	Heavy oil		$4,747	Jan 31, 2018
Tampico-Misantla Block 16	3.1	Deustche Erdoel Cía. Esp. de Petróleos	Light oil and dry gas		$569	Mar 27, 2018
Tampico-Misantla Block 17	3.1	Deustche Erdoel Cía. Esp.de Petróleos	Light oil		$569	Mar 27, 2018
Tampico-Misantla Block 18	3.1	Cía. Esp. de Petróleos	Light oil		$569	Mar 27, 2018
Cuencas del Sureste Block 29	3.1	none	Light oil		$541	Mar 27, 2018
Cuencas del Sureste Block 32	3.1	Total	Heavy oil and dry gas		$474	Mar 27, 2018
Cuencas del Sureste Block 33	3.1	Total	Light oil		$541	Mar 27, 2018
Cuencas del Sureste Block 35	3.1	Shell	Heavy oil		$541	Mar 27, 2018
Ayín-Batsil farmout			Heavy oil	62,900	na	Cancelled
Nobilis-Maximino farmout			Light oil	174,000	na	Cancelled
7 Clusters farmout (onshore)			Light oil		$4,650	Upcoming
TOTAL INVESTMENT					$49,563	

Source: Moody's Investors Service, "Petróleos Mexicanos: Update following ratings stabilization," *Credit Opinion* (April 13, 2018), 9, and Adrian Lara, "Evolving," 18. Updated production and investment data, including all data for the Seven Clusters, provided by Adrian Lara.

Yet the farmout model had severe limits. Pemex expected them to raise its output from 1.9 million bpd in 2017 to 2.5 million by 2021.[270] Even if that target was met, that would represent only modest growth and still be a long way from its 2004 peak of 3.4 million. Trión, for example, will not start production until 2022, with peak output not expected until 2025. The attempts to farm out Nobilis-Maximino and Ayín-Batsil failed, but even had they succeeded the fields would not have hit peak output until 2026. In theory, all the fields Pemex is considering farming out could produce 664,700 bpd—plus an additional 537 million cubic feet per day

270 Pemex, "Investor Presentation" (December 2017), 11, www.pemex.com/en/investors/investor-tools/Presentaciones%20Archivos/Investor%20presentation_20171212.pdf.

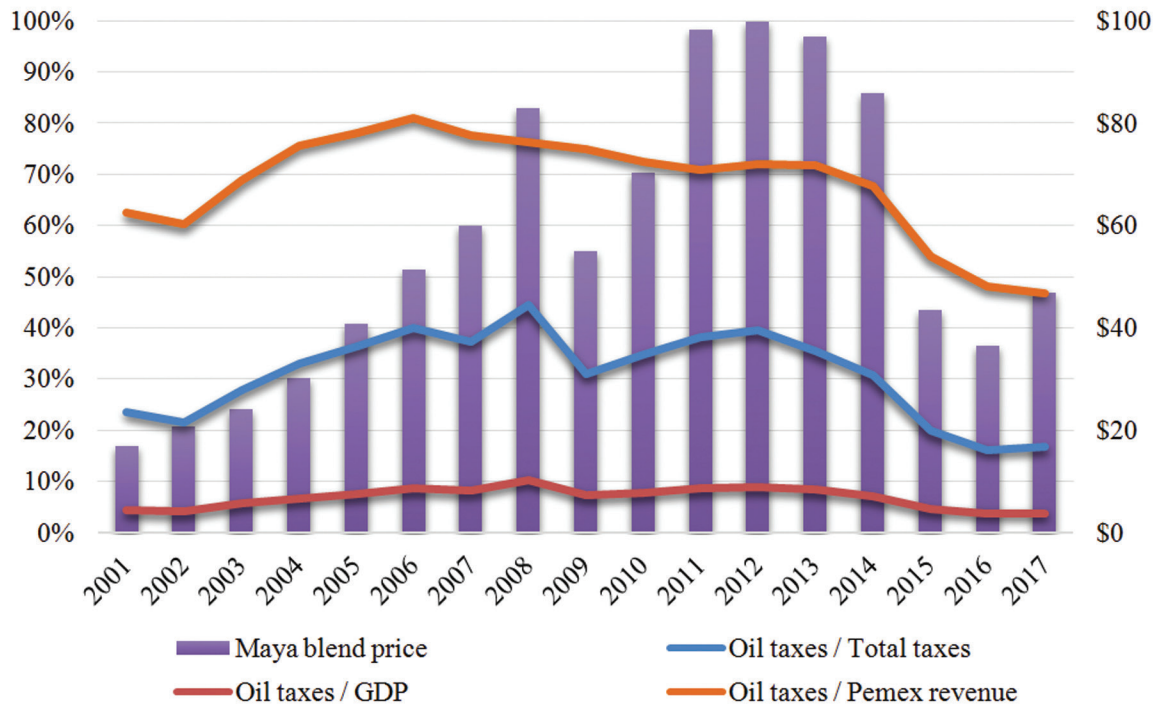
of natural gas—but not before 2026 even if everything goes perfectly.[271] With the failure of Ayín-Batsil and Nobilis-Maximino, peak production from the remaining farmouts falls to 309,400 bpd in 2024.[272] Worse still, since some of the fields are already producing, incremental production will be only 218,700 bpd.[273]

Pemex has had more success at the auctions for new fields, particularly offshore auctions where it can offer partners access to its existing infrastructure. In theory, Pemex can attract roughly $21 billion of capital expenditure to replace its own plummeting expenditures and reduce its tax burden in the process. In practice, these are multidecade projects that will take a long time to execute. In addition, they expose Pemex to execution risk: the partners will take on much of that burden, but not all. In case of the farmouts, the glass is three-quarters empty and filling very slowly.

Easing fiscal constraints

Energy reform had a rapid and dramatic effect on Pemex. After oil prices sailed off a cliff from $98 per barrel in June 2014 to a nadir of $24 in January 2016, the company's tax burden fell dramatically (figure 5.2). By 2017, the company paid only 48 percent of its revenue into federal coffers. That was still enough to drive Pemex into the red but the amount of red ink would have been incomparably higher under the old system.

Figure 5.2. Pemex Taxes as Percentage of Pemex Revenue, Federal Taxes, and GDP



Source: Pemex 20-F filings; SHCP (Secretaría de Hacienda y Crédito Público; Secretariat of Finance and Public Credit).

271 Lara, "The Evolving Role of Pemex," 17–19.

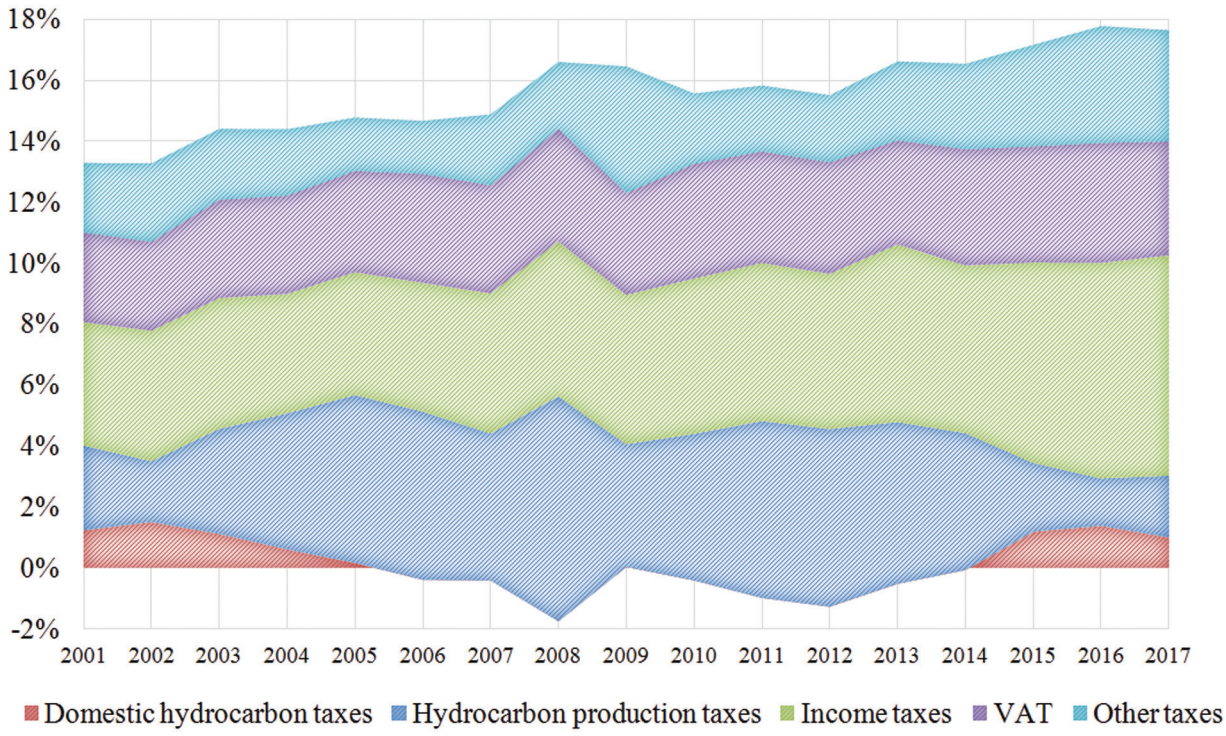
272 Including Ek-Balam.

273 Authors' calculations.

The problem for Pemex is that its tax burden is still disproportionately high. Taxes per barrel in Mexico came to roughly $16.80 per barrel in 2016, down from $41 in 2014. Taxes are far lower for other Latin American state oil companies. Colombia's Ecopetrol, for example, pays only $5.80 per barrel, Brazil's Petrobras only $5.60, Argentina's YPF only $1, and Ecuador's Petroamazonas nothing.[274] Admittedly, these figures ignore income taxes levied on the other Latin American companies—yet Pemex pays no income tax because it has no income after other taxes. The problem is worse for Pemex because its full-cycle cost, including finding and development expenses, runs around $36 per barrel.[275] Unless the company can retain something around that amount, production will inevitably fall. The farmouts may allow Pemex to get around this particular obstacle; however, as mentioned, the farmouts have a long way to go before they can make a serious dent in Pemex's constraints.

Could future administrations cut taxes further? The answer is almost certainly yes. Mexico's two rounds of tax increases under the Calderón and Peña administrations have been a success: public revenues have held up despite the meltdown in hydrocarbon revenues (figure 5.3). Mexico is still far from overtaxed even by Latin American standards. The government could increase rates and crack down on evasion. Moreover, rising oil and gas prices would raise revenues even under a more lenient tax regime. Whether the next administration will make such moves, however, remains to be seen. After all, neither the Calderón nor the Peña administration received much electoral benefit from their tax increases.

Figure 5.3: Federal Taxes as Percentage of GDP, by Type, 2001–17



Source: SHCP. Note that "domestic hydrocarbon taxes" were negative between 2006 and 2014; that is to say, the Mexican government subsidized fuel consumption.

274 Lucas Aristizabal and Paula Bunn, "Latin American Oil & Gas Netback — Peer Comparison," *FitchRatings,* September 2017, 7–9.

275 Ibid., 7.

Easing managerial and labor constraints

The energy reform did little directly to overcome Pemex's prime managerial constraint: namely, that it remained an organ of the federal government, subject to line item review by the treasury and Congress. Pemex had to justify, for example, all of its capital expenditure not only to its board but to the treasury in terms of meeting five-year production targets. Management complained about the resulting inefficiencies and bottlenecks.

Pressures to keep the refining sector open meant that Pemex could do little about its biggest loss-producing center. Refined product output is down 37 percent since 2013 and Pemex refineries rarely use more than half their listed capacity.[276] The twin natural disasters visited upon the Salina Cruz refinery—Hurricane Calvin in June 2017, followed by an earthquake in September—made matters worse. In 2015, the last year for which the earnings of the refining sector alone can be broken out, the sector lost $7.1 billion. The available data imply that things have improved from terrible to merely very bad in the years since: in 2015, the "industrial transformation" segment, of which refining is a part, collectively lost $5.5 billion. In 2017, losses had fallen to $2.9 billion.[277] It was not clear that Pemex's refining sector made any sense to be in Pemex's hands; a private operator would certainly sell the plants and might even consider shutting them down. That said, Pemex's management managed to institute a series of successful cost-cutting measures. It cut US$1.9 billion a year by renegotiating service contracts and saved an additional $300 million by shutting wells with lifting costs above $25 per barrel.[278]

The reform, however, had two additional benefits: one direct and one indirect. The direct benefit was the pension reform. In 2015, the union agreed to increase the retirement age to 60 for employees with less than 15 years of service and migrate new employees to a defined contribution plan.[279] In 2016, the government followed through on its end with a $4.2 billion bailout.[280] The indirect benefit was that Pemex was able to get a start on reducing its overstaffing. The company shed almost 30,000 employees in a three-year period. What it is surprising is how easily Mexico's strongest union—or what once had been its strongest union—folded into this plan.[281] Layoffs hit unionized and nonunionized workers alike; in fact, the share of union workers declined slightly during the mass layoffs of 2015.

Alternative facts are not an American monopoly: in a startling 2014 declaration, union leader Carlos Deschamps declared that energy reform would bring no layoffs.[282] Even more startlingly, Deschamps denied that the

276 Pemex 2017 20-F filing, p. 58.

277 Ibid., 173.

278 Lara, "The Evolving Role of Pemex," 17.

279 Montes, "Pemex, Union Agree to Overhaul Pension Benefits."

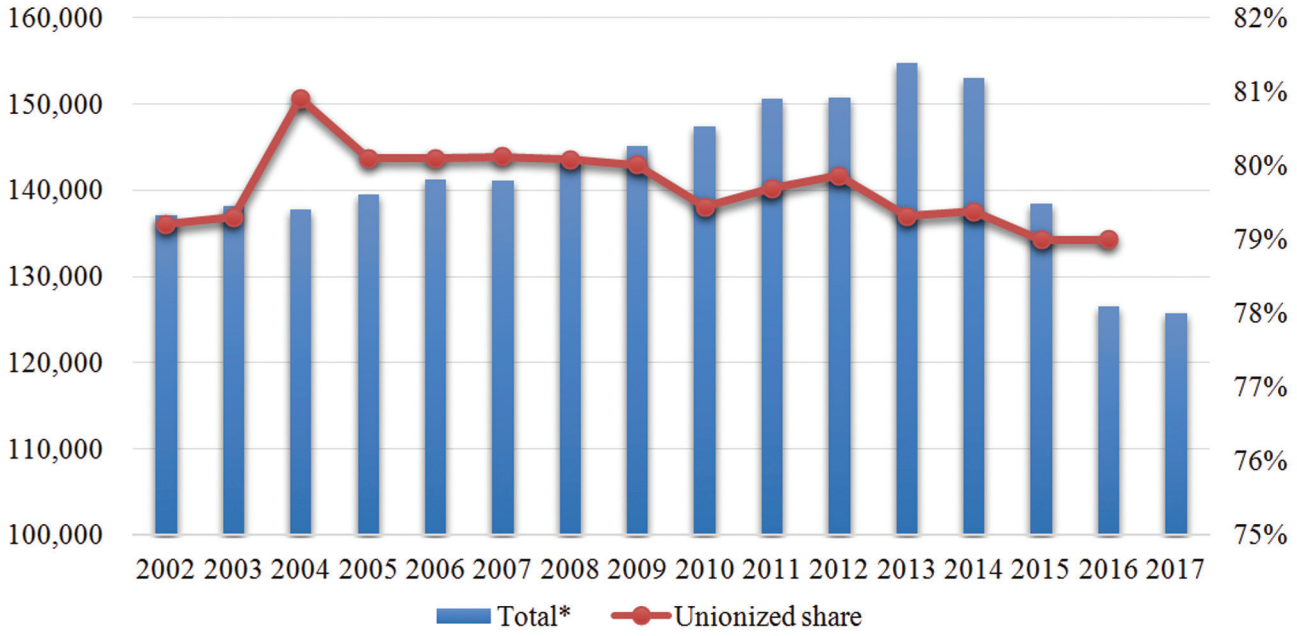
280 "UPDATE 2-Mexico gives Pemex $4.2 bln shot of liquidity," Reuters, April 13, 2016, www.reuters.com/article/mexico-pemex-idUSL2N17G17S. See also the 2017 20-F filing, 160.

281 "Senado echa al sindicato del consejo de Pemex."

282 "Reforma energética no traerá despidos: Romero Deschamps" [Romero Deschamps: Energy reform will not lead to layoffs], *Política,* January 14, 2014, www.milenio.com/politica/Romero_Deschamps-reforma_energetica-despidos_Pemex-Pemex-trabajadores_petroleros_0_226777602.html.

mass firings were taking place once they had begun. According to him, only oil workers employed in private companies lost their jobs.[283] Unfortunately, as figure 5.4 shows, the reality was otherwise.[284]

Figure 5.4: Pemex Employees and Union Share, 2002–17



Source: Pemex 20-F filing, various years.

Deschamps went along with the official line because he was complicit and the Peña administration had him in their grasp. Why, however, was the union quiescent? Deschamps could have been voted out; even if not, a series of wildcat strikes could have erupted, in shades of the movement that brought down the private oil companies in 1938. The reason was twofold. First the layoffs disproportionately hit Tabasco, Campeche, and Veracruz. There workers did vocally demand the rollback of the energy reform, secret union elections, and the firing of their *cacique*—the political boss—Carlos Romero Deschamps.[285] Some senators asked that Pemex produce a report on the causes of these massive layoffs and urged the secretary of labor to design policies to protect oil workers' rights.[286] But regional disquiet could be contained. More important, the Pemex workers who managed to hold on to their jobs continued to see their real annual wages climb steadily in a country where average wages had

283 Andrea Becerril and Víctor Balllinas, "Rechaza Romero Deschamps despidos en Pemex" [Romero Deschamps rejects dismissal from Pemex], *La Jornada San Luis,* December 1, 2016, http://lajornadasanluis.com.mx/nacional/rechaza-romero-deschamps-despidos-pemex/.

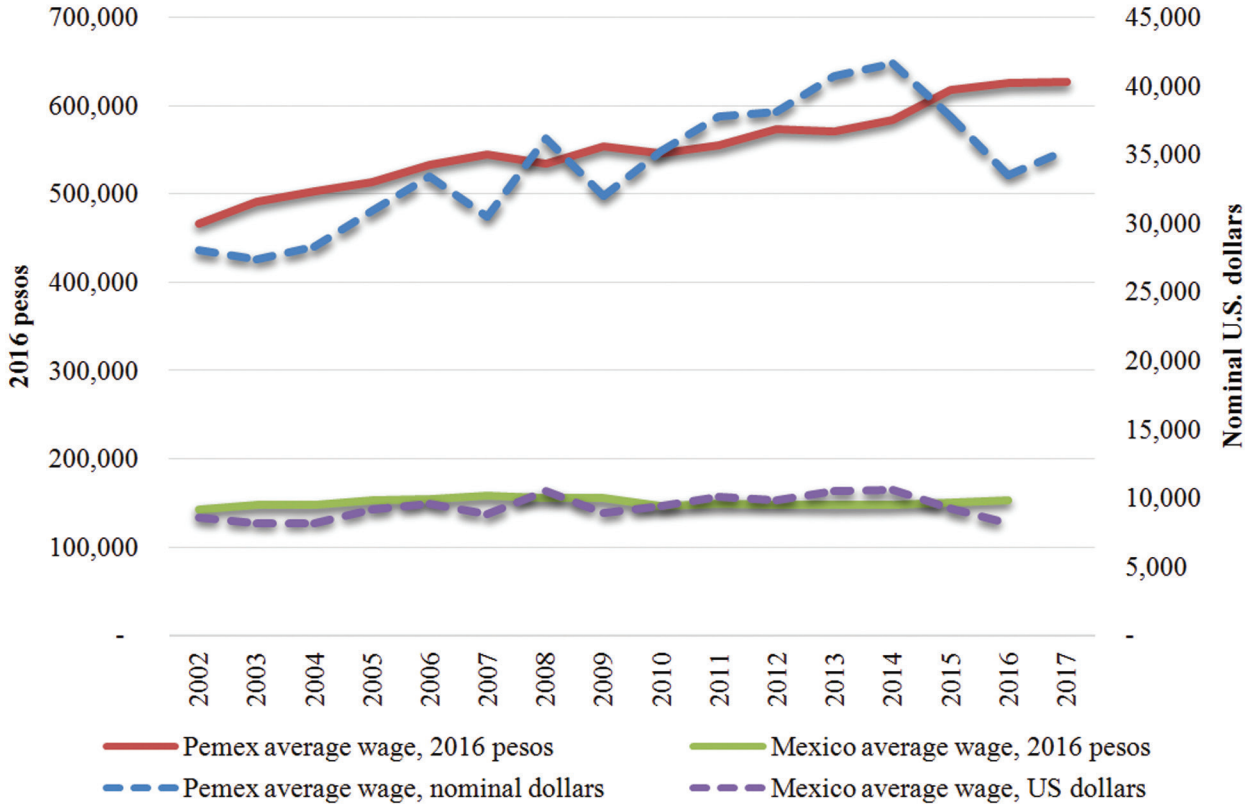
284 Note that 20-Fs record number of employees but the *Anuario Estadístico* refers to the same number as "plazas." Since SEC rules demand the reporting of actual human employees and not the number of official posts, this assessment goes with employees.

285 Armando Guzmán. "Petroleros de Tabasco exigen la renuncia de Romero Deschamps al sindicato de Pemex" [Tabasco oilworkers demand that Romero Deschamps resign from the Pemex union], *Proceso,* March 16, 2018, www.proceso.com.mx/526458/petroleros-de-tabasco-exigen-la-renuncia-de-romero-deschamps-al-sindicato-de-pemex.

286 Senadora Dolores Padierna Luna, *Comunicación del Senado,* June 21, 2017, www.senado.gob.mx/sgsp/gaceta/63/1/2016-08-03-1/assets/documentos/PA_PRD_Liberalizacion_Gas_Natural.pdf.

been stagnant for more than two decades (figure 5.5). There was a round of Pemex wage hikes in 2015, after which wages barely outpaced inflation—but outpace inflation they did.[287]

Figure 5.5. Pemex Wages and Mexican Wages, 2002–17



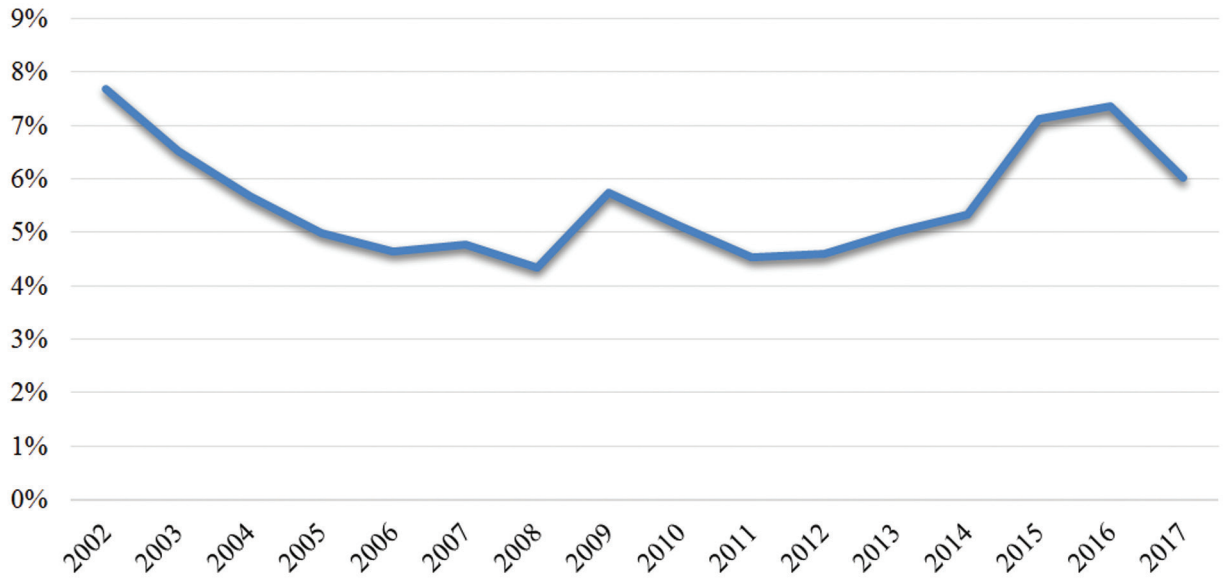
Source: Pemex.

The problem for Pemex was that there was a long way to go before labor costs came under control. Payroll as a share of revenue increased when the layoffs began. It only began to fall in 2017, as rising oil prices took off some of the pressure. Nonetheless, payroll remained around 6 percent of revenue, similar to its pre-reform level (figure 5.6). Productivity similarly failed to improve, as Pemex's upstream production continued to fall and its downstream refineries remained inefficient, money-losing wrecks. Considering Pemex's high cost structure and the fact that it was still overstaffed compared to other Latin American national oil companies, more layoffs were a likely prospect—unless a future labor-friendly presidential administration, perhaps led by a native son of one of the badly hit states, headed them off.[288]

287 The annual salary increase fell from 4.75 percent per year in the 2011–13 contract to 3.12 percent for the 2017–19 period, but the latter contracts increased the "productivity bonus" that workers receive if they meet institutional goals and objectives from 26.99 percent to 29.5 percent. See the 2013 and 2017 "Contrato Colectivo de Trabajo celebrado entre Petróleos Mexicanos por sí y en representación de sus empresas productivas subsidiarias y el Sindicato de Trabajadores Petroleros de la República Mexicana" [Collective labor agreement concluded between Pemex itself and on behalf of its subsidiary production companies and the Oil Workers Union of the Mexican Republic].

288 Noé Cruz Serrano, "Pemex Will Continue Staffs Cuts in 2018," *El Universal,* September 12, 2017, www.eluniversal.com.mx/english/pemex-will-continue-staffs-cuts-2018.

Figure 5.6. Pemex Payroll as Percentage of Revenue, 2002–17



Source: Pemex 20-F filings, various years.

Red Flags Ahead

Energy reform has been relatively good to Pemex. Round Zero gave the company the proven reserves that it wanted. Pension reform let it shed some, albeit not all, of its unfunded liabilities. A cowed union let it fire 20 percent of its labor force. The farmouts gave it access to outside equity capital. And taxes fell substantially. Despite all that, the enterprise remained troubled. Production declined, the refineries remained a money sink, and productivity did not improve. Pemex continued to lose money.

The result was a dramatic increase in debt: a 40 percent rise in total liabilities net of pensions since 2013. In basic accounting terms, Pemex was insolvent, with liabilities exceeding assets, US$184 billion to US$108 billion.[289] In the real world, however, companies can recover from long periods of negative equity, even in the absence of a bankruptcy restructuring. Pemex continued to issue debt in international markets. The question was: how sustainable was the model? Did investors have confidence that the tanker would turn around?

Much of Pemex's problems derived from low oil prices. Its overall debt sustainability indicators were not out of line compared to Latin America's other big national oil companies. Financial fragility has plagued both YPF and Petrobras. Interest coverage—defined as earnings before interest and taxes (EBIT) divided by interest—has plunged for all three companies since 2014. Like Petrobras, Pemex managed to improve its debt maturity profile by swapping short for long term debt (table 5.3.) By 2017, short-term debt had fallen from 16 percent of the total portfolio in 2008 to only 8 percent. Nonetheless, Pemex does not have a robust liquidity position and will continue to have to borrow to meet upcoming obligations.

289 2017 20-F filing, F-3.

Table 5.3. Debt indicators, 2017

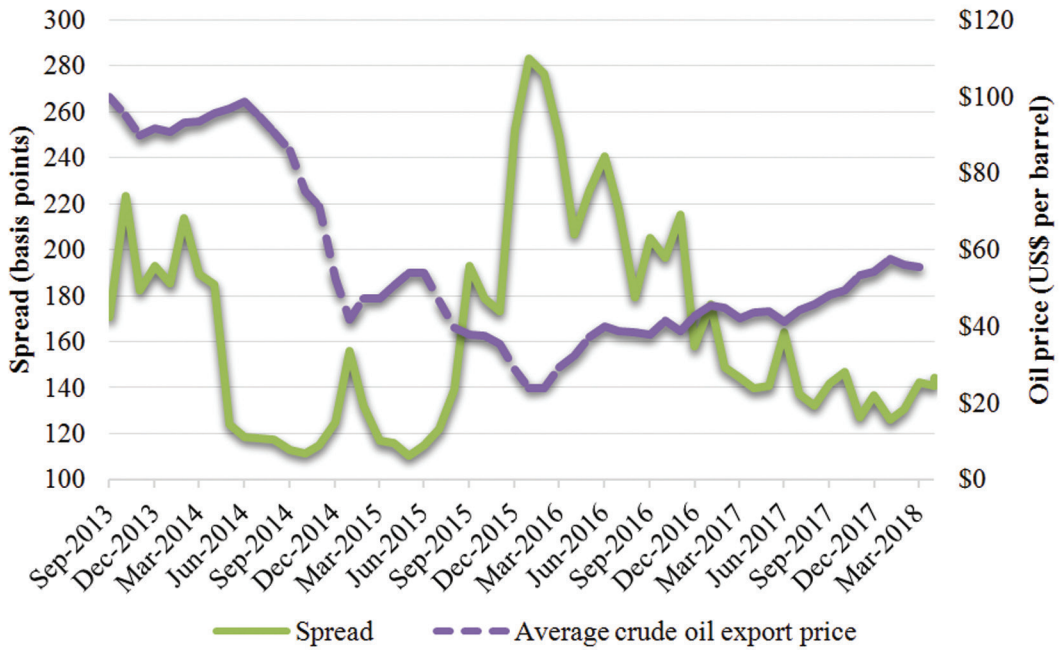
	Pemex	Petrobras	YPF
Interest coverage *EBIT/Interest*	0.91	1.51	0.56
Short term debt *share of total debt*	9%	6%	21%
Spread over sovereign *basis points*	145	127	179

Source: Bloomberg

Markets appeared to have confidence that the supertanker could be turned around without hitting the shoals, although that confidence was not absolute. Pemex is linked to the Mexican federal government, which probably would intervene if the firm headed towards default. The key word is *probably.* That probability can be measured by the spread on Pemex bonds over Mexican federal bonds provides a measure of perceived risk; the bigger the spread, the riskier Pemex bonds are relative to Mexican federal bonds.

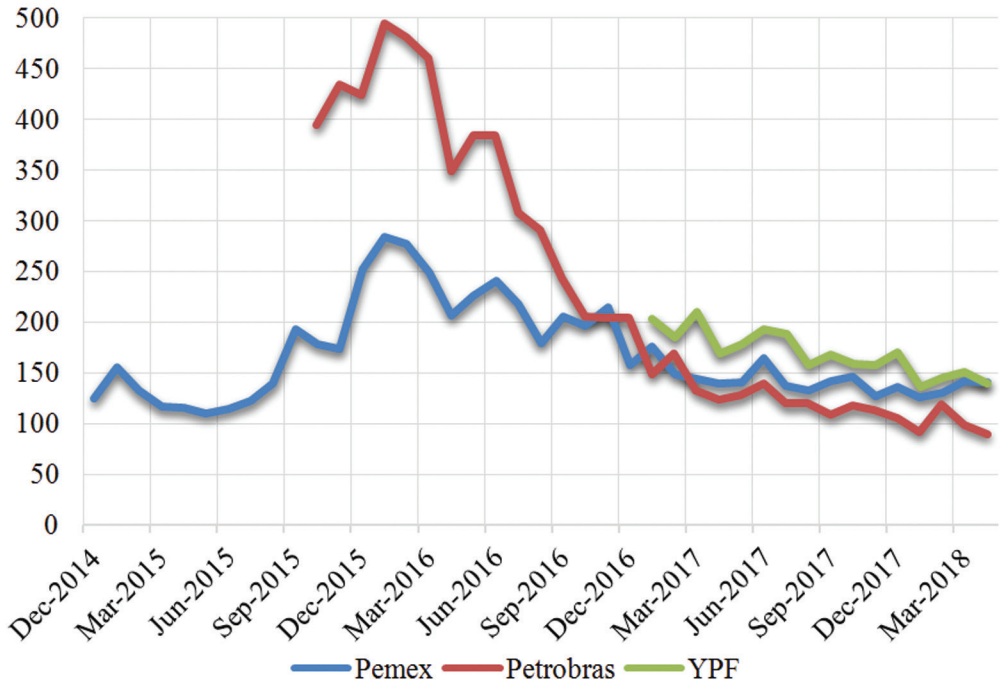
Pemex bond spreads took a rollercoaster ride after the reform. Little changed when reform passed, but spreads dropped almost 60 basis points in May 2014 (figure 5.7). Yields then spiked again in late 2015, as oil prices entered into an unexpected second round of decline. (The dashed yellow line shows the price of the Mexican export blend.) Analyzing every turn in market is a mug's game, but the available data indicate that the bond spreads of other large Latin American national oil companies followed a similar path (figure 5.8).

Figure 5.7. Spread on Five-Year Pemex Bonds over Mexican Federal Bonds



Source: Bloomberg

Figure 5.8. Spread on Five-Year Oil Company Bonds over Sovereign Bonds



Source: Bloomberg

Yet one should not take too much comfort in the bond spread. As the saying has it, "Things which cannot go on forever, don't." Pemex's current imbalances are unsustainable. To be clear, this does not mean that the firm is headed inevitably toward a restructuring. So far, the federal government has shown that it will support Pemex. It injected $1.5 billion in equity in 2014, $631 million in 2015, and $9.9 billion in 2016, in addition to the aforementioned $4.2 billion in return for negotiating the pension cuts.[290] The federal government likely will continue to bail out Pemex in the future. More straightforwardly, it could cut Pemex's taxes. But the risk of a market panic followed by a liquidity crunch and Pemex-induced financial crisis is very real.

Conclusion

The 2013 energy reform revolutionized the management of Mexico's energy reserves. In that sense, it also revolutionized Pemex, because the company now had to compete for access to reserves. Pemex also lost its monopoly over the midstream—product pipelines, tank farms, and the like—and over retail fuel sales. It was much less revolutionary, however, in its direct effect. In fact, by some metrics the reform was downright conservative as far as Mexico's national oil company was concerned.

The reform aimed to make Pemex competitive by reducing the constraints on its performance. It attempted to give the company tools to access equity capital via the farmouts, reduce the tax burden, and increase operational flexibility by weakening union power both formally and informally. These reforms were partially successful. Pemex has farmed out operations that should increase its production by at least 200,000 bpd and possibly more

290 In peso terms, the injections were 20 billion in 2014, 10 billion in 2015, and 184.2 billion in 2016. Moody's Investors Service, "Petróleos Mexicanos: Update Following Ratings Stabilization," *Credit Opinion*, April 13, 2018.

than 600,000 bpd over the next six years, and has reduced its costs and improved its debt management. What Pemex has not been able to do, however, is move securely into the black. It is still overstaffed, facing rising labor costs while productivity continues to decline. The farmouts cannot raise output quickly, and its operational flexibility leaves much to be desired. The refining sector remains a millstone that the company can neither properly reform nor abandon. And it is telling that "research and development" is not even a line-item on the statement of operations on the company's SEC 20-F filing.

More reforms are possible. A future Congress could vote to make Pemex into a real limited liability company. It also could vote to cut the company's taxes dramatically. Realistically, however, such reforms do not seem to be on the table. Rather, with AMLO's rise in the polls, a rollback of the reforms seems like a much more realistic possibility.

Many observers have taken a false confidence in the fact that the energy reform was passed as a constitutional amendment. On paper, the Mexican constitution is hard to reform, but in practice it is much less difficult, having been amended an average of once every seven weeks over the past six years. Mexico's parties are highly centralized and happy to logroll. As a practical legal matter, it would be difficult to repeal existing contracts without paying significant compensation—as Mexico discovered back in 1938—but it would not be hard to change the law going forward. In fact, it might not even take a legal change: Pemex has already been privately accused of slow-walking the opening of its midstream assets even though the company could make money doing so. Right now, the energy ministry is pushing for openness. A political movement opposed to the reforms could stop auctioning off new blocks, allow Pemex to muscle the competition, and take credit for the increase in production already underway through existing farmouts and joint ventures.

AMLO is unlikely to retake existing concessions and give them back to Pemex. He is also unlikely to push through his quixotic desire to build a slew of new refineries. But he very well might throw sand into the gears of energy reform in a desire to protect Pemex and what Pemex used to represent in Mexican politics. Such a strategy would not protect Pemex as an enterprise and eventually it would come at a large fiscal cost. But as we have seen in many countries—not least Mexico's northern neighbor—politicians often incur real future costs to satisfy today's symbolic goals.

Initial Results from the Mexico Electricity Reform, 2013–18

Peter Nance, Managing Director, Que Advisors

Introduction

This chapter will discuss recent changes in the Mexican energy sector over the past five years, including the new auction design and the role and results of the energy auctions. First, it will go over the background of the reforms, and provide a perspective on the current system and key grid changes. Next, it will offer some insights on finance and key market participants. Following this, it will discuss some of the human capital obstacles and new programs. Last but not least, it will summarize the major successes and challenges of the restructuring process.

Background

Mexico is currently the second-largest power market in Latin America and appears poised for continued growth. During the lead-up to the creation of the North American Free Trade Agreement (NAFTA) in the early 1990s, Mexico began a restructuring process to spur greater international investment in electricity infrastructure. Although more than 6,000 megawatts (MW) of capacity was installed under these programs, the investments relied largely on long-term contracts with the state-owned Federal Electricity Commission (Comisión Federal de Electricidad; CFE). Even following the reforms of early 2013, the CFE remained the manager of the generation, transmission, and distribution functions.

During this period, inefficiencies in the electric sector persisted largely because of underinvestment in capital stock. At least in part, this was a result of an ineffective pricing and regulatory policy regimen, coupled with heavily subsidized retail rates and high overall system costs. As part of this system, the government reimbursed the CFE by subsidizing retail prices through tax and dividend discounts. By 2002, however, the subsidy had become greater than the discount provided, eroding the CFE's capital base and ability to fund capital investment. Further, industrial customers faced relatively high retail electric costs and rates that varied from month to month, creating obstacles to planning and investment. During this period, efforts to address these structural problems were unsuccessful.

Overview of the restructuring process

In December 2013, the Mexican Congress passed a constitutional amendment that was designed to greatly restructure the energy sector. The CFE's legal status was modified with a goal of moving the sector from a single vertically integrated utility to include a generation subsector that would expand opportunities for private companies. Transmission investments were also to be opened to international investment under private sector contracts with the CFE. Responsibility for distribution activities remained with the CFE.[291]

291 https://sites.hks.harvard.edu/m-rcbg/cepr/Jeff%20Pavlovic%20Harvard%2021%20Mar.pdf accessed on 8 April 2018.

In August 2014, Congress passed a series of secondary laws. In parallel, restructuring was undertaken in the natural gas sector with important implications for the electricity sector. These power and gas sectoral changes included nine laws, among them the Electricity Industry Law (Ley de la Industria Eléctrica), and 12 amended laws passed with the following objectives:

- Promoting open access to facilitate consumer choice for certain classes of customers.
- Ending the CFE's monopoly on retail supply, at least to industrial or high-volume consumers, to encourage new entrants to consider developing new services and supplies.
- Encouraging the development of additional energy supplies to meet anticipated demand growth.
- Establishing capacity and ancillary service power markets to more effectively compensate generators for their contributions to grid reliability.
- Establishing an effective independent service operator (ISO) to give all participants confidence that dispatch and commitment would be nondiscriminatory.
- Separating the CFE itself into separate companies and subsidiaries for transmission, distribution, retail, and six individual generation portfolios to encourage international participation and alleviate concerns of new entrants regarding horizontal market power.
- Restructuring the regulatory and operational frameworks to provide better information and spur private investment across generation, transmission, distribution, and supply.

The keystone legislations that underpin the structure of the electric sector today are the Electricity Industry Law, laws addressing the structure of CFE (CFE Law), and the Energy Transition Law (Ley de Transición Energética). The Electricity Industry Law and the CFE Law provide for the separation of the CFE into multiple competitive enterprises and forms the legal basis for the competitive and open-access wholesale electric market (Mercado Eléctrico Mayorista, MEM). The Energy Transition Law establishes mechanisms and targets for achieving Mexico's climate goals (in cooperation with previous legislation) as well as Mexico's commitments made in Paris for the Paris Climate Agreement.[292] The Electricity Industry Law outlines responsibilities for the following key entities:

- The National Energy Control Center (Centro Nacional de Control de Energía; CENACE) is established as an ISO and charged with operation of the national electric system (Sistema Eléctrico Nacional, SEN).
- The Energy Regulatory Commission (Comisión Reguladora de Energía; CRE) organized under the Energy Secretariat (Secretaria de Energía; SENER) is the primary federal regulator, charged with implementing the Electricity Industry Law generally, and oversees specific operational items such as issuing generation and interconnection agreements.
- SENER is the part of the federal government charged with coordinating the initial implementation of market rules. Additionally, SENER coordinates policy-related matters such as establishing specific targets for renewable energy, overseeing the development of strategic natural gas storage, and encouraging third-party development activities in areas such as strategic transmission investments to support renewable development.

292 Gabriel Roldán Alonso, *Reporte anual del mercado eléctrico mayorista 2016* [Annual report of the wholesale electricity market 2016] (Mexico City: Monitor Independiente del Mercado, March 2017), www.cenace.gob.mx/Paginas/Publicas/MercadoOperacion/ReporteAnual.aspx.

Perhaps the most important change involved the opening of the market for competitive supply. This resulted in the creation of energy and capacity markets. Under the new rules, residential supply remains regulated. Although private companies are able to apply for a basic supply permit, many believe that CFE is likely to remain the primary (perhaps sole) basic supplier. Qualified users with peak demand more than 0.5 MW have the ability to select alternate competitive suppliers. Aggregation of multiple meters is permitted to reach this threshold. Consumers with demand greater than 1 MW can directly participate in the MEM and buy and sell energy directly.

The role of clean energy in the reform

Beginning in 2008, Mexico made its first efforts with respect to clean energy by setting national targets for nonfossil generation. In general, this effort was largely considered aspirational and lacked well-formed structures to encourage investment. The government provided important carbon management guidance in 2012.

From the outset of power sector restructuring, clean energy has been an integral part, incorporating aspirational goals and objectives into the design of the electricity market in the form of quota obligations for Clean Energy Certificates (Certificados de Energía Limpia; CELs). When fully implemented, the market design is expected to provide investors with information about price, timing, and location of these sources.[293] The CEL program was included in Mexico's voluntary nondisclosure agreement submitted as part of the 2016 Paris Climate Agreement. The 35 percent target for 2024 was reaffirmed by the Senate in January 2016.[294] Table 6.1 presents the long-term targets.

Table 6.1. Mexico Qualifying Generation Target by Year

Year	Qualifying Clean Generation Target (percentage)
By 2024	35
By 2035	40
By 2050	50

Source: SENER, https://sites.hks.harvard.edu/m-rcbg/cepr/Jeff%20Pavlovic%20Harvard%2021%20Mar.pdf accessed on 8 April 2018.

Although these targets are official, there are no national or international mechanisms binding the country to them. In Mexico, clean energy is defined to include renewable sources such as geothermal, hydro, solar, and wind; efficient cogeneration (carbon dioxide [CO_2] emissions less than 100 kilograms per megawatt-hour), and nuclear energy. Unlike renewable portfolio standards in the United States, the CEL program includes all non- or low-carbon-emitting sources as opposed to specific technologies such as wind or solar. Suppliers are required to source CELs for a specified portion of their annual supply. For 2024, the total requirement is less than 35 percent for existing and new renewable and non-carbon resources. Thus, CEL Target Levels are also set by SENER and intended to incentivize new supply. For 2018, the minimum level of consumption from clean

293 International Energy Agency (IEA), *World Energy Outlook 2017: A World in Transformation* (Paris: IEA, 2017), www.iea.org/weo2017/.

294 Rivelino Rueda, "Senado avala por mayoría Ley de Transición Energética" [Senate majority endorses the Energy Transition Law], *El Financiero,* December 1, 2015, www.elfinanciero.com.mx/nacional/senado-avala-por-mayoria-ley-de-transicion-energetica.html.

technologies to be demonstrated is set at 5 percent for all large consumers, including the CFE. These targets are expected to increase as shown in table 6.2.

Table 6.2. CEL Targets

Year	CEL Target (percentage)
2018	5.0
2019	5.8
2020	7.4
2021	10.9
2022	13.9

Source: SENER, https://sites.hks.harvard.edu/m-rcbg/cepr/Jeff%20Pavlovic%20Harvard%2021%20Mar.pdf accessed on 8 April 2018.

Beyond 2022, *specific* annual targets are not yet defined.

Significantly, the CEL mechanism represents the first binding program for Mexico, and can be expected to target and accelerate clean energy (largely renewable) development. Retailers of energy are required to purchase or contract for CELs according to the percentage of load served for each listed year. Failure to acquire CELs results in fines per CEL that can vary. CENACE is the manager of the CEL program.

In addition to the CEL program, Mexico allows accelerated depreciation for renewables of up to 100 percent in the first year, or up to 5 years depending on the owner's needs.

Revised roles for SENER, the CRE, and the CFE

The energy ministry, commonly referred to as SENER, is in charge of conducting Mexico's energy policy. SENER has been responsible for implementing the transition to a market-based system establishing the terms for the unbundling of the CFE and issuing the initial electricity market. SENER also monitors the CEL program.

The CRE was created in 1994 concurrent with the partial opening of the electricity sector. Since 1995, it has been responsible for the electricity and gas sectors, and obtained additional powers with respect to hydrocarbons and renewable energy generation in 2008. In the 2013 energy reform, the CRE was given budget autonomy. Additionally, the president now proposes the commissioners, and the Senate elects them. Currently, the CRE exists to:

- Promote sectoral competition while preserving minimum service levels nationally.
- Protect the interests of users.
- Ensure the reliability, stability, and security of supply.

Other responsibilities include regulating electricity generation, overseeing interconnection contracts, developing tariffs for basic electricity service, and preserving the efficiency and quality of the power grid. The CRE also oversees the wholesale power market promulgating appropriate rules and regulations, and certain verification aspects of the CEL market.

Geographic scope of the electricity system

Prior to the restructuring, the national grid consisted of nine regions. These regions included a handful of DC and synchronous border ties. Postrestructuring, SENER established a nodal pricing system. Mexico currently has four separate synchronous grids.[295]

- Sistema Interconnectada (SIN), the primary national grid.
- The Southern Baja California peninsula (Baja California Sur; BCS), which is isolated.
- A small isolated region in the middle of the Baja Peninsula (Mulegé).
- The Northern Baja California region (Baja California Norte; BCN), which is synchronously interconnected with the California ISO (CAISO) in the United States.

Subsequent sections present a more comprehensive discussion of supply resources, demand, and transmission.

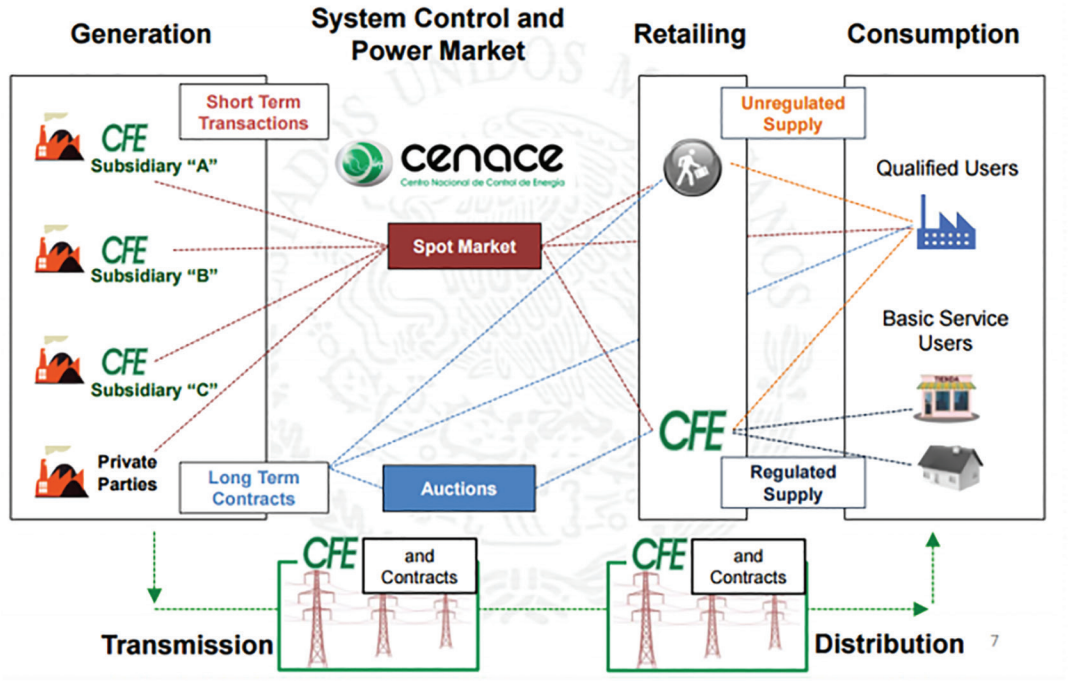
Overview of the new market structure

The new market structure is characterized by the functional unbundling of the CFE; the separation of the sector into generation, transmission, and distribution activities; and the introduction of market-based auction processes to establish prices for various activities. New market participants include qualified users and qualified suppliers, while certain activities such as basic service provision remain on a regulated rate-of-return basis.

Changes in the energy markets required a redefined set of activities. Chief among these is the role of CENACE. CENACE was created contemporaneously with the passage of the secondary laws in August 2014 as a public entity to operate the national electricity system. Beginning in 2016, CENACE initiated operation of the wholesale electricity market. The responsibilities of CENACE include guaranteeing nondiscriminatory access to the transmission and distribution grids, preparing expansion and modernization programs for the transmission network for approval by SENER, and planning and developing the National Electric System Development Program (Programa de Desarrollo del Sistema Eléctrico Nacional; PRODESEN). Schematically, the revised market structure can be visualized as shown in figure 6.1.

295 Secretaría de Energía (SENER), *Prospectiva del sector eléctrico, 2017–2031* [Electricity sector prospects, 2017–2031] (Mexico City: SENER, 2017), www.gob.mx/cms/uploads/attachment/file/284345/Prospectiva_del_Sector_El_ctrico_2017.pdf.

Figure 6.1. New Market Structure



Source: SENER, https://sites.hks.harvard.edu/m-rcbg/cepr/Jeff%20Pavlovic%20Harvard%2021%20Mar.pdf accessed on 8 April 2**.**

Revised role for the CFE

From its formation in 1937, the CFE served as a strategic state enterprise functioning effectively as a monopoly. Following the 2013 restructuring, the CFE was transformed into a productive state enterprise with budget autonomy and a new board of directors. After the restructuring, it was split into subsidiaries for transmission, distribution, and power generation, each focused on profit generation for its owner, the Mexican state. The CFE retained exclusive rights over electricity transmission and distribution.

To constrain horizontal and vertical market power, attention was focused on the CFE and its ownership and control of many of the power assets in Mexico. Over 2016 and 2017, a set of separate companies was created, and management of activities began to be separated. Table 6.3 lists the primary entities created from CFE.

Table 6.3. List of Primary CFE Entities

Entity	Role
CFE Transmission	Administer and maintain the SEN transmission system
CFE Distribution	Administer and maintain the distribution network
CFE Basic Supply	Retail to regulated customers (residential)
CFE Calificados	Competitive retail to qualified users (>0.5 MW of demand)
CFE International	Competes in international and import/export fuel and electricity
CFE Energy	Commercializes gas, diesel and fuel oil
CFE Generation Entities 1–4	Four separate competitive generation portfolios
CFE Gen 5 (IPP)	Represents legacy IPP (Independent Power Producer) contracts in the market
CFE Gen 6 (Self-Supply)	Represents legacy self-supply contracts and plants in the market

Source: SENER.

Additionally, CFE's nuclear Laguna Verde plant is to be held in a separate entity as well.

Timeline of market institutions implemented during 2016–18

With the legislated changes to the existing sector participants underway, the process of implementing the desired market design was done in stages beginning in 2016. The first market design element to be implemented was the day-ahead wholesale market in the first quarter of 2016. This was followed by the first and second long-term auctions, with minimum contract terms of 15 years. Credit support was bilateral between the parties, with the CFE as the monopoly purchaser. Pricing has been competitive, perhaps reflecting the original design idea of primarily facilitating recovery of costs of developers. Additionally, the value of CELs, which are a part of the price bid in the long-term auction, has not yet been definitively established. However, participation in the long-term auction process has been extensive.

For various reasons, the envisioned real-time wholesale market implementation was delayed and was established in the first quarter of 2017. A more fully featured implementation is envisioned. In mid-2017, CENACE, as the operator of a major portion of the Mexican natural gas transportation system, held the first auction to allow third-party contracting for firm gas transportation capacity. This was an important element for fuel supply and correspondingly long-term power pricing in other organized markets. A basic clearinghouse to provide credit support for buyers and sellers was formed in time for the third long-term auction concluded in the fourth quarter of 2017. The first medium-term auction was held in the first quarter of 2018, with bilateral credit support between buyers and sellers. Participation was low and resulted in a single completed contract.

Timeline for market developments envisioned during 2018–20

Over the next year, the following major market developments are currently contemplated.[296]

- Between 2018 and 2019, an expanded clearinghouse is anticipated to support medium-term auction transactions.
- Consistent and transparent spot-market-based gas pricing indices are expected to mature during 2018 in three to four hub locations. This can be expected to improve the day-ahead and real-time price formation processes in the wholesale power market.
- In July 2018, a national presidential election was held. Depending on resulting policies, electricity market developments could be substantively altered.
- During 2018, the values of current and future CELs are expected to be established through the introduction of a market-based mechanism.
- During 2018, a bidding process is expected for the addition of the first strategic high-voltage transmission project to be held in Mexico. It is envisioned that a selected developer will connect renewable generation to be located in Oaxaca with demand located generally in the center region of Mexico. The commercial on-line date for the project can be expected to require several years for development and construction.
- Before the end of 2018, a market in financial transmission rights is anticipated to be introduced. This market is expected to be designed to provide products that mitigate congestion costs, reducing price risk and uncertainty for consumers and generators. The design parameters are public; uncertainty remains regarding the implementation model.
- During 2018, the CFE is expected to release more detailed information about the status of and plans for its distribution system. Depending on the nature of the disclosures, this may provide a foundation and framework for additional deployment of distributed energy resources.
- By 2021, CENAGAS (Centro Nacional de Control de Gas Natural) expects to add strategic gas storage to the system to increase gas system reliability and increase operational flexibility. This has potential to offset liquefied natural gas (LNG) consumption with a corresponding reduction in the level of wholesale power market pricing as well as reducing price volatility.

Growth in Consumer Demand

Over the past 20 years, Mexico has had substantive demand growth. Using a rolling average between 1993 and 2016, annual peak demand growth has averaged 3.5 percent, and overall peak demand has almost doubled.[297] Like other North American markets, demand growth has slowed in recent, years. Between 2006 and 2016, a similar rolling average calculation returns a more modest value of 2.4 percent.[298] By way of comparison, U.S. peak demand growth has averaged less than 1 percent in recent years.

296 https://sites.hks.harvard.edu/m-rcbg/cepr/Jeff%20Pavlovic%20Harvard%2021%20Mar.pdf accessed on 8 April 2018; additional conversations.

297 SENER, *Prospectiva del sector eléctrico, 2017–2031*.

298 Ibid.; and "Programa de desarrollo del sistema eléctrico nacional" [National electricity system development program], SENER, August 30, 2017, www.gob.mx/sener/acciones-y-programas/programa-de-desarrollo-del-sistema-electrico-nacional-33462.

Compared to overall consumption, industrial load is substantial in Mexico. In recent years, growth has been driven by the hydrocarbon, textile, and automotive manufacturing sectors. Today, industrial consumption accounts for over half of total demand, comparable to that of the U.S. Gulf Coast. Nationwide, however, industrial load only accounts for 25 to 30 percent of U.S. demand.[299]

Mexico's residential electrification is substantive; more than 99 percent of houses have service. However, average household demand is relatively low thanks in large part to the temperate, consistent climate in many large population areas that holds down air conditioning demand. Table 6.4 describes regional noncoincident peak load.

Table 6.4. Regional Noncoincident Peak Load

Region	Peak Month
BCN	August
BCS	July
Central	December
East	May
North	June
Northeast	August
Northwest	July
Peninsula	May
West	May

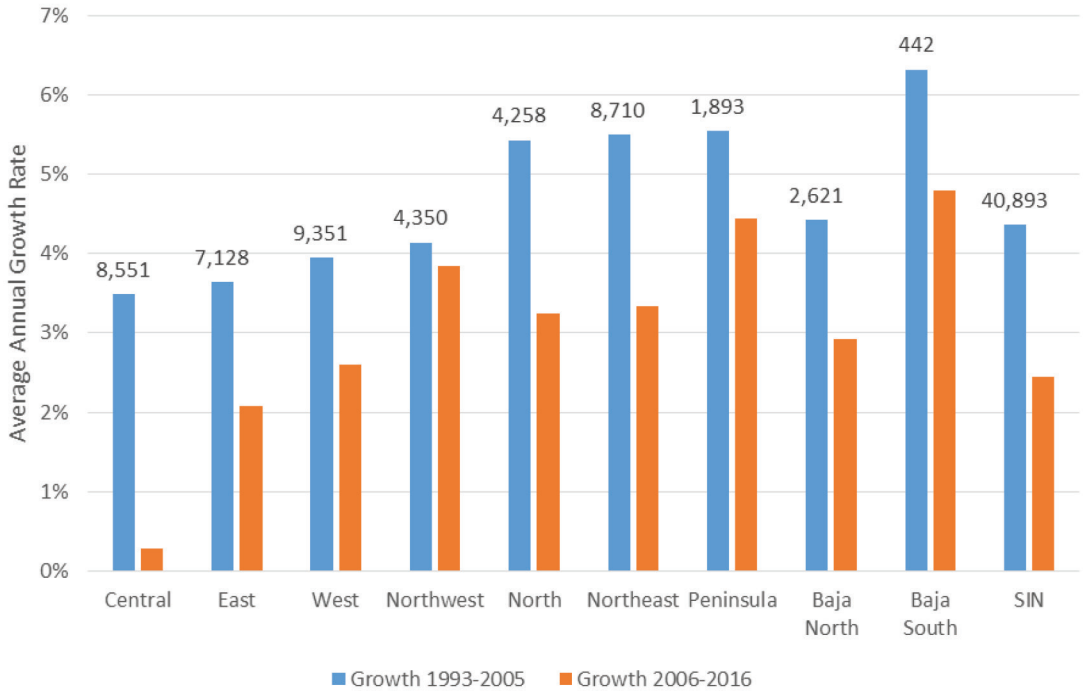
Source: SENER, "Programa de desarrollo del sistema eléctrico nacional" [National electricity system development program], August 30, 2017, https://www.gob.mx/sener/acciones-y-programas/programa-de-desarrollo-del-sistema-electrico-nacional-33462.

Regional peaks typically do not occur in the mid-afternoon (3 to 6 p.m.). In some cases, these can occur as late as 11 p.m. The lack of a summer residential air conditioning peak coupled with high industrial demand and regional peak variation contribute to a very high 83 percent annual average load factor in 2016.[300] A more typical value across North America is 55 to 65 percent (figure 6.2).

299 International Energy Agency (IEA), *Mexico Energy Outlook,* World Energy Outlook Special Report (Paris: Organization for Economic Cooperation and Development [OECD]/IEA, 2016), www.iea.org/publications/freepublications/publication/mexico-energy-outlook.html; and EIA.

300 Load factor = total energy / (peak load × 8760). This can be thought of as the average load year-round as a fraction of annual peak.

Figure 6.2. Regional Peak Demand Growth



Source: "Programa de desarrollo del sistema eléctrico nacional."

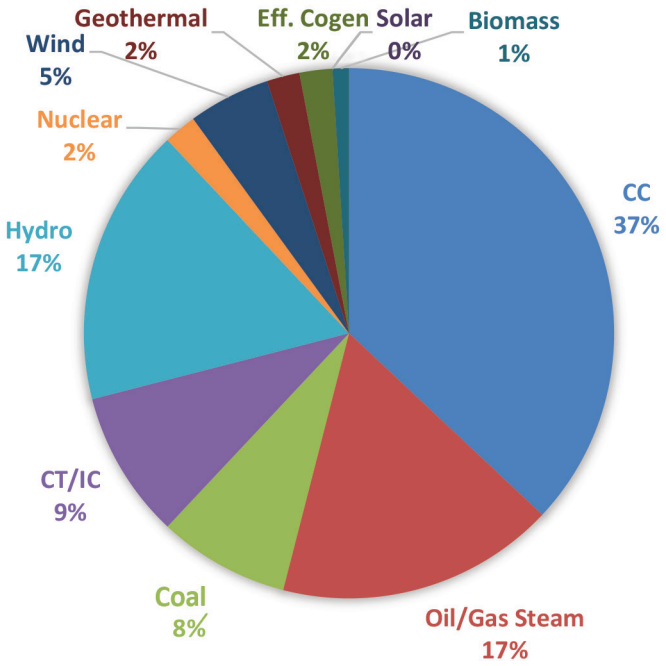
Demand growth has been highly regionalized. The North and Peninsula regions show strong demand growth over the past 10 years, while the growth in the Central region has remained static. Much of the traditional demand in this region has shifted to adjacent regions such as the West. The Peninsula and Baja South are experiencing stronger demand growth as general infrastructure improves. Industrial and population-driven growth continues in the North and Northeast regions.

Existing Generation System

Historically, Mexico's capacity mix has been a function of local fuel sources, largely oil and gas (figure 6.3). Many oil-burning steam units date from the 1980s and 1990s. Today, many of these are dual-fuel natural-gas capable. Beginning at the turn of the century, a buildout of more fuel-efficient combined cycle (CC) units took place in Mexico and North America.

Mexico has significant and large hydro resources, mainly in the south and west. Three major coal plants are in place with coal from international markets, especially Colombia. Laguna Verde, a nuclear plant, operates in Veracruz.

Figure 6.3. 2016 Capacity (73,510 MW) by Fuel Source



Source: "Programa de desarrollo del sistema eléctrico nacional."

Beginning in the early 1990s, international companies were encouraged to build generation in Mexico (table 6.4). Largely gas-fired, these new units were offered a long-term purchased power agreement from the CFE. By 2016, these companies had grown substantively in size.

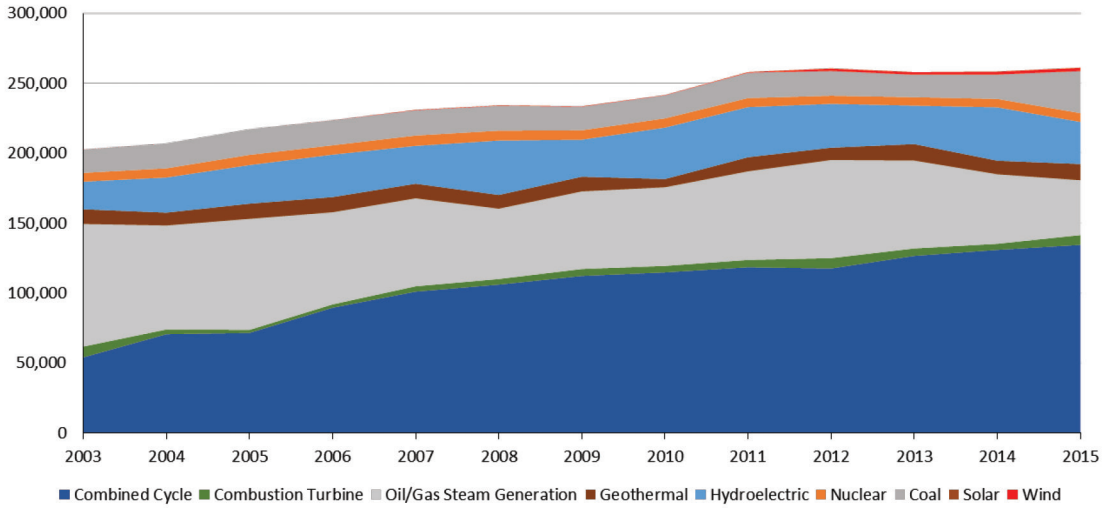
Table 6.4. 2017 Existing Capacity by Company and Type

Operator	CC	ST	GT	Hydro	Nuc	Geo	Wind	IC
CFE	6,609	15,587	5,490	11,855	1,365	911	268	418
Iberdrola	5,253	–	–	–	–	–	–	–
Intergen	2,260	–	–	–	–	–	–	–
Mitsui	2,146	–	–	–	–	–	–	–
Fuerza y Energia de Tuxpan	1,120	–	–	–	–	–	–	–
Techgen	1,025	–	–	–	–	–	–	–
Termoelectrica de Mexicali	625	–	–	–	–	–	–	–
Acciona	–	–	–	–	–	–	588	–

Source: "Programa de desarrollo del sistema eléctrico nacional."

The Northeast and East control areas have the largest amount of installed capacity, followed by the West. Gulf Coast natural gas production and gas pipelines facilitated the building of a number of CC units in the Northeast region. Oil-burning capacity is concentrated in the Central, West, and Northwest regions. Much of the clean energy renewable production has been in the East and West regions with large hydro plants; however, current developments favor solar and wind expansion (figure 6.4).

Figure 6.4. Generation Mix by Technology

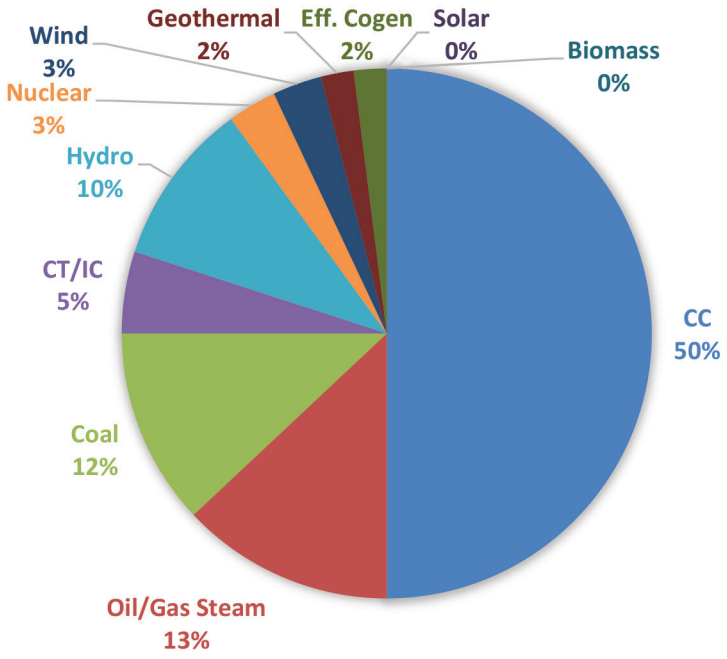


Source: SENER, *Prospectiva del sector eléctrico, 2017–2031* [Electricity sector prospects, 2017–2031], https://www.gob.mx/cms/uploads/attachment/file/284345/Prospectiva_del_Sector_El_ctrico_2017.pdf.

Owing to falling costs for gas, more attractive conversion efficiencies, and environmental considerations, the fuel mix has shifted from oil-fired to gas-fired generation. Between 2012 and 2017, the CFE has had a goal of reducing oil consumption by more than 80 percent. Although reaching this goal has proven elusive for fuel reliability reasons, progress has been made and can be expected to continue as gas pipeline expansions currently in progress are completed.

Overall, CCs generated fully half of the country's electricity in 2016 (figure 6.5). Baseload units typically with a capacity factor of 80 percent include coal and gas units. CC units typically average a 65 to 70 percent capacity factor, oil/gas units average 35 to 40 percent, and hydro averages 30 percent.

Figure 6.5. 2016 Generation Energy Production by Fuel Source (Total: 319,364 gigawatt-hours [GWh])



Source: "Programa de desarrollo del sistema eléctrico nacional."

The Restructured Wholesale Market and Participants

The electricity sector restructuring provided for the creation of a wholesale electricity market (MEM). Under this program, licensed private companies are allowed to produce and sell electricity in competition with the CFE and each other.

Background

In 2015, SENER published the Bases del Mercado Eléctrico (Electricity Market Bases) establishing the electricity market design. The document also described operating principles to be implemented in two phases.[301] The MEM has the following major components:

- Short-term markets (day-ahead, hour-ahead, real-time, and ancillary services).
- Medium-term auctions for three-year energy and capacity contracts.
- Long-term energy auctions with a 15-year minimum.
- A capacity-balancing market calculated after-the fact for the previous year.

301 SENER, "Bases del Mercado Eléctrico Acdo Sener DOF" [Bases of the electricity market Acdo SENER DOF] (Mexico City: SENER, 2015), www.cenace.gob.mx/Paginas/Publicas/MercadoOperacion/BasesMercado.aspx.

At the time of writing, the following components are currently in development.

- Enhancements to the real-time (hour-ahead) and ancillary service markets.
- Financial Transmission Rights auctions (annual first, quarterly and monthly in a later phase).
- CEL markets (at least once per year beginning in 2018).

Market participants and Basic Service

Currently, the CFE is the only provider of electricity for "basic" service. This is largely targeted at residential, small commercial users, and medium-sized commercial users under regulated tariffs. However, the new market structure allows large energy consumers to satisfy their electricity needs in a variety of ways (table 6.5). Qualified users might conclude a bilateral contract directly with power generators, or rely on the services of qualified suppliers. A consumer may register as a qualified user if it has an expected annual peak demand of 5 MW or more, and consumption of 20 GWh over the year. A qualified user may bid in the auctions to purchase energy, capacity, and CELs.[302] As of January 31, 2018, total of 80 market participants were licensed to operate in the MEM.

Table 6.5. Roles of Market Participants

Market Participant	Number of Suppliers	Description
Basic Service Supplier	1	Represents load centers corresponding to Basic Service Users.
Basic Service User		End User receiving service from a Basic Service Supplier.
Broker/Marketer (Nonsupplier)	11	Trades energy without representing physical assets.
Last Resort Supplier		Represents Qualified Users for a fixed period of time usually under emergency grid conditions.
Power Generator	38	Represents one or more generating plants.
Qualified Supplier	27 (6 in operation)	Represents load centers of Qualified Users that do not participate directly in the MEM.
Qualified User		End User with estimated demand of over 1 MW who buys energy from a Qualified Supplier.
Qualified User (Market Participant)		Represents load center for own consumption, procures electricity directly in the MEM or bilaterally.

Source: SENER, CENACE as of January 2018, https://sites.hks.harvard.edu/m-rcbg/cepr/Jeff%20Pavlovic%20Harvard%2021%20Mar.pdf accessed on 8 April 2018.

Day-ahead market

The day-ahead market began operation in January 2016. Approximately 2,360 locational marginal prices have been established with nodal price calculations including energy, congestion, and loss components. In addition, CENACE reports 101 "distributed nodes" representing average off-taker pricing in a given area. Day-ahead offers are capped to variable costs.

302 https://sites.hks.harvard.edu/m-rcbg/cepr/Jeff%20Pavlovic%20Harvard%2021%20Mar.pdf accessed on 8 April 2018.

In August 2016, CENACE undertook to recalculate prices back to the beginning of the market as bids were exceeding allowable costs, inflating reported prices. The restated prices were approximately 18 percent lower. CENACE is now implementing tools to disqualify excessive bids in real time. To date, the day-ahead market has been the primary platform for price discovery. It provides the baseline for auction and contract pricing.

Real-time market

The real-time market began reporting prices in January 2017 with prices calculated ex-post and reported the following day. Price components are the same as in the day-ahead market. Convergence issues between the real-time and day-ahead markets existed during much of 2017 with real-time prices up to 20 percent higher than day-ahead prices. The market is expected to move to real-time price formation.

Hour-ahead market

The hour-ahead market is intended to facilitate arbitrage between the day-ahead and real-time markets. It is expected to be established in the future.

Capacity-balancing market

To ensure resource adequacy, CENACE has adopted a unique structure that establishes annual capacity requirements for all load-serving entities. A priori, the protocol establishes capacity procurement requirements. Throughout the performance year, system capacity shortage or excess is measured. The ex-post balancing capacity market compares actual conditions with initial requirements for the preceding year. The resulting system levels drive prices for the longer-term capacity transactions in the same way that real-time energy price expectations drive forward energy contracting.[303]

The balancing capacity market focuses on calculations of load and delivered capacity during 100 "critical hours" of the year. The critical hours are estimated a priori and calculated ex post. Initially, the 100 critical hours were considered to be the highest load hours. In the future, however, critical hours will be those with lowest operating reserves. The ex-post market clears in February for the preceding year. Considerations include the establishment of a vertical supply curve based on availability and a demand curve that considers a minimum planning reserve for reliability, economic planning reserves from modeling results, reference technology costs, and energy revenues. The minimum reserve margin target is established by a loss-of-load expectation of 0.2178 percent, or approximately 1 day in 1.5 years. With an established value of lost-load of $2,600 per megawatt-hour (MWh), the economically efficient loss-of-load expectation is calculated at 0.0315 percent, or near the 1-day-in-10-year standard commonly used in U.S. markets.

As of this writing, the SIN has cleared as a single zone with the BCN and BCS grids clearing separately. Subzones may emerge in the future.

303 Centro Nacional de Control de Energía (CENACE), *Mercado para el balance de potencia* [Power balance market] (Mexico City: CENACE, 2017) www.cenace.gob.mx/Docs/MercadoOperacion/ResultadosBalancePotencia/2018/Informe%20Ejecutivo%20MBP%202017%20v2018%2002%2028.pdf.

Long-term auctions

To encourage the development of new capacity, CENACE has held three long-term auctions. The auctions are neutral between qualifying technologies. All transactions are completed under standardized contracts of 15 years for electricity and capacity, and 20 years for CELs. The awarded contracts support the construction of solar and wind power plants. SENER indicates that they expect that the auctions will facilitate a total investment of around US$9 billion.[304]

The first auction concluded in March 2016, the second in September 2016, and the third in November 2017. In these first two auctions, the CFE was the only buyer. However, in the third auction, CENACE established a clearinghouse (Cámara de Compensación; CdeC) through which all buyers and sellers operated with a single contract and centralized credit support. In the first two auctions, the CFE provided performance guarantees for the awarded contracts under a single buyer model. This role has now been passed to the CdeC, which will collect and hold specific guarantees. The level of these guarantees will be set in the auction guidelines. With the introduction of CdeC, the credit risk associated with a power purchase agreement will not be with a specific company but with the market as a whole. CdeC will also have a reserve fund that all parties will pay into giving it liquidity, and will manages the performance guarantees from each party.

To participate in the long-term auction, participants follow formal guidelines submitting bids. First, participants are prequalified by CENACE and make guarantee payments to demonstrate that the offers will be serious ones. The traded products include energy (as a firm delivery schedule), capacity (representing coverage in the balancing capacity market), and CELs from qualifying plants. Energy and capacity contracts are for 15 years; CEL contracts are for 20 years. Bids must be submitted as descending offer curves for each product, though prices for energy can be shaped according to the delivery schedule. Bids are then aggregated for each product and an offer curve published. Projects may submit offers for one or more products. Projects can also require all or part of the bid to clear in order to be accepted. CENACE clears the three products together, taking the least-cost combination of projects to meet the three offer curves. Offers are either accepted and paid face value or rejected. As a result, the auction does not result in a single price to be paid.

Prior to clearing, CENACE modifies the bids in two ways. First, based on SENER projections of locational pricing, CENACE can set energy price adjustments based on the location of the project. The actual payment made to the plant is unaffected. Projects bidding in a region with high price adjustments effectively can have a bid reduced in the competitive stack, making it more likely to clear even with a higher submitted price. The second element that can modify a bid is a project's interconnection status. If a project has already secured interconnection rights, it is referred to as a "priority" project. A "nonpriority" project has not gained these rights. In the second and third auctions, valuation parameters became more stringent for nonpriority projects. Additionally, for nonpriority projects, interconnection areas and export zones are identified and quantity limits set for each product in each subzone. These nonpriority projects typically must be the cheapest bidder in the subzone to be considered for clearance in the grid-wide offer curve. Thus, these additional details effectively create multiple levels of competition.

304 https://www.amdee.org/LiteratureRetrieve.aspx?ID=144215 accessed 8 April 2018

The first three long-term auctions have resulted in stiff competition. It is interesting to note, however, that the structure more closely resembles a utility request-for-proposal process than the capacity auctions in selected U.S. markets. In these markets, contract lengths are shorter and have no energy or renewable energy certificate components.

Once accepted, all contracts begin on January 1 of the year beginning three years after the auction. For instance, the 2018 auction had a contract start date of January 1, 2021. If the plant is not in commercial operation by the deadline, a fine of 5 percent of the monthly value of the contracted products is assessed. Additionally, increased payment guarantees to CENACE may be required. If the project is delayed more than two years or cancelled, these events can result in further fines or the forfeiture of bidding guarantees.

Medium-term auctions

Although the long-term auctions are open to new or repowered capacity, the medium-term auctions are designed to support existing capacity. The medium-term auction market closed in February 2018; however, only a single contract was cleared. The products available are capacity and energy, in contract lengths of one to three years. Specifically, offers are defined by the following characteristics:

- Energy offers are defined by total energy as a fraction of load per year, for given load blocks (peak, intermediate, and base), for a given load zone (of which there are eight, roughly corresponding to control areas), at a given offer price.
- Capacity offers are defined by quantity, price, year, and capacity zone (now BCN, BCS, and SIN).

The intent of the medium-term auction is to minimize merchant exposure, in both energy and capacity, for both generators and suppliers. The initial view was that the long-term auctions were designed to recover a developer's cost, whereas the medium-term auctions could better match the level of fixed-price risk with a participant's view of underlying supply and demand conditions. As a result, the health of the medium-term market ultimately may prove critical.

Viewed from this perspective, the initial 2018 results were not encouraging. In other markets, fixed price contracts of three years or less result have typically resulted in substantively higher transaction volumes as aggregators and consumers (qualified users) seek to obtain competitive prices in advance with certainty and merchant generators (qualified suppliers) seek stable revenues to provide consistent returns to investors.

Financial transmission rights

Financial transmission rights cover the difference in cost between two nodes on the transmission system due to congestion and are a feature of many markets in North America. Compared to the end-use price that a consumer might pay, these costs can be substantive.

As of February 2018, the market mechanisms have not been implemented. Some market participants have argued that success requires a market maker structure where a market participant is paid by the market operator to make a two-way (buy and sell) market. Others have expressed concerns that the product features are not clear and could lead to lower liquidity depending on the decisions that CENACE ultimately makes. Still others have argued that the credit support that CENACE will offer is not clear, and could slow down acceptance. Since the

price differentials can be large, these participants generally favor a clearinghouse for credit support to reduce the probability of default risk. For the legacy transmission system (the SIN), financial transmission rights are expected to be assigned to generators and suppliers according to their historical system usage between August 2012 and August 2014. Thereafter, rights will be auctioned or traded in the established market.

The current lack of a financial transmission rights market is cited as a factor holding back the growth of the retail market. Until these products are established, qualified suppliers and qualified users are unable to hedge transmission risks across the system. While this is a concern, other developments may also play a role.

Bilateral contracts

Whereas the long-term auctions currently result in bilateral contracts with a central clearinghouse, and medium-term contracts are expected to duplicate this in 2019, market participants are allowed to directly contract outside of the MEM. CENACE describes three types of allowed contracts (table 6.6).

CFE Basic Supply cannot sign bilateral contracts outside of the medium- or long-term auctions. However, qualified suppliers are allowed to sign bilaterally outside of the formal mechanisms. To date, only a handful of bilateral contracts have been signed. Most commonly mentioned are Blackstone through its Ektria market intermediary and its Frontera CC plant, and CFE Qualified Supply.

Table 6.6. Types of Bilateral Contracts

	TBPot	TBFin Fijos	TBFin Referencidas
Type	Capacity contract	Fixed energy delivery schedule	Percentage of unit generation or supplier demand
Settlement	Determined by parties	Financially settled	Financially settled
Fund Flow	Directly between parties	Through CENACE accounts	Through CENACE accounts
Units	MW/hour	Fixed MWh	% of unit or load
Market	Balancing Capacity	Day-ahead or real-time	Real-time only
Location	Zone (SIN)	Node	Node

Source: http://www.cenace.gob.mx/Docs/MarcoRegulatorio/Manuales/Manual%20de%20Transac%20Bilaterales%20y%20Registro%20Contratos%20Cobert%20Elec%20DOF%202017%2001%2020.pdf accessed on 8 April 2018.

Some market participants hope that contracting will increase as more qualified users enter the market and qualified suppliers attempt to increase market shares in the coming years.

Market implications

Why was participation in the first medium-term auction so low? It is hard to be certain, but some reasons have been cited frequently.

First, the restructuring established the notion of a Basic Service Rate Structure. The Basic Service Rate Structure effectively is designed to provide a user with an understanding of the rate that the CFE would offer under the new market conditions. In other North American markets, this is somewhat analogous to the "price to beat," or as economists sometimes call it, an "avoided cost." Based on the outlook for this rate, as well as the user's size,

and other factors, the user could decide how to approach the new market. The user might retain Basic Service from the CFE or (if qualified) become a qualified user (direct market participant). However, prior to December 2017, there was little clarity as to what the new rate methodology for Basic Service would be. In this information vacuum, consumers were understandably not motivated to purchase new or replacement supplies since there were few transparent price benchmarks for decision making. The CRE completed and published the Basic Service structure in December 2017, but there was little lead time for consumers to decide to become qualified users if they had not already done so. Further, for those who had obtained qualified user status, there was little time to make decisions and submit bids for the medium-term auction, which closed in February 2018.

Additionally, there was substantive confusion about the methodology used to establish the Basic Service rate. Chief among these was the inclusion of a transition mechanism (weighting factor) that effectively "phased in" the impact of the new rate—generally an increase—over a period of months during the first year. The Basic Supply structure also established a higher capacity value for certain cities and zones than it did for others, which further differentiated regional prices. This two-part structure added complexity as a consumer sought to understand the costs it would face and what value a qualified user/qualified supplier might bring in the future. Qualified user perspectives initially had been that prices were going to be lower as a result of competition, and this biased them to wait to understand more about future costs. With the possibility that prices might be more volatile (as opposed to simply lower or higher), some were not prepared to make effective decisions in time for qualified users to support the first medium-term auction. Some broker/marketers, qualified suppliers, and qualified users suggest that the lack of a market in firm transmission rights means that consumers cannot fix or hedge the costs of congestion that they accept. This means that any alternative to the Basic Rate cannot be fully guaranteed (or fixed), reducing the attractiveness of the medium-term auctions.

In subsequent medium-term auctions, price discovery can be expected to provide some visibility into forward retail price trends. Further, the transition period and monthly weighting phasing in the new rate structure will end. Thus, some of the key elements to watch and measure the success of the reforms include the following:

- How will qualified users respond to the Basic Service rate structure
- How will the pricing history of the Basic Service tariff develop?
- Will qualified suppliers accept the medium-term auction process? Will they need to stabilize their revenues to meet profit and rate of return objectives promised to their investors? Will they need to augment their revenues under the long-term auction contracts given how low prices have been in the second and third auctions, or will additional revenues from the capacity balancing markets, and the day-ahead/real-time markets prove to be sufficient?

Long-Term Auction Market Results

As of this writing, CENACE has organized three long term auctions. This section reviews the results of the auctions and the contracted generation additions. During the first auction, 5.4 terawatt-hour (TWh) was contracted. In the second auction, 8.9 TWh projects won contracts. In the third auction, 5.5 TWh of clean electricity was awarded. Table 6.7 demonstrates that the three auctions have been of substantive interest to the investment community. Prices are competitive compared with the existing system as well as reported installed prices in other jurisdictions.

Table 6.7. Auction Results by Technology Type

	First Auction	Second Auction	Third Auction
Gas (MW)			550
Geothermal (MW)		25	
Solar (MW)	1691	1853	1323
Wind (MW)	394	1038	689
Average Price (US$/MWh)	$41.80	$33.47	$20.57

Source: SENER and CENACE, http://zumma.com.mx/insights.html.

For the third auction, the average price per MWh of $20.57 (including a value for CELs) fell to a level substantively below what many believe is a levelized cost of energy for new natural gas generation. Market sources believe that the value of a CEL might be $13–$14/MWh, although these vary widely as the results of Auction 2 show. If correct, this implies a technology-specific levelized cost of energy of US$20.57/MWh + US$13.50/MWh or perhaps US$34/MWh if CO_2 emissions have a value of zero.

Gas generation, likely the next lowest cost conventional alternative, has additional value compared to renewables. These additional values include contributing to dispatch reliability and ancillary services, which solar and wind generally do not; market sources estimate current U.S. costs (in Texas) for gas-fired technology to be around US$45/MWh, assuming that the penalty assigned to this technology's CO2 emissions are zero. Many observers assume that gas prices in Mexico for the near to medium term will remain linked to market prices for gas in Texas. Further, assuming that market sources are correct in suggesting an average cost in Texas (ERCOT) of US$9/MWh for shaping and firming services to be relevant for Mexico, this means that prices bid by solar and wind projects in the third auction are believable and reasonable since US$34/MWh + US$9/MWh = $44/MWh. Finally, it is also clear that these renewable resources are at "grid parity" from a cost perspective.

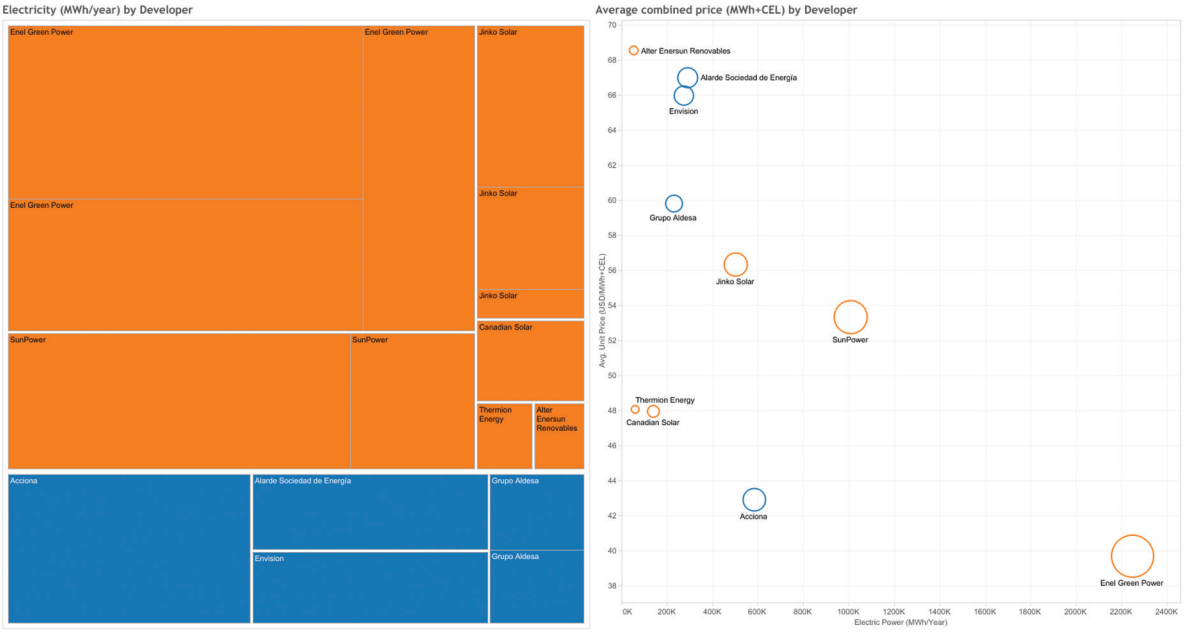
Auction 1 review

The first long-term auction started in November 2015 and ended in March 2016 (figure 6.6). Eleven companies secured contracts with 18 winning bids. They were selected out of 69 participants that submitted 227 offers (figure 6.7).

Figure 6.6. Auction 1 Price Results

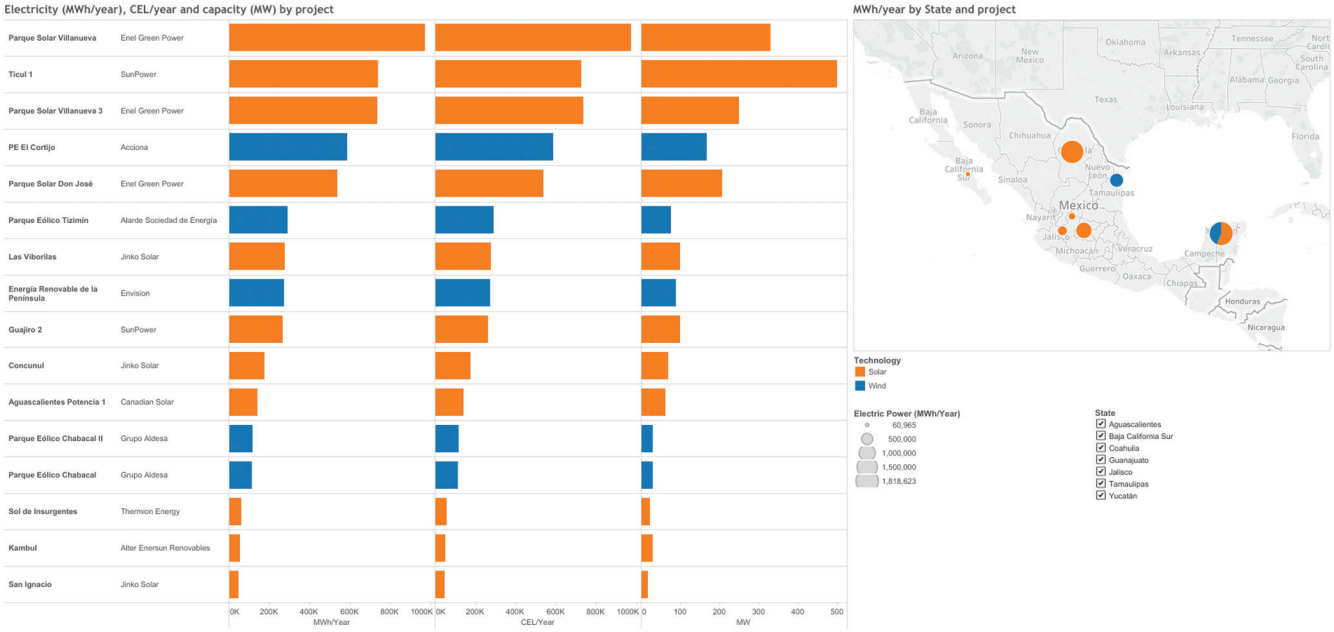
Source: zumma rg+c, http://zumma.com.mx/insights.html.

Figure 6.7. Auction 1 Price and Volume Assessment



Source: zumma rg+c.

Figure 6.8. Auction 1 Volume and Location Assessment



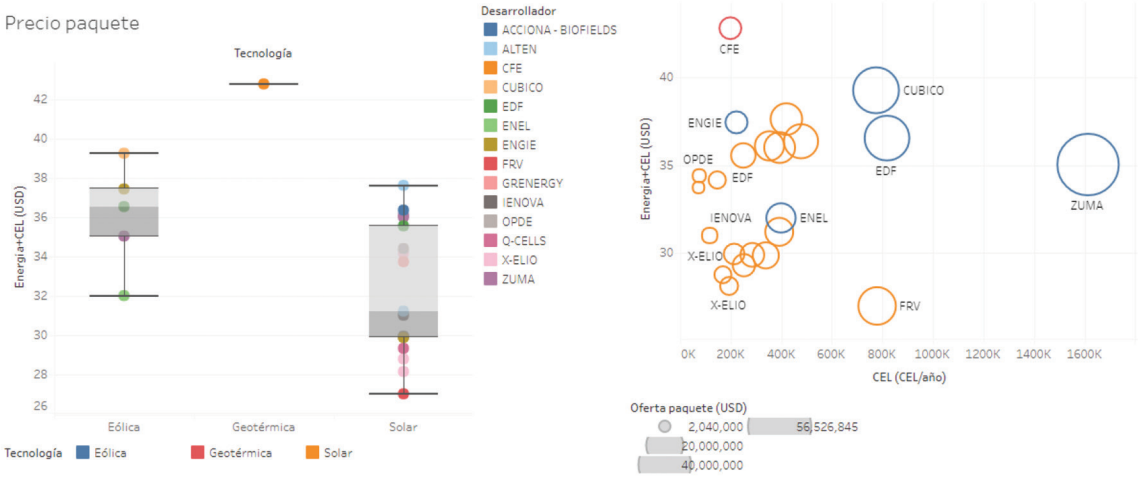
Source: zumma rg+c.

The winning projects are expected to supply 5,402,881 MWh of electricity per year. Solar represented 74 percent of the total, wind 26 percent. There was no interest in the firm capacity component as the price suggested under the auction rules was too low.

Auction 2 review

The second auction was launched in April 2016, with results announced in September 2016 (figure 6.9).

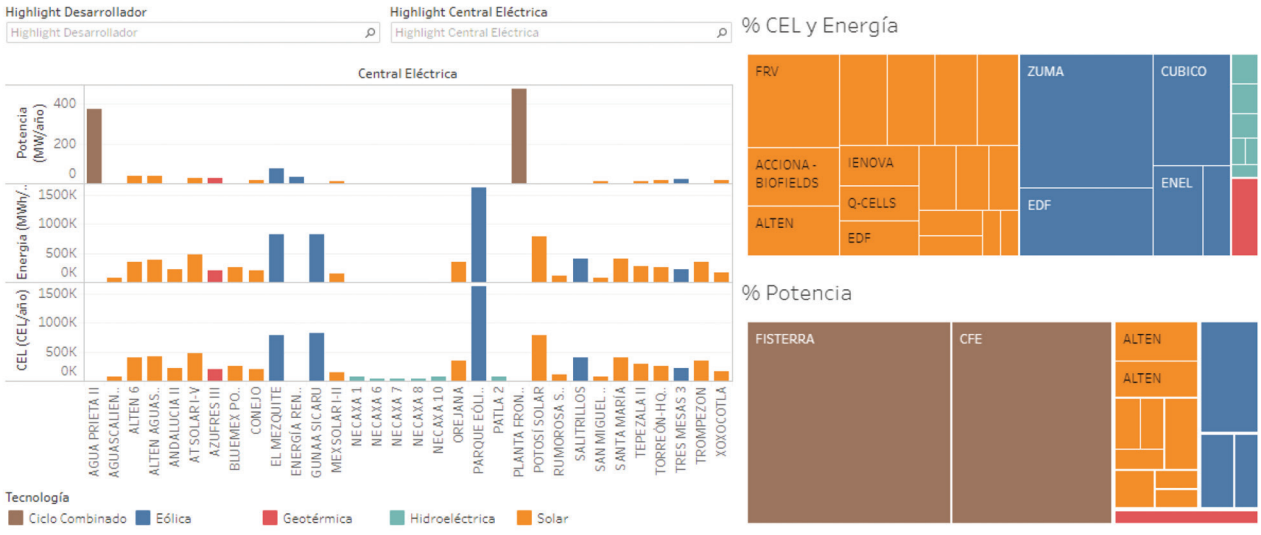
Figure 6.9. Auction 2 Price Results



Source: zumma rg+c.

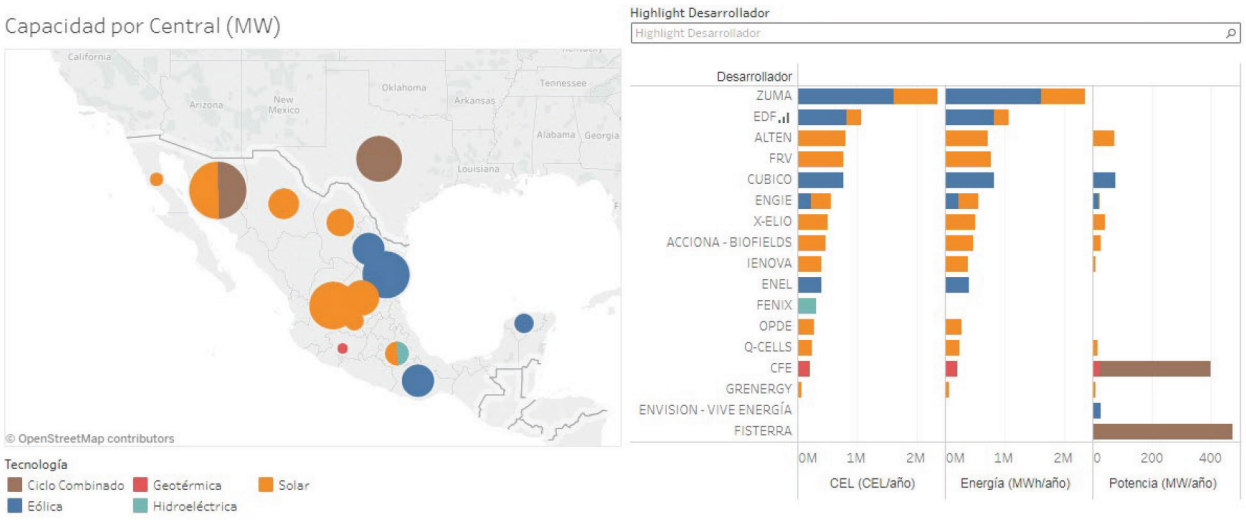
A total of 57 companies submitted economic offers in the competition, out of which 23 entities secured contracts (table 6.8). Successful projects included 1,853 MW of solar, 1,038 MW of wind, and a 25-MW geothermal project. Interestingly, 68 MW of hydropower secured CELs and a 90-MW wind project as a firm capacity contract (figure 6.10, 6.11, and 6.12).

Figure 6.10. Auction 2 Capacity and CEL Assessment



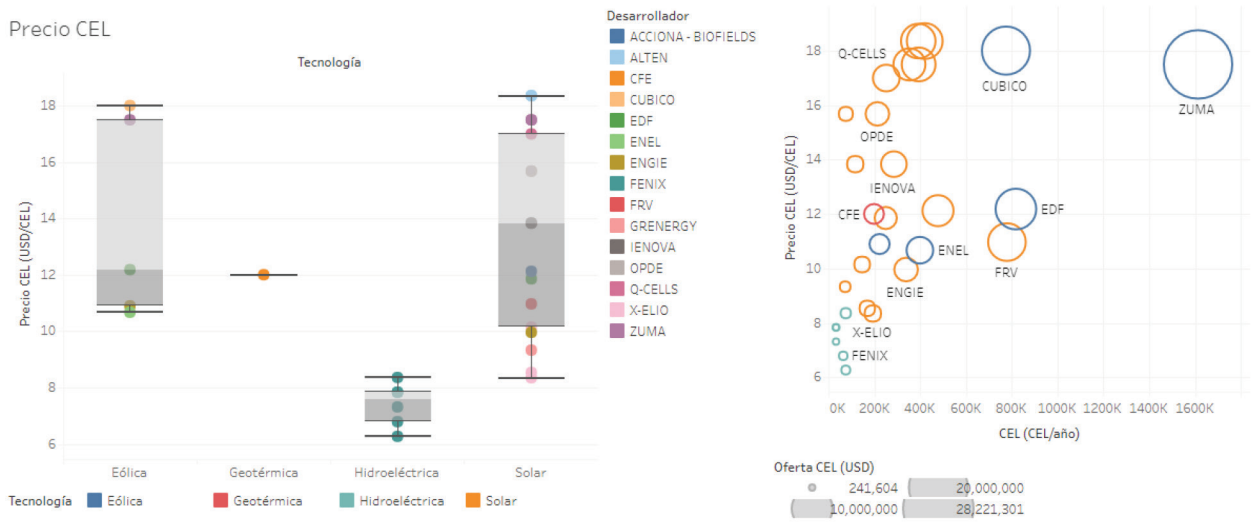
Source: zumma rg+c.

Figure 6.11. Auction 2 Volume and Location Assessment



Source: zumma rg+c.

Figure 6.12. Auction 2 CEL Price and Volume Assessment



Source: zumma rg+c.

Table 6.8. Auction 2 Company Participation and Technology Assessment

Participación por Desarrollador

Desarrollador	Energía (MWh/año)		Certificados (CEL/año)		Potencia (MW/año)	
ZUMA	18.11%	8.38%	17.39%	8.05%	0.00%	0.00%
EDF	9.18%	2.81%	8.82%	2.70%	0.00%	0.00%
CUBICO	9.21%		8.35%		6.46%	
FRV	8.74%		8.40%		0.00%	
ALTEN	8.10%		8.76%		6.28%	
ENGIE	2.50%	3.85%	2.40%	3.65%	1.82%	0.00%
X-ELIO	5.73%		5.50%		3.54%	
ACCIONA - BIOFIELDS	5.37%		5.16%		2.44%	
ENEL	4.48%		4.30%		0.00%	
IENOVA	4.40%		4.34%		0.84%	
OPDE	3.25%		3.12%		0.00%	
Q-CELLS	2.83%		2.72%		1.54%	
CFE	0.00%	2.23%	0.00%	2.14%	31.59%	2.11%
GRENERGY	0.82%		0.79%		0.84%	
FISTERRA	0.00%		0.00%		40.01%	
FENIX	0.00%		3.39%		0.00%	
ENVISION - VIVE ENER..	0.00%		0.00%		2.53%	

Porcentaje por Tecnología

Tecnología	Energía (MWh/año)	Certificados (CEL/año)	Potencia (MW/año)
Solar	54.28%	53.19%	15.49%
Eólica	43.49%	41.28%	10.81%
Geotérmica	2.23%	2.14%	2.11%
Hidroeléctrica	0.00%	3.39%	0.00%
Ciclo Combinado	0.00%	0.00%	71.59%
Grand Total	100.00%	100.00%	100.00%

Tecnología	Energía (MWh/año)	CEL (CEL/año)	Potencia (MW/año)
Solar	4,836,597	4,933,382	184
Eólica	3,874,457	3,828,757	128
Geotérmica	198,764	198,764	25
Hidroeléctrica	0	314,631	0
Ciclo Combinado	0	0	850
Grand Total	8,909,819	9,275,534	1,187

Tecnología
Ciclo Combinado
Geotérmica
Solar
Eólica
Hidroeléctrica

Source: zumma rg+c.

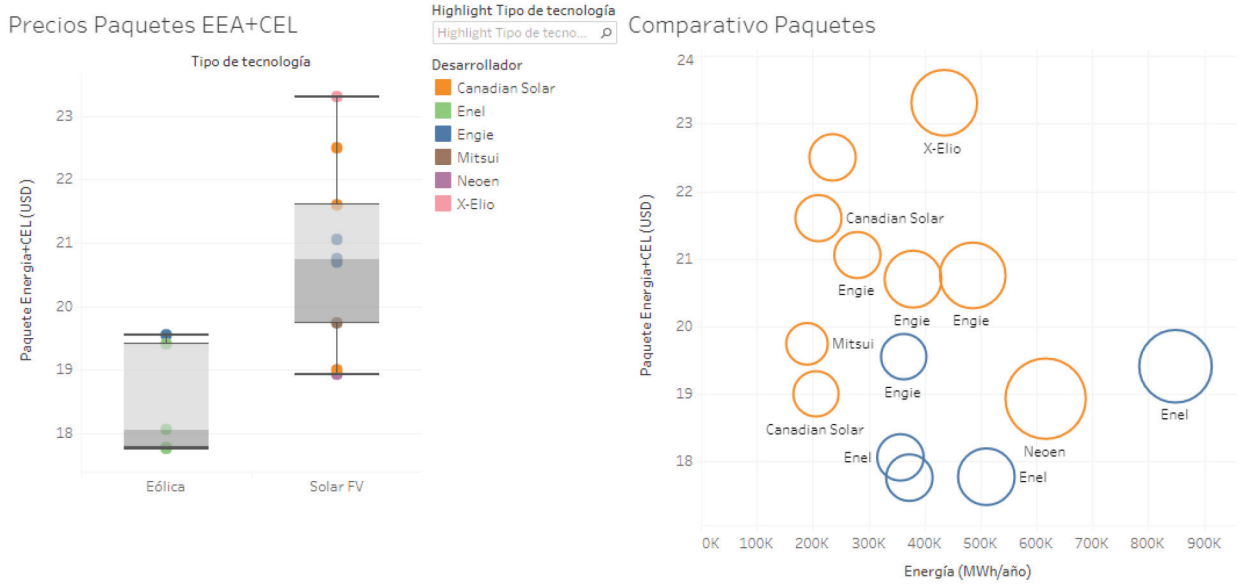
During the second auction, CFE had offered to buy a larger volume of electricity and more than 8.9 million MWh of supply was procured, which represented 83.4 percent of the proposed amount. Further, this was an increase of 65 percent from the first tender.

Zuma Energia, backed by Actis and Mesoamerica, received 725 MW. Cubico Sustainable Investments, in partnership with Alten Energias Renovables, won 540 MW. Solar developer Fotowatio Renewable Ventures won a 300-MW solar project, while EDF Energies Nouvelles won 252 MW of wind and 90 MW of solar.

Auction 3 review

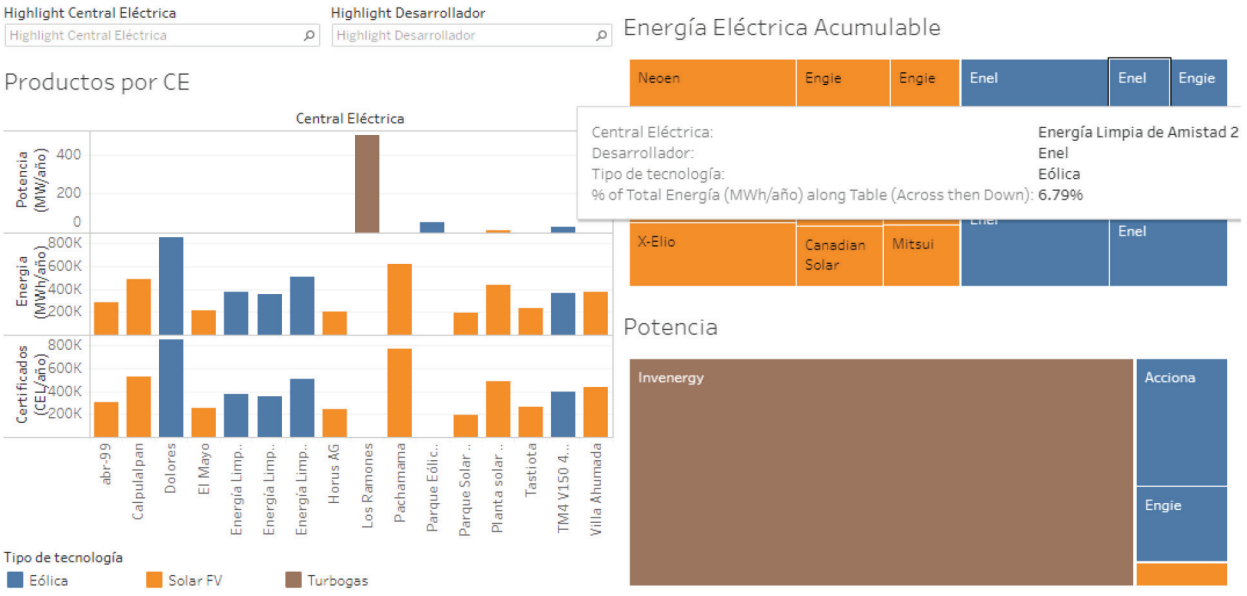
The third process began in April 2017 and concluded in November 2017 (figures 6.13, 6.14, 6.15, and 6.16).

Figure 6.13. Auction 3 Price Results



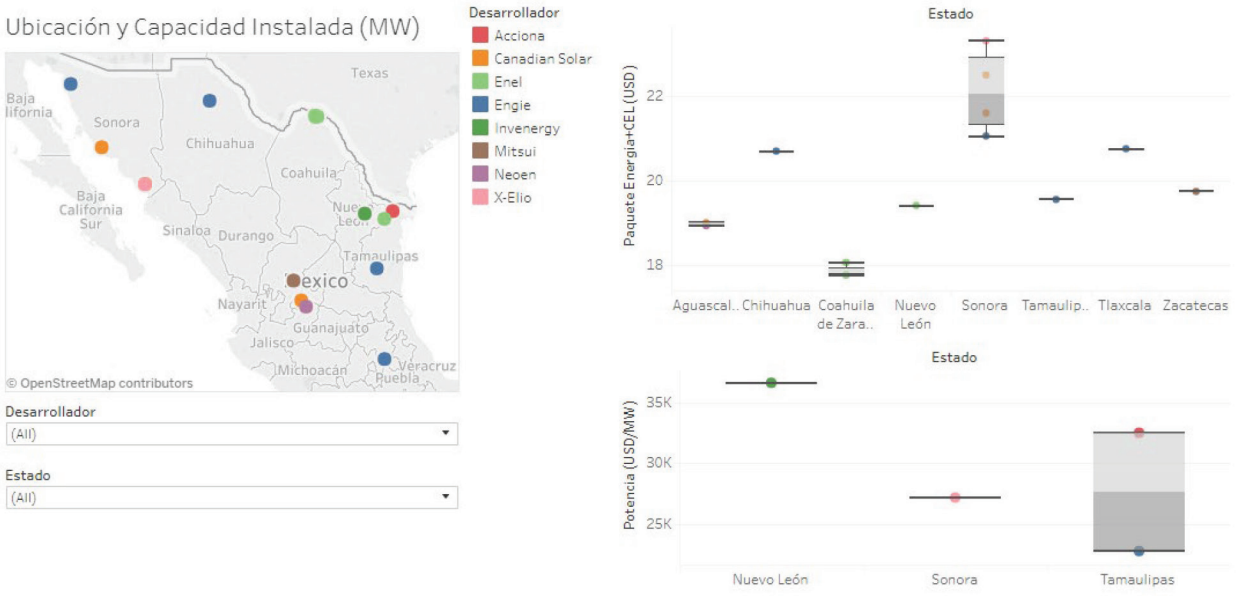
Source: zumma rg+c.

Figure 6.14. Auction 3 Capacity and CEL Assessment



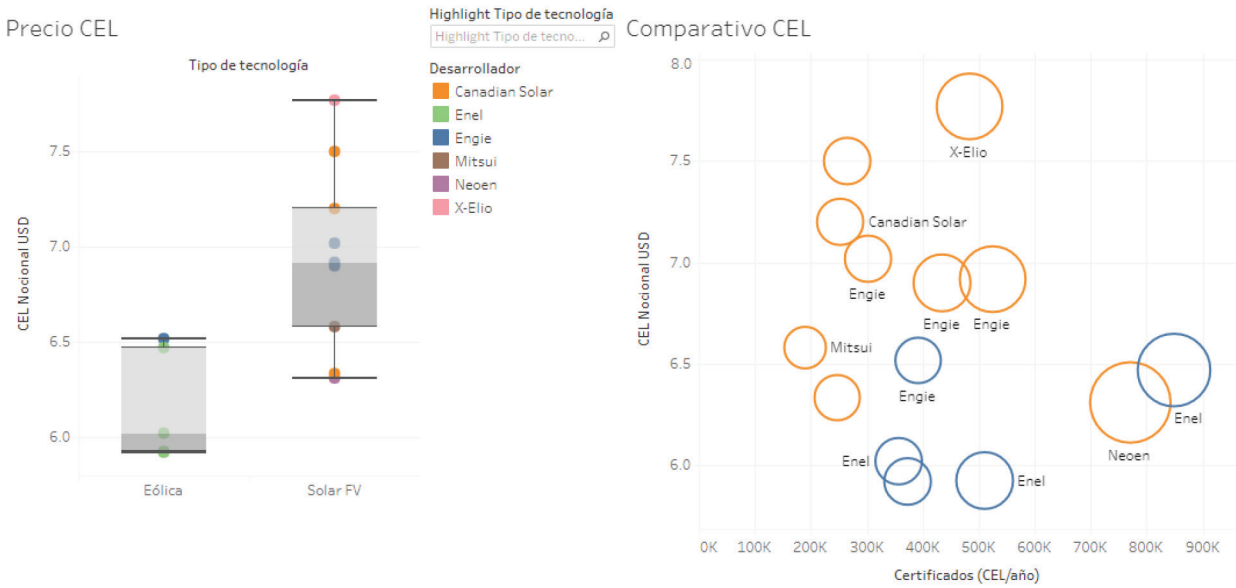
Source: zumma rg+c.

Figure 6.15. Auction 3 Volume and Location Assessment



Source: zumma rg+c.

Figure 6.16. Auction 3 CEL Price and Volume Assessment



Source: zumma rg+c.

Table 6.9. Auction 3 Company Participation and Technology Assessment

Participación por Desarrollador

Desarrollador	% de total Energía (MWh/año)	% de total CEL	% de total Potencia (MW/año)
Acciona	0.00%	0.00%	8.78%
Canadian Solar	11.87%	12.85%	0.00%
Enel	38.04%	35.10%	0.00%
Engie	6.61% 20.86%	6.58% 21.20%	5.17% 0.00%
Invenergy	0.00%	0.00%	84.36%
Mitsui	3.46%	3.19%	0.00%
Neoen	11.23%	12.95%	0.00%
X-Elio	7.93%	8.13%	1.69%

Tipo de tecnología
Eólica
Solar FV
Turbogas

Participación por Tecnología

Tipo de tecnología	% de total Energía (MWh/año)	% de total CEL	% de total Potencia (MW/año)
Eólica	44.65%	41.69%	13.95%
Solar FV	55.35%	58.31%	1.69%
Turbogas	0.00%	0.00%	84.36%

Tipo de tecnología	Certificados (CEL/año)	Energía (MWh/año)	Potencia (MW/año)
Eólica	2,481,415	2,452,547	83
Solar FV	3,471,160	3,040,029	10
Turbogas	0	0	500
Grand Total	5,952,575	5,492,575	593

Source: zumma rg+c.

Power purchase agreements were awarded for 5,492,575 MWh per year. The third auction saw the rise of additional buyers that entered into long-term contracts. CFE, Iberdrola, and Cemex, were the three successful purchasers; successful sellers included Engie, Enel, and Neoen (table 6.9).

The interconnection process

One of the important considerations for the long term auction process is a project's designation as a "priority project." If the project has obtained an interconnection agreement, bids submitted receive a designation as a priority project with increasing likelihood that its proposal will be accepted in the auction. From 2015 through 2017, the CRE relied on interim rules for interconnection as a new, more permanent interconnection manual was under development. Generally, the interim rules are extensive and mirror rules in other ISO markets.

To obtain an interconnection agreement, a developer can utilize the PRODESEN planning process or make individual requests to the CRE. The two processes present the developer with different cost and timing alternatives. Interconnection agreement terms are linked to the term of the CRE generation permit issued to the plant under the Electric Industry Law. As of this writing, a large request backlog exists, delaying approvals beyond the timeframe envisioned in the statutes.

There are numerous advantages to requesting an interconnection agreement on an individual basis. However, for projects that may have substantial network upgrade costs, the PRODESEN process may be preferable since these costs can potentially be socialized to the system. Developers indicate that the interconnection agreement process initially was a source of some frustration as the newness of the process meant that all parties were, to some extent, "learning by doing." Most of these factors have been overcome. However, the lead time needed to obtain a permit, especially under the individual request process, continues to present obstacles to development with lead times of 18 to 24 months reported. Especially for solar projects, this is a material contribution to the overall development and construction timeline.

Natural Gas Fuel Supply

Energy reform in Mexico has been a wide-reaching undertaking. For natural gas and refined products such as diesel, Pemex has historically been the supplier to the CFE. In Mexico, Pemex long served as the major natural gas supplier and operator of the gas pipeline system known as the National Gas Pipe System (Sistema Nacional de Gasoductos; SNG). Additionally, private pipelines operated off the SNG.

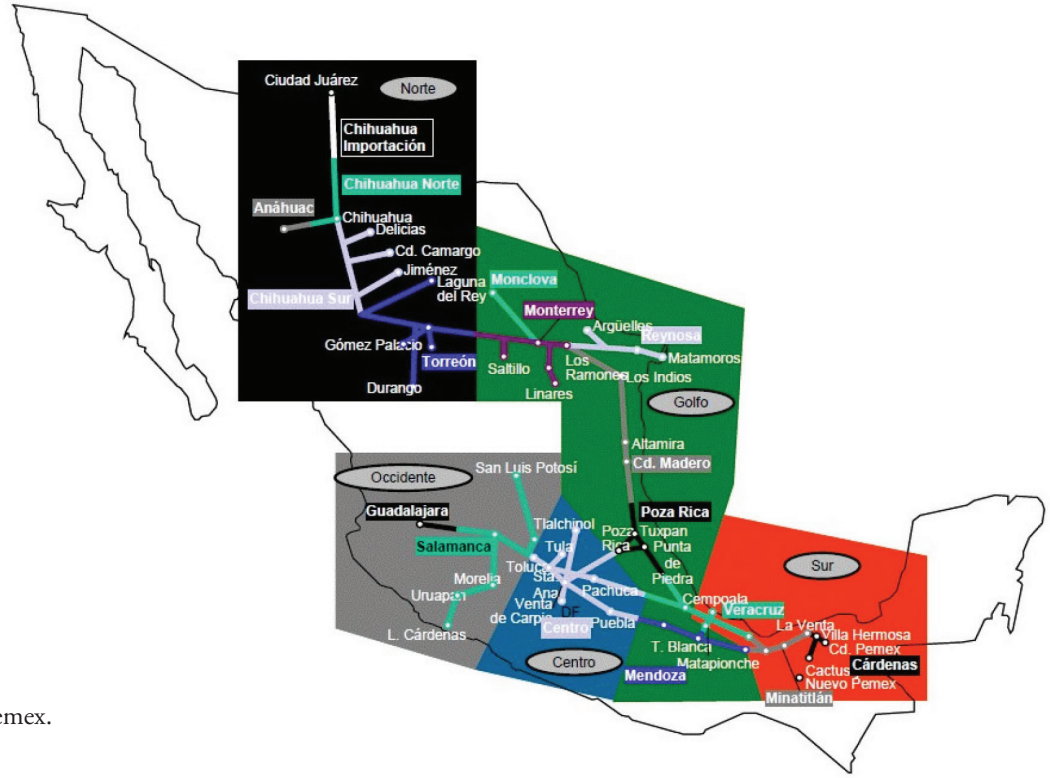
Development of CENAGAS and its relationship with VPM

Beginning in 2015 and 2016, the operation of the SNG was transferred to CENAGAS. Just as CENACE operates as an ISO to facilitate open access, CENAGAS is designed to do the same for the SNG.[305] In the past, natural gas prices in Mexico were linked to natural gas prices in the United States through a Pemex tariff. Known as Venta de Primera Mano (VPM, or "firsthand sale"), the formula relied upon U.S. prices in south Texas and linked them to two points: Reynosa and the Ciudad Pemex plant. The VPM took the source commodity price and added transport, distribution, and marketing costs. For Pemex, this proved to be a money-losing endeavor, largely because of costs associated with balancing and operating the system. In June 2017, the VPM program was formally ended (figure 6.17).

Generally, the energy reform has sought to honor existing contracts. Legacy long-term power purchasing agreements with the CFE typically based gas fuel supply on VPM or arrangements made directly with Pemex with gas costs generally passed through to the buyer, the CFE. Thus, there is little pressure to renegotiate. To transition from oil as a marginal fuel and lower system costs, the CFE substantively expanded new gas pipelines (figure 6.18). Many of these pipes support specific generation plants, especially in the Northwest. Others are expected to relieve gas supply constraints in the Center and South. To satisfy these constraints, fuel switching to imported LNG or fuel oil is typically the solution of choice.

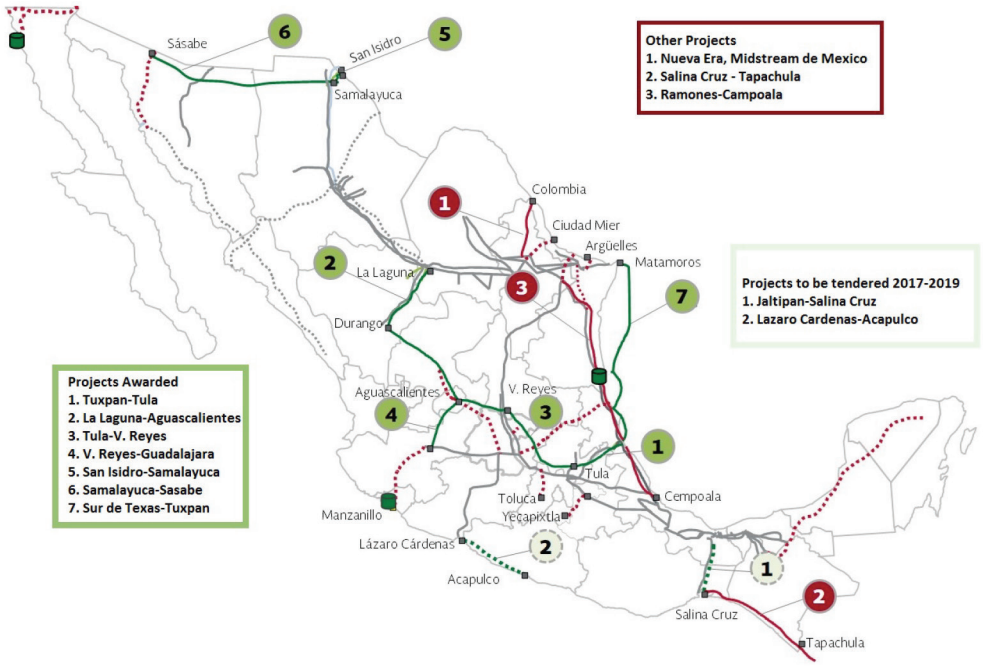
305 (SENER) *Prospectiva de gas natural, 2017–2031* [Natural gas prospects, 2017–2031] (Mexico City: SENER, 2017), www.gob.mx/cms/uploads/attachment/file/284343/Prospectiva_de_Gas_Natural_2017.pdf.

Figure 6.17. VPM Gas Delivery Zones



Source: Pemex.

Figure 6.18. CENAGAS Five-Year Expansion Pipeline Projects



Source: SENER, "Segunda revisión anual, plan quinquenal de expansión del sistema de transporte y almacenamiento nacional integrado de gas natural 2015–2019" [Second annual review, five-year plan to expand the integrated natural gas transport and storage system 2015–2019], March 31, 2017, https://www.gob.mx/sener/articulos/segunda-revision-anual-del-plan-quinquenal-de-expansion-del-sistema-de-transporte-y-almacenamiento-nacional-integrado-de-gas-natural-2015-2019?idiom=es.

Delivered LNG prices

Delivered prices in Mexico have largely tracked commodity prices in the United States. Under the VPM program, delivered prices have been highest in the regions furthest from the injection points at Reynosa and Ciudad Pemex. As a result, the North and Gulf regions often have had the cheapest delivered gas, while the Center and West experienced higher costs (table 6.10).

Table 6.10. Historical Delivered Industrial Gas Prices by Zone (US $/MMBtu)

Delivery Zone (gas, $/MMBtu)	2013	2014	2015	2016	2017
Gulf	$5.20	$6.00	$3.90	$3.80	
Central	$7.00	$7.40	$5.20	$5.10	
North	$6.10	$6.70	$4.60	$4.20	
West	$6.40	$6.80	$4.70	$4.80	
South	$6.10	$6.80	$4.70	$4.40	
Mexican Maya Crude ($/bbl FOB)	$97.25	$85.79	$44.02	$36.40	$46.95
Gulf Coast ULSD Diesel Oil No 2 ($/gal)	$2.97	$2.71	$1.58	$1.32	$1.62
Gulf Coast ULSD Diesel Oil No 2 ($/MMBtu)	$21.56	$19.68	$11.45	$9.60	$11.79

Source: CRE, "Precios gas natural a usuarios finales" [Natural gas prices to end users], https://datos.gob.mx/busca/dataset/precios-de-gas-natural-usuarios-finales; U.S. Energy Information Administration, (EIA), "U.S. FOB Costs of Mexican Maya Crude Oil," May 1, 2018, https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=IMX2810004&f=M; and EIA, "U.S. Gulf Coast Ultra-Low-Sulfur No 2 Diesel Spot Price, Annual," 2016, https://www.eia.gov/opendata/qb.php?category=241335&sdid=PET.EER_EPD2DXL0_PF4_RGC_DPG.A.

Power Market Prices

Short-run costs and day-ahead prices by major zone are shown in table 6.11.

Table 6.11. Historical Power Prices by Region (Nom $US/MWh)

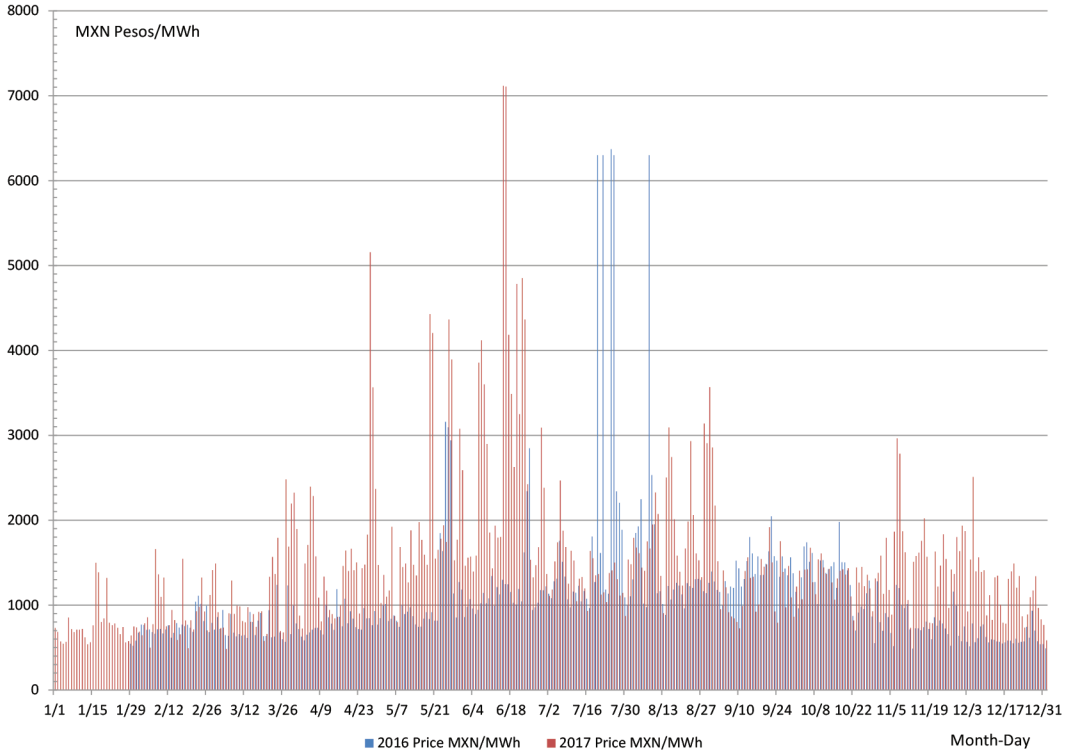
Control Area	2013	2014	2015	2016 (DA)	2017 (DA)
Northwest	$108.30	$65.90	$49.20	$44.28	$52.63
North	$99.00	$58.00	$44.10	$43.34	$61.82
Northeast	$97.00	$57.40	$44.50	$43.64	$56.96
West	$103.40	$60.50	$47.10	$47.32	$66.38
Central	$101.90	$59.90	$47.10	$46.21	$65.69
East	$101.40	$59.60	$48.00	$46.97	$67.18
Peninsula	$108.00	$73.30	$68.80	$53.02	$83.73
BCN	$31.60	$38.40	$23.40	$30.32	$31.35
BCS	$231.80	$223.30	$139.10	$108.16	$134.99

Source: CFE, CENACE, using proxies for zones and exchange rates.

In January 2016, the day-ahead market organized by CENACE began operation. Prior to that, the CFE reported short-run marginal costs. These costs did not include transmission effects (congestion), losses, and bidding effects, however. Power price trends overall are heavily influenced by oil prices and consumption of refined products. BCN is an exception as its grid is synchronous with the CAISO grid (figures 6.19 and 6.20; table 6.12).

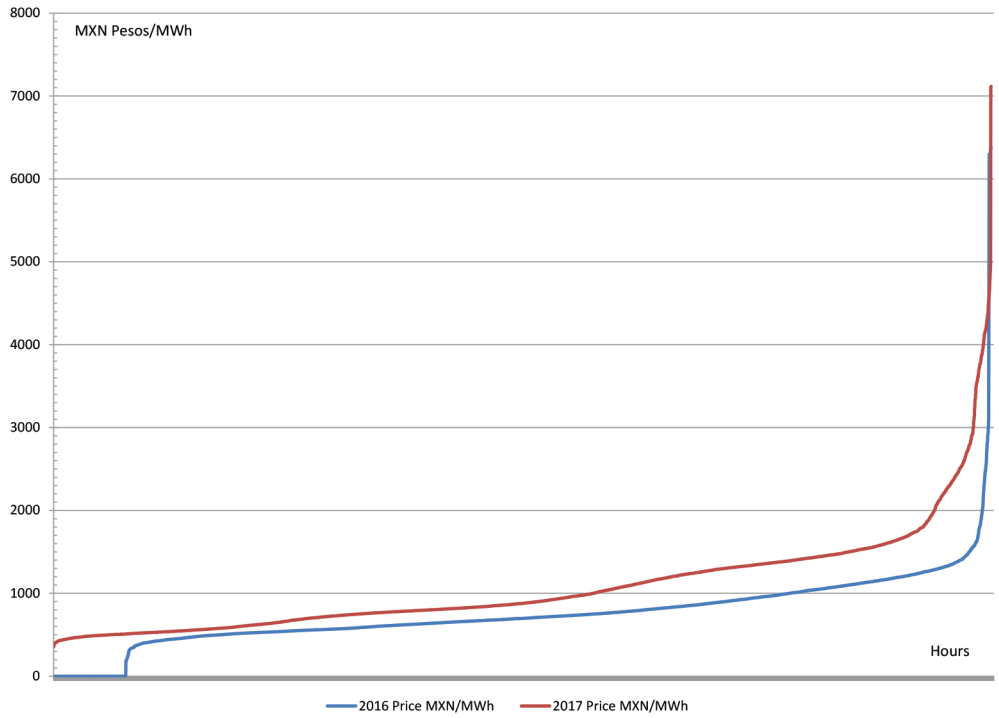
The implied heat rate can be calculated by dividing fuel consumption by generation. Since natural gas is frequently the marginal fuel, the calculation approximates the conversion efficiency of the system in a specified region. Beginning in 2014, national implied heat rates have averaged 10,000 to 12,000 British thermal units per kilowatt-hour (Btu/kWh). Further, total electrical losses (technical and other) have remained in the 13 to 15 percent during the same period. Both are relatively high when compared to other North American markets.

Figure 6.19. 2016 vs. 2017 Day-Ahead Power Prices Noreste



Source: CENACE using proxy for Noreste.

Figure 6.20. 2016 and 2017 Sorted Hourly Day-Ahead Power Prices Noreste



Source: CENACE using proxy for Noreste.

Table 6.12. 2016 and 2017 Sorted Hourly Day-Ahead Power Price Noreste Table

	2016	2017	2016	2017
	MXN/MWh	MXN/MWh	USD/MWh	USD/MWh
Lo	$0.00	$357.55	$0.00	$18.90
1%	$0.00	$438.29	$0.00	$23.17
5%	$0.00	$493.08	$0.00	$26.07
10%	$406.18	$525.18	$21.74	$27.77
50%	$697.71	$878.66	$37.35	$46.45
90%	$1,192.66	$1,643.93	$63.84	$86.91
95%	$1,137.87	$2,216.89	$70.55	$117.20
99%	$1,943.53	$3,878.21	$104.03	$205.04
Hi	$6,369.53	$7,115.60	$340.97	$376.19

Source: CENACE using proxy for Noreste.

Historical Capacity Prices

As discussed earlier, the balancing capacity market runs ex post only. Table 6.13 shows the results in the SIN, BCN, and BCS zones.

Table 6.13. Capacity Prices by Zone

Year	Zone	Total Fixed Costs ($/kW-yr)	Energy Revenues ($/kW-yr)	"Economically Efficient" UCAP (VIRPe RP)	Net Capacity Price ($/kW-yr)
2016	SIN	$109.43	$77.43	15.3%	$64.63
2016	BCN	$90.55	$20.108	16.4%	$134.23
2016	BCS	$149.46	$36.08	32.7%	$66.39
2017	SIN	$102.62	$135.09	15.3%	$37.52
2017	BCN	$83.72	$13.46	16.4%	$31.41
2017	BCS	$139.04	$9.95	32.7%	$145.64

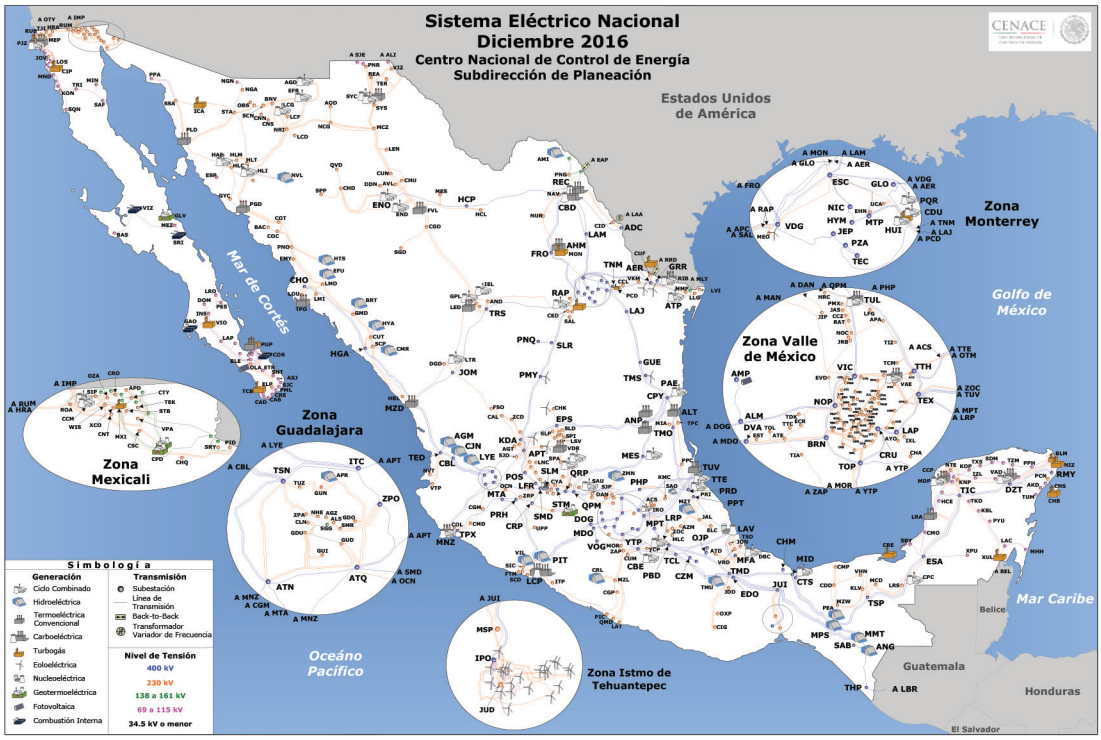
Source: CENACE. Note: Reserve margin defined against the average demand during 100 critical hours. See CENACE, "Resultados del mercado para el balance de potencia" [Reults from the balancing capacity market], http://www.cenace.gob.mx/Paginas/Publicas/MercadoOperacion/ResultadosMercadoBalancePotencia.aspx. "Net Capacity Price" FX is average. Fixed costs and energy revenues reported by CENACE.

Initially, many thought that Mexico would be long on capacity; however, the capacity process demonstrates that there were significant de-rates between the nameplate capacity and the actual measured availability during critical hours. As a fleet, the SIN averages 77 percent of nameplate capacity, including perhaps 65 percent for major oil/gas units and 87 percent for major CCs.

Existing Transmission System and Planned Changes

The Mexican electric transmission grid comprises more than 100,000 kilometers (km) of transmission lines and almost 200,000 megavolt-ampere (MVA) of transformer capacity of 69 kilovolts (kV) to 400 kV (figure 6.21).

Figure 6.21. High Voltage Transmission System

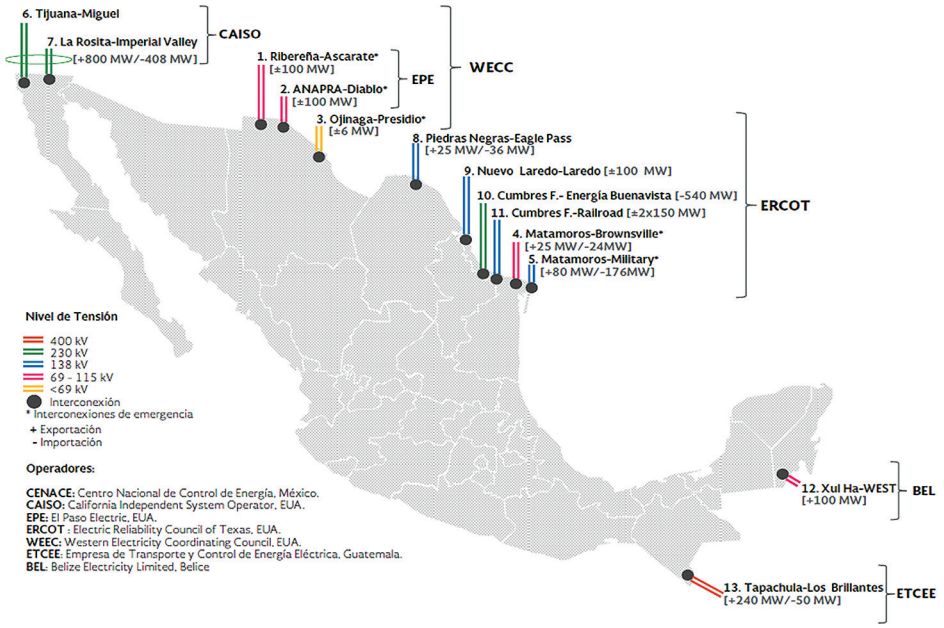


Source: "Programa de desarrollo del sistema eléctrico nacional."

Interconnections and internal transfer capabilities

The high-voltage system also connects with neighboring countries (figures 6.22 and 6.23). External ties exist with Belize, Guatemala, and the United States. Total transfer capacity with the first two is about 100 MW with Belize and 240 MW with Guatemala. For the United States, 530 MW of export and 636 MW of import is transferred with the Electric Reliability Council of Texas through a series of DC ties. Other transfers include approximately 200 MW with El Paso Electric in WECC, and two synchronous connections between the CAISO grid and the BCN region at Tijuana and the La Rosita CC plant.

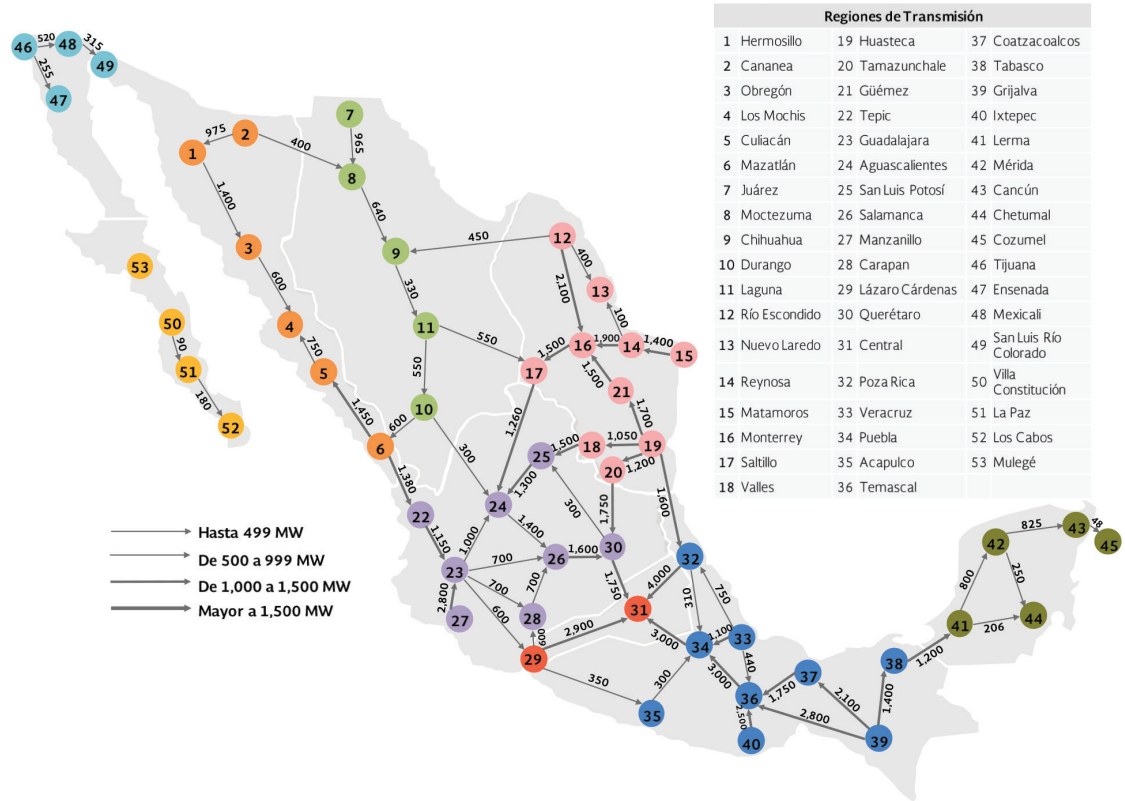
Figure 6.22. Existing Cross-Border Transmission Capabilities



Source: "Programa de desarrollo del sistema eléctrico nacional."

Figure 6.23. Internal Transmission Transfer Capabilities

(Megawatt)



Regiones de Transmisión					
1	Hermosillo	19	Huasteca	37	Coatzacoalcos
2	Cananea	20	Tamazunchale	38	Tabasco
3	Obregón	21	Güémez	39	Grijalva
4	Los Mochis	22	Tepic	40	Ixtepec
5	Culiacán	23	Guadalajara	41	Lerma
6	Mazatlán	24	Aguascalientes	42	Mérida
7	Juárez	25	San Luis Potosí	43	Cancún
8	Moctezuma	26	Salamanca	44	Chetumal
9	Chihuahua	27	Manzanillo	45	Cozumel
10	Durango	28	Carapan	46	Tijuana
11	Laguna	29	Lázaro Cárdenas	47	Ensenada
12	Río Escondido	30	Querétaro	48	Mexicali
13	Nuevo Laredo	31	Central	49	San Luis Río Colorado
14	Reynosa	32	Poza Rica	50	Villa Constitución
15	Matamoros	33	Veracruz	51	La Paz
16	Monterrey	34	Puebla	52	Los Cabos
17	Saltillo	35	Acapulco	53	Mulegé
18	Valles	36	Temascal		

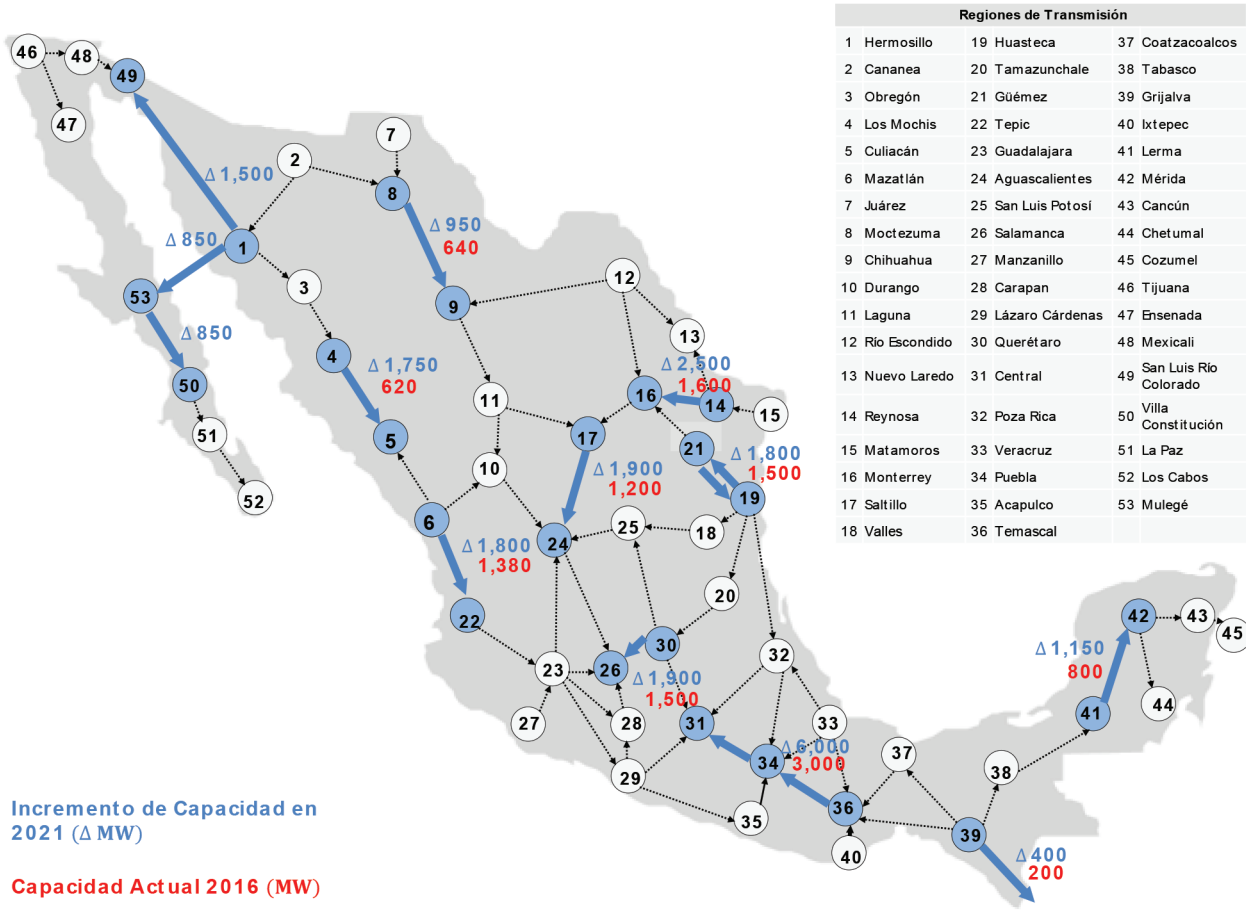
Source: "Programa de desarrollo del sistema eléctrico nacional."

Congestion and planned improvements

The PRODESEN planning document identifies existing transmission issues and planned improvements. These include a lack of interconnection between the BCN, BCS, and SIN grids; constraints in the North and Northwest regions (which are seeing large capacity buildout); limited transmission to the Yucatán Peninsula, evidenced by higher prices and the June 2017 peninsula-wide blackout due to transmission failure; and import constraints into the capital region.

SENER has prioritized and authorized a number of projects to address these issues. Figure 6.24 illustrates some of the more important changes.

Figure 6.24. Planned Expansion



Source: "Programa de desarrollo del sistema eléctrico nacional."

The 2017 PRODESEN offered details as to future power generation capacity and the fuel mix. It also provided information on expected investments in the national electricity system, as well as demand and capacity projections. Overall, 55,840 MW of utility-scale power generation capacity are expected over the next 15 years to meet growing demand, with 63 percent of new deployments expected from wind, solar, and efficient cogeneration. Investments in transmission will include various interconnection projects, 23,772 km of new transmission lines, and 58,099 MVA of additional transformer capacity.

Under the restructuring, private participants are able to finance, operate, maintain, and expand the transmission and distribution network. Smaller, standard transmission upgrades remain the responsibility of the CFE. Additionally, larger, nonstandard "strategic" projects are likely to be awarded under a competitive bidding process. Projects for the Baja California Peninsula and for Cozumel are two identified processes. The Baja California process envisions a 1.5-GW high-voltage direct current transmission line 1,400 km long connecting the California grid at Mexicali to the SIN near Hermosillo, Sonora. Initiated in December 2017, 45 companies have expressed interest. Investment is estimated at US$1.1 billion.

The Distribution System and Distributed Generation

Currently, the Mexican electric distribution grid comprises more than 750,000 km of distribution lines. Under the terms of the Electric Industry Law, the distribution system remains administered by the CFE. The PRODESEN process envisions that transmission and distribution projects will account for about 20 percent of the total US$107 billion invested over the next 15 years. Transmission investment of US$12 billion is expected with 89 percent of the spending occurring over the next five years.[306]

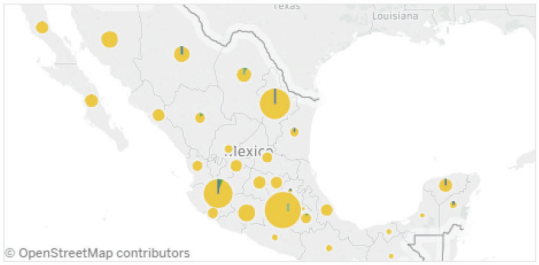
For distribution, an investment of US$9.6 billion is anticipated for distribution expansion and modernization projects, including development of smart grids. Between 2017 and 2024, between US$500 million and US$650 million is expected to be invested each year. Given technical and economic developments in other markets in North America, this distribution outlook may be subject to some changes.

In some cases, certain types of distributed energy resources can substitute for distribution system wires additions. Additionally, in recent years, distributed generation—one type of distributed energy resource—has grown. Distributed generation can require distribution upgrades or relieve constraints depending on the local conditions. It is defined as an exempt generator that does not require a CRE permit. To achieve this designation, the asset must be less than 0.5 MW in size and connected to a distribution circuit with a high concentration of load centers. A distributed generation provider can participate in the MEM if it is represented by a basic or qualified supplier. The CRE has developed a model contact for the basic supplier, as well as methodologies for net metering, net billing, and energy sales. By the end of 2016, Mexico had distributed generation capacity of 247.6 MW. Solar installations smaller than 30 kW accounted for 50 percent of the total, while 48 percent were solar bigger than 30 kW but smaller than 500 kW (figure 6.25).

306 "Programa de desarrollo del sistema eléctrico nacional."

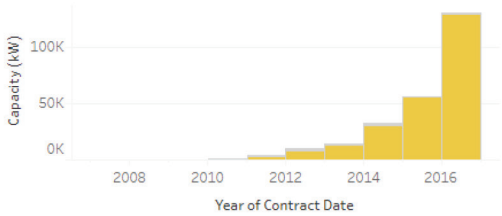
Figure 6.25. Distributed Generation Capacity and Energy Sources

Energy Source	% of Total Capacity (kW)	% of Total Number of Contracts
Biogas	1.48%	0.09%
Biomass	0.10%	0.01%
Solar	98.39%	99.85%
Solar-Wind Hybrid	0.03%	0.02%
Wind	0.01%	0.02%



Year of Contract Date
(All)
State
(All)

Additional capacity per year

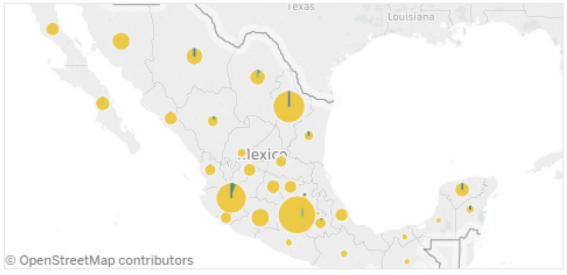


Cumulative capacity

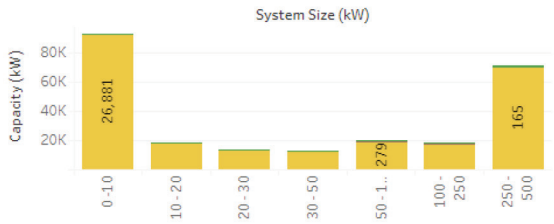
Source: Zumma rg + c.

In December 2017, a roadmap for solar development was published. By 2030, the roadmap envisions 22 GW of installed photovoltaic capacity in 2030, with 9 GW of large-scale plants and 13 GW of distributed generation solar systems. Additionally, the roadmap established an interim goal for 2024 of five GW large-scale and two GW distributed generation solar (figure 6.26).

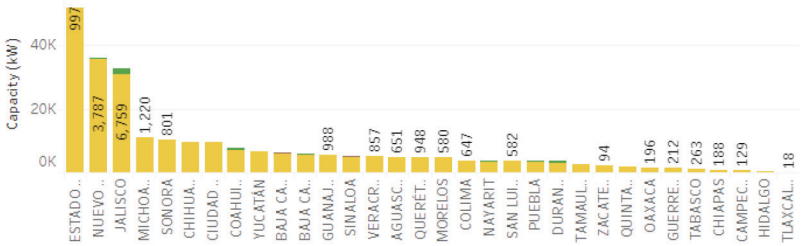
Figure 6.26. Distributed Generation System Size and Location



Residential, Commercial and Industrial Segments



State



State (All)

Year of Contract Date (All)

Energy Source
- Biogas
- Biomass
- Solar
- Solar-Wind Hybrid
- Wind

Source: Zumma rg + c.

Project Development Status

To date, the most tangible project development successes as a result of the restructuring are concentrated in the long-term auction process for generation. The first three auctions awarded more than 6,500 MW of generation power purchasing agreements. For three processes conducted over a year and a half, the participation has been substantive.

Although the award of offtake agreements from the long-term auctions is a tangible and important sign of success, some renewable projects also have been successful in obtaining offtake agreements outside of the CENACE-sponsored process. This achievement is another important marker of success. Yet converting these commitments into viable projects that have reached financial close has proven to be much more challenging. First, the financial engineering necessary to satisfy debtholders has meant that the traditional project finance structure used elsewhere in North America needed modification. Importantly, the development community, the government, and CENACE have used other intermediaries, such as development banks, to accept some of the risks that private sector capital markets found difficult to hold. Key participants have included the North American Development Bank. Second, the process of bidding itself might have included more detail that could have streamlined the process to reach financial close, such as the output profile that was bid (e.g., P50, P99) for intermittent renewables. These details lead to a nonstandard process for the capital markets and delays in closing. The process also exposed differences among money center banks in standardizing the debt-equity ratio that might be acceptable to the capital markets. Today a 70 percent/30 percent to 60 percent/40 percent debt/equity ratio predominates thanks to the important role of the development banks in assuming select risks especially with respect to profile and tenor.

Future work could be useful to identify improvements and unlock greater leveraging. Chief among these could be capital market solutions in the area of availability and tenor. The goal here would be to increase the gearing ratio by covering certain risks by third-party "enhancement" contracts that insurance-oriented participants with global capital scale might offer. This type of participation could also be key to enhancing the size of the risk warehouse of the development banks.

In the medium term, further development of market structures in Mexico's natural gas markets—for instance, greater availability of capacity release programs, or more options for firm gas supply and pricing—could lead third parties to allow wrap products that guarantee fixed prices. This would allow partially variable market-priced bids into the long-term auction market, reducing the need for CENACE participants (i.e., the CFE and other third-party buyers) to accept fixed price risk.

For many observers, one major risk to the overall restructuring remains with the developer process in the long-term auctions. Observers have been discussing several major unresolved questions:

- Are the prices bid (especially in the third auction) sufficient to compensate equity holders and allow for debt service coverage across a reasonable range of outcomes?
- Given how long it has taken for awards in the first two auctions to reach financial close, will all projects be completed and reach commercial operation in a timely fashion?

- Market participants have reported that some projects from the first two auctions are shopped for sale to new third parties for completion. Was the qualification process robust enough? Are the level of guarantees and penalties as well as awarded prices imposed by CENACE sufficient to incentivize developers to successfully complete their projects? What are the consequences to system reliability if certain awarded projects are delayed, or not completed at all?

As this is written, the strategic transmission solicitation process is underway and due to be completed in the third quarter of 2018. Many parties have expressed interest in this process. As a result, most observers are confident that a competitive process will ensue. Some developers suggest that the process may be hypercompetitive and are choosing not to participate in these first projects.

Some large international participants who might otherwise participate in the long-term auction process have had similar cautious views. As a result, some developers and private equity backers have turned to the bilateral market outside of the auctions to aid in the margins available to the project. By guaranteeing discounts to the Basic Service rate, these companies hope that their qualified supplier status can enhance project margins by selling directly to qualified users. In the first three years after the restructuring began, these qualified users entering transactions were few and far between. As grandfathered projects initiated under the old rules and protected during the transition began to assume less importance, this type of qualified supplier/qualified user transaction may assume continuing importance. Qualified suppliers are starting to consider that prices may become more volatile under the restructured process and will not fall as many believed earlier in the process. In addition, growth, reliability, and additional load needs suggest that at least some of these qualified users are rethinking their initial strategy.

Additional Issues

In addition to complications in the financing and development process stemming from the restructuring, Mexico faces other project and market development challenges in the areas of human capital and technology transfer.

Historically, the CFE played an important role in developing the Mexican energy sector's human capital. The organization historically has been a long-term employer that provided opportunities for both recent graduates and senior-level executives. Since 2016, the CFE has been split into separate organizations, and the traditional paths for personal development have been shifted. Additionally, new organizations have entered or expanded in the Mexican power sector. These new companies have created demand for staff at all levels. Some of these needs have been met by hiring people away from the CFE; others have been met by international hires. Although international hiring has brought in new talent that could supplant some domestic jobs, it has a benefit of cross-pollenizing experience gained internationally into the Mexico context. The new companies that have entered also have brought benefits to the broader economy by adding new projects and plants at lower costs. The awarded prices for wind and solar projects are clearly world-class. These experiences also have the potential benefit of broadening and deepening the acceptance of the restructuring among those beyond the sector.

Numerous observers have wondered, "Does Mexico have sufficient trained and knowledgeable people to continue to build out the sector?" To increase the odds of success, bring about economic development and global competitiveness, some of the country's primary institutions have sought to increase collaboration with

international academic and development agencies to support specialized skill development. Recent achievements include the following:

- An agreement with the University of Texas at Austin and Tecnológico de Monterrey (Monterrey Tech) to develop a reliable, clean, sustainable, and affordable electric power sector for Mexico.[307] The goal is to make it easier to transfer and share knowledge and best practices, leveraging the strengths of both institutions to meet Mexico's fast-growing demand for electricity. The partnership, managed in the United States by the University of Texas's Energy Institute, will link Monterrey Tech with more than 100 U.S. faculty members in 20 energy-related research centers. The two universities will conduct joint faculty and student exchanges, conferences and seminars, and research on electric power. Areas of collaboration will include energy security, reliability, sustainability, efficiency, affordability, and good governance for energy markets.
- An agreement with Arizona State University, the University of California at Berkeley, and Monterrey Tech to enable, by means of power electronics devices, highly reliable and efficient grid implementations.[308] Mexico's National Council for Science and Technology (Consejo Nacional de Ciencia y Tecnología; CONACYT) and SENER are also involved in the project's formation. As a consequence of the recent Mexican energy reform, the high power interconnection between Mexico and the United States has become a pressing issue that will benefit the emerging binational wholesale electricity market. Additionally, Mexico is currently migrating to the development of new technologies such as high-voltage direct current transmission systems. A new research plan that will address the current Mexican grid demands the combination of the experience of Monterrey Tech in electrical engineering and the top qualified experience of Arizona State University in high-voltage transmission. The plan consists in a collaborative supervision of more than 30 outstanding Mexican postgraduate students and the eventual development of a binational medium voltage power electronics laboratory.[309]
- Analysis of Improvements in Energy Efficiency and Energy Conservation in the Nonresidential Electricity Sector. The Mexico lead institution is the Center for Economic Research and Teaching (Centro de Investigación y Docencia Económicas; CIDE) with international partner the University of California at Davis.[310]
- Demonstration Buildings of Bioclimatic Design in Warm Subhumid Climate. The Mexico lead institution is the Institute for Renewable Energies at the National Autonomous University of Mexico (Universidad Nacional Autónoma de México) with international partner LBL Berkeley Lab.[311]
- Lighting Application Research Center for the Development of Demonstrative Projects of New Lighting Systems to Improve Energy Efficiency. The Mexico lead institution is the Autonomous University of Guadalajara (Universidad Autonoma de Guadalajara) with international partner the University of California at Davis.[312]

307 "University of Texas and Monterrey Tech Join Forces to Improve Electric Power in Mexico," University of Texas at Austin, November 17, 2017, https://news.utexas.edu/2017/11/17/universities-partner-to-improve-electric-power-in-mexico.

308 "Collaboration on U.S.-Mexico High Voltage Direct Current Links (Monterrey Campus)," Arizona State University, accessed April 8, 2018, https://mexico.asu.edu/our-mexico-portfolio/collaboration-us-mexico-high-voltage-direct-current-links-tecnol%C3%B3gico-de-monterreys-monterrey-campus.

309 "ASU's Energy-Systems Expertise and Decision Theater Will Help Shape Mexico's Power Grid," Arizona State University, April 6, 2016, https://asunow.asu.edu/20160406-global-engagement-asu-energy-systems-expertise-decision-theater-mexico-power-grid.

310 "Mexico Energy Initiative," International Energy Studies Group, Lawrence Berkeley National Laboratory, 2018, https://ies.lbl.gov/region/mexico-energy-initiative.

311 Ibid.

312 Ibid.

- Consortium for Energy Efficiency in Nonresidential Buildings. The Mexico lead institution is Monterrey Tech, Nuevo Leon, with international partner the University of California at Davis.[313]
- Observatory for Energy Efficiency in Buildings. The Mexico lead institution is the National Institute of Electricity and Clean Energy (Instituto Nacional de Electricidad y Energías Limpias) with international partner LBL Berkeley Lab.[314]

Mexico's CONACYT indicates that in the four years since the enactment of energy reform, "Over $175 billion USD in funds have been pledged that will create hundreds of thousands of well-paid jobs" across the comprehensive energy sector. It indicates that nearly 60,000 students have received support from the government to take advantage of the new opportunities in the sector. CONACYT expects to launch a new call for applications to award graduate scholarships to specialists in energy matters in 2018.[315]

Conclusion

During the 2013–18 timeframe, potential investors and industry observers expressed various opinions with respect to key elements of the reform. As discussed, many of the observations and restructuring activities have been received favorably by new and potential market participants. In this sense, then, an interim report card on electricity sector restructuring can indicate that the reforms are regarded as successful.

Some observers have cited the relatively low participation of firms outside of the long-term auctions as a hindrance to the reforms. Generally, their perspective is that power sector participation rates have been more muted compared with participation in the upstream oil and gas rondas. As with many things in life, improvements can be identified and are generally to be expected. In this spirit, the related critiques center on six major concerns.

1. The CFE's preexisting monopoly status remained unresolved for the first three years of the process. Investors and industry observers expressed concerns regarding the CFE's ability to exert vertical and horizontal market power with respect to commitment and dispatch operations, provision of firm gas pipeline capacity, and competition for qualified users (consumers).
2. The Basic Service rate-making process and overall level of these rates was the source of considerable confusion, some of which remains at the time of writing. Many qualified users approached the restructuring process with the belief that wholesale market prices were likely to decrease. This Basic Service process would determine a de-facto "price to beat" for new market entrants who would want sell at retail to consumers to substitute the Basic Service that the CFE provided to larger consumer classes. The CRE released this methodology in December 2017, but confusion over the transition mechanisms and the nature of the phase-in process has persisted. This lack of clarity set back the timing and implementation plans of new market entrants, including aggregators and generators. From conversations with market participants, the confusions likely slowed participation of qualified users in the first medium-term auction held in the first quarter of 2018. Still unclear is the role of subsidies for certain classes of residential and industrial

313 Ibid.

314 Ibid.

315 "Electricity Coverage to Reach 100% in 2018," President of the Republic of Mexico, February 8, 2018, www.gob.mx/presidencia/en/articulos/electricity-coverage-to-reach-100-in-2018?idiom=en.

customers. The finance ministry will need to provide guidance for qualified user and qualified supply participants as to timing and changes to better understand how the rate-making process may change in the future.

3. Some of the initial statements and promises made to build political support for the restructuring may have reduced the speed of its progress. One of the primary reasons established to build popular support for the restructuring was the notion that doing so would create construction and ongoing operating jobs. Second, it was promised that the reforms would modernize the sector by increasing operational efficiencies, and prices would fall thanks to the effects of market forces and competition. However, these promises also established an expectation among knowledgeable buyers that it was better to wait for these lower prices. Third, during the process of passing the constitutional amendment and secondary laws, it was frequently repeated that "not one nut or bolt" of the state-owned enterprises—Pemex and the CFE—were to be sold. By removing the possibility of full or partial privatization in the short to medium term, these enterprises were assured of their important role and the political process was concluded successfully. However, early opportunities for international capital participation were reduced. Observers have speculated that future administrations may be more (or even less) likely to make changes to this commitment. Fourth, there was an expectation that infrastructure investment could be attained on a broader scale and more rapidly by relying more heavily on international capital sources. However, certain market design elements and subsequent market developments exposed weaknesses in the structure and resulting risks that traditional project finance structures were initially expected to take on. This inhibited the utilization of traditional structures and required that other quasi-public institutions, such as development banks, devise new products to take on the risks that commercial banks and private equity would not accept.
4. After an initial wave of enthusiasm, project finance and development uncertainties, largely around timing and land acquisition, led small and medium-sized private equity capital to pull back and slow development activities. After this pullback, multinational enterprises with core rate-of-return oriented businesses, and a positive view of country risk, exchange risk, capital cost, and the success of the long-term Mexico auction process, stepped in to provide low cost development capital. In doing so, they accepted an expected rate of return lower than that some traditional private equity firms were willing to accept given the risks involved. These multinational enterprises teamed with international infrastructure funds and capital providers looking for stable, long lived returns. This has provided the multinational enterprises with a deep capital source and an exit strategy for their development activities, and they expect to profit over the longer term by continuing to operate the assets they develop. It is clear that financial close has not been reached in a timely fashion for selected projects. In a global interest rate environment rising above historic lows, additional project risks may materialize and threaten completion of a subset of the successfully awarded projects.
5. The desired market design was implemented in stages beginning in 2016. This was understandable as energy officials, regulators, and market participants needed time to understand and assimilate detailed proposals into their plans. However, stretching this process out over several years has slowed the acquisition of retail consumers by qualified suppliers and generators interested in building a business outside of the long-term auction process, owing to regulatory uncertainty associated with what remains to be structured. Staging the implementation also inadvertently contributed the qualified users' belief that retail prices would be likely to fall, which may have contributed to a reduced number of completed transactions with qualified suppliers

early in the transition since little transparent pricing and understanding of pricing processes was available. As the regulatory process has taken much longer to become clear, participants are inclined to wait and watch. Infrastructure investors are by nature a conservative bunch, and this view has tended to dominate the notion of a "first-mover advantage" that might be gained by early action.

6. Future implementation of several important market activities is not fully clear. The manner in which these activities are implemented could have substantive implications for future market success.

So, on an interim basis, how can we think about the power sector restructuring? Is it successful? Is it happening in slow motion? Is it a failure compared to the early successes of the rondas?

One's conclusion depends, at least in part, on one's assumptions. Many argue, as a counter to the ronda perspective, that the power sector is simply different. Markets are more immediate—hourly instead of daily—which leads to more complexity. Longer lead times are generally involved in the power sector, perhaps three or more years in project development and construction. Longer-term contracts often are needed; likewise, 12- to 15-year periods are often needed for completing the capital recovery phase, rather than the one to seven years more typical in the hydrocarbon sector (except for deepwater projects). Capital expenditures can also be longer than on-shore field requirements (again, ignoring deepwater projects). Technical complexity of power projects can be either higher or lower than upstream development. These differences are in no way comprehensive, but they illustrate some of the considerations need to be taken into account in any comparison.

Perhaps a better metric to judge interim success or failure is to compare the Mexican experience in power sector restructuring to that of other North American countries. Using this standard, Mexico is attempting to do in five years for power what has taken more than 15 years in other jurisdictions and markets. By this standard, Mexico is well on its way to a successful transition. When one considers the magnitude of the restructuring across many energy sectors, especially in thinking through interdependence with the natural gas sector and its system changes, the progress is even more notable. Whereas other markets had the luxury of undertaking gas sector restructuring prior to power sector restructuring, the Mexican case relies on reforming both simultaneously. Thus, mechanisms such as the long-term auction processes are understandable steps that ensure reliability through utility-like solicitation and auction process—structurally similar to but materially different from the process used in Brazil and Colombia—while enabling international capital participation as the role of retail choice and greater participation evolves.

In short, things can always be improved. An entire management subdiscipline focuses on continuous improvement. However, the Mexican government deserves substantial recognition for implementing a credible and strong process. The next five years likely will not be an easy and straight path, but they certainly hold a strong chance for additional successes.

Mexico's Renewable Energy Future

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Introduction

As the second-largest economy in Latin America with more than 40 million electricity customers, growing demand for power, and significant potential untapped renewable energy resources, Mexico is well positioned to expand its power generation from renewables. The energy reform has created many incentives to facilitate investment in renewables. However, a number of challenges remain.

Mexico has already developed substantial renewable energy capacity. Some 23 percent of its 73 gigawatts (GW) of installed capacity is renewable energy, including hydropower, wind, geothermal, biomass, and solar. This figure is close to the global average for renewable energy capacity of 24 percent, but well below the Latin American average of almost 50 percent.[316] In 2015, Mexico was among the top 10 destinations in the world for new clean energy investment, bringing in $4 billion.[317] Mexico is among the top three countries in Latin America for both wind and solar potential. As a volcanic region, it also has significant geothermal potential.

Potential renewable energy sources could be expanded to meet both existing and incremental demand for electricity. In line with the growth of Mexico's gross domestic product (GDP), its power demand is growing at about 3 percent per year—mainly from residential and industrial consumers—and the International Renewable Energy Agency (IRENA) estimates that generation capacity could almost double by 2030.[318] Heavy government subsidies, which keep tariffs below the cost of production for many households, have artificially boosted residential demand as well.

Electricity demand is poised to grow in both rural and urban areas. Mexico is a highly urbanized country; 80 percent of its citizens live in cities. Urban consumers use about 470 kilowatt-hours (kWh) of electricity, double that of their rural counterparts.[319] Yet even though Mexico's electrification rate is over 98 percent, almost three million Mexicans—about 675,000 households, mostly in rural areas—still lack access to electricity.[320] Off-grid renewable energy sources often are the most efficient and cost-effective way to bring power to this section of the population. In urban areas, Mexico's government is also looking to expand the use of electric vehicles, including cars, buses, and motorcycles. By increasing renewable energy generation and expanding transport fueled by clean power, Mexico could lower its oil demand and transport-related greenhouse gas (GHG) emissions.

316 U.S. Energy Information Administration (EIA), "International Energy Outlook 2017," EIA, September 14, 2017, www.eia.gov/outlooks/ieo/pdf/0484(2017).pdf.

317 Climatescope, "Mexico — Climatescope 2017," Climatescope, November 28, 2017, http://global-climatescope.org/en/country/mexico/#/enabling-framework.

318 Dolf Gielen, Deger Saygin, Nicholas Wagner, Laura Isabel Gutiérrez, and Eduardo René Narváez Torres, *Renewable Energy Prospects: Mexico*, REmap 2030 Analysis (Abu Dhabi: International Renewable Energy Association [IRENA], 2015), www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA_REmap_Mexico_report_2015.pdf.

319 Ibid.

320 Ibid.

In this context of growing electricity demand, Mexico's power market has witnessed a major transformation under the energy reform, which was approved by the congress and signed into law by President Enrique Peña Nieto in December 2013 and fully implemented in 2018. The reform broke the monopoly of the vertically integrated state utility, the CFE (Federal Electricity Commission; Comisión Federal de Electricidad), and fully opened the generation market to private companies. The reform also created an independent system operator, CENACE (National Center for Energy Control; Centro Nacional de Control de Energía), and allowed private players to acquire transmission rights. In 2015, the government published clean energy power auction rules as part of the reform, and the wholesale electricity market started operations in 2016.

The energy reform legislation also reiterated Mexico's aggressive target to generate 35 percent of its power from clean sources by 2024 and imposed interim targets to reach that goal. Although Mexican legislation defines "clean energy" to include renewable sources such as wind, solar, geothermal, biomass, and hydro, it also includes cleaner energy sources not generally defined as renewables, such as nuclear and efficient cogeneration. To reach the target, the reform also includes the creation of Clean Energy Certificates (Certificados de Energía Limpia; CELs) setting a minimum level of electricity consumption from clean energy sources for all large consumers in Mexico, including the CFE, and allowing market participants to buy and sell these certificates in a cap-and-trade scheme.

Although this framework provides important incentives to promote clean energy, renewable energy developers still face challenges. Mexico's power grid is in poor condition owing to years of underinvestment by the CFE, and power lines throughout the country need to be upgraded and expanded. This is a particular challenge for renewable energy developers because most of the country's wind and solar resources are in remote areas far from population centers. In addition, although costs for wind and solar have declined precipitously in recent years—over the past decade, global prices for solar panels have dropped by 80 percent, thanks largely to a booming industry in China—renewables in Mexico continue to face steep competition from cheap natural gas imports from the United States. Finally, local communities have opposed developers' plans to construct renewable energy generation and transmission projects, much as other energy, transport, and extractive industries projects all over the world have faced similar local opposition.

To overcome these hurdles, Mexican policymakers should focus on three key areas. First, they should improve grid management by increasing the capacity and efficiency of the transmission and distribution system, improving demand-side management, and incentivizing distributed energy. Second, they should make renewable energy more competitive by expanding fiscal incentives for certain technologies and building up the local industry. Third, they should garner local community support for renewable energy infrastructure by improving the process for land consultation and disputes and developing community energy systems.

Regulatory Framework

The energy reform introduced two key laws—the Electricity Industry Law and the Energy Transition Law—which are encouraging investment, particularly from private companies, in the power sector, while also advancing clean energy targets. These laws are part of a broader policy framework in Mexico for promoting clean energy and climate change goals. These goals preceded the reform, and this framework continues to complement its objectives.

A framework for clean energy in Mexico

Even before the energy reform was approved and implemented, Mexico had established laws and regulations that set the stage for increased generation from renewable energy sources. In 2008, the Law for the Use of Renewable Energies and Financing the Energy Transition was published in an effort to encourage the use of renewable energy and clean technologies for electricity generation and develop mechanisms to finance the energy transition. In 2012, Mexico approved one of the first pieces of comprehensive climate change legislation to guide national policy, which included a General Law on Climate Change, a Special Program on Climate Change, and a National Strategy on Climate Change.

In 2015, in the lead-up to the 21st United Nations Conference of Parties (COP21), where almost 200 countries signed on to the Paris Climate Accord, Mexico became the first developing country to submit its intended nationally determined contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC). In its INDC, which outlined the country's plans for climate action over the following five years, Mexico set an unconditional target to reduce GHG emissions by 22 percent below the baseline by 2030. The country also established a more ambitious target to reduce GHG emissions by up to 36 percent below the baseline by 2030, conditional upon a global agreement that includes an international carbon price, technical cooperation, technology transfer, and access to low-cost finance. Mexico was also one of the first countries to join the "high ambition" coalition pushing for a global goal to limit global warming to 1.5 degrees Celsius, below the 2-degree Celsius target that climate scientists widely agree is necessary to avoid dangerous climate change.

Since COP21, the Mexican government has taken steps to implement its clean energy targets for the power sector. In July 2016, Mexico, along with the United States and Canada, made a series of commitments on climate change, including pledges to achieve 50 percent clean power generation across North America by 2025 and to present "mid-century, long-term low GHG emission development strategies" to the UN climate change secretariat by the end of 2016.[321] More recently, Mexico also joined 23 other countries in the Powering Past Coal Alliance, whose members have vowed to phase out existing coal plants and freeze any new coal plant constructions that do not use carbon capture and storage technology.

Mexico has long offered fiscal and regulatory incentives to promote renewable energy not specifically designed as part of the energy reform. Although the government has eschewed heavy reliance on renewable energy subsidies, in part to encourage the most competitive renewable sources, it does provide fiscal incentives in the form of accelerated depreciation of investments in renewable energy equipment. Under the tax code, companies investing in renewable energy generation equipment can deduct up to 100 percent of their total investment during the first taxable year.[322] The tax incentive applies to all renewable energy sources, including wind, solar, hydro, ocean energy, geothermal, and biomass and waste.[323]

321 Juan-Carlos Altamirano, Katherine Ross, Taryn Fransen, Julia Martínez, Erika Ortiz Sánchez, Jeffrey Rissman, and Carlos Brown Solá, *Achieving Mexico's Climate Goals: An Eight-Point Action Plan* (Washington, DC: World Resources Institute, November 2016), www.wri.org/publication/achieving-mexicos-goals.

322 David Barrie, "Mexican Energy Reforms: Mexico's Path to a Clean Economy," Renewable Energy Focus. February 18, 2016, www.renewableenergyfocus.com/view/43775/mexican-energy-reforms-mexico-s-path-to-a-clean-economy/.

323 Cámara de Diputados del H. Congreso de la Unión, "Ley del Impuesto Sobre la Renta" [Income Tax Law], Secretaría de Servicios Parlamentarios/ Diputados, November 11, 2016, www.diputados.gob.mx/LeyesBiblio/pdf/LISR_301116.pdf.

Distributed generation projects also have received government encouragement. Although projects larger than 500 kW require permits from the CRE (Energy Regulatory Commission; Comisión Reguladora de Energía), smaller projects require only an interconnection contract with CFE. Through Mexico's net metering scheme, consumers with self-generation (such as solar photovoltaic [PV] rooftops) can discount the energy they generate in a billing period or sell all their electricity back to the grid.[324] Between 2014 and 2016, Mexico had more than 12,600 contracts for residential distributed generation with installed capacity of some 49,000 kW, according to CRE.[325]

Energy reform: The electricity industry and energy transition laws

The energy reform created a series of laws and regulations that introduced private sector participation in the power sector in an effort to reduce generation costs, encourage investment in transmission and distribution, and accelerate the transition to clean energy. The Electricity Industry Law, established in 2014, was the key piece of legislation that set up a new regulatory framework, opening power generation to competition and creating a wholesale electricity market with private sector participation. The reform allows all participants in the newly created power market to compete under equal conditions to sell generation supply contracts in a competitive bidding process and gives open access to the grid. The sole exception to this new open market is nuclear power generation, which remains controlled by CFE. Large-scale "qualified" users can enter the wholesale electricity market by participating in power auctions or purchasing energy directly from CFE or other suppliers at negotiated rates. At the same time, "basic" users, such as individual households, can purchase power from CFE at regulated tariffs established by CRE. The state remains responsible for planning and controlling the national power system under the newly created CENACE, which functions as a decentralized public entity with its own personnel and assets. As the independent system operator, CENACE manages the wholesale market, guarantees open access for new generators, and handles national grid planning.

Prior to the reform, private power generation was allowed only under limited schemes, such as self-generation and small independent power producers generating under 30 megawatts (MW). A lack of market competition for power generation contracts led to inefficient practices, such as the continued operation of obsolete plants. At the same time, the CFE's weak finances limited its ability to build new renewable energy generation capacity. Subsidies to residential and agricultural consumers set by the SHCP (Secretariat of Finance and Public Credit; Secretaría de Hacienda y Crédito Público) created liabilities for CFE that greatly exceeded its earnings. This widening gap—covered by Mexican taxpayers—caused the company's equity to plummet by nearly 50 percent between 2007 and 2012.[326] Opening power generation to all private entities under the reform has created opportunities to attract additional investment to deploy renewable energy sources.

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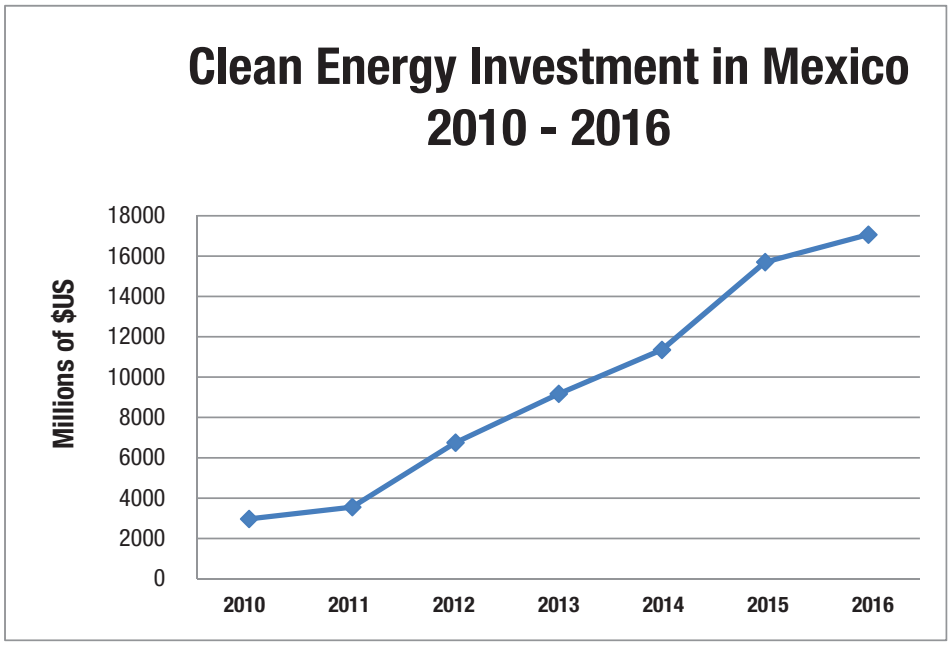
324 Jonathan Pinzon, Lilia de Diego, Rafael Carmona, and Luis Aguirre-Torres, *Renewable Energy in Mexico's Northern Border Region,* Re-Energizing the Border: Renewable Energy, Green Jobs, and Border Infrastructure Project (Washington, DC: Mexico Institute, Wilson Center, April 2015), www.wilsoncenter.org/sites/default/files/Renewable%20Energy%20in%20Mexico%27s%20Northern%20Border%20Region.pdf.

325 Marcelino Madrigal, "Webinar: Mexico's Clean Energy Market Reform: Results So Far and Perspectives," Energy Webinar Series, Institute of the Americas, August 24, 2017, www.iamericas.org/en/events/past-events/2295-webinar-mexico-s-clean-energy-market-reform-results-so-far-and-perspectives.

326 Lisa Viscidi and Paul Shortell, "A Brighter Future for Mexico: The Promise and Challenge of Electricity Reform," The Inter-American Dialogue, June 12, 2014, http://archive.thedialogue.org/page.cfm?pageID=32&pubID=3623.

Figure 7.1. Clean Energy Investment in Mexico, 2010-2016



Source: Climatescope 2017, http://global-climatescope.org/en/country/mexico/#/financing-investments

The Electricity Industry Law also creates incentives to improve the transmission and distribution system. CFE maintained its transmission and distribution network but the government can now contract with private firms to extend, upgrade, finance, or operate its transmission projects and modernize distribution networks. The reform also allows private generators to independently construct and operate transmission lines connected to the national grid rather than relying entirely on CFE to link to the grid. This arrangement reduces barriers to constructing new generation projects, particularly for renewable energy sources in remote locations, by attracting new technology, financing, and expertise to expand and improve the transmission and distribution networks. To facilitate this process, CRE is developing more clear, simple, and transparent transmission rates.

In addition to the rules that open power generation, transmission, and distribution to competition, one of the most important mechanisms for promoting clean energy under the new regulatory framework is the CEL system. The Electricity Industry Law established a form of cap-and-trade system whereby qualified users and retail suppliers have clean energy quota obligations and can buy and sell CELs in the power auctions. Each 20-year CEL is equivalent to 1 megawatt-hour (MWh) of clean energy. This approach guarantees that a growing share of total demand in the power sector will be met with clean generation. Industries with consumption greater than 1 MW, including CFE, must generate at least 5 percent of their energy from renewables in 2018, with the targets increasing to 5.8 percent in 2019, 7.4 percent in 2020, 10.9 percent in 2021 and 13.9 percent in 2022. CRE is in charge of certifying the clean energy contribution, issuing certificates, and administering and monitoring the CEL scheme.

The cap–and-trade system will help Mexico to reach its goal of a 35 percent share of clean energy in power generation by 2024, which was set by another key piece of energy reform legislation, the Energy Transition Act of 2015. Although this goal mirrors the General Law of Climate Change, it also includes intermediate targets of 25 percent by 2018 and 30 percent by 2021. The power auctions and CELs are an important incentive to

promote renewable energy, but the definition of "clean energy" applied to CELs as well as the national targets includes not only renewable energy but also nuclear power and efficient cogeneration.

Given Mexico's significant potential to develop geothermal energy, the energy reform also specifically included a law on this resource. The Geothermal Energy Act regulates the survey, exploration, development, and exploitation of geothermal resources for power and heat generation. The law establishes a framework for private companies to develop these resources and facilitates the issuing of permits for site study, as well as concessions for geothermal resource exploration and development. It also differentiates geothermal water from conventional aquifers used for human consumption, allowing specialized regulation for these water sources. The Water Act was also revised to improve coordination between the energy ministry (Secretaría de Energía; SENER) and CONAGUA (National Water Commission; Comisión Nacional de Agua).

The results of Mexico's first three power auctions indicate that the new regulatory framework already has been successful in promoting renewable energy. The auctions, in which bidders can offer packages with three products—capacity, cumulative energy, and CELs—highlighted Mexico's position as one of the countries with the lowest prices for renewable energy generation in the world. Cost per MWh dropped by more than half, from $47.78 in the first auction in 2016 to $20.15 in the third auction in 2017. The auctions drew bids from major international renewable energy players such as Italian firm Enel Green Power and U.S. firm SunPower, as well as a number of local firms.

The first clean energy tender in early 2016 resulted in 18 contracts for 11 solar PV projects with 1,691 MW of capacity and 5 wind power projects with 394 MW of capacity, as well as five million CELs with an average price of $47.78 per MWh. The first auction was widely viewed as successful. It drew commitments for the equivalent of almost double the total solar and wind capacity that had been installed in Mexico over the previous 18 years. The projects are expected to attract more than $2 billion in investment over two years.

The second tender awarded capacity of 2,804 MW, of which 1,792 MW was solar PV and 1,012 MW was wind, as well as some nine million CELs. The auction also awarded backup power capacity contracts for solar, wind, geothermal, and combined-cycle gas turbine power. The average tender price was $33.47 per MWh. The CFE was the only offtaker in the first two auctions.

The third auction drew a record of 415 prequalified bidders, resulting in 16 offers to build 2.6 MW of capacity for 15 to 20 years. Participants traded over five million CELs. Around half of the pledged investment will go to building solar plants, with the remainder in wind and natural gas. The third auction was open to private buyers, but the CFE remained the largest offtaker, offering to buy 91 percent of energy and CELs in the auction. The third auction saw record low prices with an average price of $20.60 per MWh. A wind power project bid by Enel included one of the lowest electricity project prices in the world.

Table 7.1. 2016-2017 Auction Results Since Mexican Energy Reform

	Mar-16	Sep-16	Nov-17
Number of Pre-qualified Bidders	81	68	49
Winning Bids	18 awards to 11 companies	56 awards to 23 companies	16 awards to 11 companies
Average Price / MWh	$47.78	$33.47	$20.60
Clean Energy Certificates	5,380,911.00	9,275,534.00	5,762,647.00

Source: Comisión Reguladora de Energía, PV-Magazine, http://clusterenergetico.com/wpcontent/uploads/2018/01/Certificados-Energia-Limpia-CELs.pdf

On March 15, 2018, Mexico announced the terms for its fourth long-term power auction, with results to be announced on November 2. As in the last auction, private electricity buyers will be able to participate alongside the CFE. Although the energy ministry ran the first three auctions, the CRE will lead this tender.

Status of Renewable Energy in Mexico

Mexico is rich in renewable energy resources with significant untapped potential. Today, large-scale hydropower is by far the leading source of renewable energy capacity, with wind a distant second. Other renewable energy sources, such as solar, geothermal, and biomass, represent only a tiny share of Mexico's electricity matrix. Although the energy reforms have opened up some new opportunities to boost investment in renewable energy, there are unique challenges to developing each of these clean energy technologies.

Hydropower

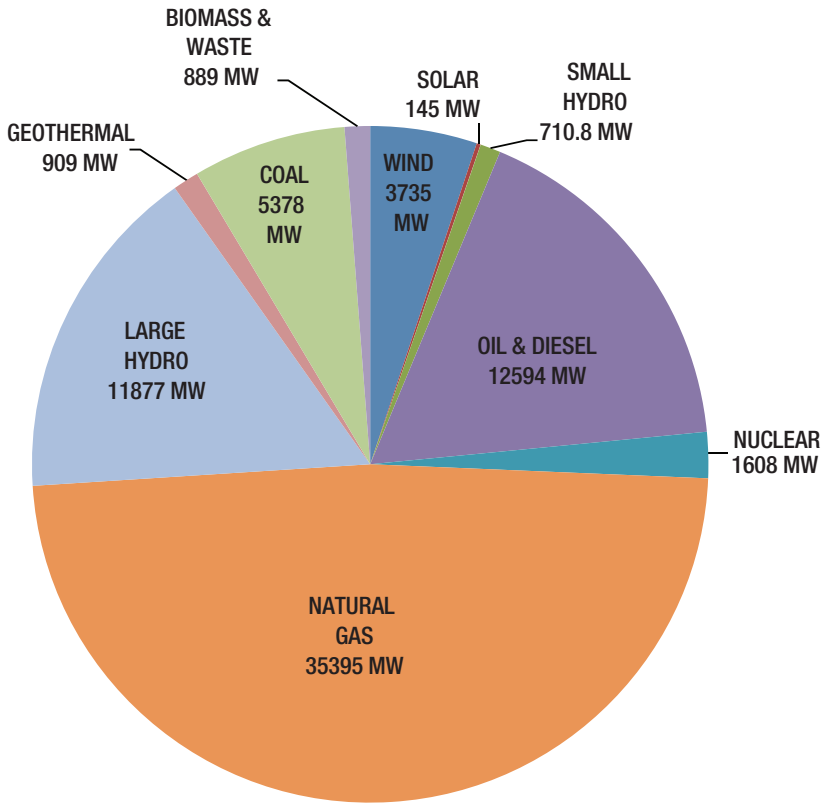
Large-scale hydroelectric dams are the largest source of renewable energy in Mexico, about 17 percent of installed capacity in 2016. Mexico has the capacity to roughly double its hydropower generation to 27 gigawatt-hours (GWh), taking into account both technical and economic viability.[327] Small hydropower currently represents only 1 percent of installed capacity. However, Mexico has significant potential to expand small, off-grid hydropower projects to bring electricity to isolated communities, especially from the rivers of the Pacific Rim and in the states of Veracruz, Oaxaca, and Chiapas. Hydroelectricity in Mexico is expected to continue to grow, as a number of both large hydroelectric dams and small and micro hydro projects are planned or already under construction.

However, hydropower expansion in Mexico faces several challenges. The social and environmental costs of building new dams, including deforestation and the need to relocate entire communities, have sparked some local and regional opposition. Moreover, changing rainfall patterns and increase droughts caused by climate

327 "World Atlas Industry Guide," International Journal of Hydropower and Dams, 2014, www.hydropower-dams.com/world-atlas-industry-guide. php?c_id=159.

change could make hydroelectric power more unreliable. "Run-of-the-river" hydropower projects (which do not require large dams) and small hydropower projects can avoid these social and environmental challenges, but are more expensive ways of producing electricity. Mexico also faces challenges to developing small hydropower, such as higher costs, the lack of reliable assessments of generation potential and basic meteorological and hydrometric information, and administrative barriers to acquiring new project permits.[328] Mexico has a gross estimate of 3.2 GW in small hydropower potential, but much of the economically viable potential already has been developed or is in the pipeline.[329]

Figure 7.2. Installed Power Capacity by Energy Source in MW, 2016



Source: Climatescope 2017, http://global-climatescope.org/en/country/mexico/#/enabling-framework

Wind

Wind power has been growing rapidly in Mexico in recent years and is currently the second-largest source of renewable energy generation, representing 5 percent of installed capacity in 2016. Mexico was one of only 25 countries worldwide with more than 1,000 MW of installed wind power in 2015, with more than 37 wind farms in states such as Oaxaca, Baja California, Chiapas, Jalisco, Tamaulipas, San Luis Potosí, and Nuevo

328 Gielen et al., *Renewable Energy Prospects: Mexico*.

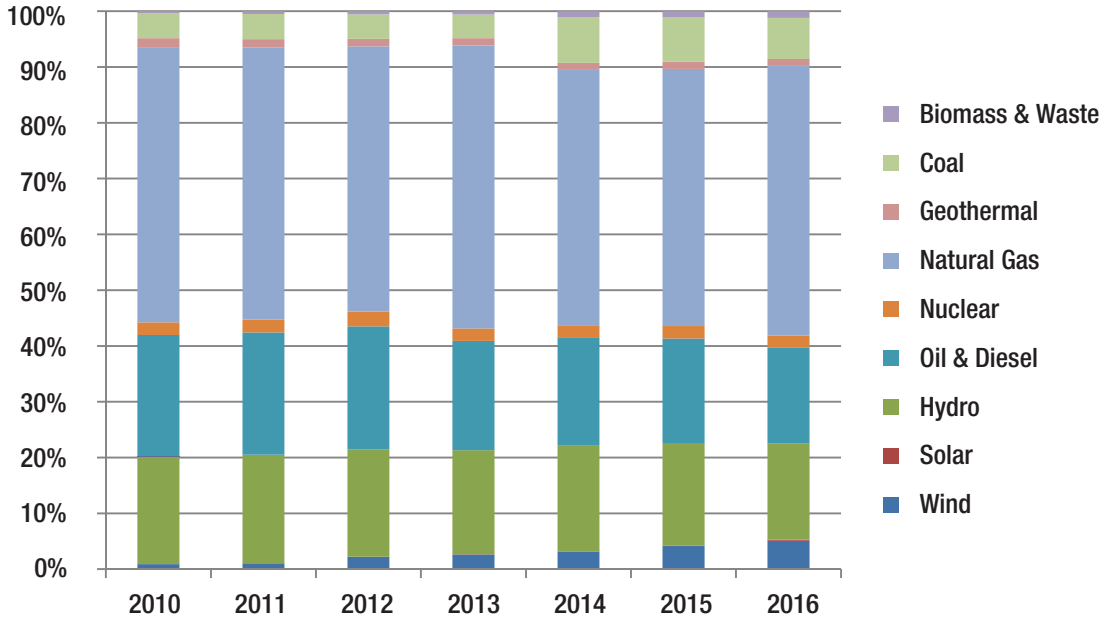
329 Ibid.

León.[330] The country has an estimated 30 GW of wind potential,[331] and its three top regions for onshore wind potential are the Isthmus of Tehuantepec (southern Mexico) and the states of Tamaulipas (eastern Mexico) and Baja California (northwestern Mexico).

A large share of Mexico's wind generation is under self-supply schemes, as the economics are favorable for some large energy-intensive companies. Latin America's largest wind farm, the Eurus Wind Farm, located in the municipality of Zaragoza, Oaxaca, is a self-supply project for the Mexican cement giant CEMEX. Operated by ACCIONA, a U.S. firm, the project is made up of 17 wind turbines. Its 250.5 MW capacity can cover a quarter of the total energy demand from CEMEX's cement plants.

Despite these promising developments, much of the high-quality wind potential remains untapped, owing mainly to the lack of transmission capacity. In addition, Mexico does not have a complete domestic wind supply chain, so the industry will continue to rely on imports.[332]

Figure 7.3. Installed Power Capacity Percentages by Energy Source, 2010-2016



Source: Climatescope 2017, http://global-climatescope.org/en/country/mexico/#/enabling-framework.

330 IEA Wind Technology Collaboration Programme, *IEA Wind TCP 2015 Annual Report* (Paris: International Energy Agency [IEA], 2017), https://community.ieawind.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=2cc82d2d-aa3f-4c9c-ca74-fa4670a9b9f8&forceDialog=0.

331 IEA, *Energy Policies Beyond IEA Countries: Mexico 2017* (Paris: IEA, 2017), www.iea.org/publications/freepublications/publication/EnergyPoliciesBeyondIEACountriesMexico2017.pdf

332 Cora Dickson, "2016 Top Markets Report: Renewable Energy," International Trade Administration, Department of Commerce, April 2016, www.trade.gov/topmarkets/pdf/Renewable_Energy_Top_Markets_Report.pdf.

Solar

Although solar power currently represents only about 0.1 percent of Mexico's total installed capacity, the country's geographic location is ideal for exploiting solar resources. Estimates of Mexico's average solar irradiation range from about 5 to 6 kWh/m2 per day, compared to an average annual solar radiation of only 2.7 KWh/m2 per day in Leipzig, Germany, home to the world's largest solar plants.[333]

Although solar resources in Mexico have scarcely been exploited on a large-scale commercial level so far, the energy reforms have already brought in millions of dollars in promised investments to expand solar energy. Solar PV was the leading technology in all three of Mexico's clean energy auctions held to date. In 2017, Mexico saw a record $6.2 billion in solar energy investment, almost half of the total investment in the previous five years combined, according to Bloomberg New Energy Finance.[334]

In addition to large solar generation projects, Mexico has witnessed significant growth in small-scale self-supply or decentralized solar energy systems, also known as distributed energy. In the early 1990s, more than 40,000 solar PV systems were installed to bring electricity to rural areas not connected to the national grid. More recently, solar PV installations have spread to urban rooftops. In 2007, the government introduced regulations allowing net metering so that residential and commercial buildings with solar rooftops could sell excess power back to the grid. By the end of 2012, some 1600 consumers were participating in this scheme, administered by the CFE.[335] Between 2015 and 2016 alone, installation of residential solar PV systems more than doubled from 118 MW to 244 MW, the largest amount of distributed generation in Latin America.[336]

Geothermal

Geothermal energy, which currently accounts for about 1 percent of installed capacity, is another renewable energy technology with significant growth potential. Mexico already has the fifth-largest installed geothermal power capacity after the United States, the Philippines, Indonesia, and New Zealand, and another 13.4 GW of potential.[337] The government has put significant funding into developing new technologies through its Geothermal Innovation Center. As a volcanic region, Mexico has significant potential for geothermal, a firm energy source that can complement intermittent sources such as wind and solar. The resource potential is spread throughout the country, but concentrated in the volcanic central, eastern, and southern regions.

The Geothermal Energy Law created new opportunities for deploying this resource by establishing a framework for private companies to explore and develop geothermal resources and drawing a distinction between geothermal and drinking water supplies. In 2015, SENER held a "round zero" for geothermal to determine which prospective sites and projects would be developed by the CFE and which would be auctioned to investors

333 Luis Gerardo Sánchez Stone, "Mexico: El Momento Trascendental de la Historia Solar", Ergo Solar.

334 "Un aumento de 53GW en capacidad solar en China impulsó la inversión global en energía limpia" [A 53 GW increase in solar capacity in China boosted global investment in clean energy], Bloomberg New Energy Finance, January 16, 2018, www.bloomberg.com/latam/blog/un-aumento-de-53gw-en-capacidad-solar-en-china-impulso-la-inversion-global-en-energia-limpia/.

335 Gielen et al., *Renewable Energy Prospects: Mexico.*

336 Climatescope, "Mexico — Climatescope 2017."

337 "Leading Countries by Installed Geothermal Capacity in 2016 (in Gigawatts)," Statistia: The Statistics Portal, 2017, www.statista.com/statistics/270251/installed-geothermal-energy-capacity-by-country/

in future bid rounds. Since the reforms, SENER has granted 21 exploration permits in seven states, and under the new scheme the private sector is expected to cover about 40.7 percent of electricity demand from geothermal resources by 2030, with the CFE covering 21 percent of demand, small producers 3.4 percent, and self-generation 8.4 percent.[338]

This developing potential notwithstanding, it is unclear how quickly geothermal energy use will grow in Mexico. Although new projects are planned, and the recent power auctions have awarded some new geothermal capacity, several units are also scheduled to be decommissioned, meaning that a larger number of new projects will have to be built just to reach a net increase in capacity. The high exploration costs, especially costs associated with drilling wells to assess the technical and economic potential of estimated resources, pose the greatest barrier.

Biomass

Biomass also represents about 1 percent of installed capacity in Mexico. The lion's share of biomass used for power generation is sugar cane bagasse used for self-supply in the sugar industry, followed by biogas power produced from agriculture, industry, and urban residues. Sugarcane bagasse accounted for almost 90 percent of all biomass power generation in 2013.[339] There are many incentives to produce electricity from biomass in Mexico. The sugarcane industry can sell excess electricity from biomass to the grid. In addition, many biomass projects with agro-industrial applications have obtained certified emissions reduction credits through the United Nations Clean Development Mechanism. The Bioenergy Law outlines regulations for activities related to biomass. Thanks to these incentives, SENER projects that Mexico will add 60 MW of installed biomass capacity between 2016 and 2030. However, to maximize Mexico's biomass potential, a biomass market would have to be created to connect supply and demand.

Challenges

Although the energy reform has created the framework for attracting investment to expand renewable energy generation, Mexico still faces numerous concerns, including challenges to managing and expanding the grid, price competition from fossil fuels, and local community opposition to potential new energy project sites.

Managing and expanding the transmission and distribution system

To fully exploit Mexico's renewable energy potential, the country needs to vastly expand its transmission capacity. Wind and solar PV potential are concentrated mainly in the northern and western parts of Mexico, distant from most population centers and industrial activity in the central and southern regions of the country. This distance between supply and demand is not insurmountable, but it means that careful planning will be needed to build out the necessary transmission infrastructure and design solutions to better integrate renewables with the grid.

Transmission capacity expansion and long-term planning for grid development are particularly important to integrate intermittent renewable energy sources—which are more abundant at certain times of the day or year—

338 SENER, *Prospectivas de Energías Renovables (2016–2030)* [Renewable energy prospects (2016–2030)], (Mexico City: Secretaría de Energía, 2016), 54–55, www.gob.mx/cms/uploads/attachment/file/177622/Prospectiva_de_Energ_as_Renovables_2016-2030.pdf.

339 Gielen et al., *Renewable Energy Prospects: Mexico.*

into the national grid. This irregularity poses a challenge for the new independent system operator CENACE. On a day–to-day basis, regulatory authorities must ensure that the system has enough available firm generation capacity to cover peak demand, while employing demand-side management to ensure grid reliability and lower costs. In long-term planning, regulators have to make complex forecasts for intermittent wind and solar generation. The Mexican government also needs to continue developing clear and adequate market operation rules and codes for grid connection and access to help encourage renewable power capacity development.

At the same time, Mexico also must account for high technical and nontechnical losses in the transmission and distribution network, a problem common to emerging markets. Technical losses are those associated with the transportation process or faults in the electricity distribution network; nontechnical losses are those resulting from illegal access, poor metering, and incorrect billing. Nearly half of Mexico's transmission lines are more than 20 years old. Technical and nontechnical losses have declined from a significant 30 percent in 2008 but are still high today at 14 percent.[340] Electricity losses in high-income Organization for Economic Cooperation and Development countries, by contrast, average between 6 and 8 percent of total electricity output.[341] The CFE has set a target to reduce losses to10 percent by 2018.

The government plans to expand transmission lines throughout the country. The CFE plans to invest some $15 billion in transmission and $18 billion in distribution by 2029.[342] In 2017, it launched a tender to build a 1,500-kilometer transmission line connecting Baja California to the national grid. This will be the first line built by a private company since the energy reform was enacted, meaning that it is a critical test of the reform and could encourage further investment if successful. It also opens up the possibility for California to import renewable energy from more distant parts of Mexico as the United States' largest economy looks to achieve its own clean energy goals. The government has also proposed a 1,260-kilometer line that will run from wind power–rich Oaxaca to more populous central Mexico.

High costs

Competition from cheaper fossil fuels–based power, particularly natural gas, poses another challenge to the deployment of renewable energy in Mexico. Imports of natural gas from the United States have contributed significantly to Mexico's declining electricity costs. Owing to soaring output from the shale boom, the U.S. natural gas benchmark Henry Hub has dropped from a peak of $8.85 per million British thermal units (Btu) in 2008 to just below $3.00 per million Btu in 2017. Between 2014 and 2015, Mexican electricity tariffs decreased by around 25 percent from $0.14/kWh in 2014 to $0.10/kWh in 2015.[343] Mexico's gas consumption has doubled from 4 billion cubic feet per day (Bcf/d) in 2000 to 8 Bcf/d at present, with new natural gas–fired

340 World Economic Forum, *Taking Mexico to Full Potential* (Geneva: World Economic Forum, February 2016), http://www3.weforum.org/docs/WEF_Future_Electricity_Mexico_case_.pdf.

341 Raul Jiménez, Tomás Serebrisky, and Jorge Mercado, *Power Lost: Sizing Electricity Losses in Transmission and Distribution Systems in Latin America and the Caribbean* (Washington, DC: Inter-American Development Bank, 2014), https://publications.iadb.org/bitstream/handle/11319/6689/Power-electricity-loss.pdf.

342 World Economic Forum, *Taking Mexico to Full Potential.*

343 Climatescope, "Mexico — Climatescope 2017."

power generation accounting for half of this growth.[344] More demand from power generation is expected over the coming years, as the CFE continues to convert fuel oil–fired power plants to cleaner and cheaper natural gas, which produces almost 50 percent less carbon dioxide than oil.[345] In addition, the energy reform has encouraged investment in new natural gas pipeline infrastructure, both within Mexico and across the border to the United States. This year, a CFE-led plan to build 22 new pipelines covering 10,000 kilometers is expected to wrap up, tripling the capacity of Mexico's pipeline network. Through October 2017, gas imports from the United States averaged 4.6 Bcf/d, up from an average of 0.9 Bcf/d in 2010, of which 91 percent came via pipeline.[346]

Although low-priced natural gas has helped to cut electricity rates for industrial users—which, unlike residential users, do not receive heavily subsidized rates—these low prices also could be a disincentive to renewable energy production. Many renewable energy projects are not cost-competitive when compared to conventional generation technologies. Under current regulations, CENACE is required to dispatch the most cost-efficient energy, a system that has tended to favor conventional energy technologies like natural gas and coal over renewables. The new CEL scheme should in principle provide an economic signal to build more renewable energy capacity, replacing fossil fuel generation by placing a price on carbon. However, some critics believe that the scheme is not aggressive enough to move Mexico toward zero carbon energy. First, the CEL scheme places no ceiling or floor on carbon prices, so prices may be too low to act as incentives for renewable energy investment. Second, Mexico's clean energy targets and CEL-eligible projects include efficient natural gas, so there is currently no official goal to move Mexico toward zero carbon energy.

New efficient natural gas power plants will reduce emissions in the short term as oil- and coal-fired generation are transitioned to gas, but this infrastructure, which will remain in operation for decades, ultimately will increase emissions compared to building zero carbon energy infrastructure. This situation appears to reflect insufficient coordination and integration between energy and climate change planning. Natural gas, coal, and nuclear power plants all have long plant life expectancy—about 50 years—so plants that have been built since the 1980s probably will not be retired before 2030. In 2011, the average age of Mexico's coal and natural gas plants was only 17 and 13 years, respectively. The government does not have plans to retire older coal, oil, or natural gas–based infrastructure before the end of its life expectancy.

Of further concern, the prices offered in recent auctions are so low that they may not be economically feasible, and the developers will be unable to acquire financing to actually build the promised capacity. Some companies may even be hoping to renegotiate their contract later. The high number of prequalified bidders for the auction is also tied to the low requirements for prequalification. Mexico has seen some cases of projects that acquired permits for construction and generation but could not be deployed because they were not economically viable without any further subsidy or financial support. In recent auctions, some bidders have reportedly used low-quality data and failed to perform proper assessments before submitting bids—for example, by submitting a bid for a project to be built in a protected national park. If developers face unforeseen environmental or social

344 "LNG Monthly," Office of Oil and Natural Gas, U.S. Department of Energy, 2018, www.energy.gov/sites/prod/files/2018/03/f49/LNG%20Monthly%202018_2.pdf.

345 Alejandro Chanona Robles, *Tracking the Progress of Mexico's Power Sector Reform* (Washington, DC: Mexico Institute, Wilson Center, 2016), www.wilsoncenter.org/sites/default/files/tracking_progress_of_mexicos_power_sector_reform.pdf.

346 "LNG Monthly."

challenges that increase the costs of the project and alter the financial structure of the deal, they may be unable to move forward with construction.

High costs and lack of availability of local renewable energy equipment and services also could make these energy sources less competitive in Mexico. Until now, developers have had little difficulty acquiring renewable energy technology and components, most of which are imported, because the market is small. But if the industry grows rapidly, then the supply chain will likely develop bottlenecks. Massive investments would be required for Mexico to build its own complete equipment supply industry for large-scale renewable energy generation plants. Significantly increasing the use of solar panels for distributed generation in Mexico would pose another set of challenges, as homeowners and retail businesses would need access to a large domestic supply not only of equipment but also of system design and installation expertise.

Local opposition

As in the rest of Latin America and many other countries, project developers in Mexico face major challenges in acquiring land rights and the consent of local communities to build power plants and transmission lines. The Electricity Industry Law requires the energy ministry to hold a formal consultation process with residents, including indigenous groups, before launching a project. Mexico has also required free and informed prior consultation under International Labour Organization rule 169 in its constitution since 2011, but specific procedures are lacking and implementation has been spotty.[347] Mexico also requires energy companies to pay local communities for the use of their lands, and dictates that the amount of those payments be determined through direct negotiations between the companies and residents. The law also calls for a social-impact evaluation as a precondition for approval of any new energy project.

The complex structure of land ownership in Mexico further complicates the consultation and land rights acquisition process for renewable energy projects. Roughly half of Mexico's land is privately owned, and the remaining half is collectively owned under the country's social property model in *ejidos* or other community land tenure structures. To build a renewable energy project on collectively owned lands, developers must consult not with individual property owners but with dozens or even hundreds of people who own the land—a more lengthy and expensive process that requires companies to hire local experts. In Oaxaca, where most of the country's wind farms are concentrated, more than 75 percent of the territory ownership is under the social property model.[348] Some developers have been unable to obtain land rights at all and have engaged in multiyear court battles over land rights. These legal complications also make it more difficult to attain financing.

Consulting and negotiating with indigenous communities, which make up about 13 percent of Mexico's population, present unique challenges for developers of renewable energy and other infrastructure. Many indigenous communities have particularly strong cultural connections to their land and surrounding environment and may be even more reluctant than other groups or individuals to allow large infrastructure projects to be constructed in their territory. Indigenous communities in southern Mexico have protested the construction of wind farms after information and consent on contracts, land lease agreements, and

347 Lisa Viscidi and Jason Fargo, "Local Conflicts and Natural Resources: A Balancing Act for Latin American Countries," The Inter-American Dialogue, May 2015, www.thedialogue.org/wp-content/uploads/2015/05/Local-Conflicts-and-Natural-Resources-FINAL.pdf.

348 Pinzon et al., *Renewable Energy in Mexico's Northern Border Region.*

compensation were withheld. The complex negotiations with the indigenous Zapotecas in Mexico over wind farm projects in the state of Oaxaca demonstrate the pitfalls of a poorly conducted consultation process. In 2015, over 1,000 residents of Juchitán de Zaragoza, a mainly Zapotec city in Oaxaca, blocked plans to build one of Latin America's largest wind farms near the city. Community members were granted an injunction to stop Energía Eólica del Sur, an international consortium, from building a 400-MW wind farm near their homes.[349] Some residents reportedly feared that the wind farm would harm cattle, migratory birds, and bats, and did not want turbines near the city. According to the community's lawsuit, the government failed to follow the legal process for consultation by giving permits to Eólica del Sur during, rather than after, the consultation process. In January 2018, Mexico's Supreme Court ruled that the wind farm project would have to be halted because local communities had not been appropriately consulted.[350]

The government's capacity to oversee consultations and mediate conflicts remains a question. As part of the energy reform process, SENER set up a new division that would focus on community relations, but this division's current staff and resources are not adequate to fully evaluate social impact assessments and analyze and mitigate all potential conflicts, creating a bottleneck for project developers.

Policy Recommendations

Under the current policy framework, the Mexican government has many opportunities to expand renewable energy for power generation. Policymakers should focus on three key areas:

1. Improving grid management by increasing the capacity and efficiency of the transmission and distribution system, improving demand-side management and incentivizing distributed energy.
2. Making renewable energy more cost-competitive by expanding fiscal incentives for certain clean technologies and building the local industry.
3. Garnering local community support for renewable energy infrastructure by improving the process for land consultation and disputes and developing community energy systems.

Improving transmission and distribution system management

Mexico needs to increase the capacity and efficiency of the transmission and distribution system to integrate more intermittent renewable energy sources, such as wind and solar, into the grid. At the same time, the system operator CENACE needs to ensure that there is enough firm capacity for system reliability. Reliable fossil fuel sources such as natural gas likely will continue to be an important part of the electricity matrix, but renewable energy sources such as large hydropower and geothermal energy increasingly should be used to provide firm energy, particularly to replace oil- and coal-fired generation.

The energy reform created opportunities to bring in private sector investment to develop and upgrade transmission lines. The Mexican government should hold additional tenders to sell rights to build new strategic

349 Victoria Burnett, "Los parques eólicos generan prosperidad en Oaxaca, pero no para todos" [Wind farms generate prosperity in Oaxaca, but not for all], *New York Times,* August 1, 2016, www.nytimes.com/es/2016/08/01/los-parques-eolicos-generan-prosperidad-en-oaxaca-pero-no-para-todos/.

350 "Court Orders Halt to Juchitan Wind Farm", *Mexico News Daily,* January 11, 2018, https://mexiconewsdaily.com/news/court-orders-halt-to-juchitan-wind-farm/.

transmission lines and upgrade existing lines. The electricity regulator also should move ahead with publishing clear and transparent rates.

Mexico's government also could do more to enhance energy efficiency and demand-side management to reduce electricity demand, particularly during peak load times. Demand-side management programs should be developed in conjunction with the expansion of smart technologies, such as smart metering in residential and commercial buildings. Smart technologies can be used to send price signals to consumers to use electricity at times of the day when renewable energy sources are more abundant. Better customer management systems can reduce nontechnical losses. Under the current system, these programs would fall mainly under the purview of the CFE, as it directly supplies most customers.

If Mexico is to significantly increase its reliance on renewable energy for power generation, it will have to boost consumption not only from large-scale power projects awarded in auctions but also from small-scale distributed energy projects, which improve system reliability and reduce transmission costs. Although Mexico has allowed net metering since 2007, more progress needs to be made to introduce advanced metering infrastructure. In urban areas, smart meters should be ubiquitous in order to take advantage of opportunities to expand distributed generation on building rooftops. Incentives to build out electricity storage also would improve reliability and allow more renewables to integrate into the grid. The government should develop a specific plan for deploying smart grids and improving energy storage. Given Mexico's large geographic area, small scale off-grid renewable energy projects also will play a crucial role to ensure access to electricity in many isolated rural areas. This arrangement will help limit grid integration challenges and expand transmission capacity.

Increasing cost-competitiveness

Despite stiff competition from natural gas, wind and solar power projects were highly competitive in Mexico's three post-reform energy auctions. However, questions remain about the economic viability of the projects and the likelihood that they will obtain construction financing.

To avoid underbidding, the government should consistently demand financial guarantees and encourage bidders that have strong technical and financial reputations. To create more certainty for participants in the bidding process, the government should provide more information to bidders about renewable energy potential and social and environmental conditions in areas where renewable energy projects could be developed. The establishment in 2017 of the National Atlas of Zones with High Clean Energy Potential is a promising first step. The atlas is a georeferenced tool that can provide developers with access to data on wind, solar, geothermal, and biomass potential; transmission and distribution infrastructure; and any possible social or environmental challenges that could increase costs. By concentrating renewable energy projects in certain areas, fewer new power lines will be needed—a factor that also could help cut transmission costs.

To make other renewable energy sources such as geothermal and ocean energy competitive with coal and natural gas, the government likely will need to increase fiscal incentives to offset the high cost associated with these technologies. The Energy Transition Law allows SENER to propose additional tax or financial mechanisms to the finance ministry to promote energy-efficient technologies and clean distributed generation. Such incentives should remain in place for only a limited time, a transitional period that would allow companies to develop and scale up these technologies in Mexico.

The government also should start to incentivize local renewable energy industry development to improve local expertise and increase the national supply of renewable energy technology components, equipment, and services. Mexico could develop a clean energy technology cluster to bring together technology developers, entrepreneurs, and investors. For distributed generation, Mexico needs a stronger energy service company market to install and maintain solar panels. Local content requirements should grow gradually over time so that the first renewable energy developers can take advantage of lower-cost equipment from other countries like China.

Garnering local community support

Mexico clearly needs to improve the processes for consulting local communities and resolving land disputes over power plants and transmission lines. Experience from other Latin American countries suggests that the key to reducing conflicts is proactive and sustained government-led engagement from the start of any infrastructure project.[351] The Mexican government should develop a clear process involving various entities, including the energy ministry, energy regulators, and the CFE, to assess the social and environmental impacts of renewable energy projects and communicate this process clearly to all stakeholders. The government also will have to take a more active mediating role between companies and communities. The new SENER unit charged with managing community relations should receive more resources to mediate conflicts and draw on best practices from other countries such as Peru, Chile, and Colombia. For their part, developers should explain to communities how they can benefit from renewable energy projects, incorporate local businesses into their supply chain, and engage in dialogue early on rather than immediately trying to settle disputes in court.

Expanding "community-driven renewable energy projects," in which communities have ownership, participation, or shared interest in projects, also can reduce the risk of local opposition. Examples of such projects in Latin America range from distributed energy projects to rural energy cooperatives, but Mexico has no large-scale, grid-connected community-driven projects. Building more small projects where communities have an equity stake and direct access to the electricity services could help to reduce local conflicts, particularly in areas like Oaxaca where communities have been strongly opposed to renewable energy projects. The Renewable Energy Policy Network for the 21st Century has proposed setting aside a specific amount of community-based electricity capacity in future auctions; adopting a national target for community-driven renewable energy projects; and including criteria besides price in determining the winners, such as the ability to produce co-benefits like local content, jobs, and local value chains.[352]

Conclusion

Nearly six years after the energy reform was first signed into law, Mexico has a more stable and competitive framework for the electricity sector, which already has led to a huge increase in pledged investments for renewable energy generation. However, even though nonhydro renewable energy generation has grown exponentially in only a few years, the industry is still in an incipient phase. With presidential elections around the corner, Mexico may soon face significant changes in energy policy and economic policy more broadly.

351 Viscidi and Fargo, "Local Conflicts and Natural Resources."

352 Hugo Lucas, Anna Leidreiter, and Miquel Muñoz Cabré, *Renewable Energy Tenders and Community [Em]power[ment]: Latin America and the Caribbean* (Paris: REN 21: Renewable Energy Policy Network for the 21st Century, 2017), www.ren21.net/wp-content/uploads/2017/09/LAC-Report.pdf.

Although renewable energy has not been a focal point of debate in the election, as energy policy discussions have focused on the oil sector, renewable will continue to be an important issue for Mexico's economic growth and climate goals. In this context of change, it is essential that the next president maintain the positive momentum of the reform, build on the sector's successes, and work to improve policies and regulations that are still wanting. The energy reform has provided important economic signals to move Mexico toward a clean energy transition, but it is too early to tell whether renewable energy sources, especially nonhydro sources, are poised to eventually form a major share of Mexico's energy matrix. To make this potential a reality, Mexico's next government will have to maintain the key elements of the reform, keep moving ahead with the clean energy auctions, and mitigate or remove additional bottlenecks to investment.

An Uncertain Future: The Energy Sector under AMLO

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Despite the impressive transformation of Mexico's energy sector set forth in this volume, the future of the 2013 reform is far from secure. With the victory of Andrés Manuel López Obrador (AMLO) in the July 2018 elections in Mexico, there is now widespread anxiety and uncertainty regarding the energy sector. This is not a surprise: during his successful Presidential election campaign, AMLO was crystal clear in his statements about the reform. He emphasized his opposition to the reform and his intention to review the contracts that had already been issued to ensure that they were legal. By "legal," he meant that they had been awarded according to the rules of the bidding process and that corruption had not determined outcomes. He has also repeatedly emphasized that his government would not engage in expropriation or random cancellation of contracts.

AMLO has long been a fervent and deeply committed opponent of an opening of the hydrocarbons sector in Mexico. Many times in his career, he has spoken out passionately about the need to maintain state and public control of the country's oil wealth, maintaining a nationalistic vision that hearkens back to the nationalization by President Lázaro Cárdenas in 1938.

Now, he will have the opportunity as President to reverse the 2013 reforms if he so wishes. But AMLO has proved to be a man of his word, at least during the transition period. His team have indeed begun a review of the contracts, and he has reiterated his commitment not to expropriate private property. Most crucially, he and his team have promised to respect the law and, despite their obvious opposition to the reform, have only committed to changing the secondary or implementing laws of the reform.

However, there are a number of factors that continue to make energy investors nervous and that may impact on the future of the sector. It is important to recognize that the reform is far from popular among the Mexican population. Rising gasoline prices in recent years, combined with a continued fall in Mexican oil production and an ongoing crisis in the national oil company, Pemex, have driven a negative opinion of the reform and encouraged anti-reform rhetoric from opposition politicians.

In this, the final chapter of this volume, I argue that we are likely to see a stagnation of Mexico's energy sector over the next three years, with the new administration unlikely to approve new oil or electricity bidding rounds, instead opting for a strengthening of the national oil company and the national electricity utility.

AMLO and energy policy

Since his unsuccessful presidential campaign in 2006, AMLO has pushed for a Mexican energy sector that is tightly controlled by the state. Although his 2006 election platform opened the door to the possibility of private (but not foreign) investment in the oil industry, AMLO has since then presented a fervently anti-opening vision of the future.

In particular in 2013, when the Peña Nieto government first announced its plans to liberalize energy in Mexico, AMLO directed his fury and passion against the reforms, but was ultimately unable to attract much interest

from the Mexican public, even when he combined forces with his former allies in the PRD party. However, the short-term results of the reform have provided him with more ammunition in his ongoing battle against the new energy model. Rising gasoline prices due to the end of subsidies, the weakening of the peso versus the dollar and, more recently, rising crude oil prices, have led large sections of the Mexican public to conclude that the reforms have been a failure. The ongoing problems of Pemex, especially with regards to corruption, its financial balance, and its dramatically declining oil production, have helped compound the idea that the reform has not delivered on its promises, despite the fact that these problems existed prior to the reform. Lastly, the much-vaunted benefits of the reform, in terms of new oil production, new fiscal revenues, new jobs, and higher economic growth, have not materialized in the four years since the reform was passed. This was to be expected but the Peña Nieto administration made the fatal error of selling the reform to the Mexican public along these lines.

In his 2018 presidential campaign, AMLO laid out plans for the energy sector, which involved an unusual combination of old and new ideas. He committed to the transition from traditional to renewable energies, but his approach was heavily focused on distributed generation and granting access to electricity to marginalized communities, rather than large-scale projects. He subscribed to the idea that Mexico needs new hydroelectric plants, although there are limited options for constructing new capacity and projects would likely face considerable opposition from local communities. On the other hand, his "Project18" plan for the energy sector commits to keeping existing thermoelectric power stations (some of which are powered by burning fuel oil) in operation, despite rising fuel costs, aging equipment, and a heavy carbon footprint. This may be seen as way to avoid massive new investments, but it would almost certainly be a false economy, especially given the fact that oil prices have been steadily rising over the past couple of years.

It is in the area of the hydrocarbons industry that AMLO has put forward his most controversial ideas. He proposes restructuring the sector by investing heavily in refining capacity, the exploration and production of natural gas in Mexico, reviewing the contracts and bidding requirements for the oil blocs that were awarded to private and foreign investors since 2015, and significant new investment in, and dependence on, Pemex to develop the nation's declining oil reserves.

A complex road ahead

This vision of Mexico's energy future was clearly laid out during the campaign period. AMLO's party, MORENA, now controls both the national congress (with a two-thirds super-majority in the chamber of deputies and a near-super majority in the Senate) as well as a majority of the state-level legislatures (which is the other requirement for changing the constitution). AMLO himself has stated that he would not seek constitutional reform during the first half of this mandate, but the administration's plan does call for changes to the secondary legislation surrounding the 2013 reform. This will be a major test of the new government's intentions and will provide clues as to how far-reaching and drastic the changes will be. Thus far, it seems as though the focus will fall on strengthening Pemex, granting it more freedom from governmental control, and especially from Hacienda (the Mexican finance ministry). Other areas of potential legislative focus will be on Pemex's fiscal regime and on its ability to determine with whom it enters into joint contracts.

An important clue will come from changes that are made to regulatory institutions and the regulatory framework for which they are responsible. One worrying development occurred in October 2018 with a

legislative proposal in the Chamber of Deputies to bring the CRE and CNH under direct control by the energy ministry, SENER. Although this initiative would almost certainly have been deemed unconstitutional, and was not overtly supported by the President-elect, it hinted at a belief that regulatory agency independence would not be a priority for the new administration. This created a wave of concern among investors in the energy sector.

Another worrying development occurred with President-elect López Obrador's announcement in October 2018 that he would seek to end Mexican crude oil exports. Although this was later interpreted to mean that the new administration would build sufficient refining capacity to handle all Mexican crude production in country, the international debt rating agency was sufficiently spooked to lower Pemex's rating by a full grade. Prospective energy minister Rocio Nahle's response that she "didn't understand" Fitch's reaction only served to heighten the sense that the new energy team was detached from the realities of global energy markets.

In addition to these concerns, there are a number of factors that the new administration will have to take into consideration when planning its management of the energy sector. The first of these concerns the reaction that any reversal of the 2013 reform would draw from global markets and foreign investors. AMLO has committed to reviewing the contracts that were awarded between 2015 and 2018, a process that was extraordinarily transparent and adhered to international best practices. There can be little doubt that the contracts themselves are valid, but there have been hints from within the AMLO camp that some of the winning firms should not have pre-qualified so as to be able to bid on the contracts in the first place. If this is indeed the approach, then it will have to be handled with the utmost delicacy and care. Any suggestion that contracts are being unfairly revoked will be met with deep concern by investors, and not just those in the energy sector. As AMLO is determined to avoid financial volatility, he must step carefully on this front.

The second factor that the incoming administration must take into account concerns oil production. Although Mexico's national production has been in steady decline since 2004 (losing over 1.5 million barrels per day since then), the new exploration and production that has come out of the energy reform will begin to pay dividends by the middle of AMLO's term. Although we do not have a reliable estimate of how much new oil will flow from the contracts, it will certainly be somewhere in the range of two to three hundred thousand barrels per day by the mid-2020s. This new oil will be essential to providing AMLO with sustained national production levels and with the crude to feed the new refinery capacity that he plans.

The third major factor that must occupy the incoming administration's energy planners follows on from this new production. The fiscal revenue that will come with new production will be essential to fund the AMLO government's plans for social and infrastructure spending, and the 74 percent average government take from the contracts will be most welcome in the effort to maintain balanced budgets. Although the economic fundamentals and the fiscal outlook in Mexico appear to be sound at the time of writing, the new government must be concerned about maintaining and raising revenues at a time when demands on the public purse will surely increase.

Recommendations for the future

In an April 2018 paper by the Wilson Center and IPD LatinAmerica,[1] John Padilla and Duncan Wood argue that, despite the success of the 2013 reform, there still remains much work to be done. Their recommendations, taken from a series of consultations with the industry and analysts, are grouped into four main areas:

1. **Strengthening the legal framework of the energy sector:** Priorities here include investor protections, clarifying language in the Hydrocarbons Law, clarifying national content requirements, the creation of national energy "corridors" and hubs, laws to govern indigenous consultations, ancillary laws involving transportation infrastructure, and rules governing land acquisition. In sum, these changes concern the need for greater certainty and clarity essential to investor and operator confidence.
2. **Strengthening Pemex:** Two main areas need to be addressed here. First, fixing the company's dire financial situation through changes to its fiscal regime, reduction of liabilities, the sale of insolvent assets, and the possibility of a partial IPO for the company. The second area of work should focus on corporate governance, involving transparency and accountability, eliminating conflicts of interest on the Pemex board, and installing a meritocracy in the company.
3. **Ensuring effective regulation and management of the midstream and downstream sectors:** Here, the recommendations focus on the need to properly regulate CFE to prevent market dominance, strengthening CENAGAS to create greater certainty and market stability, a reorganization of Pemex Logística to allow for more agile project execution, greater transparency in pricing and tariffs, and concrete actions and success to reduce fuel theft.
4. **Strengthening the regulatory framework, ensuring regulatory autonomy, and making regulation more efficient:** Here, the recommendations center on increased regulatory autonomy, improving regulatory response time through online platforms, the creation of an online "one-stop shop" to reduce red-tape overload, improving coordination between different levels of government, and improving overall rule of law in Mexico.

At the time of publication, it seems that many of these potential improvements to the existing energy sector are unlikely to be implemented by the new administration for the simple fact that they involve a "doubling down" on the 2013 reform, and the new administration has already indicated its grave skepticism thereof. The one exception, of course, concerns Pemex, which, as we have seen earlier, the administration intends to strengthen and empower to be able to compete.

And yet there are other challenges and opportunities that the new administration can address and embrace. A series of publications from the World Economic Forum (WEF) in 2018 emphasized the critical need to speed up the global energy transition away from fossil fuels, focusing on six main axes. These axes were clearly outlined in a paper by Jules Kortenhorst and Kieran Coleman: [2]

1 Duncan Wood and John Padilla, *Mexico's New Hydrocarbons Model: A Critical Assessment Four Years Later,* Wilson Center, https://www.wilsoncenter.org/sites/default/files/mexicos_new_hydrocarbons_model_0.pdf

2 Jules Kortenhurst and Kieran Coleman, "Six ways to align the energy transition with economic growth", World Economic Forum, 7 March 2018, https://www.weforum.org/agenda/2018/03/6-ways-to-align-energy-transition-and-economic-growth/

1. Integrated policy frameworks to ensure that governments approach the issue of the energy transition in a holistic manner.
2. Carbon pricing through a broad tax or cap-and-trade system to provide a stable price signal to markets over time.
3. The use of smart subsidies: this involves removing existing subsidies on fossil fuels and engaging in targeted and carefully evaluated subsidies for new green technologies.
4. Governments and companies must support innovation through increased spending on, and coordination in, research and design projects. As much as possible, these projects should involve public-private collaboration.
5. Energy efficiency must be seen as a critical component of the fight to mitigate climate change. Incentives must be provided for energy efficiency projects but also the creation of clear mandates and standards for efficiency across the economy.
6. The incorporation of new technologies and massive-scale renewable energy projects will pose multiple challenges to electricity markets. This will necessitate deep thinking about how to design these markets to maximize both competition and innovation.

All of these priorities identified clearly by the experts of the WEF are critical to ensuring a smooth and effective energy transition and to keeping to a 2 degree Celsius global temperature rise scenario. AMLO has already indicated that he wants to facilitate the move to renewable energies, and following these guidelines and working with the WEF would be a useful way of moving that goal forward.

Conclusion

The new AMLO administration inherits an energy sector that has begun to turn around after decades of neglect. The 2013 reform was hailed by investors around the world as a sign that Mexico was open for business. In the next few years, the government of Andrés Manuel López Obrador must decide on a path for the sector. There is no doubt that the President-elect wants to increase the role of the state and is leery of the benefits from private and foreign investment. However, economic, fiscal, and energy necessities may bring the new government to opt for a less radical departure from the status quo than many fear. Much depends on the ways in which the new administration responds to signals from international investors and capital markets.

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