AGENDA 2040

TRANSFORMING MEXICO

Vision and proposals for the future of the energy industry in our country.

AMEXHI
asociación mexicana de empresas de hidrocarburos

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Preface

Mexico City, Mexico, March 5, 2018

In every country, the performance of the energy sector repeatedly tests its national development model. Although there is always the temptation to see current symptoms in the present context, in reality, today's productive infrastructure depends on what was conceived, planned and begun to be developed decades before. In the energy sector, the current results are the product of the actions that were taken two decades ago. In Mexico, only 2 percent of the historical cumulative production comes from oil fields that entered production in the last 25 years.

That is the reason that this study by the Mexican Association of Hydrocarbon Companies (AMEXHI) is looking toward the horizon of Mexico in the year 2040. The energy performance of the future and its impact on our economy will depend on the decisions we make today. By the year 2040, the production of current fields will drop by 85 percent. Thus, in order to build our future, we must begin to discover, develop and take advantage of our energy potential as soon as possible.

The New Mexican Energy Model, being the group effort that it is, has the enormous advantage of ensuring that the future does not depend solely on one centralized vision, which might be correct or incorrect. On the contrary, it allows many ideas, technologies and perspectives to exist, compete and collaborate with each other—despite their differences— in building a common way forward for all.

It is the idea of this common way forward that inspires our *Agenda 2040: Transforming Mexico.* This is an effort that arose out of the industry sector, but also incorporates the voices of experts and authorities so as to reflect on our past and our present, but most importantly identify the keys to building the best possible future for everyone.

For a long time, the Mexican oil industry has been a source of strength and pride for Mexico and the Mexican people. And so it should remain. Therefore, and according to available International Energy Agency projections, we must maintain our course and pace by properly implementing Energy Reform. This will not only allow us to meet the challenges inherited from the previous model, but also, and more importantly, help us to add a billion dollars to our economy by 2040. The goal is within our reach. It all depends on the regulation and operation of the sector's adherence to four principles: consistency, competition, transparency and a commitment to knowledge.

Strict adherence to these principles is the best way to learn from our extraordinary national oil history and design today's opportunities in a global market with a profound commitment to transparency. It is, above all, the essential bridge to being able to make progress in sustainability and face the accelerated technological transformation of the future.

Mexico finally has the proper public policy framework to make the global oil outlook work in its favor over the next two decades and strengthen its national productive infrastructure for much longer than that.

We are certain that, with the correct decisions, the Mexican energy sector of 2040 will reflect well on the national development model put in place by our generation, from which all those generations to come will benefit.

PHOTO: SHUTTERSTOCK

Introduction

Modern economies derive a significant portion of their value from the production and consumption of hydrocarbons and their derivatives. In major producing countries, such as Mexico, they play an important role in revenue collection and investment. In top oil consuming countries, a group that Mexico is rapidly on its way to joining, they are the foundation of their productive activity. As such, Mexico generates value for its economy from the production of hydrocarbons, while at the same time obtaining essential inputs, from electricity and fuel, to petrochemicals and new materials, all essential to its competitiveness and economic prosperity.

What is more, the influence of hydrocarbons will continue for a period of time that is still significant. Not only in Mexico, but around the globe.

In fact, practically all energy projections—from private, government and academic sources—agree that hydrocarbons will remain the starting point for the bulk of economic activity around the world at least until the year 2040, which most of these studies look ahead to.

This is due to a profound technological transformation in the sector. Although other sources of energy, particularly renewable sources of energy, have made great technological leaps in recent years and are experiencing growth rates at times in the double digits, technologies in the hydrocarbons industry are also vigorous and profound. In addition, the renewable energies' starting basis is still small, in comparison to that of hydrocarbons.

This does not mean that the hydrocarbons sector is dragging the sustainability of the planet down; on the contrary, hydrocarbons are helping to successfully meet many current challenges. The rapid development of natural gas in recent years is one of the primary factors in the drop in greenhouse gas emissions. Carbon capture technologies are rapidly coming of age and new petrochemical processes, better fuels and the development of new materials are all helping to reduce vehicle emissions and fuel consumption, not only with regard to light vehicles, but vehicles as a whole.

This is not surprising. Since they arose in the latter half of the 19th century, hydrocarbons have played a central role in all technological revolutions since that time. Today, at the dawning of the third decade of the 21st century, the hydrocarbons industry is noted as making some of the most intensive use of computing power, operating at great ocean depths via robots and autonomous vehicles, and using advanced data management, automation, sensors and advanced manufacturing processes. This is the reason why earlier predictions of its imminent decline have turned around in recent years. Instead of declining, the opposite has occurred. Today, hydrocarbons are driving profound economic transformations throughout the world.

Despite their success, the reality is that in today's world, we must develop all types of energy resources, due to the inescapable connection between the success of an energy sector and that of the economy it serves. Global economic growth and its demands make whatever energy is produced a valuable and indispensable input. It is a symbiotic relationship, but this does not mean that the two move in tandem. The Mexican energy sector has often been a driving force in the economy, and at other times, has dragged it down.

Looking back, the Mexican oil sector first arose as a great driver of growth, later lagged behind the economy and then once again overtook it. In recent decades, the energy sector stalled and was on the verge of decline, while the economy continued on its slow but consistent upward climb. A significant gap began to widen between them that made a consistent and sustained development model impossible.

The New Mexican Energy Model set the goal of bringing the two back together and resolving an acute structural crisis in our sector. Moreover, it has set out to catapult the energy sector as a whole—including, above all, the dominant hydrocarbons sector—from its current position of lagging behind the national economy, back to a leadership position, restoring its historical role as a driver of our national economic growth.

In recent years, the good news of the opening up of the Mexican energy sector, characterized by record numbers of investment announcements, the massive entry of new competitors and a strong commitment to knowledge, has made us forget that until recently, the news was always bad.

Just five years ago, we were still experiencing what were known as critical alerts, in other words, the interruption of the natural gas supply that paralyzed industries and drove off other productive industries such as the automobile or the electronics industries. In the last decade, we have lost more than a million barrels of production, in addition to having to privatize reserves. Even in an environment of sound growth in the demand for energy, it was not possible to combine it with strategic investments, despite record high
Pemex budgets. Meanwhile, various energy subsidies were exhausting the government's finances and our air pollutant emissions were on the rise.

All of this was the reflection of the structural crisis that arose from our previous energy model that was unable to keep pace with a rapidly industrializing economy and a population

that began to demand more and more energy. The contradiction between an open and diversified economy and a concentrated energy monopoly in the midst of profound technological transformation is the root cause of our energy challenges, which remain significant.

Fortunately, they are no longer structural challenges, since the New Energy Model has resolved this contradiction and the substantial investments and new rules have halted the decline. For one thing, Mexico no longer experiences critical alerts, and for another, new discoveries will allow us to shore up current production levels, while the appearance of multiple new players investing not only all along the hydrocarbon value chain, but in the energy sector as a whole, make it possible to foresee a growing contribution on the part of the sector to the Mexican economy.

Despite the considerable improvement in the energy scene and the future outlook, making up decades of lost time will require us to continue doing what we have been doing in recent years, for many more years to come. On the basis of consistency, we need to attract and develop even more competitors specializing in diverse areas of the energy sector.

This will only be possible to the extent we are guided by a firm commitment to transparency, such as that embodied by the New Mexican Energy Model. It also requires a solid commitment to knowledge, as exemplified by the spectacular generation of knowledge by the seismic surveys over the last three years that have quadrupled the knowledge we had of the subsurface prior to the Reform.

Thus, the New Mexican Energy Model is an ambitious undertaking, based on both the current potential and the historical evidence, and there is reason to believe that it will be successful under the right conditions. It would not be possible for any one player acting alone, but with collective effort and taking advantage of national and global strengths, it becomes much more viable.

It is not the same to place all the responsibility on one company and finance it with public funds, as to have it and a multitude of other investors risking their capital, without the nation incurring any risk. What is more, each participant in the New Model is a generator of knowledge, of new perspectives, that result in the development of value, where before we did not see any. As such, many forces working in directions that are perhaps different, but coordinated, to a large extent thanks to the design of the government's public policies, make the goal accessible.

This spirit of recognizing the power of cooperation and plurality inspires this document. Instead of focusing on the perspective of a single player, it presents a collective perspective. It is a perspective that includes, in addition to the ideas and proposals of the nearly 50 companies comprising the Mexican Association of Hydrocarbon Companies (AMEXHI), the ideas and proposals of independent authorities and experts. Throughout fifteen months of analysis and interviews with experts, in addition to four months of subject-specific discussions, AMEXHI has sought to compile the knowledge, experience and vision of a diverse group of leaders in the Mexican energy sector.

To make coherent sense of all this rich data, the document has been organized in the following manner:

Chapter One is a historical reflection. Rather than provide a narrative of Mexico's oil history, a task better left to historians, we examine the interconnection between the sector and the rest of the economy. In other words, instead of taking a certain point in history as a starting point, we cover the entire history of oil in Mexico, since the first efforts to use it as a fuel and raw material for the industrial development of the country, which took place more or less in the latter third of the 19th century, through our time. As such, we will not revisit the uses of hydrocarbons in

pre-Columbian Mexico or their role in colonial shipbuilding. The perspective that emerges from this approach is one in which the economic and energy models, the orientations of which were profoundly interconnected at the beginning, eventually fell out of sync.

Knowledge plays a leading role in this story, in its origins, in the creation of Pemex, and most importantly, beginning in the 1970s, the use of science to
make the great onshore and offshore discoveries in the southeast. It is also a story of contrasts, especially when the energy sector was unable to reform and modernize at the same rate as the rest of the economy.

It highlights, in particular, the emergence of the financial challenges, frequently resolved by the State taking on debt and incurring all the risk, which on several occasions resulted in financial crises, especially when oil prices underwent their inevitable corrections.
As such, it reflects our country's ongoing search for a model that could guarantee the
Nation's ownership, but would not create a heavy burden for future generations, or provoke crises that would erode any progress that had been made.

Chapter Two of this Agenda 2040 to transform Mexico, examines the conception and the construction of the energy reform of 2013. This reform was the result of a long-standing debate over three decades, in which the country sought solutions to a growing energy problem created by the incongruence between an open economy and a closed energy sector.

The first part describes Mexico's sense of urgency resulting from its internal needs: dwindling oil production and reserves on the one hand, and on the other, the growing demand for energy on the part of various industries and consumers. What is more, this supply and demand problem placed a burden on public finances, both as a result of debt as well as the growing subsidies with which the government sought to alleviate the problem. In fact, despite record investments in Pemex, their effect was limited due to the magnitude of the problem.
After all, it was not possible for a large economy such as Mexico's to depend on a single provider of energy resources, and as such increasing delivery capacity became a central concern.

There was also a sense of urgency with regard to taking advantage of Mexican oil resources in the coming decades, as global demand continues to rise. The rapid technology transformation worldwide, and in particular in the hydrocarbons industry, demanded a significant increase in our national energy capacities to be able to keep pace.

The framework of the New Energy Model had the benefit of building upon a large number of energy sector liberalization processes all over the world, and quantum leaps in knowledge, from institutional engineering to behavioral economics.

As such, it is widely acknowledged that the total liberalization of the energy sector not only involved releasing burdens, which sounds easy, but also building institutions and processes capable of meeting needs.
This chapter describes the primary characteristics of the New Model: transparency, Rule of Law, competition, competitiveness and dialog between the government and the other players involved.

Chapter Three of this Agenda focuses on the outlook for the year 2040 and the benefits of the New Energy Model. As such, one of the main pillars of the reform is the opening up to new players that will make it possible to take advantage of the oil potential of industry, while meeting the growing energy demands of a country with one of the largest growth and industrialization processes. As such, this chapter

highlights three major benefits of the Reform: the benefits for the State of Mexico as the owner of the oil resource, the benefits for industry and for consumers,
and the benefits with the multiplier effect on the country's overall competitiveness.

It is worth noting that this chapter makes use of multiple documents and studies done on the Mexican energy sector, in particular the Mexico Energy Outlook 2017, published by the International Energy Agency, one of the main global energy sector organizations. The information in this report has been used to complement the vision for 2040, presenting medium-term production, growth and investment scenarios.

By 2040, if Mexico is consisting in building competitive markets and a knowledge economy with a strict commitment to transparency and accountability, its current production could grow by up to 40 percent and add more than one billion dollars to its GDP.

This will not happen automatically. By the end of the projection period, the difference between good and bad decisions could equal 4 percent of the country's GDP. Bad decisions and lack of consistency could undermine the economic and oil production factor; there would also be an opportunity cost of 1.6 times the total budget of the Ministry of Social Development, 1.4 times the budget of the Ministry of Health and 0.6 times the budget of the Secretary of Public Education over the next 20 years. Thus the choice of keeping the energy sector in harmony with an open economy vs. returning to the past lead to two very different Mexicos in the year 2040.

Chapter Four explains the need for a New Energy Model and the reasons why this document was created. It provides a brief description of national projections and needs for the year 2040 from a demographic, social, economic and technological perspective.

Today, Mexico has managed to position itself among the major industrialized powers, and there are studies that indicate that, within a couple of decades, our economy could be one of the top ten in the world. To achieve this sort of development, we must create ecosystems that disseminate and extrapolate the potential of the energy reform.

According to the theories of the economist Ricardo Hausmann and physicist César Hidalgo, of Harvard and MIT, respectively, the Mexican energy sector must become a complex economy that, rather than rely on the production of a single primary product, must encourage the reliable and accessible production of energy for the development and wellbeing of the population. This will result in the creation of parallel industries, in symbiosis with the energy industry, that contribute to the multiplier effect and above all generate more knowledge and capacity for national growth and development.

As part of the examination of underlying reasons, this chapter also examines the concept of energy security. The importance of reaching an optimal level of energy security is related, firstly, to the growing integration of energy value chains in the region: an energy-integrated North America that can take on the world, and secondly to the growing demand for energy on the part of the Mexican population. However, we must strike a balance between cost and security, so as to reinforce economic prosperity.

Another fundamental aspect is sustainability. The New Mexican Energy Model represents the most significant effort in the development of renewable energy sources, and in the last two years, we have seen a significant increase in the number of contracts signed by the solar and wind power industries.

However it is also clear that the hydrocarbons industry is an indispensable force in generating greater sustainability. The New Model opens the way for investment and the development of new technologies that make it possible to reduce greenhouse gas emissions, and

other innovative technologies that make the hydrocarbon extraction and production processes cleaner and more efficient.

The wider availability of gas, better energy-efficient practices, prices that are undistorted by subsidies, in addition to new venting and carbon capture technologies, better petrochemicals, fuels, and new materials constitute an important contribution to a more sustainable model. The same is true of the push toward regional development, community participation and transparency rules based on a system of checks and balances and accountability mechanisms.

In Chapter Five we take stock and identify essential principles and proposals for the good performance of the Mexican energy sector. We recognize a lot of progress has been made in just a few years. Our modern energy sector is now much more dynamic. Regulatory quality and transparency have markedly improved. Our country has successfully attracted large investments, knowledge and technology. However, much remains to be done. The challenges facing the energy sector are still significant, and an expanding economy, young population, and rapidly changing technology all mean that we need to keep them on their current track.

To do this, we have identified four principles that must be followed in implementing the energy reform. These principles are the key to achieving the optimistic scenario outlined by the International Energy Agency, or otherwise return to a model that is insufficient to meet the needs of twenty-first century Mexico. These principles are consistency, competition, transparency and knowledge.

All of them play a role in strengthening the institutional architecture, building an ecosystem of competitors, leveraging the country's international competitiveness and consolidating a knowledge economy.

Each pillar or principle includes a detailed explanation of its implications, and a description of the actions Mexico can implement in the oil industry to attain the vision of 2040.

What is more, although our analysis concludes that the reform has many virtues, although it will need time to mature and produce the expected results, we have identified, with input from the industry, authorities and experts, a series of actions and proposals that will allow us to achieve even better results. This chapter discusses all of them in depth, and at the end, highlights ten of the most substantially important proposals.

These ten proposals for enhancing the New Mexican Energy Model warrant particular attention. They include holding bidding rounds every year, so as not to lose the expertise accumulated and eliminate the backwardness still affecting our energy sector. We also highlight the importance of increasing inter-agency coordination, so as to give the sector greater execution capacity and speed, while not losing sight of the importance of not jeopardizing their autonomy, or the checks and balances of the various sector regulators and authorities. We also believe that giving the ASEA autonomy and developing a digital regulatory compliance platform could be powerful tools for the future.

Above all, we believe that the New Mexican Energy Model includes a series of elements that are worthy of being emulated in other areas of the Mexican economy, and infrastructure development in particular. Although the energy sector now has the same orientation as the rest of the economy, infrastructure development in Mexico requires a profound transformation to generate more competition, increase execution capacity, develop greater transparency and attract knowledge. Without an infrastructure capable of keeping pace with an energy sector and economy in profound transformation, the results will be meager and bottlenecks will be numerous.

Overall, this document provides a road map toward the year 2040 led by an oil sector that shares the economic vision of the rest of the country: openness, competitiveness, transparency and knowledge. By espousing the principles and policies that have the potential to restore the national and international leadership position of our energy sector, we are confident that the New Model, first created in 2013, will become the catalyst for many paths to growth and wellbeing for the Mexico of the future. A Mexico in which anyone who has a good idea for furthering the growth and wellbeing of the country will have enough energy to make them a reality.

We believe that Pemex can continue to be strengthened, creating better conditions for it to fully make use of the powerful tools the Reform has given it, seeking partners, reducing its tax burden, improving the quality of its financing and its execution capacity. We must also improve the legal and physical security of the investments, develop our unconventional resources so as to generate greater regional development, and consolidate knowledge in the decision making of the Mexican energy sector.

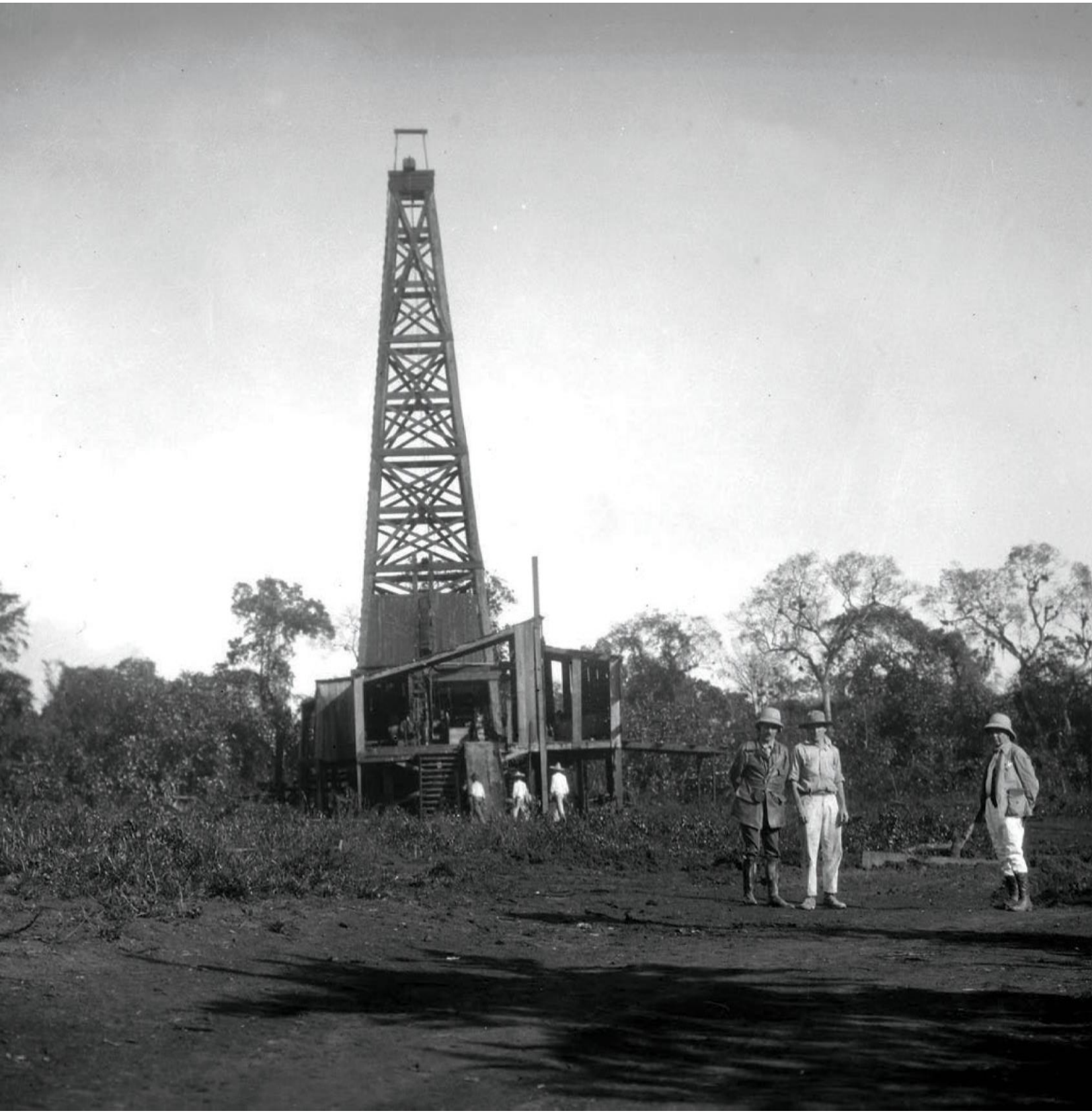


PHOTO: GUSTAVO CASASOLA COLLECTION

01

Origins of the New Mexican Energy Model

In any location, the evolution of the energy industry and the history of its economic development are inextricably linked. One aspect of this relationship is well known: in order to grow, a country needs energy. But the other side of this is no less true: in order for energy to have any worth, it needs an economy that demands it. This is particularly true in traditional oil producing countries such as Mexico. Whether its hydrocarbons are consumed domestically or exported, they are liquids or gases that, rather than having any intrinsic value, derive their value from the economy in general.

This symbiotic relationship means that the sum of the parts is not the most accurate way to calculate the impact of their interaction. When we take the time to carefully examine history, particularly in the case of Mexico, we see a key factor that explains this phenomenon: our country's potential is best achieved when the economic model and the energy model are in alignment with each other.

Throughout Mexico's history, regardless of what the specific energy model or economic model were, this principle can be seen in action. The inverse corollary is also true: when the energy model falls out of sync with the economic model, potential is lost.

This chapter explores a large portion of the history of oil in Mexico from this perspective.

Origins of the New Mexican Energy Model

1.1 Life before Energy Reform

OLD MODEL

The old energy model was unable to adapt to a more open, competitive and global Mexico and world.

The old Mexican energy model, the product of the public policy and energy realities in the 1950s, has been out of date for a long time. In its final years, particularly since the turn of the century, it was in a sort of suspended animation, since —despite substantial investments and multiple diagnoses of its multiple problems— the old model was unable to adapt to a more open, competitive, and global Mexico and world. Over time, the economic model and the energy model fell out of sync. One modernized and adapted. The other didn't.

It was not until 2013 that Mexico redesigned its energy model to respond to its current needs and realities. But, contrary to what a monolithic vision might suggest, the Mexican energy model has been significantly modified over time, on many occasions.

At the end of the 19th century, when Mexico made its late arrival to Industrial Revolution, it was not a coal-rich nation; however it was able to resort to oil—which at that time was an emerging energy source—as a potential tool with which to catch up to other nations and industrialize the country. With this in mind, the Benito Juárez and Porfirio Díaz administrations granted concessions, based on the old Mexican mining model, to try to encourage exploration and develop these activities. Under this model, the State, rather than regulate the concessions, granted freedom of action, and the resource became the property of the owner of the land.

A NEW MODEL

It was not until 2013 that Mexico redesigned its energy model to respond to its current needs and realities. The Mexican energy model has been significantly modified over time, on many occasions.

Over time, this policy led to significant discoveries, but not before a lot of capital was risked, and a lot of fortunes lost in the process. One example of success was the discovery of the La Pez 1 well in San Luis Potosí, which although it took 35 years—in 1868, Adolfo Autrey carried out the initial prospecting, in Papantla, Veracruz, and it was not until 1904 Edward Doheny and C.A. Canfield, with the help of Mexican geologist Ezequiel Ordóñez, struck oil—produced 1,500 barrels per day, at just over 500 meters deep. La Pez 1 is the first commercial oil discovery in the history of Mexico.[1] Thus the Mexican oil industry was born.

[1] *Brown, Jonathan C. Oil and Revolution in Mexico. Berkeley: United States, University of California Press, c1992 1993. p. 31 available at: http://ark.cdlib.org/ark:/13030/ft3q2nb28s/*

At that time, Mexico was positioned at the vanguard of knowledge at the global level and— thanks to the expertise of Ordoñez, Doheny, Canfield and many other Mexican and foreign investors—oil was discovered in various parts of Veracruz and Tamaulipas.

One such investor was a British railroad baron, Sir Weetman Pearson, who, like Autrey, saw potential in the oil seeps, and, in 1908, decided to begin explorations with his company, El Águila, at Hacienda San Diego de la Mar, in the Veracruz Huasteca, where he found oil in significant quantities. It was the first great discovery of an oil producing region in Mexico, and it was dubbed the "Golden Lane." This put Mexico on the global oil map.

TABLE 1

Band of Gold (North)*

Select Wells, 1908–1920

Well	Year	Barrels of Oil per Day
San Diego de la Mar 3	1908	80,000
Juan Casiano 7	1910	72,000
Potrero del Llano 4	1910	115,000
Cerro Azul 4	1916	260,000
Álamo 2	1920	45,000

Thanks to the synergy of the capital, the technology, and the expertise of Ordóñez in particular, significant discoveries continued to be made. These included the Casiano 7, Cerro Azul 4 and Potrero del Llano 4 wells, all of which were important at the global level at that time. In fact, the Cerro Azul 4 well may hold the world record for initial flow, at 260,000 barrels per day thanks to the well's considerable natural pressure. For purposes of comparison, the great Spindletop (Texas, 1901) flowed at 100,000 barrels per day, and our Cantarell (Campeche, 1976) reached just over 60,000 barrels, in its initial stage. In the first six years alone, Cerro Azul 4 had a cumulative production of 57 million barrels.[2] Most of these wells are still producing today, although their primary contribution is that these fields were the backbone of the national oil industry from the time of Porfirio Diaz through the 1960s, when discoveries were made in Tabasco and Chiapas.

** Source: Alfredo E. Guzmán, Petroleum History of México: How it got where it is today, 2013. Available at http://www.searchanddiscovery.com/documents/2013/10530guzman/ndx_guzman.pdf*

AT THE VANGUARD

Mexico was positioned at the vanguard of knowledge at the global level and— thanks to the expertise of Mexican geologist Ezequiel Ordoñez.

ENORMOUS PROGRESS

Thanks to the synergy of the capital, the technology and the expertise of Ordóñez, the first discoveries were made.

OIL EXPORTER

For most of the 1920s, Mexico was the largest oil exporter in the world. At that time, oil was being produced by more than 80 companies operating in the country.

The spectacular oil discoveries resulted in the growth of Mexican oil production, which reached more than 529,000 b/d in 1921, which represented 25% of global oil production at that time[3]. At that time, Mexico had twice the global market share that Saudi Arabia, the current world leader, has today. What is more, for most of the 1920s, Mexico was the largest oil exporter in the world. At that time, oil was being produced by more than 80 companies operating in the country.4

The strategic importance of the Mexican oil and hydrocarbons industry was clear at that time, especially after World War I and the mass adoption of the internal combustion engine for cars, planes and ships. The outbreak of the World War and the change in technology caused the industry to take off in other locations, such as Venezuela, following the important discoveries at Los Barrosos-2 in Cabimas (1922) and Moneb-1 in Monagas (1928). Meanwhile in Mexico, in 1917—just one year after the monumental success of Cerro Azul 4—the Constitutional Convention in Querétaro redefined the Nation's ownership of underground resources. The political, economic and oil model were in sync.

After the Mexican Revolution, our country benefited from a peace dividend. This does not mean that the economic, political and oil models were not hotly debated. In the energy arena, in fact, the next few years were marked by a great national debate on the role of hydrocarbons in the economy, the rights of the investors and the workers, the duties of the government and the benefits to society. These debates were not without conflict and caused a considerable drop in investments, and consequently in production as well. In the economic arena, the creation of institutions such as the Bank of Mexico and the opportunity to resume industrialization efforts had transformative effects. Thus, we got back on the road to growth.

DEBATE OVER RIGHTS

In the years following the Mexican Revolution, a debate arose regarding workers' and investors' rights, the duties of the authorities and the benefits to society.

In 1936, General Lázaro Cárdenas founded the Instituto Politécnico Nacional (IPN). Two years later, he proposed turning it into a breeding ground for technological though, with the mission to train the engineers that the country needed to develop its oil industry, a mission that continues to this day. Cárdenas also strengthened the Universidad Nacional Autónoma de México (UNAM) and succeeded in making it the *Alma Mater* of several generations of petroleum engineers.

Eventually, President Lázaro Cárdenas' administration found itself in a complex situation: on one side were the oil companies at that time had been reluctant to accept the new labor and tax conditions imposed by the Constitution of 1917, to the extent of defying a Supreme Court ruling on labor matters, and on the other side, the emerging labor unions of the era who were seeking to take over the facilities by force. Cárdenas had to rein in both sides, and on March 18,

[2]*Blickwede & Rosenfeld, The Greatest Oil Well in History? The Story of Cerro Azul #4, 2010. Available at: http://archives.datapages.com/data/phi/v11_2010/blickwede.htm*
[3]*Lorenzo Meyer, México y los Estados Unidos en el Conflicto Petrolero 1917-1942, México, El Colegio de México, p. 21.*
[4]*Ibid*

PHOTO: AF

1938, he passed the oil expropriation, just at a time when the world was inexorably moving toward World War II. His decision, motivated in part by that situation, was consistent with his political and economic views: nationalistic, but open to private investment, nor[sic] foreign investment.

President Cárdenas created Petróleos Mexicanos (Pemex) on June 7, 1938. He thus laid the foundations for the largest company in our country and one of the most successful oil producers in the world.

Ever since it was first created, Pemex faced very complex challenges, since it lacked access to spare parts, equipment and technicians due to the boycott of Mexico following the expropriation. This boycott also included denying Mexico access to oil export markets, primarily in the United States and England[5]. With the start of World War II and Mexico's entry into the Allied Forces of the United Nations, the investors were compensated, the boycott came to an end and our country reinforced its export markets.

OIL EXPROPRIATION

On March 18, 1938 Lázaro Cárdenas passed the oil expropriation, just before the start of World War II. His decision was consistent with his political and economic views: nationalistic, but open to private investment, including foreign investment.

FIRST CONTRACTS

Both Presidents Lázaro Cárdenas and Manuel Ávila Camacho sought out new avenues for keeping investors in the country, devising the first contracts that transferred the risk to investors while ensuring the preeminent authority of the State.

During this period, Presidents Lázaro Cárdenas and Manuel Ávila Camacho (1940-1946) sought out new avenues for keeping investors in the country. With said goal in mind, they devised the first contracts that transferred the risk to the investor while ensuring the preeminent authority of the State. The model that arose after the expropriation was pragmatic, and was, in many ways the precursor to current energy models around the world, which now allow private investment based on risk agreements.

Under this model, the nation was the owner of the resources and the State allowed Mexican private companies to assume the exploration and commercial risk. If they were successful, they could turn a profit, in exchange for the payment of taxes and royalties. Despite the fact that President Cárdenas actively promoted these contracts with companies, they did not attract much interest. This could have been due to the opportunities available to investors in Venezuela and the Middle East under the old concession model. Once again, partial opening to investment in oil activities was consistent with nationalist views that also acknowledged the importance of strategic openness to attract investment and be able to share the risks involved in the projects.

President Manuel Ávila Camacho expanded the ability of private companies to participate in joint ventures with Pemex, provided the latter held a controlling stake[7]. This mixed investment model remained in effect until 1958 when, during the Adolfo López Mateos administration (1958-1964), secondary laws were changed to completely close the door on private sector involvement in oil activities, thereby creating the basic structure that remained in place until 2013.

PRIVATE INVESTMENT

Ávila Camacho (1940-1946) expanded the ability of private companies to participate in joint ventures with Pemex, provided the latter held a controlling stake. This model remained in effect until 1958 when private sector involvement in oil activities was banned, creating the basic structure that remained in place until 2013.

The ban on private investment in the oil industry, as it was later described, occurred at a time in which the Mexican economy in general was seeking to close itself off from the world, laying the foundations for what would become an import substitution process. As such, the economic and energy models were consistent with each other, but as the closed economic model became obsolete, and the Mexican economy modernized and opened, the energy model, which remained relatively static, automatically fell out of sync with the realities of the country.

During the period known as the "Stabilizing Development," between 1940 and 1970, Mexico experienced spectacular growth rates due to the great migration from the country to the city, a never-before seen population boom, large-scale industrialization process and growing demand for exports due to the end of World War II. This period, also known as the "Mexican Miracle," was also noted for a commitment to keep inflation low so as to provide a minimum foundation of stability for public and private investment.

[5]Merrill Rippy, Oil and the Mexican Revolution. The Journal of Economic History, 33, issue 04, 1972, p. 248. Available at: https://EconPapers.repec.org/RePEc:cup:jechis:v:33:y:1973:i:04:p:902-903_07
[6]Rousseau, Isabelle. Tribulaciones de Dos Empresas Petroleras Estatales 1900-2014. (Trayectorias comparadas de Pemex y PDVSA). México, El Colegio de México, p. 76, 2017
[7]Christopher Helman, How Oil Reforms Could Trigger Mexico's Biggest Economic Boom in a Century, Forbes. Available at: https://www.forbes.com/sites/christopherhelman/2013/10/01/Méxicos-oil-reforms-set-to-trigger- biggest-economic-boom-in-100-years/2/#7bc3fadb430b

1965

year in which Jesús Reyes Heroles, CEO of Pemex, created the Mexican Petroleum Institute, turning it into the great disseminator of knowledge and technology. This commitment to talent yielded results almost immediately.

PHOTO: SHUTTERSTOCK

DOMESTIC MARKET

After World War II, an import substitution model was adopted. The base would no longer be the foreign market, but rather the domestic market protected by rising tariff barriers.

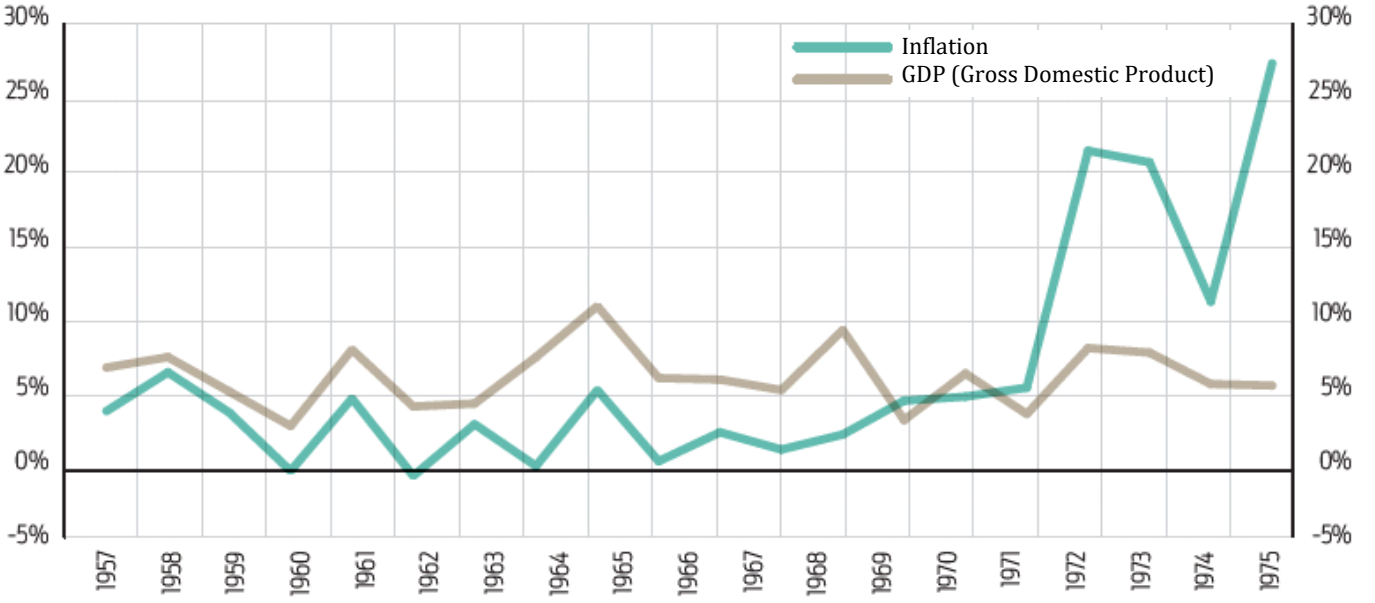
Between 1940 y 1955, exports were the principal engine of growth. This laid the groundwork for the national productive apparatus and for the average growth of the Mexican GDP of 7.4% between 1940 and 1945[8]. This spectacular growth—the highest since the end of the Mexican Revolution—was founded upon the expansionist policies of the Bank of Mexico9, based on granting loans to the nascent and vibrant Mexican industry—which was leaving behind its agricultural focus—and a fierce tariff policy that protected it from foreign competition, in this initial phase.

Despite the positive outlook, the rate of exchange, which had been fixed since 1944—as a result of the Bretton Woods Agreement[10]—and increasing exports created significant inflationary pressure, resulting in the need to devalue the currency in 1949, from 4.85 to 8.65 pesos per dollar[11]. However, the exchange rate correction was not sufficient, and a second devaluation was therefore required in 1954, from 8.65 to the infamous 12.50 pesos per dollar, which remained as the fixed rate until August of 1976.

These significant adjustments to the exchange rate parity and the reconstruction of Europe and Japan following the war changed the focus, leading to the adoption of an import substitution model. The base would no longer be the foreign market, as it was between 1940 and 1955, but rather the domestic market protected by rising tariff barriers.

GRAPH 1

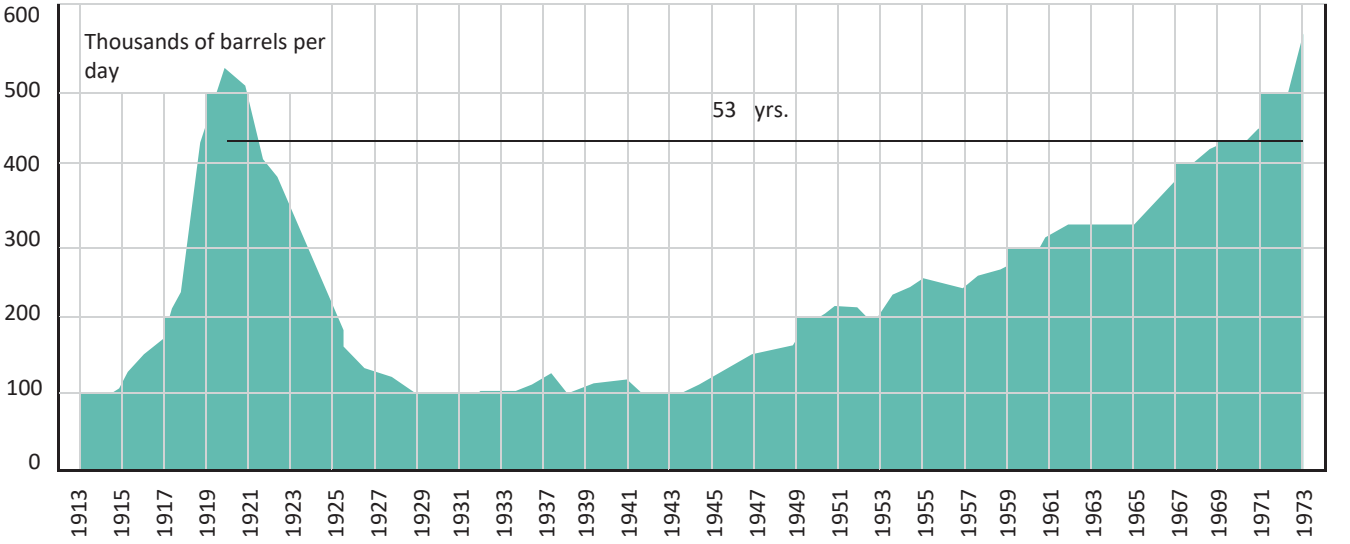
GDP Growth vs. Inflation (1957–1975)



Source: Bank of Mexico, Ministry of the Treasury and Public Credit, INEGI.

GRAPH 2

Mexican Oil Production (1913–1974)



Source: Statistical Yearbook, Pemex, various years.

The results are rather well-known: average annual GDP growth of 6.4%, which the population was growing at an average rate of 3%, representing a significant increase in the Mexican per capita GDP. The weak point of this model was the increasing underlying pressure from structural budget deficits, financed primarily by foreign debt, which paved the way for the hyperinflation and devaluations that occurred in the 1970s and '80s[12].

MODEL UNDER PRESSURE

The weak point of this model was the increasing underlying pressure from structural budget deficits, financed primarily by foreign debt.

With regard to the oil industry, from 1940 to 1970, operations continued primarily in the north of the country, with the discovery of the Camargo field in 1947, and the Valdecasas, Reynosa and Brasil fields in 1948. That same year, the first discoveries were also made in the south of the country, in the Sarlat and Moloacán (Tabasco) fields, and in 1949 the following fields were discovered: Francisco Cano (Tamaulipas, Nuevo León), Presidente Alemán and Alazán (Veracruz) and Fortuna Nacional and Tortuguero (southern Veracruz). These new fields helped to increase production. However, the backbone of national oil production remained the fields discovered between 1910 and 1925, which were already beginning their natural decline.

[8]*Aparicio, Abraham. Series Estadísticas de la Economía Mexicana del Siglo XX. [Statistical Series of the 20th Century Mexican Economy] Available at: http://www.economia. unam.mx/publicaciones/econinforma/369/06abrahamapariciocabrera.pdf*
[9]*De la Peña & Aguirre. De la Revolución a la Industrialización [From Revolution to Industrialization], Mexico, U.N.A.M., 2006, p. 329* [10]*Solís, Ricardo. México en Bretton Woods. [Mexico in Bretton Woods.] Am. Lat. Hist. Econ. 2011, n.35 [quoted 11-23-2017], pp. 333-339. Available at: http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1405-22532011000100019&lng=es&nrm=iso* [11]*Ricardo Torres Gaytán. Un Siglo de Devaluaciones del Peso Mexicano [A Century of Devaluations of the Mexican Peso], p. 308, Mexico, Siglo XXI, 1990.*
[12]*Romero, Indira. El Tipo de Cambio en la Economía Mexicana 1949 – 2002 [Rate of Exchange in the Mexican Economy 1949 – 2002]. Revista Bancomext. Available at: http://revistas.bancomext.gob.mx/rce/magazines/76/2/RCE.pdf*

IMMINENT BANKRUPTCY

In 1958, Pemex was headed for bankruptcy, and by 1959, the Mexican government had to convert its debt into sovereign debt.

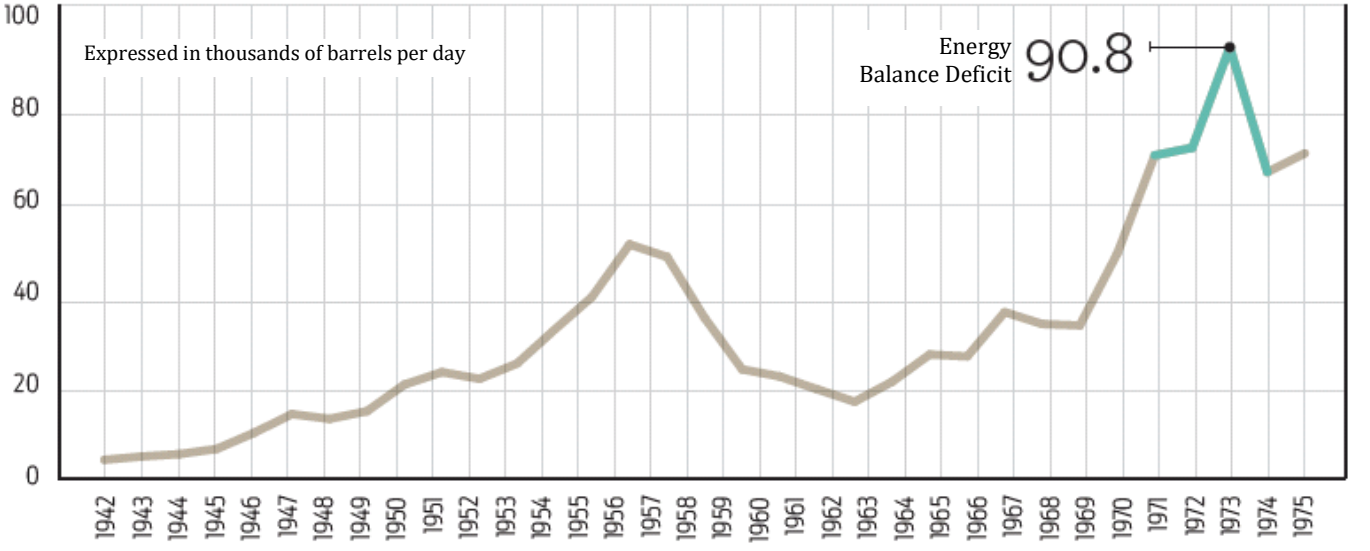
The import substitution policy also affected the Mexican oil industry in two ways: on the one hand, it stimulated the domestic production of equipment, spare parts and other industrial inputs used by Pemex, although these were often sold at higher prices than they were internationally, thereby raising costs. On the other hand, Pemex had to keep the prices of its products—particularly fuels— controlled, as an essential component of inflation control, via subsidies. In fact, between 1938 and 1958, while petroleum product prices rose no more than 185%, while cumulative inflation registered a combined increase of 458%[13].

The natural consequence of the price control of fuels was a significant increase in demand—per capita consumption increased eight fold between 1940 and 1948— but also an increase in imports. As a result of the "Mexican Miracle," a new and vigorous middle class traded fuel oil for gasolines, which were imported at market prices and sold in Mexico at subsidized prices. These dynamics spelled financial disaster for Pemex, which had been on the verge of bankruptcy since 1958 as a result of severe debt financed by loans and credits, most of which were foreign. The situation was so precarious that by 1959, the Mexican government had to convert Pemex's debt into sovereign debt[14].

That was when Pemex CEO Jesús Reyes Heroles (1964- 1970), framed the energy debate in a series of public policy decisions that crated the next version of the Mexican energy model. In his view, it was clear that the oil fields discovered in the first two decades of the 20th century were nearing the end of their life cycles and there was every reason to believe that by the early 70s, the country

GRAPH 3

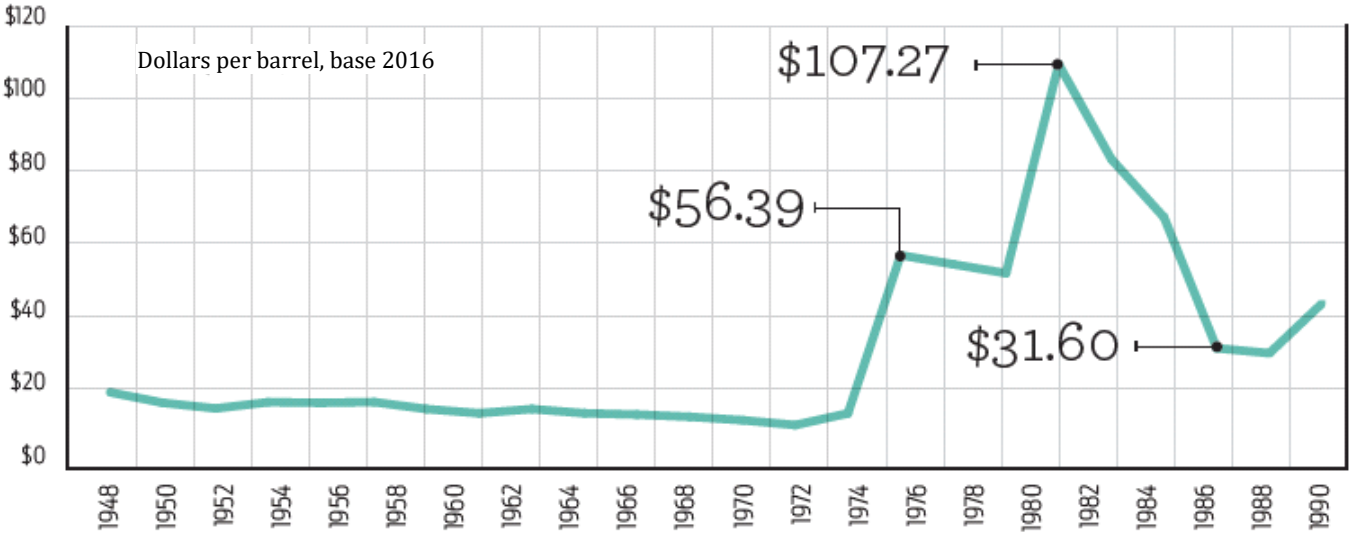
Petrochemical Imports (1942–1975)



Source: Statistical Yearbook, 1977, Pemex.

GRAPH 4

Brent Oil Price, 1948–1990



Source: U.S. Energy Information Administration.

would no longer be able to produce the hydrocarbons it needed, as a result of the staggering growth of the productive apparatus and of domestic consumption over the previous thirty years. Based on the data, Reyes Heroles was right: apparent domestic consumption of gasolines rose at an average annual rate of 7% between 1965 and 1970, as compared to 4.8% in the previous five-year period, covered by imports.

The Pemex CEO had a radical proposal: instead of continuing to rest on the laurels of Ezequiel Ordoñez and the 1920s investors, Pemex had to redouble its efforts, take risks like a great exploration company and make a commitment to knowledge. Reyes Heroles identified talented young people and sent them to the best educational institutions in the world. He also created the Mexican Petroleum Institute (1965) and turned it into the great disseminator of knowledge and technology. This commitment to talent took root and yielded results almost immediately.

We must not lose sight of the fact that the early 1970s were extremely complicated years for the Mexican oil industry, because Reyes Heroles' projections were correct and in 1970, Mexico became a net importer of hydrocarbons, as shown in red[sic] in Graph 3. In the following years, crude imports rose from 672,000 barrels to more than 23.6 million barrels (1973), and the import of refined products followed suit.

The impact of the rising imports in the 1970s was magnified by a sharp increase in international oil prices, as a result of the 1973 OPEC Oil Embargo.

COMMITMENT TO KNOWLEDGE

Between 1964 and 1970, Jesús Reyes Heroles made knowledge the guiding star for Pemex. He founded the Mexican Petroleum Institute, committed to Mexican talent and offshore exploration.

[13]*Rousseau, Op. Cit.*
[14]*Morales, Isidro, "Pemex during the 60's. Crisis in Self-Sufficiency" p. 230, in The Mexican Petroleum Industry in the Twentieth Century, University of Texas, 2010*

A GREAT DISCOVERY

In 1976, the model developed by Reyes Heroles discovered the giant Akal oilfield, a fundamental pillar of Cantarell.

A decade later, Reyes Heroles' commitment to knowledge and professionalizing the industry began to bear fruit. In 1971, thanks to its new capabilities and knowledge, Pemex drilled the Chac 1 well, opening a new oil province, which just a few years later would lead to the discovery of one of the largest oil reservoirs in the world, Cantarell. With this, Pemex became the first State-owned oil company to demonstrate significant offshore ability.

The commitment to knowledge also bore onshore fruit, with the 1974 discovery of the Chiapas-Tabasco oil province, with the drilling of the Sitio Grande and Cactus wells. The great innovation in onshore exploration that preceded this discovery was the significant increase in drilling depth. At these heretofore unexplored geological horizons, Pemex found reservoirs that were high pressure, and thus highly productive. These newly-discovered fields were responsible for the resurgent national oil production, which broke the annual crude oil production record with 209,855 million barrels in 1974. This was the first time that the record 193.3 million barrel record, set in 1921, had been broken. More importantly, in a period of less than five years, Mexico regained its status as net exporter of oil.

After 53 years, Mexico was able to once again reach crude extraction volumes it had achieved in its former glory days. This time, the increase was maintained, since the following year, the record was again broken with more than 261.6 million barrels, a figure that had never before been reached15.

By 1976, the ongoing exploration in Campeche Sound confirmed the existence of the giant Akal oilfield, a fundamental pillar of the Cantarell reservoir, the sixth largest in the world. The successes continued, and in 1979, the drilling of the Maloop 1 well confirmed the discovery of the second most important reservoir in the country, which now anchors the active Ku-Maloob-Zaap oilfield, currently the most productive field in the country.

ACHIEVING SUCCESS

The successes continued. In 1979, Pemex drilled Maloob 1, which now anchors the active Ku-Maloob-Zaap oilfield, which is currently the most productive field in the country.

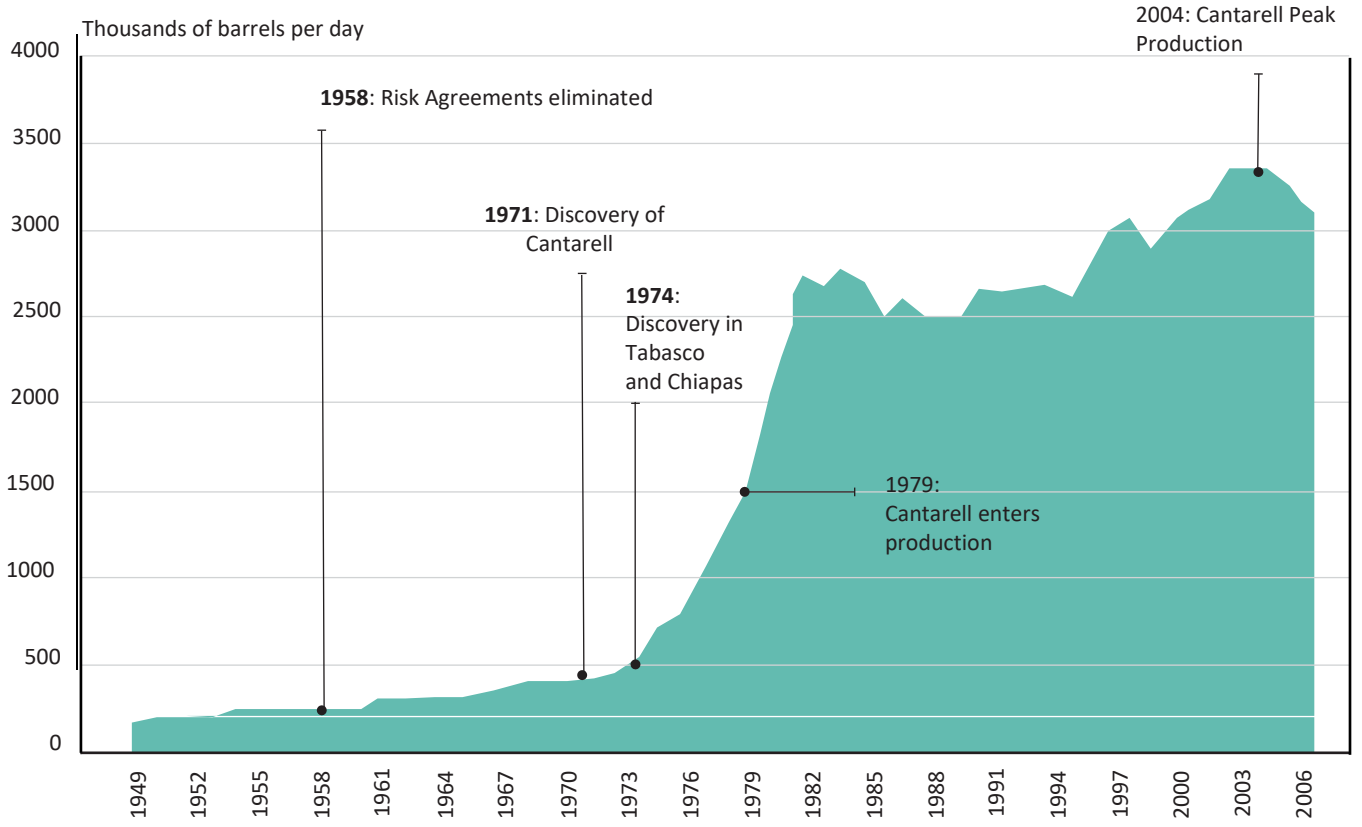
This is perhaps the most important period in the history of the Mexican oil industry. Contrary to the legend that claims that a fisherman pulled up oil in his nets, the true heroes were a generation of intelligent and hard-working oilmen who benefited from the drive for knowledge that led to the greatest oil discovery in our history. This great lesson—the commitment to knowledge, hard work and long-term vision—is the most important legacy of the history of our oil industry.

In addition to the important discoveries in Tabasco-Chiapas and Campeche Sound, Mexico's refining and petrochemical industry received an important boost with the inauguration of the refinery in Tula, Hidalgo, with a capacity of 150,000 barrels per day. The refineries in Azcapotzalco, Madero, Minatitlán and Poza Rica were also expanded to capacities of 105,000, 185,000, 270,000, and 38,000 barrels per day, respectively. In 1979, the Salina Cruz refinery was inaugurated, with the capacity for 165,000 barrels per day.

[15] *Pemex, Statistical Yearbook, various years.*

GRAPH 5

Mexican Oil Production (1949–2006)



Source: Statistical Yearbook, Pemex, various years.

TABLE 2

Pemex Investment, by sector (1972–1978)

Millions of dollars	1972	1973	1974	1975	1976	1977	1978
Exploration	$38.7	$39.2	$46.1	$72.0	$112.4	$80.8	$115.5
Exploration Drilling	$98.6	$88.6	$110.1	$122.6	$130.2	$142.1	$209.0
Development Drilling	$99.6	$116.2	$148.6	$183.9	$191.4	$175.6	$365.0
Production	$46.7	$96.1	$118.1	$144.8	$256.3	$279.8	$527.7
Refining	$44.9	$62.3	$96.6	$259.2	$270.1	$356.2	$464.3
Petrochemicals	$44.8	$77.9	$96.1	$146.0	$258.1	$271.0	$493.2
Transport and commercialization	$90.4	$136.7	$94.8	$163.9	$222.0	$175.7	$598.0
Other	$5.3	$11.5	$10.7	$3.0	$3.2	$35.9	$132.5
Total	$468.9	$628.6	$721.0	$1.095.4	$1.517.	$1.517.	$2.905.1

Source: Statistical Yearbook, Pemex, various years.

FRUITS OF THEIR LABOR

Contrary to the legend that claims that a fisherman pulled up oil in his nets, the true heroes were a generation of intelligent and hard-working oilmen who made the greatest oil discovery in our history.

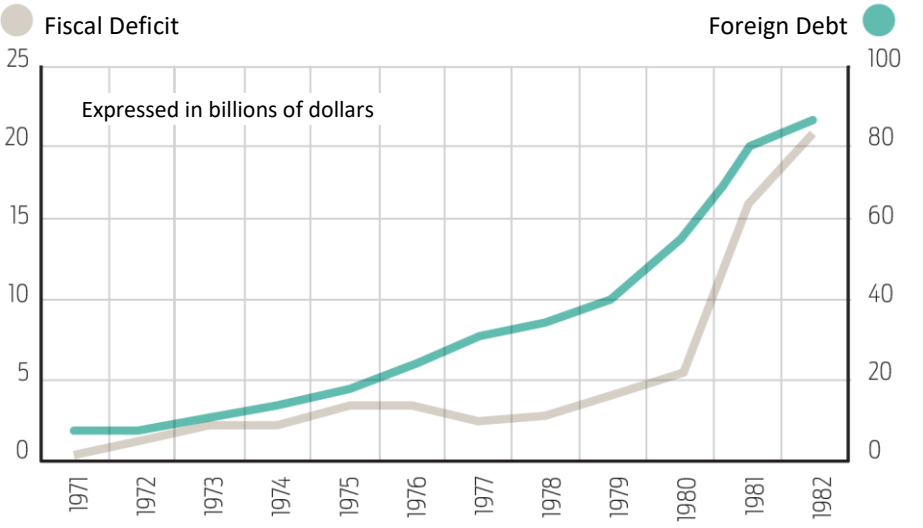
OIL EXPANSION

The large-scale expansion of Pemex in the 1970s and '80s along the entire value chain -from exploration to refining and pipelines- was financed by issuing foreign debt, which in fact, quadrupled in the space of just four years.

However, all of this expansion in exploration, production and the rest of the value chain was financed by issuing foreign debt, which in fact quadrupled in the space of just four years. Financing all of Pemex's expansion with debt, and using our oil wealth as collateral to finance many of the government's programs[16], was the great weakness of this model. Between 1973 and 1981, Mexican foreign debt rose at an average of 30% per year, from 4.0 billion dollars to more than 80 billion dollars17, and for its part, the fiscal deficit of 1981 was 14.7% of the GDP. In the medium and long term, this dynamic led to the petrolization of public finances and the economy as a whole. For example, the role of oil in our exports went from 4.8% in 1975, to 31.4% in 1978 and peaked at 77.6% in 1982.

GRAPH 6

Mexican Fiscal Deficit and Foreign Debt (1971–1982)



UNSUSTAINABLE MODEL

With what was once known as the Shared Development Model (1970-1976), the country sought to maintain the high growth rates of the "Mexican Miracle" at all costs via unsustainable increases in government spending.

Domestically, with what was known as the Shared Development Model (1970-1976), the country sought to maintain the high growth rates of the "Mexican Miracle" at all costs via unsustainable increases in government spending. This, in turn, deepened the severe budget deficit that, in addition to the debt, was covered by the Bank of Mexico's excessive issuance of currency. This began to put pressure on the rate of exchange that eventually led to the depreciation of the peso and the subsequent inflationary spirals.

In August of 1976, the government devalued the currency for the first time, abandoning the $12.50 parity for $15.69 pesos per dollar; however, this measure was not sufficient and on December 1, 1976, it declared a second devaluation, with which the price per dollar reached 22.76 pesos. In less than 15 months, the Mexican peso lost nearly half its value against the dollar.

[16] *Ibid*
[17] *International Monetary Fund, The Mexican Crisis: No Mountain Too High? Available at: https://www.imf.org/external/pubs/ft/history/2001/ch07.pdf*

TABLE 3

Select Economic Indicators (1972–1976)

Year	Annual Inflation	Unemployment Rate	International Reserves Millions of dollars	% GDP	Gross National Debt Millions of dollars	% GDP
1972	5.56%	N.D.	$1,284.70	2.84%	$5,064.60	11.21%
1973	21.37%	7.5%	$1,406.90	2.55%	$7,070.40	12.79%
1974	20.6%	7.2%	$1,443.90	2.01%	$9.975.00	13.86%
1975	11.31%	7.2%	$1,608.90	1.83%	$14,449.00	16.42%
1976	27.2%	6.7%	$1,411.30	2.06%	$19,600.20	28.59%

Source: Rousseau, Op.cit., p. 261

In short, the weakness of our government finances, caused by basing the entire development of the energy model on the acquisition of debt, and the concurrent petrolization of our economy, as manifested by the dependence on oil for the growth of our exports, placed us in an extremely vulnerable position. When interest rates around the world began to rise to bring down inflation, the weight of our foreign debt became unsustainable. What is worse, when international oil prices fell from 36.83 dollars a barrel in 1980 to 29.55 dollars a barrel in 1983, we were facing a true economic crisis18.

FINANCIAL WEAKNESS

The weakness of our government finances was caused by basing the entire development of the energy model on the acquisition of debt, and the petrolization of the economy.

The downward price trend would not abate until 1986, when it hit bottom at 14.43 dollars a barrel, slightly less than one third of the price in 1980. Mexico, which had staked its future development on hydrocarbons, found itself with insurmountable levels of debt and a product, i.e. petroleum, whose price had fallen through the floor. The inevitable result was a foreign debt payment crisis that nearly drove us into bankruptcy, wiped out several years of our economic development and created a series of devaluations and hyperinflation that decimated our savings.

The costs of the crisis were devastating and inflation returned with a vengeance: according to Bank of Mexico data, by April of 1983, the annual inflation rate had risen to 117.25% and, with the second drop in oil prices in 1986 and 1987, the annual inflation rate reached a historical maximum of 179.73% in February of 1988. As a whole, the fallout from these administrations wiped out two decades of growth and decimated the purchasing power of millions of Mexicans19.

Over time, thanks to consistent macroeconomic discipline and the switch to an export-oriented model that reduced our dependence on debt and oil, we are beginning to gain ground.

[18]*Morales, I. Escalante et al. La Formación de la Política Petrolera en México [The formation of Oil Policiy in Mexico], 1970-1986, p. 170-172, Mexico, El Colegio de México, 1988.* [19]*Sgard, Jerôme. México: la crisis de la deuda de los años 1980's [Mexico: the debt crisis of the 1980s]. p. 3, Amérique Latine Political Outlook 2012. Available at: http://www.sciencespo.fr/opalc/sites/sciencespo.fr.opalc/files/Crisis%20mexicana.pdf*
[20]*International Monetary Fund, The Mexican Crisis: No Mountain Too High? Available at: https://www.imf.org/external/pubs/ft/history/2001/ch07.pdf*

1986

year in which Mexico joined the GATT and began its transition into an open market economy. This process continued when the North American Free Trade Agreement took effect in 1994.

For the energy sector, which was at once the cause and the principal victim, the impact was devastating. Not only was it now impossible for Pemex to generate value based on a commitment to knowledge and exploration, but it could no longer invest in its own infrastructure or ability to transform itself. We had to pull the country out of the fiscal hole and debt spiral, and to do so, the production of oil was given priority over any other type of hydrocarbon.

In order to curb inflation, even stricter price controls continued to be placed on fuels, while the wealth promised by Cantarell's production was used as collateral for the 1981-1982 financial rescue[21].

As part of the negotiations for the financial rescue package, several measures had to be adopted: financial discipline in public finance (deficit, debt levels, etc.) and the commitment was made to promote reforms (such as commercial and financial liberalization, the privatization of many State-owned enterprises, and the easing of the foreign investment policy)[22]. This was the framework in which Mexico decided to join the General Agreement on Tariffs and Trade (GATT) —the precursor to what is now the World Trade Organization—in 1986.

This decision meant the end of the import substitution policy and at the same time paved the way for a more open market economy, which became a reality in 1994, with the signing of the North American Free Trade Agreement (NAFTA). The only sector that would be excluded would be the energy sector, which would remain closed to any sort of liberalization.

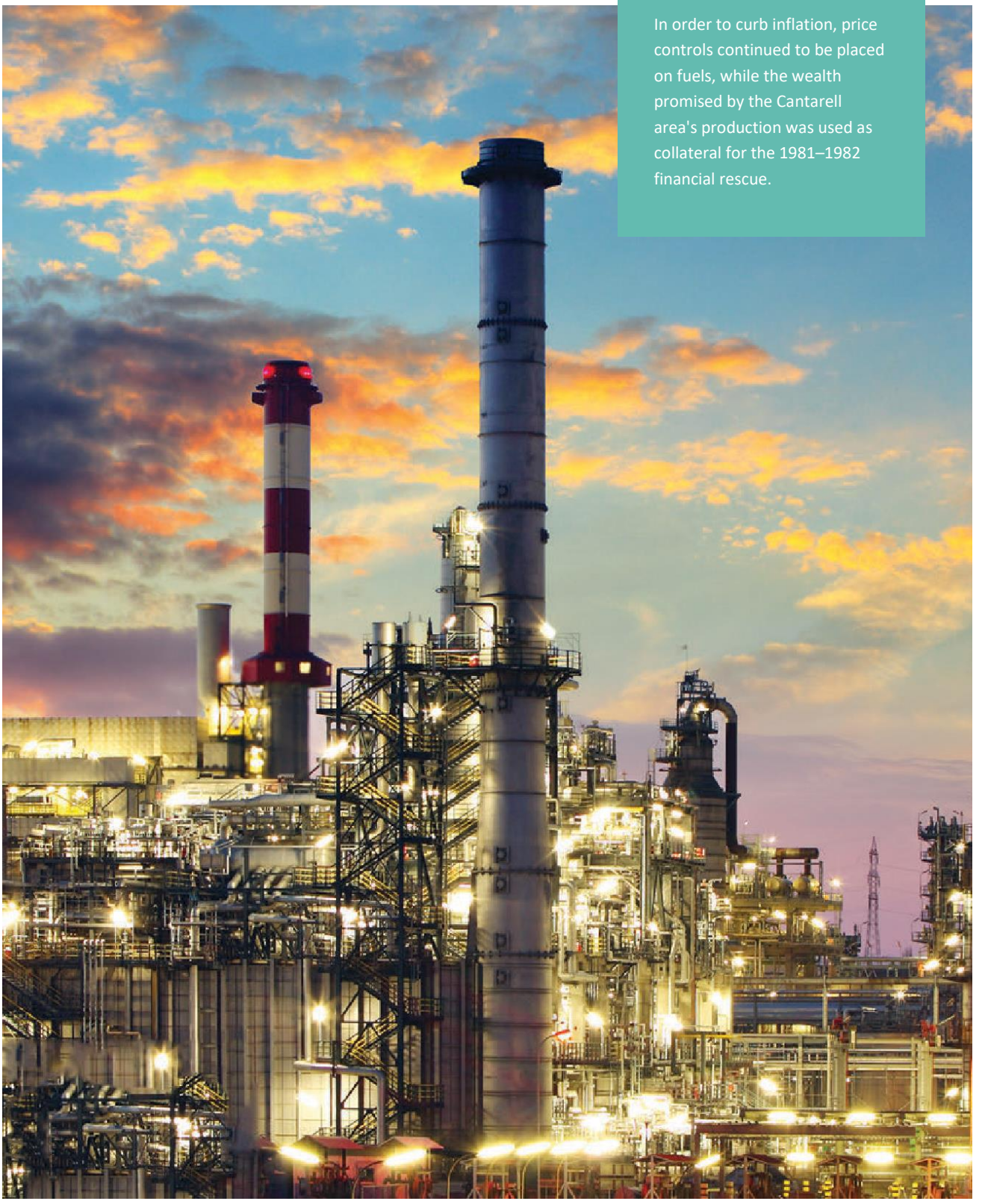
EXCLUDED SECTOR

The only sector that was excluded was the energy sector, which remained closed to any type of private investment.

NAFTA deeply changed Mexico. For one thing, many companies and sectors that had been created in the framework of a closed and subsidized economy in decades past were unable to survive in a competition-based environment —due to their lack of investment in processes that would have made them more competitive. On the other hand, this process of creative destruction23 facilitated the accelerated development of important economic sectors such as manufacturing, which allowed Mexico to find, in the liberalization, its potential as an export powerhouse.

The unilateral liberalization of the economy and the signing of free trade agreements strengthened the incipient competition, at times distorted by large monopolies and price controls, such as for example in the energy sector. The distortions created by an open model with a [closed] energy sector caused many problems, which we shall discuss later on. Despite this, the new commercial openness and stable public finances finally allowed the country to fully industrialize. Today, Mexico is a leading exporter of an infinite number of industrial products, including electronics, medical instruments, automobiles and aerospace products.

Another sector that benefited was Mexican agriculture, which just a quarter century ago consisted of subsistence farmers, now is not only increasingly competitive, but is also a formidable producer and exporter of an immense array of legumes, fruits and vegetables.



In order to curb inflation, price controls continued to be placed on fuels, while the wealth promised by the Cantarell area's production was used as collateral for the 1981–1982 financial rescue.

PHOTOGRAPH: CANSTOCKPHOTO

PRODUCTION DEPLETION

In the 1990s, Cantarell began to become depleted, and in response the nitrogen injection process was begun to increase pressure in the reservoir and increase production.

In addition, the international stature of Mexican companies has grown considerably, since they now not only export, but also invest around the world, and control assets in all continents and industries, from the food industry, to construction materials, to the most advanced manufacturing. The oil sector remained on the sidelines, clinging to the policies created in the 1950s, oil industry investment remained limited to the government budget for a long time, despite the fact that other sectors had been opened up considerably.

The progress made in the economy, however, did not mean that Mexico was free of challenges, including various crises that originated abroad, and one large internal crisis. However, our ability to respond and recover was much better than it was in the seventies and eighties. The crisis of 1995, for example, involved the contraction of our economy by nearly 7% and a significant devaluation, but unlike in the past, the foundations for growth were now supported by three fundamental pillars: the Bank of Mexico's constitutional mandate to combat inflation, the commercial openness throughout nearly all of the economy, and a freely floating exchange rate. These three pillars allowed the country to come out of the crisis quickly, and achieve GDP growth of 6 percent by the third quarter of the year 2000[24]. What is more: since the 1940s, that was the first time a new administration took office without an economic crisis.

At the same time, the stability of the government finances finally made it possible to reinvest in the energy sector, although without the multiple tools the rest of the economy had available to it. Thus, as of 1997, the Mexican government began to give Pemex larger and larger budgets, above all for the purpose of increasing oil production, but also to finance various refinery reconversion efforts.

PRODUCTION GROWTH

By August of 2003, Mexico had succeeded in raising its production to 3.38 million barrels per day, of which 2.1 million came from Cantarell.

This was no small challenge. In the mid-1990s, Cantarell began to show signs of depletion and the decision was made to execute one of the largest interventions in the history of global petroleum engineering: injecting nitrogen into the Akal reservoir so as to maintain pressure and thereby maintain and increase the production of hydrocarbons. Although injection and other secondary and tertiary recovery methods were not new, no company had yet attempted to use them on the scale that Pemex did. The nitrogen injection project began in 1997 and consisted of building a nitrogen plant in Atasta, Tabasco, and from there supplying 1,200 million cubic feet of nitrogen per day to the reservoir. The project was successfully completed in the year 2000 and the results were not long in coming.

In just three years, by August of 2003, Mexico had succeeded in raising its production to 3.38 million barrels per day, of which 2.1 million barrels per day came from Cantarell. This level currently remains the country's target production level.

[21] *Van Wijnbergen, Sweder. Mexico and the Brady Plan. Economic Policy, Vol 6. No. 12. Available at: http://www.jstor. org/stable/1344448*

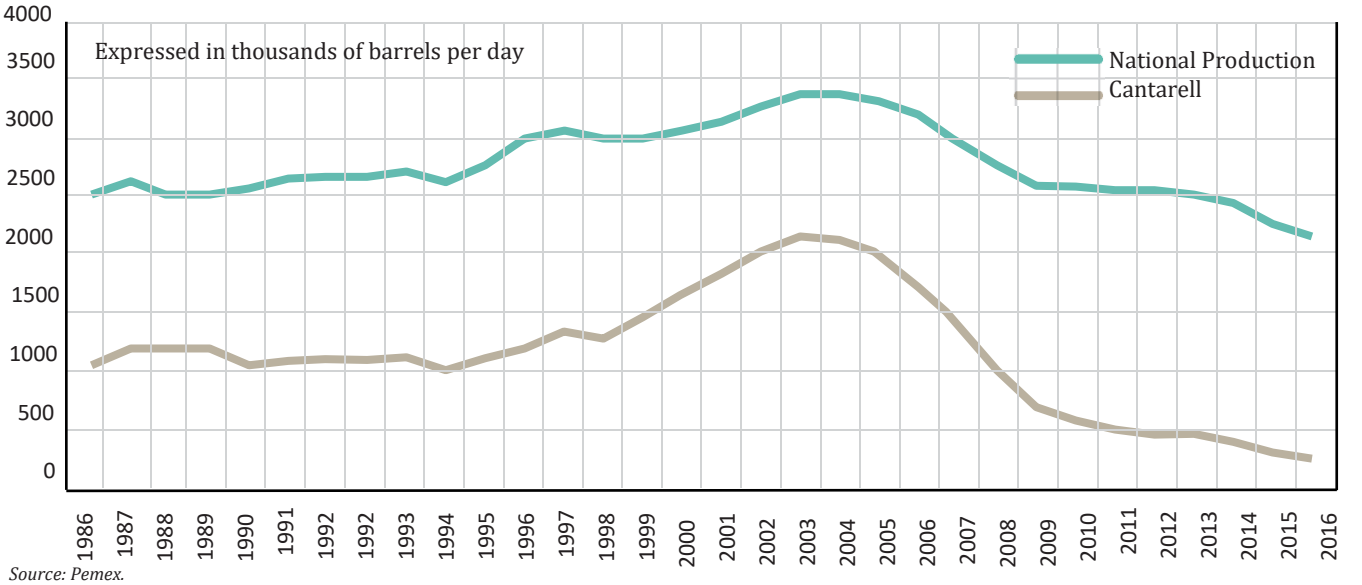
[22] *International Monetary Fund, The Mexican Crisis: No Mountain Too High? Available at: https://www.imf.org/external/pubs/ft/history/2001/ch07.pdf*

[23] *Schumpeter, Joseph, Capitalismo, socialismo y democracia [Capitalism, socialism and democracy], 1942.*

[24] *National Institute of Statistics and Geography INEGI.*

GRAPH 7

Mexican Oil Production (1986 – 2016)



Source: Pemex.

However, once again the investment was made with debt, which, while more manageable than in the past, reflected the insufficient tools that we as a country had as a result of maintaining a closed energy sector, exclusively dependent upon a single operator financed entirely by government funds. Moreover, while we had released our economy from its dependence on petroleum, this was not true of the government's finances, in which the low tax revenues collected by the government were offset by a high degree of dependence on income from Pemex.

In 1994, the situation was exacerbated when the Congress taxed Pemex's income at a rate of 60.8%—including the Special Tax on Products and Services (IEPS) applicable to gasoline and diesel. This decision was essential for the stability of the government's finances and laid the groundwork for the current stability. However, it deepened significant biases in the internal decision-making process at Pemex, where extraction activity was prioritized at the expense of all other areas of the business— including exploration— and crude oil production projects were prioritized at the expense of non-associated natural gas projects.

What is more, the disconnect between our open and competitive economy and our closed energy sector became even worse. Pemex's investments acquired an eminently fiscal character, lacking the incentives to serve the needs of the country's productive apparatus, or otherwise to adapt to a world in a rapid process of technological transformation. The inevitable result was that the energy sector, rather than contributing to our competitiveness as a nation, began to become a burden.

For example, in 1992, the Federal Electricity Commission (CFE) launched an aggressive

ECONOMIC PILLAR

As of 1982, oil production once again became a pillar of government finances, on which macroeconomic stability rested. As a result, Pemex prioritized extraction activity at the expense of any other area of the business, including exploration.

LAGGING SECTOR

While the country was becoming more and more competitive, the energy sector continued to lag behind, despite significant investments that began in 1997 and continued over the next twenty years.

program to reconfigure its electricity generation capacity, adopting combined-cycle plants so as to take advantage of competitive gas prices, reduce emissions, and improve its power generation capacity. Despite its importance for the national economy and for another State-owned company, Pemex was unable to guarantee it had the ability to cover future demand for hydrocarbons. Not only that, but since no one else other than Pemex was authorized to produce hydrocarbons in this country, the CFE had no choice but to buy imported gas, when we had abundant reserves.

In this particular case, the CFE—the largest consumer of natural gas in Mexico — went out in search of alternative sources of supply and signed contracts to import it via pipeline and via Liquid Natural Gas (LNG) regasification terminals. This contract made it possible to build and operate a LNG regasification plant in Altamira to supply the CFE's power plants and those of private investors in the area. The country later built an additional two plants to meet the growing demand for gas for electric power generation and industry.

But in general, while the country was becoming more and more competitive, the energy sector was lagging further and further behind, and despite substantial investments — which began in 1997 and continued over the next twenty years— Pemex was unable to keep pace with an economy that was becoming ever more diverse, more vibrant and more remarkable in highly competitive areas. Instead of an engine of growth, the energy sector had become a burden.

It gradually became clear that the model based on the autarchic vision of import substitution had run its course and that government investment, despite being ever more significant, was not sufficient. By all accounts the energy sector needed a profound reform, but the political conditions were not ripe for making the changes the country needed. In fact, throughout this period, from the time of the trade liberalization until just a few years ago, there was a great and interesting debate on the challenges and potential of the Mexican energy sector. This conversation focused on how to bring the country's energy model and its economic model into alignment with each other. It was also a period of many failed attempts and incomplete reforms.

NEW ENERGY MODEL

The passage of the New Energy Model in 2013 and 2014 was the culmination of one of the deepest and most interesting debates on the role of government and our national destiny. It was a long conversation with more than 30 years of arguments, reflection and at times, disagreement.

1.2 A thirty-year conversion: dilemmas and paradoxes

The passage of the New Energy Model in 2013 and 2014 was the culmination of one of the deepest and most interesting debates on the role of government and our national destiny. It was a long conversation with more than 30 years of arguments, reflection and at times, disagreement. As such, the genesis of our energy model is the story of one of the most thought-out decisions ever made in our country.

It deserved nothing less. This decision was at the intersection of several important vectors of our national identity and the future of our economy. Clearly, it could all be traced back to the inalienable nature of the nation's ownership of underground resources; on this point, the parties were in

agreement. The disagreement arose when discussing how to improve the generation of oil wealth for the wellbeing of society.

At the time, the discovery of Cantarell, which promised to catapult Mexico into an era of abundance and social justice, gave rise to one of the most important debates in the national oil industry: should it be developed as quickly as possible, or should it be done at a slower, more deliberate pace?

This discussion is related to a more general reflection on the role of hydrocarbons in the modern economy. On the one hand was the argument that the hydrocarbons may suddenly be replaced by new sources of energy—such as nuclear energy in the 60s and 70s, or by renewable energies today. This argument pointed to the case of agave fiber production in Yucatan, which almost completely disappeared when petroleum-based synthetic fibers were developed. According to this argument, the petroleum should be extracted quickly before it became obsolete and worthless.

Others thought that a steady pace of hydrocarbon exploration and production would make it possible to more effectively plan for the potential decline of hydrocarbons in the future energy matrix and their role in national development. Along these lines, the argument was that if the sector were liberalized, the pace of oil extraction would no longer depend exclusively on the availability of State resources, but would be supplemented by private investment via annual bidding processes.

What is more, this discussion opened another discussion as to which was better for Mexico: some argued that it was preferable to depend on a single company, though production were limited, as happened in the past; others argued that it was better to increase production —and oil revenue— and thereby multiply execution capacity and the number of companies able to develop projects.

This debate was illustrated using the following analogy: is it better to have the entire pie for ourselves, even though it is small, or be willing to give a small piece to third parties, in exchange for having a larger pie for us? Here, it generally became difficult to argue against the math. A larger pie was better for the country.

The thought processes became even more interesting when they ceased to be abstract and were placed in the context of the national reality. At the heart of these discussions was the disconnect between the energy model—at that time based on a state model and import substitution principles—and the national economic model, based on economic liberalization and competition among many public and private economic actors, with a clear focus on exports.

The old autarchic production model was barely sufficient for a small economy that was not highly industrialized and much less diversified, that exported raw materials without generating any added value in the process. In other words, Mexico in the 1940s or 1980s. By the early 21st century, it had been a long time since the Mexican economy had behaved like that.

PACE OF PRODUCTION

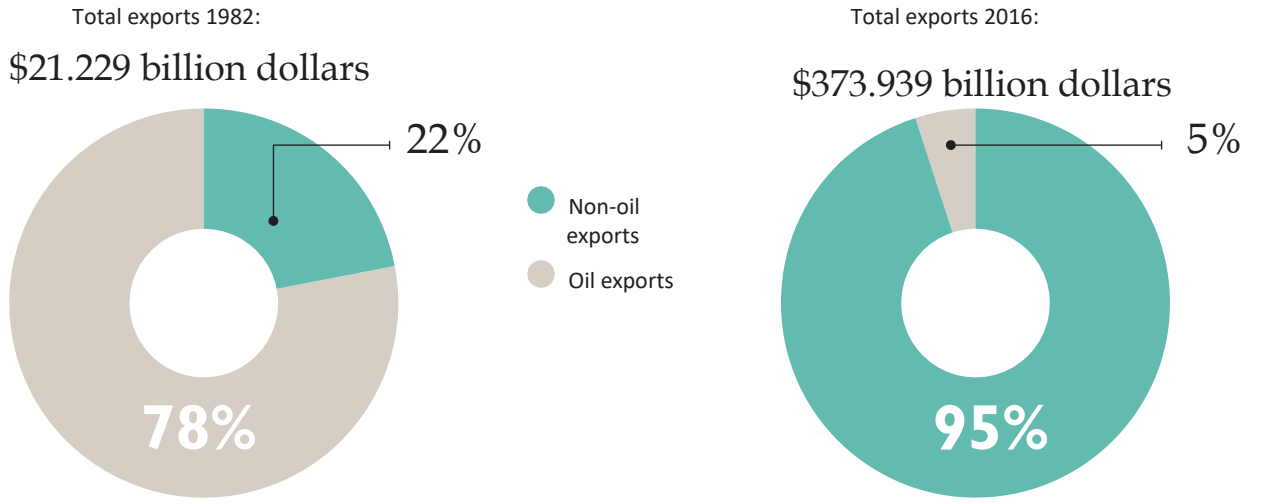
A steady pace of hydrocarbon exploration and production would make it possible to more effectively plan for their potential decline in the future energy matrix and their role in national development.

INSUFFICIENT MODEL

The old energy model was barely sufficient for a small economy that was not highly industrialized and much less diversified. An economy that exported raw materials without generating any added value in the process.

GRAPH 8

Mexican oil and non-oil exports (1982–2016)



Source: INEGI.

MANUFACTURING GROWTH

After long periods of macroeconomic stability and the signing of free trade agreements with more than 40 countries, Mexico had become a manufacturing powerhouse that required more energy every day.

After long periods of macroeconomic stability and the signing of free trade agreements with more than 40 countries, Mexico had become a manufacturing powerhouse that required more energy and petrochemicals every day in order to remain competitive.

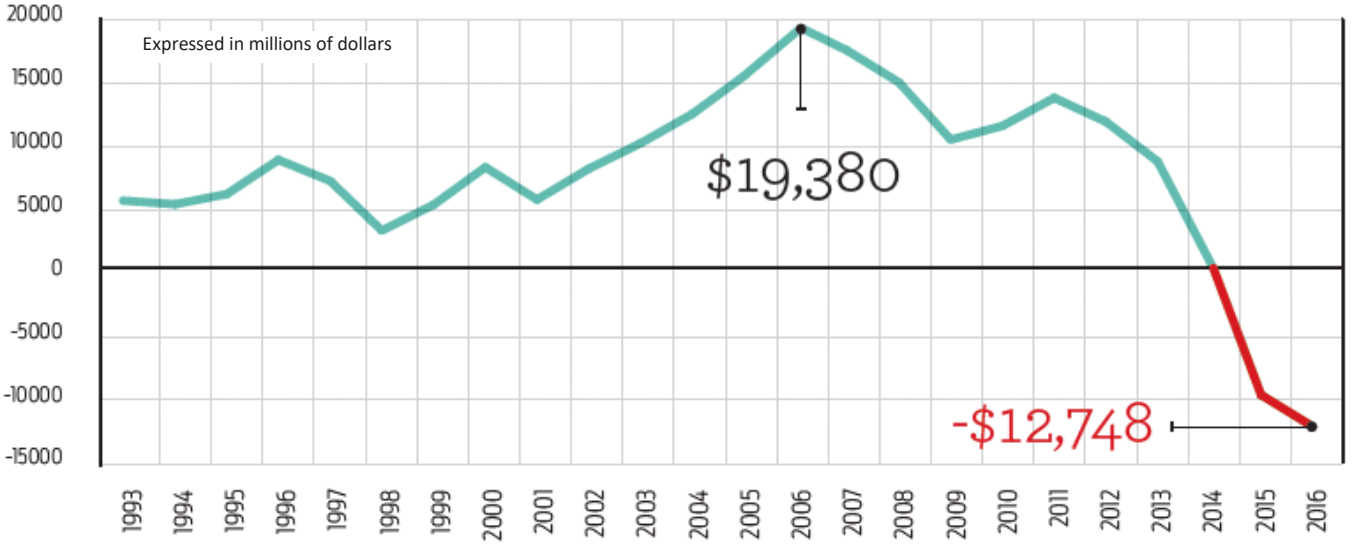
This demand for energy and petrochemical products could not be efficiently met, since on top of the autarchic production model, Mexico had built a State monopoly on the import and export of hydrocarbons. It was not just a matter of the ownership of the subsurface, underground resources and their exploitation, but of a lack of mechanisms with which to meet the demand on the part of the State monopoly of production, importation and commercialization in the downstream sector and part of the petrochemical sector.

Only the CFE, a State-owned company, had the freedom to access international markets in search of the supply that Pemex was unable to provide. Private companies lacked this freedom and as such, were forced to restrain their growth, manage their demand or use expensive energy, thereby rendering themselves less competitive. Investors began to look for destinations with more reliable energy supplies, particularly in Asia. The situation worsened when China joined the World Trade Organization (WTO), in December of 2001. This set up a fierce competition between Chinese and Mexican exports due in part to the fact that the Asian giant's entry into the WTO increased the predictability of trade with China. The impact was soon felt: hundreds of factories shut down in various parts of the country, in particular along the United States-Mexico border, and moved their operations to China. In those years it became clear that in corporate cost structures, Mexican energy was not competitive.

GRAPH 9

Petroleum Product Balance (1993–2016)

Source: INEGI.



This became the great paradox that is key to understanding the relevance of the Energy Reform of 2013: an energy-rich country with enormous potential from many sources—hydrocarbons, geothermal, wind and solar—was incapable of providing reliable, competitive energy to its industry.

This indisputable fact offered the first clues to this debate: the Mexican energy sector, due to the restrictions and priorities discussed, could provide no certainty with regard to the supply or availability of energy to meet the country's growing needs. Faced with the inability to reach agreements to develop our own capacities, we had no other choice than to substantially increase imports.

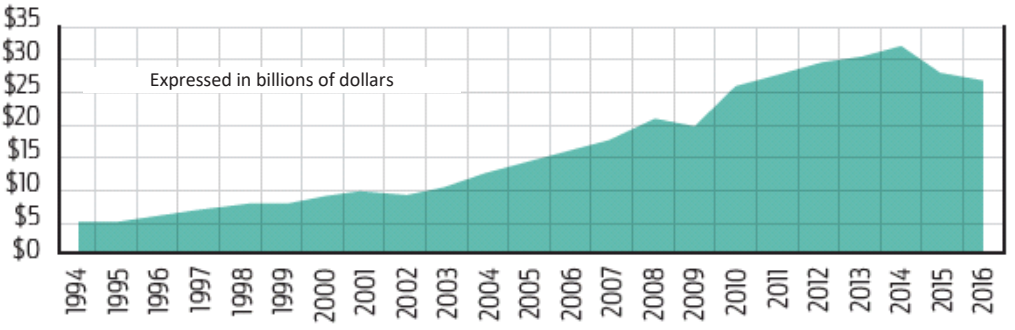
The clearest example, due to its volume and importance, is the case of petrochemical imports: since NAFTA took effect, the demand for petrochemicals—essential for the manufacturing industry—had tripled, while domestic production remained unchanged.

CONSUMPTION VS. PRODUCTION

Since NAFTA took effect, the demand for petrochemicals—essential for the manufacturing industry—had tripled, while domestic production remained unchanged.

GRAPH 10

Petrochemical imports (1994–2016)



Source: Mexican Chemical Industry Association

WITH HISTORY

The Mexican and U.S. energy industries are, along with Russia's, the oldest in the world.

One of the key discussions that arose with regard to the energy sector in the last forty years involved the advances and achievements in terms of drilling, energy infrastructure and the electrification of the country.

The Mexican and U.S. energy industries are, along with Russia's, the oldest in the world. At the time the 21st century energy model was being discussed, Mexico, as we said at the beginning of this chapter, had been one of the top global producers of hydrocarbons for some 110 years and had been the cradle of some of the most revolutionary methods of their time in the oil industry, such as the active use of geology in prospecting (Ezequiel Ordonez), offshore production (Reyes Heroles) and nitrogen injection (Cantarell), just to name a few. However, despite this impressive legacy, the country was lagging behind.

For example, a drilling map of Mexico and the United States along the Gulf of Mexico shows that on the Mexican side, the oil and gas activity is in its infancy—even now after the first rounds of bidding have taken place—while on the other side of the border, the drilling density is much more intense and dynamic.

Map of Drilling Density in the Gulf of Mexico

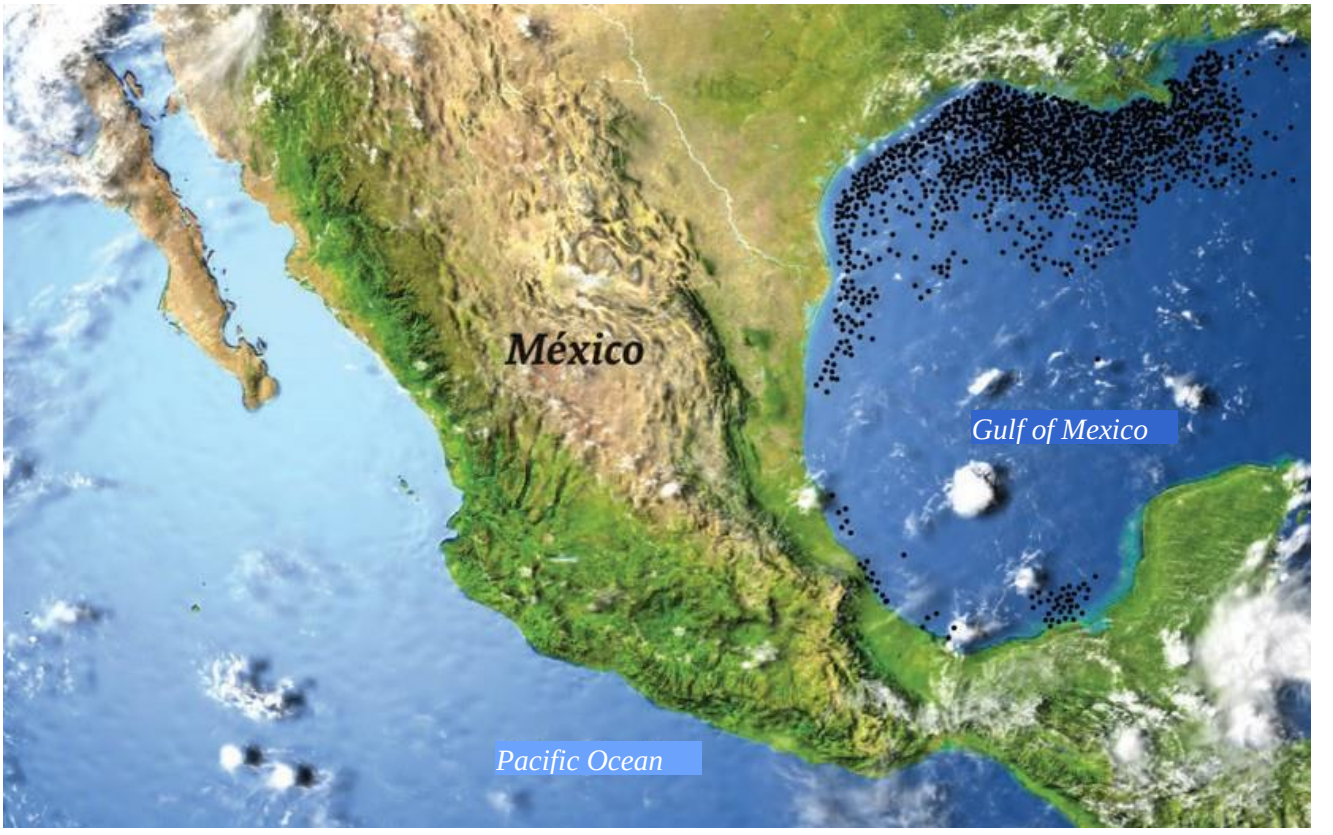


PHOTO: SHUTTERSTOCK

The same asymmetry exists between the two nations with regard to energy infrastructure, particularly pipelines, as well as the quantity and quality of the electricity in the two countries. Here is where we can see the difference between the two models, the Mexican model in which a single company tried to do it all and the U.S. model, in which hundreds of companies have dramatically increased our neighbor's execution capacity.

Essentially, what was being debated was how to increase the country's execution capacity.

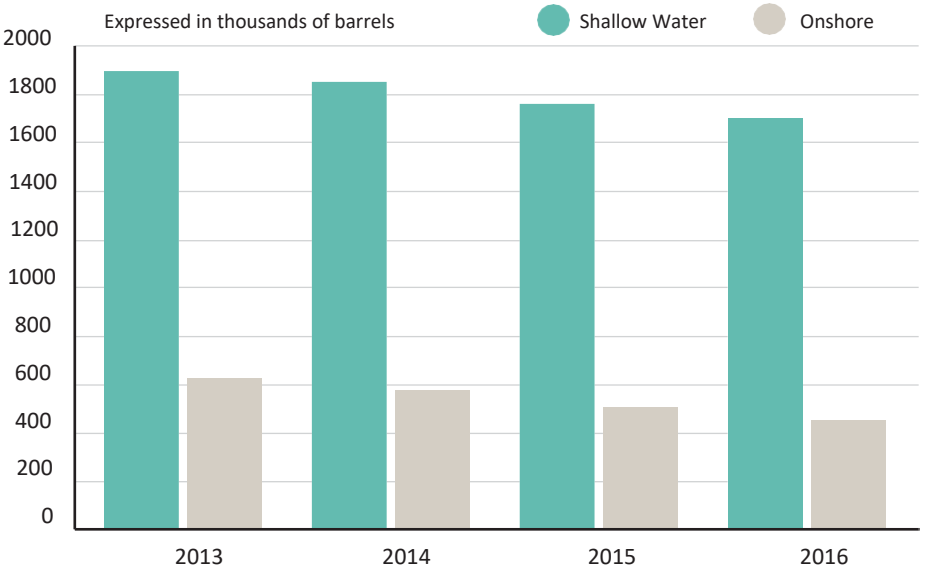
Some argued that increasing Pemex's budget would be sufficient, and that way Mexico would invest in refineries and production, and be able to meet its needs. This view, which we shall explore in greater detail later, sidestepped the fact that record amounts were already being invested in Pemex, and its budgets were at times on a par with the largest companies in the world. But, the challenges were so enormous, that it would simply take years to correct all the deficiencies, never mind serve as a dynamo to give Mexican exporters the competitiveness they needed.

CHALLENGES AHEAD

Record amounts were already being invested in Pemex, and its budgets were at times on a par with the largest companies in the world.

GRAPH 11

Mexican Oil Production by Resource (2013–2016)



As of that time, there was no deep water production or production of unconventional resources.

Source: Report 20-F, 2016, Pemex.

The closed vision meant that only those resources that Pemex could handle would be developed—and oil revenue generated—at whatever pace and using whatever processes Pemex had available. On the other hand, the open vision—in step with the rest of the economy—would involve multiple companies coming together, of varying sizes and specializations. So, while the autarchic vision was based on a sequential process, the New Mexican Energy Model would allow for simultaneous operations. All for the benefit of the country.

EXCHANGE TO GROW

Mexico should aspire to increase trade with the entire world, to expand its growth potential for the wellbeing of the population. The goal of self-sufficiency limits this potential.

However, one of the most common criticisms of the liberalization idea had to do with a very specific idea of energy sovereignty, which argued that if multiple Mexican and foreign actors were allowed to participate in the energy industry, Mexico would lose sovereignty. However, this line of thought is based on falsely equating sovereignty with energy self-sufficiency. Upon closer examination, various cracks appear in the argument regarding the concept and implications of self-sufficiency.

The goal of self-sufficiency is incompatible with an open economy, or with one of the largest economies in the world. Self-sufficiency inevitably promotes the autarchy that limits growth. A country like Mexico should aspire to increase trade with the entire world, to expand its growth potential for the wellbeing of the population. The goal of self-sufficiency limits this potential.

What is more, self-sufficiency is only an illusion. No country is self-sufficient. The United States, despite its amazing energy revolution, imports 8.3 million barrels of oil a day, primarily from Canada, Saudi Arabia, Venezuela and Mexico. Venezuela, which has the largest reserves in the world, imports 5,000 b/d of oil from Ecuador and Algeria. Brazil, which has a State-owned oil company that has led some of the largest discoveries in recent years and maintains an import-substitution model, imports more than 215,000 b/d of refined products from the United States. Meanwhile, Japan and Singapore, who have no significant hydrocarbon reserves in their territory, are among the top refining powerhouses in the world, capitalizing on their industrial and organizational capacities by importing hydrocarbons from third parties.

GROWTH POLICIES

To be able to grow, a country must have policies that ensure the availability of energy, no matter where it comes from, and the best way to ensure it is by having multiple actors coming together and interacting with each other in a market that facilitates exchange, with low operating costs.

Mexico is no exception. According to data from the Bank of Mexico, our country has imported gasoline and fuel oil since 1938. In addition, it even imported oil between 1972 and 1974. Since 1980, Mexico has been a net importer of petrochemicals. In terms of energy trade balance, it had deficits from 1942 to 1960, and again in recent years.

To be able to grow, a country must have policies that ensure the availability of energy, no matter where it comes from, since the availability of energy is key, and the best way to ensure it is by having multiple actors coming together and interacting with each other in a market that facilitates exchange, with low operating costs.

Those who argued that the whole problem would be solved by increasing Pemex's budget are generally referring to a budget situation the company had between 1982 and 1997, in which its ability to invest was indeed reduced. A situation that, by the way, was endemic to the industry as a whole, all around the world, due to the low price of oil at that time. However, and contrary to what is commonly believed, since 1997 and until a couple of years ago, Pemex has had the largest budgets it has ever had in its entire history. The last four administrations have given Pemex more resources over the last 25 years, than any of their predecessors.

In fact, on several occasions, Pemex's budgets have been on a par with those of the top international oil companies, or IOCs. This avalanche of resources, beginning in 1997, becomes clear upon examining Pemex's budgets between 1970 and 2014, the year in which the Reform was completed. It is clear that they have been brought down significantly over the last three years, in response to the sharp drop in oil prices, but it is also important to mention that Pemex's behavior has been similar and comparable to that of other large companies.

In other words, the country's energy problems were not due to an insufficient budget, but to the barriers against the participation of other players who would increase the country's execution capacity and thus be able to keep pace with the rest of the economy.

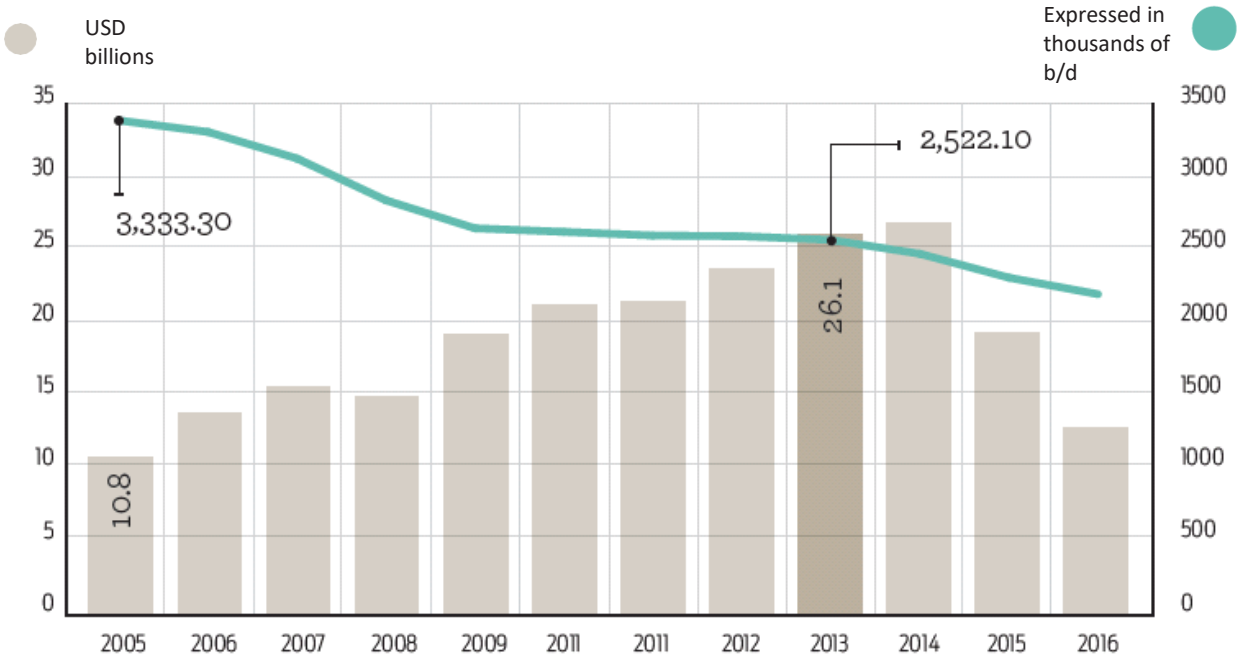
But this does not mean that the arguments in favor of increasing Pemex's budget were entirely wrong. In fact, as shown in the following graph, Mexico enjoyed a significant increase in production as Pemex's budget was increased and it was able to inject nitrogen into several very large shallow water reservoirs. Investments were also made in several high-risk exploration projects, but as shown in the same graph, production began to fall when said projects failed to produce the results that were hoped for.

BARRIERS TO PARTICIPATION

The country's energy problems were not due to an insufficient budget, but to the barriers against the participation of other players who would increase the country's execution capacity.

GRAPH 12

Pemex Investment and barrels per day produced (2005–2016)



Source: Annual Report, Petróleos Mexicanos and Statistical Information, National Hydrocarbons Commission.

HIGHS AND LOWS

In 2013, the investment in Pemex reached its historical high: 26.1 billion dollars. Despite this, production fell from 3.3 to 2.5 million b/d.

As shown in the graph, in 2013—the year in which the Energy Reform was completed—the investment in Pemex reached its historical high: 26.1 billion dollars. Despite this, production fell from 3.3 to 2.5 million barrels per day. In other words, over a period of just eight years, (2005-2013) investment grew by 14%, while production fell 25%.

The debate over increasing the budget as opposed to execution capacity revealed that one cannot work without the other. In other words, the key for Mexico being able to achieve its objectives was not merely allowing in other players, thereby promoting a competitive environment, nor did it consist solely of increasing Pemex's budget. The key was to do both.

Recent studies conducted by the International Energy Agency (IEA) have concluded that the only way for Mexico to return to 3.5 million b/d production would be by conducting successful exploration rounds and maintaining Pemex's budget levels. If both things are not done, the goal is not attainable.

Although we will discuss this in greater depth in later chapters, it is important to note that after only three years of reform, the Zama discovery—made by a consortium of private companies in shallow water— and Ixachí —an onshore discovery made by Pemex— are perhaps the best indicators of the synergy that is obtained when Pemex is allowed to focus on the areas in which it generates the most value and private companies assume the risk of finding value where none has been seen before.

EXPLORATION ROUNDS

The IEA has concluded that the only way for Mexico to return to 3.5 million b/d production would be by conducting successful exploration rounds and maintaining Pemex's budget levels.

Thus, by combining the idea of increasing execution capacity with that of increasing Pemex's budget, the discussion finally focused on the most important part of the entire debate: the importance of knowing how to manage risk in a closely competitive environment.

If there is anything that separates the hydrocarbon industry from other economic activities, it is the complexity of the risk involved. No other industry faces such a concentrated risk as the oil and gas industry. These risks are derived from various interconnected levels of uncertainty.

These include the exploratory, commercial, technological, political and social risks it faces in each of its projects, which often involve investment horizons of forty or fifty years. What is more, the risk is prevalent despite the use of some of the most advanced technologies in the world: complex calculations performed by supercomputers, advanced visualization and modeling based on data analytics, automated and at times, robotic, operations.

This is even more astonishing when we consider no human economic activity is possible without hydrocarbons. In other words, despite the most advanced technology, and the fact that hydrocarbons are at the heart of all economic activity, projects are more often failures than they are successes.

Oil projects face a complex universe of variables that could prevent them from reaching their targets, in other words, the risk is expressed in many different ways. The first expression of risk is geological. Despite the fact that we now have an advanced seismic industry that makes it possible to capture billions and billions of bits of geologic data, and advanced computational capacity with which to process and interpret it, we have been unable to eliminate exploratory uncertainty.

After spending years analyzing the data obtained from such seismic surveys, exploratory geologists determine areas where it is perhaps advisable to drill, in other words, to test whether the hypotheses and conjectures they have formed are correct. The day the drill bit finally bites into the Earth's crust, the geologists know that the most likely outcome is that oil will not be discovered in commercial quantities. In fact, at the time drilling commences, the likelihood of failure often ranges between 60 and 80 percent.

The next dimension of risk is commercial. Despite the plethora of available data on global supply and demand, the price of oil and gas has been shown to be impossible to predict. Two dimensions frequently intersect: one is geopolitical complexity. Oil, as a globally traded commodity, is highly vulnerable to revolutions, accidents, strikes and ideological shifts. Further complexity surrounds the psychological factors of supply and demand (present and future). All these elements make the price inscrutable.

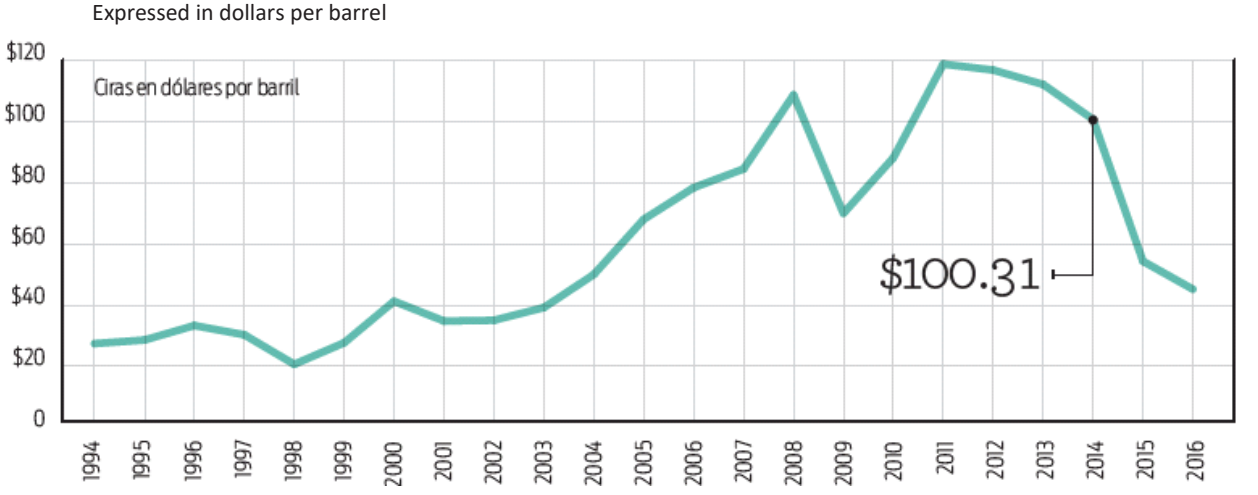
The only certainty is that from year to year, the price of oil—and of hydrocarbons in general—can vary drastically. One good example is that the Mexican energy reform was discussed and approved when prices were 100 dollars a barrel, but implemented the following year when prices were at the 40 dollar level.

SECTOR RISK

If there is anything that separates the hydrocarbon industry from other economic activities, it is the complexity of the risk involved. No other industry faces such a concentrated risk as the oil and gas industry, due to various interconnected levels of uncertainty.

GRAPH 13

International Price of Crude Oil (WTI) (1994–2016)



VARIETY OF RISKS

In addition to geological and commercial risk, there are operating, technological, political-social risks. Taking into account that investment horizons are between forty and fifty years.

In the debate surrounding the destiny of the Mexican energy sector, much has been discussed with regard to the advisability of having Mexico incur all the risks, particularly geological risk. In other words, was it worth it for Mexico to dedicate large sums of money to projects with, at best, success rates of around 20 or 30%? Some argued that it was, given that a single successful project would compensate for all the previous failures. The other side of the argument was that it is the very nature of the State to be risk-adverse, and that it was not worth it to risk resources when there were other certain and pressing need such as education and fighting poverty.

The case against the State assuming the risk was strengthened by the idea that the age of the great reservoirs—like Cantarell or Ku-Maloob-Zaa—was over. Any cost-benefit analysis—given that it would assume smaller, more diverse reservoirs and greater operating complexity— would be enough to make such and adventure prohibitive. The best way to confront this risk was to diversify. Hence the need to liberalize and allow Pemex to collaborate with other companies to improve any prospect of risk.

In addition to the geological and commercial risks—which are maximized when assumed by a single company—there are operating, technological, political-social risks. The long investment horizons, of between forty and fifty years, make risk control critical.

ENERGY MONOPOLY

Mexico was essentially the only country that attempted to develop its energy sector with a monopoly over all links in the chain, while the rest of the world incorporated private sector participation in one way or another.

Lastly, the final dimension of the thirty-year debate (1984-2014) on the best energy model for Mexico was international comparative analysis. When Mexico was analyzed against the models of other nations, one aspect quickly came to light: Mexico was essentially the only country that was trying to develop its energy sector with a monopoly over all links in the chain, while the rest of the world incorporated private sector participation in one way or another, including the most hydrocarbon-rich countries—such as Saudi Arabia, Russia or the United States— and the most autarchic nations— such as Cuba and North Korea.

Moreover, there were many examples of rapid transformations and improvements in energy sectors in countries following efforts to liberalize them— such as in the case of Norway, Malaysia and Colombia— as well as counterexamples where situations quickly worsened when commercial opportunities were closed — such as what happened in Venezuela. Lastly, there were some cases that exemplified both dimensions, such as Brazil which, following liberalization, had a series of spectacular discoveries and a vibrant State-owned oil company, and after closing its energy model, experienced a crisis and corruption scandals.

Thus, in these thirty years since the liberalization of our economy, our country has been engaged in a deep and animated discussion about the energy model and the advisability of keeping it closed. Infinite angles were discussed in light of technological advances, failed and successful energy projects, news from other parts of the world, impacts on the productivity of our economy and the competitiveness of our companies, in addition to various price scenarios. This rich and fascinating debate among experts arose, above all in the context of the reform efforts made since the 1970s, and took place in the framework of legislative debates open to national public opinion.

1.3 Genesis of the New Model

What was perhaps the great paradox in the debate on modernizing the Mexican oil industry and bring it in step with the rest of the economy, was that despite the increasingly rich discussion, the universe of potential solutions was limited by the expectation that any change or reform would be implemented without amending the Constitution.

It seemed useless to point out that Articles 27 and 28 of the Constitution, as they related to energy, had been modified 16 times since 1917. Many people could not accept any change to the language of the Constitutional Reform of 1960 which banned any type of contract or concession in relation to oil.[25]

INSUFFICIENT EFFORTS

The restriction of reforming to the extent possible without touching the Constitution meant that practically all of the reform efforts between 1974 and 2013 were insufficient.

The restriction of reforming to the extent possible without touching the Constitution meant that practically all of the reform efforts between 1974 and 2013 were insufficient, at best, to reverse the decline of the closed model.

One of the first efforts to reform the energy sector arose with regard to petrochemicals in 1986 and 1989, with an effort to open this industry to greater levels of private participation. Mexico had just joined the GATT, and the new export model was expected to have the effect of raising the national demand for petrochemicals. However, instead of a true opening, the only thing that was achieved was a reduction in the number of chemicals that were exclusive to the State, which went from 81 to 34 in 1986 and from 34 to 19 in 1989. Finally, with the entrance of Mexico into NAFTA, and our export platform in expansion, Congress agreed to one last reduction, and only 8 products remained exclusive to the State in the reform of the Law in 1992.26

Many casual observers saw this six-year process of opening 73 products to private participation, and reserving just eight of them, as a great liberalization success. However the opening of the so-called “secondary” petrochemicals never produced the expected results, since the products that remained reserved were required in order to engage in practically any petrochemical activity, thereby rendering any investments non-viable. Today, our demand for petrochemicals has quadrupled, to keep pace with our rapid industrialization, but our country imports the great majority of them.

In 1992, the Electricity Public Service Law was amended to allow private enterprise to participate in power generation, for self-consumption or as an independent power producer (IPP) in the exclusive service of the CFE. The vast majority of private power plants that participated in this new scheme were natural gas plants, aligned with the State-owned electricity company's strategy of creating energy matrix based on cleaner fuels—in terms of emissions— than the diesel and fuel oil they consumed. However, no measures were implemented to support

[25] *Decree amending paragraphs four, five, six and seven, part I of Article 27 and Articles 42 and 48 of the Constitution of Mexico. Available at: http://www.diputados.gob.mx/LeyesBiblio/ref/*

[26] *Unger, Kurt. Las industrias petroquímicas y de máquinas herramientas [Petrochemical and machine tool industries]. Mexico, CIDE, 1994.*

TABLE 4

Reserved Petrochemical Products

Used exclusively for Pemex's production until the Law of 1992

Up to October of 1982		In 1986	In 1989	In 1992
Acrylic acid	Propylene dichloride	Acetaldehyde	Ammonia	Ethane
Acetic acid	Dodecyl benzene	Acetonitrile	Benzene	Propane
Hydrocyanic acid	Styrene	Acrylonitrile	Butadiene	Butane
Hydrochloric acid	Ethane	Alpha olefins	Dodecyl benzene	Pentanes
Muriatic Acid	Methyl tert-butyl ether	Ammonia	Ethane	Heptane
2-ethylhexanol	Ethylbenzene	Benzene	Ethylene	Hexane
Acetaldehyde	Ethylene chlorohydrin	Butadiene	Heptane	raw materials for
Vinyl acetate	Ethylene	Cyclohexane	Hexane	Napthas
Acetylene	Heptane	Vinyl chloride	raw materials for carbon	
Acetonitrile	Hexane	Cumene	Methanol	
Acrolein	Isopropanol	Dichloroethane	n-paraffins	
Allylic alcohol	Isoprene	Dodecyl benzene	o-Xylene	
Lauryl alcohol	raw materials for carbon	Styrene	p-Xylene	
Oxo alcohols	Methanol	Ethane	Pentanes	
Alpha olefins	Xylenes (mixed isomers)	Methyl tert-butyl ether	Propylene	
Aliphatic compounds 5,	n-butanol	Ethylbenzene	Methyl tert-butyl ether	
Heavy alkylate	n-paraffins	Ethylene	Propylene tetramer	
Ammonia	Naphthalene	Heptane	Toluene	
Acetic anhydride	Nonane	Hexane	Xylenes	
Carbon dioxide	Internal olefins	Isopropanol		
Solvent naphtha 100	o-Xylene	raw materials for		
Solvent naphtha 150	Ethylene oxide	Methanol		
Heavy aromatics	Propylene oxide	n-paraffins		
Sulfur	p-Xylene	Internal olefins		
Benzene	Tetrachloroethylene	o-Xylene		
Butadiene	Polybutylenes	Ethylene oxide		
Butyraldehyde	Polyethylene AD	p-Xylene		
Cyclohexane	Polyethylene BD	Pentanes		
Chloroprene	Polypropylene	Polyethylene AD		
Allyl chloride	Propylene Chlorohydrin	Polyethylene BD		
Ethyl chloride	Propylene	Propylene		
Dichloromethane	Ammonium sulfate	Propylene tetramer		
Methyl chloride	Tetrachloroethane	Toluene		
Vinyl chloride	Carbon tetrachloride	Xylenes		
Cumene	Propylene tetramer			
De-emulsifiers	Toluene			
	Trichloroethane			
Paraffin removal	Trichloroethylene			
Ethylene dibromide	Vinyl Toluene			
Dichloroethane	Xylenes			
Total: 81 products		**34 products**	**19 products**	**8 products**

Source: Unger, Kurt. Las industrias petroquímicas y de máquinas herramientas [Petrochemical

gas production, either by allowing private participation or changing the incentives so that Pemex would invest in developing this hydrocarbon. Nor was private participation allowed in the transport, distribution or storage of natural gas.

The lack of coordination between what was being done in electricity generation and what was being done in the hydrocarbons industry quickly led to further distortions. With the entrance of the independent power producers, there was a great surge in demand for natural gas, but in light of the inability to meet such needs, the sector was reformed again in 1995.

That year, changes were made to the Regulatory Act regulating Article 27, in relation to Oil, to allow private participation and ownership in the transport, storage and distribution of natural gas. This liberalization, though partial, in the natural gas industry was primarily due to two factors: the growing demand for natural gas-related services —particularly in the construction and operation of gas pipelines— and the lack of resources —on the part of the State— to provide them.

Equally important is that in that same year, the Energy Regulatory Commission (CRE) was created as a decentralized agency of the Ministry of Energy (SENER) — with technical, operating and financial autonomy— charged with regulating the activities of public and private electric power and natural gas operators. It was also given the authority to issue resolutions to apply the regulation and resolve disputes in relation to the regulated activities.

On the supply side, with the priority to crude oil projects at the expense of natural gas projects given since the 80s, the projected supply was significantly insufficient to meet the future demand that would come from combined-cycle plants.

Unlike the reforms that were accomplished with regard to electricity and secondary gas activities, the subject of any significant opening in the production and processing of natural gas and oil remained closed. Trapped in this dynamic, Pemex sought contractual solutions. The clearest example took place in 2004, with the introduction of the Multiple Services Contracts (MSC), which despite attracting private participation in the Burgos area, fell far short of meeting expectations.

These contracts had the fundamental weakness of not involving any element of risk, and there was therefore no incentive to maximize production. Remuneration, on the other hand —based on a Service Catalog and not tied to production— rendered these opportunities commercially unattractive to private oil companies, who were free to develop projects in any part of the world. The results were predictable, although some operators were awarded these contracts, the majority of the industry showed no interest.

It was not until 2008 when the first successful, though still modest, effort was made to modernize the Mexican oil sector. That was the year the Regulatory Act was amended to include several changes and openings:

CLOSED TO ANY OPENING

Despite reforms in electricity and secondary gas activities, the subject of any significant opening in the production and processing of natural gas and oil remained closed. Trapped in this dynamic, in 2004, Pemex sought contractual solutions.

ATTEMPT AT CHANGE

It was not until 2008 when the first successful, though still modest, effort was made to modernize the Mexican oil sector.

THE CNH IS BORN

The creation of the CNH was, without a doubt, the best decision that came out of the 2008 reform.

- **The commercialization of methane was opened to third parties, other than Pemex;**
- **Pemex was allowed to offer its contractors cash incentives, always under service agreements (Integrated EP Contracts), though they were still not true risk agreements;**
- **The definition and method for developing a cross-border reservoir were more clearly described;**
- **The National Hydrocarbons Commission (CNH) was created.**

Just as the creation of the CRE had been, the creation of the CNH was of vital importance for the Mexican oil industry. The CNH was not created as an autonomous regulator, but as a technical arm of the SENER, with the idea of forming specialized technical panels, outside of Pemex, to conduct oil policy. The creation of the CNH itself demonstrated the importance of regulatory agencies in setting a State vision, a long-term commitment and significant decision-making autonomy.

The creation of the CNH was, without a doubt, the best decision that came out of the 2008 reform, although other elements were also important: the Pemex Board of Directors was restructured to include four professional board members, for the purpose of increasing transparency, the quality of the decision making, and above all a growing culture of accountability, even with regard to technical decisions, within the State-owned enterprise.

In addition, long-term planning was regulated by the National Energy Strategy and other mechanisms to improve the quality of the data gathered by the State. In addition to data quality, clear steps were taken to improve transparency, requiring Pemex to submit yearly and quarterly reports to Congress on its operations, and to the Ministry of the Treasury on its debt and management. In another very important area, SENER was given the decision-making authority and power to cancel a Pemex permit, based on the recommendations of the CNH, in the event of noncompliance.

REFORM UNDER THE MICROSCOPE

One interesting aspect of the 2008 reform was the organization of televised discussion forums in the Senate. This was the first time the Mexican public had seen the great debate that had been raging in the energy sector for years.

One interesting aspect of the 2008 reform was the organization of televised discussion forums in the Senate.

This was the first time that the Mexican public had seen, with great clarity, the debate that had been raging in the energy sector for years. These forums, held twice a week for nearly three months (from mid-May to late July), were the first clear evidence of how much there was to do to get our energy sector up to speed.

Principles of competition, transparency, clear regulation, safety, economic competitiveness, sovereignty and guiding principles were debated in an atmosphere of great freedom and respect among the various positions. These forums informed the thought processes of Congress, which when sessions began again in the fall, sought to enshrine many of these ideas into law.

However, despite its many good decisions, the 2008 and the debate surrounding it were limited from the outset, because the political parties would agree to discuss any idea, as long as it did not involve any changes to the Constitution. As a result, several of the elements that were essential to transforming our industry, such as allowing Pemex to form joint ventures with third parties, or allowing Mexico to sign production or profit sharing agreements, remained outside the universe of reform options.

LIMITED DEBATE

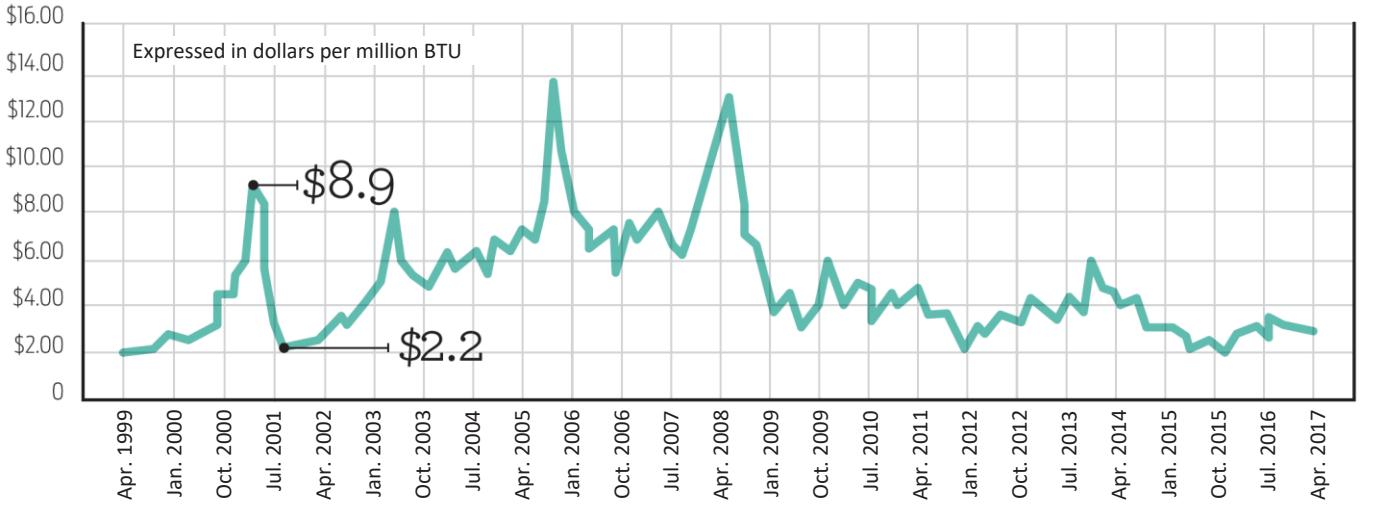
The 2008 Reform and the debate surrounding it were limited because they would not entertain changes that were necessary from the outset.

It did not take long for the results to be seen in the economy. Domestically, fuel and electricity production remained unable to meet increasing demand. Although by 2008 Mexico had succeed in exploiting certain advantages *vis a vis* China to bring back many investors, the loss of competitiveness against the Asian giant was becoming increasingly apparent. What was worse, was that Mexico was not prepared for another profound energy revolution that was beginning to roar to life at the same time as Mexico was discussing the 2008 reform, and that first became apparent in natural gas.

The growing global demand for gas, particularly in Asia, led to a great era of innovation in technology and management that led to the rise of what are known as unconventional resources. Many of these resources had been discovered decades before, but were not considered viable. Now, with the coordination of various technologies and the use of stimulation and hydraulic rock cracking techniques, these resources suddenly became commercially viable overnight. The technique known as *fracking* made it possible to extract gas trapped in shale rock, the low porosity of which kept the hydrocarbons trapped. Once free, the gas began to flow into the markets and turned the world upside down.

GRAPH 14

Spot Price of Natural Gas (Henry Hub) (April 1999–October 2017)

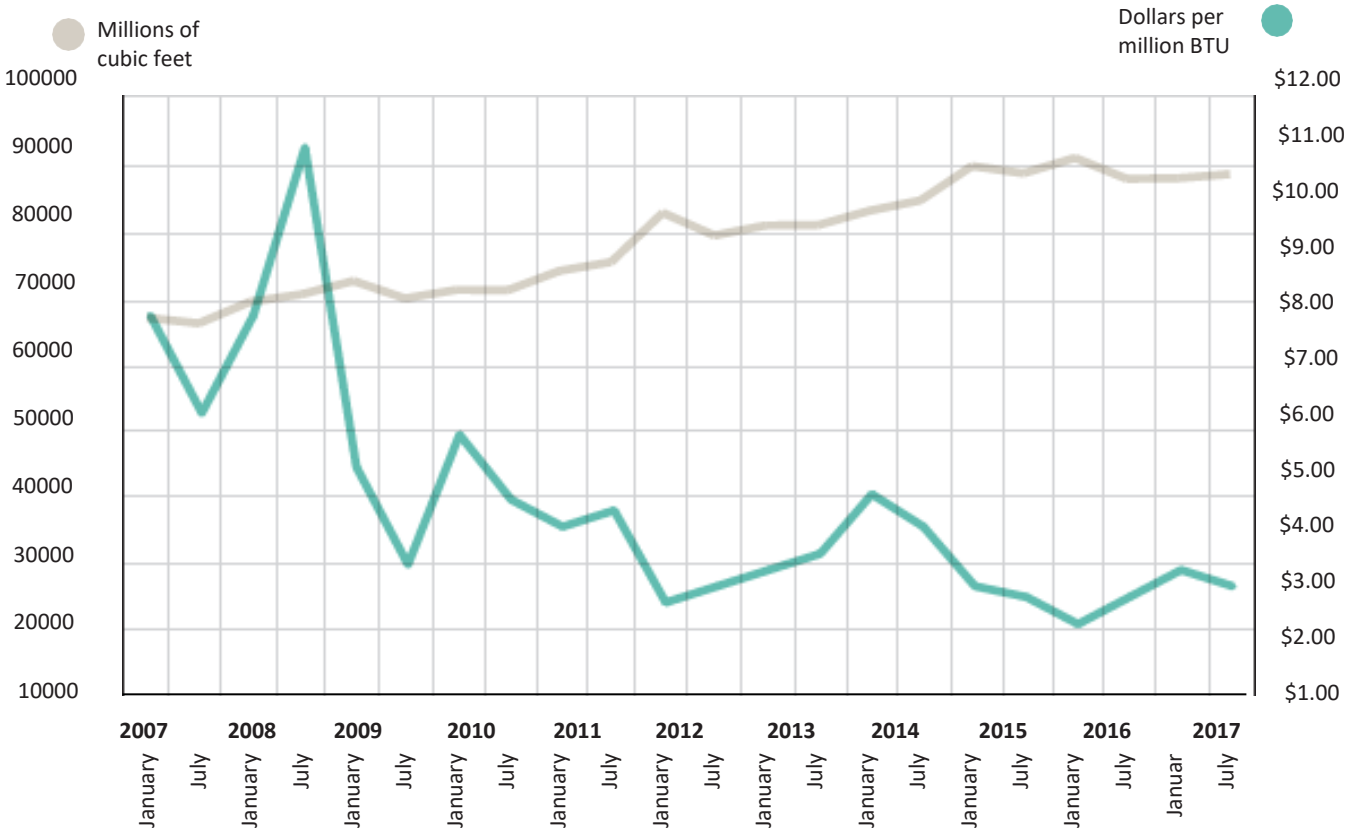


Source: U.S. Energy Information Administration.

[27] *Article 6, Regulatory Act for Article 27 of the Constitution as Regards Oil. Repealed. Available at: http://www.diputados.gob.mx/LeyesBiblio/abro/lrart27_rp/LRArt27_RP_abro.pdf*
[28] *Calder, Kent E., Asia's Empty Tank, Foreign Affairs, March/April 1996. https://www.foreignaffairs.com/articles/asia/1996-03-01/asias-empty-tank*
[29] *Rosen, Dan H., How China is Eating Mexico's Lunch, International Economy, Spring 2003. http://international-economy.com/TIE_Sp03_Rosen.pdf*

Graph 15

Natural Gas Production vs. Prices in the U.S. (January 2007–July 2017)



Source: U.S. Energy Information Administration.

THE FIRST TRY

Despite the good effort, the 2008 reform did not provide the necessary tools with which to respond to this technological and geo-strategic transformation.

In a few years, the global ranking of oil producers changed dramatically. In our region, the United States and Canada had clear price signals, flexible regulatory systems and policies that allowed for taking risks in disruptive technologies. Soon, the United States went from being a gas-deficient nation to one of the top producers in the world, thereby bringing prices down significantly.

We took five or six years to realize what was happening right next to us. The Mexican Institute for Competitiveness finally made the magnitude of this change clear when it said "they've redrawn the map."29 However, despite the good effort, the 2008 reform did not provide the necessary tools with which to respond to this technological and geo-strategic transformation. Encouraged by more competitive gas prices, thanks to what are known as "unconventional" resources, the *reshoring* phenomenon drove the return of investors from Asia to North America. More and more plants were built, reopened their doors or increased their capacity. The automobile and aerospace industries entered a golden age in Mexico. With all of this, the problem was no longer price, but capacity. The gas simply was not reaching its destination.

The old problem of the local production remained unresolved and moreover the few pipelines that did exist were not adequate to meet market demands. Soon the natural gas supply began to be rationed with scheduled outages and access restrictions to natural gas, known as "critical alerts." Once again, the old energy model was not capable of responding to the needs of an open economy, connected to the world, or to rapidly changing technologies and geopolitics that were restructuring the world economic order.

When the reform finally passed in 2008, several adverse dynamics began to intensify. For example, in terms of prices. When the Senate discussion forums began in mid-May of 2008, the price of oil was around 126 dollars per barrel; when the discussion ended, on May 22, the price per barrel had just broken the historical record for WTI, at 145.29 dollars per barrel, and by the time it was published, the price had plummeted to 60 dollars per barrel.

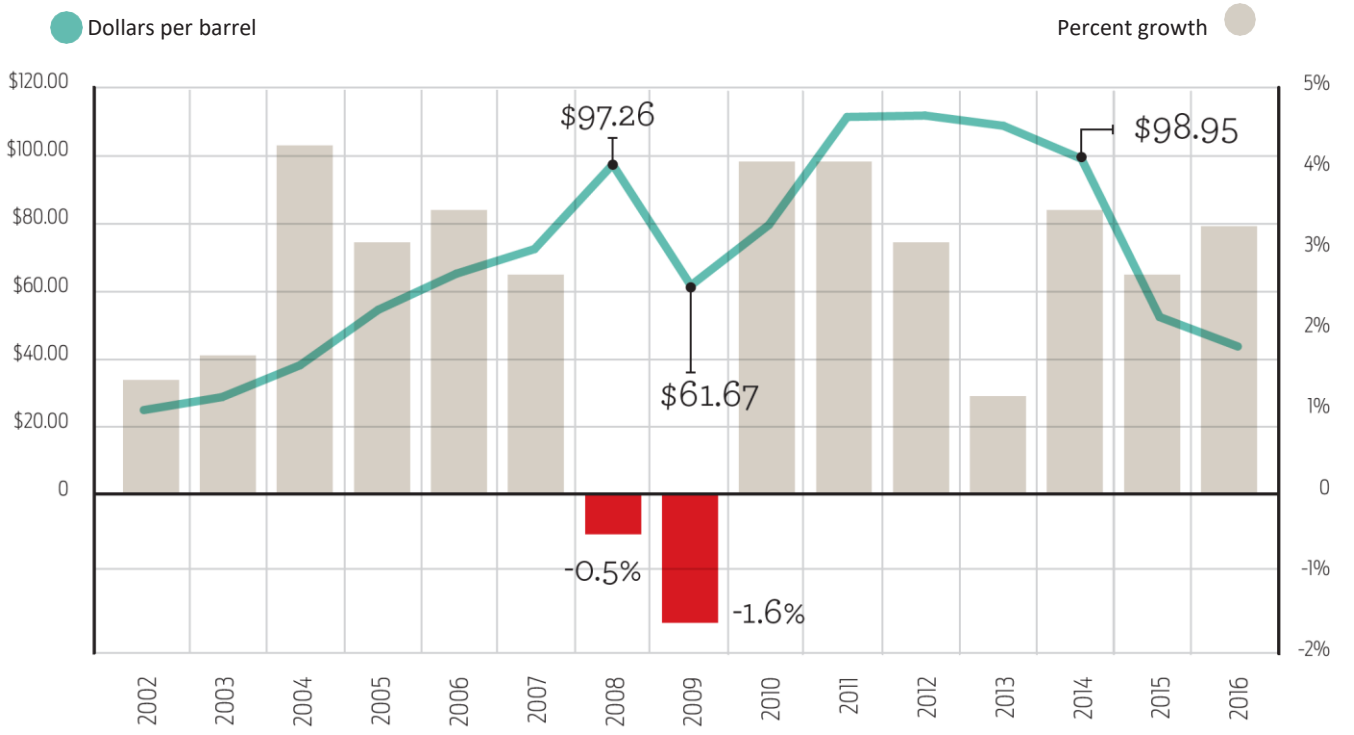
However, prices recovered quickly. When the reform had been in effect for one year and was fully in its implementation phase, the price was around 80 dollars per barrel. Despite the fact that we entered a period of rapid price expansion, since that time and as of late 2014, when the New Energy Model entered into effect, the large investments some anticipated with the 2008 did not materialize.

UNRESPONSIVE MODEL

Soon the natural gas supply began to be rationed with scheduled outages and access restrictions to natural gas, known as "critical alerts." Once again, the old energy model was not capable of responding to the needs of an open economy.

Graph 16

Mexican GDP vs. Brent Oil Price (2002–2016)



Source: INEGI and U.S. Energy Information Administration.

REFORM IN SIGHT

Every day it became more clear that it was time for Mexico to reform its energy sector from the ground up.

On the contrary, the critical alerts became more frequent and cost the country $18.9 billion pesos at that time (approximately 1.5 billion dollars)[30]. Despite considerable investment budgets, production continued to fall; between 2008 and 2013, oil production had declined by more than 250,000 barrels per day. Although the 2008 reform was a good effort and instituted important regulatory innovations, the energy sector was still unable to meet the country's needs or adapt to sudden global changes.

The 2008 reform marked the end of the great discussion that began with the first generation of structural reforms in the late 1980s. After a quarter century of looking for fixes within the current regulatory framework and without amending the constitution, the weight of the evidence was significant.

In those areas in which spaces had been created that promoted competition, the long-term planning and above all transparency, Mexico was making progress, though it was not enough. In areas in which the rules of the game did not allow the State or its companies enough flexibility or tools to respond to sudden changes and in which we lacked market prices, we were falling behind. Every day it became more clear that it was time for Mexico to reform its energy sector from the ground up.

[30] *A Pemex 'se le fuga' el gas natural. Expansión. [Gas is escaping from Pemex. Expansion] Available at: http://expansion.mx/negocios/2013/05/06/a-pemex-se-le-fuga-el-gas-natural*

PHOTO: CANSTOCKPHOTO

02

A New Energy Model for Mexico

The road Mexico has traveled down to its New Energy Reform was long and winding—as the previous chapter has described— but its direction was very clear. It was essential for Mexico to have an energy model that was fully consistent with its economic model, but the evolution took time. While it was evolving, many countries went ahead and concluded and applied what is now a practically global consensus: in order to have a prosperous and competitive energy sector, it is essential to have an economy that is growing in a sound manner; abundant resources are not enough, one must attract the right type of investment based on competition, collaboration and transparency. This involves a profound change in the understanding of the role of the energy sector in an economy.

Traditionally, the hydrocarbons sector has been viewed in terms of revenue extraction, rather than in terms of value generation. Moreover, when it was viewed as a lever for developments, it was seen as a source of cross-subsidies, inputs that had to be inexpensive to allow for the development of other industries. As such there was—in Mexico and many other countries— a fiscalist view of energy, either as revenue or as a subsidy. However, the technological reality of the industry and its role in the economy's performance proved to be much more complex.

Rather than an extractive industry focused on generating raw materials, the energy sector (and the oil and gas industry in particular) is a capital-intensive industry. In fact, it may be the most capital-intensive industry of all. It is also a technology-intensive sector, in which technologies that are still science fiction in other industries —such as robotics, data analytics, visualization technologies and new materials, just to name a few— are current realities. This is a true knowledge-based industry, and it is essential to conceptualize it that way if it is to develop soundly and vigorously, and above all, if it is to serve as the great dynamo of productivity for the country.

CHANGE IN PERCEPTION

The change in the Mexican concept of this sector to that of generator of value and not just of revenue, necessitated a broader concept of the stewardship of the State.

The change in the Mexican concept of this sector to that of generator of value and not just of revenue, necessitated a broader concept of the stewardship of the State, in at least three aspects.

The first is the realization that the need for more investment means that the system must expand to include a greater number of potential investors. This change is reflected in the establishment of clear, solid rules for the New Mexican Energy Model that facilitate the attraction of additional investors. These are: guaranteed objectivity and impartiality, in addition to transparency, respect for contracts and intellectual property. Through these, legal interests (such as the nation's ownership) in relation to the resources, the stewardship of the State in resource development and the importance of the public consultation process in the projects. In other words, the creation of a genuine Rule of Law for this new century.

The New Mexican Energy Model incorporates the lessons of the past and includes mechanisms for the successful liberalization of the Mexican economy. As Luis Rubio explains in *Energy, The Law, and "The Mexican Way,"* published by the Baker Institute, Mexico essentially made a commitment not to "change the rules on a whim to favor some interests over others."[1] The successful implementation of the New Mexican Energy Model, in this sense, involves accomplishing the simple goal to "guarantee clarity and observance of agreements and contracts."[2]

The second aspect, in line with this renewed emphasis on the Rule of Law, is the modernization of the concept of the State's guiding role, since setting public policy is no longer just a matter of issuing directives on the type of investments that the CFE or Pemex should make, or creating rules for secondary spaces, but rather designing and implementing objective rules that seek to maximize the common good under impartial parameters. In this context, the role and scope of regulatory agencies, which had made significant progress under the old model, was further enhanced, to the point that they are now true "market referees."[3]

The third aspect recognizes that maximizing the value added and committing to the use and development of leading-edge technologies is not possible in an environment without any competition that could encourage the competitiveness of each and every link in the value chain.

MORE INVESTMENT

The need for more investment means that the system must expand to include a greater number of potential investors.

The new design— using mechanisms to seek the common good with market oversight— sought to generate incentives so as to align the interests of the market players with the objectives of the State, and thereby counteract the negative impact on the domestic economy and the State-owned enterprises caused by the monopolies and monopsonies. This model became key for the State to exercise its new guiding role.

[1]*Rubio, L. (2016). "Prologue: Energy, The Law, and The Mexican Way," in The Rule of Law and Mexico's Energy Reform. USA: Baker Institute Mexico Center at Rice University. Taken from https://www.bakerinstitute.org/media/files/re search_document/bc76b99a/MEX-pub-RuleofLaw_Rubio-121316.pdf*

[2]*OECD (2017). Driving Performance of Mexico's Energy Regulators. France: OECD Taken from: http://www.oecd.org/publications/driving-performance-of-mexico-s-energy-regulators-9789264267848-en.htm*

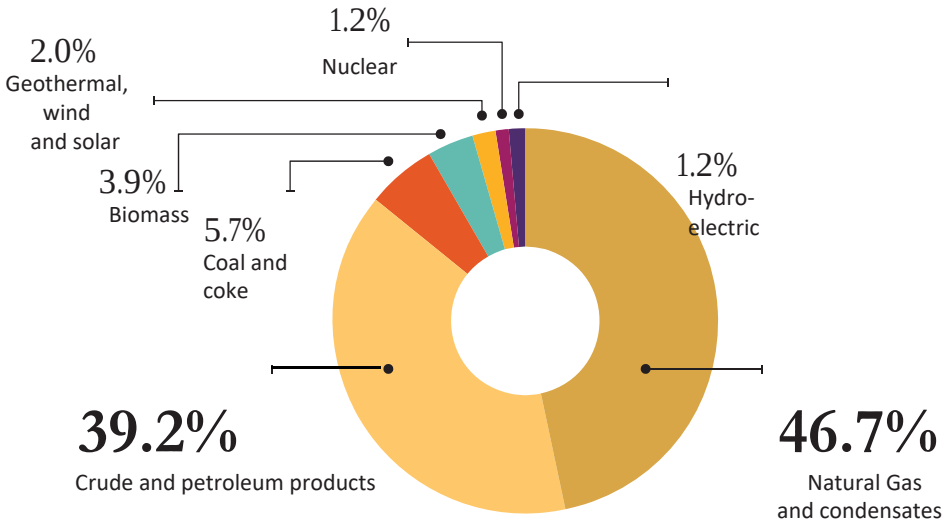
[3]*OECD (2017). Driving Performance of Mexico's Energy Regulators. France: OECD Taken from: http://www.oecd.org/publications/driving-performance-of-mexico-s-energy-regulators-9789264267848-en.htm*

Having arrived late, or at least later than other countries, at this definition of the State's guiding role has consequences for the institutional design itself. For one thing, it has resulted in a profound sense of urgency. The many years of debate over the energy model resulted in deep distortions, the effects of which we are still feeling today, such as the drop in production or the overdependence of certain inputs on a single market. In addition, as Juan Carlos Zepeda, the Commission Chairman of the CNH, has so often rightly said, the advantage of being last is that we have the opportunity to learn from the successes and failures of others.

There is a sense of urgency surrounding the New Mexican Energy Model that other countries, who defined their model under different circumstances decades ago, did not have. Much of the urgency is due to the relatively immediate energy and economic needs, exacerbated by Mexico's progressive decline in recent years.

Over the relatively long term, and guided by the marked energy transition toward the electrification of the global economy, oil producing companies are moving to quickly exploit their reserves and resources, recalibrating their production platforms, their infrastructure and their expectations. An example of this is the growing demand for gas, which has joined crude as the world's prime focus. In fact, some analysts predict that in a few decades, the demand for crude could embark on a slow decline.

Mexico's Energy Matrix, 2016



Source: Energy Information System, SENER.

On a more institutional level, the New Mexican Energy Model was created at a time when, at the global level, there has been an important leap forward in the global understanding of institutions and processes. Although at one time it was believed that the mere liberalization would attract the investment needed for growth, we now realize that this is necessary, but it is not enough.

CONSEQUENCES OF TIMING

Having arrived late, or at least later than other countries, at this definition of the State's guiding role has consequences for the institutional design itself:
it has resulted in a profound sense of urgency.

MOVING FORWARD

Oil-Producing Countries are moving to quickly exploit their reserves and resources, recalibrating their production platforms, their infrastructure and their expectations.

WHAT IS TO COME

It is to be expected that over the next three decades, the collective understanding of how to create and govern institutions that produce the desired results will evolve significantly, in response to input from both practical and theoretical sources.

Barely two decades ago —when most of the world had already liberalized its energy sectors— social scientists such as Giovanni Sartori invited the world to think beyond the mandates and prohibitions established by a legal framework: "the incentives, rewards and deterrent factors [that] regulate behavior"[4] are equally important or at times, more so.

Researchers such as Richard Thaler, winner of the Nobel Prize in Economics, have led social sciences to take huge leaps forward with their studies on the economy of behavior, which describes, among other things, how public policy designers can improve market decision-making by taking simple actions.

Lastly, Mexico has a trove of examples of polices that have worked (and just as many that have not) in the establishment of competitive energy models. This represents an opportunity to learn from the experiences of others, and understand which buttons and which levers produce what movements.

It is to be expected that, just as it has happened in the past, over the next three decades, the collective understanding of how to create and govern institutions that produce the desired results will evolve significantly, in response to input from both practical and theoretical sources.

The institutional framework, on which we must continue to build, will have to focus on the new principles of the State's guiding role described in this section, that have been shown to be a solid basis on which many different models, each with their own peculiarities, have been successfully built.

In line with this objective, this chapter picks up the thread of the conversation, chronologically, where the last chapter left off. It briefly describes the process of reforming the previous model that resulted in the New Mexican Energy Model, the characteristics of the new model and the primary strengths that, to date, it has been shown to have.

2.1 Constitutional Reform

ESTABLISHED PRINCIPLES

The guiding principles of Mexico's energy sector have historically been enshrined in the Mexican Constitution.

The guiding principles of Mexico's energy sector have historically been enshrined in the Mexican Constitution, specifically Articles 25, 27 and 28. These articles, in conjunction with the rest of the Constitution, have defined the set of energy-related activities in which the State and private enterprise are permitted to engage (and those in which they are not).

The New Mexican Energy Model was created, naturally, as a Constitutional reform. Specifically, certain additions, repeals and amendments to the aforementioned articles were proposed and ultimately adopted.

[4]*Sartori, G., (1999). La Ingeniería Constitucional y sus límites. [Constitutional Engineering and its Limits.] USA: Columbia University. Taken from: http://historico.juridicas.unam.mx/publica/librev/rev/trcons/cont/3/est/est5.pdf*

The decree enacting the "Energy Reform" at the constitutional level establishes the following:

> **Article One. -** Hereby amended are paragraphs four, six and eight of Article 25; paragraph six of Article 27; paragraphs four and six of Article 28; a paragraph seven is added, with the following paragraphs renumbered, in order, to Article 27; a paragraph eight is added, with the following paragraphs renumbered, in order, to Article 28 of the Mexican Constitution.[5]

In addition, 21 transitional articles were added, that established when the Constitutional amendments would enter into force. As we shall discuss later on, building a robust legal and temporal framework has facilitated the implementation of functional values and principles that have defined the character of the reform itself.

BUILDING CONSENSUS

The specific requirements that must be met to amend the Constitution are there to ensure a consensus and the stability of the result, since it is difficult to obtain this type of "super majority" in a country with such fragmented political factions.

Before entering into a discussion of the content, it is important to highlight the fact that the constitutional nature of the origin of the New Mexican Energy Model has a series of significant implications. This is because, under the Constitution, its articles can only be amended with a vote in favor by two thirds of both houses of Congress, in addition to a majority vote in favor by at least half of the local (state) congresses in the country.

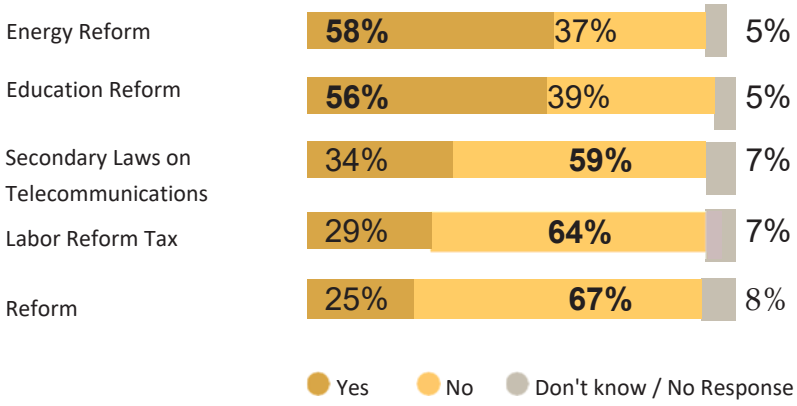
The specific requirements that must be met to amend the Constitution are there to ensure a consensus and the stability of the result, since it is difficult to obtain this type of "super majority" in a country with such fragmented political factions.

In addition, it is important to mention that the Energy Reform was also the result of a series of debates —some official debates that took place in Congress and some involving experts, the media and the general public— which created significantly transparent conditions.

Regarding the Energy Reform

Despite the fact that the Energy Reform was approved in a context in which a series of structural reforms were being developed, debated and implemented, the National Survey on Structural Reforms —developed in September of 2014 by the Center for Social and Public Opinion Studies of the Chamber of Deputies— concluded that the Energy Reform was the reform most often spontaneously recalled by the Mexican public, and the reform about which the public was best informed.[6]

Are you familiar with or have you heard of...?



Source: Structural Reforms, National Housing Survey, Center for Social and Political Opinion Studies, Chamber of Deputies, September 1, 2014

[5] *Ministry of the Interior (2013). Presidential Decree amending the Mexican Constitution on Energy Matters. Taken from: http://cdn.reformaenergetica.gob.mx/decreto-reforma-energetica.pdf*

[6] *Chamber of Deputies (2013). National Survey on Structural Reforms. Taken from: http://www5.diputados.gob.mx/index.php/camara/Centros-de-Estudio/CESOP/Opinion-Publica/Encuestas/Encuesta-Nacional-Sobre-las-Reformas-Estructurales*

HAND IN HAND WITH THE STATE

The State continues to play an exclusive guiding role in the energy sector, but it is now understood and exercised in a more modern way.

With regard to the content, as the introduction to this chapter made clear, the State continues to play an exclusive guiding role in the energy sector. Under the New Mexican Energy Model, however, this role is understood and exercised in a more modern way.

As Supreme Court Justice José Ramón Cosío Villegas explains in *The New Energy System in the Mexican Constitution*, the Mexican Constitution contains rules that, on the one hand, regulate the use of certain goods that are necessary for the production of energy and, on the other hand, regulate the activities and services necessary to produce and/or distribute energy (*lato sensu*).[7]

Thus, it is very important to remember that the State's ownership of these goods for energy generation (such as hydrocarbons below ground) has not changed; what has changed is the way the activities and services necessary to produce and/or distribute energy are regulated. The monopolistic control of all the activities and organizations or companies involved in these activities was gradually eliminated.

Taking into account the historical lessons of the sub-optimal results of partial liberalization, in which one link in the value chain was opened to competition and private investment but not all the others (such as primary and secondary petrochemicals as previously discussed), the New Mexican Energy Model liberalized the entire industry.

ENERGY SECTOR LIBERALIZATION

At the level of exploration and extraction, liberalization was primarily achieved by allowing the Ministry of Energy —with the support of the National Hydrocarbons Commission— to sign license, production sharing, profit sharing and service contracts with companies other than State-owned enterprises.

At the level of exploration and extraction, liberalization was primarily achieved by allowing the Ministry of Energy (SENER)—with the technical and implementation support of the National Hydrocarbons Commission (CNH)—to sign license, production sharing, profit sharing and service contracts with companies other than State-owned enterprises. This element is essential for the New Mexican Energy Model to work, and we shall discuss it in greater detail in the following sections of this chapter.

The Energy Reform not only reinforced the role of the SENER, empowered the CNH and the Energy Regulatory Commission (CRE) as the two primary market referees, but it also created a third institution, what is now known as the Agency for Safety, Energy and the Environment (ASEA).

Other important institutional adjustments made by the reform include the establishment of the National Center for the Control of Natural Gas and the National Center for the Control of Energy to independently operate the country's gas transport and electricity transmission infrastructure, respectively, and the Mexican Petroleum Fund (FMP) for Stabilization and Development to receive, administer and distribute the income from the permits and contracts for the exploration and extraction of hydrocarbons.

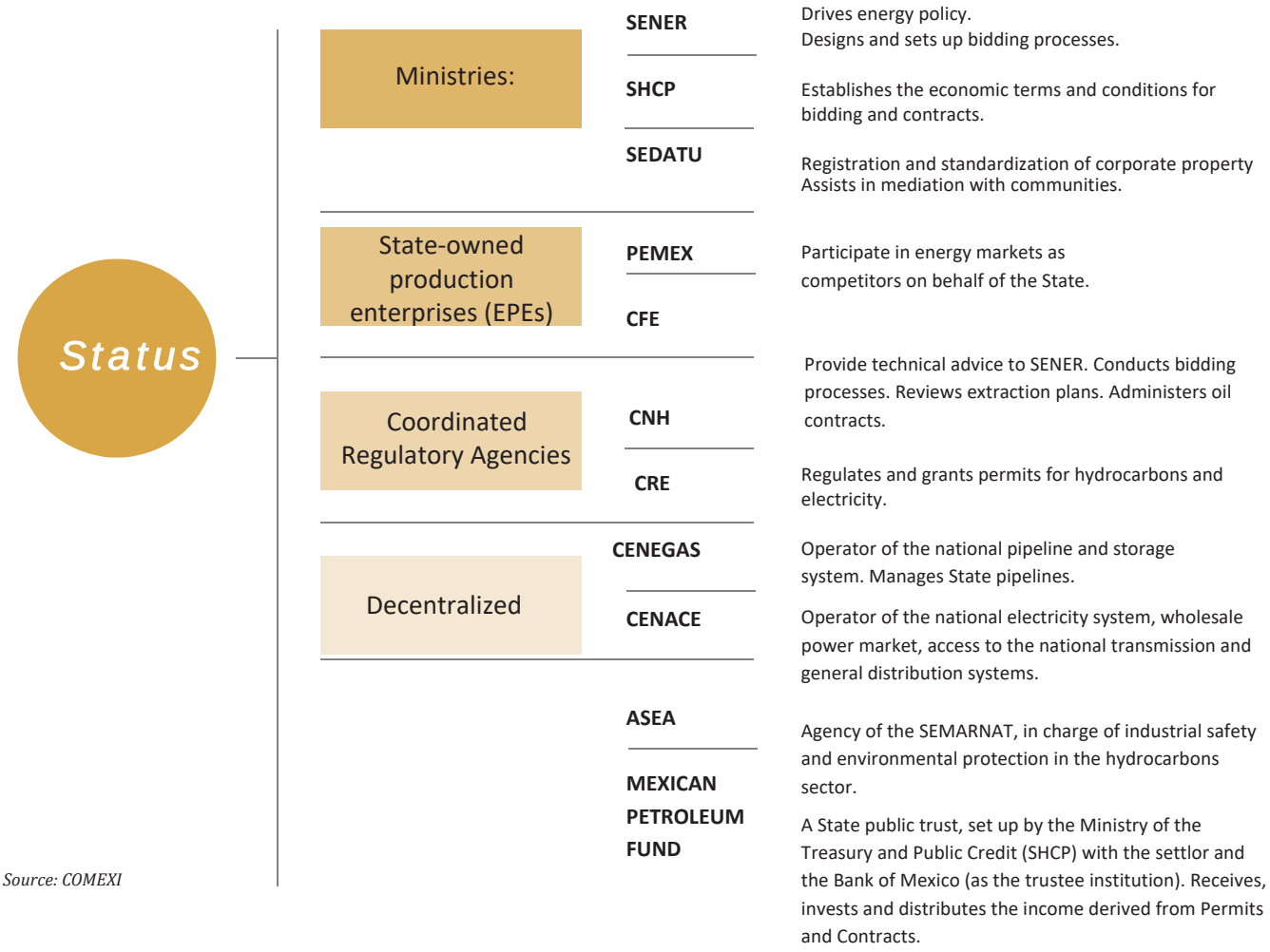
Perhaps the greatest virtue of the constitutional amendments is not in any one individual element, but rather the way they work together, and in the strengthening of institutions, tht is to say, the creation of checks and balances.

[7] *Cossío Díaz, J., & Cossío Barragán, J., (2016). "The New Energy System in the Mexican Constitution," in The Rule of Law and Mexico's Energy Reform. USA: Baker Institute Mexico Center at Rice University. Taken from: http://www.bakerinstitute.org/files/11669/*

Thanks to the involvement of a multitude of government actors—several of which are explicitly independent—the constitutional underpinnings of the New Mexican Energy Model enshrined an extraordinary degree of transparency and accountability. This is perhaps one of the primary contributions of the New Mexican Energy Model in achieving the long-desired accountability and transparency of State endeavors and their impact on the market.

This is possible thanks to the important institutional framework in the creation of new rules and instruments that enable the society and the institutions to monitor the actions of the State and the market, and thereby protect the Nation's authority over the hydrocarbons.

Institutional Framework of the Mexican Energy Sector



Source: COMEXI

In this section we will explain the different processes and roles of the various institutions, illustrating how, in the process, the drive for transparency, accountability and protection of the public interest became even more solidified as the processes resulted in secondary laws, regulations and controls.

IMPLICATIONS OF THE CHANGE

The New Mexican Energy Model not only involved amending three articles of the Constitution, but also amended 12 existing laws and created 9 new laws, for a total of 21 laws regulating the sector.

2.2 Secondary legislation, regulations and other regimes

The new Mexican Energy Model not only involved amending three articles of the Constitution, but also amended 12 existing laws and created 9 new laws, for a total of 21 laws regulating the sector. This process was completed approximately six months after the Constitutional reform

9 new laws

1. Hydrocarbons Law.
2. Electric Industry Law
3. Coordinated Energy Regulatory Agencies Law;
4. Petróleos Mexicanos Law
5. Federal Electricity Commission Law
6. Law of the National Agency for Industrial Safety and Environmental Protection in the Hydrocarbons Sector
7. Geothermal Energy Law
8. Hydrocarbons Revenue Law
9. Mexican Petroleum Fund for Stabilization and Development Law

12 amended laws

1. Foreign Investment Law
2. Mining Law
3. Organic Public-Private Partnerships Law
4. Organic Federal Government Law
5. Federal Parastatal Law
6. Public Sector Procurement, Lease and Services Law
7. Public Works and Services Law
8. National Waters Law
9. Budget and Fiscal Responsibility Law
10. General Public Debt Law
11. Government Service Charges Law
12. Fiscal Coordination Law

The 21 laws that were created or amended, once again required congressional approval under the same terms and followed the same procedures set forth in the Constitution. In addition to debates in specialized committees and the vote in favor by the majority of members in both chambers.

SHARED DECISION-MAKING

The decision-making authority is effectively shared over several links in the process, thereby helping to create a system of checks and balances.

Although a detailed discussion of the content of each of these laws is beyond the scope of this document, we note that under the New Model, there are institutions and individuals working on each specialty. Moreover, apart from what strictly relates to energy, the legal framework establishes a series of institutions, of a more general nature, to work with the specialized institutions.

All of this ensures that the decision-making power is effectively shared across various links in the process, which helps to create a system of checks and balances.

Some of the institutions that participate in energy-related decisions—apart from those that strictly belong to the sector—are:

» Ministry of the Treasury and Public Credit
» Ministry of the Economy

» Tax Administration Service
» Bank of Mexico
» Federal Commission on Economic Competition
» Federal Consumer Protection Agency
» Federal Environmental Protection Agency
» National Institute for Access to Information and Personal Data Protection
» Federal Judicial System

As we have said, the multidisciplinary and inter-institutional nature of the New Model promotes accountability and transparency. It also enhances the powers and reach of the regulatory agencies as market referees, dedicated to promoting competition in each link of the hydrocarbon value chain.

In addition to the 21 laws that were created or amended, the New Mexican Energy Model has resulted in the promulgation of 25 regulations, 9 Guidelines, 7 General Administrative Orders (DACG), 1 interpretive opinion on a DACG, 1 Technical Provision, 6 Resolutions, 40 Forms and 2 Guides.

As always, balance is key. That is why we must carefully address the process of strengthening the institutions, because if it is done without consideration, it could result in unnecessary bureaucratic bottlenecks. It is estimated that an oil operator could be required to complete more than a thousand bureaucratic steps throughout the life of a single project.[8] Although this is in line with the most basic idea of the guiding role of the State, it could result in regulatory compliance cost overruns that would undermine the oil revenue the State would receive.

Despite the potential for inefficiency resulting from over-regulation, the New Mexican Energy Model, defined by a series of regulations, is not only more transparent, but also reinforces the Rule of Law and promotes the monitored development of the energy sector in our country.

What is more, as we shall explain in greater detail in later sections, independent experts such as the International Energy Agency (IEA) have estimated that by the year 2040, the creation of Mexico's new legal framework for energy will have generated more oil production, lower electric power generation costs and greater purchasing power on the part of Mexican households. Specifically, the IEA attributes up to 4 percent of Mexico's 2040 GDP to the New Mexican Energy Model, but for this to happen would require a full and successful implementation. Reversing the reform would generate a loss of more than one trillion in economic activity.[9]

Before entering into the discussion of the energy outlook, let us take a moment to describe how oil projects work under the New Mexican Energy Model.

AVOIDING BUREAUCRACY

We must carefully address the process of strengthening the institutions, because if it is done without considering how it could impact the process, it could result in unnecessary bureaucratic bottlenecks.

[8]Vargas, L., & Cota, M., (2017). "Hacia una Rectoría Eficiente de la Industria de E&P" ["Toward Efficient State Guidance of the E&P Industry,"] in Pulso Energético. Taken from: https://pulsoenergetico.org/hacia-una-rectoria-eficiente-de-la-industria-de-ep/
[9]IEPICA (2017). Energy Policies Beyond IEA Countries: Mexico, 2017. France: IEA. Taken from https://www.iea.org/publications/freepublications/publication/EnergyPoliciesBeyondIEACountriesMexico2017.pdf

REGULATED PROCESSES

Under the New Model, each stage of the oil process (access, exploration, development, production and end of life) involves compliance with processes and regulations overseen by various institutions.

2.3 Functional description: the practical impact of the changes to the legal and regulatory framework

In general, the State's oversight and regulatory authority is strengthened under the New Mexican Energy Model. For example, thanks to the exploration, development, production and remediation processes, the CNH has greater authority that it had under the old model, in which Pemex was the only operator.

Increasing the number of personnel was one of the first and most important actions taken to accomplish this strengthening. Thus, between 2014 and 2016, the CRE increased its personnel from 211 to 462 persons and in the case of the CNH, the increase was from 214 to 380.[10] These increases in the number of employees was for the purpose of performing their new functions.

Moreover, the creation of a specialized regulatory agency in the oil and gas industry, the ASEA, allowed regulations to be created based on technical knowledge of the industry.

Under the New Model, each of the 5 stages of an oil project (access, exploration, development, production and end of life) involves compliance with processes and regulations overseen by various institutions, such as the CNH, the ASEA and the FMP. What is more, the State obtains very significant economic benefits in the intermediate stages (exploration, development and production).

The principal change between the earlier model and the new one is in the first stage: the access. This change establishes the conditions under which the new actors can participate in the development and exploitation of the petroleum resources.

As we discussed in Chapter One, until a few years ago, Pemex was exclusively in charge of exploring and producing petroleum resources throughout Mexico. In practice, this was a true mission impossible, and wide areas of the country and countless projects were neglected.

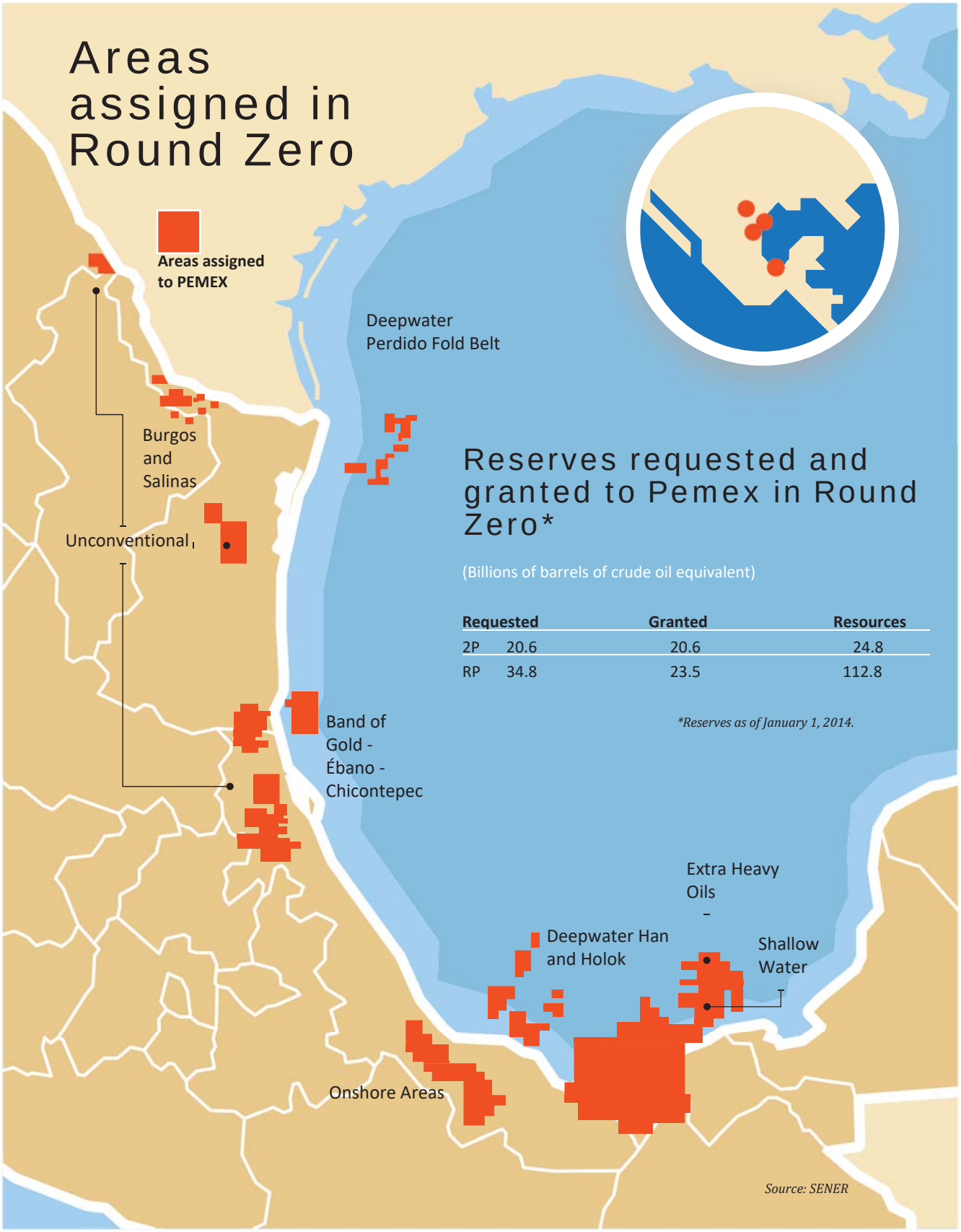
INVESTMENT AND PROFITABILITY

The New Mexican Energy Model allows Pemex to concentrate its resources on those projects it considers profitable and competitive.

The New Mexican Energy Model, in contrast, allows Pemex to focus its resources on those projects it considers to be the most profitable and competitive. In Round Zero, Pemex was assigned most of the areas where oil reserves are located (see table of Reserves) and many of the areas with prospective resources (estimated but not yet discovered). This guarantees Pemex the leading role as the oil company with the most reserves and production, even in the future.

To incentivize activity and take advantage of the opportunities that it had not been possible to develop under the earlier model, the State—which administers the petroleum resources—remained in charge of inviting bids for petroleum reservoirs that had been discovered or prospective resources not assigned to Pemex.

[10] *Ramos, G, (2017), Presentation of three studies on the internal governance of Mexico's three energy regulators*



Reserves requested and granted to Pemex in Round Zero*

(Billions of barrels of crude oil equivalent)

	Requested	Granted	Resources
2P	20.6	20.6	24.8
RP	34.8	23.5	112.8

**Reserves as of January 1, 2014.*

RIGHTS UNDER BIDDING PROCESSES

To obtain the rights to explore or produce in areas not assigned directly to Pemex, it and the rest of the companies must compete in bidding processes organized by the CNH, which are grouped into rounds.

To obtain the rights to explore or produce in areas not assigned directly to Pemex, it and the rest of the companies must compete in bidding processes organized by the CNH, which are grouped into rounds. In general terms, the company that wins a bidding round obtains the right to sign a contract allowing it to invest in exploration and/or production activities in a certain area.

Each bidding process has various areas, called blocks. Interested companies that meet prequalification criteria—technical, financial and safe operating criteria—set by the authorities in each case may compete for one or more blocks. They may compete on their own or in partnerships with other companies.

Blocks are won by offering better terms than the competition. To date, the CNH has established three parameters for determining the successful bidder. The main parameter is the economic variable, which may be a royalty (an additional tax percentage paid to the Mexican State) or a payment in kind (deliver to the Mexican State a portion of the hydrocarbons produced).

In addition to the foregoing, the bidding process may include a minimum work commitment or, in some cases, an established maximum amount of royalties, in which case companies can offer an additional cash bonus as a tie-breaker.

Results of Bidding Processes

109 Participating Companies

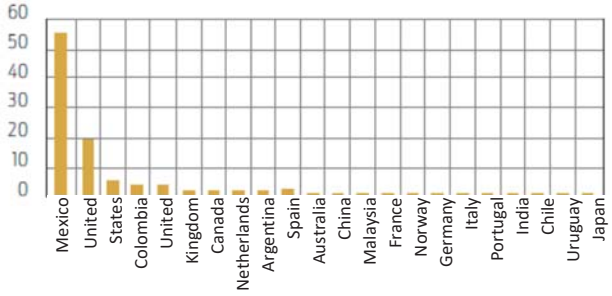
69 Company contract award

97 Blocks offered

72 Blocks awarded

33,448.6 km² area awarded

Round 1.1	Shallow Water	14	2
Round 1.2	Shallow Water	5	3
Round 1.3	Onshore fields	25	25
Round 1.4	Deepwater	10	8
Farm out Trión	Deepwater	1	1
Round 2.1	Shallow Water	15	10
Round 2.2	Onshore fields	10	7
Round 2.3	Onshore fields	14	14
Farm out Ogarrio	Onshore fields	1	1
Farm out Cárdenas-Mora	Onshore fields	1	1
Farm out Ayín-Batsil	Shallow Water	1	0



57 Licenses awarded

15 Production sharing contracts awarded

19 Production sharing not awarded

5 License not awarded

Average Winning Bids

61.71% State Share

34.81% Additional Royalty

It is important to point out that winning a round does not guarantee the success of a project. This is because there are two types of areas up for bid: those that contain reservoirs that have already been discovered (known as production projects) and those in which there is no certainty that hydrocarbons will be discovered (known as exploration projects.)

In areas with reservoirs that have already been discovered, the successful bidder agrees to appraise the reservoir at its own expense and risk, and if it so decides, it will have the option to invest in its development and production. The most recent bidding processes have included blocks that contained reservoirs that had already been discovered with the option—at the risk of the investors—to conduct further exploration.

In the case of exploration areas, the investments are also made at the risk of the investors and may turn out to be failures, either due to the absence of hydrocarbons or because what is discovered is not commercially viable. In fact, the vast majority of exploration activity has a very low rate of success, between just 20 and 30 percent.

Clearly, in both cases, the investor takes on the risk, either the exploratory risk or the commercial risk, in other words, it is impossible to guarantee that the market conditions, techniques or costs will make the project profitable. This can be due to the fact that exploiting the resources discovered may be more costly than expected or the income less than predicted (due to a drop in oil prices or having miscalculated the reserves.)

TAKING ON RISK

The investor takes on the risk, either the exploratory risk or the commercial risk; in other words, it is impossible to guarantee that the market conditions, techniques or costs will make the project profitable.

Seismic Studies

Another important change is the structure for contracting seismic studies that are comparable to ultrasounds of the subsurface that generate essential data for modern oil exploration. The New Energy Model allows companies other than Pemex to contract these seismic studies around the country, which has resulted in a very significant investment in information on the composition of the subsurface of the country.

In contrast to the earlier model, in which the State assumed all the risks, under the New Mexican Energy Model, the State need not assume the risks with public resources, since the investors take them on. Thus, no public funds are risked, but the State is the main beneficiary through taxes, royalties and other charges, if the projects are successful.

By October of 2017, the CNH had authorized 56 projects, of which 47 were 2D or 3D seismic acquisitions or reprocessing; of these, 6 projects were finalized, 6 expired and 7 companies withdrew without executing projects that had already been approved.

Thus, the agencies of the Mexican State involved in the new exploration and exploitation process participate at different stages: the CNH exercises primary contractual and regulatory control, oversees authorizing exploration, development and eventually, abandonment plans; the FMP collects the income from charges and royalties (what is frequently termed “oil revenue”); for its part, the ASEA continuously monitors industrial safety and environmental protection.

STATE RISK FREE

Under the New Mexican Energy Model, the State need not assume the risks with public resources, since the investors take them on. Thus, no public funds are risked, but the State is the main beneficiary through taxes, royalties and other charges, if the projects are successful.

INTERNATIONAL STANDARDS

The Ministry of Energy has made an effort to continue to refine the contract terms to align with international standards and best practices.

2.4 Initial results of the New Model

Although the most profound impacts of the energy reform will be felt over the long term, in the short term, we have already had clear results based on the progress made by the energy institutions individually and as a group.

Ministry of Energy

The Ministry of Energy is responsible for a positive development in the design of the New Mexican Energy Model. One of the great pieces of public policy it has created is the Five-Year Plan for Bidding Processes for the Exploration and Extraction of Hydrocarbons, providing a preview of the targets of the bidding processes for the next five years. Since its initial version was first drafted, the document has been used as a valuable mechanism for planning and scheduling for all the actors involved; but has also been used in the constructive dialog and interchange processes with various actors in the sector, to improve the bidding process.

Such changes include the process of nominating areas which, though the first version of the Plan already contemplated this process, the more recent versions have increased its relevance to make it a mechanism for shaping subsequent versions. These consultations involve receiving input from specialists with access to geological information on the country to identify those areas they would wish to include as the next blocks in the bidding rounds.

With regard to oil contracts, the SENER has also made an effort to continue to refine the contract terms to align with international standards and best practices. For one thing, the terms that have been modified (primarily those related to withdrawing and guarantees) have lent clarity and structure to the various processes. Moreover, the correct definition of the type of contract has resulted in an ongoing learning process. Although the SENER defines the contract model, in its technical review of the terms, the National Hydrocarbons Commission has recommended a different model.

On several occasions, the Ministry has reevaluated its choice of model and has taken the regulatory agencies recommendations for changing it. One example is the deepwater area bidding process, which was initially proposed as a Production Sharing Contract but later changed to a License Contract.

ROLE OF THE CNH

The CNH has played a vital role, be it via the adoption of innovative transparency standards, its technical opinions on oil contracts and the creation of new data compiling institutions (for the use of the industry and the general public).

National Hydrocarbons Commission

The CNH has played a vital role in securing the progress of the New Mexican Energy Model and providing continuity to the process of creating the sector. Its role has included the adoption of innovative transparency standards, its technical opinions on oil contracts and the creation of new data compiling institutions (for the use of the industry and the general public).

One of the first achievements in the first few months of the new energy model was the creation of the National Hydrocarbons Information Center (CNIH). This body began operating with several urgent challenges to solve. The first was to compile and organize all the geological, geophysical, and lithographic data that Pemex had gathered over more than 60 years, and create a mechanism that would facilitate accessing, searching and managing the information. This challenge had to be met in record time so that the first bidding process in Round One could be held. The result exceeded expectations: the initial data was made available in just 3 months.[11]

The task has been ongoing. For Round One alone, the CNIH managed to compile in a single location 58 (2D and 3D) seismic packages, in addition to data from 20 seismic surveys and data from 220 wells. Without this data migration, the companies would not have been able to properly evaluate the areas.

Now, 3 years into this process, the CNIH has broadened access to the data with new access mechanisms. Today, companies can not only review the data associated with areas they are bidding on in the bidding process rounds, but can also consult all the data in the country that has been compiled over decades. At the same time, the CNIH has a variety of access licenses that companies can purchase to gain access to the available data. Moreover, it is in the process of building a national mineral collection.

The CNIH is not only a compiling institution, it is also a depository and in charge of publishing the sector's operating indicators, the building of the first national mineral collection.

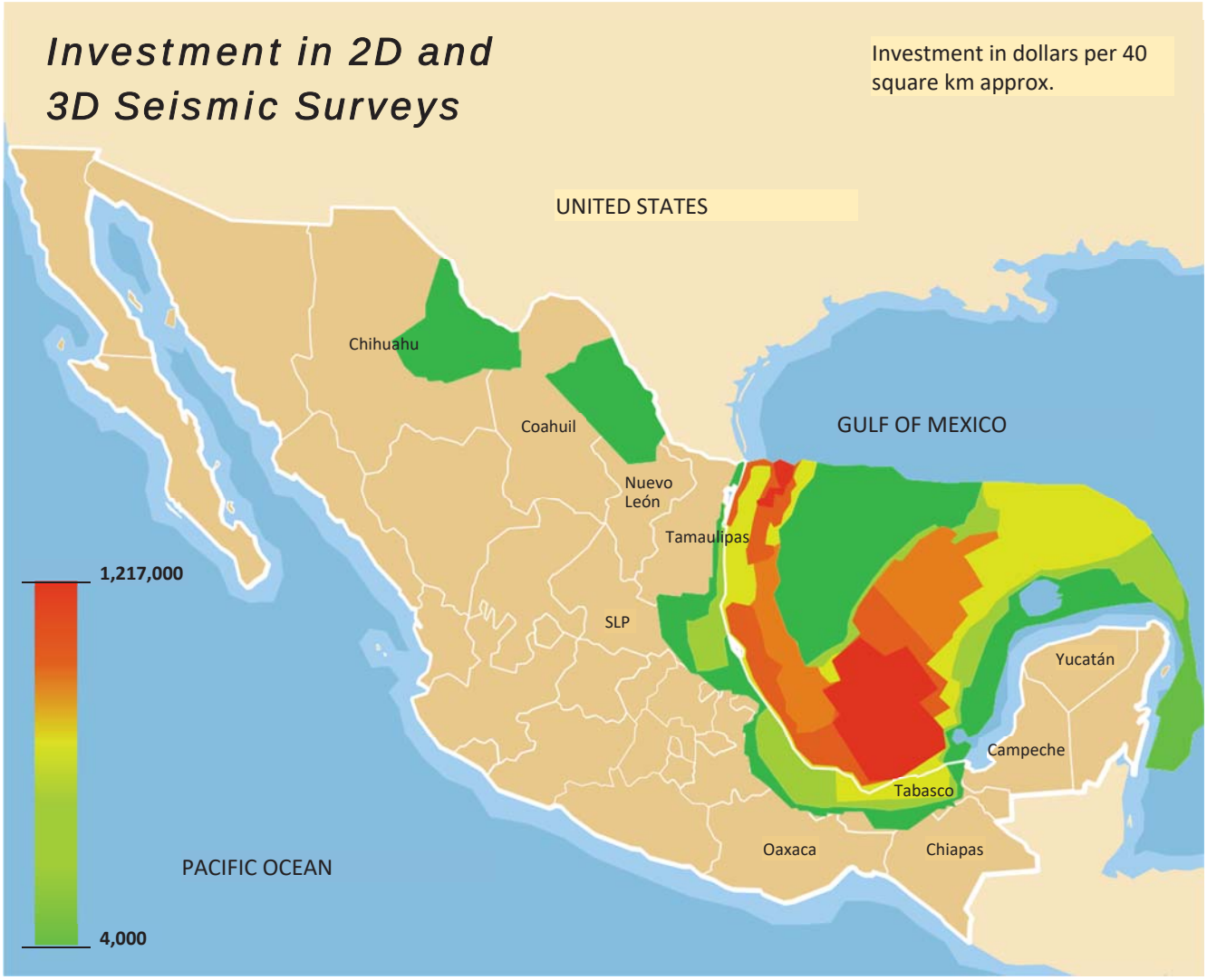
In response to this sophistication on the part of the CNIH, and the regulations issued for the exploration and production of hydrocarbons, the industry that takes seismic surveys of the subsurface has exploded. Today, the Mexican portion of the Gulf of Mexico is one of the areas with the most subsurface seismic survey activity with investment potentially totaling 2 billion dollars. The CNIH, the depository of all this data, allows the companies that conduct these studies the exclusive right to commercialize it for a period of time.

The CNH has also been recognized in its technical capacity in building the new energy model. In this process, the entire agency has become a highly specialized body that not only submits technical opinions to the SENER in creating the oil and gas contract bidding rounds, but has also provided recommendations and comments on exploration, development and production plans signed by sector contractors.

OUTSTANDING AGENCY

The CNH has become a highly specialized body that has also provided recommendations and comments on exploration, development and production plans signed by sector contractors.

[11] *Eniday. The Importance of Data Rooms. https://www.eniday.com/en/human_en/importance-of-data-rooms-oilgas-industry/*



Source: CNIH

One example of its proposals is to change the payment schedule in Production Sharing Contracts to a hybrid model in which the petroleum income to be paid to the State can be paid in kind or in cash. Under this hybrid system, in Production Sharing Contracts the State's contractor commercializes one hundred percent of the hydrocarbons and delivers to the State its portion of the fuels sold. If the State so decides, with prior notice, it can change this payment scheme and request payment in kind. This recommendation has been incorporated into current versions of the contract.

Another area in which the CNH has earned international recognition is transparency. The CNH is even a model of best practices, which are not limited to the bidding process for areas, but are applied across the board in all the tasks the agency performs. An example of this is the publication of the statements of potential conflicts of interest in which the Government Agency commissioners and top executives describe their family's relationship to the industry.

The CNH also imposed additional transparency rules on itself that go beyond the requirements set by the Coordinated Energy Regulatory Bodies Law, such as restrictions against meeting with bidders in the bidding processes to discuss the progress of the same. Another is the creation of the Rondas Mexico Internet portal which not only incorporates the information related to the development of the bidding processes, but also on the administration of contracts, with a vast amount of information (at the portal, for example, information on the details of the approvals and permits granted, development plans submitted and the companies' progress in the tasks is available for each contract.)

Even in controversial procedures such as the termination of the first oil contract, the agency has opted to keep its policy in accordance with the Law and proceed via institutional channels without any closed-door mediation or unilateral procedures.

To date, the CNH has conducted 14 bidding processes in shallow water and onshore fields, and in deep water and partnerships with Pemex. As a result, it has awarded 70 oil contracts and granted 59 licenses to 20 different companies for the development of surface exploration studies.

IMPROVED SAFETY

The Agency for Safety, Energy and the Environment (ASEA) is the newest of all the energy regulatory agencies in the sector. Thanks to its recommendations, in 2016 Pemex achieved the lowest accident rate in its history

Safety, Energy and Environment Agency

The Agency for Safety, Energy and the Environment (ASEA) is the newest of all the energy regulatory agencies in the sector. The Energy Reform stripped the Ministry of the Environment and Natural Resources, its oversight bodies, the SENER, the CNH and other authorities of their industrial safety oversight and management duties and deposited them in a single agency charged with regulating this area.

As of the end of 2017, the ASEA had published more than 20 new rules[12] (standards, provisions and guidelines) and more than 30 regulations to implement industrial safety throughout the entire energy sector chain. Critical regulatory gaps have been covered in record time. Some of the regulations that have been recognized for their broad applicability are the guidelines for the exploration and production of unconventional hydrocarbons; guidelines for purchasing insurance to cover hydrocarbon exploration and extraction work and activities and guidelines for conducting accident cause analyses, among others.

It is noteworthy that all the open cases in the various agencies that used to coordinate safety activities in the sector were transferred to the ASEA. Despite being in existence for only a short time, the Agency has already produced results, since Pemex, for example, reported that in 2016, it had the lowest accident rate in its history thanks to ASEA recommendations. In the exploration and production segment, Pemex reported a rate of 0.25 injuries per one million man-hours worked.[13] This is 45 percent fewer accidents than it reported in 2015.

[12] *https://www.gob.mx/asea/acciones-y-programas/leyes-y-normas-del-sector*
[13] *Pemex (2017). "Alcanza Pemex en 2016 el índice de frecuencia de accidentes más bajo de su historia" [In 2016 Pemex achieves the lowest accident rate in its history"]. http://www.pemex.com/saladeprensa/boletines_nacionales/Paginas/2017-045-nacional.aspx*

RESOURCE MANAGEMENT

The Mexican Petroleum Fund (FMP) was founded as a long-term savings mechanism to administer the income and ensure the transparency of the flow of income from the resources.

Ministry of the Treasury and Public Credit

The Ministry of the Treasury and Public Credit (SHCP) has also played an important role. The various bidding processes have allowed the agency to use the lessons learned from the results of the bidding processes to improve its own performance. One example is the modification of the bidding variables, such as the advance publication of the minimum royalty values that will be variables in awarding the contracts, the inclusion of the signature bonus as a new tie-breaking variable which, in addition, is a source of extraordinary income for the public treasury, and the inclusion of a maximum royalty to ensure that the contracts awarded remain within profitable range.

Under these contract award terms, oil and gas contracts have been awarded with high rates of royalties to be paid to the State, in successful and competitive bidding processes. According to the Mexican Council on International Relations (CO- MEXI), if the contracts are commercially successful, the State will receive, on average, 70 percent of the profits from the contracts, "without having risked public funds or having resorted to government debt to finance them."[14]

Mexican Petroleum Fund

The Mexican Petroleum Fund (FMP) was founded as a long-term savings mechanism. In addition to providing better resource management, this mechanism provides transparency for the flow of revenue from the resources because it lists the revenue generated by each contractor and where it is allocated, such as sector research funds, Federal, State or Municipal Treasuries or long-term savings.

The Fund has a mandate to calculate and pay the considerations generated from the oil and gas contracts. Between January of 2015—when it first began reporting on its activities—and October of 2017, the FMP has administered a total volume of 1 trillion, 73 billion, 500 million pesos, which have been allocated to the government finance stabilization funds, CONACYT-SENER research funds, and to reimbursing the contractors for their operating costs. In 2017, the cumulative transfers represented 1.81 percent of Mexico's GDP.

MANAGED RESOURCES

As of October 2017, the Fund has administered 1 trillion, 73 billion, 500 million pesos. Cumulative transfers represent 1.8 percent of the country's GDP.

FMP Revenue Allocation[15]

(pesos, cumulative between January 2015 and October 2017)

Destination Fund	Amount
CONACYT-SENER Hydrocarbon Fund	10,570,934,369
CONACYT-SENER Sustainable Energy Fund	21,141,868,738
Mexican Petroleum Institute (IMP) Scientific Research and Technological Development Fund	1,588,321,606
Oversight of petroleum matters	82,745,407
Consideration paid to contractors	9,326,628

Source: The Mexican Petroleum Fund for Stabilization and Development

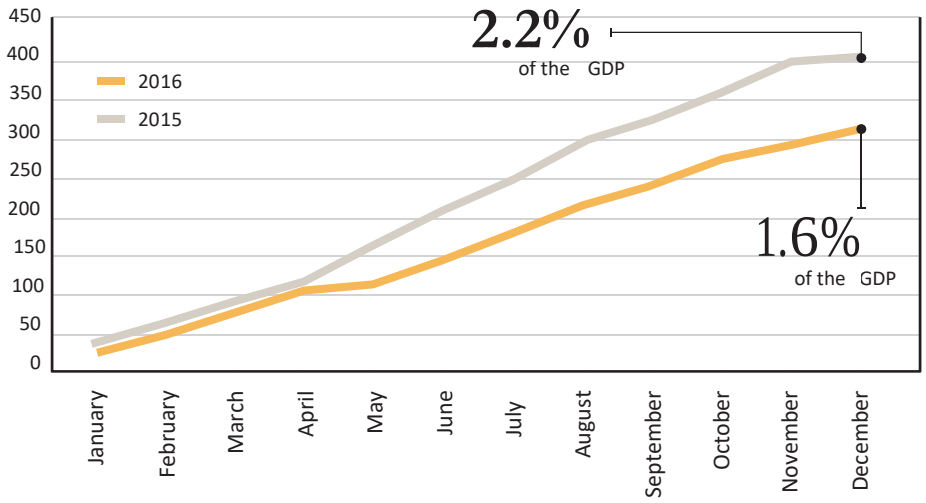
[14] *Comexi (2017). México Ante el Espejo. Lecciones Internacionales para la Consolidación del Nuevo Modelo Energético Mexicano. [Mexico before the Mirror. International Lessons for the Consolidation of the New Mexican Energy Model.] http://www.consejomexicano.org/index.php?s=contenido&id=1508*

[15] *http://www.fmped.org.mx/administracion-ingresos.html#origenes_destinos*

GRAPH 2

Cumulative monthly ordinary transfers

(Expressed in billions of pesos)



FUND RECOMMENDATIONS

The Fund has made recommendations to streamline the calculation and payment of the considerations generated from the oil and gas contracts.

The FMP, for its part, has participated in the design of the contract bidding processes. As reflected in its annual reports,[16] the Fund has made recommendations to streamline the calculation and payment of the considerations generated from the oil and gas contracts. The Fund has also worked with other sector authorities in creating the standard contract for Pemex to serve as the trader for the State's hydrocarbons.

The Fund has also formalized two agreements with the SHCP and Pemex. The first is to exchange information and documentation on the verification procedure that the Treasury Ministry must conduct inside the FMP. The second is to simplify financial transactions between Pemex and the Fund.

2.5 Four defining characteristics of the New Model

The above sections have described the legal structure and workings of the New Mexican Energy Model, which are fundamentally necessary for understanding the current Mexican energy ecosystem (actors, institutions and mechanisms). This task, without a doubt, has required enormous effort, particularly considering that in less than four years, the Mexican State has designed and implemented an entirely new model

Apart from how quickly it has been implemented and attracted investment, the Mexican Energy Model has a series of characteristics that ensure its viability over the long term. To the extent that these characteristics (transparency, institutional framework, consistency and flexibility) continue to guide decision making and the determination of parameters and processes, the Mexican Energy Model will continue to become stronger and the most optimistic projections will be within reach.

[16] *Taken from: http://www.fmped.org.mx/transparencia/%7B6D2E1971-59C2-A87C-FFC1-C629EEF81013%7D.pdf*

COMPETITIVE BIDDING

The characteristics of the competitive bidding process in a closed-envelope process with contract award criteria determined well in advance, in addition to being broadcast live, are largely responsible for the success in maximizing transparency.

In the same spirit, the following parts of the document each contain a section that offers "ideas going forward," with suggestions on how to continue deepening the various characteristics of the model.

1.- Transparency

The transparency with which the oil and gas contract bidding processes have been conducted—which, as we explained in the previous section, constitutes a critical step in the life cycle of each project—has not only raised the standards of public bidding processes in Mexico, but has earned international recognition.

Upon the completion of the first phase of Round One, the Atlantic Council (one of the top research centers in the United States in international affairs) noted that "the process the Mexican government employed to carry out the auction exceeded international best practices with respect to transparency, reflecting its efforts to craft one of the most transparent oil and gas sectors in the world."[17]

The characteristics of the competitive bidding process in a closed-envelope process with contract award criteria determined well in advance, in addition to being broadcast live, are largely responsible for the success in maximizing transparency.

Another significant reason for the success is the competitive nature of the process, since the competitors—who spend months analyzing the bidding terms and conditions for the blocks up for bid—would be the first ones to complain about any atypical terms or conditions that would compromise the impartiality of the process. Given the high number of participants, any collusion would be difficult to imagine. What is more, the civil society has all the necessary information to follow the process, since all the rules, clarifications and discussions are fully transparent and anyone may review them. In conclusion, the normalcy with which the bidding rounds have taken place, without any disqualifications or accusations, illustrates the transparency of the process.

TRANSPARENT PROCESS

The normalcy with which the bidding rounds have taken place, without any disqualifications or accusations, illustrates the transparency of the process.

The New Model also involves various government agencies that create a system of checks and balances: the SENER determines the contract format, particularly the operating characteristics; the CHN publishes guidelines for the participation of private companies, conducts the bidding process and administers the contracts; the SHCP establishes the fiscal aspects of the contracts and the minimum royalty amounts. With regard to the more operative fiscal arena, the Tax Administration Service (SAT) receives the traditional taxes via a highly specialized group, while the FMP collects royalty payments and other charges specific to the oil and gas sector.

The combination of the work of each independent actor ensures that each stage in the New Mexican Energy Model process can be cross checked and compared against the rest, all the more so due to the fact that, as we mentioned earlier, the contract terms and conditions and subsequent documentation are all public.

Ideas going forward

Two recent milestones have significantly enhanced transparency in different components of the model: Mexico joining the Extractive Industry Transparency Initiative (EITI) and the International Energy Agency (IEA).

In the future, if Mexico continues to carefully meet its commitments to these two organizations, they will be important mechanisms for enhancing transparency.

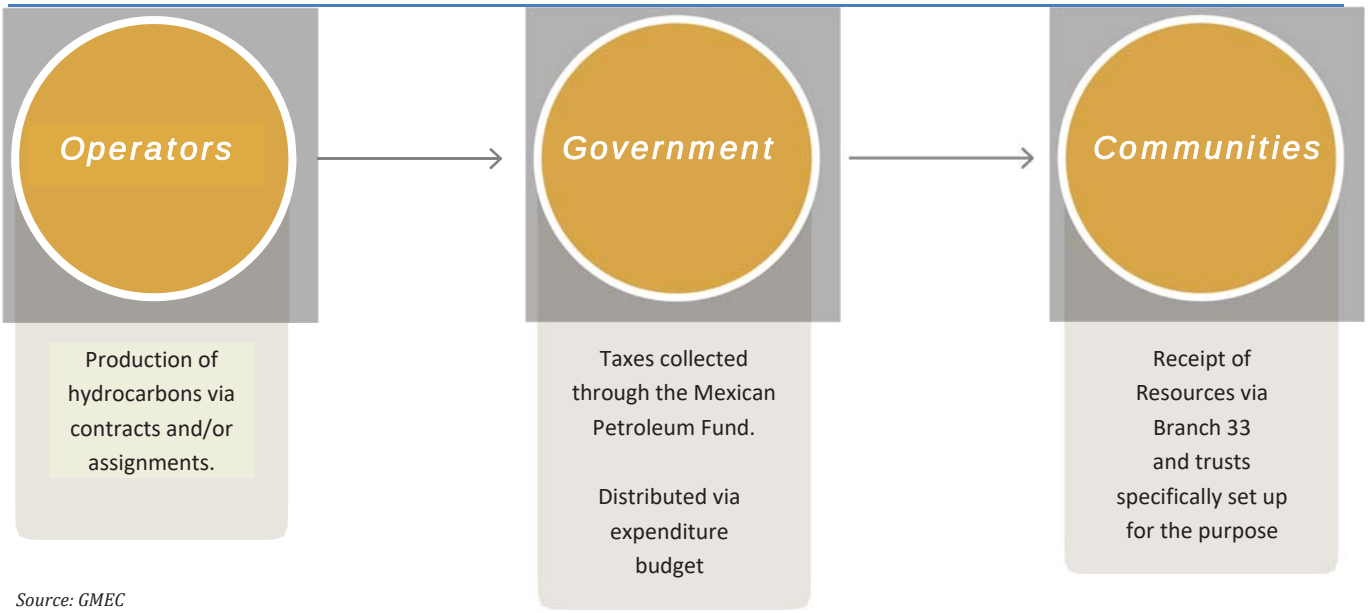
The EITI is a global standard for the good governance of extractive industries, created to allow governments, companies and the civil society to participate and interact with each other. The three sectors establish the evaluation parameters and reporting areas, so that each one can provide the information it has so as to compare it and verify that everything has been reported and nothing has been left out. As such, the EITI is a key mechanism for overseeing and monitoring the government's use of the resources obtained from extractive industries.

This initiative makes it possible to observe where the oil and gas revenue comes from and where it goes. Thus, Mexico and the companies agree to publish accurate and timely information on key aspects of the sector, including licenses granted, tax paid by the companies, and how the funds were allocated within the government at various levels. All the information is verified by the civil society and EITI personnel.

TRANSPARENCY INITIATIVE

Having reinforced transparency, Mexico is now part of the Extraction Industry Transparency Initiative (EITI) and the International Energy Agency (IEA).

EITI Process



Source: GMEC

STANDARDS CREATED

The role that Pemex played as the sole operator also resulted in its creating Official Mexican Standards (NOMs) and other standards as though it were a de facto regulatory body.

Moreover, by joining the IEA, apart from important energy security aspects, Mexico and its institutions commit to truthfully, clearly and transparently reporting the energy data and statistics that the country generates. Joining this select group of countries allows Mexico to endorse certain standards regarding competitiveness and transparency, and provides greater certainty for Mexico's statistical data.

An important symbol of the progress in terms of transparency is the publication of the *Mexico Energy Outlook 2016*, with outstanding technical detail, in-depth analysis and production projections for the country. This, along with a large number of other independent publications and research projects, has generated highly in-depth data, which under the old model was difficult to find.

Institutional Framework

The earlier model, which by definition was a monopoly, placed a lot of emphasis on the vision of just a few people, and focused entirely on Pemex. At times, its vision resulted in good decisions that added value to the country, but the structural characteristics in which it operated also resulted in poor decisions that did not necessarily benefit Mexico. In both cases, the accountability and transparency of the decision was not a central value or requirement.

The role that Pemex played as the sole operator also resulted in its creating Official Mexican Standards (NOMs) and other standards as though it were a de facto regulatory body. As discussed earlier, the CNH—the current regulator of the hydrocarbons sector—was not created until 2008. In a multitude of cases, the public review and consultation processes—most of which was conducted by the Federal Regulatory Improvement Commission (COFEMER)—imposed by Pemex under the earlier model, was not subject to the decision-making accountability or transparency that now prevails under the New Mexican Energy Model.

The New Model makes use of the lessons learned by incorporating aspects of the old model that worked. For example, the SENER, the CNH and the CRE not only continue to play the roles given to them under the earlier model, but were given additional duties and authority. With the difference that the CNH and the CRE acquired budgetary autonomy and diversified their sources of income when they were given the authority to receive consideration for administering contracts, rights and fines imposed.

REGULATORY AUTONOMY

In the New Mexican Energy Model, the CNH and the CRE acquired budgetary autonomy and diversified their sources of income.

This—in addition to the collegial nature of their governing bodies—has allowed these agencies to be independent, with their own budgets, specialties, not subject to six-year cycles, and empowered as true independent market referees.

[17] *Goldwyn, D., & Gill, c., (July 2015). "Mexico's Inaugural Bid Round: What Happened and What's next?", in Atlantic Council. Taken from: http://www.atlanticcouncil.org/blogs/new-atlanticist/mexico-s-inaugural-bid-round-what-happened-and-what-s-next*

Consensus

The consensus and the autonomy of the regulatory agencies, and the collegial nature of the CNH, CRE and the FMP, have provided the proper incentives to give priority to transparency and data generation based on constructive design. In addition, CNH and CRE commissioners have cast reasoned votes, publicly expressing their objections to decisions made by the majority of commissioners.

In contrast to the autonomy enjoyed by the CNH and the CRE, the ASEA, despite having only some of these characteristics and being subordinate to the Ministry of the Environment and Natural Resources, has already made significant progress in the area of industrial safety and environmental protection.

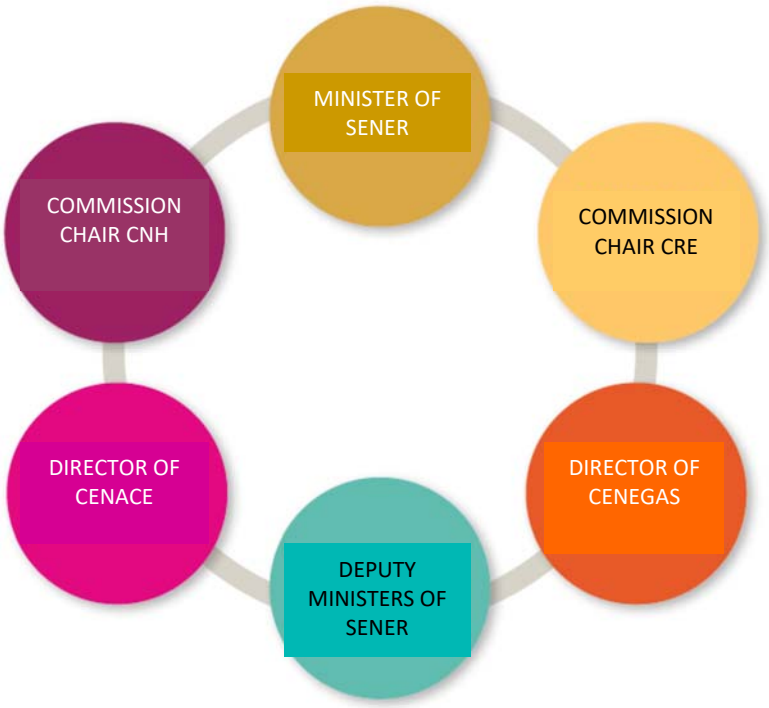
Ideas going forward

Unlike the CRE and the CNH, as we have discussed, the ASEA does not have autonomy, or a collegial governing body with members appointed in a staggered manner not subject to six-year periods. An example of this discontinuity is that the head of the Federal Executive Branch appoints the director. This situation has been noted by the OECD, which has recommended that the Mexican Government develop a reform bill to grant autonomy to the ASEA and make it part of the Council of Coordinated Agencies.

NO AUTONOMY

Despite having made significant progress in the area of industrial safety and environmental protection, ASEA is not autonomous.

Energy Sector Coordination Council



Source: Coordinated Energy Regulatory Bodies Law;

INVITEES

Minister SHCP
Minister SEMARNAT
Minister of the Economy

Director ASEA
Director CNSNS
Director CONUEE

Civil Service Representatives

PROJECTS WITH NO FUTURE

The former model favored the deployment of oil and gas resources and investments in line with certain political plans and outlook and a multitude of projects were unlikely to outlast the six-year administration.

Moreover, it is important to ensure that the institutional framework that creates desirable checks and balances does not lead to a lack of coordination or clear contradictions. Thus, another key recommendation given by the OECD is to make the Energy Sector Coordination Council—which brings together the main energy authorities—into a key body for designing and implementing government energy policy.

Thus, as the implementation of the New Mexican Energy Model continues to progress, it is of utmost importance to achieve greater coordination among federal authorities, beyond those strictly related to energy, so as to generate beneficial synergies and thereby develop infrastructure from specific development poles.

After this challenge has been met, it will be time to achieve successful coordination with state and local authorities.

Consistency

Opportunities to attract investment arise in a particular period in time. This means that not only do the individual parameters of each opportunity (round or bidding process) determine its ability to attract investors, but its entire relationship to the process largely determines its success.

The former model favored the deployment of oil and gas resources and investments in line with certain political plans and outlook and a multitude of projects were unlikely to outlast the six-year administration. The New Energy Model, on the other hand, creates processes and systems that ensure that the participation and placement of investments will be administered responsibly and intelligently, with a long-term view of the national interest in building a competitive sector.

Round Zero was an essential starting point for creating this consistency, but it was as of Round One and the rounds that followed that Mexico entered into a true recurring process. To the extent that the terms and conditions prove to be well-calibrated and are replicated in each process, important synergies will arise that will reduce operating costs and make the Mexican oil and gas industry more competitive.

CENTRAL PLAN

The Five-Year Plan for Exploration and Production is a central element of planning and compliance that sends important signals to the industry, academia and the civil society.

It will also allow companies to engage in orderly planning, in which each bidding process will attract the attention and interest of the greatest possible number of competitors. Moreover, this is a key element in talent management, since the technical lessons that come out of each round quickly generate value for the next round and down the road—when the process is more mature—it will do the same with regard to the attraction of qualified teams and personnel. As such, the Five-Year Plan for Exploration and Production is a central element of planning and compliance that sends important signals to the industry, academia and the civil society.

Consistency in the rounds is also important due to the colossal size of the challenge Mexico has before it. The IEA, in the aforementioned *Mexico Energy*

Outlook 2016, estimates that Mexico's crude production could rise significantly by 2040, to up to 3.4 mbd.[18] But to reach this goal would require $640 billion dollars in investment. This means there would have to be 15 Rounds as successful as Round One.[19] Otherwise, were we to suspend the bidding Rounds and farmouts as a whole for just one year, it would generate a loss of potential investments of nearly 19 billion dollars.[20]

DISCIPLINED INVESTMENT

The IEA estimates that Mexico's crude production could reach up to 3.4 mbd by 2040. But this would require $640 billion dollars in investment. Absolute consistency and discipline in the bidding rounds is therefore essential.

Ideas going forward

In mid-2017, the SENER announced a change to its Five-Year Plan for Exploration and Production. This change placed greater emphasis on the nomination of areas by the industry, and standardized the block area. The nomination process itself is one of the biggest changes with regard to which blocks should be developed and at what pace. Under the previous monopoly model, Pemex was the only one involved in making this decision, and it asked the SENER for the relevant permits to develop its blocks. Under the current open and competitive model, companies conduct seismic studies of the national territory at their own expense—either directly or via third parties. If a certain area interests them, they ask the SENER to add this block or area to future bidding rounds.

It must be noted that SENER is under no obligation to determine which blocks will be made available for bidding based on any such requests from companies or groups of companies. Its guidance of the sector is never compromised or questioned. The idea that companies could nominate or request blocks or areas is a step the SENER took to gauge the market's interest in certain assets. This is in turn reflected in greater participation and competition in the bidding processes, with results that are ever more favorable to the State.

In addition, in the Five-Year Plan, the SENER proposes that the shallow water and conventional onshore blocks should be offered for bidding during the first six months of each year, while deepwater and unconventional resource blocks should be offered for bidding in the latter six months of each year.

In general terms, this standardization idea promotes consistency and predictability in the Model. Going forward, it is essential that the size of each block remain large enough for the potential opportunities to be substantial. To the extent that the Plan is fully implemented and each bidding process provides access to a greater number of opportunities, Mexico will achieve the greatest possible amount of investment, and oil and gas activity.

[18] *IEPICA (2016). Mexico Energy Outlook. France: IEA. Taken from: https://www.iea.org/publications/freepublications/publication/MexicoEnergyOutlook.pdf*
[19] *Pulso Energético (March 2017). "El camino a USD $640 mil millones de inversión" [The road to USD 640 billion in investments"]. Taken from: https://pulsoener- getico.org/el-camino-a-640-mil-millones-de-dolares-de-inversion/*
[20] *Pulso Energético (November 2017). "Volver al futuro o revisitar el pasado: El Proyecto de Nación 2018-2040" ["Go back to the future or revisit the past: 2018-2040 Nation Project"]. Taken from: https://pulsoenergetico.org/volver-al-futuro-o-revisitar-el-pasado-el-proyecto-de-nacion-2018-2040/*

November 2017 Version

CONTRACT FORMATS

With the new Mexican Energy Model, the State has a variety of contract formats. This diversity allows it to attract the best companies in each specialty, provided they meet the prequalification criteria required by the CNH as part of each bidding process.

Flexibility/adaptability

A key element of the New Mexican Energy Model is that the State has a variety of contract formats available to it for the optimal development of its diverse resources. This diversity of mechanisms allows it to attract the best companies in each specialty, provided they meet the prequalification criteria required by the CNH as part of each bidding process. In fact, each of the bidding processes has been a learning and information gathering experience on the part of the government and the industry.

As we mentioned, one of the first changes that were made after Round One was that the minimum royalty values, a criterion for the award of oil and gas contracts, went from being secret in the first competitive bidding process to being public in subsequent bidding processes. This change has allowed a greater number of blocks to be awarded.

[21] *ANP (September 2017). "Brazil's 14th Bidding Round had the largest signature bonus in history." Taken from: http://www.anp.gov.br/wwwanp/noticias/anp-e-p/4052-brazil-s-14th-bidding-round-had-the-largest-signature-bonus-in-history*

Another important change was incorporating a royalty cap or maximum royalty amount, as a bidding variable. Upon observing that the danger of overbidding was real and would eventually result in projects that would not be carried out, the maximum amount of royalties that could be offered was capped and a tie-breaker mechanism established in the form of a cash bonus. This requires bidders to immediately internalize the risk of overbidding.

Ideas going forward

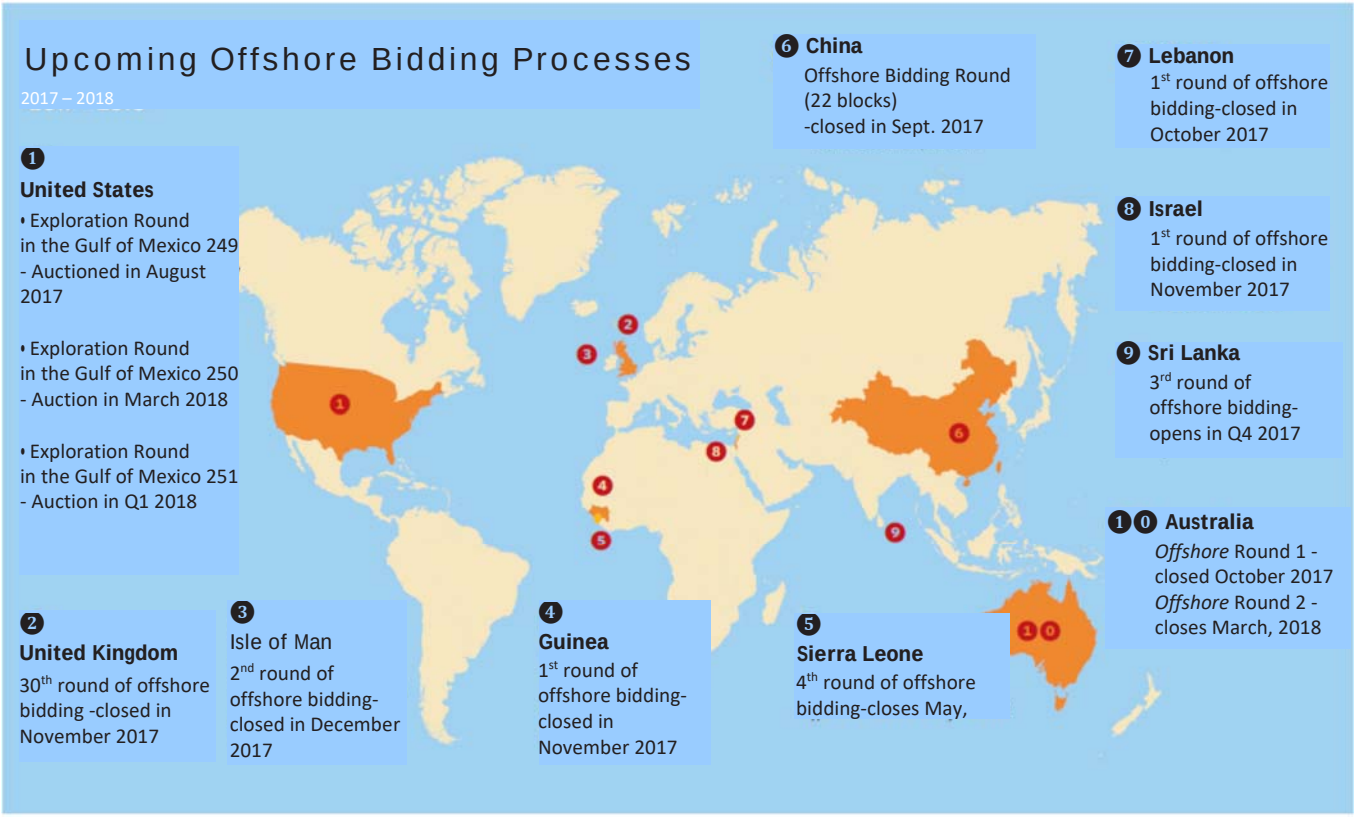
Competitiveness is never static and for Mexico to remain one of investors' favorite destinations in the world, it must refine and adapt its model to global competition conditions. A clear example of the benefit of such successful adaptation is the recent bidding round in Brazil, in which the country collected 1.2 billion dollars in signature bonuses and 267 million dollars in minimum work program investments in the areas it awarded.[21]

If we take into account that the capacity for investment in any given industry is finite, it is important for Mexico to continue to refine and calibrate its competitiveness parameters as global conditions change.

It is therefore critical for Mexico to constantly look around at the world and reflect on what best practices could make this country more competitive and what formula could help achieve even better results.

GLOBAL COMPETITIVENESS

Competitiveness is never static and for Mexico to remain one of investors' favorite destinations in the world, it must refine and adapt its model to global competition conditions.



Source: Petroleum Economist

LONG-TERM COMMITMENT

It would be a mistake to conclude that by adopting this model, success is now guaranteed. Movement never comes from a design, but rather the will to meet the commitments the State has undertaken objectively, transparently and consistently.

2.6 Conclusions

This chapter described the New Mexican Energy Model: the constitutional reform, the creation of the legal framework, the principal processes and functions of the model and its principal characteristics and virtues. As such, it described a profound shift in the way the State performs its guiding role. It covers more, and has more tools at its disposal, but it also took on commitments to objectivity, transparency and impartiality that were heretofore inconceivable.

Everything we have described (from the laws to the rounds) can be further perfected, but in general, the design is robust and competitive as it stands. However, it would be a mistake to conclude that by adopting this model, success is now guaranteed. Movement never comes from a design, but rather the will to act.

The structure is institutional, but adaptable; flexible, but at a pace that must be regular. To the extent our public policy keeps these characteristics in mind, as well as their importance for the sound functioning of the oil and gas sector, Mexico will benefit from the excellent structure it has built.

The potential rewards of doing so are immense. Mexico could completely turn the decline of the petroleum industry around and get back on the path to growth in the oil and gas sector. What is more, it will lay the foundations for higher rates of productivity and benefit the Mexican economy as a whole. The next chapter describes these prospective scenarios.

PHOTO: ISTOCKPHOTO

03

The Apex of National Development

In the history of any country, there are few decisions that, from one day to the next, can create significant prospects for growth. This is the case of the New Mexican Energy Model and its ability to interconnect the widest-ranging areas of the domestic economy, and connect Mexico with the world.

The recent Energy Reform, enacted in 2013 has demonstrated its immediate ability to generate potential value, although this should come as no surprise. As we explained in Chapter 1, the evidence of potential best practices is accumulated over decades.

It was clear that the capacity of a single company, in a closed model, would never be sufficient to take advantage of the oil and gas potential of an entire industry, much less meet the growing energy needs of a country undergoing rapid industrialization, with a significant population boom and on the threshold of a great worldwide technological transformation.

The change that took place in 2013, described in the preceding chapter, was the great axis of convergence of all the evidence and proposals that had been accumulated. The decisions that have come out of the Reform —from secondary laws, regulations, provisions and guidelines, and including the response of the industry, which has actively participated, risking its capital in this new energy development framework— have provided direction, continuity and concrete form to this new energy vision. Particularly with regard to hydrocarbons, which will be the lynch pin of all the energy needed by 21st century Mexico.

It has now been possible to get a better estimate of the potential value of the reform, since a precise model is now in operation, as well as some initial efforts at competitive bidding processes and auctions. As we shall discuss later on, the total potential of the New Mexican Energy Model is so vast that, by 2040, it adds hundreds of thousands of barrels per day, hundreds of billions of dollars of investment, and several whole percentage points to the Gross Domestic Product (GDP). All of this will have a positive effect on productivity, competitiveness and the development of our society.

ROAD TO TRANSFOR-MATION

The Energy Reform charted the road to transformation so that the Mexican energy sector could become an energy market.

In 2018, the Mexican economy is already highly complex, as a result of the significant investment Mexico has made in its own development in recent decades, through elements such as trade liberalization, macroeconomic stability, building a competitive environment and solidifying processes and institutions, all of which was developed in the last decade of the 20th century and consolidated in the 21st century.

However, the delay in enacting the energy reform was creating a drag on not only economic growth, but also the development of the ability to produce with greater value added, and it was a vision for the country decision that led Mexico to transition from an energy sector to an energy market.

The decision to become an energy market will be of significant benefit to the country's future, in three fundamental ways:

- **The benefits the Mexican State will obtain as the owner of the petroleum wealth.**
- **The benefits for those who demand energy (industry and consumers).**
- **The benefits with the multiplier effect on the country's overall competitiveness.**
- **In this chapter, we will analyze and estimate some of these benefits in the ways described.**

3.1 Benefits of the new Mexican energy model from the supply perspective

The new Mexican energy model allows the country to fully and efficiently exploit its hydrocarbon wealth. The implications of this greater supply are multiple:

- **More income for the State from the royalties it received as the owner of the hydrocarbon reserves, from both Petróleos Mexicanos and from contracts it will sign -thanks to the reform- with other domestic and foreign companies.**
- **More tax revenue for the Mexican State, derived from both the production and the distribution and trading of a greater volume of hydrocarbons.**
- **More tax revenue resulting from more dynamic economic activity and a higher GDP.**

- **More investment in Mexico's sustainable development, via the resources that the Mexican Petroleum Fund (FMP) will administer under the provisions of its regulatory act.**

- **More social initiatives and projects via the environmental sustainability and development projects for the communities in the geographic areas where the hydrocarbon projects will be located.**

After analyzing the studies conducted by academic centers, specialized groups, government agencies and centers for prospective studies, the Mexican Association of Hydrocarbon Companies (AMEXHI) has determined that the most complete and independent study conducted to date is that which was conducted by the International Energy Agency (IAE) in 2016[1]. The year 2017 marked the 40th anniversary of the IAE's flagship publication, the World Energy Outlook, which has over time become one of the top authorities on this subject, and which, since 1993, has used a multi-factor simulation model known as the World Energy Model, as its fundamental tool[2], providing inputs for public policy design in countries that wish to get more out of their natural resources than tax revenue or a raw material export industry. It is a prospective model that, based on the demand, places the needs of the population first and seeks to identify how to best meet these needs.

ATTENTION TO NEEDS

A prospective model that, based on the demand, places the needs of the population first and seeks to identify how to best meet these needs.

This year, for the first time, the Agency analyzed Mexico with the level of detail necessary to publish a specific energy outlook for our country, the Mexico Energy Outlook.[3]

Mexico's entry into this distinguished association is a recognition of our country's global influence in the energy world and is, above all, the reflection of the energy future to which Mexico can now finally aspire.

MEXICO'S GLOBAL INFLUENCE

Mexico's entry into the IEA is a recognition of our country's global influence in the energy world and is, above all, the reflection of the energy future to which Mexico can now finally aspire.

Such a future has two salient characteristics: first, the fact that in addition to remaining one of the top producers and exporters of raw materials, our country can also be a top energy consumer; and second, the leadership role Mexico has developed in relation to sustainability and climate change.

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[1] *The Agency focuses on the principal energy economies, in other words, those that seek to develop energy policies that will ensure the reliable, accessible and sustainable development of energy resources, rather than simply exporting their oil. Its members include the top producers (such as the United States, Canada, Australia or Norway) and several top consumers (such as Japan, Germany or once again, the United States), and some of the most innovative nations in sustainability (such as Denmark and the Netherlands), leaders in the development of energy value chains (such as South Korea) or those that have manged to make nuclear energy a safe and reliable option (such as France).*

[2] *It is a large-scale simulation that makes it possible to examine energy models in light of various public policy options. It is built in three major areas:*

- *End-user consumption by activity block (household, services, agriculture, industrial and transportation.)*
- *Energy transformation including (electric power generation, refining, petrochemistry and other transformation processes.)*
- *Supply, in other words: the ability to meet the energy needs of an economy, by generating energy from fossil and biofuels.*

In a judicious exercise of transparency, the methodology may be reviewed by any interested party just by visiting theIEA Website

[3] *https://www.iea.org/publications/freepublications/publication/MexicoEnergyOutlook.pdf*

IMPACT TO 2040

The IEA's conclusions are essential to continue building the future, above all its decision to project out to the year 2040 to see the full impact of each scenario.

Not to mention the enormous potential that the New Model is triggering in renewable energies, infrastructure and storage capacity.

In the foreward to the *Mexico Energy Outlook*, the IEA recognizes the profound changes in the Mexican energy sector, catalyzed by the 2013 Energy Reform. According to the Agency, this Reform was in response to:

> The recognition that key energy indicators were moving in the wrong direction, with the attendant risk of a widening gap between the performance of the oil, gas and power sectors and the needs and aspirations of a modern Mexico. The Reform recasts the structures that have governed the energy sector for over 80 years, and seeks to bring in new investment and technology across the value chain by ending the monopoly of Petróleos Mexicanos (PEMEX) and by attracting new players into the power sector to ensure cost-efficient investment into both traditional and low-carbon sources of electricity[4].

To understand the importance of the Mexico Energy Outlook, we must take a look backward and also look outward. Just as the start of the last chapter stressed the quantum leaps that have been taken with regard to the understanding of the workings of institutions, energy governance and the impact of public policy, here it is important to highlight the progress made in the prospective analysis of global energy under which the IEA team analyzed the case of Mexico in the early days of our New Energy Model. Its conclusions are essential to continue building the future, above all its decision to project out to the year 2040 to see the full impact of each scenario.

For all of these reasons, we have decided to explore the Agency's prospective analysis of the impact of the New Mexican Energy Model for Mexico in relation to the supply of hydrocarbons in various scenarios, including:[5]

- **Scenario in which the Energy Reform is completely rolled back and the legal framework in existence prior to December of 2013 is put back in place (called the "no reform" or "counter-reform" scenario.)**

- **Scenario in which the current status of the New Mexican Energy Model is maintained and in addition, a series of polices and strategic changes are implemented, called the "new policies" scenario. Some of the policies the IEA considers essential[6] are:**

  - **The 2013 Energy Reform and 2014 secondary laws remain in effect and are properly implemented.**

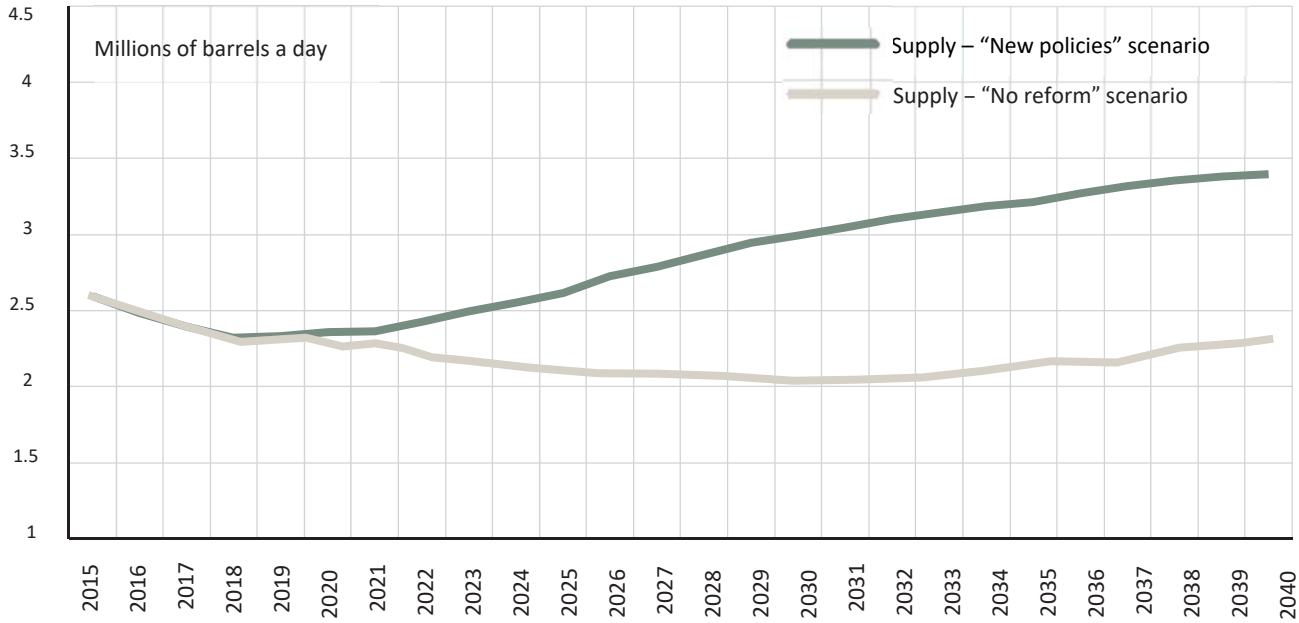
  - **The participation of the private sector in the upstream, midstream and downstream oil and gas sectors.**

  - **Hydrocarbon exploration and production based on a five-year plan published by the State and new contracting schemes.**

Graph 01

Projected Oil Supply and Demand in Mexico (2015-2040)

Under the "New Policies" and "No Reform" scenarios



Source: Self-prepared based on the projections in the International Energy Agency document.

The Agency projected the oil supply in Mexico for these scenarios until the year 2040.

As shown in the above graph, the oil supply is where the benefit of the Reform becomes fully apparent:

- **In the "No Reform" scenario, oil production (supply) in 2015 is 2.5 million barrels of oil per day (dotted red line)[sic]. In 2022, it falls to 2.2 million and in 2024, to 2.1 million. It does not recover until 2039, and then only to 2018 levels.**

- **On the other hand, under the "New Policies" scenario, oil production (grey area)[sic] starts out like the previous scenario with 2.5 million barrels per day in 2015. However, by 2030, it reaches 3 million barrels per day and by the end of the projection period in 2040 reaches 3.4 million barrels of oil per day, a growth of 36 percent.**

With this estimation of the behavior of the energy supply in Mexico, the Agency models two potential economic growth scenarios, in which the benefits of the full implementation of the energy reform are clearly apparent:

BENEFITS OF THE REFORM

The oil supply is where the benefit of the reform becomes fully apparent.

[4] *Mexico Energy Outlook, International Energy Agency, p. 11 https://www.iea.org/publications/freepublications/publication/MexicoEnergyOutlook.pdf*

[5] *https://www.iea.org/publications/freepublications/publication/MexicoEnergyOutlook.pdf*

[6] *The full list of policies considered by the Agency is found on page 43 of Mexico's Energy Outlook*

ADVERSE SCENARIO

Taking the path of No Reform, the energy sector —and consequently the country as a whole— remain tied to inertial growth.

3.1.1 Economic growth projected by the IEA in the "no Reform" scenario

This scenario shows what Mexico's performance would have been had it not passed the 2013 Energy Reform and is also a reference scenario in the event the New Mexican Energy Reform is rolled back, either by a legal counter-reform or a hypothetical decision on the part of the government not to use the tools given to it by the reform, turn away investment or attempt to once again force Pemex and the CFE to handle all of the country's energy needs.

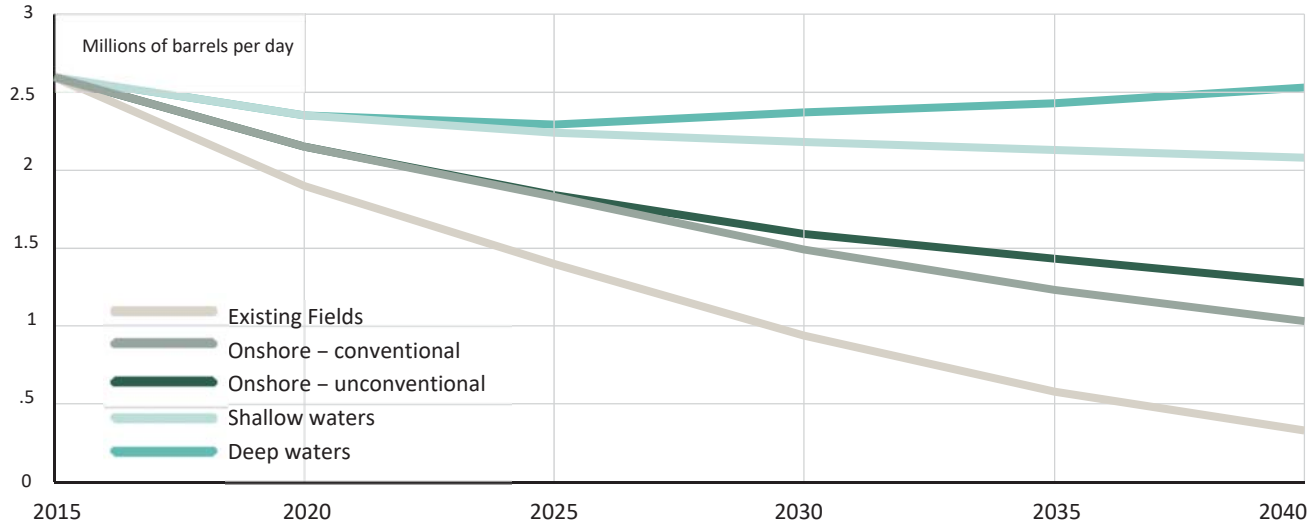
In this sense, the "No Reform" scenario is counterfactual to the constitutional amendment of 2013. According to the Agency, if we take this path, the energy sector —and consequently the country as a whole— remain tied to inertial growth.

Under such conditions, the investment capacity would be reduced to the amount of debt contracted and the budget allocated by the Mexican Congress to financing existing and future projects, at the expense of other national priorities.

It is important to mention that, for the "No Reform" scenario, it was assumed that the budget resources allocated to Pemex would compete with other national priorities —such as education, security, fighting poverty, among many others— and that there would be no price liberalization, and as such fuel would potentially be subsidized.

Graph 02

Oil Production - No Reform Scenario 2015-2040



Source: International Energy Agency, Mexico Outlook 2016

It is important to note that many of the projects currently being handled by the new participants would be handled by Pemex, but with longer horizons and later dates. That is, it would only do what it was able to do, given its execution capacity, financing and profitability in the portfolio of a single player. Thus, certain exploration and production opportunities would be out of reach for the country because they would be outside Pemex's optimal investment portfolio.

In terms of oil production, the "No Reform" scenario would involve a cumulative loss of 1.03 million barrels per day (mmbd) with respect to the 2015 production level of 2.5 mmbd (including natural gas liquids).

As shown, by 2040, Pemex's production would fall to a little over 300,000 barrels per day, from existing fields, due to their natural decline. As far as new exploration and production projects are concerned, they would primarily be in conventional onshore and shallow water areas, and would contribute only 1.5 mmbd in 2040.

Lastly, those projects involving greater technical, operating and financial complexity, such as unconventional resource and deepwater projects, would not begin operating until 2025, since they would be developed exclusively by Pemex. By the 2040 horizon, these two types of assets would contribute just under 700,000 barrels per day.

In this inertial model, the IEA estimates that the Mexican GDP would grow at a compound rate of 2.9 percent per year, which would equal a per capita growth rate of the Mexican GDP of 2 percent by the year 2040.

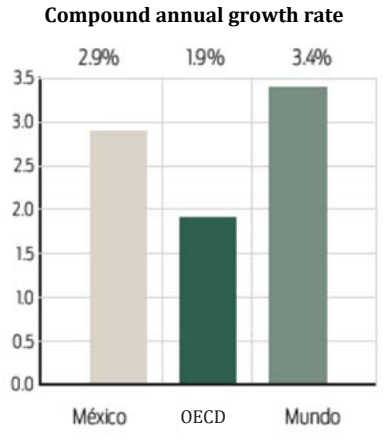
GDP GROWTH

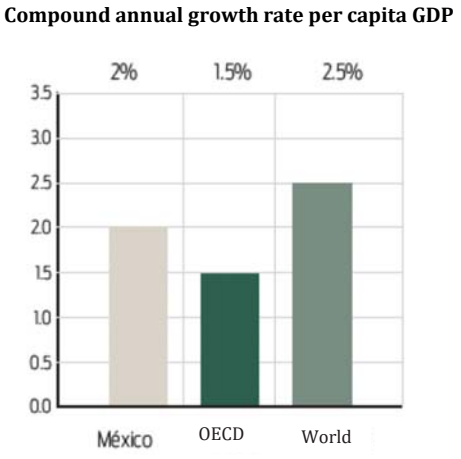
In this inertial model, the IEA estimates that the Mexican GDP would grow at a compound rate of 2.9 percent per year, which would equal a per capita growth rate of the Mexican GDP of 2 percent by the year 2040.

Graph 03

GDP Assumptions 2014-2040: Mexico, OECD and Worldwide

-No Reform Scenario-





Source: International Energy Agency, Mexico Outlook 2016

POSITIVE IMPACT

In terms of oil production, the impact is notable: 3.4 million barrels per day (mmbd), with complex projects such as deepwater and unconventional projects.

3.1.2 Economic growth projected by the IEA in the "new policies" scenario

This scenario projects the results expected from the New Mexican Energy Model created by the 2013 reform. As we have discussed, the importance of the New Model is that it transformed, at the most basic level, not only the hydrocarbons sector but the entire energy sector as a whole (electricity, hydrocarbons, renewables, energy transition and efficiency measures, among others).

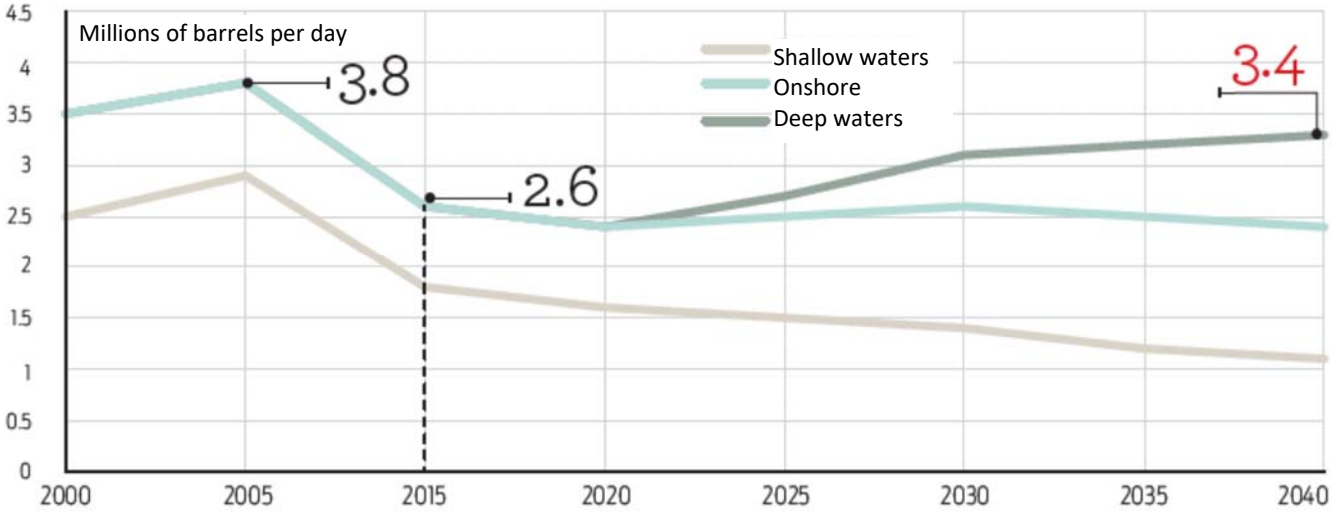
According to the Agency, the impact of the New Mexican Energy Model from now until the year 2040 is significant and is not limited solely to the production of hydrocarbons, but rather also has indirect and multiplier effects on other areas of the economy and the country in general.

In terms of oil production, the impact is notable: 3.4 mmbd, with a contribution of 1 mmbd from complex projects such as deepwater projects and just under 500,000 barrels per day from unconventional onshore projects.

In other words, compared to the "No Reform" scenario, Mexico would be producing one million barrels of oil more. This number is significant, because it puts the country at volumes that approach our historical maximum production levels. This is a very remarkable possibility, since, as any energy expert will tell you, increasing production by one million barrels per day involves not only exploring new sources, but also turning around the natural tendency to decline of any field.

Graph 04

Oil Production[7] – New Policies Scenario 2015 - 2040



Source: International Energy Agency, Mexico Outlook 2016

This growth is possible thanks to numerous projects that will place significant focus on new types of resources (for example, unconventional reservoirs and deepwater) or will emphasize the importance of technology transfer under the New Mexican Energy Model.

As such, the great differentiating factor between the previous model in the "No Reform" scenario and the New Energy Model in this scenario, is the capacity the country has gained to attract and develop leading edge technologies and apply best practices that have been successful in other locations in the past. Here is where the knowledge of the Mexican Petroleum Institute converges with the technological abilities of Pemex and all the other companies of the world.

From the beginning it has been clear that one of the great benefits of the Model is that it allows and incentivizes competition and collaboration among different players, which means that technology is the great differentiator between them.

This differentiator does not mean that Pemex is not capable of developing the technology to explore deepwater and shale resources, or to enhance recovery at mature onshore fields, but it does mean that the results would not appear until much later, at a higher cost to the company and, most importantly, with the Mexican State taking all the risk, which is unsustainable from the financial perspective.

The New Model, in contrast, as described in this scenario, will use the foundations developed over the more than 130-year petroleum industry in Mexico and catalyze them with the knowledge, capital and experience of the entire world. This will also allow the Mexican State to supply only the resources, while private companies incur the risk.

The following graph is very interesting: it shows the onshore and offshore exploration wells drilled between 1986 and 2017, and the price per barrel in USD (West Texas Intermediate). It also shows the wells to be added for the period 2018-2021 to be developed in shallow and deepwater, according to the National Hydrocarbons Commission[8].

As shown in the graph, the behavior appears counter-cyclical beginning in 2003: in that year Pemex was developing the largest number of exploration wells in the period (57 onshore and 39 offshore) with the price of oil relatively low (USD 31.08 per barrel). Moreover, when per barrel prices were approaching record highs (between USD 99 and 93 between 2008 and 2014), the number of exploration wells Pemex was developing steadily declined until they reached their lowest point in 2014.

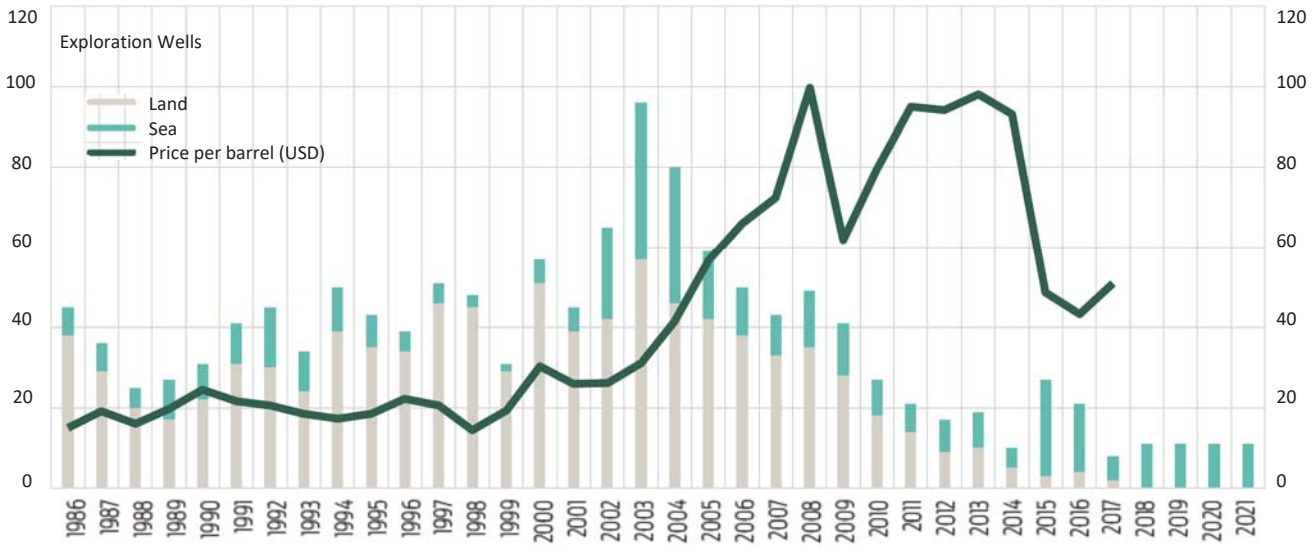
MODEL WITH POTENTIAL

The New Model has the potential to use the foundations developed over the more than 130-year petroleum industry in Mexico and catalyze them with the knowledge, capital and experience of the entire world.

7 Exploración marina alcanza su mejor nivel en 10 años [Offshore exploration highest in 10 years], NATIONAL HYDROCARBONS COMMISSION, available at: https://portal.cnih.cnh.gob.mx/estadisticas.php
8 Exploración marina alcanza su mejor nivel en 10 años [Offshore exploration highest in 10 years], NATIONAL HYDROCARBONS COMMISSION, available at: https://portal.cnih.cnh.gob.mx/estadisticas.php

Graph 05

Exploration Wells in Mexico and WTI Price 1986-2021



Source: CNH and US Energy Information

The number of exploration wells begins to recover as of 2014 (thanks in large part to the new participants). Of course, the price of oil for the 2018-2021 period cannot be predicted, but the CNH can confidently state that the number of offshore exploratory wells that have already been committed to is 43, an average of 11 per year (three in shallow water and eight in deep water).

Another significant difference between the "new policies" and the "no Reform" scenarios is in the production of deepwater reservoirs. In the "new policies" scenario, by 2025, Mexico will reach production of 120 thousand barrels of crude and condensates per day; while in the "no Reform" scenario, it will not be until 2030 that anything is produced in deep water. By 2040, the last year of the Outlook, the difference widens considerably: under the New Model, our country would reach 900 thousand barrels per day; in contrast, under the "no Reform" model, this figure would practically be halved.

The situation with unconventional reserves is similar, and although the IEA only projects their potential production up to 2025, more than half of it (throughout the entire prospective) can be attributed to the conditions put in place by the New Model.

This is demonstrable under current conditions, since Mexico is now, in 2018, firmly entrenched in the New Policies scenario, in which the results are markedly better than they would have been had we remained in the inertia we were in during the 30-year debate on changing the model.

Moreover, and despite the fact that the IEA does not have a separate category for the use of new technologies and perspectives in shallow water, the bidding rounds that have been held have already provided some good examples of how the New Model adds value to both existing opportunities and new projects. The recent discovery of the Ixachi field is partly the result of Pemex's increased capacity to devote its resources to exploration.

RESOURCES FOR EXPLORATION

The recent discovery of the Ixachi field is partly the result of Pemex's increased capacity to devote resources to exploration.

The Zama discovery and the expansion of the Amoca-Miztón-Tecoalli reserves show that, even in areas where Pemex has operated intensely, there are opportunities to read the geology from new perspectives and make new discoveries.

An important example of the significance of the new perspectives and the strong incentive they have been given is the seismic survey industry —which provides invaluable information for oil exploration— which in only two years has managed to survey four times more offshore data than it had in the previous forty-five years.

Despite how important this data is, we must remember that it is useless without the science to process it, technology to display it, and most importantly, the experts to analyze and interpret it, all tasks in which the role of the private sector is decisive.

Moreover, the New Mexican Energy Model is already a hotbed of experts who are currently providing their knowledge to companies of all sizes. In other words, execution capacity has risen, and with it, the density of the data and the professional debate on the merits of various basins. This great capacity is reflected in Zama and Amoca-Mizton-Tecoalli, as well as in Ixachi, Pemex's most recent discovery.

Similarly, although the IEA does not explicitly describe the production of other hydrocarbons, natural gas in particular, it can be expected to behave similarly to crude. However, it is always necessary to point out that Mexican production is competing with the discoveries and development of the natural gas infrastructure in south Texas, so it will require attention in the coming years if Mexico is to develop its significant natural gas potential.

This is not a minor issue, since natural gas is the key to a major portion of the industrial development of the country, and the reduction of greenhouse gases. We will discuss this topic further in the proposals section in Chapter 4.

What the Agency's prospective does say is that all this activity in the hydrocarbon's sector, along with what is projected in the electric power generation sector, could result in significant economic benefits for the country.

COMPETITION FOR GROWTH

In the New Policies scenario, the Mexican per capita GDP could rise by 74 percent over 2014 levels. It will all depend our our ability to keep up the pace, continue to cultivate competition, and perpetuate a transparent and predictable model.

The IEA estimates that if we keep up the current pace in the "new policies" scenario, our country could see compound growth rates of 3.1 percent between 2014-2040 (rather than the 2.9 percent projected in the "no Reform" scenario.) This figure is highly relevant, since it means that Mexico would double its GDP in that time. In other words, when children born in 2018 graduate from college, in the year 2040, they will be living in a country with an economy that is double the size it is now, with the corresponding expansion in opportunities, largely due to the virtuous cycle of energy and people's quality of life and their access to technology.

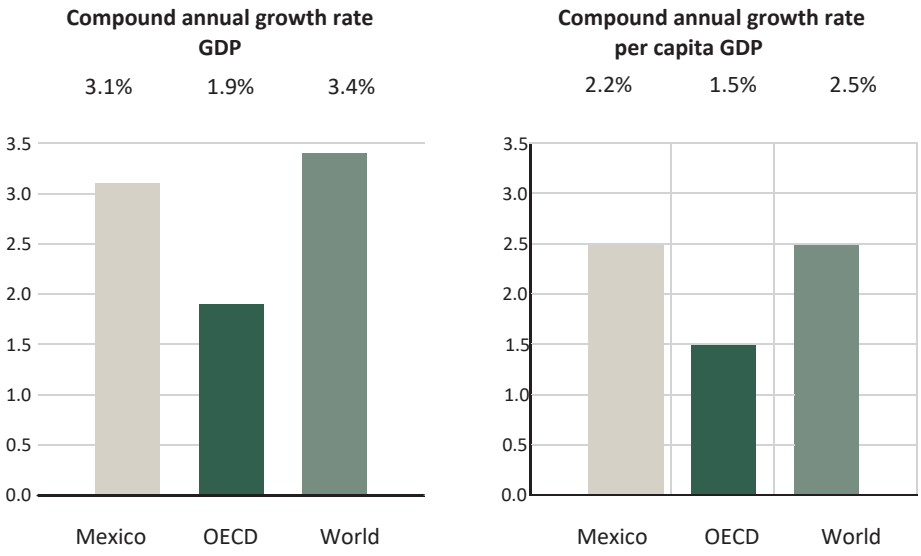
It is therefore not surprising that a second very important impact is on the Mexican per capita GDP, which, in the "New Policies" scenario, will rise by 74 percent over 2014 levels. Once again, it will all depend our our ability to keep up the pace, continue to cultivate competition, and perpetuate a transparent and predictable model.

The comparison table below shows this growth in greater detail:

Graph 06

GDP Assumptions 2014-2040: Mexico, OECD and Worldwide

-New Policies Scenario-



Source: International Energy Agency, Mexico Outlook 2016

[8] *Exploración marina alcanza su mejor nivel en 10 años [Offshore exploration at highest level in 10 years], NATIONAL HYDROCARBONS COMMISSION, available at: https://portal.cnih.cnh.gob.mx/estadisticas.php*

The opportunity cost of rolling back the Reform (and not following the "new policies" scenario) is not only in terms of the GDP and the per capita GDP, but also larger royalties, greater investment, more and better examples, all of which, in the end, means more income for the government.

Failing to properly implement the Energy Reform, or undoing it, would result in significant opportunity costs related to decreased supply, which the Agency has calculated along two primary lines:

- **The mere growth of the GDP (from 3.1 to 2.9 average percent) involves a cumulative loss for the 2015-2040 period of more than a trillion USD. The Agency makes this calculation based on its World Energy Model and the Organization for Economic Cooperation and Development (OECD) General Equilibrium Model known as ENV-Linkages[9].**

  In terms of the size of the GDP, this means that by 2040, it would be 4 percent smaller.

  The figure of one trillion USD of cumulative GDP by 2040 may seem difficult to grasp. To better understand its size, we can compare it to the 2015 GDP of Mexico and other countries[10]: it equals 46 percent of Mexico's GDP in 2015, 239 percent of Chile's GDP and 150 percent of Colombia's. Compared to Canada, it represents 63 percent of that country's GDP.

- **Gains derived from oil and gas production: For this calculation, the Agency models the gains that the Mexican State would have in the "new policies" scenario as a result of higher royalties arising from greater efficiency on the part of Pemex and the partnerships the State itself may enter into (either through joint venture agreements signed by Pemex or as a direct partner of private companies) to participate in extractive activities in shallow water, deep water, and for unconventional resources in onshore fields, as a result of the full implementation of the energy reform.**

  According to the Agency, the cumulative value of the difference in oil production by 2040 - "between the new policies scenario and the no Reform case" - is USD 650 billion[11]. The primary impact of this loss will be felt, of course on the Mexican State's tax revenue.

FULL IMPLEMENTATION

Failing to properly implement the Energy Reform, or undoing it, would result in significant opportunity costs related to decreased supply.

REFORM DIFFERENCE

According to the Agency, the cumulative value of the difference in oil production by 2040 - between the new policies scenario and the no Reform case - is USD 650 billion.

9 The ENV-Linkages model is a dynamic neo-classical general equilibrium model. It is a global model built primarily on national databases. Each such region has an input-output table that is usually sourced from national statistical agencies. These tables quantify economic flows across the different economic agents, including purchases of intermediate products and primary factors in all industries and the associated production outputs, as well as sources of income for households and governments, and the costs associated with consumption. In the ENV-Linkages model, production is assumed to operate in a minimum cost scenario with dynamic markets and technologies that permit returns to scale.

10 All calculations expressed in purchasing power parity and in year 2015 USD.

11 All figures in long scale (traditional system in which on billion = one million millions)

SOCIAL IMPACT

How many years could the various current high-impact social programs be paid for by the resources derived from a larger GDP (USD one trillion) and the added value of hydrocarbon production (USD 650 billion)?

When discussing numbers of such magnitude, it is easy to lose sight of their impact on social programs. How many years could the various current high-impact social programs be paid for by the resources derived from a larger GDP (USD one trillion) and the added value of hydrocarbon production (USD 650 billion)?

The following assumptions were used in estimating it:

- **13 percent of the additional GDP in tax revenue. In other words, the following calculations assume that 13 percent of the USD one trillion cumulative opportunity cost to the GDP by the year 2040 based on tax revenue estimated for greater economic activity.**

- **The additional resources for the State from greater hydrocarbon exploitation for a total of USD 650 billion estimated by the Agency as a result of higher oil and gas production. It was assumed that 20 percent of this loss would be Mexican State revenue.**

- **Average allocations to the selected social programs in the Federal Expenditure Budget for the 2013-2017 period, projected to 2040 in net present value (year 2015 constant pesos) assuming a 2.5 annual inflation rate for those years.**

Based on these assumptions, the opportunity costs derived from a "no Reform" scenario expressed in social programs that are vital for development is as follows:

Table 01

Opportunity Costs

Examples of the opportunity cost of not implementing the energy reform expressed in 2015-2040 budget for selected social programs

Calculations are mutually exclusive	Ministry of Social Development	Prospera Program	Ministry of Health	Seguro Popular Program	Ministry of Public Education	UNAM	CONACYT
Tax loss - equivalence in projected allocations 2015 - 2040	1.6	2.1	1.4	2.5	0.6	5.5	6.3

Source: Self-prepared based on IEA figures, Federal Expenditure Budget, Pemex, Bank of Mexico.

This means, if the 2013 Energy Reform is not fully implemented (or is undone) the opportunity cost, according to the Agency's calculation assumptions, would be equal to 1.6 times the total Ministry of Social Development budget for 2015-2040, 1.4 times the Ministry of Health budget, and 0.6 times the Ministry of Education budget for the same period.

It would also be equal to 2.1 times the 2018-2040 budget of Prospera, 2.5 times that of Seguro Popular, 5.5 times the budget of the Autonomous National University of Mexico (UNAM) and 6.3 times that of the National Council of Science and Technology (CONACYT), for the same period.

What is the effect if the opportunity cost of a lower GDP is expressed in terms of selected industries' contribution to the GDP?

NEGATIVE IMPACT

The Agency calculates that failing to implement the energy reform would have a 4 percent on the 2040 GDP.

Table 02

Key industries for Mexico's growth

Percent Mexican 2015 GDP represented by industries that are key for growth.

Period	Transportation equipment	Agriculture, Animal husbandry Exploitation of forestry, fishery and hunting	Health and social assistance	Temporary lodging and food and drink preparation services	Manufacturing
% 2015 GDP	3.4%	3.2%	2.3%	2.3%	17.1%

Source: Inegi, Economic Information Bank

What is more -and as we have already mentioned- **the Agency calculates that failing to implement the energy reform would have a 4 percent impact on the 2040 GDP.** That means, if the Reform were not implemented, it would have (in the year 2040) a greater impact than completely cutting -from the year 2015 Mexican GDP- the entire transportation equipment manufacturing industry, which contributed 3.4 percent to the 2015 GDP.

Other comparisons turn out to be equally alarming: the opportunity cost of not implementing the Reform (calculated as 4 percent of the 2040 GDP) would be comparable to eliminating in 2015 just under a quarter of the contribution of all manufacturing industries to the current GDP, which is equal to 17 percent. It is nearly double that of health services and temporary lodging and food and drink preparation, which is so important for tourism (2.3 percent each). The impact would also be greater than eliminating the entire 2015 contribution to the GDP by agriculture, since that was "only" 3.2 percent, while the opportunity cost of not implementing the Reform would be, in 2040, 4 percent of the GDP.

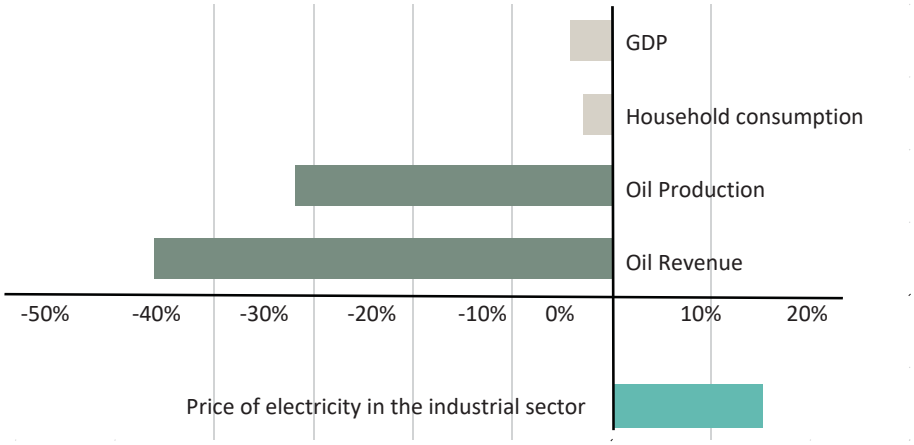
IMPACT ON PRICES

The "no reform" scenario modeled by the Agency would involve a 14 percent increase in electricity prices for the industrial sector, higher costs for households and/or a significant government subsidy.

Thus, the estimated impact of not implementing the Energy Reform, calculated by the Agency as a cumulative loss of GDB of one trillion USD over the 2018-2040 period, and a loss of 4 percent of the total GDP in 2040, is summarized in the following graph:

Graph 07

Effects on the Mexican economy by 2040 if Energy Reform is not implemented



Source: International Energy Agency

In other words, the "no Reform" scenario modeled by the Agency, also involves a loss of approximately 4 percent of the 2040 GDP, in addition to a 3 percent drop in household consumption, 46 percent drop in oil and gas revenue and a 32 percent drop in oil and gas production. All of this in addition to a 14 percent increase in electricity prices for the industrial sector, higher costs for households and/or a significant government subsidy.

LOSSES IN THE BILLIONS

The Agency projects a cumulative loss of USD 260 billion in potential investment in the upstream sector, as a result of rolling back the reform.

But in addition to the opportunity cost from the supply side due to a lower 2040 GDP and lower oil and gas production, the Agency calculates two additional costs that we must also mention:

- **Loss of investment in the oil and gas industry: the Agency projects a cumulative loss of USD 260 billion in potential investments in the upstream sector, as a result of rolling back the Reform.12 This figure equals an investment of USD 10.4 billion per year (over the 25-year period 2015-2040). To put this figure in context, in 2016, Mexico received USD 26.738 billion in direct foreign investment (see Graph 09). When we compare the estimated USD 10.4 billion per year to this figure, the potential upstream investment equals, per year, 39 percent of total direct foreign investment in Mexico.**

- **Cost in the electricity sector:** **the impact of rolling back the reform would not only be felt in the hydrocarbon sector. We must remember that this also includes changes to the electric power generation sector. To model the cost of rolling back the reform in this sector, the Agency took into account the costs of not privatizing the Federal Electricity Commission, and assumed that Mexico would not be able to achieve open competitive markets for electric power generation, capacity or clean energy certifications. In such a situation, the Mexican State would face the challenge of generating the necessary amount of electricity for the 2018-2040 period, but would need to do it in a highly inefficient system plagued by energy leaks which (it must be noted) makes the product more costly.**

Under such conditions, the Agency estimates that the cost of electricity for the industrial sector would be 14 percent higher in 2040 under the "no Reform" scenario than it would be under the "new policies" scenario. For residential users, it would be 16 percent higher.

As such, while in the "new policies" scenario the current electricity subsidies completely disappear in 2035 (thanks to the privatization of the CFE and the switch over to clean energies), in the "no Reform" scenario, the Mexican State must implement an additional subsidy, which could take the form of a loss to be incurred by the CFE or an actual subsidy that the State would have to implement so that users could afford the high cost of electricity that is produced in an inefficient manner.

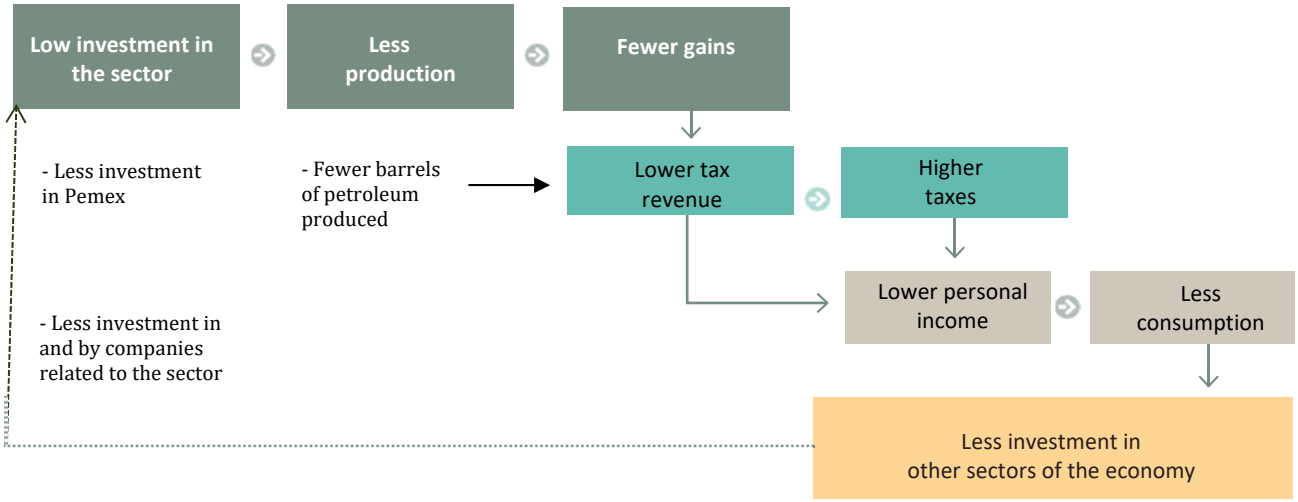
The Agency calculated that the cumulative cost of such a subsidy to the year 2040 would be USD 50 billion.

COST OF THE SUBSIDY

While in the "new policies" scenario the current electricity subsidies completely disappear in 2035, in the "no reform" scenario, the Mexican State would have to implement an additional subsidy, which the Agency estimates would involve a cumulative cost to the year 2040 of USD 50 billion.

Table 03

Repercussions on the Mexican Economy of eliminating the Energy Reform



Source: De la Calle, Madrazo, Mancera (CMM)

[12] *Despite the fact that the multiplier effect of this investment in unrelated industries was not calculated, it would be significant, as let us not forget that there is no human activity that does not require energy.*

ATTRACTIVE MODEL

If the energy sector keeps up the current pace, it will certainly be a central factor in attracting investments for other sectors.

The potential to which Mexico can aspire in the "new policies" scenario is transformative, but it would be naive to think that we are automatically going to achieve these elevated levels of production and economic activity, just by having created a legal framework open to investment and competition. The only way to ensure success is by persevering in designing and implementation of public policies, with processes that enhance Mexico's ability to attract investment and an indispensable commitment to transparency.

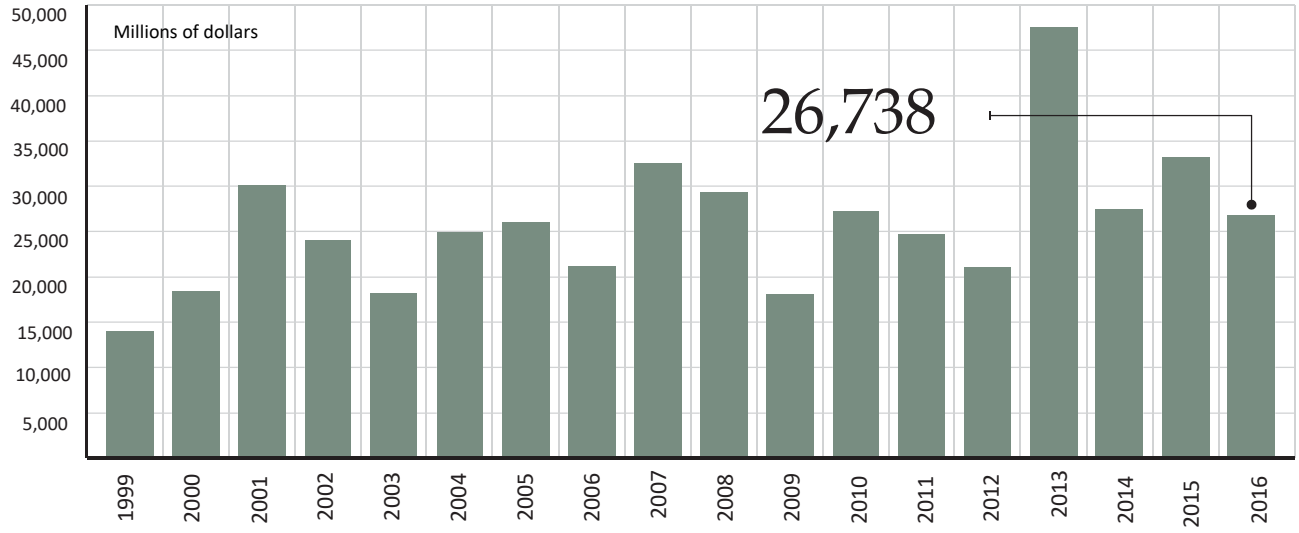
The engine of all this growth and economic payoff is investment and the aggregation of knowledge. We must therefore encourage competition with clear and reliable rules that attract investments, and along with them, new technologies.

Cases of countries that have prodigious amounts of natural resources but fail to develop are as well-known as those that, despite having few natural resources, achieve significantly superior results. Two clear examples: Japan and Venezuela. Japan has no significant petroleum reserves or production, but it refines 3.2 million barrels a day; while Venezuela has the largest petroleum reserves in the world, but has seen its refining capacity fall nearly 20% in the last decade and it now refines barely 800 thousand barrels a day.[13]

Thus, if the energy sector keeps up the current pace, it will certainly be a central factor in attracting investments for other sectors, in the same way as the performance problems under the previous model (such as the critical alerts due to low availability of natural gas) led many industries to leave Mexico.

Graph 08

Direct Foreign Investment 1999 – 2016



Source: Ministry of the Economy

As of the 2013 Energy Reform, we have begun to see cases of investments in non-energy industries as a result of the reliable supply and quality now available under the New Model. The case of the Anheuser-Busch In-Bev beer company is one of the most interesting, since in 2016 it announced the transformation of the largest plant it owns in the world, located in Zacatecas, to take advantage of the rapid deployment of renewable energies under the New Energy Model. This plant, by the way, is the key to an ambitious energy transformation project this company is undertaking worldwide, spearheading it in our country.[14]

PARALLEL INVESTMENTS

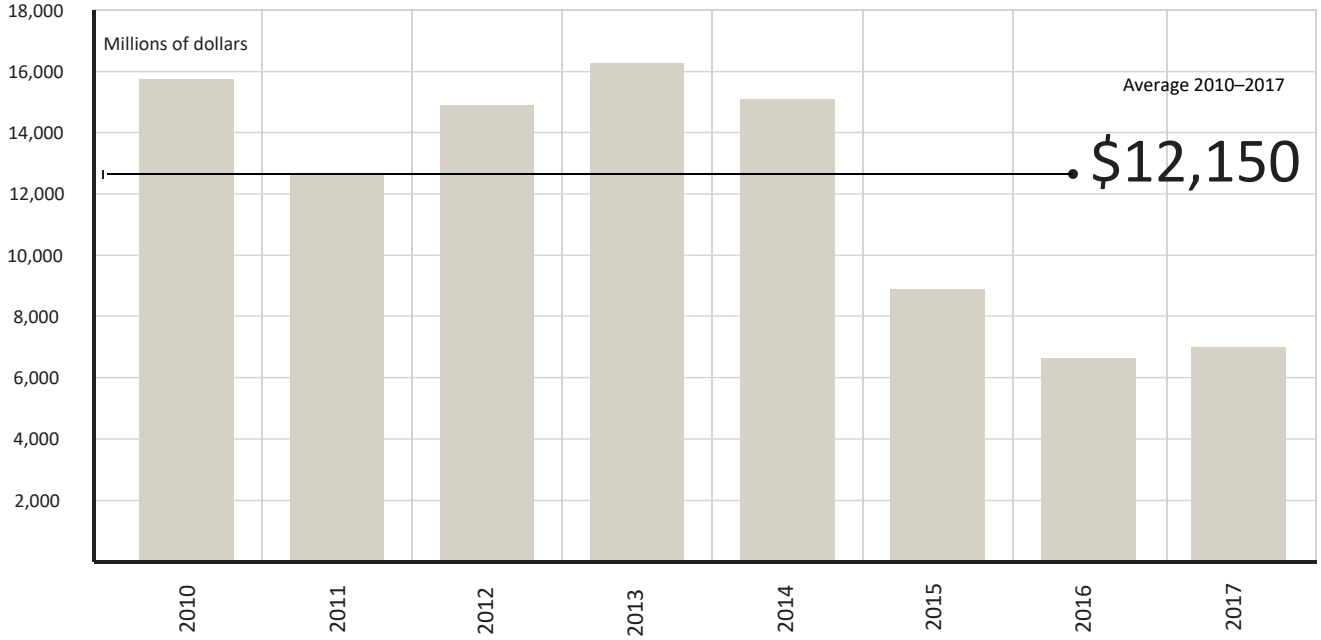
As of the 2013 Energy Reform, we have begun to see cases of investments in non-energy industries as a result of the reliable supply and quality now available under the New Model.

As shown in the above graph, direct foreign investment in Mexico peaked during the 1999–2012 in 2007 at USD 32.457 billion, subsequently falling to USD 21.061 billion by 2012 (a 35 percent drop). In 2013 it rose notably to USD 47.537 billion, linked to the purchase of Cervecería Modelo by Anheuser-Busch Inbev for USD 13.249 billion.[15]

Looking at subsequent years (2014, 2015 and 2016), we can see that while it does not match 2013 levels, direct foreign investment recovers from the 35 percent drop during the 2008–2012 period and not only meets but even slightly exceeds 2007 levels in 2015, at USD 33.181 billion.

Graph 09

Pemex Investment in Exploration and Production (E&P) 2010–2017



Source: Petróleos Mexicanos

[13] *BP Statistical Review 2016. https://www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2016/bp-statistical-review-of-world-energy-2016-full-report.pdf*

[14] *Anheuser-Busch InBev Commits to a 100% Renewable Electricity Future. http://www.ab-inbev.com/content/dam/universaltemplate/ab-inbev/News/press-releases/public/2017/03/EN%20-Anheuser-Busch%20InBev%20Commits%20to%20a%20100%20Renewable%20Electricity%20Future.pdf*

[15] *Notimex México duplicó inversión extranjera directa en 2013, destaca la Cepal [Mexico doubled direct foreign investment in 2013, according to CEPAL] Excélsior May 29, 2014*

GLOBAL CAPITAL

Under the New Energy Model, Mexico — rather than simply use the resources in the public treasury and Pemex's debt capacity to finance oil and gas operations, as it did in the past— can compete for a portion of the global capital that is invested year after year in exploration and production.

Investment growth is even more noteworthy in the energy sector itself, since in terms of investments in the petroleum industry specifically (exploration and production only), the New Energy Model has led to an increase of 1.8 times the amount invested by Pemex in 2014 alone. This is even more remarkable if we recall that the increase in investment coincided with a worldwide drop in oil prices and a clear contraction in nearly all oil-producing countries.

In addition to the historical factors we examined in Chapter 1, there are several reasons why requiring a single company to maintain such a dramatic level of investment would be counterproductive. First of all, all else remaining constant (price, production and capital access structure), an increase in investment would necessarily involve an increase in debt, with all the accompanying financial risks this involves.

Moreover, for any company, no matter the industry, absorbing resources for investment after such enormous growth (more than 119 percent) would be a tremendous administrative challenge. Arbitrary growth of such magnitude would hardly generate incentives for efficiency, much less if it were responsible for the entire chain, from the identifying opportunities to operating projects. The problems become exacerbated in a "lower for longer" price scenario, in other words, when prices remain low for a longer period, as they did during the eighties and nineties, and when profit margins are squeezed and cost minimization becomes essential to success.

All of these factors taken together illustrate that in a scenario involving a single company, the challenge is nearly impossible. As the Agency explained when describing the differences between the New Model and the "no Reform" scenario, limiting the capacity to deploy capital investments is the thing that most negatively impacts the development of the sector.

But, what represents a colossal challenge for an individual company might be a manageable risk at the industry level. Under the New Energy Model, Mexico — rather than simply use the resources in the public treasury and Pemex's debt capacity to finance oil and gas operations, as it did in the past — can compete for a portion of the global capital that is invested year after year in exploration and production.

The Agency notes that in order to achieve the benefits projected in the "new policies" scenario, Mexico needs USD 640 billion in cumulative investments over the 2015–2040 period. According to Pulso Energético, to meet the goal of attracting 640 billion dollars between now and 2040, Mexio needs to attract 2.4 percent of global investment in exploration and production.[16] Our country currently attracts barely 1.9 percent, so it is essential to increase Mexico's share of the capital available for global investment.

[16] *Pulso Energético. May, 2017 https://pulsoenergetico.org/el-market-share-de-mexico-en-inversiones-ep-indica-dor-clave-del-exito-del-nuevo-modelo/*

Another way of looking at it is that Mexico needs to regain 50 basis points in its global market share or raise its current position by 25 percent. From the perspective of a global industry, such growth is significant, but not so dramatic as to be unattainable, particularly as of such a profound transformation as Mexico is currently undergoing.

It is important to remember that the growth involved, in the context of an industry that is expected to increase its total exploration and production investment, is marginal in relative terms, but exponential in real terms. It means increasing investments in the country from around 12.1 billion dollars to more than 26 billion dollars per year.

Next, we will attempt to complement the Agency's Outlook, using its projections as the basis for a more in-depth analysis of the economic impact of the New Model from the demand perspective.

OIL REVENUE

The key concept is "oil revenue" which is the sum total of all taxes, royalties and other charges that Pemex and the new participants in the sector are required to pay to the Mexican State for the right to explore and extract hydrocarbons.

3.2 Benefits of the New Mexican Energy Model from the demand perspective

The touchstone of the New Mexican Energy Model is the historical reaffirmation that underground resources belong to the Nation. Mexico maintains its legal authority over them and in no way yields ownership of the resources.

The difference from the earlier model hinges on the fact that our country is now developing new ways to make use of them, seeking investment to maximize oil revenue, in the same way as the vast majority of countries in the world do. In other words, Mexico is acquiring the capacities that other countries use in order to compete.

The key concept is "oil revenue" which is the sum total of all taxes, royalties and other charges that Pemex and the new participants in the sector are required to pay to the Mexican State for the right to explore, if they are successful, extract oil and gas in our country.

It must be noted that these participants do so at their own risk. In other words, if their exploration projects fail to find hydrocarbons, or the hydrocarbons are not commercially exploitable, Mexico suffers no negative economic impact; but in the event they are successful, Mexico is guaranteed the bulk of the profits. This model, known as risk contracts, reflects an inescapable reality: the fact that the vast majority of all exploration projects fail.

LOW PRODUCTION

The Agency notes that low oil and gas production would have a multiplied negative impact that would be felt by sector suppliers, transportation and logistics companies and service companies.

Moreover, the Agency notes that low oil and gas production and low levels of investment in the Exploration and Production (E&P) sector would have a multiplied negative impact that would be felt by sector suppliers, transportation and logistics companies and service companies, for whom lower productivity and investment in the petroleum sector would mean fewer sales, lower profits and less capacity to create well-paying jobs.

INDISPENSABLE INPUT

Energy is an indispensable input for production. It is difficult to imagine any area of the country, or any productive activity, that would not significantly benefit from the effects of the New Mexican Energy Model.

As we know, these industries are concentrated in certain states, including Tamaulipas, Veracruz, Tabasco and Campeche, and as such, the impact would be more strongly felt at the regional level, as we have seen in recent years as a result of the drop in international oil prices.

Up to this point, we have examined the impact of the New Mexican Energy Model from the supply perspective (in other words, the resources that Mexico obtains from producing hydrocarbons).

However, the impact is not limited to what Mexico is capable of offering as a producer of hydrocarbons, but also includes the impact that the New Mexican Energy Model has on all the productive sectors and households in Mexico as demanders of energy.

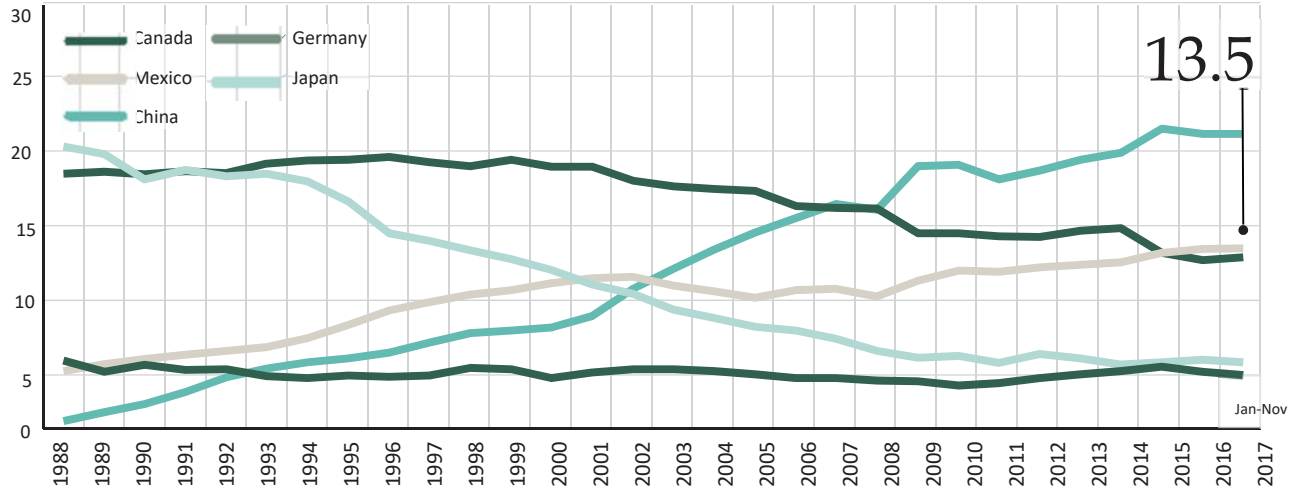
Energy is an indispensable input for production. It is difficult to imagine any area of the country, or any productive activity, that would not significantly benefit from the effects of the New Mexican Energy Model, which include
(i) access to fuels at market prices, as a result of competition, (ii) access to a more diverse energy basket and (iii) an energy transport and storage infrastructure that not only meets the demand for the same, but does so in compliance with international safety and quality standards.

Mexico's economic development and its place among world economies is well known. In 2013 (the year of the Energy Reform) the country was the fifteenth largest economy in the world (based on GDP) and the third largest supplier of imports to the United States.

Graph 10

Imports in Mexico

Penetration of imports from Mexico in total US imports



Source: United States Economic Census Bureau

The impact is not limited to what Mexico is capable of offering as a producer of hydrocarbons, but also includes the impact that the New Mexican Energy Model has on all the productive sectors and households in Mexico as demanders of energy.

PHOTO: SHUTTERSTOCK

SECOND LARGEST SUPPLIER

The impact of the reform is that in 2013, Mexico was the third largest supplier of goods and services to the US, and by 2017 it is now the second largest, having surpassed Canada.

This with an uncompetitive model in which, as we have said, all the exploration and production risk was incurred solely by the Mexican State. In other words: the country's energy supply was shackled to the State's capacity (through Pemex) to generate energy.

As such, a significant impact of the reform is shown in the above graphic, since whereas in 2013 Mexico was the third largest supplier of goods and services to the US, in 2017 (just four years after the reform) it is now the second largest, having surpassed Canada.

This leads us to the question: What is Mexico's potential for development with an open energy market? To answer this question, we must consider not only what the State can do with the boon of a larger supply (oil and gas production) and the tax revenue therefrom — analyzed in the above section — but also ask what impact would an open energy market have, with full implementation of the energy reform as a multiplier of the productive capacities of those who **demand** energy: the agriculture, industrial, commercial and services sectors? Lastly, energy is also demanded by Mexican households.

It has often been pointed out that varying levels of regional development exist in our country. Although each state and each region's development agenda is unique and presents specific challenges, we can say that there are four general areas in which the less developed states could aspire to attain their neighbors' growth rate:

- **Quality Logistics**
- **Rule of Law**
- **Education**
- **Access to Energy**

PRODUCTIVITY TRIGGER

Equitable access to energy, primarily natural gas, is a clear productivity trigger. Although energy alone is not enough for growth, growth is not possible without energy.

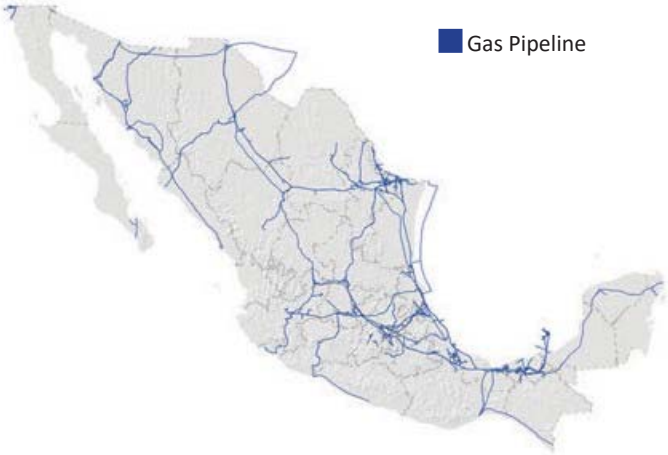
Equitable access to energy, primarily natural gas, is a clear trigger for productivity, and even more so, to the democratization of it. **Although energy alone is not enough for growth, growth is not possible without energy.**

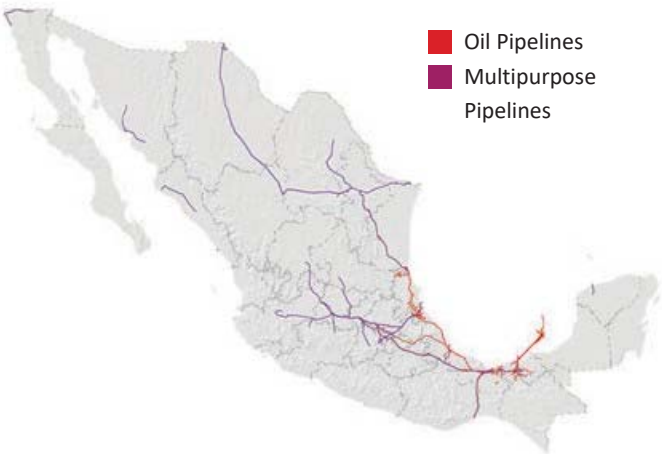
In the summer of 2017, the Heinrich Boll Foundation Mexico[17] mapped hydrocarbon transport infrastructure in Mexico in two very interesting ways: **by type of hydrocarbon and by company**. The result is shown in the maps below:

[17] *Llano, Manuel and Flores, C. Ductos ¿por dónde circulan los hidrocarburos en México [Pipelines: Where do hydrocarbons travel in Mexico?] [map] Scale 1:3:500,000 Mexico: Cartocrítica/ Heinrich Boll Foundation (2017)*

Map 1

Analysis of pipelines in Mexico by type of hydrocarbon



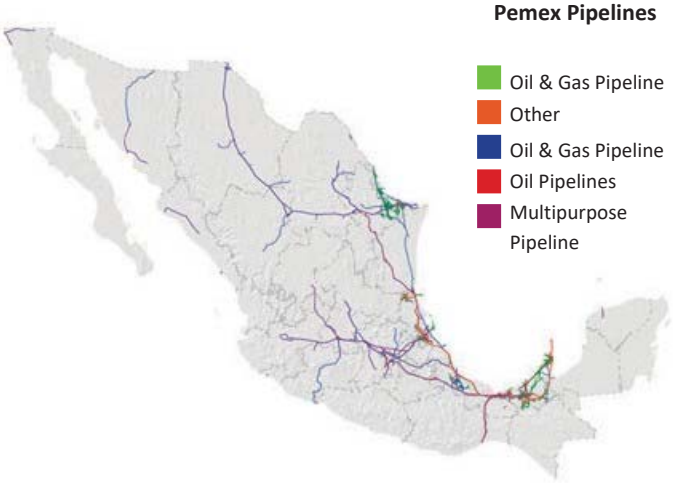


Map 2

Analysis of pipelines in Mexico by company

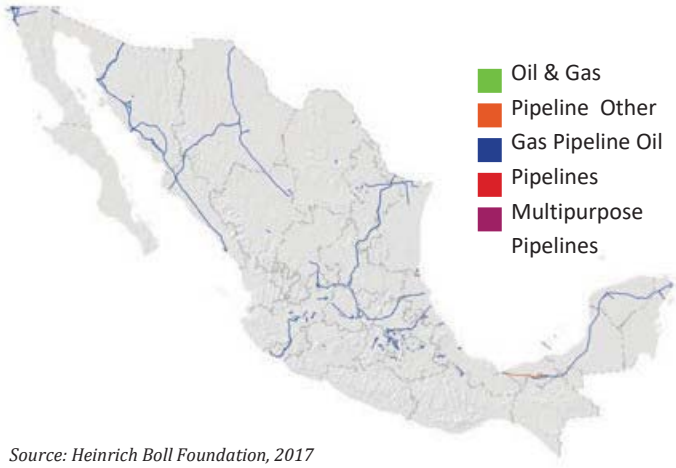
The Heinrich Boll Foundation also analyzes the pipelines by type of company:

Pemex Pipelines



Federal Electricity Commision Pipeline

Pipelines of other companies



Source: Heinrich Boll Foundation, 2017

MORE OPPORTUNITY

Areas of opportunity by geographic region with regard to greater and lesser access to energy, due to more supply and better transport infrastructure.

The above maps reflect (i) the country's enormous dependence on the infrastructure developed by the State Production Companies and (ii) that significant areas of the country have no ducts of any kind, limiting energy transport to other methods such as by tanker vessel or tanker truck.

The maps clearly reflect the areas of opportunity by geographic region with regard to greater and lesser access to energy, due to more supply and better transport infrastructure. As an example, in this document we will run some exercises to estimate the impact of the New Mexican Energy Model in various regions of the country.

The econometric analysis presented here is based on Barro's (1991) growth prediction and the concept of **convergence**, which assumes that poorer countries (in our case, our states) grow more quickly to make eventual convergence possible. Given that Barro could find no empirical evidence of absolute convergence, he focused on conditional convergence.

Conditional convergence **assumes that the ratio between the future growth rate and the current per capita GDP can only exist if certain conditions are present**.

To analyze the impact of Energy Reform on the various regions of the country, we selected two indicators that are closely linked to energy: qualified human capital and level of industrialization. Given the fact that the interaction between the two is also part of the equation that explains production growth, the higher the latter is, the higher said indicator will be.

The states we analyzed can, therefore, **aspire** to achieve the growth of their more developed neighbors in a sensitivity scenario with respect to the industrialization and qualified human capital of said neighbors. In order to arrive at a conservative projection, we estimated that the convergence of each region would be considered to be between 30 and 60 percent.

We grouped the states from the perspective of the potential impact of the energy reform on them:

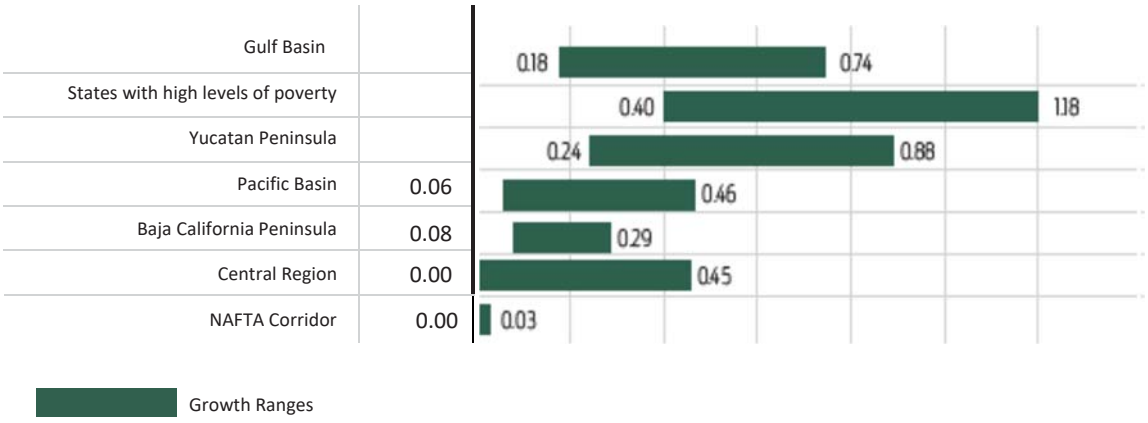
- **Hydrocarbon production-intensive states in the Gulf basin (Campeche, Tabasco, Veracruz and Tamaulipas)**
- **States with higher levels of poverty (Guerrero, Oaxaca and Chiapas)**
- **Yucatan Peninsula (states of Yucatan and Quintana Roo)**
- **States in the Northwest Pacific Basin (Michoacán, Jalisco, Colima, Nayarit, Sinaloa, Sonora, Durango and Zacatecas)**
- **Baja California Peninsula**
- **Central States (Mexico City, Morelos, Tlaxcala, Hidalgo, State of Mexico and Puebla)**
- **States whose economies are highly integrated with North American industrial production (Guanajuato, Querétaro, San Luis Potosí, Aguascalientes, Nuevo León, Coahuila and Chihuahua)**

To analyze the impact of the convergence of two variables that are highly influenced by the full implementation of the Energy Reform, we started with (as a baseline scenario) the average annual growth rate[18] for the 2015–2040 period set by the IEA for the scenario involving the full implementation of the Reform (the "new policies" scenario) which is 3.1 percent.[19]

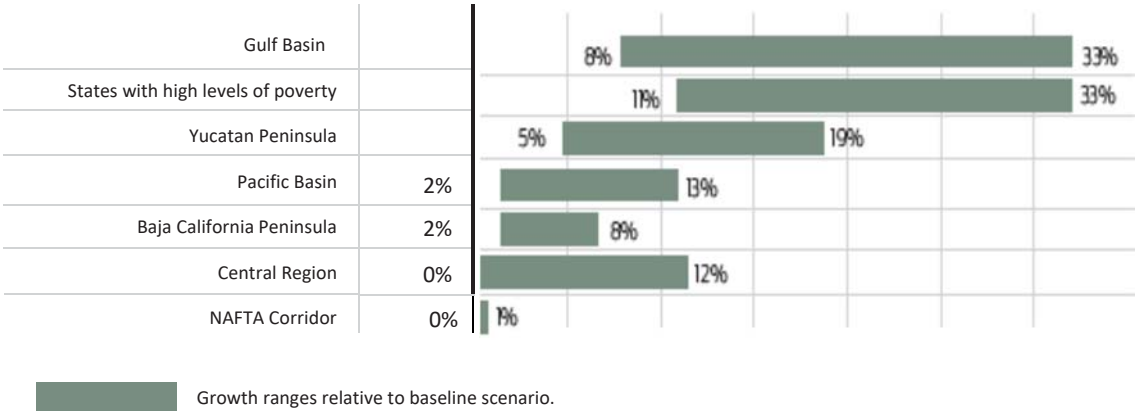
Graph 11

Convergence model: qualified human capital and industrialization (regions)

Range of marginal contribution to GDP growth by region - projected to 2040 (Convergence between 30% and 60%)



Range of marginal contribution to GDP growth compared to baseline growth rate - projected to 2040



Sources: Self-prepared with INEGI, National Population Council and Ministry of Public Education data

[18] *GDP growth rate figures calculated in real terms. Given the baseline used for the calculations, the growth rates are comparable in the real terms used here and the PPP GDP used by the Agency.*

[19] *It is worth recalling what we have discussed in previous sections: in the event the reform is rolled back or the implementation is incomplete, the rate (according to the Agency) would be 2.9 percent.*

NATIONAL IMPACT

The impact is positive throughout the country, but the multiplier effect is particularly remarkable in the poorest states and those with an oil and gas focus.

The foregoing leads us to the following conclusions:

- **Gulf Basin States:** add between 0.18 and 0.74 additional percentage points to their growth rates. This works out to a growth rate that is between 8 and 33 percent higher than the original growth rates of these states.

  This is not surprising, given (i) the importance of the energy industry in these states and (ii) the recent drops in their industrial production precisely due to the drop in oil production and prices.

- **States with higher levels of poverty:** in the case of these states, the growth rate depends on the impact the Reform has on their levels of industrialization as a result of the double effect of more energy infrastructure and greater access to the input. Moreover, it must be taken into account that the inertial growth of these states has been low, and as such it would not be surprising for them to have a more significant increase in growth rate percentage.

  These states add between 0.40 and 1.18 additional percentage points to their growth rates. This works out to a growth rate that is between 11 and 33 percent higher than their original growth rates.

- **Peninsulas:** on both peninsulas, the growth rate is primarily due to greater industrial development as a result of energy infrastructure and secure access to energy inputs. The impact is less pronounced in Baja California due to the already high level of industrial development it enjoys due to its border with the United States and an energy system that is relatively independent from the rest of the country.

  The peninsulas add between 0.24 and 0.99 (Yucatan and Quintana Roo) and between 0.08 and 0.29 (Baja California Peninsula) additional percentage points to their growth rates. This works out to an increase of between 5 and 19 percent in the case of Yucatán y Quinta Roo and of between 2 and 8 percent in the Baja California Peninsula.

- **Northwest Pacific Basin States:** are states with high industrial potential, in which industrialization and human capital could generate significant growth, despite starting from a baseline that is already high. They add between 0.06 and 0.46 additional percentage points to their growth rates. This works out to a growth rate that is between 2 and 13 percent higher than the original growth rates of these states.

- **Center States:** given that these states already have a high level of industrial development, efficient access to energy, and a greater proportion of universities, growth is less pronounced than in other regions. They could add between 0 and 0.45 additional percentage points to their growth rates (the 3.1 national rate given by the Agency), which works out to an increase of between 0 and 12 percent.

- **States whose economies are highly integrated into North American industrial production: show no significant growth since they are the leaders. However, they do show an impact of up to 0.03 additional growth rate percentage points, which could represent a 1 percent increase.**

Thus, the convergence model can provide an estimate, differentiated by region, of the marginal impact in addition to the impact *per se* of the Energy Reform (fully implemented as indicated by the Agency) thanks to two elements for which the Reform is key: qualified human capital and industrialization.

The impact is positive throughout the country, but the multiplier effect is particularly remarkable in the poorest states and those with an oil and gas focus.

COMPETITIVENESS AND PRODUCTIVITY

Energy is not an end unto itself. There is a direct causal relationship between energy and the historical competitiveness and productivity of civilizations.

3.3 Impact on the country's competitiveness

The hardest thing to understand about the energy sector is that despite enormous investments and earnings it generates, energy is not an end unto itself. Nor is it limited to being just a fuel. There is a direct causal relationship between energy and the historical competitiveness and productivity of civilizations, and it therefore comes as no surprise that entire periods of history have been defined based on how humanity has used energy.

The dawn of civilization dates to the time when the first hominids learned to use fire for some of their daily activities (like eating). Eras changed again when, some thousands of years later, humans used it to transform other raw materials into tools like bronze or iron.

This becomes even more obvious with the First Industrial Revolution, the era in which the human economy changed from an economy based on manual labor to one based on machine labor.

The great defining element of this change was James Watt's invention of the steam engine, which made it possible to convert hydrothermal energy into mechanical energy, thereby creating the first internal combustion engine and modernizing transportation and manufacturing processes.

HISTORIC

The modern hydrocarbons sector arose during the Second Industrial Revolution, when hydrocarbons became the basis for transportation, electric power generation and petrochemistry.

The modern hydrocarbons sector arose during the Second Industrial Revolution, when hydrocarbons became the basis for transportation, the most efficient way to generate electricity and the key to developing new materials thanks to petrochemistry.

Their contribution continued in what is known as the Third Industrial Revolution, characterized by the emergence of the digital world, computers and the communications revolution. The latter resulted in a pronounced expansion of the demand for energy to support such a significant transformation.

HAND IN HAND WITH TECHNOLOGY

The energy sector is at the forefront of the use and exploitation of technological advances, since they owe their rapid development to the use of technology.

We are now on the threshold of the Fourth Industrial Revolution, in which the physical and digital worlds are merging with revolutionary technologies in robotics, advanced manufacturing, data analytics, nanotechnology and artificial intelligence. Due to the intense use of technologies, the world's energy requirements are exponentially increasing.

It is important to note that the energy sector is at the forefront of the use and exploitation of technological advances, since they owe their rapid development to the use of technology. For example, advanced computing and data analytics make it possible to use seismic data reprocessing to discover oil; robotics and automated vehicles are the key to deepwater exploration; while smart networks, 3D printing and the fusion of physical, digital and biological elements are some of the most promising responses to the challenges relating to emissions and advanced fuels that we are now facing.

The relationship between energy and changes in civilization is not limited to these great transformations, but also includes shorter periods and smaller day-to-day advances. Energy has multiple impacts at the international, regional and local levels, as reflected in the following rubrics:

- **Well-being of individuals:** **thanks to energy, families can aspire to improve their quality of life. In fact, the impact of energy on well-being is immeasurable, considering its contribution to electrification, heating and refrigeration, in addition to the health, food, hygiene, leisure, education, employment, transportation, communications and entertainment we enjoy today.**

- **Transportation:** **energy is the fuel that enables the transportation of human beings and goods, such that without it, it would be impossible to imagine life in urban areas or their supply, or the productivity rates we have achieved in the countryside.**

- **Urbanization:** **petroleum is used in the manufacture of asphalt and tar, key elements in the process of urbanization. In addition to often being the primary source of electric power generation, as reflected by public and private lighting, emergency response systems and the proper functioning of sewer systems and waste management.**

- **Industrial, commercial and service sectors:** **an adequate amount of energy is essential for a country's industrial development. Energy is also key to the economic activities in the business and service sectors.**

- **Energy as raw material (petrochemistry):** **in this industry, energy is used not only used as a fuel, but also as a raw material for the**

Energy is the fuel that enables the transportation of human beings and goods, such that without it, it would be impossible to imagine life in urban areas or their supply, or the productivity rates we have achieved in the countryside.

PHOTO: SHUTTERSTOCK

ENERGY: THE HEART OF A NATION

Energy is at the heart of a competitive nation, and those countries that can successfully incentivize its highest impact throughout all the activities in their economies are the ones that obtain the best results.

extraction of chemical substances from fossil fuels, from which resins, polyurethanes and acetaldehydes are obtained. These provide the basis for the plastics and new materials that make computers, cars and the aerospace industry possible.

- **Banking and Finance: it is hard to imagine any economic activity without an adequate foundation, the series of transactions, records and reports that support it and make it reliable, without the benefits of energy. Recently, the development of advanced currencies, known as crypto-currencies, is the result of complex numerical sequences that involve significant energy consumption and computing capacity.**

- **The energy sector itself: in addition to the profits of energy companies, the economic dividend received through direct, indirect and induced jobs created and the tax revenue they generate for the national treasury; the technological advances implemented by the sector can have applications and benefits for other sectors.**

As such, energy is at the heart of a competitive nation, and those countries that can successfully incentivize its highest impact throughout all the activities in their economies are the ones that obtain the best results.

Naturally, such a central industry may be an important axis of development, but we cannot lose sight of the challenges and extremely high financial, exploratory and operating risk it involves. Thus the need for a model that maximizes the impact on national competitiveness while at the same time controlling risk.

Therein lies the importance of examining whether or not we are headed in the right direction. In the five years since it took effect, the New Mexican Energy Model is beginning to show significant results in areas that are strategic to the country's competitiveness.

For this purpose, we can use some of the sub-indexes used by the Mexican Institute for Competitiveness (IMCO) to measure the state competitiveness. These ten sub-indexes are short-term and structural indicators used to measure the capacity of a state to attract and retain investment and talent.

In the table below, we compare and contrast these ten sub-indexes with the impact of the New Model in energy production (hydrocarbons, renewable energies) and in the creation of a system of checks and balances in their management. All for the purpose of guaranteeing a long-term vision, in addition to greater transparency and accountability.

Chapter	What does it measure?	New Mexican Energy Model contribution to the indicator
Reliable and objective legal system	Public safety and legal certainty	Constitutional reform and new secondary laws that guarantee legal certainty Bidding processes, contract administration and data access that is open and equitable to all participants.
Sustainable environmental management	Responsible, sustainable relationship	Creation of the Agency for Safety, Energy and the Environment (ASEA) manage industrial risks and reduce environmental impact. Strong emphasis on the development of renewable energies. Clear and accessible greenhouse-gas reduction targets
A qualified, inclusive and healthy society	Education, health and inclusion	Energy sector based on competition and knowledge, that includes significant investment in education, science and technology. Greater access to energy, fuels and electricity, for the benefit of all families
Stable and functional political system	Quality political system to promote accountability	Transparent system of bidding processes on the part of CNH and SENER. Mexican Petroleum Fund accounts for the receipt and management of oil revenue. National energy policy is governed by a system of institutional checks and balances that ensure the impartiality of government authorities. Competition-based model that encourages accountability.
Efficient and effective governments	Government's ability to positively influence competitiveness (local economic development)	Established foundations for the development of goods and services providers for energy generation companies. Multiplication of anchor projects in various parts of the country, thanks to increased execution capacity. More energy infrastructure and availability in underserved areas.

Chapter	What does it measure?	New Mexican Energy Model contribution to the indicator
Factor market	Worker productivity	Creation of a more robust national energy industry that will multiply the supply of jobs in the sector. Considerable investments on the part of economic agents and the state in training personnel and in innovation
Stable economy	Economic indicators and access to credit	Direct income for the State both from oil revenue and the taxes derived from it.
Precursor sectors	Financial, telecommunications and transportation sectors	Competition in the sector that ensures that energy users benefit from the economic agents' efforts to product better quality products at lower prices. Encourages development of energy infrastructure, with the resulting positive impact on the factors of production
Taking advantage of international relationships	Tourism, flow of capital and capacity to exploit foreign ties	Openness to direct foreign investment in the energy sector and a significant increase in foreign investment in the national total. Increase in Mexico's export capacity by allowing productive sectors more and better access to energy.
Innovation in productive sectors	Productivity in high value added and knowledge-intensive sectors	Openness to allow private domestic and foreign companies to commit to Mexican innovation in the energy sector, either in the upstream, midstream and downstream sector companies themselves, or in energy industry goods and services provider companies

Source: Self-prepared based on the Competitiveness sub-indexes of the Mexican Institute for Competitiveness

3.4 Other competitiveness factors

When the industry analyzes the various exploration and investment projects in which it can invest, their analysis is not limited solely to calculating the number of barrels that can be extracted from the reservoir and comparing the financial terms. Public policy conditions, both strictly petroleum-related as well as broader economic and political policies, have a significant impact on the assessment of risk and the competitiveness of a country.

Each year, the Fraser Institute in Canada conducts one of the most comprehensive analyses on this topic, based on its political perception index (PPI).[20] The index is created from a survey of more than 300 oil executives operating at the international level, focusing on 16 criteria, or barriers to investment, related to the aboveground risks of exploiting a reservoir. As such, it serves as a good guide to the factors on which Mexico should focus to increase the international competitiveness of its energy sector.

Factors analyzed by the Fraser Institute:

1. Fiscal terms of contracts
2. Tax regime applicable to any business and the execution of the same
3. Environmental regulations
4. Regulatory enforcement
5. Cost of regulatory compliance
6. Certainty with regard to areas that are declared protected natural areas
7. Trade barriers
8. Labor regulations and employment agreements
9. Quality of available infrastructure
10. Database quality and access to geological data
11. Availability of skilled labor
12. Dispute resolution
13. Political stability
14. Security
15. Redundant, duplicate or inconsistent regulations
16. Legal System

The Fraser Institute Report specifically mentions that the Energy Reform is perceived as a favorable element that has significantly improved the competitiveness of projects in Mexico. It even states that the New Mexican Energy Model is worthy of emulation, despite needing time to mature, development and consolidation.

COMPETITIVENESS REPORT

The Fraser Institute Report specifically mentions that the Energy Reform is perceived as a favorable element that has significantly improved the competitiveness of projects in Mexico.

[20] *Fraser Institute (December 2017). Global Petroleum Survey 2017. https://www.fraserinstitute.org/studies/global-petroleum-survey-2017*

FALLING RANKING

Despite the profound transformation of our sector, in 2017, Mexico ranked number 77 of 97 in perception of competitiveness in exploration and production policy.

Despite the profound transformation of our sector, in 2017, Mexico ranked number 77 of 97 in perception of competitiveness in exploration and production policy. Note that the Fraser Institute does not measure countries, but rather petroleum regions, and as such, Texas is in first place. In fact, practically all of the regions in the United States and Canada were ranked higher than Mexico.

As far as the Latin American countries analyzed, Mexico is only ranked higher than Bolivia, Ecuador and Venezuela.

Moreover, the United States Energy Information Administration analyzes unconventional resources and asserts that the United States, Argentina, China and Poland have even greater potential than Mexico.

It is important to note that in the specific case of Mexico, the three factors that most negatively impacted our industry's rating were labor relations, legal proceedings and security. These all refer to the general status of the country, more than the exploration and production of hydrocarbons, but they must be addressed in order to consolidate a solid Rule of Law.

Another important barrier to investment mentioned in the analysis is the inconsistency and duplication of regulations. The SENER, CNH and the SCHP have recently worked on this matter and have mechanisms that can help improve competitiveness, but they still have more work to do to offer greater trade certainty with more competitive fiscal terms, greater access to opportunities and reduce the regulatory burden.

3.5 Impact on Mexican productivity

It has often been said that in recent decades, our country's productivity has been lower than what Mexico requires. Despite the enormous population boom that we are now enjoying, and the liberalization of most of the Mexican economy in the 1990s, Mexico has productivity rates lower than those achieved after the Mexican Revolution and World War Two.

As we discussed in the previous chapters, this is partly a reflection of the distortion created by having an open economy with a closed energy sector, which moreover consisted of a monopoly. In fact, the existence of a monopoly in the energy sector and in other parts of the national economy has been identified as largely responsible for the low productivity of the economy.

Productivity is a measure of the goods and services produced by each factor used (labor, capital, technology) during a given period. Mexican productivity is one of the lowest despite Mexico being the nation that works the most hours.

This was one of the reasons that the Mexican Congress focused on passing what are known as the Structural Reforms that seek to break these bottlenecks that cause so much frustration and negative economic impact. Thus far, the Reforms are working their transformation and should, over time, contribute to higher rates of productivity.

An important contributor in this transformation is the energy sector. Since the Reform was passed, it has succeeded in getting energy to areas that were not formerly covered — such as the case of the natural gas pipelines in the west of the country — and has made it possible to increase investment levels, despite falling prices.

We are also beginning to see a transformation in fuel supply and storage, which will increase in reliability and quality as the infrastructure is modernized.

To measure productivity in Mexico, the National Institute of Statistics and Geography (INEGI) used the LA KLEMS model[21] coordinated by the United Nations Economic Commission for Latin America (CEPAL) as a methodology for estimating the results of the total productivity of the factors.[22]

Using this model, in addition to the System of National Accounts and its databases, the INEGI has created a platform of comparable statistical and analytical data that makes it possible to identify production factors (capital, labor and intermediate inputs) and their contribution to their economic growth of 20 groups of economic sectors, with 67 groups of subsectors in Mexico.

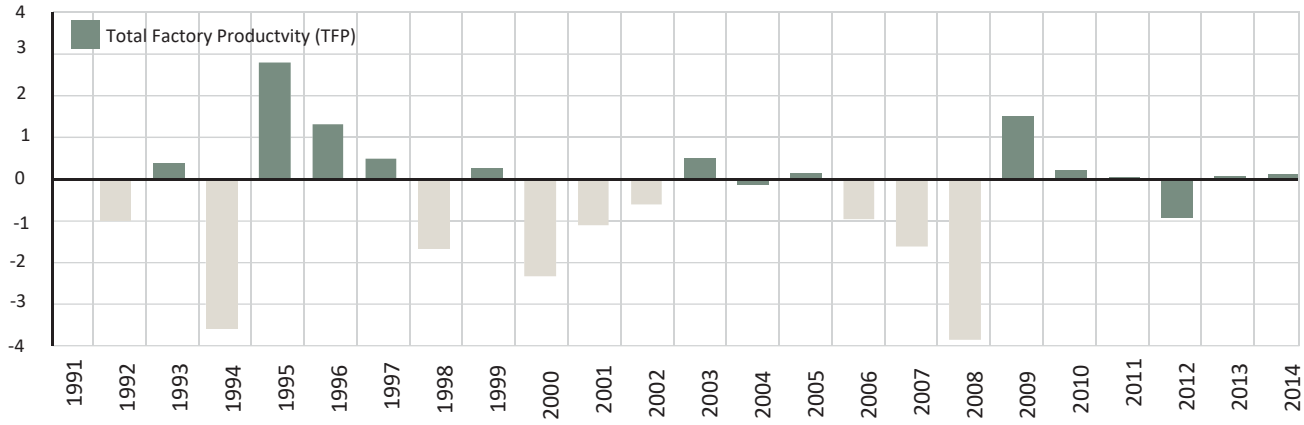
WITH A VIEW TOWARD EFFICIENCY

The Mexican Congress focused on passing what have been called the Structural Reforms that seek to break the bottlenecks that cause so much frustration and negative economic impact.

Graph 12

Total Productivity

Factors and contribution to economic growth in Mexico, based on the total production of the economy (annual growth percentage rates).



Source: INEGI

[21] *The LA KLEMS acronym represents Latin America (LA), capital (K), labor (L), energy (E), materials (M) and services (S).* [22]

DEMAND FOR ENERGY

One of the principal mechanisms for disseminating the benefits of energy reform is via the demand for energy for productive uses.

With these data, the INEGI estimated how efficiently we use the production factors, to assess Mexico's historical productivity over the 1991–2016 period, arriving at an average total factor productivity of -0.34:

The above graph shows a lower growth rate in the total factor productivity with significant drops in 1995 and 2009 (years of severe financial crises). These drops are likely overestimated, as idle capital in recession years was included. If this measurement were corrected, the average for the period would be a positive number.

This low productivity growth was one of the reasons driving the passage of the Structural Reforms, including the energy reform, that are now beginning to have a positive impact on Mexican society.

One of the principal mechanisms for disseminating the benefits of energy reform is via the demand for energy for productive uses. Such a mechanism requires sources of energy that are safe, competitive and good quality, as they go on to trigger development and growth.

To assess how the sectors benefit, we can use the data available on the INEGI's National Accounts page, which contains the intersectoral account with energy prices for the entire North American Industry Classification System (NAICS).

Thanks to these tabulations, it is possible to view the energy costs of the various sectors and see which of them would be most benefited by the New Mexican Energy Model:

Table 04

Energy and total factor productivity by sector

Productive Sectors	Expenditure at current prices in millions of pesos (2016)	%
Total	**1,758,264**	100
Primary sector	**3,716**	0.21
Secondary sector	**1,133,002**	64.44
Tertiary sector	**621,547**	35.35

Source: INEGI, Total Factor Productivity, Intersectoral Account

Since the Reform was passed, it has succeeded in getting energy to areas that were not formerly covered — such as the case of the natural gas pipelines in the west of the country — and has made it possible to increase investment levels, despite falling prices.

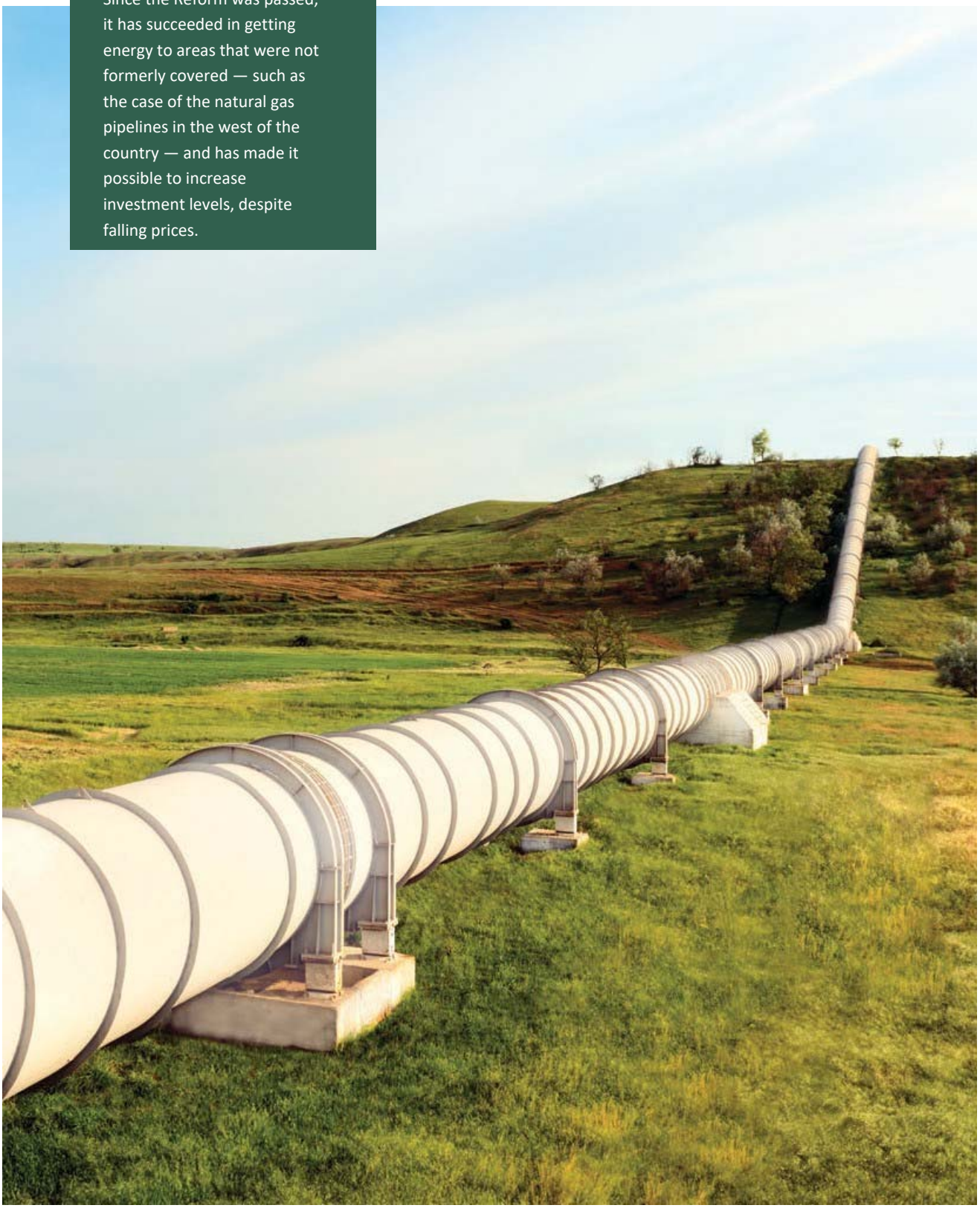


PHOTO: SHUTTERSTOCK

BENEFIT BY SECTOR

The greatest beneficiaries of the New Mexican Energy Model will tend to be concentrated in the secondary sector (industry) and the tertiary sector (services).

According to this analysis, the greatest beneficiaries of the New Mexican Energy Model will tend to be concentrated in the secondary sector (industry) and the tertiary sector (services), although in the primary sector, energy also plays an essential role in the development of fertilizers.

On the other hand, the country needs to be more adaptable in certain areas in response to competition from certain countries (China) and the rise of new technologies (robotics, artificial intelligence).

We must analyze the productivity of the various sectors and their demand for energy to fully understand the multiplier effect of increasing access to energy.

Although there are several ways to analyze productivity, we have selected a model that views productivity as necessarily knowledge-intensive, since this is the notion that best fits the situation in Mexico in the age of the Fourth Industrial Revolution and its struggle to elevate the added value of its production and capture a larger international market share.

In the next chapter, we will analyze productivity in depth, primarily from the perspective of knowledge as the great growth magnet and driver of growth, inspired by the concept of "economic complexity" developed by Ricardo Haussman and a distinguished group of researchers at Harvard University and MIT.

Hausmann and his colleagues defined economic complexity as follows:

> Economic complexity is the knowledge in a society as expressed in the products it makes. The economic complexity of a country is calculated based on the diversity of exports a country produces and their ubiquity (i.e., the number of countries able to produce them) and those countries' complexity.
>
> We have discovered that those countries that are able to sustain a diverse range of productive know-how, including sophisticated, unique know-how, are able to produce a wide variety of goods, including complex products that other countries cannot make.[23]

Another concept that is essential to an understanding of Haussman's methodolgy is that of "distance."

> Distance is the measure of a location's ability to enter a specific product. A given product's "distance" (from 0 to 1) looks to capture the location's capabilities to make the product as measured by how closely related that product is to its current exports. A "nearby" product of a shorter distance requires related capabilities to those that already exist in the country, which increases the likelihood of success.[24]

Hausmann's model also makes it possible to analyze the economic complexity of all the productive sectors in the country in a product-space diagram, showing the similarity of the know-how required to produce them (proximity of the nodes). The size of the nodes reflects its share in world trade.

A product-space diagram measures productivity viewed as export potential, through the Revealed Comparative Advantage:

> A measure of whether a country is an exporter of a product, based on the relative advantage or disadvantage a country has in the export of said product. A country is an effective exporter of a product if it exports more than its "fair share" of the international market, or a share that is at least equal to the share of total world trade that the product represents (in which case the Revealed Comparative Advantage is greater than 1.)[25]

This means, that the notion of economic complexity essentially recognizes the exchange of information and know-how as the primary engine of economic growth. To put it another way, the nations or regions that exchange the most know-how — either via synergies between industries or the development of academic-economic clusters — and in which there is proximity between productive activities, are those that experience the most growth.

ENGINE OF GROWTH

The notion of economic complexity essentially recognizes the exchange of information and know-how as the primary engine of economic growth.

In the case of Mexico, the primary contribution of the New Mexican Energy Model must be to give us the energy and financial capacity to add know-how that will promote synergies throughout our society.

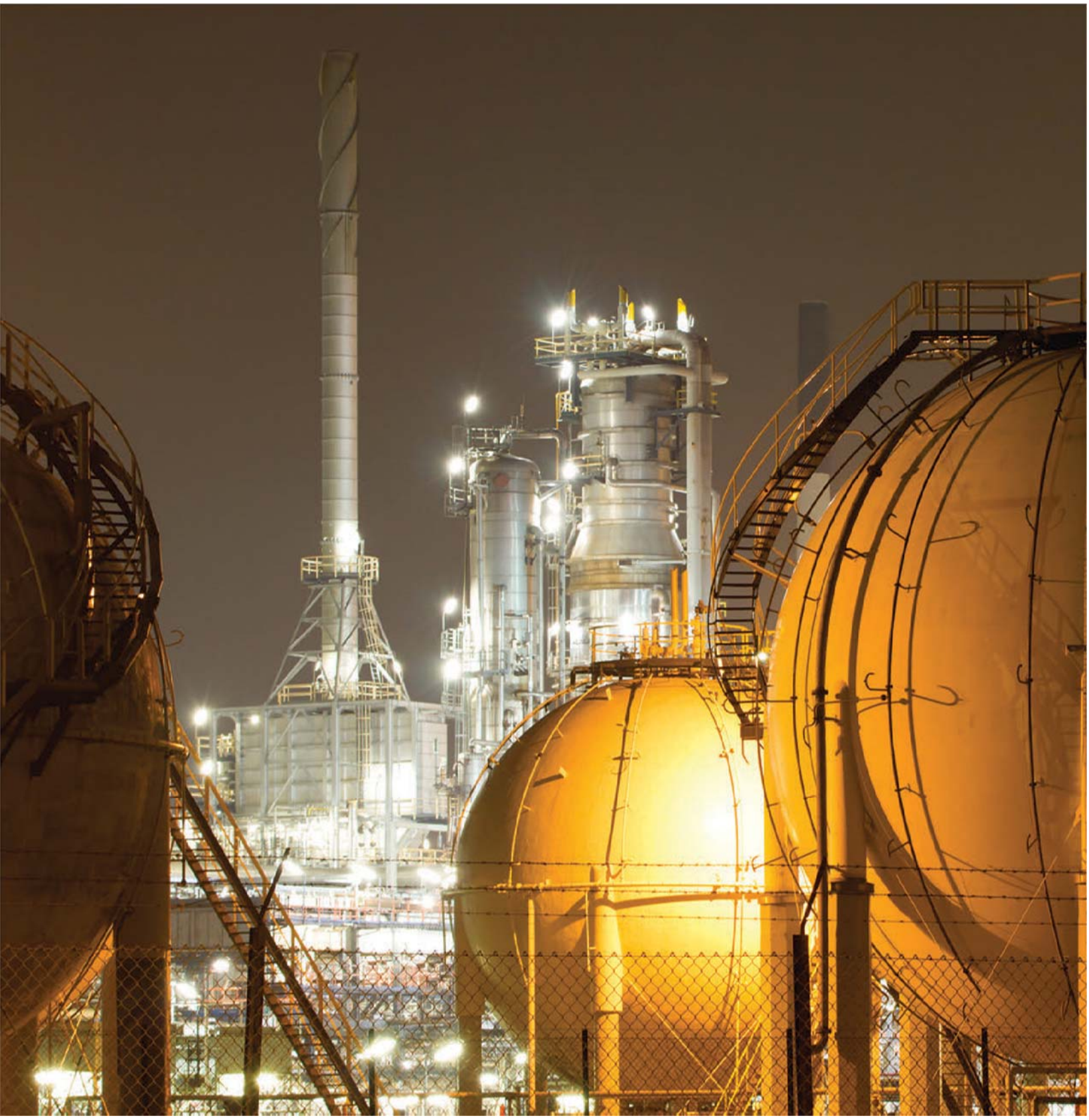
In conclusion, it is important to remember the cardinal point that has guided us: if Mexico keeps up the pace of its New Energy Model, is able to ensure competition and transparency, it can reap significant benefits not only in the energy sector but in the Mexican economy as a whole.

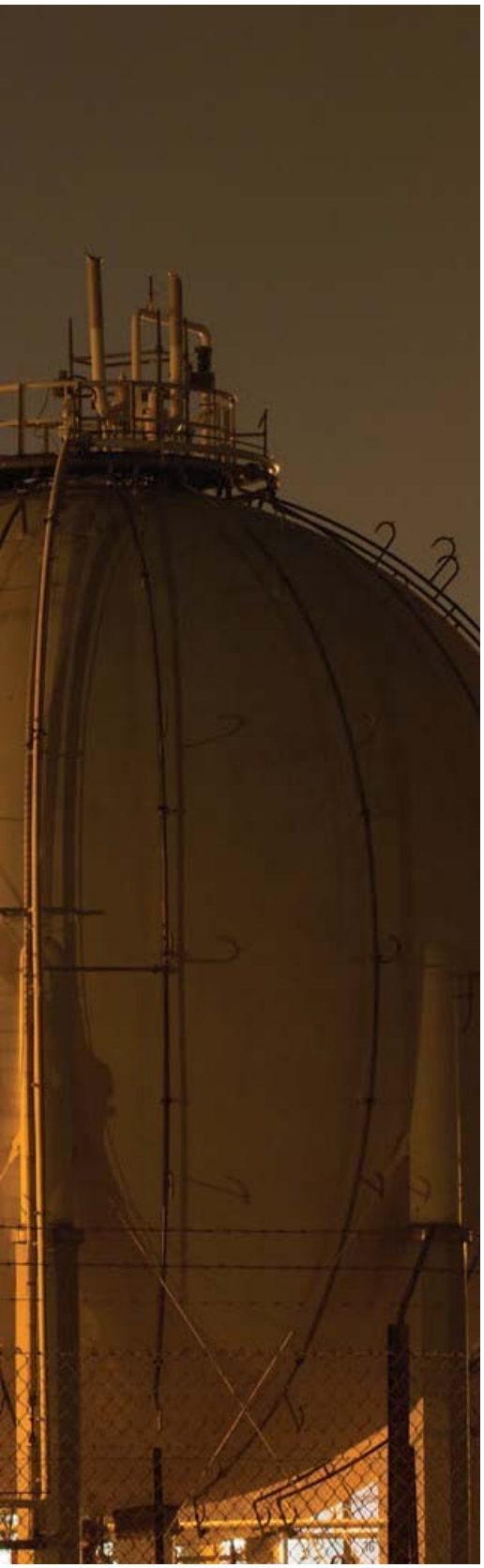
Such consistency will provide us the benefits so carefully quantified by the IEA, which represent a more solid and promising future, to the extent we meet the new challenges posed by the 21st century.

In line with the spirit of making constructive proposals that will help Mexico accelerate its economic growth thanks to the energy sector's contribution to its development, in our next and final chapter we will discuss a series of proposals for the 2017–2040 period. These proposals are the result of an intense dialog with various experts and sectors of the society, over the last few months.

[23] *Atlas of Economic Complexity*
Available at http://atlas.cid.harvard.edu/learn/glossary/

[24] *Idem*
[25] *Idem*





PHOTOGRAPH: SHUTTERSTOCK

04

Keys to Mexico's Energy Future

The Mexico we can become

In the last chapter we reviewed Mexico's promising energy outlook to 2040. Despite over a decade of declining petroleum production and a pronounced drop in economic activity in the oil-producing areas of the country after oil prices fell in 2014, the New Mexican Energy Model has introduced new perspectives, a clear path to return to growthand is creating the necessary conditions for our country to regain its position as a global energy leader.

By 2040, if Mexico is consistent in building competitive markets and a knowledge economy that is fully committed to transparency and accountability, it could catapult the growth of its current production by up to 40 percent and add more than a billion dollars to its GDP. We must also remember that some discouraging scenarios exist in which the New Mexican Energy Model is not implemented, or is implemented in an incomplete or partial manner. This would occur if the implementation is halted, slowed down or if we fail in our efforts to establish consistency, competition, transparency, or building a knowledge economy. The most extreme case, which would involve failing to take advantage of the tools created by the energy reform —in other words, returning to the past— would result in the loss of nearly a million barrels per day of production and around 4 percent of the GDP by 2040.

CONSOLIDATION FOR THE FUTURE

By the year 2050, Mexico could consolidate its position as the seventh largest economy in the world.

Staying on this path, using all the tools provided by the New Mexican Energy Model, means allowing Mexico to compete on equal footing with other nations, since these tools are the same tools that all other nations of the world have provided themselves with, and which, until recently, we were denying ourselves.

Having these tools is the key to building a better future. According to PricewaterhouseCoopers (PwC), a global consulting firm, by the year 2050, Mexico could consolidate its position as the seventh largest economy in the world, even surpassing two historically more-advanced nations, the United Kingdom and Germany.[1]

Right now we are in 11th place in this ranking. Moving up four places is no small thing, but it is possible if we continue to modernize our economy and develop all of our potential. In fact, we have already done it in the recent past, and within a similar period of time. Thirty-two years ago, in 1986, when we first began opening up our economy, we were ranked 15th in the world.[2] Thus, the importance of persevering in the process of transforming our country is clear.

Emerging markets

By the year 2050, emerging markets will dominate the 10 largest economies in the world (PPP GDP)

Country	Ranking in 2016	Ranking in 2050	Country
China	1	1	China
USA	2	2	India
India	3	3	USA
Japan	4	4	Indonesia
Germany	5	5	Brazil
Russia	6	6	Russia
Brazil	7	7	Mexico
Indonesia	8	8	Japan
UK	9	9	Germany
France	10	10	UK

E7 Economies G7 Economies

Source: Table by PwC

Whether Mexico will reach its potential depends, in large part, on our national capacity to reinvent ourselves while taking the long view. We have come a long way in the last three decades of trade liberalization, expanding our economy, becoming industrialized and competitive in various categories (from avocados to aerospace). But it is no secret, as a society we know we can do better and the areas that remain backward are disappointing, such as inequality, regional development, rule of law, or extreme poverty.

REACHING POTENTIAL

Whether Mexico will reach its potential depends, in large part, on our national capacity to reinvent ourselves while taking the long view.

In this sense, we are a successful emerging economy, because we have efficient platforms for the production of manufactured goods, but the 21st century presents much more complex challenges. Being industrialized is not enough. We must become a knowledge economy with high levels of productivity in light of the profound transformation of global energy markets and the rise of disruptive technologies in this Fourth Industrial Revolution.

Thus, those nations that are successful will be those that first become attractive, competitive, and sustainable markets, and then seek to benefit their consumers. In our country, this means working to make the entire economy adhere to the principles of legal certainty, competition, transparency, and focus on the technology and knowledge that are already central to the New Mexican Energy Model. A country that prioritizes consistency and predictability in government proceedings, impartial competition in the markets, legal certainty, accountability and transparency that builds credibility with the society, and the key role of knowledge and technology in decision-making.

SUCCESSFUL NATIONS

In the 21st century, being industrialized is not enough. Those nations that are successful will be those that first become attractive, competitive and sustainable markets, and then seek to benefit their consumers.

In practice, incorporating all these ideas in every petroleum industry process might appear complicated, but the starting point is simple: to obtain the most possible benefits, the energy industry and the economy (as we discussed in Chapter 1) must have fully compatible systems that are consistent with each other. As such, the energy sector that lagged behind the progress the rest of the economy has been making over the last three decades is now taking the lead with regard to how best to manage all of our economic sectors. The three decades in which we debated how to build a better energy sector have proved to be fruitful.

We are doing well, but we can do better. To do so, not only must we stay the course, but we must pick up the pace, simplify processes so as to further strengthen competition and transparency, and never forget that knowledge must be our guiding light.

Reflecting on the future

Throughout 2017, the Mexican Association of Hydrocarbon Companies (AMEXHI) performed an in-depth analysis of Mexico in the year 2040 based on the projections of the International Energy Agency (IEA) in the first outlook it has published on the Mexican energy sector. The results are encouraging, if we keep the pace, but if we lose our way, they predict a great loss of opportunity for our country.

GUIDING PRINCIPLES

The Mexican economy must adhere to the principles of legal certainty, competition, transparency, and focus on the technology and knowledge that are already central to the New Mexican Energy Model.

Here are a few important questions that the Agency's report did not answer. The first is, what actions are necessary to stay the course? In other words, what are the essential principles that must serve as the guiding light for the New Mexican Energy Model? Another key question is what can we do to make the emerging model even more effective? What tasks are still pending completion or what areas could be reinforced? Lastly, what are the new challenges that this New Energy Model must be able to tackle in order to be useful to Mexican society in the year 2040?

These are no small questions, nor are they easy to answer.

[1] *https://www.pwc.com/gx/en/world-2050/assets/pwc-world-in-2050-slide-pack-feb-2017.pdf*
[2] *http://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx*

ENCOURAGING DIALOG

This document seeks to encourage a discussion of the essential principles the New Mexican Energy Model must follow and offer some proposals that could help to solidify it.

This document is, after all the result of brainstorming on the problem, and seeks to encourage a discussion of these important issues and offer some proposals that could help move us forward. For this purpose, throughout 2017, AMEXHI conducted a series of weekly discussions, reviewed relevant literature and analyzed the New Mexican Energy Model. What is more, with the help of the De la Calle, Madrazo, Mancera consulting firm, and in order to guarantee an environment of healthy competition and impartiality, we conducted surveys and interviews with AMEXHI member companies, as well as dozens of industry experts with diverse and inclusive vision, in addition to four discussion and analysis forums.

Work Group

In late 2016, AMEXHI decided to create a work group to analyze the New Mexican Energy Model, and propose any ideas it could for its continuous improvement. In order to do this, AMEXHI brainstormed the issues internally and surveyed a large number of Mexican energy sector experts. For this exercise, each of the 50 AMEXHI member companies were directly contacted and various industry experts and authorities were interviewed. Weekly discussion and analysis meetings were held throughout 2017, as well as four specialized forums with academics, business people from other sectors, government officials and representatives of civil society.

For the purpose of strict adherence to the law on economic competition, and so as to have an objective and diverse discussion, AMEXHI hired the consulting firm De la Calle, Madrazo, Mancera, S.C. This document is the most recent expression of this brainstorming exercise which will continue through mid 2019, so as to cover the first five years of operation of the New Mexican Energy Model.

Thus, based on available energy and economic projections, both domestic and international, this chapter describes the key characteristics that the New Mexican Energy Model must continue to aspire to, and in some cases, expand upon.

The first part describes the national projections and needs for the year 2040, and the second part lists the proposals that a group of experts has developed — including AMEXHI members, economic and energy specialists— to get the Mexican energy sector to align with the rest of the national economy and operate at the level of its enormous potential.

Lastly, in the second part of this chapter we systematized and summarized the four principles and the four spheres of action identified during our brainstorming process. Here is where the reader will find the heart of the vision and proposals in the Agenda 2040.

[3] *AMEXHI seeks to maintain at all times the highest standards of compliance with the rules regarding economic competition in Mexico and the world. That is why we hired a third party to conduct the interviews with each of our members, so as to maintain an appropriate distance between competitors. The policy guiding AMEXHI's activities may be found at: http://www.amexhi.org/*

Mexico's challenges in 2040

According to the National Population Council (CONAPO), Mexico will experience an obvious slowdown in its population growth. Projections indicate that the annual growth rate will drop by nearly 66 percent.
This is a reduction of 1.2 percent per year compared to the 2010 population, a loss of one third or perhaps 0.41 percent by 2030. The economic impact of this slowdown is very significant, as it marks the end of the population boom and the beginning of our aging process as a society.

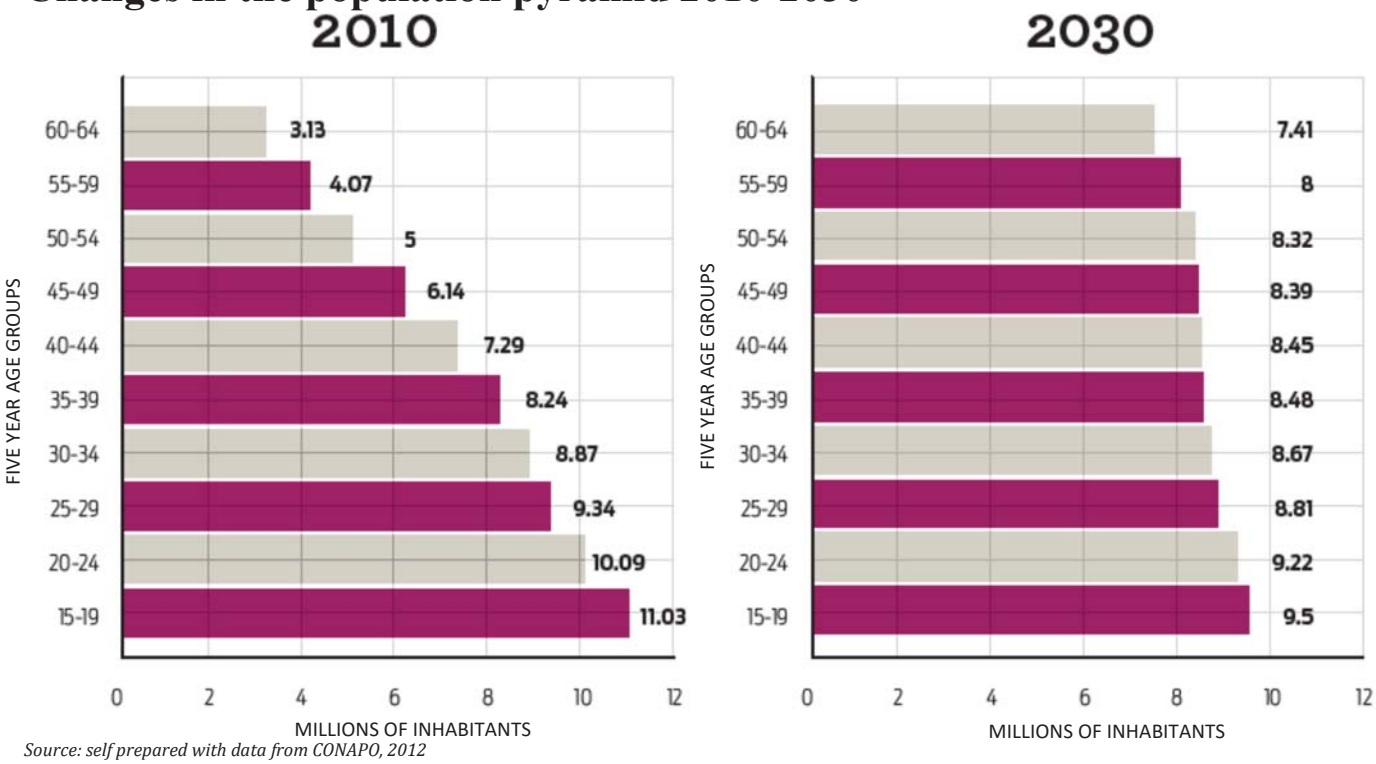
Thus, the drop in population growth rates in Mexico and the resulting drop in the economically active population will be reflected, in 2040, by a considerable increase in the ratio of retired people to active workers. In specific figures: whereas in 2010 the ratio between those entering the economically active population group (age 15 to 19) and those leaving said group (age 60-64) was 3.5. By the year 2030, the ratio will be less than 1.3. In other words, population growth rates will cese to be a significant asset for economic growth.

POPULATION GROWTH SLOWDOWN

Mexico will experience a slowdown in population growth. The challenge will be to replace the "population boom" on which we have depended as a source of economic growth.

GRAPH 1

Changes in the population pyramid 2010-2030



Source: self prepared with data from CONAPO, 2012

PRODUCTIVITY AND EDUCATION

The OECD stresses that Mexico's low labor productivity is due to low levels of quality in education and work skills.

Thus, the challenge for Mexico from now until 2040 is to replace the "population boom" on which we have depended as one of our primary sources of economic growth. Increasing productivity is the solution to this challenge, becoming able to do more and more with less. In this sense, it is difficult to imagine that we will be able to maintain our strong competitiveness in the manufacturing sector solely via the quality and price of our population.

In the future, we must be competitive as a result of high education levels, the great efficiency of our energy matrix and the growing incorporation of technology and innovation in our productive processes.

This unavoidable demographic change becomes even more complex when we recall that the world is on the threshold of a great economic transformation, known as the Fourth Industrial Revolution. That is the rise of robotics, rapid progress in artificial intelligence, market penetration of self-driving vehicles, advanced manufacturing using 3D printers and the use of data analytics. This world, in which digital technologies merge with analog production processes poses big challenges for employment and productivity in countries with large populations.

This is the fourth time that the world has entered such a large-scale industrial transformation. In the first three, Mexico was more of a spectator than an actor. Over the last two decades, Mexico has finally managed to join the group of industrialized nations, but if we do not manage to significantly improve productivity, it is hard to imagine that we will keep our position.

This is no small challenge. In its compendium of productivity indicators for 2017, the Organization for Economic Cooperation and Development (OECD) concluded that Mexico has significant productivity challenges, rating it below half the average.[4] Although the cause is multifactorial, the OECD stresses that the low labor productivity in Mexico (measured as GDP generated per man-hour worked) is due to our low-quality education and low levels of work skills.

INVEST IN EDUCATION

Tackling the quality of education requires sustained investment. The New Energy Model is an important contribution to this strategic need to invest in education quality.

Addressing this challenge involves, above all, addressing one of Mexico's biggest challenges: education quality. To be successful in this extremely important mission, we must remember that according to the OECD, "high quality education needs sustainable financing."[5]

The current situation is cause for concern: in 2013 Mexico invested 3,400 dollars per year in each student. That figure is an average amount spent for elementary through high school. In contrast, the OECD average for this age group is three times that (10,500 dollars) and is even less than other Latin American countries, such as Brazil. However, despite its low comparative rating, in the last ten years Mexico has seen a significant increase in its investment in education, and with the education reform, a strong commitment to transforming education, placing it at the service of the students and transforming its content. Having said this, it is essential that investment in education be increased even more, with a growing focus on education quality.

As such, the New Energy Model represents an important contribution to this strategic need to invest in quality education, since the development of energy no longer depends exclusively on government finances, by allowing private investors to invest at their own risk and Pemex to seek partners to reduce its risk, the country is freeing up resources for the education sector. What is more, these investments will lead to higher levels of tax revenue, as we described in the previous chapter, based on International Energy Agency projections.

In this regard, if Mexico were to stop using these new financing tools for the energy sector, it would have to divert tax revenue from education to oil extraction. Although reducing corruption is an urgent way to free up said revenue (and the New Mexican Energy Model is already helping to accomplish this), the truth is that eradicating corruption is not enough, in and of itself, for the country to be able to allocate sufficient resources to quality education.

It is therefore necessary to attract more investment in energy and infrastructure, using more productive technologies and more efficient logistics to create the conditions under which our country can be one of the beneficiaries of the 21st century.

EDUCATION FINANCING

If Mexico were to stop using these new financing tools for the energy sector, it would have to divert tax revenue from education to oil extraction.

Investment requirements by decade

Percentage of GDP

	Total requirements %GDP			GDP Totals (MMD in 2009 constant pesos)		
	2011-2020	**2021-2030**	**2031-2040**	**2011-2020**	**2021-2030**	**2031-2040**
Brazil (no change scenario)	2.6	2.5	2.4	19,526	26,007	33,472
Brazil (scenario with convergence)	2.9	3.1	3.3	24,799	44,500	73,851
Mexico (no change scenario)	3.0	2.9	2.8	10,758	14,31	18,110
Mexico (scenario with convergence)	3.3	3.3	3.4	13,988	24,373	38,474
Argentina	5.6	5.7	5.8	4,174	6,046	8,366
Chile	5.4	5.7	5.8	2,367	3,869	6,043
Venezuela	3.9	4.0	4.2	4,083	5,475	7,012
Colombia (no change scenario)	3.9	3.9	3.9	2,557	3,380	4,363
Colombia (scenario with convergence)	4.4	5.0	5.9	3,357	6,523	11,760
Dominican Republic	7.2	7.4	8.0	675	1,100	1,714
Peru (no change scenario)	3.6	3.6	3.6	1,619	2,246	3,003
Peru (scenario with convergence)	4.1	4.8	6.1	2,218	4,508	8,305
Costa Rica	5.9	6.5	7.4	416	661	1,002
Ecuador	4.0	3.8	3.7	745	1,033	1,367
Other countries	6.7	7.9	10.9	2,328	3,366	4,708
Total (no change scenario)	3.6	3.7	4.0	49,248	67,496	89,159
Total (scenario with convergence)	3.7	3.9	4.2	59,151	101,453	162,601

[4] *http://www.oecd.org/std/productivity-stats/oecd-compendium-of-productivity-indicators-22252126.htm*
[5] *http://www.oecd.org/education/skills-beyond-school/EAG2016-Mexico.pdf*

INVESTMENT IN INFRASTRUCTURE

In a conservative scenario, between 2031 and 2040, Mexico must invest nearly 2.9 percent of its GDP in developing new infrastructure; in a high-growth scenario, it would need to invest 3.4 percent, in other words, 38.5 billion dollars per year.

In fact, in 2017, the World Economic Forum suggested that in order to grow, countries must focus on the long-term development of infrastructure. Despite the fact that few academic studies focus on measuring the specific needs of Mexicans in this area, there are some that cover Latin America as a whole, for example the *Requirements for Infrastructure Investment in Latin America Under Alternate Growth Scenarios: 2011–2040* notes that, in a conservative scenario (l*ow-growth business as usual*), between 2031 and 2040, Mexico must invest nearly 2.9 percent of its GDP in developing new infrastructure; in a high-growth scenario, it would need to invest 3.4 percent, in other words, 38.5 billion dollars per year. This is such a large investment that it equals the current value of the entire Bolivian economy.

The Mexican energy sector alone could attract a significant percentage of this investment. In addition to megaprojects such as the one being developed by BHP Billiton and Pemex around Trión, a deepwater project with total investment estimated at 11 billion dollars, the consulting firm Ernst & Young (EY) has estimated that "one of the biggest opportunities is the need for investors to develop *midstream* (transport) capacity to support new exploration and production."[7] The analysis conducted by the Heinrich Boll foundation, discussed in the previous chapter, reached a similar conclusion.

GRAPH 2

Energy Reform, a reality

Significant investments all along the value chain.

Estimated investment: **257 billion Dollars**

Investment committed: **86 billion Dollars** (30 billion additional dollars for 2017)

Extraction and exploration: Round One and Two

Round 1
1st Bidding Process: USD 2.7 billion
2nd Bidding Process: USD 3.1 billion
3rd Bidding Process: USD 1.1 billion
4th Bidding Process: USD 34.4 billion
Round 2:
1st Bidding Process: USD 8.2 billion
2nd Bidding Process: USD 1.1 billion
3rd Bidding Process: USD 1.0 billion
4th Bidding Process: USD 31.5 billion
Farmouts:
Trión: USD 11 billion
Cárdenas-Mora: USD 127 billion
Ogarrio: USD 95 billion

Seismic:
USD 2.5 billion

Natural Gas, LPG and Petroleum Products

Gas Pipelines:
USD 12 billion

LPG:
USD 97.1 billion

Petroleum Products
USD 18.2 billion

Transport: USD 3.9 billion
Storage and Distribution
USD 2.3 billion
Waste: USD 12.0 billion

Electricity

1st Auction: USD 3.9 billion
2nd Auction: USD 4 billion
3rd Auction: USD 2.4 billion

Other in PRODESEN*:
Generation: USD 97 billion*
Transmission: USD 12.8 billion*
Distribution: USD 9.6 billion*

A total of **133 companies** from 19 countries, of which 51 are Mexican, have been awarded contracts for the development of hydrocarbons and electricity.

**Estimated investment by PRODESEN 2017-2031. Source: Ministry of Energy.*

In terms of their aggregate impact, the Energy Regulatory Commission (CRE) recently estimated that, if all the projects that are currently outlined are executed, the potential investment would total 257 billion dollars, of which more than 60 percent are directly attributable to the hydrocarbons sector. This is equal to 6.7 years of the estimated investment needs for the entire Mexican economy. It is important to point out that of these 257 billion, to date, 86 billion are considered to have been "committed."

On the whole, the economy's growing need to replace the "population boom" with productivity points to the necessity of improving the population's skills (work skills) as well as the infrastructure that interconnects us. To put it another way, only a large investment in improving the quality of our education, a profound transformation (in financing and availability) of our energy sector and an unprecedented investment in infrastructure will allow Mexico to create the necessary conditions to increase its productivity. The New Energy Model is a good path toward this.

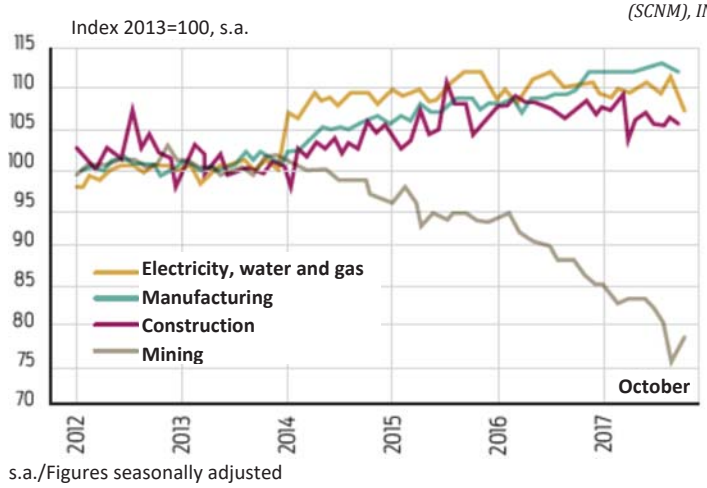
At this juncture, it is worth responding to a criticism frequently leveled at the New Energy Model, which to say that it is to blame for the recent poor results of our energy sector, when they actually reflect a temporary situation related to the fall of oil prices and our delay in reforming the sector.

For example, if we analyze industrial activity in Mexico from 2014 to date, the mining sector, under which the hydrocarbon sector is included, has experienced a significant drop, taking the year 2013 as 100, last year it fell to 75. In fact, it is estimated that these performance challenges in the sector are costing approximately an entire half percentage point of GDP growth. Moreover, in terms of exports there has been a steep drop in both value and volume.[8]

GRAPH 3

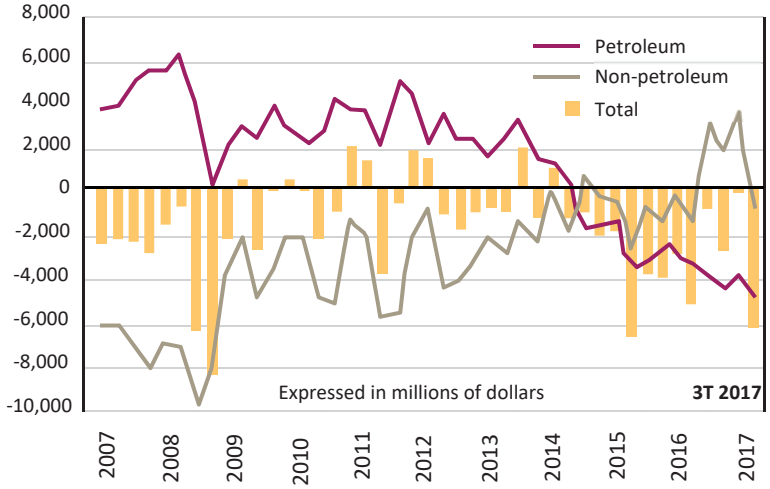
Trade Balance

Source: Monthly Industrial Activity Indicator, Mexican System of National Accounts (SCNM), INEGI.



Industrial Activity

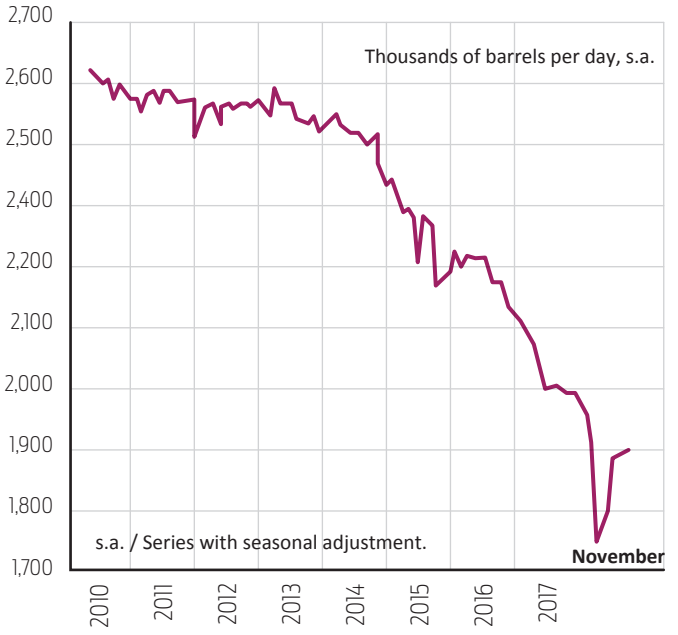
Source: SAT, SE, Bank of Mexico, INEGI, Mexican Commodities Trade Balance, SNIEG. Information of National Interest.



[7]*http://www.ey.com/Publication/vwLUAssets/EY-mexicos-emerging-infrastructure-opportunity/$FILE/EY-mexicos-emerging-infrastructure-opportunity.pdf*
[8]*Monetary Policy Challenges in Mexico. Presentation by the Governor of the Bank of Mexico, Alejandro Diaz de León. Autonomous Technical Institute of Mexico. http://www.banxico.org.mx/publicaciones-y-discursos/discursos-y-presentaciones/presentaciones/%7B1C24FFBE-31BA-F3E1-99DB-1313435A7A85%7D.pdf*

GRAPH 4

Crude oil production platform



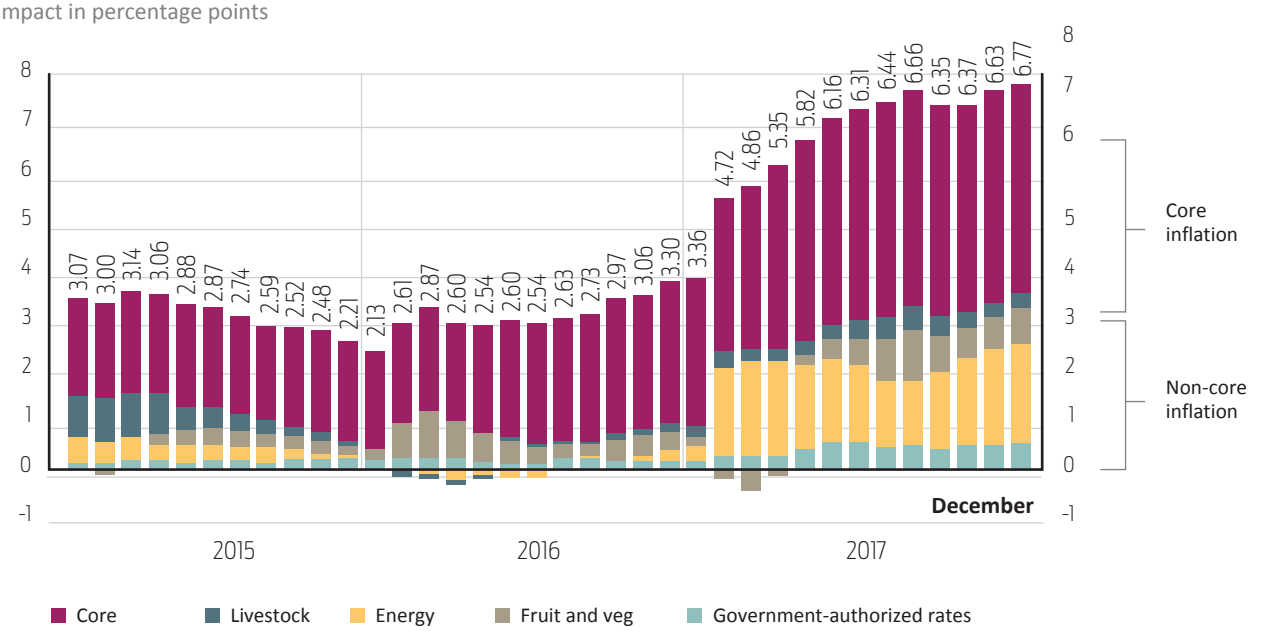
Source: Deseasonalization of the Bank of Mexico with figures from the PEMEX institutional Database.

In point of fact, the energy sector has been one of the main reasons for budget revisions and inflationary pressure, for example, as a result of the jump in gasoline prices when prices were initially liberalized. To a casual or ill-intentioned observer, it might seem that rather than helping the country, the energy sector is the cause of many problems, but it is worth gaining a more in-depth understanding of what is really going on. All of these performance problems are primarily attributable to the three-decade delay in modernizing the sector in harmony with the rest of the economy, in addition to specific factors for which Mexico is not at fault, such as the steep drop in prices that began in 2014 and the very active hurricane season in 2017. In fact, the data bears this out: the drop in the sector's contribution to growth and exports began in 2014, and some of the inflationary pressure coincides with the closure of platforms and refineries throughout the Gulf of Mexico, both in Mexico and in the United States, during the hurricane season.[9]

GRAPH 5

National Consumer Price Index

Impact in percentage points



Source: Bank of Mexico and INEGI.

Despite the foregoing, there are indeed parts that can be explained by the failure to act. The drop in oil and gas production is a phenomenon that the country has been combating since the mid 1990s. In that decade it was temporarily reversed thanks to the injection of nitrogen, and reached record production levels, but since the turn of the century it has been one of the primary energy policy challenges.

The solution is to find hydrocarbons in new basins and in order to do this, Pemex's budget was first significantly increased, and then the sector was opened to competition, as we have discussed in earlier chapters.

Raising production is no small challenge. An energy policy decision takes approximately ten to fifteen years to be reflected in production figures. In other words, todays data reflect the decision made in 2003 or 2008. Current conditions are not surprising if we take into account that in 2003, the discussion of a comprehensive energy reform was postponed, and the scope of the 2008 reform was insufficient. As such, the drop in production and the significant jump in oil imports reflects the decisions that were not made and the incomplete reforms over the last thirty years. This situation has been further exacerbated by the drop in oil prices and the transformation of the United States' competitiveness in the energy sector.

Throughout this chapter we have discussed many challenges, via their figures, but it is also important to look behind the figures. That is the only way we can find the root causes, the overarching principles, that will help us to successfully transform our production. For this reason, in addition to facing the profound transformation of the Mexican demography and making use of 21st-century technology, we need an energy sector that is adaptable, diverse and competitive. The magnitude and position of energy in the Mexican economy make it key to the success of the country, but in order for our New Mexican Energy Model to be a true driving force of the Mexico we must become, it must embody the principles of consistency, competition, transparency and knowledge.

DROPS AND INCREASES

The drop in production and the increase in petroleum imports reflect the decisions that were not made and incomplete reforms. This situation has been further exacerbated by the drop in oil prices and the transformation of the United States' competitiveness in the energy sector.

Energy for 21st-century Mexico

Mexico is thinking more and more about its future. Recently, México Exponencial (MX), a think tank that brings together scientists, technologists and thinkers in search of solutions for the future, published its first study. The study picks up the thought that Marco Steinberg expressed during the International Innovation Conference, in which he said that "it is time to decide whether Mexico wants to copy the past or design the future."[10]

The document provides a conceptual framework and important thoughts on the importance of actively designing the future. For example, México Exponencial says that the Fourth Industrial Revolution represents an important moral and ethical dilemma. On the one hand, it empowers society and facilitates decision making, but on the other it has the potential to deepen inequalities and economic polarization.[11]

[9] *Ibid.*
[10] *México Exponencial. Una nueva óptica para construir el futuro [A new perspective for building the future]. Digital Book. Loc. 112 of 555.*
[11] *Ibid. Loc. 181 and 188 of 555.*

KEYS TO SUCCESS

Consistency, competition, transparency and knowledge are the keys to success in the 21st century.

Although the dilemma is not destiny. If Mexico can create *decision-making environments* in which information converges efficiently, it will be a substantial step in building a better future. The Mexican economy must also create *productive ecosystems* based on competition and collaboration that make it possible to transform knowledge into innovation and growth. To do this, our society must acquire *skills and attitudes that transform its capabilities*, by making changes to the educational system to encourage flexibility and adaptability

In this sense, the principles guiding the New Mexican Energy Model, which we could call its cardinal points, are fully in line with the needs that have been identified to exponentially transform Mexico. Consistency, competition, transparency and knowledge are the keys to success in the 21st century.

Creating solid, transparent and efficient decision-making environments is possible, if we remain consistent in implementing the institutional framework's checks and balances. To the extent that the various sector authorities remain focused on protecting the various regulatory, protection, and development priorities we discussed in Chapter Two, this will solidify the certainty, clarity and accountability the society demands of us.

Similarly, the creation of competition and collaboration-based productive ecosystems is only possible to the extent that year after year, the Ministry of Energy (SENER) holds bidding rounds, the National Hydrocarbons Commission (CNH) approves exploration plans, and the Agency for Safety, Energy and the Environment (ASEA) ensures the industrial safety of the projects, just to mention a few aspects. What is more, competition necessitates a price system that properly transmits the information.[12]

SUBSIDIES HOLDING US BACK

The New Mexican Energy Model focused on liberalizing prices, limiting the energy subsidies that discouraged competition, drained public funds and encouraged waste and pollution.

Thus the New Energy Model has focused on liberalizing prices, limiting the energy subsidies that discouraged competition, drained public funds and encouraged waste and pollution.

In fact, Mexico and Germany agreed to conduct a peer review of each other's subsidy systems, under the auspices of the OECD. The conclusions of said review were rather positive, pointing out the gradual process from 2013 to date, by which Mexico reduced its fuel subsidies, saving some 8.3 billion dollars and turning that money into a new source of income totaling some 10 billion dollars. Apart from the impact on public finances, having a price that is a more accurate reflection of reality is the key to directing investment to the places it is most needed and reducing the greenhouse gas effect.[13]

Such a positive transformation for our economy and for the environment is only possible via the convergence of predictive and reliable decisions on the one hand, and a growing competitive ecosystem. This is no small thing. The decision to reduce the fuel

[12] *Hayek, Friedrich, "The Use of Knowledge in Society", American Economic Review 35, no. 4 (1945): 519-530.*
[13] *http://www.oecd.org/site/tadffss/Mexico-Peer-Review.pdf*

subsidies was implemented throughout two politically different administrations, and it was possible thanks to the expansion of areas of free competition. The latter are causing the projected investment in fuel storage and transport, and in service stations, to increase considerably, given that Mexico's energy security tools are getting better all the time.

What is more, the convergence of the two environments: one of rules and institutions and the other of competitive ecosystems, provides the basis for the expression of the other two great cardinal points. This is where environments and ecosystems create skills, attitudes and virtues. Transparency is only possible when a system of checks and balances is created between authorities and regulators and competition between economic agents is encouraged. This is where nations build their continuous monitoring and accountability systems in line with the interests of each player, and perfectly auditable by the society.

Especially in environments in which no one has privileged information, rules are clear and predictable, and competition is guaranteed, information begins to accumulate and become knowledge. It is in these educational areas that innovation, adaptability and better skills are created. In the specific case of hydrocarbons, their current value is due not only to their status as a raw material, but also their use in the reliable and accessible production of the energy necessary to produce all types of goods and services, tangible and intangible, and transport them.

This makes hydrocarbons the ideal fuel for Mexico's transition from an emerging to a mature economy, an intermediate to a more complex economy. To explain this potential transformation, it is worth revisiting the concepts developed by Ricardo Hausmann and César Hidalgo, from Harvard and MIT, respectively.[14]

Their theories tie economic growth to the capacity of a body (country, corporation, individual) to process information, via "know-how" and accumulated knowledge. The most productive countries are those that produce and process more information, allowing them to accumulate it in an almost physical way.

Hidalgo, a physics professor at MIT, explains, in accordance with the characteristics of his discipline, but his incisive perception would seem very familiar to students of history. This is only the continuation of historical discipline intersections: it would be hard to imagine ancient Greek culture without the library at Alexandria, the Renaissance without the founding of universities, the Islamic Golden Age without the role of scientists like Avicena and Averroes, or the glory of the Ming Dynasty without the role of the Yongle Emperor in attracting knowledge from all corners of the earth.

Back to the work of Haussman and Hidalgo, they conclude that the key to accumulating knowledge is based on the capacity to generate "economic complexity," which measures:

> *The knowledge in a society as expressed in the products it makes. The economic complexity of a country is calculated based on the diversity of exports a country produces and their ubiquity (i.e. the number of countries able to produce them), and those countries' complexity.*
>
> *Those countries that are able to sustain a diverse range of productive know-how,*

MORE PRODUCTIVE

The most productive countries are those that produce and process more information, allowing them to accumulate it in an almost physical way.

[14] *Haussmann, Ricardo, et. al., The Atlas of Economic Complexity. Mapping Paths to Prosperity. MIT Press (2013); Hidalgo, Cesar, Why Information Grows. The Evolution of Order, from Atoms to Economies. Basic Books (2015)*

USE GEOGRAPHIC POSITION

Mexico has significant advantages in several manufacturing sectors, and with regard to its geographical location in the world. Knowing how to take advantage of these to generate proximity and economic complexity is one of the keys to the future.

MORE CONNECTIVITY

Based on Haussman's analysis, Mexico is ranked 24th in the world in terms of its economic complexity. In other words, we are not generating sufficient connectivity between Mexican industries and the rest of the world.

including sophisticated, unique know-how, are able to produce a wide variety of goods, including complex products that other countries cannot make.[15]

The history of the energy sector itself bears this argument out. For example, when Norway opened its energy sector to private investment in the 1960s, it successfully created the proper conditions to create production chains around the areas in which it was already successful, specifically, its shipping industry. It is no accident that the areas in which Norwegian companies excel are areas related to or near shipbuilding. We can confirm this by looking at the meager results of other nations who have sought to create industries merely through national content laws, which often only make things more expensive, less transparent and thus make investment in their sector less attractive.

Mexico has significant advantages in several manufacturing sectors, and with regard to its geographical location in the world. Knowing how to take advantage of these to generate proximity and economic complexity is one of the keys to the future.

In specific terms, based on Haussman's analysis, Mexico is ranked 24th in the world in terms of its economic complexity, despite being the 11th largest economy (under PPP conditions). In other words, we are not generating sufficient connectivity between Mexican industries and the rest of the world. Consistent with more traditional views on emerging economies, Haussman and Hidalgo assert that in the information age, the road to growth goes through the production of increasingly complex goods.

Building integrated electronic circuits is one specific example of a "complex good" that Mexico could benefit from producing. According to the concepts and terms used by this theory, producing such a product would represent a significant opportunity gain (0.218) but currently doing so in this country would involve a "high distance" (0.83). This distance measures the difference between current capabilities and those necessary for that type of production. The challenge, then, is to reduce the distance so as to be able to produce those goods that constitute an opportunity gain.

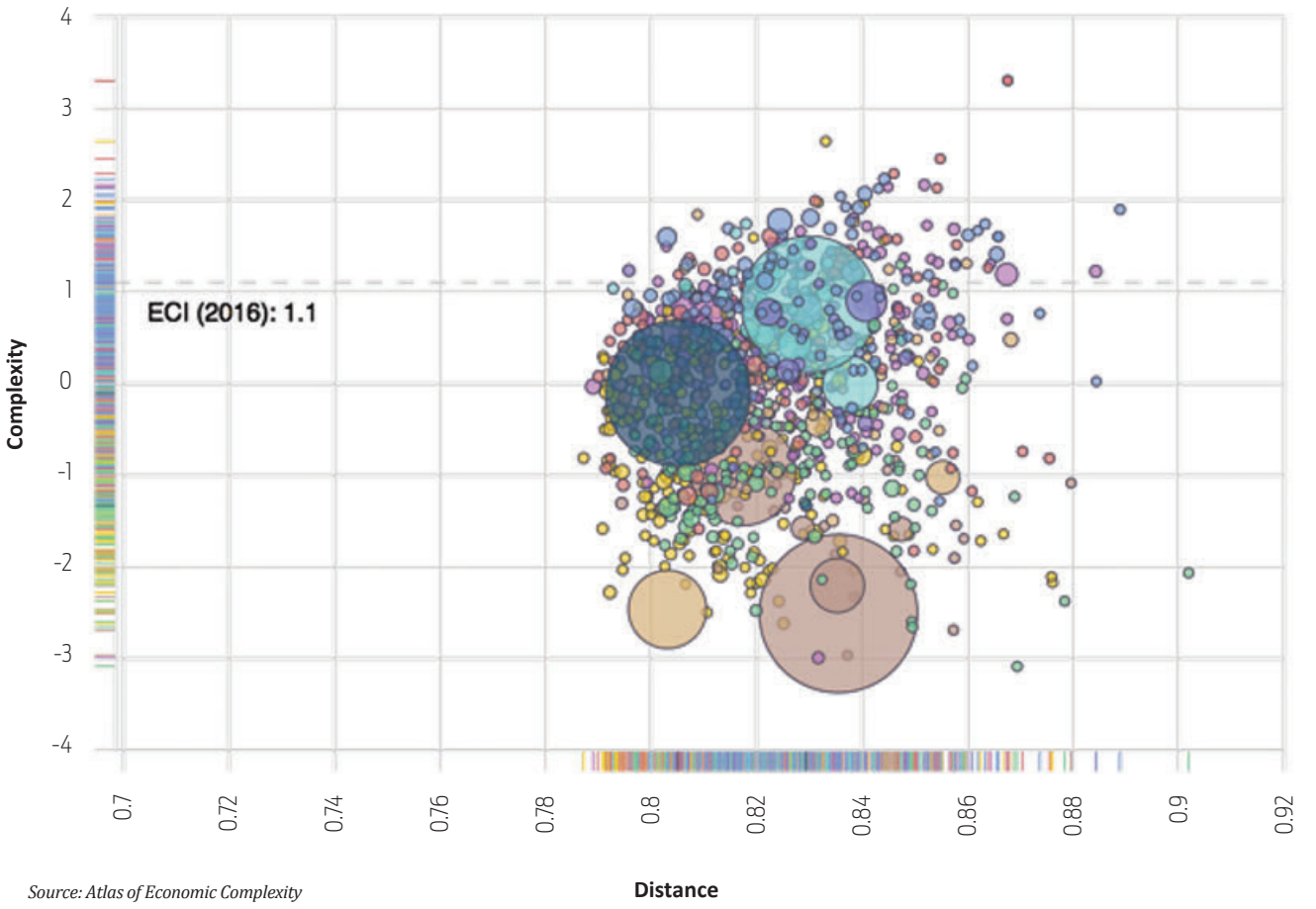
The vertical axis (*Figure 1*) represents "potential opportunity gains" and the horizontal axis the "distance." The size of the nodes is relative to the percentage of world trade the Mexican product represents. The pale blue circle represents integrated electronic circuits.

The graphic shows that Mexico, given the current composition of its economy, has a lot of potential "opportunity gains" to take advantage of. The success of such efforts will depend on the capacity to expand the network (system, industry or market) and its capacity to generate, process and store information and the capacity to process the information derived from expanding the network. The needs of the networks and the ecosystems created in each country will raise the demand for energy. In other word, the more complex an economy is, the more energy it consumes.

FIGURE 1:

Selected Products

Opportunity gains for Mexico from the potential production of selected products:



Source: Atlas of Economic Complexity

Mexico can use the energy and the infrastructure it requires to interconnect regions, economic sectors and productive processes. This is where economic complexity is generated, in which knowledge accumulates and generates growth. Thus, energy is the key to a virtuous cycle that connects the legal certainty of the institutions that lay the groundwork for the opportunities, the feverish activity of a complex ecosystem of competitors that transform the opportunities and together seek greater transparency and the accumulation of knowledge, in the furtherence of their own interests.

Greater complexity in an economy, however, not only demands more energy, but the nature of its activities requires that access to energy be reliable and immediate at all stages of the value chain. In other words, we cannot aspire to all of the above without energy security. Much of the foregoing is expressed in the importance of natural gas in electric power generation and of the latter in the development of a highly complex economy, as shown in the following graph. Thanks to it, Mexico generates more than fifty billion dollars a year.

[15]*Atlas of Economic Complexity. Available at: http://atlas.cid.harvard.edu/learn/glossary/*

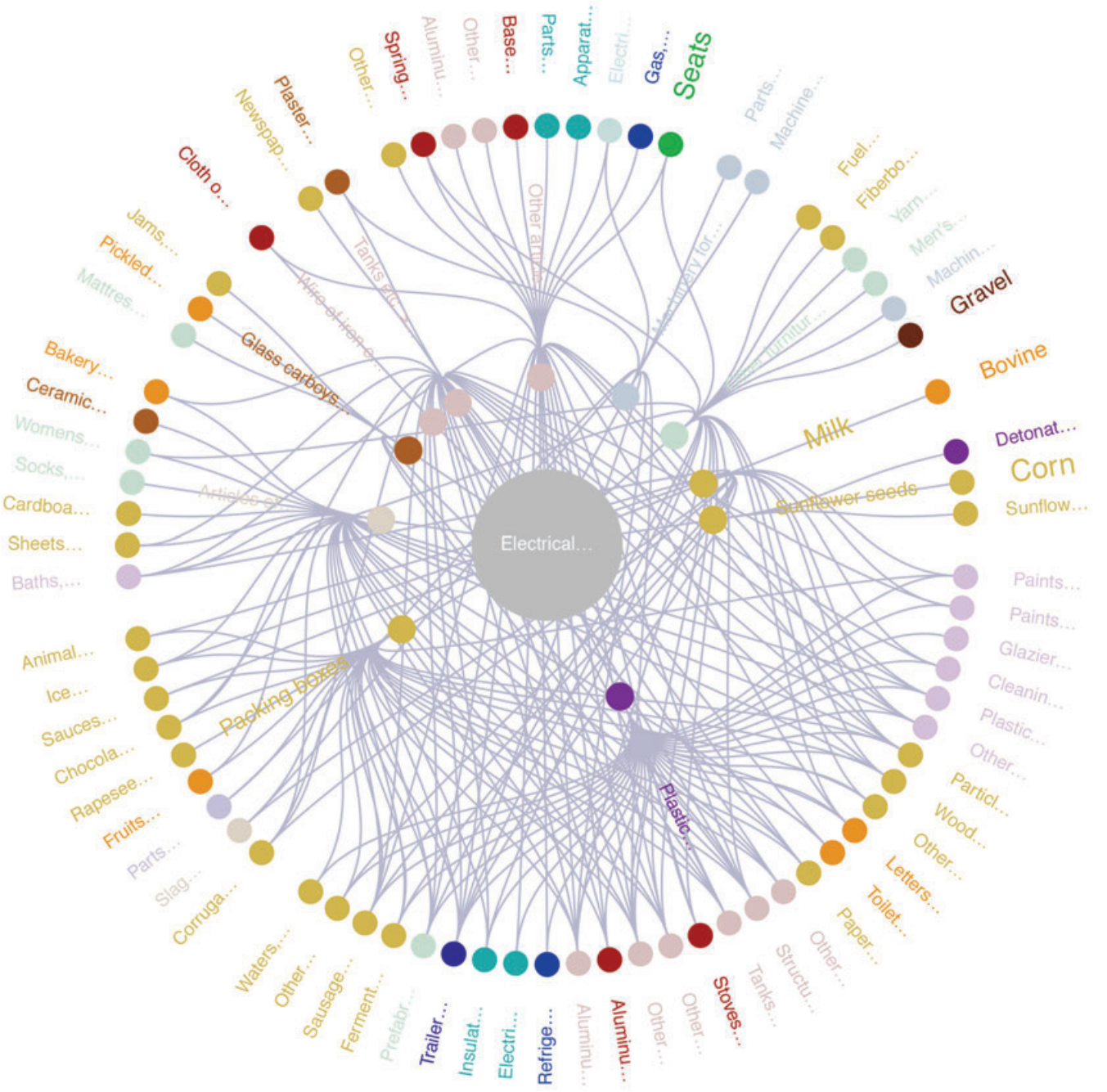
ECONOMY AND ENERGY

Greater complexity in an economy not only demands more energy, but requires that access to energy be reliable and immediate at all stages of the value chain.

FIGURE 2:

The central role of energy in Mexico's economic development

$51.4B



Energy Security in an environment of openness and competition

A few months before the Energy Reform of 2013, a study conducted by the Global Energy Institute ranked Mexico as the most energy-secure nation in the world. In fact, according to said Institute, Mexico was the country that most often ranked first in this regard over the last thirty years. At first glance, this might seem to be a success on the part of the energy model at the time, but it was actually evidence of the country's failure to generate wellbeing for the population, since according to the study, Mexico has large reserves, but very low levels of energy use per capita. In other words, if we had a high degree of energy security it was at the expense of Mexican citizens' prosperity, so as to prop up a closed system. In fact, according to the study, the conditions that had allowed Mexico to have that level of energy security —many resources and very low consumption— were rapidly changing, because Mexico was consuming more and more energy, and we were facing increasing challenges in maintaining our petroleum production platform.[16]

To put it another way, the relevance of the energy security for Mexico has increased significantly, and must be a key factor in how the energy sector is thought about and developed. First due to the increasing integration of energy value chains in the region, and second due to the increased demand for energy on the part of Mexican consumers. Mexico, in this sense, is discovering that energy security is very secure, very costly and as such finding the proper balance between energy security and cost is one of the keys to its economic prosperity.

In order to find this balance between security and prosperity, the key, as international experience shows, is to find market mechanisms that can develop the energy production, transport and storage infrastructure, complementing them with interdependence on other nations.

Closely related to the above point is that Mexico's ability to deal with shocks, in either supply or demand, has increased along with the growing number of tie-in points (electrical and hydrocarbon-related) with North America. I this sense, the energy interdependence between Mexico and the rest of the world, in particular with the United States in recent years, is what has allowed us as a nation to maintain access to energy and generate economic prosperity at the same time. In fact, without these tie in points, Mexico could hardly have managed to build its electronics, automotive or aerospace sectors.

Nor would much of the foregoing have been possible without the energy revolution that is also taking place in the rest of North America, though for other reasons. Thanks to technology, Canada and the United States have successfully developed energy resources that until recently were not technically viable. Indeed, it is an interdependence that goes both ways. Without the Mexican market, it is hard to imagine prices high enough to maintain the expansion of the natural gas market in the United States, thanks to its unconventional resources.[17]

SELF-SACRIFICING PROSPERITY

If we had a high degree of energy security it was at the expense of Mexican citizens' prosperity, so as to prop up a closed system.

[16] *https://www.globalenergyinstitute.org/sites/default/files/InternationalIndex2012.pdf*

FORMING CLUSTERS

We can achieve more solid energy integration based on developing the local economy, by forming clusters.

What is more, certainty can become consolidated, and according to Harvard University energy security expert Meghan O' Sullivan, it is possible as a planet to attain a more solid level of energy integration by developing the local economy, in other words, by forming clusters – defined as networks or groups of entities engaging in the same economic activity – that become transnational energy ecosystems.[18]

The groundwork for this to be possible is already laid, thanks to the close trade relationship between the two countries and the certainty of the flow of trade and investment provided by the North American Free Trade Agreement. As a result, the oil, natural gas and fuel industries, like the automobile, aerospace or television screen industries, operate in relation to the needs and supply of our neighbor. This is why AMEXHI, along with chambers of industry in the United States and Canada, have taken a clear position of support for the North American Free Trade Agreement as key to regional prosperity and stability.[19]

In Mexico it is widely acknowledged that the integration of the North American economies has been a significant boon to Mexican productivity, which now not only produces more goods and services, but also complex goods and services.

In short, the road to 2040 is not similar to any other road Mexico has traveled down in the past. To materialize all its potential, the country must transition from an emerging economy to a mature economy, or in other words, from a relatively simple economy to one that is significantly more complex.

SECURITY AND INTEGRATION

Against a backdrop of significant growth in energy consumption, our country must address energy security and global energy integration.

Against a backdrop of significant growth in energy consumption, our country must address, perhaps for the first time, matters of energy security and global energy integration. This requires attracting investments and players based on permanent principles, such as consistency and predictability, competition and impartiality, transparency and credibility, and focusing on an economy based on the aggregation and interconnection of knowledge.

The foundations of a sustainable Mexico

The challenges Mexico is facing in the 21st century are not just economic. We are living in an era when every economic decision must also be viewed from the perspective of its impact on social and environmental sustainability. If balancing the need for energy security and economic prosperity is a significant challenge in and of itself, when we add the sustainability variable to the equation, the challenge becomes even more relevant for building the future.

[17] *https://www.joc.com/mexico-prime-customer-us-natural-gas-producers_19921012.html*
[18] *O'Sullivan, Meghan. Windfall: How the New Energy Abundance Upends Global Politics. New York, NY: Simon & Schuster, 2017.*
[19] *AMEXHI: Position in favor of the North American Energy Alliance (August 2017). http://www.amexhi.org/noticias/amexhi-api-y-capp-presentan-postura-sobre-las-politicas-para-fortalecer-la-alianza-energetica-de-america-del-norte/ AMEXHI: Perspectives on NAFTA negotiations (November 2017). http://www.amexhi.org/noticias/seguimiento-a-perspectivas-sobre-las-negociaciones-del-tlcan/*

This is no small challenge. As we have seen, it is unthinkable to disentangle the actual relationship between economic growth and environmental and social impact. According to data from IPIE- CA (2017), an institution that represents the global energy industry in climate change discussions, the upstream sector alone must invest around 700 billion dollars per year to meet the global demand for energy. If we take into account investments in refining and transport, the petroleum industry will need to invest approximately 22.8 trillion dollars over the next 25 years.

This is particularly relevant if we take into account that in 2015, nearly 1.1 billion inhabitants had no access to electricity and 2.8 billion (41 percent of the world's population) had to meet their energy needs with solid sources of energy like wood, coal and animal dung for cooking and heating.[20] It is therefore becoming ever more important to find mechanisms and promote actions to ensure the necessary energy supply, while at the same time balancing the care and protection of the environment.

Fortunately, the New Mexican Energy Model provides our country with the essential tools to adequately respond to the country's environmental and social needs. For example, with regard to the social aspect, and as we have discussed throughout this chapter, thanks to the competition between various actors developing the industry via risk contracts, it is possible to refocus public funds on more pressing and relevant needs of the society, such as education, for example. Moreover, such contracts, over time, lead to increases in the country's execution capacity, and with it a more robust economy, with higher economic growth rates than if we had not implemented a reform. So, the public treasury then benefits from higher levels of tax collection, which in turn allow it to support the country's social priorities.

The impact is not just fiscal. The New Energy Model is laying the foundations to significantly increase the availability of energy products all over the country, with time we hope that electricity consumption per capita (an essential measurement of wellbeing) will increase in Mexico.

As such, energy is the key for attaining anything that improves wellbeing, from education, to health, access to better food or the ability to save, just to name a few. However, while in recent years Mexico and South Korea have emerged as two of the top exporters in the world and are among the more solid emerging economies, since 1971 said Asian country has been able to significantly increase its per capita electricity consumption. It should come as no surprise that in part as a result of this, South Korea has a higher penetration of information technology and ranks higher in education.

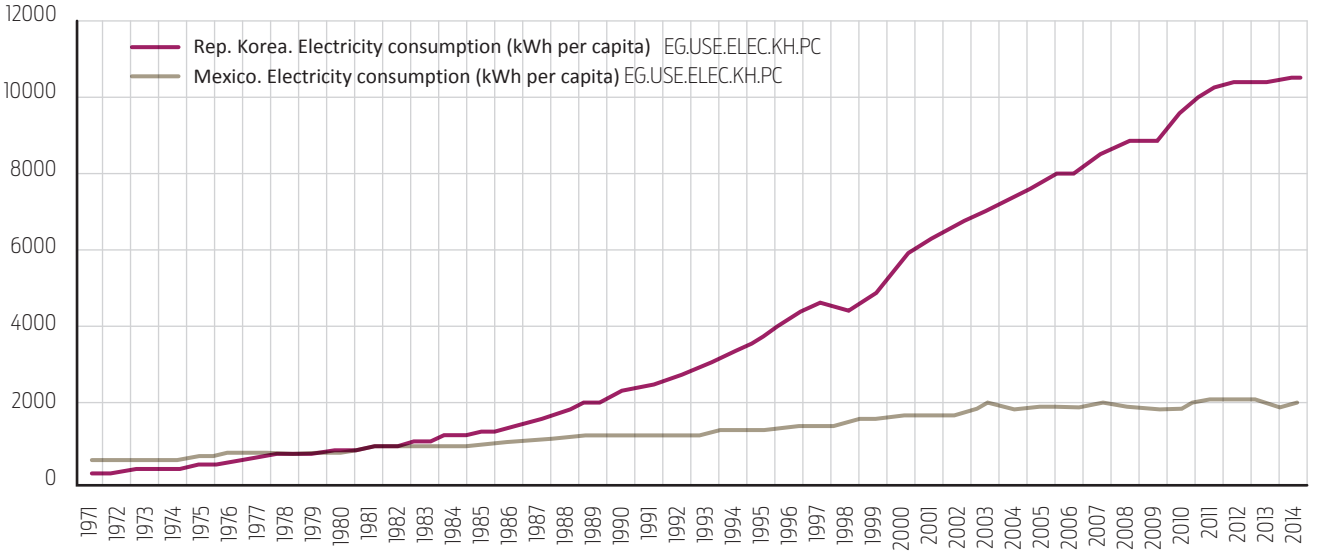
22.8

trillion dollars over the next 25 years is approximately what the petroleum industry needs to invest if we take into account investments in refining and transport.

[20] *IEPICA (2017). Mapping the oil and gas industry to the sustainable development goals: An Atlas. Taken from: http://www.ipieca.org/media/3093/mapping_og_to_sdg_atlas_lr_2017.pdf*

GRAPH 6

Per capita energy consumption 1971-2014



Source: World Bank

Another important dimension of the reform is in the public hearing processes held with indigenous populations. Here, the New Model has important dialog and interest alignment tools with which we can visualize more harmonious development between operators and their communities, although it must be noted that there is much to be done to strengthen the authorities' execution capacity and define clear rules. If this is not done, we should not be surprised to see cases of what is known as the claims industry, in which the last one to benefit are the communities.

REDUCE EMISSIONS

The New Model significantly widens the array of tools Mexico has to meet the commitments we have undertaken to reduce emissions under the Paris Agreement.

The New Mexican Energy Model is also a decisive step toward greater environmental sustainability. The reform, as we know, is the most significant effort to develop alternative sources of energy, and in recent years we have seen a significant increase in contracts signed by companies engaged in solar or wind power generation. The environmental dimension of the New Model, however, does not stop there. On the hydrocarbon side it is, in fact, particularly promising for keeping our country up to date with the great technological and economic changes that will allow us to reduce greenhouse gas emissions in the not-so-distant future.

In fact, this dual dimension of the reform and its emphasis on sustainable development, either through the adoption of alternative energies or through new technologies that increase the sustainability of hydrocarbons, it is essential to have multiple avenues to a low-carbon future. What is more, the New Model significantly expands the tools Mexico has available for compliance with the commitments we have undertaken under the Paris Agreement to reduce emissions.

Mexico has played a tremendous leadership role in this global discussion, for example at the COP 16 held in Cancun, the agreement was reached with regard to the importance of keeping the temperature increase at 2º C above pre-industrial levels. This agreement, promoted by Mexican diplomacy, laid the groundwork for the vast majority of countries of the world to ultimately undertake commitments to achieve that goal, at the COP 21 held in Paris in 2015. Mexico followed suit, undertaking unconditional commitments to reduce its greenhouse gases (GG) by 22% and its black carbon emissions by 51%. It should come as no surprise that the New Energy Model is essentially the foundation on which our country demonstrates its ability to achieve such significant goals.[21]

One salient element of the strategy is the replacement of heavy fuels with less polluting fuels, such as replacing fuel oil with natural gas in electric power generation and industrial processes. Natural gas, in combination with energy efficiency and carbon capture, are perhaps the three main tools Mexico and the world have to respond quickly and decisively in reducing emissions and meeting the commitments the nations undertook in the Paris Agreement. To put it another way, the immediate response that makes it possible to maintain prosperity and move forward to a low emissions future, necessarily involves natural gas.

The importance of natural gas as a strategic element of energy transition to the use of less polluting technologies is due to its smaller carbon footprint. According to the International Energy Agency (IEA), burning natural gas generates 40 percent less emissions than coal and 20 percent less than crude oil.

Thus, higher gas production and consumption in the world also implies lower emissions. In fact, we are already seeing the first encouraging results. Between 2014 and 2016, carbon emissions have remained practically stable, even though the global economy has grown significantly. For example, in 2016, the economy grew at a rate of over 3 percent and as we said, emissions remained stable.

This effect is largely explained by declining emissions in the United States and China, two of the largest energy consumers, and consequently also emissions generators. The largest reduction in 2016 came from the United States, where carbon emissions fell by 3 percent, or 160 million tons, while the economy of that nation grew by 1.6 percent. According to the IEA, the increase in the supply of shale gas is the primary reason for this phenomenon.

In the future, it is hoped that emissions will continue to fall as the use of gas grows. As such, the IEA has estimated that, as more effective and efficient technologies are adopted, up to 50 percent of methane emissions could be eliminated along the natural gas value chain, particularly in emerging economies.

[21] *Mexican Government, Intended Nationally Determined Contribution. https://www.gob.mx/cms/uploads/attachment/file/162973/2015_indc_ing.pdf*

GAS, THE CLEANER ONE

According to the IEA, burning natural gas generates 40 percent less emissions than coal and 20 percent less than crude oil.

LOW CARBON

Natural gas is an important avenue to a low-carbon future.

This will allow the gas industry to consolidate its position as a key element for generating greater sustainability. As such, natural gas is an important avenue to a low-carbon future.

The importance of having multiple avenues is demonstrated by the case of Europe. Although Europe has played a central role in raising awareness and fostering agreement on the importance of increasing sustainability and reducing emissions, rather than taking the multiple avenue strategy toward a low carbon future, it focused entirely on developing primarily renewable energies, via large tax subsidies. It has even gone so far as to penalize or prohibit the development of other options, such as unconventional resources, which are essential to the natural gas supply, or nuclear energy.

The results of the European model require much analysis, but the first clues are worthy of consideration. On the one hand, although Europe has reduced its emissions, it has not achieved significantly better results than the United States. This is even more relevant when we remember that the United States economy has significantly expanded during this period, and as such its demand for energy has also risen.

Upon more detailed analysis, although Europe has increased its generation of renewable energy through subsidies, it has also seen a significant increase in its consumption of coal for electric power generation. This situation is surprising, since as we have said, coal creates 40% more emissions than natural gas. The question then becomes, would Europe have achieved even better results, had it not penalized natural gas and other sources of energy?

The discussion of multiple avenues is not one that takes place solely with regard to sources of energy. Other very important and promising avenues are taking hold in the world of technology and knowledge. In other words, it is not just important what source of energy is produced, but above all, how it is consumed. Carbon capture and sequestration is a particularly relevant technology for building a low-emission future.

LOW-EMISSION FUTURE

It does not matter what energy source is produced, but rather how it is consumed. Carbon capture and sequestration is a particularly relevant technology for a low-emission future.

This technology not only limits the emission of pollutants, but above all actively reduces emissions, potentially to zero. In this regard, carbon capture and sequestration (CCS) is widely recognized as an essential technology for building the future.

According to Nicholas Stern, Chair of the Grantham Research Institute on Climate Change and the Environment of the London School of Economics and Political Science, “most serious analyses have concluded that it will be very difficult to achieve the Paris goals without carbon capture and storage or use.” Before his current post, Stern played a vital role in Great Britain that included the development of a study, the Stern Report, which analyzed the impact of climate change on the economy.

The subject is of vital importance. The Intergovernmental Panel on Climate Change (IPCC), the group of scientists that, under the auspices of the United Nations, has

analyzed the causes and solutions to climate change – receiving the Nobel Peace Prize for their efforts in 2007 – has concluded that without carbon capture and sequestration technology, meeting emissions reduction targets would be approximately twice as expensive.[22] In this regard, the International Energy Agency has estimated that without this technology, the energy transition would cost 3.5 trillion dollars more.

Here is an important avenue for creating a low-carbon future, but it will require significant investment. A report on the process of implementing this technology at the global level, called *Global Status of CCS:* 2017, explains that we must go from the 17 facilities that currently have this technology, and another four that are starting up operations in 2018, to a total of 2000 facilities by the year 2040. This means that carbon capture and sequestration technology could mitigate 14% of total carbon emissions.[23] To place this in context, the 21 facilities that will be operating by the end of 2018 will be capturing the carbon emissions equal to 8 million automobiles per year. This is 160% of all the emissions generated by automobiles in Mexico City.

In fact, it is possible to imagine a future in which this technology, in conjunction with others, could lead to a zero emissions scenario. For example, CO2 emissions of anthropogenic origin can be balanced to zero if energy systems are configured in which carbon is actively captured from fossil fuels, along with the same capture in processes involving biomass.[24]

CLEAN FUTURE

It is possible to imagine a future in which technology can lead us to a zero-emission scenario.

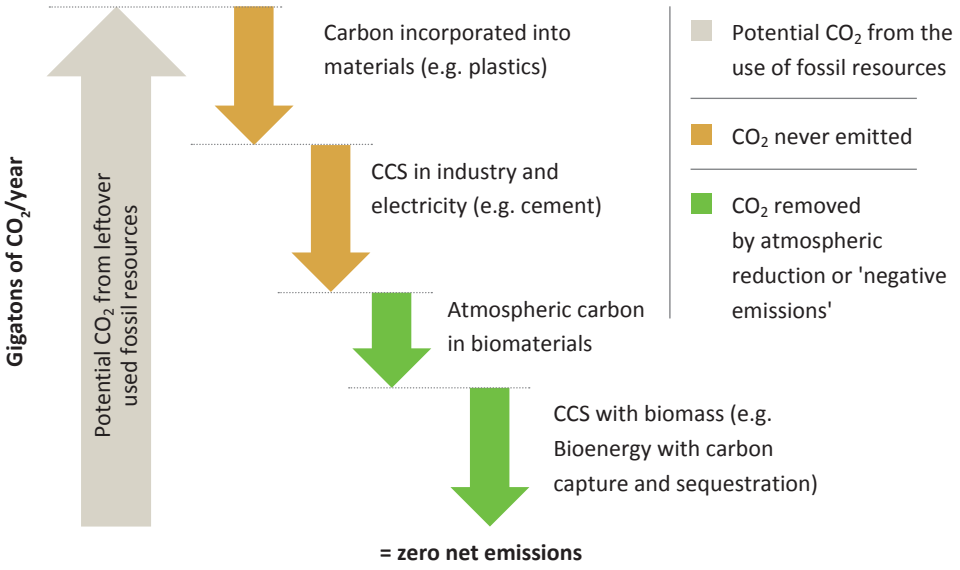
Zero net emissions

An example of zero net emissions with carbon captured in biomass and geologically stored[3]

This diagram shows how a balance of anthropogenic emissions could be reached in a conceptual scenario.

The configuration of the energy system with fossil fuel and biomass results in zero net CO_2 emissions.

NB: although zero emissions technologies will play a role in this scenario, they do not affect the balance of emissions and as such, are not reflected in the graph.



[22] *The Paris Puzzle. Pathways to a low emissions future. IPIECA, 2017, p.6 http://www.ipieca.org/resources/fact-sheet/the-paris-puzzle-the-pathway-to-a-low-emissions-future/*
[23] *The Global Status of CCS: 2017. http://www.globalccsinstitute.com/sites/www.globalccsinstitute.com/files/uploads/global-status/1-0_4529_CCS_Global_Status_Book_layout-WAW_spreads.pdf*
[24] *https://www.shell.com/energy-and-innovation/the-energy-future/scenarios/a-better-life-with-a-healthy-planet.html*

PRIVATE SECTOR

The private sector created by the New Energy Model is a key ally for the country in building a sustainable future, in which, via contracts awarded in auctions and competitive bidding processes, many avenues can be built to a low-emissions future.

As we have already discussed, this avenue, like all the others, will require significant investment in addition to what energy generation already requires for the security and prosperity of any nation. As such, if developing energy was already a costly and risky endeavor, when we add the variable of sustainability, the costs of such investments are even higher. But there is generalized consensus over practically the entire world as to the importance of acting, and countries like Mexico that send clear signals of consistency, and have effective competition mechanisms, are in a better position to benefit from these emerging technologies.

In this area, the private sector created by the New Energy Model is a key ally for the country in building a sustainable future, in which, via contracts awarded in auctions and competitive bidding processes, many avenues can be built to a low-emissions future. This is how we are now seeing record investment in renewable energies and we are taking the critical steps to attract leading edge technologies, such as those associated with carbon capture.

We have done well so far. It was thanks to this effort that our electric power plants and industry have gone from using heavy, more polluting fuels to the widespread adoption of natural gas. In fact, while electric power generation doubled between 1990 and 2013, the economy's total emissions (electricity and all others) only rose by 49.2%.[25] The reason for this is that the majority of investments made in electric power generation were based on natural gas, instead of fuel oil. In the future we can expect even more, as the New Energy Model continues to bear fruit.

POSITIVE EFFECTS

One area in which we are sure to see significant positive effects in emissions reduction is in the fuel market. Mexico has taken important steps to dismantle many of the subsidies that had toxic effects on the environment.

Up to this point we have reviewed the role of energy sources (such as natural gas) and technologies (such as carbon capture and sequestration) in building many avenues to a low-emissions future; but the road to sustainability, in addition to technologies and sources of energy, needs public policy that aligns with the interests of producers and consumers, in the interest of more rational resource management.

One area in which we are sure to see significant positive effects in emissions reduction is in the fuel market. Here, Mexico has taken important steps to dismantle many of the subsidies that had toxic effects on the environment. For nearly a decade, this public policy has led to gasoline and other fuel prices increasingly reflecting actual market prices and it is now the foundation on which we will build a low-carbon future, thanks to energy efficiency.

Mexico has reduced its greenhouse gas emissions. This is reflected in the fact that we are the eleventh largest economy in the world and in terms of emissions we rank 13th. We are responsible for barely 1.6 percent of global energy emissions. However,

[25] *Mexican Government, First Biennial Update Report to the United Nations Framework Convention on Climate Change, 2015. http://unfccc.int/resource/docs/natc/mexbur1.pdf*
Greenhouse Gas Emissions in Mexico, 2015. https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_GHG%20Emissions%20Factsheet_Mexico_0.pdf

Mexico now represents

25%

of all greenhouse gas emissions in all of Latin America. According to Mexican government data, in 2006, 61 percent of these emissions came from energy generation and consumption. Of all emissions created by the use of energy, 62 percent were from transportation.

PHOTOGRAPH: DREAMSTIME

SUSTAINABLE MODEL

The new Mexican Energy Model has created very valuable tools with which to build a more sustainable future. The bidding processes and the five year plan help to better project and prepare conditions for sustainability.

Mexico already represents 25% of the emissions of all of Latin America, and given that it is a developing country with medium-high levels of income, according to the World Bank, its share of global emissions is likely to continue to rise. In fact, according to Mexican government data, in 2006, 61 percent of these emissions came from energy generation and consumption, and of all the emissions created by the use of energy, 62 percent were from transportation, 10 percent from household use, both of which were heavily subsidized at that time.[26]

The gradual process of eliminating the subsidies is having an impact on costs, a situation that as consumers we have resented, but which is helping us to be more conscious of our energy consumption. This situation is also leading fuel suppliers in Mexico to increase their product offering, and of additives in particular, which help improve engine performance and reduce emissions. Similarly, automobile manufacturers are placing increasing emphasis on their offering of vehicles that get more miles to the gallon.

In this sense, the New Energy Model is giving Mexico a series of very important tools for building a more sustainable future. First, the tools related to consistency, such as the bidding processes and five-year plan, which help to better project and prepare the conditions for sustainability. The contract, for their part, which are the centerpiece in the creation of an ecosystem of competitors, play a key role in attracting emissions-reducing technologies.

SUSTAINABILITY TO BETTER COMPETE

The focus on knowledge is allowing an ever-increasing number of Mexicans to focus on achieving sustainability goals and making it an important global competitiveness parameter for the country.

The focus on knowledge has allowed us to enter an ever-larger world of Mexicans with diverse ideas and proposals for achieving sustainability goals. On the other hand, sustainability itself can become an important global competitiveness parameter for the country.

In other words, in addition to sources of energy, technologies and public policies, a true commitment to sustainability, in the broadest sense, is represented by the adoption of best practices. These practices are closely linked to the industry's transparency goals and those of the New Energy Model.

In fact, given that the energy sector has a considerable impact on the environment, oil companies are subjected to closer scrutiny than almost any other industry. This is why Environmental, Health and Safety (EHS) standards to which energy companies must adhere are significantly more rigorous than those of other industries or sectors. In fact, it is worth noting that these practices arose out of the petroleum industry and have been increasingly adopted by other industries.

The result is that matters of sustainability, and above all, the actions and mechanisms to be used to promote sustainable economic development, are now a fundamental part

[26] *United Mexican States: Reducing Fuel Subsidies. Public Policy Options. World Bank. 2013. https://openknowledge.worldbank.org/bitstream/handle/10986/21755/ACS37840P1129500use0only0900A9R29E6.pdf?sequence=1&isAllowed=y*

of the planning processes of oil companies and their projects. In fact, the global petroleum industry now makes important efforts in the area of sustainability, including: economic development, local content and technology transfer, support and commitment to the communities, anti-corruption measures, in addition to the environmental protection and greenhouse gas reduction efforts that we have described with some examples.

The 17 UN Sustainable Development Goals

This effort is in line with the 17 Sustainable Development Goals for 2030 (SDG) established by the United Nations. In other words, the industry's focus on sustainability reflects the importance of providing available, progressively cleaner energy, of having an economy that generates prosperity while at the same time reduces emissions and helps to tackle the challenges of climate change, in addition to representing a clear commitment to the development of the communities.

According to the International Institute for the Environment and Development (IIED), some companies in the energy sector are considered leaders in the area of corporate social responsibility (CSR), one of the must frequent parameters for measuring the performance of oil companies in taking actions that involve the communities and decrease their impact on the environment.

In this regard, there are various international organizations and agencies that are committed to ensuring that more and more companies in the oil and gas sector report their progress in the areas of sustainability, including IPIECA (International Petroleum Industry Environmental Conservation), the American Petroleum Institute (API), the IOGP and in our country, AMEXHI seeks to serve a similar function. In fact, AMEXHI maintains a

SOCIAL RESPONSIBILITY

According to the International Institute for the Environment and Development (IIED), some companies in the energy sector are considered leaders in the area of corporate social responsibility.

GLOBAL EFFORT

AMEXHI participates with IPIECA, API and IOGP in a global effort to generate best practices and sustainability environments.

close relationship with these institutions, and participates with IPIECA, API and IOGP in a global effort to generate best practices and sustainability environments.

There are also several initiatives focused on certain areas, such as climate change, in which the Oil and Gas Climate Initiative (OGCI), consisting of the 10 largest oil companies in the world, including Pemex, has positioned itself as a relevant platform in which its members can look for synergies to reduce greenhouse gases through new business models and technologies.

This initiative, in concordance with the Paris Agreement, announced that it would invest one billion dollars in energy efficiency and technology to accelerate carbon capture and storage. Moreover, several leading companies in the industry are making significant investments in sustainable technologies that give them a competitive advantage in this 21st century, either focusing on ways to increase efficiency, retaking solar or wind energy portfolios, developing commercial carbon capture solutions or investing in advanced biofuel solutions.

In fact, the energy sector trails only the financial services sector in its level of participation in the Global Reporting Initiative (GRI). This same study evaluated the sustainability reports of a group of oil companies and concluded that in general the sector is at a medium/medium high level of maturity on the Lowell scale, which assesses the maturity of EHS systems.[28]

SUSTAINABLE TECHNOLOGIES

Several of the leading companies in the industry are making significant investments in technologies that will give them a competitive advantage in the 21st century.

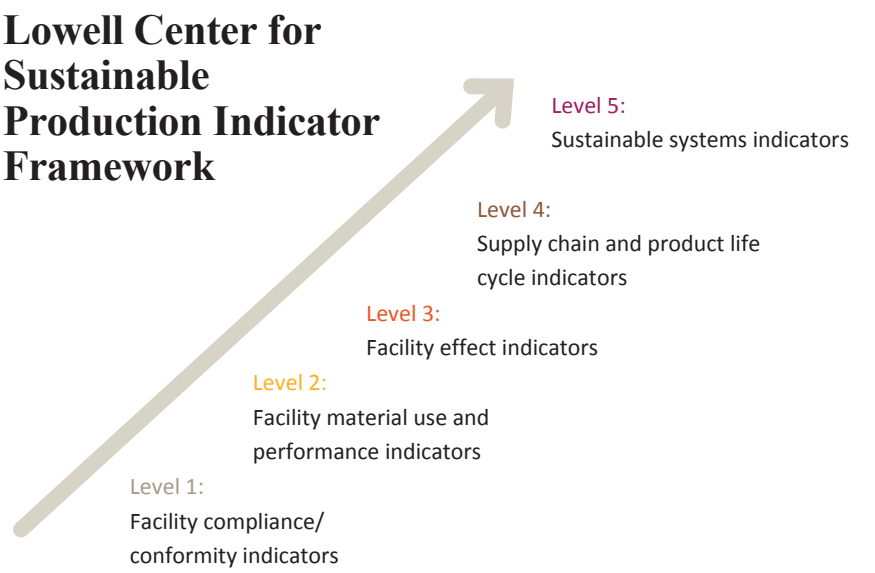


Figure 1: Lowell Center for Sustainable Production Indicator Framework

[27] *OGCI (2017). Catalyst for change. Collaboration to realize the energy transition. Taken from: http://oilandgasclimateinitiative.com/wp-content/uploads/2017/10/OGCI-2017-Report.pdf*

[28] *Schneider, J., et al (2013) "Towards Sustainability in the Oil and Gas Sector: Benchmarking of Environmental, Health, and Safety Efforts," Journal of Environmental Sustainability: Vol. 3: Iss. 3, Article 6. Taken from: http://scholarworks.rit.edu/cgi/viewcontent.cgi?article=1028&context=jes*

According to IPIECA, sustainability reports —which include corporate citizenship, social, environmental and governance (ESG) reports—are important tools for the sector to get involved with various actors and encourage an informed dialog on the sustainability goals to be reached. In fact IPIECA publishes a guide for the oil and gas industry that helps companies report their sustainability goals and targets.[29]

Sustainability Actions

Principal sustainability and climate change actions performed by the petroleum industry

- Increase energy efficiency improvement processes for petroleum operation and production (improve energy use using systems such as cogeneration, reducing the volume of contaminating emissions from burning and venting natural gas, increasing exploitation of hydrocarbon production via enhanced recovery and secondary recovery processes).
- Develop carbon capture and storage technology (CCS).
- Investment in and development of second-generation biofuels
- Promote the use of fuels with lower carbon content and less impact on the environment (transition to natural gas).

Although reporting the goals and actions is voluntary, the guide represents a consensus among the industry on the most relevant facts and indicators (environment, health and safety, and other important social and economic topics) in matters of sustainability. The IPIECA seeks to provide ongoing support for improving sustainability and its performance in the sector.

Thus, after the contracts are signed and the decision is made to invest in an exploration and production project, a company must also automatically consider a number of assets that will impact the development of infrastructure projects that include a significant deployment of resources for the development of infrastructure, technology, community support and above all, EHS standards.

In this regard, the sector evaluates and continuously seeks new alternatives and opportunities to cover the world's growing demand for energy, while mitigating the adverse impacts of the projects it develops and investing in research to find solutions to climate change risks.

For example, in conjunction with the United Nations Development Program (UNDP), the International Finance Corporation (IFC) and IPIECA, the industry has developed an Atlas that seeks to find synergies and spaces in which the global petroleum industry can collaborate more efficiently in pursuit of the UN 17. Although the goal of meeting the objectives has the year 2030 as a timeframe, many of the practices and actions that this Atlas suggests are designed for the even longer term.

MITIGATING IMPACT

The sector evaluates and continuously seeks new alternatives and opportunities to cover the world's growing demand for energy, while mitigating the adverse impacts of the projects it develops and investing in research to find solutions to climate change risks.

[29] *IPIECA (2015). Oil and gas industry guidance on voluntary sustainability reporting. Taken from: http://www.ipieca.org/media/2849/og_industry_guidance_on_voluntary_sustainability_reportnig_3rd_ed_2016.pdf*

TRANSPARENCY VS. CORRUPTION

Transparency is an important tool for combating corruption, which widens the inequality gap and is linked to higher levels of poverty, infant mortality, low levels of education and gender inequality.

LAWS THAT PROMOTE TRANSPARENCY

In recent years we have seen considerable progress around the world in the implementation of standards and laws establishing transparency parameters for extractive industries, particularly in natural resource-rich countries.

A fundamental part of the Atlas is to find ways to mitigate climate change and propose actions that help to reach net zero emissions, so as to stabilize the concentration of greenhouse gases in the atmosphere and the global temperature, in line with the objectives posed in the Paris Agreement of 2016.

The Atlas illustrates how the oil and gas industry can effectively contribute to compliance with the UN 17, but above all, its purpose is to promote dialog and raise awareness about how the petroleum industry can help (individually and as a group) governments, communities, the civil society and other actors, to meet said goals.[30]

Although the Atlas explicitly outlines how the petroleum industry can help meet all the UN 17—given their interdependence—goals 7 and 13 specifically mention clean and accessible sources of energy and climate change, respectively. As such, the industry helps to meet these objectives both directly and indirectly, from the creation of jobs, providing energy for economic and social development, developing technology and investment for research and development, long-term social and economic investment in the communities in which the projects are developed and properly managing the impact of the extractive projects by adhering to strict EHS standards.

Transparency and sustainability

Though mentioned in other sections of this document and considered to be one of the essential pillars for the future of the New Mexican Energy Model, transparency is also a key aspect of sustainable social development. Be it via the publication of government contracts, the live broadcast of bidding rounds for oil contracts or the reporting of income and contracts with State-owned enterprises, creating and preserving an atmosphere of transparency is a fundamental aspect of how the sector reports progress in the area of sustainability.

Moreover, transparency is an important tool for combating corruption, which widens the inequality gap and is linked to higher levels of poverty, infant mortality, low levels of education and gender inequality. Sustainability faces the greatest challenges in poor environments, or turning it around, one of the most effective tools to build sustainability is to build prosperity.

Collectively, in recent years, we have seen considerable progress around the world in the implementation of standards and laws establishing transparency parameters for extractive industries, particularly in countries that are rich in natural resources. As we

IEPICA (2017). Mapping the oil and gas industry to the sustainable development goals: An Atlas. Taken from: http://www.ipieca.org/media/3093/mapping_og_to_sdg_atlas_lr_2017.pdf

Industry Conflicts

List/Table of the principal conflicts faced by the petroleum industry:

- Regulatory sensitivity
- Environmental risks
- Industrial health and safety
- Social sensitivity/impact on communities
- Corporate responsibility/ CSV

have said, the primary mechanism in the world is the Extractive Industry Transparency Initiative (EITI), created by countries with oil and mining industries so that the data on the income obtained from these activities could be made public. In the case of Mexico, its recent entry into this organization will make it possible to monitor the government's use of the resources obtained from the oil and gas industry, thereby promoting the improved regulation of the industry, and its assistance in the creation of sustainability reports.

In summarizing the challenges Mexico will face in the near future, we discover that they may be the most significant challenges we have faced in our entire history. We have before us a great demographic transition, profound technological revolution and pressing social and environmental concerns. Inevitably, the challenges of energy security, economic prosperity and sustainability will become larger every day, and given how quickly they change, will likely be very uncertain.

Mexico will need clear political principles, flexibility in implementing them, and a significant increase in financing costs and technological solutions. Fortunately, if used correctly, the New Energy Model can provide Mexico with the tools, processes and principles that will make it possible to build a secure, prosperous and sustainable 21st century.

MONITORING OF RESOURCES OBTAINED

Mexico's recent entry into the Extractive Industry Transparency Initiative (EITI) will make it possible to monitor the government's use of the resources obtained from the oil and gas industry.

PHOTO: ISTOCKPHOTO

05

Agenda 2040: Vision and proposals for the future

As we have seen in the previous chapter, the challenges ahead for Mexico in the coming years are perhaps the greatest challenges Mexico has ever faced. In the next 25 years, the country has the opportunity to finally become a fair, just, generous, sustainable and prosperous nation. A maturing society and economy, in addition to the emerging rapid technological transformation, are creating the potential conditions for it. However, these are no small challenges. We have far to go, and it is no secret that the Mexican population is beginning to age.

Success in the coming years will depend on our ability to design a better future, in which the economy, including the energy sector, is more complex. To the extent that Mexico can generate certainty and prospects for the future—through a solid focus on consistency, competition, transparency and a commitment to knowledge—it will have laid the groundwork for processes that are increasingly dynamic and transforming.

Thus, it is critical that we promote discussion on how to continue to improve our energy sector. It is this understanding of the multiplicity of visions and perspectives on the economy and energy that was the starting point for AMEXHI to survey not only its 50 members, but also a series of independent experts on their predictions and proposals for the Mexican energy sector as we approach the year 2040. Over four months of discussion and multiple individual interviews, they shared their vision of the Mexican energy sector they imagined and would like to see in 2040, as well as their concrete proposals for achieving it.

This multidisciplinary dialog revealed many points of agreement and also some differences of opinion. As such, the dialog revealed a sense of common purpose on the part of a broad segment of energy experts. This being said, our survey did not cover all experts. A country such as Mexico, with such a rich history in the oil industry, by definition has a very large group of experts.

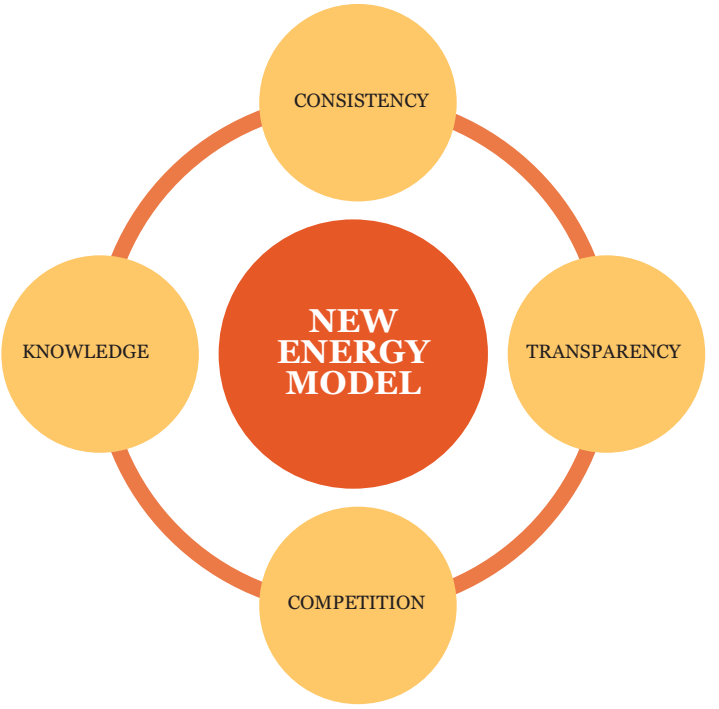
STARTING POINT

AMEXHI seeks to be a starting point for brainstorming. There is much more to discuss, and we hope that the proposals described below will be expanded upon in the future.

Moreover, in recent years the broad, rich debate in our sector has fortunately led to significantly increased interest in energy. This growing group, with diverse perspectives and specialties will certainly continue to refine the thinking and the design of our energy future. It is in this context that the discussion promoted by AMEXHI, far from being the last word on the subject, seeks to be the starting point for further brainstorming. There is much more to discuss, and we hope that the proposals described below will be expanded upon in the future.

The agreement with regard to the visions and proposals in general had to do with the application of a set of principles, that from the outset have guided the conception and implementation of the New Mexican Energy Model: competition and impartiality, transparency and credibility, knowledge and vision for the future.

These principles, despite being clear, are sufficiently relevant and general that they may be expected to remain important in the national energy conversation over the next 22 years.



To summarize the vision and proposals, it was concluded that the four cardinal points to which the New Mexican Energy Model must be oriented are: Consistency, Competition, Transparency and Knowledge. Moreover, we have collected a series of proposals that may help in the process of solidifying our institutions, ecosystem of competitors, international competitiveness of the country and building a knowledge economy.

We shall explain the four principles in the following pages. After that, we will describe the proposals regarding which there was the most consensus, grouping them into four large spheres of action: solidifying the institutional framework, building an ecosystem of competitors, leveraging the country's international competitiveness and consolidating a knowledge economy. Lastly, we will highlight ten such proposals that warrant particular attention.

In each specific proposal, we can observe how the direct or indirect application of this set of principles, according to the experts consulted, aligns with growth, while deviation from said principles leads to lost opportunity. It is very important to state that with regard to adopting these principles, which implies broad acceptance of the spirit of the New Mexican Energy Model, the experts were in full agreement.

First principle: Consistency and predictability

In the petroleum industry, the sources of volatility and economic uncertainty are many, ranging from exploration risk to the prices of energy products. Although there are mechanisms for mitigating the risks, such as the diversification of the investment portfolio and price insurance, the ups and downs are inevitable. This is true despite the fact that the demand for oil and gas products is relatively constant, since access to reliable energy is always needed. This being the case, petroleum companies often have to produce hydrocarbons under economically adverse conditions, since without them, the economy would be paralyzed.

Apart from the interconnection with the global energy system, the processes in an energy model provide two very necessary elements for an industry with so much uncertainty to be able to generate stable results: consistency and predictability. If these two elements are given priority—from the creation of new regulations to the pace of implementing the bidding rounds—this can mitigate the costs of the uncertainty, generate important competitive advantages for a country, and attract more investment. An erratic and unpredictable system, however, results in the loss of opportunities, higher costs and loss of dynamism in the economy.

Let us take the bidding rounds as an example: on the one hand, it is common for more advanced and competitive energy systems to have annual bidding rounds, on well understood dates and with similar rules, regardless of the behavior of the price of oil. Nations with less advanced systems, in contrast, frequently have a lot of uncertainty with regard to the dates and content for the rounds, and their calenders tend to suffer considerable delays. In such cases, annual bidding rounds are hard to imagine.

Let us first consider it from the economic perspective. Hydrocarbons, as with other raw materials, are developed in cycles, in which periods of high prices are followed by periods of low prices. This cyclical nature makes it essential to find mechanisms to reduce its effect, for example, on employment or investment. Thus, countries that hold annual rounds reduce the negative impacts of divestment and unemployment when prices fall, while those countries whose rounds are more sporadic tend to intensify the positive and negative aspects of each cycle, creating profound continuity problems for their energy sectors.

This is not only expressed as investment/divestment or employment/unemployment shocks. The main problem is that these uncertainties destroy knowledge.

Whereas those countries that have consistency encourage the creation of groups of experts that analyze the subsurface continuously, learning, studying and identifying opportunities—such as happens, for example, in the North Sea or the US side of the Gulf of Mexico—such teams cannot be maintained when the bidding processes are uncertain. Oil companies simply do not have enough people to wait until the seismic

GLOBAL CONNECTION

Apart from the interconnection with the global energy system, the processes in an energy model provide two very necessary elements: consistency and predictability.

SOLIDIFYING COMPETITION

If we can solidify a competitive system, Mexico will be in a better position to deal with future price cycles, whenever they may occur.

data is available or a bidding round is held on which to focus their efforts. The talented geologists, engineers and scientists end up being transferred to other more urgent projects and with that, much of the knowledge dissipates. Consistency is therefore essential for data aggregation and the creation of complex economies whose growth is based on knowledge.

In the last three years, Mexico has made a lot of progress in adopting a predictable system of bidding rounds and calendars, and has established this as a short-term goal. We have not yet achieved the regularity of other OECD countries, but if we continue to make progress in this direction, very soon the country will have periodic and predictable bidding rounds that become powerful knowledge-building tools.

A similar phenomenon occurs when a country depends on a single company and its financial capacity in a given year completely determines the pace of activities. Every time there is a price drop or financial squeeze, efforts dissipate, experts retire and data is disaggregated and knowledge is lost.

This is one of the reasons why competitive systems that bring multiple participants together achieve better results. The recent years when prices have been low under the New Model, based on competition, have borne this out, since exploration activity has not slowed, in fact it is breaking records. An example of this is the seismic acquisition and reprocessing, but given how recent the opening took place, this is not yet occurring in production. If we can solidify a competitive system, Mexico will be in a better position to deal with future price cycles, whenever they may occur.

From the dialogs and conversations held in the creation of this study, it became clear that the principal elements that provide consistency and predictability can, in turn, be divided into three: consistent vision, consistent interpretation (legal certainty) and consistent processes.

Consistent vision

CONSTRUCTIVE CONSISTENCY

The goal is that, over the years, the vision will be consistent and the efforts made at one time can be reused at a later date to keep building.

Under the Organic Law of the Federal Government, it is the responsibility of the Ministry of Energy (SENER) to establish, conduct and coordinate the country's energy policy; however, to be an authentic vision, it must be consistent over time.

The legal framework supporting the Mexican energy sector clearly establishes the spirit and the general aims under which the energy policy must be implemented. In general terms, given that the characteristics of a country's economy and its needs remain relatively stable, objective economic criteria must be used. The goal is that the vision remains consistent over the years and the efforts made at one time can be reused at a later date to keep building.

Taken to the extreme, an inconsistent energy policy vision paralyzes investment.

Consistent interpretation

Competitive economic activities are necessarily based on multiple perspectives. However, the rules and criteria that define the system must be clear and interpreted in a consistent manner. Then, competition is vital for investment to be efficiently deployed, without generating costly distortions in the market.

In the energy sector, legal certainty means the adherence on the part of the State and economic agents to the laws governing national energy policy, the operation of the sector and the administration of the contracts between private parties and the State, and between the State-owned Production Company (Pemex) and private parties.

A system of checks and balances among institutions, such as those adopted by the New Mexican Energy Model, favors the option that objective criteria will be used to interpret the legal framework rather than individual considerations.

Consistent processes

Companies in the global petroleum industry frequently compare the competitiveness of the opportunities offered by each country. This means they must conduct complex analyses ranging from the geological potential and risk to the estimated production costs and fiscal and legal terms of each country. In order for one of the opportunities offered to attract the greatest possible number of competitors, the energy model must follow standardized processes, with predictable execution times.

In this sense, Mexico has several tools with which to create a predictable and consistent model in the implementation of its public policy. On the one hand, the Five Year Exploration and Production Plan and its annual updates—not just as a document containing guidelines but also as a public policy creation process—is an essential element of the New Mexican Energy Model to get an idea of the opportunities Mexico offers in exploration and production of new reservoirs. On the other hand, the public hearing on new regulations is another tool for ensuring the consistency of the energy model over the long term.

In this constructive process, clear and simple administrative paperwork must be given the priority it demands. Discretionary rules and redundant administrative processes are undesirable elements in a predictable model.

OBJECTIVE CRITERIA

A system of checks and balances among institutions favors the option that objective criteria will be used to interpret the legal framework rather than individual considerations.

COLLECTIVE EFFICIENCY

Our country now has various actors that are independent from the federal government with the capacity to increase the investment, diversify risk and create collective efficiency parameters in the pursuit of their own interests

VALUE INCENTIVES

The more the rules generate incentives so that the successful bidders are those that offer the most value added, the more competition there will be.

Second principle: Competition and impartiality

Under a closed model, in which the number of participants in an economic activity is frequently no more than one, competition and the need for impartiality in determining the successful bidder in competitive bidding processes, if any, are useless.

Moreover, in an environment in which the government itself determined the amount and scope of the investment in the industry, Mexico was able to ignore the competitiveness of its sector, in relation to the opportunities the rest of the world offered.

The New Mexican Energy Model allows all actors to compete on the same footing. Thus, our country now has various actors that are independent from the federal government with the capacity to increase the investment, diversify risk and create collective efficiency parameters in the pursuit of their own interests.

This means that no participant should be arbitrarily favored or placed at a disadvantage, either via rules regarding exclusion/inclusion or other criteria that skew the results in a certain direction. In simple terms, no company should be discriminated against for any reason but its ability to execute specific projects and its appetite for risk.

The more the rules generate incentives so that the successful bidders are those that offer the most value added, the more competition there will be. This is the only way that the forces of competition can be used to generate productive innovation and not just to capture value under the existing rules.

At another level of aggregation, the Mexican State has retained its full authority to direct investments to the Mexican energy sector through the State-Owned Production Companies which, with regard to service contracts, must be governed by the same principles of competition and impartiality. The additional investment that the New Mexican Energy Model facilitated, through companies other than Pemex, tends to respond to trade competitiveness criteria.

Generating access to competitive opportunities is essential for the model to work properly. Thus, opportunities that offer similar levels of profitability to what the rest of the world offers will be more likely to attract investors to convert them into productive projects than those that do not.

In any case, the rules must be clear, and as the previous principle explained, interpreted consistently. That is what we have seen in recent years. The results are beginning to be felt, since Mexico has gone from a single company trying to do everything in the hydrocarbons sector, and another company with similar responsibility in the electric power generation sector, to dozens and dozens of companies—most of them Mexican—which has helped to develop energy in Mexico all long the value chain. These companies have made investment commitments and injected technology at levels never before seen by our energy sector at any time during the last 130 years.

Mexico has gone from a single company trying to do everything in the hydrocarbons sector, and another company with similar responsibility in the electric power generation sector, to dozens and dozens of companies—most of them Mexican—helping to develop energy in Mexico all long the value chain.

PHOTOGRAPHY: CORTESÍA NUVOIL

TRANSPARENCY AND ACCOUNTABILITY

AMEXHI joined Mexico's effort to become a part of the Extractive Industry Transparency Initiative, to promote transparency and accountability.

Third principle: Transparency and accountability

One of the most important virtues of the New Mexican Energy Model is that the energy policy is accessible to the entire population, in other words, transparency is a key element.

Transparency ensures that the information can be consulted by the industry and by citizens. Every report can be verified, as can any payment made to the government and any contract award in a bidding process. For example, it guarantees access to accurate information on the economic agents that are conducting exploration and extraction activities (their technical capabilities, risk factors, prior experience and reputation in the industry), the income obtained from the petroleum activity and where it is allocated; the decision made by regulatory bodies (permits, authorizations and penalties, measurement methodologies, statistics and development commitments, among others).

The accountability that transparency enables is also interconnected with the other principles: it makes the actions of institutions predictable based on legal certainty which indicates duties, establishes targets, prevents abuses and makes sure the procedures by which any daily task is accomplished remain within established parameters.

Apart from the formal transparency mechanisms that the New Mexican Energy Model created, which we described in Chapter 2, we must create an open and transparent dialog with various sectors of the population to inform them of policies, regulations and results. Thus AMEXHI has joined Mexico's effort to join the Extractive Industry Transparency Initiative (EITI). Through it, authorities, investors and the civil society disclose their information and compare it, so as to verify that the payments made or costs incurred by the sector are known by the society.

TRANSPARENT DIALOG

In order for the sector to retain the legitimacy that the dialog and consensus processes have given it, it is important to foster dialog and promote policies that continue to prioritize transparency and accountability based on factual and accurate information.

In order for the sector to retain the legitimacy that the dialog and consensus processes have given it, it is important to foster dialog and promote policies that continue to prioritize transparency and accountability based on factual and accurate information.

Fourth principle: Knowledge economy

The energy sector has great potential as a promoter of a knowledge economy. Without energy it would be impossible to have education, since the basic elements to support schools and universities, and to run computers, libraries or databases, would be lacking. Moreover, on the threshold of the Fourth Industrial Revolution, it is only possible to connect the digital and analog worlds via energy. Lastly, for a country like Mexico, with a rapidly changing population pyramid on the horizon, it is only by deepening our knowledge that we can be a relevant player in the 21st century.

The Energy Reform is a knowledge-based reform. It involves attracting, via the New Mexican Energy Model, the knowledge and technology of the entire world to benefit the development of our energy sector, and thus our economy and society.

This has been of central importance in the current transformation. The opening of the sector has been accompanied by a significant investment in educational programs, chairs of excellence, scholarships, internships and research stays. One need only glance at the reports by CONACYT-SENER and CFE-CONACYT to get an idea of the effort currently being made, or the various advanced laboratories created by the Mexican Petroleum Institute (IMP) and the new energy studies programs at public and private universities.

Mexico had not seen such a decisive drive for energy knowledge since the nineteen sixties when Jesús Reyes Heroles promoted the creation of the IMP and led Pemex to conduct offshore explorations. The difference is that now there are multiple academic and research institutions, in addition to companies, who are developing knowledge. An example of this is the impressive collection of seismic data developed by the National Hydrocarbons Information Center, a body under the CNH, and the participation of private industry in the oil contract bidding rounds. In fact, between 2014 and 2016, practically all of the offshore seismic survey capacity in the world was concentrated in our territorial waters in the Gulf of Mexico.

This accumulated data is being transformed into knowledge by scientists from all the participating companies and is beginning to generate economic growth. After all, as Haussman and Hidalgo discovered, the ability to aggregate data is key to building a highly complex economy, and thus high growth. The New Mexican Energy Model addresses these issues head on, creating institutions focused on aggregating data, such as the CNIH, generating powerful incentives for the development of knowledge as key to the performance of companies in competition with each other, and imparting a strong, long-term vision, committed to the education of young people and consolidating academic and research programs with initiatives such as the CONACYT-SENER Sectoral Fund.

KNOWLEDGE REFORM

The Energy Reform is a knowledge-based reform, in which the knowledge and technology of the entire world benefit the development of our energy sector, and thus our economy and society.

1 These Sectoral Funds are trusts through which research, scholarships and projects are funded.
The information regarding the funds allocated to the hydrocarbons sector is found at: https://www.conacyt.gob.mx/ /index.php/fondos-sectoriales-constituidos2/item/conacyt-sener-hidrocarburos
The information related to energy sustainability is found at: https://www.conacyt. gob.mx/index.php/fondos-sectoriales-constituidos2/item/conacyt-sener-sustentabilidad-energetica
The CFE-CONACYT funds for technological research and development in energy are found at: https://www. conacyt.gob.mx/index.php/fondos-sectoriales-constituidos2/item/cfe-conacyt

CONSISTENT COMPETITIVENESS

The process is well on its way, we must simply call for consistency, picking up the pace, strengthening competition, the role of knowledge, and transparency.

CLEAR RULES

Consolidate a system of annual bidding rounds, on dates that are well-understood by all players, regardless of the price of hydrocarbons or political cycles.

Proposals for consolidating the New Mexican Energy Model

Throughout one year of dialog for a better understanding of the New Mexican Energy Model and identifying proposals for its improvement, it became clear that the majority of the academics and experts surveyed, as well as government officials and investors, feel that the process is well on its way, and in any event, call for consistency, picking up the pace, strengthening competition, the role of knowledge, and transparency.

It was in this line of thinking that various participants supported actions to strengthen these areas, which generally fell into one of four categories or spheres of action.

The first has to do with the institutional framework, and is aimed at generally strengthening the autonomy or improving the decision making of the authorities.

The second category seeks to enrich and invigorate the ecosystem of competitors.

A third sphere of action focuses on measurements that help to enhance the competitiveness and productivity of the Mexican economy, either via a more solid energy sector, or delving deeper into the sector's role as the key to the rest of our economy's competitiveness.

Lastly, the fourth sphere of action seeks to create a long-term vision, increase the complexity of the economy, and make a great leap in productivity by wholeheartedly focusing on the consolidation of a knowledge economy.

Throughout these discussions, the role of transparency stood out as such a fundamental principle that it is expressed in each one of these spheres of action. As such, transparency is the product of the interaction of all four spheres.

First sphere: Institutional Framework

Consolidate a system of annual bidding rounds, on dates that are well-understood by all players, regardless of the price of hydrocarbons or political cycles. Also continue to make progress on the technical focus of the Five Year Plans, the selection of areas for bidding rounds based on the nomination system and professionalizing the national energy sector institutions.

Enhance the mechanisms of coordination among the various regulatory agencies and government ministries with responsibilities in this sector, for greater efficiency in the execution of projects. In particular, we recommend expanding the levels of interaction through the Energy Sector Coordination Council so that it can promote dialog not only at the highest level, but also at the operating level.

Make the ASEA independent and make its decision-making authority collegial, similar to other sector regulators such as the CNH and the CRE, as recommended by the OECD.

Purchase professional liability insurance for professionals in the public sector, regulators and employees of the State-owned production companies to avoid any impact to public funds in the event that, in the good faith performance of their duties, they make errors that result in extraordinary and potentially catastrophic expenses.

Give the regulatory bodies more budget autonomy to perform their duties.

Second sphere: Ecosystem of competitors

Creation of a unique digital platform for compliance with regulatory and contractual requirements, and the development of a unique file to simplify the process, reduce costs and increase efficiency. This must be done without undermining the system of checks and balances among the regulators. In particular, it was recommended to intensify the efforts of the National Productivity Committee in this area.

Prevent the duplication of effort on the part of institutions via full regulatory integration, so that the requirements and paperwork requested by one institution may be moved forward as a result of requests from other institutions.

Make progress in eradicating or limiting barriers to competition, particularly those related to infrastructure, public hearing processes and the competitiveness of the projects for obtaining financing.

> **Infrastructure:** reduce monopolistic controls, promote clear access rules and reduce barriers to the development of new infrastructure.
>
> **Social:** strengthen the public hearing, social and indigenous impact assessments and the personnel responsible, particularly at SENER.
>
> **Financing:** strengthen contracts to increase their bankability, without changing their nature or sacrificing the general oversight of the State.

Incentivize Pemex's capacity to form partnerships and attract capital via the Round Zero assignments, to increase its financial balance, reduce its risk and ensure the energy security of the country and the international competitiveness of the New Energy Model.

Streamline cost recovery procedures, in the case of profit sharing and production sharing contracts, so as to prevent confusion between the CNH and the SHCP;

AVOID DUPLICATING EFFORTS

Prevent the duplication of effort on the part of institutions via full regulatory integration, so that the requirements and paperwork requested by one institution may be moved forward as a result of requests from other institutions.

TOTAL OPENING

Consolidate the full opening of the markets all along the *upstream*, *downstream* and *midstream* value chain.

since the system causes uncertainty among operators, because costs that have already been approved by the former may be rejected in the latter's subsequent review.

Strengthen the corporate governance of Pemex with robust and independent decision-making that improves its planning and implementation of business plans consistent with (long term) industry cycles. These include:

» Eliminating potential conflicts of interest on its Board of Directors;
» Continuing to improve its accountability mechanisms via business administration processes (budgets, performance indicators, public reports).

Consolidate the integration of information available at the CNIH, conducting a full review and inventory to ensure that it has all existing information and thereby ensure competition on equal footing under the New Mexican Energy Model. Explore lowering the cost to access the CNH mineral collection to encourage the entry of more market participants.

Increase production at mature fields by raising the factor of production.

Consolidate the full opening of the markets all long the upstream, downstream and midstream value chain.

Implement a regular practice of creating manuals and guides for agents participating in the energy sector, for the purpose of supporting them in completing all the administrative steps and paperwork they have to deal with in projects in which they are partnering with the Mexican State.

Third sphere: International competitiveness

PROTECTION AND GUARANTEES

Consolidate the investment protection mechanisms and guarantees of the Rule of Law.

Consolidate the investment protection mechanisms and guarantees of the Rule of Law in the following areas:

» Safety of persons, installations and assets, in addition to full protection for property rights;
» Strengthening arbitration mechanisms for dispute resolution, as well as investment protection instruments both in national law as well as the principal relevant international treaties;
» Zero tolerance for corruption;
» Effective protection of the energy transport and logistics chain.

Make progress in the development of an unconventional resource development policy that will allow Mexican projects to compete economically with opportunities in other areas of the world. This involves revising the fiscal terms, depreciation mechanisms, effective and appropriate public hearing processes, regulations that allow these

resources to be developed to foster economic growth in harmony with the communities and the environment.

Promote the development of the industry with a balance between the need to generate oil revenue for government finances and the development of a dynamic energy sector that makes the rest of the economy more competitive and adds value to it.

Revise the methodology for measuring national content and deploy a vigorous investment development and attraction policy in the supply chain that complements our country's well-developed capacities.

» Start with the idea that the market to be developed is not the supply market for projects in Mexico, but the supply market in Mexico for projects around the world.
» Avoid allowing the mechanisms for measuring, reporting and complying with national content to lead to increased costs or lack of transparency.
» Offer competitive salaries to public servants to attract and retain talent. Improve the work/life balance at public institutions to promote productivity.

Take into account in bidding processes, extraction project oversight and rate setting (electricity and gas) that the costs and risks of extraction will increase as easily extracted resources decrease and as exploration and production increases.

Fourth sphere: Knowledge economy

Create a "career plan" system at federal government institutions in charge of managing energy policy, making merit and knowledge the keys to professional advancement.

» Continuous training programs and clear professional development and career management paths.

Develop certification and training mechanisms and processes for technicians and professionals that participate in the entire value chain, upstream, midstream and downstream, with international standards or the equivalent to enhance global reach.

Create joint investment incentives for public-private investments in research and development. For this joint investment, the ties between academia, industry and the government must be incentivized so that research activity at universities will meet industry and national energy policy needs.

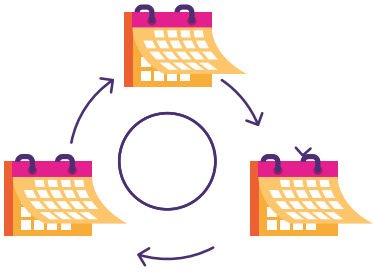
Make progress in teaching the English language, computer programming languages and leadership skills at all levels.

Foster and expand (via scholarships and exchange professors) academic opportunities with more energy specialization.

INVESTMENT INCENTIVES

Create investment incentives for public-private investments in research and development.

Ten proposals for enhancing the New Mexican Energy Model



ANNUAL ROUNDS

Consolidate a system of annual bidding rounds with predictable dates, regardless of political cycles or prices, based solely on the Five-Year Technical Plans and the nomination system.

INTERAGENCY COORDINATION

Enhance the mechanisms of coordination among the various regulatory agencies and government ministries, for greater efficiency in the execution of projects. Enhance interaction through the Energy Sector Coordination Council and place special emphasis on pressing infrastructure needs.

REGULATORY AUTONOMY

Make the ASEA independent and make its decision-making authority collegial, similar to other sector regulators, to enhance long-term regulatory certainty. Grant greater budget autonomy to all regulators.

A NEW INFRASTRUCTURE DEVELOPMENT MODEL

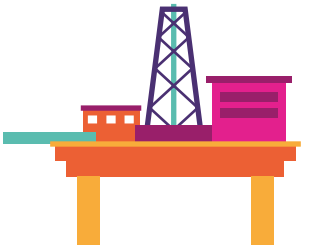
Without significantly expanding seaport, air and land transport capacity, as well as educational, energy storage and data transmission capacity, the energy sector will encounter significant bottlenecks and delays. More investment, technology and competition are required, under clear principles of transparency.

ELIMINATE ENTRY BARRIERS

As a fundamental principle for consolidating greater competition, it is essential to make progress in the access to and development of the information, the infrastructure, and improving the public hearing and environmental impact assessment processes. It is also very important to improve the bankability and stability of the contracts.

INCENTIVIZE PEMEX'S DEVELOPMENT

By creating better conditions in which it can form partnerships that reduce its tax burden and risk, while improving its financing and execution capacity, by having more partners.



DIGITAL PLATFORM

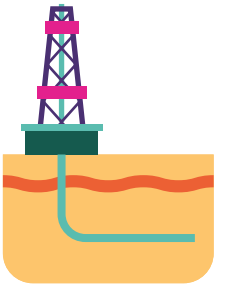
Creation of a unique digital platform for compliance with regulatory and contractual requirements, without undermining the weights and balances among regulatory agents. Special emphasis must be placed on contract cost recovery mechanisms.

CERTAINTY AND SAFETY

Enhance the legal certainty of investments, guaranteeing access to arbitration mechanisms for dispute resolution, in both legislation and treaties. Ensure the physical safety of workers, assets and minimize the negative impact to communities and the environment in the locations where sector projects are developed.

UNCONVENTIONAL RESOURCES

Develop unconventional resources, with the same determination as with which our conventional resources have been developed, recognizing the need to come up with contract terms that allow us to compete in North America, making progress in the availability of seismic data and enhancing regulations and encouraging dialog that will provide certainty to communities and operators.



KNOWLEDGE ECONOMY

Consolidate the integration of the data kept by the CNIH, maintain and if necessary enhance scholarship, internship, certification and research programs in the energy sector, always placing them at the center of planning and problem-solving.

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