

The Political, Economic, and Social Roots of Energy Insecurity in México

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Abstract—In December 2013, a historic constitutional energy reform was approved to let private investments in the oil sector. The energy reform tries to reverse Pemex production decline caused by low productivity and low reinvestment of profits and to strengthen the energy framework. Trends in the energy sector show that Mexico could become an energy-deficient country in 2020. The energy reform tries to reverse this scenario. However, Mexico's energy insecurity not only derives from declining oil reserves but also from political, economic and social problems in the country. With this in mind, this paper aims to analyse the post-reform energy scenario to reveal the sources of energy insecurity prevailing in the country.

Index Terms—Oil, energy insecurity, energy reform, México.

I. INTRODUCTION

In December 2013, a historic constitutional energy reform was approved to let private investments in the oil sector. The energy reform tries to reverse Petróleos Mexicanos (Pemex) production decline caused by low productivity and low reinvestment of profits and to strengthen the energy framework. From 2000 to 2011, energy consumption in Mexico grew at an annual average of 2.08 percent, while the Gross Domestic Product annual growth rate was only 1.82 percent. Moreover, primary energy production decreased at an annual rate of 0.3 percent. These figures indicate that Mexico will likely become an energy deficient country by 2020 if the trend does not change. Even though the country currently has sufficient generating capacity to supply its electricity needs, this was achieved by investing heavily in gas power stations, which currently generates about 50 percent of the country's electricity. In part, this trend is due to the reduction in natural gas prices in recent years in the United States and the increased efficiency of gas power stations compared to those using petroleum. If continued, this trend will lead to a greater natural gas demand, which is heavily imported as the country's investment in hydrocarbons are focused primarily on oil extraction. Between 2000 and 2004, oil production in México increased to reach a peak, and then began to decline, reaching 2.5 million barrels per day (bpd) in 2012. Thus, maintaining production at current levels represents an important technical and economic challenge for the country, since most of the producing fields are in mature stages or in the process of decline. Between 2003 and 2012, proven oil reserves fell 31.2 percent from 20,077 million barrels of oil equivalent (MMboe) to 13,810 MMboe. In the

same period, probable reserves decreased 27.2 percent, from 16,965 to 12,353 MMboe. At the same time, Mexico has become a net importer of gasoline, diesel, jet fuel, natural gas, liquefied petroleum gas, and petrochemicals. In addition, many of the energy transport systems show signs of insufficient capacity, deterioration, or obsolescence in its integrity or functional performance. Moreover, few pipelines could provide alternate supply routes [1]. Additionally, there is an enormous risk related to illicit market combustibles, which affects the refining industry. The main factors that aggravate such losses are the presence of increasing activity of drug cartels.

With this in mind, this paper aims to analyse the post-reform energy scenario to reveal the sources of energy insecurity prevailing in the country. Unless otherwise stated, all currency amounts are expressed in United States dollars.

This paper is organized as follows. Section 1 analyses briefly the concepts of energy security and energy insecurity. Section 2 describes the oil sector in Mexico. Section 3 examines the sources of insecurity in the country. Section 4 concludes and derives policy implications.

II. ENERGY INSECURITY AND ITS SOURCES

The importance of energy security appeared in the first half of the 20th century when political and military leaders realized that it was indispensable to secure fuel supplies through diversifying suppliers and substituting foreign imports with domestic production, mainly for military purposes. In the early 1970s, the first oil crisis revealed the vulnerability of developed economies to oil prices volatility and energy security concerns increased. By the end of the 20th century, world leaders shifted their attention towards security of transmission and generation systems, vulnerability of nuclear power plants, environmental concerns, and demand security [2].

Consequently, energy security concept has evolved over the years, from adequate supply of energy at a reasonable cost to the availability of energy at all times, in several forms, in sufficient quantities, at affordable prices. Energy security also refers to the capability of a country to obtain stable, sufficient, and clean energy supply to balanced development of its economy and society. Energy security is closely linked to governmental strategy and policy [3], [4]. The guiding principles of energy policy are safeguarding energy supplies, environmental protection, and economic growth [4]. A main goal of the energy security policy is to provide greater energy efficiency in all sectors, while, at the same time, assuring a high degree of reliability and robustness of the energy system. Energy security can be measured in terms of domestic

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production capacity, ability of energy acquisition from the international market, national emergency control ability, and environmental safety control ability.

So far, the economic literature has focus on the definition and indicators of energy security. Few studies analyse energy insecurity and its sources [4], [5]. According to Winzer (2012, p. 42) energy insecurity is related to “sudden physical shortages [that] can disrupt the economic performance and social welfare of the country in the event of supply interruptions and/or large, unexpected short-term price increases.... No energy form and no source of supply can offer absolute security, so improving security of supply means reducing the likelihood of sudden shortages and having contingency arrangements in place to limit the impact of any which do occur.” [5]. Energy insecurity also refers to import dependency, aging infrastructure, insufficient production capacity (mainly in emergent economies), high energy intensity, and rapid demand growth [2]. In many low-income countries, energy insecurity can be related to weak institutions, political uncertainty, corruption, and diverse forms of violence.

Some sources of energy insecurity are: a) physical risks (due to interruptions in energy production or to depletion of energy resources); b) economic risks (caused by instability in energy prices); c) political risks (when oil producers intend to employ energy as a political weapon); d) regulatory risks (due to weak institutions in the domestic markets and regulatory variability in exporting countries); e) social risks (riots, violence and criminality) and f) environmental risks [4].

Analysing the sources of energy insecurity is especially relevant for oil producing developing countries since those countries frequently face challenges associated with economic growth, rent-seeking, lack of an appropriate fiscal framework, and inefficiency in the distribution and use of public incomes. The case of Mexico gives us an opportunity to analyse the energy scenario and reveal the sources of energy insecurity prevailing in the country.

III. THE OIL SECTOR IN MEXICO

Pemex is a state owned enterprise (SOE) created in 1938 to take over the oil and gas exploration, production and refining as a monopoly. Pemex emerged as the result of the Mexico's oil sector nationalization. The original corporate structure of the company included the Director General and three deputy directors, each in charge of production, marketing and administration and legal affairs. In 1992 the original structure was modified by law and the Mexican state assigned Pemex the central leadership and strategic direction of all activities covered by the state oil industry, separating industrial and commercial tasks originally concentrated, creating four¹ subsidiaries engaged in the production, refining, and marketing of gas and oil. Pemex and the four subsidiaries remained state-owned.

Mexico's oil sector has gone through several stages. During the early years, Pemex did not have the capability to conduct the oil industry. In fact, between 1937 and 1943 the

total production decrease was 4.66 percent. Several reasons explain this low production level. First, domestic demand was relatively low; consequently, Pemex reduced the amount of geological and geophysical studies, and exploring wells. Second, inexperienced technicians, unfamiliar with geological knowledge, performed the exploration activities. Third, Pemex lacked the technical resources to carry out drilling activities [6]-[7]. Drilling activities received a major boost; as a result, the SOE began the exploitation of new deposits in Veracruz and Tamaulipas and expanded its refining capacity by modernizing and building some refineries. The discovery of new mining areas allowed the reserves to increase from 1,276 billion barrels in 1945 to more than 4 billion barrels in 1958 [8]. In the period of 1945-1953, Pemex continued suffering some problems in drilling prospecting due to lack of experience. In that period the SOE earned modest gains, mainly caused by a policy of low prices and subsidies to stimulate economic development. The revenues were not sufficient to carry on a long-term exploration program; instead, they were used for oil production, transportation, and commercialization purposes. Additionally, the taxes on the oil revenues started to create financial problems to the company, impeding infrastructure investment [9]. This policy of low prices and the excessive taxes on oil revenues endured over time becoming a deep problem for Pemex, as we will see later.

From 1959 to 1964, however, the company had a slightly higher amount of revenues thanks to an adjustment in domestic prices of some oil products, yet the low pricing policy prevailed in time². During those years, Pemex preferred to invest in other activities of the industry rather than in exploratory activities. For example, between the six-year period 1959 to 1964, the production wells increased 94 percent compared to the previous six-year period of 1953 to 1958. In contrast, the number of exploring wells increased only 25 percent compared to the previous period. Because of this strategy, a strong decrease was recorded in the reserves-to-production (R/P) ratio and Pemex began to sell imported oil in the domestic market at subsidized prices [6] - [7]. Evidently, Pemex lacked of a long-term strategy, for example, in 1968 for the first time the government requested Pemex to make a ten year plan; previously, de planning horizon was two or three years. Simultaneously, its essential purpose of producing oil to stimulate Mexican industry was becoming gradually more expensive. Pemex fixed investment reached a more than threefold increase between 1952 and 1958 but the price of petroleum products continues lowering in real terms [10]. Besides, the SOE had to manage high operational costs due to technical and administrative inefficiency [6]. In consequence, even though Pemex strategy was in a good direction with respect to Mexico's industrial policy, the SOE faced deep financial problems. During the first twenty years of operation Pemex was unable to grow through its own resources, rather, its growth was supported by long term and short term loans. As a result, from 1959 to 1973 the expansion of Pemex suffered a significant slowdown ending in a productive crisis [8]-[10].

¹ Pemex-Exploración y Producción, Pemex-Refinación, Pemex-Gas y Petroquímica Básica and Pemex-Petroquímica.

² In fact, the price of oil products did not increase between 1959 and 1970 [7].

The 70s was a critical decade for Mexico's oil sector. At the end of 1970, Pemex had drilled over 2,505 exploratory wells. Approximately 67 percent was unproductive. As oil reserves began to run out it was evident that drilling would have to be deeper so exploration activities became more expensive. In order to augment the oil reserves, the main goal of Pemex in 1971 was to increase the exploration activities to discover new fields to replace those who were being exploited, expanding the production of hydrocarbons without undermining the existing proven reserves. This had happened before because of a poor management of the exploration activities that led to an excessive drilling of wells in the producing fields previously discovered, causing a partial disablement of fields, and reducing accounted reserves. To make matters worse, the SOE was forced to import oil, gasoline, diesel, liquefied petroleum gas, and petrochemical products, whose prices quadrupled in the international market [8]-[7].

In order to finance its expansion, Pemex received loans from the United States in exchange for gas. Despite that, Pemex was no able to expand the refined products production and started to import over a fifth of oil demanded by the country, beginning a path to lag, resulting in a production crisis in early 70s. During those years, the oil policy was improvised and limited in scope. Since the Mid-1970s the government faced two opposing positions. On the one hand, an important group of engineers questioned Pemex oil exports. According to them, Pemex should produce just enough oil to meet domestic consumption, preserving stocks for future generations. On the other hand, a group of politicians defended the idea of increasing exports in order to obtain financial self-sufficiency and ensure the country's development. The latter idea prevailed and Mexico expanded its oil exports mainly to United States [9]. Simultaneously, Pemex's contribution to public finances became a key element of Mexican economy. From 1976 to 1982, the government taxed between 97 percent and 99 percent of Pemex the gross profit. This amount represented almost a half of the public income. The next years the tax policy prevailed.

In 1974, stocks began to grow progressively (Fig. 1). The vast reserves discovered in the southern part of the country allowed a production increase of 70 percent from 1973 to 1977, so that by 1978 this region became the principal supplier of oil. The country transformed from a net oil importer in 1973 to a net exporter in 1982.



Fig. 1. Mexico's oil production 1938-2013 (Thousand barrels).

Due to oil prosperity Pemex's total share to public expenditure ascended from 12.3 in 1973 to almost 30 percent in 1980 and the public expenditure expanded from 16 percent in 1970 to 40 percent of GDP in the early 80s [8]-[6]. At the present, Pemex contributions represent between 30 and 40

percent of Mexican tax revenues.

In December 2013, a historic constitutional energy reform was approved to let private investments in the oil sector. The energy reform tries to reverse Pemex production decline caused by low productivity and low reinvestment of profits and to strengthen the energy framework. However, the reform will not solve the Mexico's energy problems because international oil companies are only interested in exploiting oil for their own benefit. Mexico's energy insecurity not only derives from declining oil reserves but also from political, economic and social problems in the country that private companies would not solve. In fact, some of the sources of insecurity we analyse are a serious threat for private companies and a challenge for the reform's success.

IV. SOURCES OF INSECURITY

The long-term effect of Mexico's economic policy was an oil-dependent country. At the same time, Pemex faces deep structural problems. As previously described, through the years oil industry has gone through serious problems (directly or indirectly related to economic conditions, opacity in the use of oil revenues, corruption, and poverty) that have become a source of energy insecurity for the country.

A. Financial Problems

Pemex was born as a non-profit company. At the beginning, its main objective was to supply the domestic market with cheap oil products, creating collective benefits in exploitation zones. As previously described, through the years Mexico's energy policy was inadequate, erratic, or even non-existent, resulting in severe financial and structural problems for Pemex. Surprisingly for a monopoly that used to drill every barrel of oil at an average cost of less than \$7, and sells it for around \$100, Pemex accumulated \$29 billion lost between 2007 and 2011. This is partly because although its oil-and-gas-production side generates huge profits, its refining business loses a fortune, and its petrochemicals division is loss-making as well. Besides, the government employs the cash flows to compensate for the lack of tax revenues it collects from the rest of the economy. In 2012, 55 percent of Pemex's revenues went in royalties and taxes. This eternal leak on its cash flow means its debt has ascended to \$60 billion [11].

For several decades, Mexico's public finance has consistently depended from oil revenues on an average of 30-40 percent. The new tax regime did not eliminate the excessive taxes on Pemex revenues. The tax regime establishes that, from 2015 onward, the hydrocarbon sector should contribute to public finance at least the equivalent of 4.7 percent of gross domestic product estimated. The point is that in 2015, and perhaps for several subsequent years, only Pemex will be able to produce hydrocarbons and to provide resources to achieve that goal, because private companies will be newcomers starting their operations without earnings report. Consequently, Pemex will have to continue paying about 65 percent of its earnings. As we pointed out before that is the one of the main reasons the SOE has a severe lack of technology, infrastructure investment, and deep-sea drilling expertise and a source of insecurity for fuel supply.

Pemex has no commercial deep-sea drilling. Cantarell, Mexico's main oil field, is offshore but in relatively shallow water. At the present, Cantarell field is declining and the SOE has only a few exploratory wells. To exploit the area of international waters known as the Western Gap (Mexico owns 62 percent and United States 38 percent) Mexico would first must develop deep-sea drilling capabilities and then pre-salt drilling technology [12]. As we will explain later, Mexican oil reserves are declining, the discoveries of new deposits occur in increasingly remote regions, and, due to its present financial situation, Pemex cannot afford the exploration and extraction costs.

B. Declining Fields

At various moments of Mexico's oil sector history, Pemex lacked of a long-term exploring plan, focusing on exploiting rather than exploring new fields. Pemex's concern about the country's reserves only arose when the R/P ratio was getting very low. The declining reserves and production of crude oil is largely due to the exhaustion of Cantarell field, the vast well discovered during the oil boom of the 70s. In the 90s, Cantarell became the main source of crude oil, reached its peak in 2003 with a production of 2.2 million barrels, and then started to decline. In 2007, Cantarell accumulated a 51 percent drop in production, while the total production in the country reached a 19 percent drop. The costs of exploration and extraction are increasing for conventional fields and for those that require hydraulic fracturing. Consequently, Pemex would need a large investment to recover the production volume of the early 2000s. Nevertheless, due to its financial problems this would not be feasible [13], [14].

According to the new energy framework, the Secretariat of Energy (Sener) carried out the first bidding Round (phase one and two) in July and September 2015 to develop fourteen fields under a production-sharing scheme. The objective is to allow private companies participate in the upstream sector by entering into contracts with the government. The fields offered in the first phase of the bidding process had only prospective resources and the conditions were rigid. The disappointing results of this bidding, led Mexico's government to modify the terms of the second phase, which ended with better results mainly because all fields have proven reserves. The Mexican government postponed auctions for deepwater oil exploration contracts [15]. Consequently, at this moment, there are no private oil companies involved in exploration activities.

C. Insufficient Refining Capacity and Deficient Pipeline System

As we pointed out before, Pemex's infrastructure is obsolete, not appropriate for processing and refining the heavy and ultra-heavy crude oil that increasingly dominate oil production in Mexico. Additionally, the current production of refined products does not meet the demand. Pemex's refineries are considerably more energy intensive, if compared with industry standards, susceptible to more downtime (because of inadequate maintenance budgets, malfunctions unplanned interruptions), and, therefore, less efficient [16]. Consequently, Mexico has been forced to increase its imports of refined oil products since it is not able

to refine its own oil. As a result, Mexico imports about half the gasoline that it uses. So far, the government has not set the new market structure for refined products. Thus, it is not clear how the Mexican government will solve refining problems.

As for the national pipeline system operated by Pemex, it also presents several problems. Firstly, the poor infrastructure in the pipeline network, prevent importing larger volumes of natural gas to meet the needs of industry. Secondly, between 2005 and 2014 Pemex has reported 2,181 oil leaks [17], which caused economic losses in 2012 of \$1,436 million, according to the Sener; but according to the Confederation of Industrial Chambers the economic losses were up to \$2,200 to \$3,300 billion [4]. Thus, both insufficient refining capacity and deficient pipeline system, represent a strong source of insecurity, which might cause stockouts, and problems of rates for the industry.

D. Illegal Oil Products Market

Theft of fuel from Pemex pipelines in Mexico is growing every year. Between January and August 2015, Pemex lost around \$3 million per day through more than 3,000 illegal taps into its pipelines. The SOE estimates a loss of \$18.25 billion in 2015, including the cost of repairing the pipeline network [19].

Fuel theft is an old problem in Mexico, initially committed by individuals and small, localized groups. Since 2000, however, fuel theft has transformed into a very lucrative business for drug cartels looking for new sources of income [20]. As organized crime in Mexico has grown, fuel theft has expanded. The arrival of private energy companies (most of them foreign companies) will introduce a new variable because the same cartels that, at present, exploit Pemex pipelines probably will target the new companies as well. In particular, firms investing in the energy retail market will be threatening since organized crime has a substantial participation in the illegal fuel market [19]. Quite apart from the fact that fuel theft involves a high economic cost, it also represents a serious security concern for oil companies that will be arriving in the next years. Furthermore, fuel theft results in corruption of public officials, pipeline explosions, leaks and, violent conflict over territory for control of those areas, which means that fuel supply in Mexico, is anything but secure.

E. Renewable Sector Remains Underdeveloped

Mexico's energy scenario remains dominated by oil and natural gas. Only 7 percent of primary energy is produced by renewable means. Public policies on renewable energy are emerging and there has been no substantial increase in the use of renewables. The Law for the Use of Renewable Energies and the Financing for the Energy Transition approved in 2008 did not make a significant change in the energy scenery [18].

So far, there are not real programs to boost renewable energy generation because Mexican Senate is still discussing the Law for the Energy Transition approved by the Chamber of Deputies in 2014, a key piece in Mexico's renewable energy strategy. Powerful polluting industries, such as steel and cement, are lobbying to modify the definition of clean energy to include natural gas. In this case, these industries would be released from having to adopt measures to implement strict energy efficiency standards, which imply

higher operating costs [21], [22]. This would imply that the mechanism of Renewable Energy Certificates (REC)³ mentioned in the law would be useless even before being applied.

The fact that cheap gas power generation will continue to provide low-cost electricity and, therefore, attractive tariffs may restrict investment in renewable energy. Additionally, the lack of transmission capacity in zones with high renewable energy resource potential limits the development of renewables. In many cases renewable energy projects are not profitable. Prior to the energy reforms, there were no economic incentives to promote the development of renewable energy technologies. The new laws do not include a program to domestically produce a certain amount of components for renewable energy industry as solar cells or wind turbines [24]. If this new industry is not created and this new expertise is not developed, the country would depend on imports of components and know how, creating a dependence problem.

V. DISCUSSION AND POLICY IMPLICATIONS

The previous analysis leads us to conclude that Mexico's energy insecurity is product of deep political, economic, and social problems. In this sense, there are three preconditions to achieving energy security in the country.

In the political aspect, it is necessary to develop a fairer fiscal policy that collects a larger share of taxes not only from the oil sector but also from other sectors. Mexico's government has to design fiscal arrangements that encourage efficient oil resource development. In designing fiscal instruments, the government should weigh its desire to maximize short-term revenue against a long-term plan to rescue Pemex from its financial and operational problems.

In the economic aspect, one of the Sener's strategic objectives is to have a vast supply of energy in order to support economic growth [25]. So far, Pemex still dominates the energy scenario and is the only company that is able to help the Sener to reach this objective in the next years, since the other companies are newcomers that are only involved in exploiting activities⁴. However, the Sener is cutting the company's 2016 budget by about 20 percent; delaying the modernization of its refineries and the contracts of some 10,000 workers (employed through outsourcing companies) will not be renovated [27]. The oil sector is facing severe problems, as the changes in the law have not attracted as much private investment as expected. As we pointed out before, in the subsequent years, only Pemex will be able to produce hydrocarbons and contribute to public finance. With a declining oil market, Sener's chances to reach growth and energy supply objectives are low.

³ A REC represents proof that one megawatt-hour (MWh) of electricity was generated from a renewable energy resource. Once the electricity provider has fed the electricity into the grid, the REC they received can then be sold on the open market as a commodity. Due to the additional cost for producing clean energy, the RECs provide an additional income stream to the energy provider, making it more attractive to produce [23].

⁴ Mexico's government is planning to open gas stations to private investors in 2017 but until 2020 it will control gasoline prices. Private investments in gasoline refining will be allowed in 2018 [26].

In the social aspect, population's access to energy should translate into better quality of life and social inclusion. However, the lack of urban planning, illegal housing, unemployment, and corruption have led to energy theft. Drug cartels expansion only makes the problem worse. Beyond energy reform, drug cartels represent a major challenge for business. Drug gangs attack gas stations and electricity facilities, try to control ports⁵, and diversify their source of income in several zones of Mexico. To overcome those problems is essential to build strong institutions to improve social conditions, to stop violence and to restore law and order.

Additionally, to reach energy security, the country has to diversify its energy matrix and rely more heavily on renewable energy, ensuring large-scale integration of different renewable energy technologies in different sectors. Government has to promote the uptake of renewable energy for heat and fuel applications in the buildings, industry and transport sectors and to build a renewable energy market, creating new opportunities for renewable energy development. This is also a chance to think about the correlation between patterns of energy demand, technology, and policy.

In the beginning of 2015, Mexico's government was confident the new energy laws would attract international oil companies to invest in the energy sector. Attracting private companies was a priority as low oil prices have sped up Pemex's decline. As we pointed out, the response has been less enthusiastic than expected. Policy makers must be aware that energy reform is not sufficient to reduce energy insecurity. In order to improve the entire energy system, it is necessary to eradicate the sources of energy insecurity. New policies must be launched to enhance political, economic, social, and environmental conditions. A new policy and institutional context, thinking forward in time, can bring greater energy efficiency as well as economic and social benefits.

REFERENCES

- [1] Sener, *Perspectiva petrolero y petroleros*, México: Secretaría de Energía, 2013.
- [2] A. Cherp, A. Goldthau, J. Jewell *et al.*, "Energy and security," in *Global Energy Assessment: Toward a Sustainable Future*, L. Gomez-Echeverri, T.B Johansson, N. Nakicenovic N, A. Patwardhan, Cambridge/ New York: Cambridge University Press, 2012. pp. 325-383.
- [3] Z. Hu and Y. Ge, "The geopolitical energy security evaluation method and a China case application based on politics of scale," *Sustainability*, vol. 6, pp. 5682-5696, August 2014.
- [4] X. Labandeira and B. Manzano, "Some economic aspects of energy security," *Economics for Energy*, WP 09/2012.
- [5] C. Winzer, "Conceptualizing energy security," *Energy Policy*, vol. 46, pp. 36-48, 2012.
- [6] L. Palacios. (September 2002). The petroleum sector in Latin America: Reforming the crown jewels. Le Etudes du CERI. [Online]. Available: <http://www.sciencespo.fr/ceri/en/content/petroleum-sector-latin-america-reforming-crown-jewels>
- [7] A. M. Sordo and C. R. López, "Exploración de petróleo en México: antecedentes y evolución, 1938-1985," México: El Colegio de México, 1988, pp. 13- 80.
- [8] J. Álvarez, *Crónica del petróleo en México, de 1863 a nuestros días*, México: Petróleos Mexicanos, 2006.
- [9] A. Alonso and C. R. López, "La industria petrolera en las políticas de desarrollo del estado," in *Industria y estado en la vida de México*, P. Arias, Ed. Zamora: El Colegio de Michoacán A.C., 1990, pp. 283-302.

⁵ For example, Lazaro Cardenas, a port of entry for the chemicals used for methamphetamine production and a main export port for minerals [28].

- [10] G. Philip, *Oil and Politics in Latin America: Nationalist Movements and State Companies*, Cambridge: Cambridge University Press, 1982.
- [11] The Economist (August 10, 2013). Mexico's oil industry: unfixable Pemex, [Online]. Available: <http://www.economist.com/news/business/21583253-even-if-government-plucks-up-courage-reform-it-pemex-will-be-hard-fix-unfixable>
- [12] Stratfor. (October 21, 2015). Why drug cartels are stealing Mexico's fuel. [Online]. Available: <https://www.stratfor.com/analysis/why-drug-cartels-are-stealing-mexico-fuel>
- [13] I. Morales. (December 9, 2013). The twilight of Mexico's state oil monopolism: policy, economic, and political trends in Mexico's natural gas industry. [Online]. Available: <http://bakerinstitute.org/research/twilight-mexicos-state-oil-monopolism-policy-economic-and-political-trends-mexicos-natural-gas-industry/>
- [14] Z. R. Peláez. (2008). Cantarell ayer y hoy. *Petroquímex*. [Online]. Available: <http://www.petroquimex.com/030409/articulos/9.pdf>
- [15] Offshore. (August 7, 2015). Mexico revises rules for second phase of Round One auction. *Offshore Magazine*. [Online]. Available: <http://www.offshore-mag.com/articles/2015/08/mexico-revises-rules-for-second-phase-of-round-one-auction.html>
- [16] E. León, I. Martín, R. Livas, and M. Mereles. (April 9, 2014). The promise of Mexico's energy reforms. *The Boston Consulting Group ENERGIA*. [Online]. Available: https://www.bcgperspectives.com/content/articles/energy_environment_promise_mexicos_energy_reforms/#chapter1
- [17] Pemex, *Informe Anual*, México: Petróleos Mexicanos, 2014.
- [18] CIDAC. (2013). México inseguro... energéticamente, diagnóstico y propuestas para asegurar el futuro suministro nacional de energía. *Centro de Investigación para el Desarrollo, A.C.* [Online]. Available: http://cidac.org/esp/uploads/1/Mexico_Inseguro_energicamente_fina1_280813.pdf
- [19] Stratfor. (October 21, 2015). Why drug cartels are stealing Mexico's fuel. [Online]. Available: <https://www.stratfor.com/analysis/why-drug-cartels-are-stealing-mexico-fuel>
- [20] Puebla on Line. (July 23, 2015) Quecholac, Tepeaca y Acatzingo, triángulo dorado de la ordena de ductos: Pemex, *Puebla on Line*. [Online]. Available: <http://pueblaonline.com.mx/2014/portal/index.php/estado/item/26957-quecholac-tepeaca-y-acatzingo-triangulo-dorado-de-la-ordena-de-ductos-pemex#.Vjs1greKE1k>
- [21] D. Dyer. (October 8, 2015). Will Mexico be able to meet its COP21 pledge? *El Daily Post*. [Online]. Available: <http://www.eldailypost.com/opinion/2015/10/will-mexico-be-able-to-meet-its-cop21-pledge/>
- [22] F. Muciño. (May 19, 2015). México le da la espalda a las energías renovables. *Forbes*. [Online]. Available: <http://www.forbes.com.mx/mexico-le-da-la-espalda-a-las-energias-renovables/>
- [23] S. C. Hackett. *Environmental and Natural Resources Economics: Theory, Policy, and the Sustainable Society*, London: M.E. Sharpe, 2010.
- [24] IRENA. (2015). Renewable Energy Prospects: Mexico, REMap 2030 analysis. International Renewable Energy Agency. [Online]. Available: www.irena.org/remap
- [25] Sener, *Perspectiva petróleo y petroleros*, México: Secretaría de Energía, 2013.
- [26] E. Siegler. (May 2, 2014). Peña quiere gasolina 'libre' hasta 2020, *CNN Expansión*. [Online]. Available: <http://www.cnnexpansion.com/negocios/2014/04/30/pena-quiere-gasolina-libre-hasta-2020>
- [27] E. Malkin. (March 13, 2015). In Mexico oil market, mood moves from excited to anxious. *New York Times*. [Online]. Available: <http://www.nytimes.com/2015/03/14/business/energy-environment/pemex-seeks-private-investment-as-mexico-oil-industry-falters.html>
- [28] R. Rhoda and T. Burton. (February 17, 2014). Mexico's drug cartels and their areas of operation, a 2014 update, *Geo-Mexico; the geography and dynamics of modern Mexico*. [Online]. Available: http://geo-mexico.com/?page_id=2



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