AN ENERGETICALLY INSECURE MEXICO

DIAGNOSIS AND PROPOSALS TO ENSURE MEXICO’S FUTURE ENERGY SUPPLY
EXECUTIVE SUMMARY

In 10 years, Mexico could lack the energy required for its economic development. In the face of forecast growth of rates higher than 3% over the next 6 years, the number of energy inputs remains insufficient: from 2000 to 2011, Mexican society increased its energy consumption at an average annual rate of 2.08%, while reducing its primary energy production at a 0.3% annual rate and within a context in which Mexico has a limited capacity of importing basic hydrocarbons such as natural gas. According to that scenario, the Secretariat of Energy (SENER) considers that, by 2020, Mexico will turn into a nation with a serious energy deficit. In other words, everything seems to point out that the country will lack the capacity to ensure national supply, that is to say, to guarantee energy security that allows the industry to develop its productive activities uninterruptedly.

Where to begin? In order to identify a series of problems of the energy sector that, if not sorted out, will not only prevent the country from capitalizing the major opportunity that it is facing but will also produce a scenario in which the risk of energy being a bottleneck for economic growth. The problems that increase the risks of not having the energy we require in the future are:

a. Depletion of reserves and decrease in production due to a plunge in drilled exploratory wells and a greater number of declining fields;
b. Excess of demand for natural gas due to an insufficient transport capacity and distribution network;
c. Market inefficiencies caused by the symbiosis prevailing among the State and Pemex which, on one hand, undermine the company’s assets and, on the other, send the wrong message to the market regarding the price of certain fuels;
d. Obstacles in the electricity sector: a low geographical interconnection in the National Interconnected System, an aging broadcast network, an increase in non-technical losses and a declining Operating Reserve Margin, which are well below international standards;
e. Inefficient and regressive energy subsidies, with pernicious effects; and, finally,
f. An energy matrix largely dependent on hydrocarbons whose prices are susceptible to high variations.

In addition, Mexico has worsened the aforementioned issues on four grounds:

1. On the verge of the Mexican Oil Expropriation’s 75th anniversary, President Enrique Peña Nieto stated that proven reserves, which amount to 44,530 million barrels, will run out in 10 years.
2. Primary energy is defined as one that cannot be used directly, that is to say, all energy that is available in nature before being converted or transformed, (e.g., crude oil).
4. For the Center of Research for Development (CIDAC), energy security means the capacity of Mexico to access the energy required to enhance its growth and economic development.
5. See ¡No Más Subsidi os Injustos! [No More Unfair Subsidies!], Center of Research for Development (in publication)
1. Maintaining a short-term view that concentrates the energy production solely on hydrocarbons and appoints Pemex with the role of microeconomic and tax balancer;
2. Promoting an inadequate hydrocarbon investment portfolio that favors the maximization of oil extraction over the sustainable management of its wells;
3. Not acknowledging the opportunity cost of unexploited hydrocarbons; and, lastly,
4. Individuals that associate oil possession with the defense of national sovereignty and, consequently, rise up the political cost of carrying out the reforms needed for the sector.

Taking this into account, the Center of Research for Development (CIDAC) wrote four punctual recommendations in order for Mexico to achieve, in the long term, a sufficient energy supply that allows it to fulfill the expected economic growth and development:

1. Creating a long-term vision in the Office of the President of the Republic, as well as SENER, the Secretariat of Economy (SE) and the Secretariat of Finance and Public Credit (SHCP) that, on one hand, enhances the sustainability of the sector by diversifying the composition of the national energy matrix and, on the other, allows Pemex to reinvest its oil revenue on research and development, as well as a National System of Pipelines able to satisfy the production needs of the country;
2. Having a hydrocarbon investment portfolio that goes in line with the company’s strengths in oil exploration and production;
3. Recognizing the opportunity cost of non-exploited hydrocarbons; and,
4. Associating the concept of national sovereignty with energy security, in such a way that Pemex might acquire the structure of an efficient company that will benefit the country.

In the next sections, the aforementioned points are thoroughly detailed. Particularly, what is understood as energy security and its relevance (Section 1), what are the challenges and energy issues that Mexico is currently facing (Section 2), why problems were created and why energy issues became more complex (Section 3), what are the principles for making a transition towards energy security in the coming years (Section 4), what energy scenarios await for Mexico (Section 5) and, lastly, what conclusions are obtained with this report (Section 6).

1. MEXICO’S LACK OF ENERGY SECURITY

CIDAC understands energy security as the capacity that Mexico has to access energy at competitive prices with the purpose of it being an engine and not a constraint for its economic growth and development.\(^6\) Why is it necessary to analyze Mexico’s energy security? Because it is a cornerstone in the process of the country’s economic and social growth and its problems require

\(^6\) See the Appendix for concepts on energy security from an important group of decision-makers in Mexico: political parties.
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immediate attention. According to SENER, from 2000 to 2011, Mexican society increased its energy consumption at a 2.08% annual rate. In contrast, production of primary energy decreased at a 0.3% annual rate and kept a fixed imports rate. According to this scenario, by 2020, Mexico will turn into a country with an energy deficit.

In fact, Mexico does not currently have energy security due to four reasons:

a. There is a short-term vision that is highly dependent on hydrocarbons and that bounds Pemex to being a provider for the country’s macroeconomic numbers and public finances;
b. A hydrocarbon investment portfolio is being promoted with the aim of maximizing the amount of extracted oil in the shortest amount of time, without considering the damage that the aforementioned practice might do to the wells’ productive lifespan;
c. Costs of opportunity of non-exploited hydrocarbons are not integrated within Pemex’s line of business; and
d. There is a linkage between oil possession and the defense of national sovereignty that prevents Pemex from acquiring the structure of an efficient company.

These conditions have created a series of problems: a drop in oil production due to a low reserve incorporation and drilling of explored wells, as well as for a decrease in “easily extractable” fields; an insufficient infrastructure for natural gas distribution that also has leakage and “winding” problems; a paradoxical electricity sector that, on one hand, keeps an electric energy network that operates at full capacity and sustains losses associated with illegal

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7 Secretariat of Energy, 2013, _op. cit._, p. 3.
8 Ibid, p. 3.
9 Gas winding consists in the non-utilization of a gas that comes from a production oil field and that is burned due to several reasons (e.g. lack of pipelines or exclusive utilization of oil).
consumption and, on the other hand, presents an excessive and aging installed capacity that is also becoming obsolete; inefficiencies in the energy sector associated with the symbiosis between Pemex and the Mexican State; the maintenance of inefficient energy subsidies; and the creation of an unsustainable energy matrix that is highly dependent on hydrocarbons.

Taking this into account, CIDAC believes that, in order to achieve a long-term energy security, the country requires: to adopt a vision that allows the definition of a sustainable energy matrix and that makes Pemex a productive and efficient company, able to reinvest its resources in research and development, as well as a natural gas distribution network that satisfies the needs of residential and industrial users; to establish an investment portfolio based on the strengths of Pemex that allows it to be efficient and productive; recognize the cost of opportunity that non-exploited hydrocarbons possess, so Pemex can generate a sustainable line of business; and the reconstitution of the national sovereignty, which will eliminate the idealization of oil possession and will allow associating sovereignty to the capacity the country has to guarantee necessary conditions for its economic growth and development.

CIDAC considers that, if this inertial trajectory keeps on going, the energy sector problems will aggravate, which will affect the country’s production activity and, thus, its economic growth. Given that this is a necessary condition for development, if the deadlock remains, Mexico will face major obstacles for its economic development in the long term. Nevertheless, if Mexico adopts the measures demanded by its energy security, it could put the country in a position of a competitive actor within the worldwide energy market.

II. CHALLENGES AND ENERGY PROBLEMS FACED BY MEXICO

In order to achieve energy security, Mexico needs to guarantee several conditions that it currently does not have. Firstly, an energy surplus that ensures that inputs are available for industrial and residential consumption is required. Secondly, users of energy inputs need to be provided with certainty that they will be able to perform their production activities uninterruptedly. Thirdly, in the face of a decrease in well production and exploration, the country cannot guarantee its energy supply if Pemex still has a symbiosis with the State and its operation remains related with short-term political goals. Fourthly, in this efficiency rhetoric, the energy subsidies are to be eliminated as well given that, in addition of being regressive and deceitful, they represent an opportunity cost for the country. Fifthly, the country is forced to review the electrical sector: a nation with excess in obsolete installed capacity, with an operational reserve margin far below the best practices worldwide and that has a growing illegal robbery problem, is in no conditions to guarantee the energy supply. Lastly, the energy security implies to open the consumers’ possibilities regarding technologies available: maintaining a diversified national energy matrix is a foreseeable long-term strategy, due to the fact that it minimizes the risk of energy shortfalls in the face of availability variations and changes in the price of certain resources.
A. Acquiring an energy surplus

Energy security requires the country to have an access to energy at competitive prices along with a quality supply that covers society’s needs. That way, productive activities and consumers’ needs of residential users will be ensured. There is still a long way to go in order to get to that point.

There is a warning sign regarding the primary power generation’s two main inputs: oil and gas. In the case of the former, the greatest obstacle to achieve an energy surplus strides in the growing difficulty that Pemex is facing to find new oil and gas fields. The aforementioned has an impact in production, due to a large portion of Pemex’s proved reserves (including 2p oil reserves) are formed by wells through which oil extraction is more complex and expensive. As for the latter, the obstacle for energy surplus relies on a limited infrastructure that distributes natural gas at low prices towards key points of demand. This situation has caused many critical alerts on shutting off supply that represent major costs for the country’s industrial activity.

I. Decrease in oil production and well exploration

In Mexico there exists a gap between the incorporation of reserves and crude oil production. While from 1960 to 2009, crude oil production increased by 838%, incorporation of reserves decreased by 3,725% from 1980 to 2010.\(^\text{10}\) In the face of that situation, the National Hydrocarbon Commission was ordered to procure the regulation of exploitation and extraction projects within Pemex to be done via restocking hydrocarbon reserves, as a guarantee of the country’s energy security.

From 2006 to 2011, oil production decreased by one million barrels of crude oil equivalent per day.\(^\text{11}\) This drop is apparently linked with two phenomena. Firstly, there is a drop in drilled exploratory wells. Between 1960-1979, more than 100 wells were drilled per year, which is a sharp contrast compared to the 57, 25, 67 and 37 wells that were drilled during the 1980s, 90s, 2000s and 2010-2012, respectively.\(^\text{12}\) Secondly, from a total of 262 fields containing oil and associated gas, 192 have either reached its maximum level of production (technically known as plateau) or are at a decline process.\(^\text{13}\) This means that approximately 3 out of every 4 fields in the country will not increase their production over the next years. The problem is aggravated when considering that 40% of the fields currently in a stage of development are part of the Chincontepec deposits.\(^\text{14}\)

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\(^\text{10}\) Source: Prepared by the authors using data from the National Hydrocarbons Commission’s *Hydrocarbon Index* report.

\(^\text{11}\) National Hydrocarbons Commission

\(^\text{12}\) Ibid.

\(^\text{13}\) Ibid.

\(^\text{14}\) Even though Chicontepec has 3p reserves that amount up to 2.2 billion barrels of crude oil equivalent per day, a large part of them are heavy crude oil. By having a greater density, its extraction requires different processes than conventional oil. Thereby, not only is it more expensive and has a larger impact on the environment, but only 6-10% of the resource can be extracted. (Source: Dr. Vinicio Suro Pérez, General Director of the Mexican Petroleum Institute).
II. Excess of demand for natural gas

Mexico is one of the countries with the largest natural gas reserves in the world. However, domestic gas production hasn’t been able to satisfy its demand, which increased by 246.3 million cubic feet per day in 2012. In order to satisfy that demand, over 73 million cubic feet of natural gas per day were imported to the country during that year. Demand will keep on growing and the ability to transport the resource throughout the country is not enough.

In the process of exploration and production, that is to say, the initial stage of the production chain (upstream), Pemex is releasing a considerable amount of natural gas. The aforementioned

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162011-2018 Natural Gas Balance, Secretariat of Energy
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phenomenon, better known in the industry as “winding”, happens for two reasons: firstly, due to the lack of infrastructure to capture and process natural gas that is associated with oil extraction and its main deposits; secondly, because natural gas is considered by Pemex as a low-value resource due to its low sale price. In 2008, Pemex wasted 18% of the natural gas produced. The amount of losses due to “winding” during the second half of the year amounted to 1.131 billion dollars at current prices. Though measures to tackle the issue have been taken, losses due to “winding” reached 300 million dollars\(^{17}\), and during 2012, losses of approximately 150 million dollars\(^{18}\) were reported.

\(^{17}\) Ángel Larraga Palacios, Country Manager at Fenosa México Natural Gas, Debating Energy.

\(^{18}\) Source: compiled by the authors using data from the Secretariat of Energy and the National Hydrocarbons Commission.
The excess of demand for natural gas in our country may be satisfied by the use of non-conventional gas. It is estimated that Mexico has the sixth largest shale gas reserves.\textsuperscript{19} Given the apparently worldwide availability of the resource, it is foreseen that its price will be lower than other hydrocarbons. However, technical considerations as well as possible negative consequences for the environment due to the process of hydraulic fracturing indicate that its common use within the Mexican energy basket is not feasible in the short term. As for the former, Pemex estimates that it would need to drill around 60 thousand barrels in the next 50 years, which, in turn require an amount of non-available investment under the company’s current regulatory framework.\textsuperscript{20} As for the latter, the International Energy Agency (IEA) has warned that as methane that is part of shale gas contributes to the greenhouse effect in a larger proportion than CO\textsubscript{2}, methane emissions released in the production chain ought to be strictly monitored.\textsuperscript{21}

Shale gas exploitation is intensive for water and may contaminate aquifers. This produces technical complications and environmental considerations regarding its use in Mexico, especially given the fact that most of the gas reserves are located in the North Eastern part of the country.\textsuperscript{22}

B. Certainty for the uninterrupted development of production activities.

Currently, Mexico cannot guarantee its users an uninterrupted energy supply, that is to say, a supply without constant power cuts that takes an important toll in the industry as well as the country. This is due to two reasons. Firstly, the country has a limited transportation infrastructure of natural gas, in addition to an inadequate distribution. Secondly, the waste of inputs and the money costs that the following problems cause: illegal taking of Pemex property; oil spills, leaks and natural gas burnings in the initial stage of the productive chain; non-technical losses in the generation of electric energy, as well as technical losses due to the obsolescence of the domestic electric sector’s infrastructure.

I. Infrastructure of network of limited transmission with security issues.

a) Gas and oil pipelines

The National Gas Pipelines System developed by Pemex – Gas and Basic Petrochemicals (PGPB) presents a series of problems that greatly affect users of natural gas. Firstly, according to SENER,

\textsuperscript{19} It was believed that Mexico was the fourth place worldwide, with 681 billion cubic feet, behind China, the U.S. and Argentina. However, new estimations provided by the U.S. Energy Information Administration indicate that Mexico has 545 billion cubic feet, a number 10 times higher than the natural gas reserves in the country.

\textsuperscript{20} According to Flavio Ruiz Alarcón, a professional advisor for Pemex, the investment that Pemex Exploration and Production would have to make in order to exploit shale gas amounts 60 billion dollars per year. A capitalization of the oil company could be made if contract schemes with private entities were to be allowed.


\textsuperscript{22} The aforementioned zone is considered by the National Institute of Ecology and Climate Change as one of great ecological vulnerability and with a high pressure on its hydrological resources. See Global Change and Hydric Resources in Mexico: Hydropolitics and Contemporary Conflicts Over Water, National Institute of Ecology, 2002, p. 25.
the National Gas Pipelines System operates with use levels of 85% or higher, an amount close to its capacity limit. Secondly, limits within the transportation between offer points and consumption points due to the lack of infrastructure in the pipeline network, make the importing of a greater volume of natural gas to satisfy the industry needs a virtually impossible ordeal. Finally, the National Pipelines System transports natural gas one-way only, which makes thousands of users, or in this case, full states, to be left out of fuel when technical faults occur within the network. As a consequence, critical alerts are generated regarding the resource’s directly and negatively affect the production activity. The amount of 22 critical alerts reported in 2012 amount up to 1.436 billion dollars, according to SENER and 2.2-3.3 billion dollars, according to the Mexican Chamber of Industry (CONCAMIN).

Another issue that is currently undermining a constant energy supply needed for productive activities and residential consumption is oil theft. According to SENER, this criminal activity costs the government 5 billion dollars a year. During the first four months of 2013, reported thefts rose from 377 to 730. Around 90% of these thefts are fuel-related.

A minor issue is the gas and oil leaks occurring within the pipelines network. According to CNH, during the 2000-2012 time period, 6.24 billion cubic feet of gas and 12.67 million liters of oil were leaked. The amount of leaked gas amounts to 1.32 million dollars and is equal to the average monthly consumption of 231 thousand families from 4 or 5 members.

b) Electric energy network

There is a low geographical interconnection within the Interconnected National System. According to SENER, up to 11.3% of the electric energy is lost in the transmission, transformation and distribution due to the aforementioned problem, which amounted 57 billion pesos in 2011.

In addition, the electric transmission network presents signs of age-related weariness and requires maintenance. According to the Federal Electricity Commission (CFE), almost half of the transformation sub-stations are over 26 years old, while half of the transmission lines are over 20 years old.

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23 Secretariat of Energy, 2013, op. cit. p. 22
24 Ibid, p. 22. An average annual exchange rate of 13.1613 pesos per dollar was established, based on the FIX exchange rate reported by the Bank of Me
25 Source: elaborated by the authors using the statements made by Francisco Funtanet, President of Concamin. An average annual Exchange rate of 13.1613 pesos per dollar was established based on the FIX Exchange rate reported by the Bank of Mexico on 2012, as well as a loss of between 100 to 150 million dollars due to a critical alert.
26 Information provided by Insight Crime, an independent research institution with headquarters at the American University, Washington D.C.
28 Ibid.
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Another aspect that damages the efficiency of the electric network is the loss in distribution for medium and low-tension energy, which, according to SENER represents between 13 and 14% of the total amount of the system’s electric energy. It is important to highlight that since 2006, the losses for illegal use (e.g. theft or informal trade) or non-technical losses, represent more than half of the total energy losses, reaching a 7.6% peak in 2011.

C. Lack of efficiency due to a symbiosis between Pemex and the State.

Mexican Constitution establishes that the federal government is exclusively responsible for the strategic areas of hydrocarbons as well as the owning and controlling of the decentralized institutions that may be established in this regard. Thereby, in the face of a context of nationalist industrial policies and import-substitution, on 1960 Congress established within the Regulatory Law of the 27th Constitutional article Regarding Oil, a vertical monopoly within all oil-related activities, which goes well beyond what was originally conceived in the Constitution as a strategic area of State exclusiveness.

In 1992, the separation of Pemex into several subsidiary bodies and a main corporate was designed due to the privatization of secondary petrochemical activities with the aim of increasing investment on the sector. Nevertheless, the role of Pemex as a State tool has produced highly expensive inefficiencies for the country’s energy sector:

1. The symbiosis between Pemex and the Mexican State forces the company to guarantee the country’s public finances, which makes it unproductive and prevents it from capitalizing and carry out productive energy initiatives. For years, Pemex was conceived as a world-class company, but numbers tell a different story. On one hand, the ratio of sales per worker in Pemex is 0.83, while this number increases to 2.44 and 4.89 in the cases of Petrobras and British Petroleum (BP), respectively. On the other hand, the production ratio of crude oil equivalent barrels per worker in Pemex was 24.47, while the figure increases to 28.89, 37.49, 38.86, 68.92, 76.79 and 78.38 for Petrobras, Shell, BP, ExxonMobil, Ecopetrol and Statoil, respectively.

2. In addition, competition issues are emerging in some of its subsidiaries. For example, PGPB processes, sales and transports natural gas but, at the same time, is affected by the monopolist status of Pemex Exploration and Production (PEP). PGPB is not only the main carrier of the gas molecule, but also its principal first-hand retailer. Nevertheless, it depends on PEP’s level of production since it cannot compete under similar conditions.

3. Given that Pemex’s complex internal functioning lacks a transparent accountability process, there exists practices that: have no market-oriented logic, do not generate reliable information for decision-making and project assessment at corporate levels. Thereby, the only subsidiaries of Pemex that reported a positive income during 2012 were

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32 Compiled by the authors using the Form 20-F, U.S. Securities and Exchange Commission.
PEP (93.982 billion pesos) and PGPB (1.613 billion pesos), partially offset by the large losses of Pemex Petrochemicals (-11.27 billion pesos) and Pemex Refining (-102.097 billion pesos).³³

D. A decreasing Operating Reserve Margin in the electric sector.

The electric generation’s Reserve Margin (RM) is defined as the difference between installed capacity and the electric sector’s maximum demand. If faults, maintenance and other variables are taken into account, it is known as Operating Reserve Margin (ORM).

When RM reaches such magnitude that it is able to address any contingency or adverse conditions, it becomes a guarantee of safety within the operation of an inter-connected electric system. The concept of energy security requires an ORM to be as the aforementioned guarantee, but not so much as to show excessive levels of energy storage, since they lead to obsolescence in electric power factories. That way, the need to determine what sort of ORM magnitude the country needs turns into a priority, given the fact that a low level negatively affects users of electric services since they are not poorly provided or not provided at all, while an excessive ORM level rises the cost of infrastructure by turning it unproductive.

From 2002 to 2011 there have been RM and ORM higher than limits below 27% and 6%, which are the ones recommended worldwide.

From 2002 to 2011, RM was higher than the minimum recommended percentage of -27%. However, as can be seen in the next chart, it is clearly declining, regardless of the growing

³³ Audited Financial Results Reports as of December 31st, 2012, Pemex
participation of private entities in electricity generation, whether as self-consumers or external producers.

Graph 7: Reserve margin is clearly decreasing

An excessive and expensive preventive storage of electric energy enhances power plants to become obsolete in the long term and diminish their generation capacity. In 2012, the ORM of CFE was lower than 6% due to the cease of operations of 17 thousand MW of generation for lack of maintenance and scarcity of natural gas.  

E. Unfair and perverse energy subsidies

Energy subsidies in Mexico are toxic: they provide negative incentives for consumers; promote the unequal distribution of public resources; and increase the negative externalities associated with fossil fuel consumption.

Toxic subsidies of liquid petroleum gas (LP gas), electricity and gasoline amounted up to 1.15 billion, from 2005 to 2011, which is equal to 10% of the average GDP during the aforementioned time period.

Subsidizing fuel is a complex activity, with a low allocative efficiency. It is not directly transferred through cash flow but through market mechanisms that start operating with Mexico’s artificial price management. As a consequence, Mexico is the only member of the Organization for Economic Co-operation and Development (OECD) that has net tax liabilities regarding fuel.

34 Francisco Rojas, Director General of CFE, May 2013.
Subsidizing electric energy represents a regressive vicious cycle for CFE. Other issues in addition to the aforementioned subsidy are: a) “implicit subsidies”, which are provided through clandestine takeovers and b) labor benefits of CFE workers. That way, by increasing the subsidy rate to users, CFE’s financial viability is undermined, and by increasing the cost of production per kilowatt in the medium term, subsidizing electric energy should rise as a compensation.

Mexico is the only OECD member with more expensive rates of electric energy for industrial production than for household consumption. IEA estimates that in Mexico, rates of 178.5 USD/MWh are paid; while in the rest of the OECD countries that figure is only 109.3 USD/MWh. At residential level, Mexicans pay around 145.2 USD/MWh, as opposed to the 159.4 USD/MWh paid by other OECD members.

The tax expenses associated with subsidies of fuel and diesel represent around 3% of the GDP. In addition, despite the fact that subsidies are considered as something that embraces social justice and compensation for vulnerable groups, it is actually one of the most regressive subsidies. According to IEA, 75% of the subsidies benefits the 40% richer part of the population and only 12.5% is distributed to the 40% poorest individuals. That way, 20% of the poorest part of the population only receives 4 cents per each peso spent on subsidizing fuel and diesel. Finally, subsidies to fuel and diesel enhances that 70% of the population that does not own any sort of automobile transportation pays for the other 30%’s daily mobility. This resource transfer rose to 3.153 billion pesos in 2010.

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37 Ibid.
38 Center of Research for Development civil association (in publication process), op. cit., p. 27.
39 Ibid, p. 27.
40 Ibid, p. 28.
41 Ibid, p. 28.
OECD estimates that, from 2005 to 2009, the amount of subsidies to fuel, diesel, LP gas and electric energy amounted to 1.5% of the average annual GDP. In 2008, 10% of the richest population received energy subsidies 9 more times than the amount of resources received by the 10% poorest part of the population. Thereby, the regressive subsidy is equal to: a) increasing 10 times the budget of the Oportunidades program; b) 4.5 times the total expenditure of programs such as Seguro Popular and Senior Adults; c) the construction of 650 thousand houses of social interest; d) 400 billion pesos for productive investments in SMEs; e) 400 billion pesos for developing electric energy using renewable sources; and f) 400 billion pesos for investments in productive capital for projects destined to marginalized communities.

F. Energy matrix that is highly dependent on hydrocarbons.

Maintaining an energy matrix that is highly dependent on hydrocarbons is not only an environmental issue, but also one of energy security, ever since it deals with supplying the market in the face of a low-production risk or a limit on hydrocarbon imports. Energy transition cannot be conceived as an isolated event that may take place once energy security has been acquired. Thereby, transition to a cleaner energy matrix is not a luxury once energy security has been achieved. It is a necessity.

Diversifying the energy matrix in Mexico is quite a commitment. On one hand, the General Law on Climate Change orders that non-fossil fuels should produce 35% of electricity by the year 2024. On the other hand, there is a goal for reducing greenhouse gases (GHGs) by 30% on the year 2020. Likewise, the Law for the Proper Usage of Renewable Energies and Financing the Energy Transition considers the aforementioned activities as public utilities, with the aim of reducing the dependence on hydrocarbons as a primary source for electric energy (2nd article).

Graph 9: To 2011, primary energy production depends on hydrocarbons

![Graph showing energy production](source)

Source: elaborated by the authors using data from the Secretariat of Energy’s National Balance on Energy.

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42 Ibid, p. 28.
44 Center of Research for Development civil association (in publication process), *op. cit.*, p. 27.
As of December 2012, almost half of the gross generation of electric energy is based upon mixed cycles technology, which require gas as an input. This implies a supply problem for generation plants that use that sort of technology. Firstly, as it was previously mentioned, Mexico is facing an offer scarcity of the aforementioned resource. Even though the current price of natural gas is low, given the limited importation capacity of the resource due to the scarce pipeline infrastructure, every time more natural liquid gas is imported. If additional infrastructure that allows a larger natural gas importation is not created, prices will rise in the long term.

Currently, CFE operates with an MRO well below the standard international levels and its gross energy generation largely depends on combined cycles, which in turn, regularly use natural gas. How can energy security be offered when gross generation of electric energy depends on a fuel whose supply is limited by a scarce dissemination network that cannot satisfy the country’s needs?

The fact that currently only 15% of the gross electric energy is produced using renewable sources is quite an alarming fact regarding the electricity production’s sustainability. The fact that approximately 80% of renewable energy is based on hydroelectric production should not be overlooked. In terms of energy security, concentration of energy generation in major hydroelectric factories is compromised with the dry season.

The strong mythological association of oil ownership with national sovereignty has tarnished the relevance that electric and renewable energy sectors have in guaranteeing the country’s energy
Energy security has the essential condition of diversifying the gross generation of electricity in Mexico, hence the need for renewable energies to acquire relevance. Nevertheless, this implies the additional challenge of generating an adequate regulatory framework. On one hand, regulation has to generate certainty among investors through programs of private participation in the capacity of electricity generation that take into account competitive and clear prices. On the other hand, despite that renewable energies generate virtually zero GHGs they do have an environmental impact, mainly linked to pressure that projects of electricity generation using renewable sources put on natural resources of potential zones, which ought to be closely followed by the corresponding regulating agency.

### III. WHY ARE ENERGY CHALLENGES CREATED AND BECOMING INCREASINGLY COMPLEX?

The previous section discussed the challenges that prevent the country from achieving its energy security. This section explains why those challenges were created and became increasingly complex. Firstly, CIDAC believes that decisions about the functions and development of the Mexico’s energy sector have been undertaken with a short-term view that gives Pemex a role as an arm of the State. Thereby, the strengthening of the company’s human and technical resources has not been prioritized nor has research and development programs that provide it with the capacity to be competitive. Secondly, Pemex has established an investment portfolio that is inadequate for the country’s resources. Particularly, it doesn’t have a defined business metric needed for well exploitation, whether it is on deep or shallow waters. Thirdly, there is no acknowledgment of the opportunity cost that the un-exploited resources in Pemex represent. The sustainable management of wells may provide the company a revenue source that could be invested on infrastructure or research and development and has currently been wasted. Finally, Mexico will not be able to reach its energy security while the idea that national sovereignty lies on oil ownership remains in the collective imagination. This ancient way of thinking ties and bounds Pemex and makes it take all the risks that the production activities dealing with hydrocarbons.

#### A. Short-term vision

The management of Pemex in the last couple of decades shows that its role as a promoter of national economic growth changed to become an instrument of short-term macroeconomic and

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46 For a discussion regarding the impact of the electric sector in the development of renewable energies, see Beyond Cantarell: Diagnosis and proposals to boost the development of renewable energies in Mexico. Center of Research for Development civic association, 2013.

47 For a diagnosis and proposals regarding the aforementioned, see Ibid.
tax adjustment. The sustainability of the country’s main energy source was endangered by intensifying crude oil production while at the same time restitution of reserves was neglected due to new discoveries and expenditure made on exploration and development.

The drop in Cantarell field’s oil production is a clear example of the short-term vision reigning over Pemex. Instead of designing a sustainable management of the field that could guarantee a larger crude oil extraction in the long-term, maximizing the amount of crude oil equivalent extracted in the shortest time possible became the top priority, regardless of the fact that this course of action would lead to the well’s prompt decay and decompression.

Scientific oil research in Mexico has been forgotten. Out of 2,148 institutions dedicated to scientific and technological research, only 122 study topics dealing with the oil industry. The Mexican Oil Institute (IMP), stronghold of oil research and the institution responsible of assessing technological advances that might increase Pemex’s production capacity, has been abandoned. With the exception of 2010, when the budget for IMP increased by 18%, the growth rate of resources destined to the aforementioned institute have not matched the financial needs of oil research.

Graph 11: Oil research resources increase in a slow manner

The vision of Pemex as a company that generates wealth for the country demands focusing on talent development for hydrocarbon research. The Institutional Postgraduate Program was created in 2002 with that purpose in mind. However, two facts point that such a program is not quite enough: the number of students enrolled in the PhD program went from 61 in 2006 to 28 in 2011; and the number of graduates went from 15 to 6 in the same time period. Additionally, IMP reported that the total of financial resources destined to the formation of human resources went from 66 million pesos in 2006 to 45 million in 2011.49

49 Mexican Oil Institute, 2013, op. Cit., p. 71.
B. Inadequate investment portfolio for Pemex.

Pemex is the number-one company for waste oil production in shallow waters. Nevertheless, inspired by the North America successful experience, Pemex intends to enter the deep-water fields exploitation and exploration business. Is such an action justified? The answer is yes, but taking these considerations into account.

According to CNH, 60% of historical production in Mexico has been extracted from fields within shallow waters, on the southeastern part of the country. Likewise, CNH estimates that 80% of the 2p reserves that were incorporated during the last decade come from the aforementioned basins. Given the differences between the shallow and deep water fields regarding the project timing, the technical and technological requirements, as well as the quality of resources and the cost structure, it is clear that Pemex has a greater experience and, thus, faces less risk while exploring and exploiting oil in shallow waters.

Regardless of the high risk that deep-water projects represent, exploratory investment in these sort of fields increased by 500% in the 2007-2012 period, going from 2.591 billion pesos in 2007 to 15.627 billion pesos in 2012.
According to CNH figures for the 2007-2012 period, for every 100 dollars invested in deep water exploration, between 14 and 23.5 barrels of crude oil equivalent were discovered, while at shallow waters, that number rose up to 147 barrels. This does not mean that the results of both types of fields may be compared, due to the technical differences that were previously mentioned. However, it does show that deep-water exploration and exploitation is a high-risk, costly activity. Additionally, it also shows that Pemex has not decided its involvement with such an enterprise, due to the obstacles that it faces regarding capitalization and investment on technology and human resources.

In Mexico, a large part of hydrocarbon resources can be found on deep waters, so leaving out the opportunity to exploit them is not an option for Pemex. The problem is that, in order to face the technical and financial difficulties of the deep-water projects, Pemex needs to cease being an arm of the State that is always absorbing every risk associated with them. Otherwise, instead of acting under an adequate business framework, Pemex decides to be part of these high-risk projects.

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50 The calculation range in deep-waters depends on the inclusion of Trión and Supremus. It was assumed that 3P resources of Trión range up to 436 million barrels of crude oil equivalent and the Supremus resources amount 198 million barrels of crude oil equivalent.
based on criteria that are not backed up by geological studies\textsuperscript{51}, and despite the high risk associated, it can be economically profitable.

\textbf{C. The opportunity cost of non-exploited resources is not considered by Pemex}

One of the main purposes of Pemex is to maximize the revenue obtained from oil production. That way, there is an emphasis on exploiting wells that have yet to reach their plateau or are about to reach it. Declining fields tend to be forgotten.

According to CNH, there are 60 fields that did not report production for months as of January 1\textsuperscript{st}, 2013. The production potential of them is 1,020, 2,287 and 4,608 million barrels of crude oil equivalent in 1P, 2P and 3P reserves, respectively. More than half of those wells (38) have over 10 billion barrels in 2P reserves.\textsuperscript{52}

The aforementioned implies that, taking into account 2P reserves, an average of 62 million barrels of crude oil equivalent have stopped being produced during 102 months. When considering the total of resources (1P, 2P and 3P), the inactivity of fields represented an annual loss of 343 billion pesos for the country.\textsuperscript{53}

\textbf{D. Misunderstood sovereignty}

The 1938 oil expropriation plays a key role in the collective imagination of Mexican society. Since then, oil and hydrocarbon ownership is linked in a somehow mythological manner with defending national sovereignty.

The current contract scheme of hybrid services under which Pemex operates the exploitation of oil and gas wells make it the only investor and, consequently, puts all inherent risk of exploring and producing. That way, while the company absorbs all losses in case of a failure, private oil companies charge millions of dollars for their participation without facing any kind of risk.


\textsuperscript{52} National Hydrocarbons Commission’s \textit{Hydrocarbon Index} report.

\textsuperscript{53} The following assumptions were taken into account in order to come up with the previous calculation: average production is equal to the average productivity of inactive wells; the amount of average production is 22.83 thousand barrels per day; the exchange rate is equal to $12.5 pesos per dollar; annual production is equal to 365 days; and the average crude oil price is $86.67 dollars per barrel taking into account the Mexican Oil Mix (MME) price.
IV. HOW TO MAKE THE TRANSITION TOWARDS ENERGY SECURITY?

Given that the energy challenges that Mexico faces are quite considerable, the transition towards energy security in the country is a process that cannot be put on hold any longer. For that purpose to be met, firstly, the Mexican State needs to implement a long-term vision that will grant independence to Pemex regarding its objectives and operations. That way, Pemex will be free to capitalize and reinvest its revenues obtained through extraction towards research and development, which will allow it to be efficient and competitive, as well as to have the capacity of sharing the risk that its production activity implies. In addition, long-term vision requires the country to diversify the energy sources to which the company can access. Secondly, Pemex needs to build an investment portfolio based on strengths, that is to say, to consider the risk of its assets in investment decision-making. Thirdly, the opportunity cost of unexploited resources of Pemex needs to be addressed. Any other way and the company will not be efficient or productive. Finally, a reconfiguration of the concept of energy security needs to be made, in such a way that its meaning changes from “doing everything all on their own” to another one that implies having the physical and human resources, as well as the institutions required for Mexico to use its energy sources efficiently but, above all, to allow our country to have access to inexpensive and quality energy.

A. Long-term vision.

A long-term vision means to decouple Pemex as an operative arm of the Mexican State and to provide it with the structure of an efficient and productive company. Any other way, Pemex will remain operating within a symbiosis that depends on political whims, and which affects the company decisions on exploration and production.

The aforementioned vision also demands a sustainable exploitation of oil and gas fields, particularly when it’s a super field that is susceptible of generating incentives of unmeasured exploitation in the short-term. The objectives of a tax balance with political ends cannot be placed over the future of the country.

Making the hydrocarbon industry to remain as a cornerstone in Mexico’s growth and economic development requires a substantial investment plan in oil well exploration. If energy security is pretended within a competitive global context and given that the energy needs of Mexican society are increasing, Pemex needs to enhance its capacity to find new fields. This can only be achieved through financial capitalization and diversifying risk with new partners.

A long-term strategy on energy ought to strengthen the formation of human resources that contribute to develop the technological solutions that Pemex requires facing the challenges that have been thoroughly specified in this report. In that sense, it is not enough with increasing the number of students enrolled in postgraduate and/or training programs, but it is also essential to
maximize the number of graduates that come from those programs and allowing their talents to be used in the benefit of Mexico.

A long-term vision that allows the country to enhance its production capacity requires for the infrastructure of the National System of Gas Pipelines to be able to provide gas to those areas that need it. In addition, the issue of gas “winding” should be addressed. The access to the aforementioned energy source is not possible if: firstly, considerable amounts of the resource are lost due to “winding” and leaks; secondly, the network is constantly operating at its maximum capacity, which generates saturation; and thirdly, the distribution network does not possess enough national coverage.

The exploitation of unconventional resources, such as shale gas, is not only in need of specific training and technology. If its exploitation does not seem feasible, infrastructure needs to be developed in order to transport it towards the points of demand, as well as to strengthen the Mexican environmental regulatory framework with the purpose of reducing the environmental impact of the aforementioned exploitation.\(^{54}\)

The country’s energy security demands diversifying the matrix of energy production. Despite that fossil resources are still found within deep waters, keeping a strong dependence on a non-renewable and highly polluting energy source\(^{55}\) cannot be considered as a long-term, sustainable strategy.

**B. Investment portfolio based on strengths.**

Pemex needs to have a strategy of investment that is not linked to serve political purposes of fiscal balance. Currently, oil revenues represent 32.8% of the public sector’s budget.\(^{56}\) This turns Pemex into an operative arm of the Mexican State, which promotes that the company’s investment decisions, instead of being directed towards efficiency and risk management of its portfolio, turn out to be submissive towards criteria of maximizing the available oil resources in the short term. Pemex could maximize its efficiency if it allocated its resources towards the exploitation of those fields that it currently has more experience on, as well as having the needed technology and technical know-how.

The aforementioned does not mean that Pemex should abandon exploring and exploiting deep-waters, especially because the hydrocarbon industry sees that source as the most important for the energy future of nations in both the short as well as medium term. Nevertheless, for that adventure to be made possible and profitable, Pemex needs to use its resources freely or have the ability of acquiring them through international markets. Pemex even needs to share the capital

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\(^{54}\) For the aforementioned to occur, one can make use of the recommendations on good practice. See International Energy Agency, 2012, *op. cit.* p. 17-52

\(^{55}\) It is estimated that the transformation of microorganisms found on oil takes between 50 to 70 million years.

\(^{56}\) Secretariat of Public Finance’s Accurate Statistics, Data as of April 2013.
risk as well as operating with third parties. Only that way will financial capital, as well as technological and human capacity, be ready to face the technical challenge that the full exploitation of hydrocarbons in the Gulf of Mexico implies, given the fact that they’re between 500 and 3200 meters underwater.

C. Acknowledging the opportunity cost of non-exploited resources.

The objective of Pemex cannot be reduced to maximizing oil revenues only, but also to be the spearhead in acquiring national energy security.

Pemex needs to acknowledge the opportunity cost that the non-exploitation of fossil resources of declining fields imply.

The expected revenue that these resources represent could be used in investment programs for training its employees in order to face the technical challenges of deep-water exploitation.

D. Rethinking the concept of national sovereignty.

The etymological root of the word sovereignty, *super omnia*, means “above all things”. The exclusive ownership and exploitation of natural resources that belong to the country should not be “above everything else” when that constitutes an obstacle for the country’s growth and economic development. That way, national sovereignty should be closely linked with Mexico’s energy security, that is, an energy supply that ensures uninterrupted industrial, commercial and social development rather than oil itself.

Rethinking the concept of national sovereignty implies accepting that the global and national’s energy future demands companies to establish associations in order to fulfill society’s demand. The Mexican State does not cease to be sovereign if Pemex is enabled to celebrate a contract with a private company in order to share a common risk, in such a way that Pemex enjoys the benefits of oil revenues and the private company obtains a profit for the capital that it invested.

Finally, Pemex’s net debt at the end of 2012 amounted to 667 billion pesos, that is to say, 33% of its total assets.\(^57\) Though it cannot be yet qualified as a hazardous level of debt, the idea of national sovereignty that encompasses the motto “all Mexicans are owners of the country’s oil” still remains on the collective imagination, thereby not allowing Pemex to efficiently address all the challenges that may come their way and, thus, putting the nation at risk.

\(^{57}\) *Audited Financial Results Reports as of December 31st, 2012, Pemex*
V. MEXICO’S ENERGY SCENARIOS

The previous sections have described a country that currently has serious energy issues: oil uncertainty; an excess of demand of natural gas; uncertainty regarding the electricity supply; an obsolete electric transmission network; market inefficiencies due to Pemex’s monopolistic structure; inefficient and perverse energy subsidies as well as an energy matrix that is highly dependent on hydrocarbons.

If one decides to ignore those issues, the inevitable future of Mexico will be facing a major problem of energy security, characterized by: the cease of productive activities, high opportunity costs on non-exploited resources; operative inefficiency and adverse effects due to energy subsidies; low capacity of investment in research and development; a Pemex that is hurt and unable to be a relevant actor within an increasingly competitive sector; and low or zero economic growth and development.

If, however, both interested parties are open to debate and focus upon the technical solutions that such complex problems require, while leaving political considerations aside, Mexico will have an energy supply that: will count on Pemex as an efficient and productive company; that it will have a large network of natural gas distribution; that it will provide a well exploration that is filled with criteria of investment portfolio based on strengths and that it recognizes the costs of opportunity of non-exploited resources; and, that it keeps a sustainable energy matrix with a higher participation of renewable energies. All of the aforementioned shall be done with the purpose of providing the energy sector as the engine of economic growth and development in the country.
Mexico with a supply shortage by 2023

- Interruption of productive activities
- Mexico with a supply shortage by 2023
- High costs of opportunity with non-exploited resources
- There is no growth or economic development
- Pemex with a low competitiveness in a sector with a new geopolitical arrangement
- Sustainable energy matrix
- High economic growth and development
- Exploration with criteria of investment portfolio and acknowledgement of opportunity costs

Mexico with an energy supply

- Large natural gas network with the ability to supply it throughout the country

Mexico 2013

- Decreasing Operative Reserve Margin
- Obsolete electric network
- Market inefficiencies due to a symbiosis between Pemex and the State
- Inefficient energy subsidies
- Excess of natural gas demand
- Energy matrix dependent on hydrocarbons
- Low investing on I&D

Pemex as an efficient and productive company

Sustainable energy matrix

High economic growth and development

Exploration with criteria of investment portfolio and acknowledgement of opportunity costs

Mexico 2013

- Inefficient energy subsidies
- Energy matrix dependent on hydrocarbons
- Excess of natural gas demand
- Low incorporaton of reserves and a decrease in crude oil production

Market inefficiencies due to a symbiosis between Pemex and the State

Obsolete electric network

Decreasing Operative Reserve Margin

An Energetically Insecure Mexico
VI. CONCLUSIONS

If the current strategy continues, the Federal Government will not be able to guarantee the access to energy that the country needs for its economic growth. To achieve this, CIDAC believes these points should be addressed:

I. Pemex should not maintain its symbiosis with the federal government and its role as an arm of the State, given the fact that it creates economic uncertainty and a patrimonial damage to the nation. The minimum required change for the company is to provide it with a freedom to invest its oil revenues on technology, infrastructure and human resources.

II. Pemex should not function as a short-term tax balancer. It needs to be an efficient and productive company with an investment portfolio that is designed to exploit its strengths and to take risks by sharing those projects that are both expensive and underdeveloped.

III. Pemex’s Administration Council needs to acknowledge the cost of opportunity of declining wells that are not currently exploited.

IV. The network of the National Gas Pipeline System, as well as the National Interconnection System, ought to be looked upon as the cornerstone of the country’s access to energy. Even though the costs due to leaks of natural gas and oil spills have no relevant order, the problems of electricity and oil thefts as well as natural gas “winding” do. The unacknowledged cost of opportunity of these resources is represented by an improved network of gas transportation and modern electric facilities.

V. The transition towards renewable energy has to be understood as an essential part of the country’s energy security. It has to enhance the conditions for diversifying the country’s energy basket. CIDAC will be publishing a policy brief that analyzes thoroughly such a needed transition.

VI. Energy subsidies are regressive and oppose the transition goal towards renewable energy. Due to the fact that they affect the rest of the country, they ought to be eliminated.

VII. Promoting a shift in the paradigm regarding national sovereignty. If the aforementioned recommendations are not influential in the decision-making regarding Mexico’s energy security, “the country can end up without its oil, but also without its industry”.

58 “The true urgency”, Luis Rubio, CIDAC.
An Energetically Insecure Mexico

Energy security is the cornerstone that will determine the path that Mexico will go through in the next decades. In order to make the best possible decision, the road of which path we want the country to follow must draw away from ideological passions and myths that have been gathered within our society’s collective imagination. On the contrary, it has to be backed up by technical and informed arguments, always keeping in mind that the main target is to guarantee the best possible conditions for Mexico to reach an economic development that will benefit its population.
APPENDIX:

**What is energy security for the different political parties?**

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<th>MORENA⁵⁹</th>
<th>PRD</th>
<th>PRI</th>
<th>PAN</th>
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<td>It’s an essential component of national security and a key element for the country’s modern and sustainable development. Likewise, it’s the basis for a national energy strategy that will address long-term requirements and will constitute an energy policy decided by Mexicans in order to satisfy their own needs. Energy security implies protecting sovereignty, or in other words, defending Mexico’s oil.</td>
<td>It’s the ability that the country has to adapt and develop the necessary technology that will allow it to be energetically self-sufficient. Additionally, the energy security ought to be guaranteed for future generations in an abundant, continuous, inexpensive, diversified and high-quality manner.</td>
<td>It’s the ability that the country has to sustain an energy surplus that provides certainty that production activity and inputs will ensue. Likewise, energy security involves addressing issues in which energetics whose dependency on imports might increase to dangerous levels.</td>
<td>It’s the diversifying of availability and use of energetics that will ensure the infrastructure for a sufficient, trustable, high-quality and inexpensive supply. In addition, it ought to satisfy the basic energy needs of the current and future population, as well as to develop the human and technological capabilities needed for production and an efficient energy use.</td>
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⁶⁰ Even though the National Regeneration Movement (MORENA) is not a registered political party, its concept on energy security was included in order to include a broader range of definitions.
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About CIDAC

Centro de Investigación para el Desarrollo A.C. is an non-profit independent think tank devoted to the study and interpretation of Mexican reality and the presentation of viable proposals for the development of Mexico in the medium and long term. It formulates proposals that: contribute to strengthening the rule of law and creating conditions which encourage the economic and social development of Mexico; that enrich public opinion; and that contain the elements necessary to be useful in society's decision-making process.