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Technology Transfer and Energy Reform in Mexico

Javier Martínez-Romero, Ph.D., Summer Visiting Scholar, Mexico Center

INTRODUCTION

As the implementation of Mexico's historic energy reform gets underway, the debate has tended to overlook a key question at the intersection of technology and the new legislation: How can Mexico create an institutional framework supported by policies, laws, and organizations to facilitate technology transfers and foster local innovation? Simply put, how will international oil companies (IOCs) transfer technology to Mexican companies and research facilities? What technological advancements in and for Mexico will accompany foreign investment in the energy sector?

These questions are central to the success of the reform. Mexico expects both capital and technology to flow into the energy sector, and, in turn, reinvigorate its hydrocarbons potential. This expectation, so far largely implicit, is based on several key facts. First, Mexico's education system is not churning out enough engineers to satisfy future demand.¹ At the same time, Mexico does not have the technology to tap into deep-water reserves. Finally, there is a lack of a substantial base of specialized services and suppliers in the domestic energy industry. Thus, in terms of technology transfers, the approach taken by the government in the energy sector appears similar to other liberalization processes. It rests on the notion that market competition can be achieved by lifting regulations that once prevented capital and technology from entering the national market. The assumption is that all interested players

would not only be free to enter the market but also to bring with them the appropriate technologies, with the final result being one of overall economic efficiency.

Needless to say, this has not been the case for many sectors in the recent history of Mexico, which have, in fact, suffered from suboptimal capital investment and technological flows. Recent industrial development policies in Mexico do not give reasons to be optimistic; for instance, local inputs for the maquiladora industry do not exceed 5 percent. Consequently, without a comprehensive strategy to transfer technology and then cultivate local research and development (R&D), the new energy policy may yet fail to live up to its expectations. Given the potential of the energy industry to trigger economic development in different sectors, technology transfers and R&D should receive much more attention and resources explicitly embodied in a strategic policy. Not doing so would only compound the effects of the already small percentage of public expenditures that goes into R&D, well below the recommended level.² Worse, the recent drop in oil prices may prevent the flow of foreign capital in quantities previously expected, possibly resulting in an inadequate supply of resources and insufficient technology transfers.

This issue brief discusses the ways in which the energy reform and enabling legislation seek to support technology transfers, R&D, and innovation. It then examines recent changes in the regime of the *Instituto Mexicano del Petróleo*³ (IMP), the industry's R&D organization. Finally,



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a brief presentation of the technological forces shaping the international oil industry highlights some ideas for potential technologies worth pursuing in Mexico.

TECHNOLOGY PROVISIONS IN MEXICO'S ENERGY REFORM

Contrary to a purely market-driven approach, Mexico's energy reform includes some elements of a state-led industrial policy.⁴ For instance, along with the Ministry of Economy, the Energy Ministry is expected to establish a strategy for the industrial promotion of local production chains. Special attention is given to small and medium enterprises (SME). By design, part of this strategy includes financial assistance, technical assistance, and partnerships between foreign and national companies. There are also some regulations regarding local content and local employment with which the foreign companies must comply. These objectives, among others, are meant to facilitate technology transfer to local Mexican players, but the government currently lacks a concrete strategy for enforcing these provisions. Unfortunately, it may not be in a position of strength to demand compliance. This is because it is in great need of capital flows to the sector and because there may be an important gap in local and foreign capacities, meaning full technology transfer would not be a cost-efficient option for foreign players.

The reform also creates the Mexican Petroleum Fund for Stabilization and Development, which, if sufficiently funded, will finance projects for future technological development in the energy sector. The creation of this fund is a novel addition to the set of institutions that should strengthen the energy sector in Mexico. On paper, the fund guarantees access to financial resources to improve and modernize the Mexican energy industry. Competition for these funds, however, will be fierce. Savings from it will, for example, not only be used for science, technology, and innovation related projects, but also for other uses like maintaining the pension system. Retirement pensions are a particularly onerous fiscal

burden on the Mexican federal government, and they are likely to require a sizeable portion of the fund. Moreover, funds will be available only when a surplus exists.

It makes sense that Pemex should play a leading role in the post-reform era. The reform explicitly allows Pemex to carry out the R&D required in the petroleum, petrochemical, and chemistry industries—that is, in the entire energy R&D chain, up and downstream—through the IMP or a specialized third party. But it is crucial to note that the law merely opens the door for Pemex to engage in these activities without making them mandatory. It is also worth noting that the IMP is only mentioned marginally in the new legislation, even though the IMP should probably be a key player in technological development.

THE ROLE OF THE IMP

The IMP was created in 1965 to be the technology development branch of Pemex.⁵ This arrangement was meant to aid in achieving technological independence for the country's hydrocarbons industry. At the time, Mexico followed an import substitution industrialization economic model. Although this national development policy had flaws and critical contradictions, it did create an institutional context that nurtured technological innovation processes in specific industries.⁶ In the case of the oil industry, for instance, Pemex and the IMP had a close relationship that allowed the IMP to produce cost-saving technologies for Pemex.

Without close collaboration between Pemex and IMP, it would have been difficult for the latter to build technological capacity.⁷ This is because IMP lacked the capacity to produce its own fluid catalytic cracking technology and its product, catalyst—the organization's main technological development. Therefore, IMP had to contract foreign companies in order to do so. Once the catalyst was produced, IOCs required pilot testing before introducing it to their processes, which the IMP was unable to do because no agent in the country had appropriate testing facilities. Pemex stepped in at this stage and agreed to buy and use

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these IMP technologies without requiring the pilot test. Thus, there are two important lessons of the Pemex–IMP relationship. On the one hand, it helped IMP accelerate its learning process, which benefitted Pemex as well; on the other hand, it prevented IMP from developing full-scale engineering and production capabilities, which limited its ability to serve other markets.

In some cases, this symbiotic relationship created significant savings for Pemex because it did not have to procure these technologies on the international market. At the same time, however, the IMP never developed technology commercialization and marketing skills because it only operated for a single client.⁸ Paradoxically, while the IMP was considered a symbol of technological sovereignty, in order to produce its proprietary technologies it was dependent on foreign companies. Moreover, although there are some exceptions, the organization failed to fully deploy its knowledge and expertise in global, or at least regional, markets.⁹

It should be noted, however, that although Pemex has funded most IMP projects, accurate accounts are available only for those that were successful; thus, cost-benefit assessments of this relationship are hard to calculate.¹⁰ This was perhaps an argument against continuing this institutional arrangement. In any case, in the new arrangement, Pemex will not be funding IMP research. The IMP will have to obtain its own resources by selling its products and services and profit from developing, commercializing, and marketing its own intellectual property.

TECHNOLOGICAL KNOWLEDGE BASE IN THE OIL INDUSTRY AND POLICY CONSIDERATIONS

Although there are important lessons that can be drawn from the IMP experience, it is clear that the new industry landscape calls for ways to deal with current technological challenges. Therefore, it is critical to know which technological fields are changing the landscape of the industry and how these changes have an impact on the different players that participate in the industry.

New upstream technologies in the industry seek to extract oil from increasing depths, tap into tight oil, and rejuvenate old oil fields.¹¹ This is particularly relevant for Mexico, as the government and other proponents of the reform often point to Pemex's lack of technology for deep-water development, shale operations, and revival of the country's once prolific conventional resources—like the Cantarell field—which have seen dramatic drops in production. In developing these more unconventional resources, IOCs will play a leading role. However, there is not much in the new laws to encourage technology transfer from IOCs to Pemex or smaller- and medium-sized Mexican companies in the supply or service sectors. This is not to say that this will not happen, but a lack of specific legal provisions for technology transfers may fail to incentivize IOCs to share their technology and expertise—a presumed ultimate goal of energy reform. Experiences like that of Petrobras in Brazil show that national oil companies can be at the forefront of technology in some fields, but Mexico seems not to have structured this goal into the law. Although IOCs are still dominant players in the industry, oilfield service companies have increasingly gained considerable space in the upstream value chain.¹² Service companies have a greater propensity to patent their inventions and their levels of innovation generation are on par with IOCs. In general, the oil industry has undergone vertical disintegration of its fundamental structure. Increasingly, IOCs play the role of system integrators, with other companies performing specific tasks. As in other industries, this is done to share the risks of ever-rising costs, comply with new environmental regulation, access new ideas, and focus on comparative advantages.

This is particularly relevant for Mexico, which lacks a domestic upstream oilfield service sector. Pemex's absolute monopolistic position under the old legislation was in fact the culprit for the absence of Mexico's oilfield service companies. Mexicans were simply barred from investing in the sector. The dearth of such companies led Pemex to contract out much of its specialized oilfield services work

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to foreign firms. Without legal provisions for technology and knowledge transfers, there may be further delays in the development of a domestic oilfield service industry.

A comprehensive energy policy for Mexico must contemplate several factors, some of which have been discussed here. However, financial restrictions and the current state of technology development pose severe limitations on the potential policies the country can execute.

It is also worth noting that while this issue brief has focused on upstream operations, growth in the downstream of the industry might be more promising. Downstream activities like refining and petrochemical manufacturing can produce a variety of products, such as chemicals and fertilizers, which are of use in several industries.¹³

FINAL COMMENTS

The upstream segment of the oil industry is still dominated by IOCs that have the technological prowess Mexico requires to develop its deep-water and shale resources and to rejuvenate aging plays. Opening the doors to foreign investment in those areas is a step in the right direction. The energy reform does acknowledge technology transfer, particularly in terms of promoting production chains, local content, and foreign-domestic partnerships. However, a stronger policy framework is needed to realistically encourage such cooperation. A mandatory technology transfer from IOCs to Pemex or to another Mexican organization, for that matter, could help achieve this goal. This mandate, however, could also be a deal-breaker for these companies, which could see these technology transfer requirements as too onerous. Thus, the incentives have to be calibrated carefully.

Creating the institutions and policies to encourage technology transfers and domestic R&D should be a priority in the post-reform era of the Mexican energy industry. Though not easy to develop, such institutions and policies should contain specific technology and knowledge objectives based on a combination of transfers and domestic development. Given all the effort that has

gone into reforming the energy sector, it would be a mistake to miss this chance to encourage technological development in the industry and support national economic development goals.

ENDNOTES

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AUTHOR

Javier Martínez-Romero, Ph.D., is a social sciences professor and researcher at Universidad Autónoma de Ciudad Juárez and a 2015 summer visiting scholar at the [Mexico Center](#). His research focuses on dynamics of industrial clusters and innovation policy. Martínez-Romero earned his Ph.D. in administration with a concentration in technology management from Université du Québec à Montréal and his master of science in economics and technology management from Universidad Autónoma Metropolitana in Mexico City. His work has been published in *Innovation and Development* and the *International Journal of Technology and Globalisation*.

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