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SHALE DEVELOPMENT AND THE ENVIRONMENT

Policy Lessons for Latin America

Jed Bailey and Lisa Viscidi

As the world's top – and only significant – producer of shale oil and gas, the United States has the greatest experience in designing and implementing environmental regulations for the industry. Although the basic technologies used for shale development – such as horizontal drilling and hydraulic fracturing – have been in use for decades, only recently have technological advances allowed for profitable development of this resource. As a result, shale development is still a relatively young industry, with rapidly changing technologies and processes as companies seek to reduce costs and improve the productivity of each well drilled. Pressure to cut costs and boost productivity is particularly acute in the current low oil price environment, further accelerating the pace of innovation. As the industry evolves, so too must the regulatory regime that governs it. This is particularly true of environmental regulations, as changing practices may create new environmental risks or mitigate old ones.

The US experience demonstrates that with adequate resources and flexibility for federal and local regulators to set and enforce regulations the risks from shale development can be mitigated. Robust data collection, proactive communication between industry players and with the public and timely disclosure of information such as the contents of fracking fluids are also crucial. Indeed, the United States has already implemented regulations that address many of the potential environmental impacts of shale development, such as water contamination and air pollution. Other possible risks, such as earthquakes resulting from wastewater disposal, are still being studied. While our understanding of the environmental impacts and best practices for regulation continues to evolve, the US experience to date offers many lessons to other countries looking to develop shale reserves.

As Latin American countries reassess their energy policies amid low oil prices, they can apply lessons learned in the US to mitigate environmental risks and attract investment.

Foreword

I am pleased to present "Shale Development and the Environment: Policy Lessons for Latin America," a report by Jed Bailey, Managing Director at Energy Narrative, and Lisa Viscidi, Director of the Energy, Climate Change and Extractive Industries Program at the Inter-American Dialogue.

Although shale oil and gas development is still incipient in Latin America, several countries in the region hold sizeable technically recoverable reserves. Governments in these countries and others around the world are seeking to develop their shale resources but are also concerned about the environmental impacts.

This report seeks to shed light on the policy debate in Latin America by clarifying current understanding from the US experience about the potential environmental risks of shale development and strategies for mitigating those risks through regulation, data collection and sharing of information and best practices. The report analyzes how lessons from the United States – the only country in the world with considerable experience producing oil and gas from shale formations – may be useful for policymakers, companies and nongovernmental organizations (NGOs) in Latin America. The report reviews case studies in Argentina, Mexico and Colombia, three countries where governments are particularly interested in developing their shale oil and gas reserves.

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The Dialogue's Energy, Climate Change and Extractive Industries program informs and shapes policies that promote investment while encouraging economically, socially and environmentally responsible development of natural resources. The views expressed in this report are those of the authors and do not necessarily reflect the perspectives of the Inter-American Dialogue or its partners or sponsors.

MICHAEL SHIFTER
President

This report seeks to shed light on the policy debate in Latin America by clarifying current understanding from the US experience about the potential environmental risks of shale development and strategies for mitigating those risks.

Latin America is one of the regions with the greatest potential for shale development outside of the United States, according to US government estimates of global shale reserves.[1] Argentina is the only Latin American country currently producing commercial quantities of oil from shale deposits, with output of over 50,000 barrels of oil equivalent per day.[2] Colombia awarded its first contracts for drilling in blocks with potential shale deposits in 2012 and established regulations for exploration using hydraulic fracturing in 2014.[3] Mexico's state oil company Pemex produced its first shale gas in early 2011 from an exploratory well and plans to auction unconventional fields as part of its first competitive bid round since the oil sector was opened to private investment.[4]

All three countries are undergoing seismic shifts in energy policy – Argentina recently elected its first market-oriented government in years, Mexico is enacting a sweeping energy reform and Colombia is overhauling its oil sector incentives to attract investment amid lower oil prices. As these countries reassess their shale development policies and incentives in light of lower oil prices, there is an opportunity to apply lessons learned from the US experience to enact regulations that mitigate environmental risks and strengthen public support while attracting investment.

The following sections analyze the key environmental risks of shale production, lessons learned from the US experience and how they apply to the critical challenges currently facing regulators in Argentina, Mexico and Colombia.

Shale environmental impacts and regulation

Like the traditional oil and gas industry, shale exploration and development have the potential to damage the environment and pollute water, air and land. The novel processes and technologies used to develop shale can create specific environmental concerns, from proper disposal of wastewater to a heightened potential for methane leaks. In addition, much of the largest shale deposits in the United States are located in areas that have not traditionally had a sizeable oil and gas industry. The rapid growth of this new heavy industry can create friction with local communities and has contributed to public backlash against shale development in some communities.

Within the United States, various federal laws establish the legal and regulatory structure governing the environmental impacts of oil and gas development. Each law was enacted

HOW SHALE WELLS ARE DRILLED

Shale development follows a similar process to traditional oil and gas development. A potential well site is prepared on the surface by clearing the area, building access roads and on-site structures and erecting the drilling rig and support mechanical equipment. The well is then drilled down to the shale resource and horizontally along the shale rock to provide a greater volume of the shale to be fractured. Many drilling rigs are able to drill multiple horizontal wells in different directions and at different depths within the shale deposit to get the maximum production from the same drilling pad (see Figure 1).

A water, chemical and sand mixture is then pumped into the well and subjected to sudden high pressure to create a shock wave that fractures the rock. The shock wave also forces the sand in the mixture into the newly created cracks, allowing the oil and gas held within the rock to escape into the well. The well is then connected to a gathering pipeline or local storage container and starts to produce. Much of the water used to fracture the rock also returns to the surface during this initial production. This wastewater is typically put into disposal wells that are drilled into deep rock formations away from any underground aquifers.

Shale wells tend to have a large initial surge as the fracturing process liberates the trapped oil and gas, but this initial production falls off very quickly. Additional wells can then be drilled in other directions to fracture a different section of the shale and boost production.

well before shale development became a significant source of oil and gas production and the associated regulations have been adapted over time to better address the specific challenges of shale development. The most important are the Safe Drinking Water Act (SDWA), which governs groundwater and other drinking water sources, the Clean Water Act (CWA), which governs surface rivers and bodies of water and the Clean Air Act (CAA), which governs all air-borne pollutants.[5] These laws are enforced at the federal level by the Environmental Protection Agency (EPA) and at the state level by a number of similar agencies focused on water, air and land quality. Each oil-producing state also has specific requirements for hydrocarbon development, such as permitting, reporting and restrictions on water and air pollutant discharges.

Water

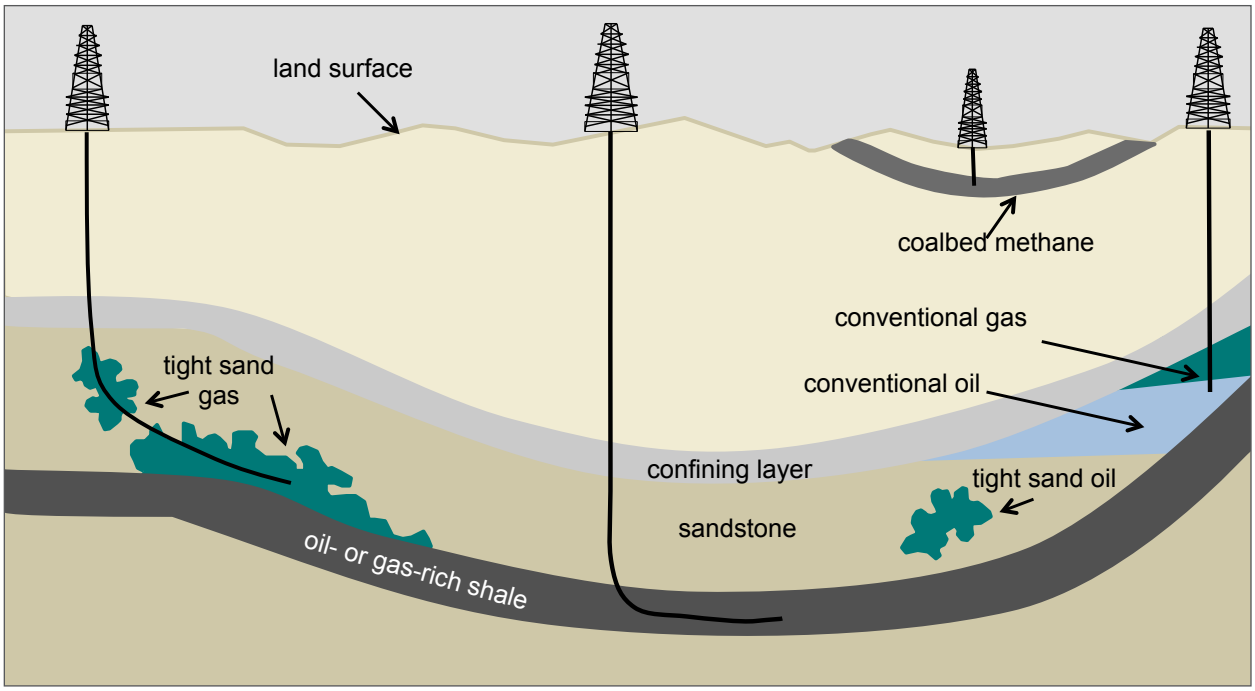
Hydraulic fracturing uses water mixed with an array of chemicals and additives, in addition to sand and other particles. Millions of gallons of this "slickwater" mixture are used in each fracture operation. Approximately one quarter of the volume returns to the surface, often with additional contaminants picked up from the source rock itself, and is then reinjected into separate disposal wells.[6]

Shale development can endanger water resources in a number of ways: through improper disposal of the fracking waste water, by contaminating underground aquifers with oil or natural gas escaping from the well or by spilling chemicals or oil into rivers or other bodies of water.

Under normal operations, the risk of water contamination is minimal. As each well is completed, the upper portions are lined with cement, a process called casing. When properly completed, well casings prevent the natural gas or oil produced from the well from leaking into the surrounding rock. Because well casings extend deeper underground than any aquifer from which drinking water is sourced, the producing well remains sealed off from the drinking water supply.[7]

The EPA oversees enforcement of minimum federal water environmental standards under the authority of the SDWA and the CWA, and states have additional requirements for well construction and operations to prevent water pollution. The EPA requires oil and gas operators to inject waste water into underground disposal wells, prohibiting them from discharging industrial waste water into surface water bodies such as rivers and lakes.[8] Oil and gas developers must also report any accidental spills that may affect navigable waterways and prepare and implement plans to control and clean up potential spills.

FIGURE 1: SHALE AND CONVENTIONAL OIL AND GAS DEVELOPMENT
Source: US Environmental Protection Agency



In June 2015, the EPA released a draft report summarizing the results of a multi-year study, which noted that although there are specific instances of water contamination from shale development, the number of cases was small relative to the number of shale wells. In this draft report, which is now undergoing public review and comment, the EPA did not find evidence of widespread, systemic impacts on drinking water resources.[9]

Environmental advocates have also raised concerns about the volumes of water used in the hydraulic fracturing process, which vary widely, from 2 million gallons (7.6 million liters) per well in some shale plays to as many as 16 million (60.6 million liters) in others.[10] Total water volumes used for hydraulic fracturing are small relative to other water uses, particularly for agriculture. However, many shale plays lie in arid regions with limited water resources, making the highly water-intensive drilling process a major concern. To address potential water shortages, operators can sometimes tap underground saline aquifers that meet their technical requirements but are unsuitable for drinking or agriculture, treat and re-use a portion of their produced water or bring water to the drilling site by truck.

Air

Shale development can affect air quality through the production process with the release of dust and exhaust from truck traffic and emissions from diesel-powered pumps and drilling equipment. Air quality can also be affected by the intentional flaring or venting of gasses or unintentional releases, for example, through faulty equipment or operational error. At the local level, pollution from trucks and pumping equipment is of greatest concern. This pollution is similar to trucks or heavy equipment used in any industry, so the main social impact comes from the rapid rise in shale activity in areas that have not traditionally had oil and gas exploration, such as rural Pennsylvania.

On a global level, the greater concern is the release of methane, a potent greenhouse gas. Shale wells can release some 230 times more natural gas and volatile organic compounds that can create smog and other local pollution than standard wells.[11] This is potentially due to the reflux of the fracking water and surge in natural gas production just after the initial hydraulic fracturing process.

The Clean Air Act (CAA) gives the EPA authority to set air quality standards for specific air pollutants (now including greenhouse gases) and to regulate emissions from mobile and stationary sources. For the oil and gas sector, the CAA governs emissions from diesel engines in trucks and motors used in pumping the hydraulic fluids as well as fugitive emissions from operations. These emissions and air quality standards are reviewed periodically and have been tightened since the CAA was initially passed.

Shale wells can release 230 times more gas and volatile organic compounds than standard wells. In 2015, the EPA proposed rules requiring companies to capture methane pollution at new wells, set emissions standards for new equipment and detect and repair methane leaks.

In 2012, the EPA issued the first changes to emissions standards, establishing air pollution standards for natural gas hydraulic fracturing and other modified oil and gas operations. The new rules, which came into effect in 2015, affect well completions for hydraulically fractured natural gas wells and storage vessels used at well sites. They also require oil and gas production facilities to report greenhouse gas emissions (including CO2, methane and nitrous oxide) from all sources if annual emissions are greater than 25,000 metric tons of CO2 equivalent.[12] In 2015, the EPA also proposed new regulations that would require oil companies to capture methane pollution at new wells, set emissions standards for new oil and gas equipment and detect and repair methane leaks. States have also introduced new regulations to limit emissions from oil and gas activity.

Land

On the surface, shale hydrocarbon development can affect the environment and wildlife populations through clearing and ground preparations for drilling pads and new access roads, as well as greater human activity and vehicular traffic. Rapid development of this new industry can create socio-economic dislocations in areas with little supporting infrastructure or experience with heavy industry.

Most land use permitting is done at the local and state level. As most shale development is done on private land that is not owned by the oil company, shale developers must receive permission from the landowner to make any changes to the surface area surrounding the well. These contracts generally include provisions to return the land to its previous state once the well is no longer operational.

In addition to potential damage to the land surface, shale development has been linked with increased numbers of earthquakes. Since 2009, the central and eastern United States has seen a notable increase in moderate earthquakes.[13] The US Geological Survey (USGS) is still studying this phenomenon, but it appears to be linked to the use of water disposal wells as opposed to the hydraulic fracturing process itself. Wastewater from both hydraulic fracturing and traditional oil and gas development that is injected into disposal wells appears to be flowing into the rock formations, lubricating natural fissures and allowing them to slip more readily, creating increased low-intensity earthquakes. The potential impact of hydraulic fracturing and wastewater disposal on seismic activity depends on various factors including the specific geology of each region and how operators dispose of wastewater.

Several states have expanded requirements for wastewater monitoring, reporting and control. A number of mitigation options are being examined as well. Examples include requiring the bottom of new disposal wells to be cased with cement just as the upper portions are cased to prevent contamination of underground aquifers. This would prevent the waste water from flowing into deep rock formations, thereby reducing induced seismicity.

Best practices and lessons learned

The United States' experience in regulating shale development over the past decade highlights a number of important challenges to monitoring and enforcing environmental standards. The section below notes specific lessons learned and evolving best practices that may be applicable to other countries seeking to develop shale oil and gas resources.

- **Overlapping federal and state jurisdictions brings benefits and drawbacks.** Multiple federal and state laws and agencies are responsible for implementing and enforcing environmental laws. At the federal level, the EPA is charged with environmental

Latin American countries developing shale reserves may need to create a regulatory framework that allows flexibility and variation among regions. Transferring authority to regional governments may also require capacity building for local regulators and a sound satrategy for attracting technical staff, as the rapid growth of the industry creates competition for a limited pool of qualified professionals. But the US experience also suggests that countries should enact minimum environmental standards at the central government level.

oversight of upstream oil and gas activities. The federal government also owns large land areas across the country, and various agencies set specific requirements for land use within their jurisdictions while keeping within EPA guidelines and regulations. Each state also has its own departments that oversee energy and environmental affairs, and the EPA delegates most regulatory and oversight responsibilities to these state-level entities if they meet or exceed federal standards. Within each state there may also be multiple departments regulating groundwater, surface water, and land and air quality.

Transferring authority to the state level allows local priorities and circumstances to play a greater role in environmental policy while still maintaining federally-enforced minimums. This can also result in more rapid regulatory experimentation as different states test alternative approaches. Such a structure is more complex, however, as both regulators and private companies must accommodate different standards and processes in each state. This approach can also result in a widening gap between state level requirements and federal minimums if the federal rule making process is unable to keep pace with state level innovations.

- **Environmental regulations must balance risks and benefits.** Most of the relevant environmental laws include exemptions for the oil and gas industry that also apply to shale development. These exemptions have helped to facilitate industry development and reduce the time and cost of environmental compliance. However, several exemptions also limit the EPA's ability to monitor and enforce environmental standards before a problem has occurred. The speed of fracturing processes can also make it difficult for the EPA and state environmental agencies to inspect wells during the initial drilling as the process is often completed before the inspector is able to visit the site.[14]

- **Timely information on developer activities and baseline data are critical.** Timely information on shale development activities and the equipment and materials being used is often too limited, making it difficult for the EPA to determine where and when site inspections should be made. State level regulators perform more frequent site inspections, but the degree of oversight has been criticized in some states. The dispersed nature of the shale industry (with numerous companies, many relatively small) and the rapid pace of development have also made it difficult to simply identify the location of new well sites.

Regulators' ability to monitor and enforce environmental regulations is also inhibited by inadequate data. There is no federal requirement for shale developers to establish baseline data on groundwater quality prior to well development, although many states do have such requirements. The EPA's draft Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources found 1,076 separate chemicals used in hydraulic fracturing based on data from FracFocus, a hydraulic fracturing chemical disclosure registry, with the average well containing 14 different chemicals.[15] Where there is limited baseline data, it can be difficult to prosecute cases of alleged groundwater contamination.

Environmental advocates have raised concerns about the volumes of water used in the hydraulic fracturing process, which vary widely, from 2 million gallons/well in some shale plays to as many as 16 million in others.

- **Continuous communication is needed.** As the industry continues to rapidly evolve, ongoing sharing of regulatory best practices is important for continued improvement. The State Review of Oil and Natural Gas Regulations (STRONGER), a non-profit group, promotes state-level environmental regulations by publishing best-practices regulatory guidelines and performing state regulation audits to

identify gaps or areas for improvement. STRONGER's guidelines are developed through multi-stakeholder workshops and subject matter expert input and cover all aspects of oil and gas development.

- **Disclosure requirements must balance confidentiality.** Protecting business trade secrets must be balanced with the required disclosure of potentially harmful substances. This is especially challenging when monitoring the chemical makeup of fracking fluids as each company's "cocktail" can be particularly sensitive information, but also of great interest to nearby communities. The initial secrecy surrounding fracking fluids has steadily evolved into greater levels of disclosure and the development of state inventories. For example, the Emergency Planning and Community Right-to-Know Act provides individuals and communities access to information on the storage and release of specific chemicals, including many of the chemicals that oil and gas companies use in hydraulic fracturing.

  In addition to state and federal agencies, non-profit organizations and non-governmental organizations are also involved in monitoring groundwater quality, industry compliance and policy development. For example, the FracFocus Chemical Disclosure Registry maintains a registry of chemicals and additives used in each hydraulically fractured well within participating states. Although FracFocus[16] is an independent non-profit, all but six of the 29 states that currently require disclosure of the chemicals used in hydraulic fracturing use FracFocus as a means of official state chemical disclosure.

There is limited public awareness of or opposition to shale development in Argentina outside of the shale producing regions. Within producing areas there is broad support for shale development as a means to boost economic development, although some towns have attempted to ban hydraulic fracturing. At the central government level and within the Greater Buenos Aires region, where the public has no direct experience with oil and gas development, there is some debate about the merits of shale development.

- **Public outreach and education on the environmental risks of shale development is important.** Government agencies at both the federal and state levels reported very high public interest in shale development and have greatly expanded their public outreach activities as a result. This is particularly true in areas that do not have a history of traditional oil and gas development.[17] As the United States is one of the only countries in the world where subsoil resources are the property of private landowners rather than the state, tensions have flared between landowners who approved drilling on their property and communities opposed on environmental grounds. There are also debates within communities about the economic benefits of shale development versus the perceived environmental risks.

- **Regulators must be able to attract talented individuals and maintain their expertise.** A high degree of technical skill is needed to adequately regulate oil and gas industry activities. The rapid pace of technological and process innovation in shale oil and gas operations makes it even more challenging to remain up-to-date with the industry's state-of-the-art technology.

FIGURE 2: TECHNICALLY RECOVERABLE SHALE RESERVES IN THE AMERICAS

Source: US Energy Information Administration

	WET SHALE GAS (TRILLION CUBIC FEET)	TIGHT OIL (BILLION BARRELS)
U.S.	622.5	78.2
Canada	572.9	8.8
Argentina	801.5	27
Mexico	545.2	13.1
Brazil	244.9	5.3
Venezuela	167.3	13.4
Paraguay	75.3	3.7
Colombia	54.7	6.8
Chile	48.5	2.3
Bolivia	36.4	0.6
Uruguay	4.6	0.6

Applications for Latin America

Latin American countries' policies and conditions for unconventional oil and gas development differ greatly from those in the United States. For example, many Latin American countries have more centralized environmental policy, state oil companies that dominate upstream activities and laws granting subsoil resources to the state rather than private individuals, which impacts the licensing and permitting processes. And yet, Latin American countries can benefit from adapting some of the lessons learned in the United States to their own challenges.

Within Latin America, Argentina, Mexico and Colombia all have significant potential shale oil and gas resources, which their respective governments have sought to develop. Each country has, to varying degrees, implemented environmental regulations specific to shale development. However, policymakers and regulators must continue to improve regulations and practices, focusing broadly on two areas: balancing centralized regulations with flexibility and improving transparency and public outreach.

Argentina

The Vaca Muerta shale play in Argentina's western Neuquén province has attracted interest from domestic oil and gas companies, such as the national champion YPF, as well as international companies, such as Chevron and ExxonMobil. Shale resources extend south through the Golfo San Jorge Basin and into the Austral–Magallanes Basin at the far south of Argentina and Chile (see Figure 3). Although many companies are exploring opportunities, shale oil and gas is not yet produced in significant volumes in Argentina.

Argentina's new president Mauricio Macri, elected in November 2015, has vowed to increase foreign investment in the oil and gas sector, especially shale development. In contrast to the previous government's approach of negotiating deals with individual energy companies, the new government is expected to take a more methodical, law-based approach, which would include further clarity on federal environmental standards.

Similar to the United States, Argentina has a dual federal and provincial-level structure for environmental regulation of hydrocarbon activities. Responsibility for oil and gas environmental regulation is reserved for the provinces under the constitution. Broad environmental laws set requirements for environmental impact assessments, standards for environmental management, treatment of hazardous waste, protection of biodiversity and sustainable development for all industrial activities, including oil and gas development. The federal government can set minimum environmental standards that must be met by all provinces, although a bill proposed in 2013 to establish such a federal minimum was not passed.[18]

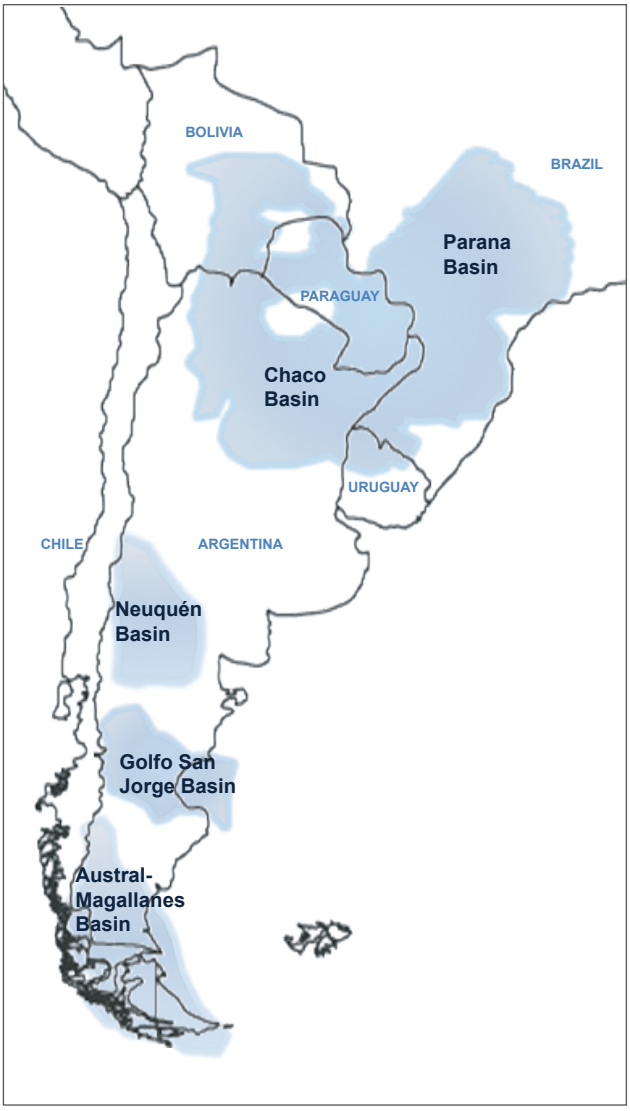
The federal environmental agency, the Ministry of the Environment and Sustainable Development, was recently raised to ministry status by the new government, adding additional weight to federal environmental policies. Each hydrocarbon producing province also has its own energy department, and many provinces have a state-owned energy company of their own that may partner with private companies to develop oil and gas resources. Some provinces have enacted environmental legislation beyond the national framework. For example, in March 2014, Neuquén Province enacted regulations specific to unconventional hydrocarbons, requiring companies to file an environmental report in order to obtain an operating license. Other provinces have environmental regulations for oil and gas industry activities, but no specific rules for shale development.

While Argentina's federal legislation and rule making process is slow, provincial level regulations have the potential to be far more adaptable to the specific needs of each province. The new administration may propose new federal environmental laws, which could establish national minimums but also restrict regional flexibility.

At present, there is limited public awareness of or opposition to shale development in Argentina outside of the shale producing regions. Within producing areas there is broad support for shale development as a means to boost economic development, although some towns have attempted to ban hydraulic fracturing within their jurisdictions. At the central government level and within the Greater Buenos Aires region, where the public has no direct experience with oil and gas development, there is some debate about the merits of shale development.

FIGURE 3: SOUTHERN SOUTH AMERICA SHALE GAS BASINS

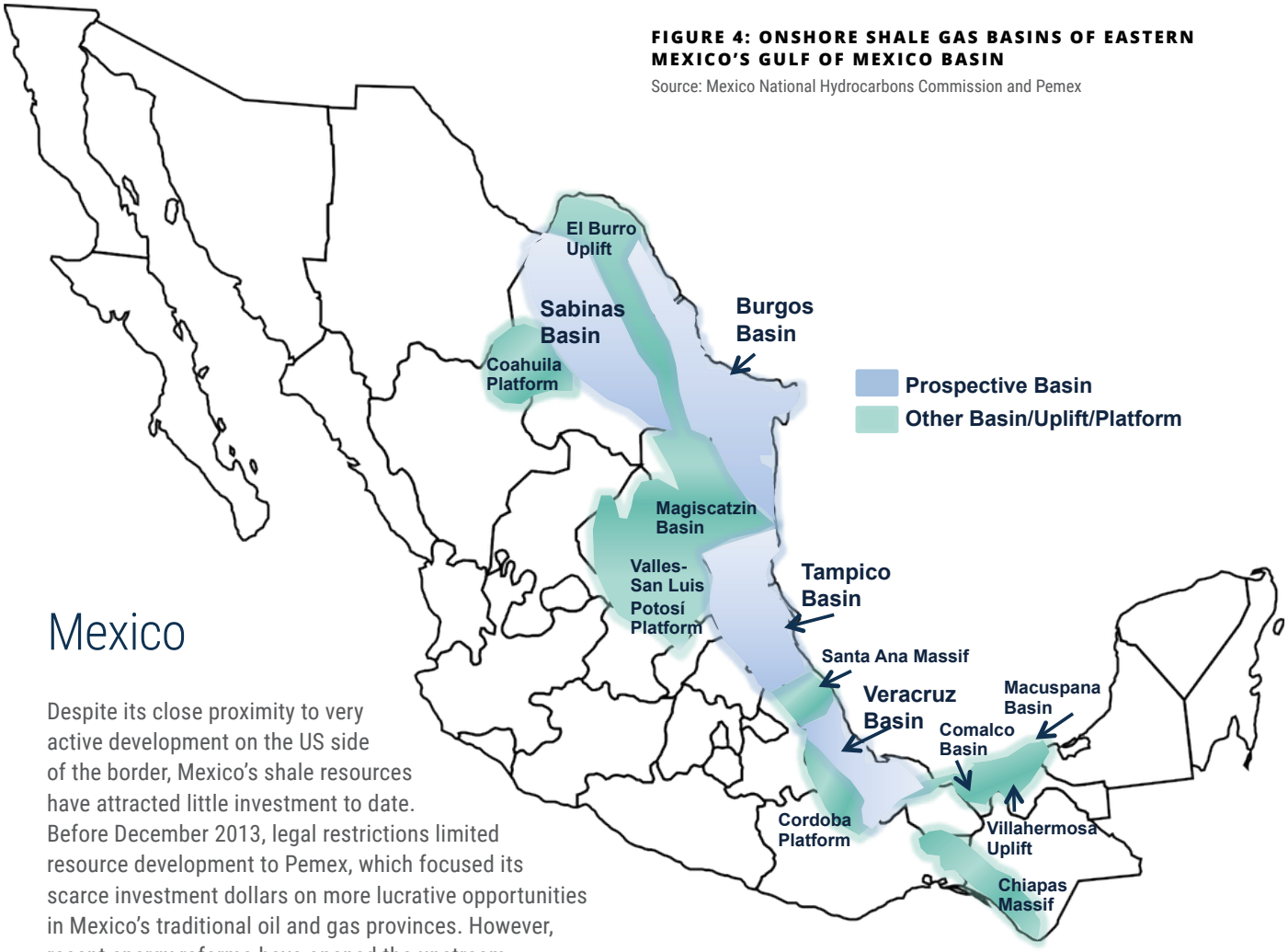
Source: Advanced Resources International



Argentina's shale development is still in the early stages. As the industry grows, issues such as centralized environmental oversight versus local regulatory flexibility and the need for public outreach and education will likely come to the forefront.

FIGURE 4: ONSHORE SHALE GAS BASINS OF EASTERN MEXICO'S GULF OF MEXICO BASIN

Source: Mexico National Hydrocarbons Commission and Pemex



Mexico

Despite its close proximity to very active development on the US side of the border, Mexico's shale resources have attracted little investment to date. Before December 2013, legal restrictions limited resource development to Pemex, which focused its scarce investment dollars on more lucrative opportunities in Mexico's traditional oil and gas provinces. However, recent energy reforms have opened the upstream sector to private investment, including shale resources. Although development may be slow, owing to limited infrastructure, security concerns and the low oil and gas price environment, the government still plans to include blocks with shale potential in its first upstream bid round.

Mexico's environmental regulations for oil and gas operations are undergoing significant changes as a result of the ongoing energy reforms. The Secretariat of the Environment and Natural Resources (SEMARNAT) is responsible for environmental protection and restoration and oversees multiple independent and decentralized government agencies collectively known as the Federal Environmental Sector. Within the oil industry, the most important environmental oversight body is the recently formed Agency for Security, Energy and the Environment (ASEA), which oversees environmental permitting and compliance for hydrocarbon exploration and development. As a new agency, ASEA is developing its internal organization, processes and methodologies and is currently focused on supporting and managing conventional oil and gas exploration. Plans to auction the country's shale resources have been delayed, opening a window for deliberation and consultation before large scale development begins.

Mexico has a stringent policy for setting regulatory and legal processes with limited flexibility to adapt to specific situations or circumstances. This rigidity is intended to limit any single individual's influence and to avoid perceived or actual corruption but also limits the system's ability to respond to changing industry standards in a timely manner. Because Mexico's oversight of the energy sector is solely at the federal level, the government does not have to deal with the challenges that have been noted in the United States in managing communications and information sharing across various levels. At the same time, however, there is less scope to tailor environmental standards or enforcement practices to local conditions.

Relations with local communities and the public could also become a more prominent issue when shale development begins in earnest. Mexico requires companies to consult with indigenous communities prior to development to protect these groups from unwanted encroachment on their land, although they do not have veto power over development projects. Unlike the United States, which prioritizes landowner rights, Mexican law gives hydrocarbon activities priority over other land uses, potentially even above the landowner's preferences, in order to reduce the risk of local interference with project development. Similar provisions for wind power development are now undergoing initial challenges, and the first cases related to hydrocarbon development may also be heard in the next few years as local communities are affected by conventional oil and gas development from recent tenders.[19] Any judgements that are seen as unfair to local communities or landowners could trigger a backlash against hydrocarbon and shale development in general.

Most shale deposits within Mexico are located in areas that currently produce oil and gas or are in remote, sparsely populated regions. Although the Mexican government is actively promoting shale development, there is still limited public awareness of related environmental issues. However, some NGOs are working to raise awareness and shape government policy. Once Mexico's government starts to auction shale blocks, it may face increasing pressure to respond to public concerns.

Though development may be slow, owing to limited infrastructure, security concerns and the low price environment, Mexico intends to include blocks with shale potential in its first upstream bid round. But these plans have been delayed, opening a window for deliberation and consultation before large scale development begins.

Colombia

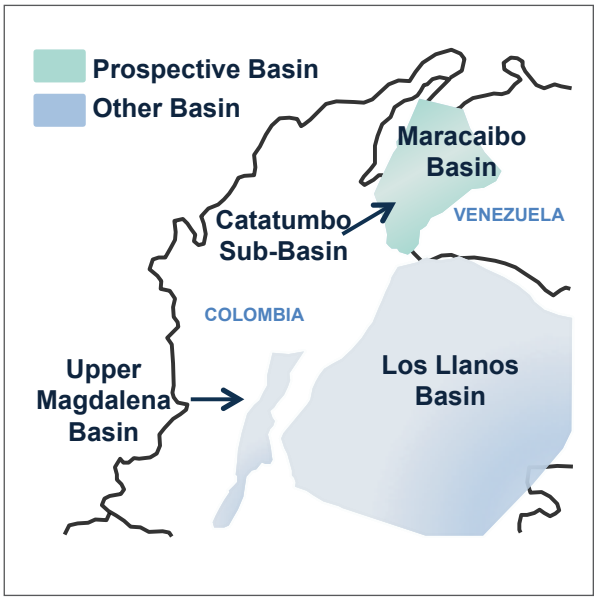
Colombia's shale resources have attracted the attention of global oil companies, including ExxonMobil and Shell, and the government held a first auction for shale gas exploration licenses in 2012. More recent exploration rounds have been disappointing, however. In 2014, only one of the eighteen unconventional blocks on offer received bids.[21] Although Colombia has already tendered a number of shale blocks and there is substantial industry interest, the sector is still in the early stages of development.

Colombia is not a federal system, but rather a single government with responsibilities delegated among the national, regional and local levels. As such, the country benefits from simplified coordination but may have greater difficulty tailoring policies and enforcement to local circumstances. Colombia's national legislation and rule making process is lengthy, and regional entities have limited jurisdiction for environmental oversight of oil and gas industry activities. While some environmental enforcement activities, such as water use permits, are delegated to regional and local governments, environmental permitting for the oil and gas industry is reserved for the National Environmental Licensing Agency (ANLA).

Colombia's regulatory development process has included a high level of involvement from stakeholders and outside experts. Perhaps as a result, the process to establish environmental regulations for shale exploration took longer than expected – the final regulations were ultimately released a year after the initial licenses were awarded. Legislation passed in 2012 and 2013 set specific procedures for unconventional hydrocarbon exploration and development and established criteria to define and award blocks and E&P contracts for unconventional development. The laws also set technical standards and procedures for water injection, hydraulic fracturing and other technical aspects of unconventional resource development. Further work is needed to set the environmental requirements for the production phase.

FIGURE 5: NORTHERN SOUTH AMERICA SHALE GAS BASINS

Source: Advanced Resources International



This uncertainty regarding the environmental regulations for shale oil and gas production is one reason given for declining interest in shale development in Colombia. Although the oil and gas industry supports the current regulations for shale exploration, fears that a different standard may be set for the production phase have slowed investment in exploration and dampened interest in tenders for shale exploration blocks.

Oil companies have also been wary of investing in Colombia's shale blocks because of fears that local opposition would stall or block project development. Like Mexico, Colombia has provisions for prior consultation with indigenous communities for oil and gas related activities on their lands. Colombia also allows the compulsory award of rights-of-way and other land uses and related compensation if oil and gas companies are unable to reach a negotiated agreement with the landowner. As a result, any judgements that are seen as unfair to local communities or landowners could trigger a backlash against shale development.

There was a significant level of public concern regarding shale oil and gas development when Colombia's first blocks were being tendered in 2012. More recently, the dramatic fall in oil prices and limited success in attracting investors and replenishing Colombia's oil and gas reserves have muted environmental concerns. Yet the government needs to continue licensing new areas for exploration in order to maintain the country's reserve life of just six years and appears committed to auctioning more shale blocks in the future. As a result, environmental regulations and policies need to continue to evolve.

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CONCLUSION

Although the United States continues to grapple with questions about the environmental impacts of shale drilling, years of varying experiences of state and federal regulators in the United States has provided a large body of knowledge about best practices that may be applicable to shale development in Latin America and other regions around the world.

The US model, whereby state governments hold most responsibilities for setting and enforcing environmental regulations, has many advantages. States have been able to adapt regulations quickly to local conditions and changing industry practices. This flexibility is particularly important for shale development as shale wells are drilled much faster than conventional wells, and the technologies used for shale development have evolved very quickly. The decentralized regulatory model has also allowed different regulatory practices to be applied simultaneously in different states. This process of experimentation has created a body of best practices that are shared among the states and federal government. Moreover, although public opinion within states is not uniform, local governments have been able to respond to local community input and to the preferences of the majority within their states. Populations in states such as Oklahoma, North Dakota and Texas, for example, have been more willing to embrace shale development as an important source of economic development. In contrast, states such as New York have banned hydraulic fracturing altogether on environmental grounds.

However, the decentralized model also has drawbacks. It is more cumbersome for industry to navigate overlapping state and federal regulations, and to comply with different regulations in each state. Moreover, certain federal level regulations are necessary to ensure minimum environmental standards for the country and avoid a race to the bottom as states compete for investment.

Latin American countries that develop shale reserves may need to create a regulatory framework that allows some degree of regulatory flexibility and variation among different regions, even in countries with more centralized government systems. Creating a local government-led regulatory system may also require capacity building for local oil and gas regulators and a sound strategy for attracting adequate technical staff, as the rapid growth of the industry creates competition for a limited pool of qualified professionals.[22] At the same time, the US experience suggests that Latin American countries should also enact minimum environmental standards at the central government level.

As the shale industry has grown in the United States, efforts have arisen to improve transparency and information sharing among state and federal governments, industry and civil society. This has improved coordination to help regulators strengthen their oversight capabilities. It has also helped to build public confidence and clarify real and perceived environmental risks associated with shale development. However, the increase in transparency also has to be balanced with protecting companies' intellectual property rights and trade secrets.

In Latin America, governments, companies, NGOs and the media could do more to improve access to data and other information about shale development as the industry grows. For example, some countries should introduce requirements for disclosing fracking fluids and collecting and publishing baseline data on water, air and land surface quality. The region's think tanks and other NGOs can help spread best practices, establish formal programs for sharing lessons learned and information with other regional environmental groups and strengthen links with US and other foreign governments, universities and other institutions. As shale activity increases and becomes more visible, more public outreach and education will also be needed, particularly for regions where the public has no direct experience with the oil and gas industry. Latin America could also benefit from expanding region-wide efforts to share best practices among different countries. Doing so could allow the region to mimic the state-level regulatory experimentation in the United States and potentially accelerate regulatory innovation.

ENDNOTES

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