

Chapter 16

Hydraulic Fracturing in Latin America: Prospects and Possibilities?



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Abstract During the last three decades, unconventional gas and oil development has substantially transformed the energy section. One of main developments is hydraulic fracturing, or “fracking”, a practice which has had substantial impact on people’s economic, social and political lives in those areas where unconventional energy reserves are present and are being exploited or could be exploited.

Latin America is one of the world regions with the highest potential for unconventional gas and oil development. Thus, the objective of this chapter is to look at unconventional oil and gas from a geopolitical perspective in the Latin American region, and in particular, the evolution of the industry and related energy policies in key countries of the Western hemisphere (namely Mexico, Argentina and Colombia) since the U.S. shale revolution of the early 21st century.

This chapter begins with a brief review of how hydraulic fracturing works and where in the world it is currently operational. The chapter then presents a review highlighting subsequent developments in the Americas over the last 10 years, giving special attention to Mexico, Argentina and Colombia, countries with large assessed reserves. The chapter thus shows the availability of oil and gas shale resources in Latin America, the developments that have been emerging to regulate the sector, and the enabling regimes/policies. The chapter concludes by considering the extent to which resolving environmental – and particularly water – issues related to hydraulic fracturing may be key for the economic growth for these Latin American countries (i.e. Mexico, Argentina and Colombia). These hurdles must be considered and addressed, in order to better shape the future of Latin American fracking in the coming years.

Keywords Latin America · Columbia · Mexico · Argentina · History of fracking

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16.1 Introduction

Currently global population is on the rise and with it the consumption of food, water and – most relevant to the current chapter – the demand for energy. As stated by the U.S. Energy Information Administration (EIA) (2017) Energy Outlook, world energy consumption is projected to increase 28% by 2040. Meanwhile, conventional fossil fuels (still around 70% of the world energy supply) are gradually being exhausted, triggering a search for alternatives, including unconventional hydrocarbons. As we have seen in other chapters in this volume, technological developments together with changing energy sector economics have helped grow the unconventional hydrocarbon sector, especially in the US.

Latin America is one of the world regions with the highest potential for unconventional gas and oil development. Thus, the objective of this chapter is to look at unconventional oil and gas from a geopolitical perspective in the Latin American region, and in particular, the evolution of the industry and related energy policies in key countries of the Western Hemisphere (namely Mexico, Argentina and Colombia) since the U.S. shale revolution.

The chapter is structured in the following way: first, it briefly describes fracking as a technique and its potential impacts, both positive and negative, as are also discussed in other chapters in this book, but here giving particular attention to the region. Second, the chapter then presents a review highlighting subsequent developments in the Americas over the last 10 years, giving special attention to Mexico, Argentina and Colombia, countries with large reserves. The chapter discusses the availability of oil and gas shale resources in the Western Hemisphere, the developments that have been emerging to regulate the sector, and the enabling regimes/policies. Third, the chapter considers whether it is still premature to determine whether fracking is key for the economic growth for these Latin American countries (i.e. Mexico, Argentina and Colombia). The chapter concludes with some recommendations to help address the several challenges that still remain for the further sustainable development of the unconventional hydrocarbon sector, and its potential at the national and regional levels in Latin America. These hurdles must be considered and addressed, in order to better shape the future of Latin American fracking in the coming years.

16.2 Innovation in the U.S. and its Diffusion into Latin America and around the World

Building on earlier work, during the 1940s Standard Oil and Gas Corporation refined the technique and a decade later, the first “official” application of fracking for energy extraction was undertaken in North America. Private energy consultancies such as Halliburton further developed and championed the technique in the 1960s and 1970s. From that point on, the technology gradually started to take off, usually as a collaboration between the government, the private sector and local

Table 16.1 U.S. Gas and oil productions (Modified from U.S. Energy Information Agency (EIA) (2013a, b))

ARI Report Coverage	2011 Report	2013 Report
Number of countries	32	41
Number of basins	48	95
Number of formations	69	137
Shale gas (trillion cubic feet)	6622	7299
Shale/tight oil (billion barrels)	32	345

communities (Manfrenda 2015; Montgomery and Smith 2010). Thus, the 1990s ‘explosion’ of hydraulic fracturing activities in the US actually built on decades of experimentation and technical innovation.

Shale gas basins are located all around the globe, with at least one formation in each continent (see Figure 1.1). The most recent assessments from the US EIA world assessment report on shale gas have identified 137 shale formations in the world, which account for a total volume of technically recoverable shale gas of an estimated 7299 trillion cubic feet (tcf) and 345 billion barrels (bbc) of oil (Table 16.1).

16.3 Ten Years of Fracking in Latin America

Roughly 80% of Latin America’s energy is supplied by fossil fuels (coal, gas and oil), according to the International Energy Agency. As population grows, conventional sources of energy are gradually being exhausted, and the extraction of shale gas through fracking is seen as one of the solutions to ensure access to reliable energy resources in the coming decades to maintain the current lifestyle and consumption rates. Likewise, it could be an opportunity for countries that have stocks of unconventional sources (e.g. shale formations), to start exploring and developing unconventional energy resources. It also represents a geopolitical chance for companies (mainly U.S. ones) to implement this technique in Latin American countries and territories, which at the moment have assessed resource reserves, but relatively little domestic capacity to develop, thus offering a win-win deal for all the involved parties. In this context U.S. Department of Energy launched in 2010 the Unconventional Gas Technical Engagement Program (UGTEP) as a tool to promote knowledge sharing between the U.S. and other countries, to help them to successfully develop their shale resources (oil and gas), including the sharing of technical, regulatory, administrative and diplomatic expertise with all interested countries (Tincher 2015).

One particularity of the Latin American region, as compared to the U.S., is that oil and gas companies—some of the most profitable enterprises in these countries—are usually partially or totally owned by the State. This is the case for Argentina (YPF), Brazil (Petrobras), Colombia (Ecopetrol), Mexico (Pemex), Venezuela (PDVSA) and Ecuador (Petroecuador). This, along with some other factors, will be critical to the expansion of fracking in Latin America, since any increase in profits from this sector could also be beneficial for national budgets. This is important

because due to the global economic crisis of 2008 and the 2014 drop in oil prices, there is a huge incentive to develop domestic reserves to address national trade imbalances.

The 2005–2014 period probably represented some of the best years in the history of the energy industry since oil prices reached on average US\$100 per barrel of oil, higher than most break-even prices for producers around the world. The story in Latin America was similar, since the oil producing countries (with state-owned companies) were enjoying the biggest oil profits in their histories, and therefore were in a better position to be able to support national budgets at the time. In addition, fracking in the U.S. was seen and promoted as the key for energy self-sufficiency. Aware that there were important shale formations in the Latin American region, soon these national oil companies started exploring the possibilities for extracting shale resources using fracking. This was the case for Colombia, which in 2013 started to search for joint ventures with companies to start developing domestic fracking. However, these early moves towards fracking in the region had to be put on hold due to an external factor—the global drop in oil prices after 2014, which forced companies to focus only on the most profitable oil and gas resources, and therefore excluded fracking (non-conventional oil and gas fields) due to relatively high extraction costs at the time.

Today the economic scenario seems to be different, and there is a renewed willingness to start fracking in Latin America. Nevertheless, it would still take some years, since there is still uncertainty both on its technical feasibility and over its environmental and social impacts. In the following sections, the aim is to put a spotlight on the enabling environment for fracking in Latin America, comparing how favourable is the region for the development of the unconventional energy industry. The fact that the U.S. government has continued to strongly promote fracking on its national territory (though not without some opposition as other chapters in this volume demonstrate), together with the historical relationship between the US and Latin America has allowed them to position themselves as “ambassadors” of the technology in the region.

In order to reduce the costs, if the future energy outlook in terms of demand and supply remain the same, energy companies need to explore countries that have abundant shale gas reserves, and whose enabling environment (e.g. productivity and regulation costs) are favourable to the expansion of this technique. As an example of enabling environments, the cases of three Latin American countries will be briefly analysed (Argentina, Colombia and Mexico), as examples of the evolution of fracking in the region since the turn of the twenty-first century.

16.4 Argentina

Currently fossil fuels account for roughly 90% of the energy needs of Argentina (40% oil & 50% gas), making it extremely dependent on this type of resource. At the same time, Argentina has not been self-sufficient in hydrocarbon production,

making the country vulnerable to the market fluctuations and instability in oil producing regions.

As also noted in Chap. 8 of this volume, Argentina has a potential for energy production from shale resources that is nearly unrivalled in Latin America. Four major basins have so far been identified: Neuquén, San Jorge, Austral-Magallanes (shared with Chile) and Paraná (shared with Uruguay, Brazil and Paraguay, see Map 8.1). The country has an estimated shale energy stock of around 27 billion barrels of oil and 802 trillion cubic feet of gas and is ranked among the top ten worldwide potential producers of shale gas (#2) and oil (#4), along with Mexico, China, Russian and the U.S. (EIA 2015).

The main shale play in Argentina to undergo exploration and development so far is located in the centre of country in Neuquén province. It is known as the Vaca Muerta play, and, according to Argentine President Mauricio Macri, it represents a new stage for the energy future of the country, since Vaca Muerta by itself could provide 38% of the natural gas and 60% of the oil in the country (Chequeado 2017). Like the U.S., Argentina is a country rich in shale resources, with the potential to go beyond self-sufficiency and become a net exporter of (unconventional) fossil fuels. As tantalising as this prospect may be, achieving anything like this promise will require a very large investment (as much as US\$ 120 billion) from the joint venture created by Yacimientos Petrolíferos Fiscales (YPF) and Chevron. As of early 2019, at least this amount of inward investment had been pledged by major global energy companies such as Chevron, BP and Total.

The current enabling environment with Law 26.741–2012 sets the stage for Argentina's fuel independence, declaring the achievement of the Argentinian energy self-sufficiency to be of "national public interest" (Oxford Institute for Energy Studies 2016; Mares 2015). Moreover, the law also mandated the creation of the Federal Council for Hydrocarbons (Ministry of Justice and Human Rights of Argentina 2012) and required the state to renationalise YPF, the most important oil and gas company of the country and a big energy player in Latin America. As the analysis in Chap. 8 clearly shows, Argentinian leaders (if not all Argentinians!) sought to follow the U.S. in aggressively pursuing unconventional hydrocarbon development (Bertinat et al. 2014). By 2014, around 500 fracking wells to extract tight gas were reported in Argentina, a number that has likely increased since 2014. Given the advances in the country with this extractive technology, some organisations have demanded that more research on this area must be gathered (AIDA 2016).

In terms of regulation of the impacts of fracking, social perception and environmental protection, there are a number of mechanisms, laws, decrees at the national, regional and local level in Argentina aimed at developing a comprehensive legal framework to regulate the energy sector and promote the safe and environmentally-sensitive development of the fracking industry in the country. The overarching framework mechanism for legal environmental protection in Argentina is the General Environmental Law (Law 25,675 of 2012). The Ministry of the Environment and Sustainable Development (MAyDS in Spanish) is responsible of ensuring compliance at the level of national policy, and in specific operations anywhere in the national territory. The 25,675 Law "seeks to supply the minimum

financial resources *to accomplish the sustainable and adequate management of the environment, preservation and protection of biological diversity and implementation of sustainable development*". While Argentina is already performing fracking, one important weakness is that, even though Argentina has in place a general national law for environmental protection, it does not have a targeted fracking-oriented regulatory policy towards the prevention of its environmental and social impacts. As elsewhere around the world, hydraulic fracturing raises challenges that are not always well-accommodated in existing law, policy and regulatory practice.

Like in the U.S., the social perception of fracking in Argentina indicates a significant level of social concern, as reflected in several conflicts and protests that have happened in different parts of the country in recent years (one of these, in Neuquén province, is discussed in Chap. 8). Over 60 municipalities, including Río Negro, Choele Choel, Beltrán, Chimpay, Cipolletti, Mendoza, Tunuyan and General Alvear and San Carlos, have passed local legislation or declarations banning fracking on precautionary grounds. It is uncertain if these local actions are to be considered legally binding, since the jurisdiction and competence over hydrocarbons is at the provincial or national (rather than local) level (El Sol 2013; Observatorio Petrolero Sur 2016).

The Argentinian government promotes unconventional oil and gas as "bridge (or "transition") fuels", capable of helping the country to become energy self-sufficient and to grow high wage employment throughout the energy supply chain. To date development has been hampered by a lack of transport and pipeline infrastructure, appropriately rigorous regulatory standards and – most importantly – social legitimacy amongst the population at large.

16.5 Mexico

Natural gas is fundamental to the energy matrix of Mexico. Based on data from the Mexican Commission on Hydrocarbons (CNH in Spanish), in 2017 Mexico was importing 81% of the natural gas used the country, implying a high level of vulnerability to the politics and economic vagaries of trade. Yet Mexico is also known as a world-class exporter of oil over recent decades, producing around 2.1 million barrels per day in 2016, accounting for roughly 30% of the total government income. However, production by the national oil company, Pemex (Mexican Petroleum), has shrunk since 2016 to 1.9 million barrels in 2017 and 1.7 million barrels in 2018. The government needs to find a way to re-establish its domestic energy production in order to maintain its exports, increase government income rates, and achieve energy independence (Export.gov 2017). In this sense, and given the current geopolitical scenario, fracking and the latest findings on shale resources in the country present themselves as a possible way forward.

In the last updated report from the U.S Energy Information Administration (EIA), Mexico is described as a country with "excellent potential for developing its shale gas and oil resources" (US EIA 2015). The EIA ranked the country among the

top ten potential producers of shale gas (#6) and oil (#8), along with Argentina, China, Russian and the U.S., with a shale energy reserve of 13 billion barrels of oil and 545 trillion cubic feet of gas. The main shale formations are mostly located along the Gulf of Mexico, in particular the Veracruz, Sabinas, Tampico, Tamaulipas basins. Also, the Eagle Ford Transboundary Shale (shared by the U.S. and Mexico) is located in the Burgos basin, and it is (as we have seen in other chapters in this volume) a major shale gas play. Its estimated potential yield, estimated at 343 trillion cubic feet of gas and 6.3 billion barrels of oil, dwarfs other Mexican energy basin estimates (EIA 2013a, b).

Oil and gas exploration in Mexico dates back to the early 1900s, and since the ratification of the Constitution of 1917, the state and/or its companies have been the owners and the only entities authorized to explore and extract underground resources such as fossil fuels. This was the scenario in 2013–2014 when, due to multiple factors including a decrease in fossil fuel production and the limited capacity of the Mexican state to explore and increase production rates of shale resources, the Mexican Congress decided to reform the energy sector to provide the enabling environment (investment, lower barriers and private sector participation) for multinational companies to work jointly together with Pemex to extract existing energy resources (Vinson and Elkins 2016). In 2014, within the framework of the Energy Reform in Mexico, the National Agency for Industrial Safety and Environmental Protection (Ansipa in Spanish) was created, to complement the capacity of the country to oversee and regulate industries and production standards.

One critical factor to be highlighted in the Mexican case is water availability. In the U.S., fracking consumes 9–29 million litres per well per year, equivalent to the annual water consumed by approximately 90,000 to 290,000 people (at a rate of 100 l daily per person). The Mexican Secretariat of Energy has estimated that each shale gas well developed in Mexico will require around 21 million litres of water (Posadas and Buono 2016). Mexico is rated to have high average water stress over the shale play area (Reig et al. 2014). In this regard, there is concern from civil society and the community that, with the massive implementation of fracking in the northern states of the country near the Gulf of Mexico, which are arid and semiarid region and thus naturally dry areas, this practice would increase water scarcity in a region which is already water scarce, causing shortages and irreversible consequences to the peoples and ecosystems of this sub-region (Mares 2015).

Water resource allocation for hydraulic fracturing also presents a potential tension with the adoption by Mexico, shortly before the energy reform in 2013, of a human right to access to water (Posadas and Buono 2015). The law adopting the new human right included a mandate to enact a new General Law on Water, offering an opportunity to shift water management paradigms in the country from one based primarily in hydraulic engineering to one that embraces a more sustainable development agenda). As of July 2019, the Congress has not enacted the new water law (Agua.org 2019).

As elsewhere, the negative popular perception of the social and environmental risks linked to fracking remain. Civil society and the government's concerns on the issue are similar to the ones of the other countries of the Latin America region,

including the impacts from the increase on GHG emissions, to human health, and to the water quality of rivers and aquifers in and near fracking basins. In addition, some of the most important shale plays in Mexico (e.g. Burgos and Tampico) are located near indigenous and peasant agricultural communities, whose livelihoods could be greatly affected by fracking (Fundar 2017).

Relative to other parts of Latin America, Mexican civil society has probably had the most organized network of stakeholders against fracking, known as the *Mexican Alliance against Fracking*. This is a group of about 40 civil society organizations from across the country that seek to forbid fracking, with the ultimate goal of defending land and water resources. It is a very active group that is constantly organising technical seminars and papers, publishing magazines and press releases, and releasing campaigns and videos with celebrities to raise awareness on the potential threat of fracking to the people of Mexico and especially to its water sources.

Today, Mexican government policy depends on fracking to recover the fossil fuel production and to boost its economy. This has been reflected in the willingness of its government to start making reforms (2013–2014) and to create the enabling environment for engineering and scientific investments necessary to exploit Mexican shale plays. Nevertheless, the current geopolitics (especially current and future fossils fuel prices), social resistance, and the lack of capacity to fully implement fracking in Mexico still remain as big challenges, where further measures need to be taken in several sectors and the final success is yet to be determined.

16.6 Colombia

The Colombian case does not differ much from the cases of Mexico and Argentina presented above. The overall production and stock of oil and gas in the country has been declining in recent years whilst demand has been rising, creating a clear challenge to achieving energy security. Despite the efforts to increase extraction rates—especially oil—by the country and its main oil company (Ecopetrol), only limited inroads have been made into the production-consumption deficit. This is due to the decrease in oil prices over the last years (which made it difficult to invest in exploration and extraction), the exhaustion of current oil stock, and the lack of discovery of new reserves. Based on data from the World Bank's World Development Indicators, the oil rent in Colombia as a percentage of the GDP for the country was 8.5% in 2011, which declined to 6.46% in 2014 and 2.87% in 2016 (KAS 2016). At this point neither the government nor the sector wants to allow further decline in the energy industry, since this may bring consequences for the economy and its macro components, affecting everyone in the country. In this context, and as elsewhere in Latin America, fracking presents itself as the most likely vehicle for rescuing the energy sector and wider economy (National Agency of Hydrocarbons, or "ANH", 2016).

Based on data from the National Agency for Hydrocarbons, Colombia had identified 43 shale plays in the country by 2016. These major shale basins are located in the mid-upper Magdalena, Catatumbo (within the binational Colombia-Venezuela Maracaibo shale basin), Caguan and the Oriental mountain regions. The 2013 U.S. EIA report estimated total technically recoverable unconventional resources of 55 trillion cubic feet of shale gas and 6.8 billion barrels of tight oil for Colombia, figures that triples the amount of known oil reserves and increase by ten the known reserves of natural gas.

Colombia is one of the Latin American countries with the best-established framework for the implementation of non-conventional extractive practices. As the U.S. shale gas boom was taking off, Colombia started to make sure that all necessary arrangements for enabling shale exploration were in place. For example, the 2010–2014 National Development Plan, drafted by the executive branch and issued by the Congress, contemplated as a priority the development of the energy and mining sectors (including investing on exploration and extraction of shale resources). Moreover, in 2014, the Ministry of Energy and Mining and the ANH, after undertaking due diligence and consultations, established the “Technical requirements and procedures for the exploration and exploitation of hydrocarbons in unconventional wells” (Ministry of Energy and Mining, Colombia 2014). This defines all the parameters and standards to develop fracking projects in the country, including social and economic issues.

One differentiating element in Colombia (as compared to Mexico, Argentina, and others) is the role of the Attorney General’s Office, the entity charged with ensuring that government actions are lawful. With regards to fracking, in 2012 the Colombian Attorney General released a special report based on the United Nations Precautionary Principle, requiring the Ministry of Environment and Sustainable Development, the Ministry of Mining and Energy, the ANH, and the National Authority for Environmental Licensing (ANLA in Spanish) to reassess and update any mechanisms and norms that foster fracking in the country, due to its potential risk for human and environmental health (water, animals, earthquakes, etc.). It also provided references to the government to consider or recall actions of ban and moratorium done by other countries on this issue.

In December 2015 the Colombian government signed a contract with two multinational companies (ConocoPhillips and Canacol Energy) to explore and exploit hydrocarbons from unconventional deposits through fracking in the northeastern provinces of Santander and Cesar. The first exploration well, Picoplata 1 in the upper Magdalena Basin, was completed in summer 2017 and showed promising results. After significant public opposition, in spring 2019 the Colombian government declined operator permits to the ConocoPhillips and Canacol joint venture, effectively shutting down hydraulic fracturing operations in the country.

Though Colombia is a relatively water-rich nation (average per capita availability of 45,000 m³/year), there are areas of relative water scarcity, as well as areas where climate change impacts are being particularly keenly felt. One of these regions is the upper Magdalena Basin (southwest of Bogota), precisely the area where there is much current interest from shale gas and oil producers. Resource

surveying and extraction (including deforestation) over the last generation have radically altered the regional hydrosphere, altering groundwater-surface water interactions and changing seasonal rainfall and humidity. As a result communities have been impacted by greater vulnerability to flood and drought, with consequent impact on livelihoods and well-being. It is by no means clear that areas currently being considered for hydraulic fracturing actually have the necessary volumes of water. As of mid-2019 the High Court of Colombia was maintaining its moratorium fracking on environmental grounds.

The social perception of fracking in Colombia is similar to other countries in the region, even though social mobilization against fracking in Colombia is still incipient. It was only in 2017 that civil society groups got together and discussed the creation of the group “Alliance: Colombia Fracking-Free”, which was expected to be formally established in 2019, composed by nearly 70 organizations representing different concerns around fracking. Additionally, and in contrast to other countries in the region, the guarantees and participation mechanisms for civil society in Colombia are very strong with respect to the extractive industries (including fracking). This is, for example, the case of the popular consultations done with the support of citizens in the municipalities of Piedras de la Cruz, which ended with a prohibition of mining activities.

However, with regard to oil production and energy independence, Colombian politicians, like their Mexican and Argentinian counterparts, are increasingly seeing unconventional hydrocarbon exploitation in terms of domestic energy security as well as job creation. The national oil company of the country Ecopetrol expects that by 2019 fossil energy reserves could be tripled by means of fracking. This has been reflected in the willingness of the government in setting the regulatory framework for enabling shale plays in the country. Nevertheless, the current geopolitics (especially current and future fossil fuel prices), further research on impacts and resources availability for Colombia, and future development of social positioning against current fracking activities remain as big challenges, and the long-term implementation and results of the technique are yet to be known.

16.7 Enabling and Regulating the Environment for Fracking in Latin America: Challenges and Opportunities

Latin America is a region that has historically been highly dependent on natural resources exploited by nationalised energy companies. Historically this model has worked well, and even with the strong economic shocks from the 2014 drop in fossil fuel prices, countries such as Mexico, Argentina, Colombia, Ecuador and Brazil are still firmly committed to energy independence and energy-led economic development. As in other shale gas and oil rich countries however, technical possibility and government enthusiasm does not necessarily translate into public acceptance. On the contrary, it seems that the greater the level of political enthusiasm for fracking

there is in Latin American countries, the greater the level of opposition in civil society. Thus, there are several challenges for development and implementation of fracking at the national and regional level in Latin America that must be considered and addressed in the future.

One of the main arguments in favour of fracking is that the technology will help accelerate the energy sector across the world to transition from higher carbon (coal and conventional oil) to lower carbon energy sources, with GHG reductions of 50% touted even in the short term. This claim of course depends on total fossil fuel-related energy consumption remaining flat or even declining – an argument that goes out the window if the prospect of shale gas is actually used to accelerate fossil fuel consumption. It is also the case that the potential for environmental harms to local land and water resources (and therefore other forms of local livelihoods) in Latin American shale basins is as yet poorly understood. Therefore, what follows is a series of recommendations.

- First, it is very important to promote more research and public debate on the economic, environmental and other costs and benefits of fracking in the Latin American region, as this will help to build both the knowledge base and public understanding. Currently, the lack of publicly-available data about energy operations combined with the top-down nature of decision-making in most Latin American countries seems a recipe for popular protest.
- Second, and linked to the above, assessment of water needs in the areas surrounding fracking wells is limited. Latin American countries should adhere to IWRM principles, particularly around integrated assessment of development applications and (meaningful) public consultation prior to initiating or licencing potentially impactful hydraulic fracturing activities.
- Third, regulation is very limited in the region. Financing and development of mechanisms, institutions, laws (national and local), personnel and know-how (especially on environmental criminal law) should be a priority in the countries implementing fracking in the Latin American region. Key to strong regulation will be adherence to the “precautionary principle” (UNESCO COMEST 2005).
- Fourth, exchange of experiences (common approaches to common challenges) is important amongst energy and environmental regulators and activists throughout the region. Countries from the region doing or considering fracking should promote the creation of a hemispheric task force for sharing and knowledge and to collect practical experiences on fracking, their experiences and approaches, policies, management challenges, and community engagement.
- Fifth, the distribution of benefits of hydraulic fracturing activities between the private and public sectors needs to be much more transparent and accountable. Countries should develop policies and systems (tax revenues, programs or others) which seek a proper and equitable distribution of income from fracking activities, designed to compensate stakeholders and governments accounts accordingly.
- Sixth, because fracking is expensive, it is therefore crucial that countries work on the promotion of integrated economic investment opportunities such that local

employment is appropriately developed, creating the enabling environment and guarantees for investors to finance these sorts of projects.

- Seventh, transboundary Shale Basins need a transboundary approach to exploitation and regulation. In the Latin American region, several shale basins are shared among two or more countries (i.e. Paraná and Austral Basins). While basins as geographical units do not recognize borders, conjunctive assessments (multinational), management and use of its resources, needs to be agreed on these areas.
- Eighth, particular care needs to be taken where energy exploitation activities may impact on indigenous communities, given the fact that these communities have historically been entirely excluded from the political process.

As other chapters in this volume have shown, appropriately and effectively regulating hydraulic fracturing is a challenge for all countries with potentially-exploitable resources, whatever their pre-existing level of political and economic development.

References

- AIDA (2016) Principio de Precaución: Herramienta Jurídica ante los Impactos del Fracking. Greenprint, Ciudad de México. Available at: https://aida-americas.org/sites/default/files/publication/publicacion_fracking_aida_boell_0.pdf
- Agua.org (2019) “La Nueva Ley General de Aguas” (19 July) Available at: https://agua.org.mx/analisis_integral/la-nueva-ley-general-de-aguas/
- Bertinat P, D’Elia E, Observatorio Petrolero Sur, Ochandio R, Svampa M, Viale E (2014) 20 Mitos y Realidades del Fracking. Editorial El Colectivo. Available at: www.opsur.org.ar/blog/wp-content/uploads/2015/06/2014-20-Mitos-Final.pdf
- Chequeado (2017) Macri: “Vaca Muerta representa la 2° reserva mundial de gas y la 4° de petróleo no convencional”. Available at: <https://chequeado.com/ultimas-noticias/macri-vaca-muerta-representa-la-2o-reserva-mundial-de-gas-y-la-4o-de-petroleo-no-convencional>
- EIA (2013a) North America leads the world in production of Shale gas. Available at: www.eia.gov/todayinenergy/detail.php?id=13491
- EIA (2013b) Technically recoverable shale oil and shale gas resources: an assessment of 137 shale formations in 41 countries outside the United States (Updated 2015). Available at: www.eia.gov/analysis/studies/worldshalegas
- EIA (2015) World shale resource assessments. Available at: <https://www.eia.gov/analysis/studies/worldshalegas/>
- EIA (2017) Energy explained. Available at: https://www.eia.gov/energyexplained/index.cfm?page=natural_gas_where
- El Sol (2013) General Alvear: la presión social revierte un veto que anulaba la ordenanza contra el fracking. Available at: www.elsol.com.ar/general-alvear-la-presion-social-revierte-un-veto-que-anulaba-la-ordenanza-contr-el-fracking.html
- Export.gov (2017) Mexico – oil and gas. Available at: www.export.gov/article?id=Mexico-Upstream-Oil-and-Gas
- Fundar, Centro de Análisis e Investigación, AC (2017) Las Actividades Extractivas en Mexico Estados Actual. Available at: <http://fundar.org.mx/mexico/pdf/Anuario2016corr.pdf>
- KAS (2016) The geopolitics of oil and gas: the role of Latin America. Available at: www.kas.de/c/document_library/get_file?uuid=dec202ba-72f8-4793-2bc7-f65236b972fd&groupId=252038

- Manfrenda J (2015) The origin of fracking actually dates back to the Civil War. Business Insider. Available at: www.businessinsider.com/the-history-of-fracking-2015-4?r=US&IR=T
- Mares DR (2015) Shale gas in Latin America: opportunities and challenges. Energy Policy Group of the Inter-American Dialogue. Available at: www.thedialogue.org/wp-content/uploads/2015/03/MaresShaleGasforWebposting.pdf
- Ministry of Energy and Mining, Colombia (2014) Resolución 90341 DE – Por la cual se establecen requerimientos técnicos y procedimientos para la exploración y explotación de hidrocarburos en yacimientos no convencionales. Available at: www.minminas.gov.co/documentos/10180/23517/22632-11325.pdf
- Ministry of Justice and Human Rights of Argentina (2012) Law 26741. Available at: www.sec.gov/Archives/edgar/data/904851/000095010312002488/dp30521_6k.htm
- Montgomery C, Smith M (2010) Hydraulic fracturing: history of an enduring technology. *J Pet Technol* 62(12). <https://doi.org/10.2118/1210-0026-JPT>
- Observatorio Petrolero Sur (2016) Un año de victorias en la lucha contra el fracking. Available at: www.opsur.org.ar/blog/2016/12/26/un-ano-de-victorias-en-la-lucha-contra-del-fracking
- Oxford Institute for Energy Studies (2016) Unconventional gas in Argentina: will it become a game changer? Available at: www.oxfordenergy.org/wpcms/wp-content/uploads/2016/10/Unconventional-Gas-in-Argentina-Will-it-become-a-Game-Changer-NG-113.pdf
- Posadas A, Buono R (2016) Looming conflicts? Energy reform priorities and the human right of access to water in Mexico. In: Payan T, Zamora SP, Ramón Cossío Díaz J (eds) *Estado de Derecho y Reforma Energética en México*. Mexico, Tirant lo Blanch
- Reig P, Luo T, Proctor J (2014) Global shale gas development: water availability and business risks. World Resources Institute, Washington, DC
- Tincher G (2015) The unconventional gas technical engagement program how to ensure the U.S. shares its experience in a socially and environmentally responsible manner. *Energy Law J* 36:1
- UNESCO COMEST (2005) The precautionary principle. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000139578>
- Vinson & Elkins (2016) Shale & fracking tracker: Mexico. Available at: www.velaw.com/Shale%2D%2D-Fracking-Tracker/Global-Fracking-Resources/Mexico

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