MITIGATION OF GREENHOUSE GASES AND SHALE GAS FROM A LEGAL PERSPECTIVE IN BRAZIL

Raíssa Moreira Lima Mendes Musarra[1]

Abstract

Shale gas, an abundant and available resource that promises to be useful, in addition to emitting less GHG than conventional means such as oil and carbon, has also been identified as sufficient to generate energy sufficiency and the consequent economic development of the country. However, its extraction depends on the controversial hydraulic fracturing process. This work uses the analytical, deductive method, with documentary and theoretical research techniques to describe the Brazilian legal perspective for the mitigation of Greenhouse Gases related to this type of exploration.
Keywords: Greenhouse Effect, Shale Gas, Global Warming, Hydraulic Fracturing, Precaution.

MITIGAÇÃO DE GASES DE EFEITO ESTUFA E GÁS XISTO SOB A PERSPECTIVA JURÍDICA NO BRASIL

Resumo

O gás de xisto, recurso abundante e disponível que promete ser útil, além de emitir menos GEE do que meios convencionais como petróleo e carbono, também tem sido apontado como suficiente para gerar suficiência energética e o consequente desenvolvimento econômico do país. No entanto, sua extração depende do controverso processo de fraturamento hidráulico. Este trabalho utiliza o método analítico, dedutivo, com técnicas de pesquisa documental e teórica para descrever a perspectiva jurídica brasileira para a mitigação de Gases de Efeito Estufa relacionada a este tipo de exploração.
Palavras-chave: Efeito Estufa, Gás De Xisto, Aquecimento Global, Fraturamento Hidráulico, Precaução.

[1] Pós-doutoramento do Programa de Pós Graduação em Ciência Ambiental (PROCAM), vinculado ao Instituto de Energia e Ambiente da Universidade de São Paulo (IEE/USP)

1. Introduction

Global warming is a reality that has been a matter of concern. This is because its effects affect the planet as a whole and not just the place where greenhouse gases are being emitted.

Shale gas is an unconventional natural gas modality that compared to oil and coal emits less GHG, which may be an alternative for the country in the medium term to achieve the president's goals.

In Brazil, the link of economic development to sustainability is registered in the Major Law and complementary laws.

Thus, the exploitation of shale gas is a complex and controversial theme because its exploitation depends on fracking, a technique of controversial effects that requires much study and caution for its implementation.

With the constitutional provision that present and future generations have the right to the balanced environment any and all practices that do not offer the right security will run into legal and judicial impediments, regardless of the economic gain that can be obtained from it.

2. Greenhouse Gases Emissions

The greenhouse effect, thus regarded as the phenomenon causing global warming worries environmentalists for a long time, but recently has gained space in the media by virtue of the Federal Government having committed to mitigate the emission of greenhouse gases by 2050.

> Current levels of greenhouse gas (GHG) concentration are already worrisome, and scientists predict that the planet's average temperature could rise between 1.8°C and 4.0°C by 2100, which would cause a complete change in the environment (IPPC, 2007).
> With this scenario would increase the intensity of extreme events, such as hurricanes, and also change the rainfall regime, with greater occurrence of droughts and floods. In addition to endangering the lives of large population contingents located on coasts and on islands, such disasters could generate epidemics and threaten water and light supply infrastructure, as well as compromise road and transportation systems.[2]

The first milestone worth mentioning in the fight against global warming is the Kyoto Protocol, signed in 1997 by numerous countries, such as Brazil. In spite

[2] MOTTA, Ronaldo Seroa's. The Regulation of Greenhouse Gas Emissions in Brazil. Available in < http://repositorio.ipea.gov.br/bitstream/11058/1894/1/td_1492.pdf>. Accessed 29.04.2021.

of the United States of America being a major polluter, at first they did not sign this international treaty.

Brazil is an important country for maintaining the balanced environment. Either because it has one of the greatest biodiversity in the Amazon Forest, or because of its energy potential.

Without making a case of CO^2 emissions, it is necessary to know:

> It is estimated that worldwide, about 19-23% of anthropic emissions, which include nitrous oxide (N2O) and methane (CH4), come from agricultural production and changes in land use (IPCC, 2014). Together with carbon dioxide (CO2), they comprise the main greenhouse gases (GHG) and are named for retaining and redirecting excess infrared radiation on the earth's surface (Primavesi et al., 2007). In Brazil, it is estimated that 84.2% of N2O emissions and 74.4% of CH4 are resulting from the agricultural sector, and for CO2, approximately 40.2% of emissions come from the use and change of land and forest use (Brasil, 2016).[3]

It remains clear that despite the energy sector being a major polluter, it is not the only one that needs to be the subject of studies to combat global warming. It is also necessary to consider the agrarian, livestock, deforestation sector, etc., but in this work the focus will be on the energy sector:

> It is estimated in all scenarios a considerable increase in Brazilian oil and natural gas production due to the exploration of the Pre-Salt. It was assumed that most of the volume extracted (57% in 2030 in the CPG) is destined for export, but there is a significant increase in the fugitive emissions (venting and flaring) of oil and gas production platforms. They were added to the fugitive emissions from the exploitation of coal, coal, the final consumption of the energy sector and the self-producing power plants, in addition to the emissions from the burning of biomass for the generation of electricity, to total ghg emissions from the Energy Supply sector. .

In the Kyoto Protocol, Brazil was committed to reducing GHG emissions by 36.1% and 38.9% by 2020 (art.12, Law No. 12,187/2009). To reduce GHG emissions, the country needs to invest in other energy options that emit less CO2. There is little point in raising awareness campaigns if the price of biofuels is high.

According to Ronaldo Seroa da Motta it is estimated that by 2030 China will be a polluter with potential equivalent to that of the USA. According to their analyses, developing countries need to increase the quality of life of their

[3] BROOM Marcos Renan. RIBEIRO, Ricardo Henrique(MONTEIRO, Alessandra Nardina Trícia Rigo. IWASAKI, William Seiki. PIVA, Thiago Jonatas. Soil Conservation Practices and Greenhouse Gas Emissions in Brazil. Available at < http://www.scielo.org.pe/scielo.php?script=sci_arttext&pid=S2077-99172018000300015>. Accessed 27/04/2021.

populations, which implies higher energy consumption and consequently more CO^2 emissions.

Another important international milestone on global warming is the Paris Agreement, in which the international community has committed itself to combating global warming of 2ºC, limiting the rise in temperature to 1.5ºC.

The developed countries parties should continue to take the lead, adopting absolute emission reduction targets for the economy as a whole. Developing countries should continue to strengthen their mitigation efforts, and are encouraged to progressively move towards emission reduction or limitation targets for the economy as a whole, in light of different national circumstances (Art. 4, Item 4, Paris Agreement).

Anywhere on Earth where a gram of GHG is ethed, it is the entire atmosphere being (about) charged with increasing the concentration of these gases; and it is also known that the effects of the changes will not be defined depending on where the emissions occurred, nor will these effects be restricted to certain locations (RUIZ, 2012).[4]

3. From Shale Gas, Economics and the Environment

In the search for energy self-sufficiency, the U.S. leads the exploration of unconventional natural gas called shale gas or shale gas in Portuguese. It is a fuel modality that emits fewer greenhouse gases compared to oil and coal, for example.

Brazil, which recently pledged to reduce its GHG emissions, is among the ten countries with the highest amount of shale gas in the world. This energy potential may be an alternative to the medium term to reduce GHG emissions because it is less polluting.

The obstacle that is envisaged is in the only extraction technique used so far: hydraulic fracturing. It is a technique that does not admit human errors, must be done with excellence and without failures, or the damage can be

[4] KING Fernando Cardozo. GATES Alcindo Fernandes. SOUZA Luciano Pereira of. Paris Agreement: Reflections and Challenges for the International Climate Change Regime. Right footings. Available in < http://revista.domhelder.edu.br/index.php/veredas/article/view/996>. Access on 28.04.2021.

unimaginable. It happens that in Brazil, much of the shale gas is under important groundwater such as the Guarani Aquifer, and any error can generate its contamination, among other environmental consequences.

> Fracking, is an extraction method that uses fractures produced by high hydraulic pressure and introduction of water, sand and a mixture of about 700 chemicals, some of which are toxic, inside the reservoir, which allows the gas to flow from the subsoil. Hydraulic fracturing allows drilling between 1,500 and 3,200 meters deep.[5]

Shale gas exploration, however risky, is an alternative for the developing country and could benefit economically from the exploitation of this ore. Even if there is a non-renewable resource, the country's shale gas reserves are sufficient to maintain energy supply for decades.

> If the shale gas market develops, as it has demonstrated, technologies for the transportation and exploration of gas, it could inhibit the cartel's might, estimates from Brihish Petroleum [BP outlook] show that natural gas can provide the same amount of energy in the world as oil, as it is found scattered in several countries, oil that is concentrated in some regions. With the new gas extraction technologies, the prospect of gas growth is already a reality, especially in North America, and has been affecting the world price of this commodity.
> (...) With this, we can better understand the recent revolution in the natural gas market that occurred in the USA and that has been affecting the world. The increase in exploratory activity of shale gas has increased economic production and employment, as well as creating greater demand for a wide range of goods and services. The decrease in gas and energy prices enables an increase in household income and lower business expenses.[6]

As it turns out, the exploitation of shale gas offers numerous economic advantages and can be a great ally to reduce GHG emissions. The only obstacle that is visualized is in the process of fracking or hydraulic fracturing, which if not done right can cause serious damage to the environment.

In this regard, in Brazil numerous member states have spoken out against the 12th round of bids of the ANP (National Agency for Petroleum, Biofuels and Natural Gas) that offered areas for the exploration of shale gas, resulting in the

[5] CARPEJANI, Gabriela. Environmental, Social and Economic Impacts of Shale Gas Exploration By *Fracking.* Available in < https://riuni.unisul.br/bitstream/handle/12345/12316/REV%20FINAL%20%282%29%20Gabriela%20Carpejani.pdf?sequence=1&isAllowed=y>. Accessed 26/04/2021.

[6] ZUÑEDA, Luiz. The Energy and Economic Revolution of Shale Gas (*Shale Gas*) : Influences in the Brazilian Petrochemical Industry. Available at < https://www.lume.ufrgs.br/handle/10183/109485>. Accessed 28/04/2021.

suspension of its effects in many of the states involved. There have also been numerous protests against fracking, such as in Toledo in Paraná.

In the contrahand of American success in the exploitation of shale gas, Italy through hydraulic fracturing ended up polluting a water sheet, which led to the need to import this essential insum into society.

4. From the Principle of Prevention

Environmental Law as an autonomous branch of law is based on numerous principles responsible for the idea of maintaining sustainability, among which in this work we will emphasize the principle of prevention. The Federal Constitution makes a great advance by providing in its art.225:

> Art. 225. All have the right to the ecologically balanced environment, well of common use of the people and essential to the healthy quality of life, imposing on the Public Power and the collectivity the duty to defend and preserve it for the present and future generations.
> § 1 - In order to ensure the effectiveness of this right, it is incumbent upon the Public Authorities to:
> I - preserve and restore essential ecological processes and provide ecological management of species and ecosystems;
> (...)
> IV - require, in the form of the law, for installation of work or activity potentially causing significant degradation of the environment, a prior study of environmental impact, to which advertising will take place;
> V - control the production, marketing and use of techniques, methods and substances that are at risk to life, quality of life and the environment;
> VI - promote environmental education at all levels of education and public awareness for the preservation of the environment;
> VII - protect the fauna and flora, sealed, in the form of the law, practices that endanger their ecological function, cause the extinction of species or subject animals to cruelty.
> (...)

First, the Federal Constitution has to be subject to environmental health for years to come, given the importance of international agreements signed by the country such as the Kyoto Protocol, the Paris Agreement and the most recent commitment signed by Brazil. The new Federal Constitution tie the idea of economic development to sustainability, that is, one cannot coexist without the other. On the National Environment Policy: This policy is explicitly highlighted in Article 225, which, using the ecologically balanced expression, presupposes harmony in all facet aspects that indelibly make up the environment[7].

[7] FIORILLO (ITALY), Celso Antonio Pacheco. Rodrigues, Marcelo Abelha(NERY, Rosa Maria Andrade. The Principle of Prevention and use of Injunctions in Brazilian Environmental Law. Available in <

The right to a balanced environment is a negative right, which means that it imposes an obligation not to do it on the State and individuals, such as not to engage in degrading activities. Its full effectiveness, however, depends on the application of other principles such as the polluter pays.

> In this sense, according to the crossing of information, and the result obtained in the cloud of words, it is verified that the development of "Fracking" goes against the Sustainable Development Goals proposed by the 2030 Agenda (Merino-Saum et al., 2018; United Nations, 2015). This is because sustainability seeks a balance between environmental, economic and social variables. With this actions to: conserve and use in a sustainable way the oceans, seas and marine resources seeking sustainable development (SDGs 14), search for the distribution of water and quality sanitation (SDGs 06), combat climate change, greenhouse gas emissions (SDGs 13) and preservation of the terrestrial ecosystem and biodiversity (SDGs 15) (Ngan et al., 2019; United Nations, 2015) are necessary to mitigate the anthropic impacts of this type of exploitation on the ecosystem.[8]

The precautionary principle implies as item 225, IV, CF requires environmental impact analysis of all activity with degrading potential to the environment, such as hydraulic fracturing.

The precaution requires that environmental measures be adopted that prevent the start of an activity potentially and/ or harmful to the environment, also acting when the environmental damage is already achieved, so that the harmful effects are minimized or ceased.[9]

This principle is directly linked to the idea of security, of caution, so that there can be a balanced environment also for future generations, ensuring the integrity of human life.

There is no doubt that the use of shale gas for economics is a tangible alternative to development, but what really needs to be balanced in this area is the extent to which this economic development compensates if it can be harmful to the environment. This is because the pollution of a sheet such as the Guarani Aquifer would harm not only Brazil and its neighboring countries, but the planet.

---

https://bdjur.tjdft.jus.br/xmlui/bitstream/handle/tjdft/34945/o%20principio%20da%20preven%C3%A7ao%20e%20a%20utiliza%C3%A7ao%20de%20liminares%20no%20direito%20ambiental%20brasileiro%5B.pdf?sequence=1>. Accessed 29/04/2021.

[8] CARPEJANI, Gabriela. Environmental, Social and Economic Impacts of Shale Gas Exploration By *Fracking*. Available in < https://riuni.unisul.br/bitstream/handle/12345/12316/REV%20FINAL%20%282%29%20Gabriela%20Carpejani.pdf?sequence=1&isAllowed=y>. Accessed 26/04/2021.

[9] COLOMBO, Silvana. The Precautionary Principle in Environmental Law. Available at < https://www.seer.furg.br/remea/article/view/2889/1644>. Accessed 30/04/2021.

Brazil undoubtedly still needs to invest a lot in technology in so that it can explore its full energy potential. The suspension of the effects of the 12th round of ANP bids is a reflection of environmental concern versus the need for economic development in the country. Fracking is a procedure still surrounded by many scientific uncertainties, which generates a need for support in its implementation despite the success obtained in the USA.

Thus, the precautionary principle covers the risk or danger of environmental damage, even if there is scientific uncertainty, which means that its application predate the environmental damage that may result from human actions or omissions.[10]

Introductoryly it is necessary to clarify here that civil liability in environmental matters is objective and implies the reversal of the burden of proof in favor of the environment.

5. Regulation of Emissions in Brazil

Since climate change is a global phenomenon its mitigation depends on international cooperation, given the importance of international treaties in this sense, as president Jair Bolsonaro did. In 1997 we have the first international milestone in the search for ghg reduction, the Kyoto Protocol.

The awareness that we live in a world with limited resources is what drives environmentalists to defend the so-called green economy.

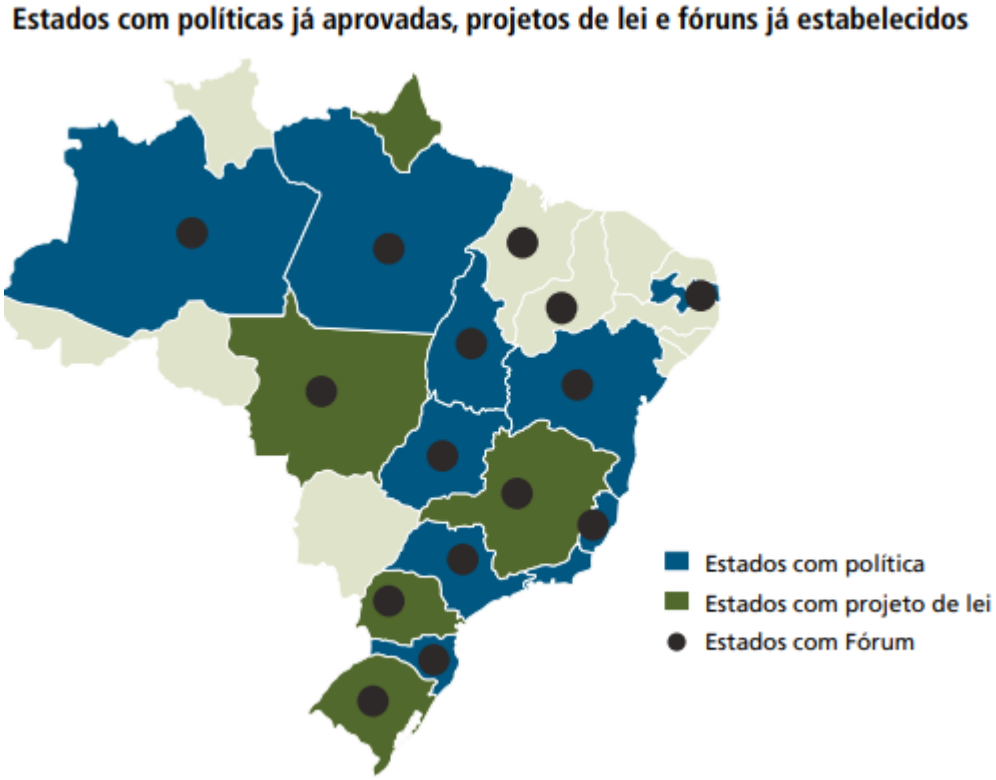
> At COP-15, held in Copenhagen in 2009, Brazil made a commitment for the first time to control its GHG emissions and, domestically, instituted the PNMC (National Climate Change Policy) through Law No. 12,187 of December 29, 2009. The Brazilian goal is to reduce between 36.1% and 38.9% the projected emissions for the year 2020. These projections4 were presented in Decree No. 7,390 of December 9, 2010, which regulates Articles 6, 11 and 12 of Law No. 12,187. The decree also establishes that annual estimates of GHG emissions in Brazil be published for the purposes of monitoring the PNMC.[11]

[10] COLOMBO, Silvana. The Precautionary Principle in Environmental Law. Available at < https://www.seer.furg.br/remea/article/view/2889/1644>. Accessed 30/04/2021.

[11] COSTA, Vanessa Cristina S.P.A. da. ALVES José Eustatius Diniz. The Regulation of Greenhouse Gas Emissions in Brazil in the Context of Global Climate Governance. Available in <http://www.abep.org.br/~abeporgb/publicacoes/index.php/anais/article/viewFile/2247/2202>. Accessed 17/05/2021.

Despite the constitutional provision on the environment and the National Energy Policy Law, the country still lacks strong regulation that establishes how ghg reduction will take place, which makes international treaties so important.

Additionally, it is observed that some states have also created their local policies, establishing regulations to encourage mitigation and adaptation actions. Also according [12]to Romeiro and Parente, states such as São Paulo and Rio de Janeiro have adopted local policies to minimize GHG emissions, but the success of their local policies will depend on how they will measure and verify compliance with emission reduction targets, applying the appropriate sanctions, whenever necessary. See the demo map of local policies in all states of the federation made by the aforementioned authors:



[12] ROMEIRO, Viviane. RELATIVE Virginia. Regulation of Climate Change in Brazil and the Role of Subnational Governments. Available in < https://documentacao.socioambiental.org/noticias/anexo_noticia//20850_20110902_103740.pdf#page=42 >. Access on 17.05.2021.

Since during fracking there is GHG emission, it is necessary to use CCS (Carbon Capture and Storage) techniques so that there is no damage to the atmosphere. Geologist Cristina Rodrigues, in 2018 said that:

> What is established is that it is impossible to achieve the emission reduction targets that are set without the application of CCS. In Europe, in particular, one of the storage options that companies have considered a lot are the saline aquifers. In them, CO_2 is dissolved in saline water. Because the implementation of CCS today is an imposition of the European Parliament. The big broadcasters in all sectors will be forced to do so. The European Commission has concluded that it is not possible to meet the targets without these initiatives. Even Carbon Capture and Utilization (CCU), which was vetoed until the other day, is being encouraged today.[13]

Despite what experts say, there have been numerous CCS projects cancelled in the world for various reasons, including technical, regulatory, and political risks. What can be said with certainty is that the use of shale gas to reduce GHG emissions without CCS techniques is totally useless, but there is a lack of regulatory frameworks to do so.

It is also important to highlight that in case of environmental accidents involving geological reservoirs of CO2 storage, the responsibility among the agents involved is solidary, according to Art.5 of Law No. 6,453/77.

6. Incentives and Emission Mitigation Technologies in Brazil

In 1988 the Federal Constitution, the highest standard in the legal system, already provided in an entire chapter for the guidelines for maintaining and obtaining a healthy environment for the present and future of humanity.

The Kyoto Protocol was signed below and Law No. 9,478/97, the National Energy Policy Law, was sanctioned. As can be seen despite the numerous problems that the country still faces in the environmental area, the legislator was deeply concerned about sustainable development.

Thus, law no. 9,478/97 says:

> Art. 1 "National policies for the rational use of energy sources will aim at the following objectives:
> (...)

[13] RCGI. Expert warns: "We will not meet emissions reduction targets without CCS". Available at < https://www.rcgi.poli.usp.br/pt-br/especialista-alerta-nao-vamos-atingir-as-metas-de-reducao-de-emissoes-sem-ccs/>. Access on 17.05.2021.

> II - promoting development, expanding the labor market and valuing energy resources;
> (...)
> XVIII - mitigate emissions of greenhouse gases and pollutants in the energy and transport sectors, including the use of biofuels."

Economic growth is necessarily linked to the preservation of natural resources. Thus, regardless of the normative status that international treaties occupy when entering the national order, the reduction of GHG emissions, one way or the other is a goal to be met.

In Brazil, the National Petroleum Agency (ANP) published resolution 21/2014 of April 10, 2014, which regulates drilling activities developed by hydraulic fracturing in unconventional reservoirs. In which, preliminary estimates indicate reserves of around 226 trillion cubic feet (tcf), placing the country as the tenth largest reserve in the world, while proven reserves of natural gas are 16 tcf (SBPC, 2013).[14]

Unlike what happened in Brazil, American environmentalists were in favor of using shale gas because it was a better energy source than coal-based thermal scares at the time.

In November 2013, the ANP promoted the 12th round of bids for the exploration of shale gas in Brazil. In April, the regulatory agency published resolution no. 21, which deals with the fracking procedure, but due to numerous actions to prevent the exploitation of shale gas through hydraulic fracturing, its effects were suspended.

> Little is known about the main Brazilian aquifers and nothing about the petrophysical and geomechanical characteristics of the shale, an essential condition for the correct application of hydraulic fracturing so that environmental studies evaluating the effective and potential impacts of this activity should still be elaborated to subsidize the competent environmental agencies with elements that allow them to decide whether or not to grant environmental licenses, which, according to the new Resolution, should precede approvals by the ANP.[15]

According to MME data, the U.S. has nearly doubled its natural gas production in the last decade using shale gas. With this the country is gaining

[14] FILE Attila Campos de. ANGELS José Ângelo Sebastião Araújo dos. *Shale Gas*: Environmental Issues of Its Production. Electronic Energy Magazine. Available in < https://revistas.unifacs.br/index.php/ree/article/view/3640/2817>. Accessed 12/04/2021.

[15] FILE Attila Campos de. ANGELS José Ângelo Sebastião Araújo dos. *Shale Gas*: Environmental Issues of Its Production. Electronic Energy Magazine. Available in < https://revistas.unifacs.br/index.php/ree/article/view/3640/2817>. Accessed 12/04/2021.

more and more energy independence. Following the American model however is not such a simple task. The theme is controversial and its results generate divergences among the main scientists in the area:

> Brazil needs to analyze and discuss these risks with society before any exploitation of shale gas. The country does not know its true potential for shale gas, there is a lot of speculation and few geological studies, to know the true Brazilian potential. The lack of transport structure will be a major barrier to shale gas production, and the speculative reserves of shale gas are mostly within the country, consequently outside the main pipelines and also the main consumer markets. It is noted that many doubts regarding its real revolution and its true potential in Brazil, cannot forget the impacts that can generate in our country, both in health and in the environment.

A known form that can mitigate the impacts of fracking is seismic monitoring, the purpose of which is to ensure that hydraulic fracturing induces microseismic activities only within the reservoir.

Natural gas is almost 50% less greenhouse gas than coal-hot power plants. If, however, the benefits [16]of using shale gas are relevant to the environment and the economy, the risks of its extraction through fracking, if not properly managed, may lose all the advantages mentioned above. Thus, the ideal according to this line of reasoning would be not to use shale gas to obtain energy self-sufficiency, however beneficial it may be for economics.

7. Environmental Liability

With the constitutional prediction that everyone has the right to the balanced environment for present and future generations, governments have been challenged to promote sustainable development, that is, to progress economically without degrading the environment. The environment is a common good of the people and belongs to everyone at the same time, and every society has the right to enjoy it.

> Therefore, it is possible to point out that environmental quality must be recognized as an integral element of the normative content of the principle of human dignity, especially because of its imprescindibility not only of the maintenance of the existence of life, but also of a life with

[16] FILE Attila Campos de. ANGELS José Ângelo Sebastião Araújo dos. *Shale Gas*: Environmental Risks of Its Production For Brazil. Magazine management and environmental sustainability. Available in < http://portaldeperiodicos.unisul.br/index.php/gestao_ambiental/article/view/3353/2386>. Access on 13.05.2021.

> quality, being fundamental to the development of all human potential in a complex existential well-being.[17]

The position of the author mentioned above about environmental protection is that since it is no longer possible to remove the risk, the best solution is prevention and caution in the face of its effects.

In legal language, it can be said that sustainable development aims to create intergenerational links with a view to the rational use of environmental resources, not allowing their exhaustion or irreversible deterioration, using them in a durable way and ensuring their perenity for successive generations (sustainability).[18]

Which brings us to the legal principle of the polluter pays, which implies that the one who causes the environmental damage is obliged to repair it. The responsibility for the degradation of the environment is objective, that is, it is independent of guilt.

> As a legal rule, environmental liability, as has already been said, must ensure that polluters are held accountable for their actions against the environment, in strict application of the polluter pays principle. This responsibility, however, should be analyzed at three different times, in accordance with the results of said actions on the environment, and should give way to different reactions of the legal and environmental order. We refer to the three levels of environmental responsibility: prevention (A), reparation (B) and anticipation (C), not all deserving the same degree of attention from the legislator, jurisprudence or doctrine and even with doubts about their admissibility.[19]

According to the teachings of the author above, the first moment is to prevent environmental damage, that is, prevent environmental damage from occurring. If it is not possible to avoid it, it remains only to minimize it. The second moment is the one in which the damage has already occurred and we seek to remedy it. There is talk here of accountability itself. Finally, the third moment where the damage is irreparable. The precautionary principle is thus applied to

---

[17] JUNIOR Inio Duarte Fernandez. Environmental Civil Liability: The Composition of Interests to Be Related to the Identification of Harmful Conduct. Paco Editorial. 2015. Available in <https://books.google.com.br/books?hl=pt-BR&lr=&id=iiWSDgAAQBAJ&oi=fnd&pg=PT4&dq=responsabilidade+ambiental&ots=nkA_1-qS0z&sig=hEj0Yf8VxEGgzpVZfeRvQZOVONQ#v=onepage&q=responsabilidade%20ambiental&f=false>. Access on 04/05/2021.

[18] CROSS Branca Martins da. Sustainable Development and Environmental Responsibility. Available in <http://revistas.lis.ulusiada.pt/index.php/lda/article/view/2106/2226>. Access on 10/05/2021.

[19] CROSS Branca Martins da. Sustainable Development and Environmental Responsibility. Available in <http://revistas.lis.ulusiada.pt/index.php/lda/article/view/2106/2226>. Access on 10/04/2021.

foresee its effects. The main function of this principle is to prevent scientifically uncertain risks from becoming a reality.

Also according to this author, the simple possibility of damage should already give way to the responsibility of the perpetrator of the action causing the damage. Caution should always be taken in order to prevent the damage from becoming real.

The non-realisation of the damage cannot serve as an excuse to deny the breach of the principle and the precautionary obligation that arises from it.[20]

In the case of the use of shale gas, from this perspective there are two points that need reflection. First, one has to face an abundant energy resource. In contrast, fracking is an activity that imports in risk and demands high investments in technology and research:

> Another fact to be mentioned refers to the reversal of the burden of proof. In the environmental sphere, unlike in other areas of law, objective civil liability prevails. This was inserted by Article 14 of the National Environment Policy Law (Law 9391/81) and received by Article 225, § 3 of the Federal Constitution, which expresses: "The polluter is obliged, regardless of the existence of the fault, to indemnify or repair the damage caused to the environment and to third parties affected by this activity." [21]

The environment is a legal good that needs protection from the State and individuals, since it must be ensured for the survival of humanity, this is the greatest meaning of sustainable development. It was concerned about this the Federal Constitution and gave this good the status of fundamental right, still linked to the principle of the dignity of the human person. All caution is little when it comes to sustainable development, which is nothing more than economic development that ensures human survival.

The objective of environmental civil liability, thus, is to impute to the cause of the damage its reparation even if it has not incurred with fault in its degrading action, either through a system of rapid accountability, or by means of protective measures. Guilt in its legal sense encompasses three aspects, including negligence, recklessness or malpractice. Although no such items exist, the cause of environmental damage is linked to the duty of repair. It is also important to

[20] CROSS Branca Martins da. Sustainable Development and Environmental Responsibility. Available in <http://revistas.lis.ulusiada.pt/index.php/lda/article/view/2106/2226>. Access on 10/04/2021.

[21] COLOMBO, Silvana. The Precautionary Principle in Environmental Law. Available at < https://www.seer.furg.br/remea/article/view/2889/1644>. Accessed 30/04/2021.

emphasize that the civil accountability of the agent does not exclude accountability in other spheres of law. If there is damage and causal link is before the institute of accountability.

The exploitation of shale gas implies a risk of damage to the collective, since if there is any failure in its execution the consequences are unpredictable. When talking about repairing a damage, the objective is the return to the so-called status quo ante, which is the one before the damage. It happens that in the case of fracking is very difficult this restoration, which leads countless environmentalists to protest against this technique and many Brazilian states have prohibited it either through laws or by Public Civil Action.

It is also necessary to discuss the theory of created risk that admits exclusions of responsibility in the following cases: exclusive guilt of the victim, exclusive fact of third party and fortuitous case or force greater force. Remote possibilities occur when it comes to fracking, but one must mention.

In all states of the federation where there is no law of its own prohibiting fracking, there is the general rule that what is not prohibited is allowed. However, jurisprudence has understood the need for Environmental Assessment of the Sedimentary Area (AAAS) before starting the exploration.

Although there is another current regarding environmental responsibility (created risk theory), the trend in Brazil is the theory of integral risk, without excluding culpability, which shows the national rigor with regard to environmental preservation.

Thus, Bedran and Mayer understand that: "Brazil has no tools to repair the damage immediately after its occurrence, as occurs in the United States and Italy, whose environmental protection agencies take action, regardless of the imputation of responsibility to its cause. In this respect, despite the legislative rigor, the repair of the damage in Brazil is ineffective, and executive instruments should be created so that there is more effective protection. "[22]

[22] BEDRAN, Karina Marcos. MAYER, Elizabeth. Civil Liability for Environmental Damage in Brazilian and Comparative Law: Created Risk Theory versus Integral Risk Theory. Veredas do Direito Magazine. Available in < http://revista.domhelder.edu.br/index.php/veredas/article/view/271>. Accessed 11/05/2021.

8. Final Considerations

Emitting less GHG is not the same as failing to emit, i.e. ghg emissions in a smaller amount, so it is said in this article that the use of this energy potential is a medium-term alternative. Even so, its use implies the generation of jobs and consequent economic development.

The obstacle that needs to be observed is the issue that involves hydraulic fracturing, because it is a high-risk technique, and that if it is not well done among others can cause the contamination of large water sheets such as the Guarani Aquifer, reserve this is not even only under the national territory.

Despite having committed to the end of the GHG emission, the president has not yet expressed his way showing how this will happen. In this project, shale gas can be very useful and bring numerous economic benefits, but it should be noted that the use of fracking has been the subject of great national reluctance due to its risks to the environment.

Theexploitation of shale gas is not envisaged without previously being safe for natural resources and ecosystems. Sustainable development and civil accountability of the polluter do not mean the effective return to the status quo ante is not always possible, those interested in the exploitation of shale gas will have legal and environmental challenges that by the nature of the technique are expected, in addition to them, the challenge of emissions must be taken seriously.

References

ABREU, Miriam Santini de. A Exploração de Gás de Xisto e a Ameaça Ambiental: Discurso e Poder no Sistema Energético. Disponível em < https://ojs.sites.ufsc.br/index.php/rebela/article/view/2731/1908>. Acesso em 30.04.2021.

BENJAMIN, Antonio Herman de Vasconcelos E. A Responsabilidade Civil Pelo Dano Ambiental no Direito Brasileiro e as Lições do Direito Comparado. Disponível em < https://core.ac.uk/reader/79061950>. Acesso em 11/05/2021.

BEDRAN, Karina Marcos. MAYER, Elizabeth. A Responsabilidade Civil por Danos Ambientais no Direito Brasileiro e Comparado: Teoria do Risco Criado versus Teoria do Risco Integral. Revista Veredas do Direito. Disponível em <

http://revista.domhelder.edu.br/index.php/veredas/article/view/271>. Acesso em 11/05/2021.

BESEN, Marcos Renan. RIBEIRO, Ricardo Henrique. MONTEIRO, Alessandra Nardina Trícia Rigo. IWASAKI, Guilherme Seiki. PIVA, Jonatas Thiago. Práticas Conservacionistas do Solo e Emissão de Gases do Efeito Estufa no Brasil. Disponível em < http://www.scielo.org.pe/scielo.php?script=sci_arttext&pid=S2077-99172018000300015>. Acesso em 27/04/2021.

CARPEJANI, Gabriela. Impactos Ambientais, Sociais e Econômicos da Exploração do Gás de Xisto Por *Fracking.* Disponível em < https://riuni.unisul.br/bitstream/handle/12345/12316/REV%20FINAL%20%282%29%20Gabriela%20Carpejani.pdf?sequence=1&isAllowed=y>. Acesso em 26/04/2021.

COLOMBO, Silvana. O Princípio Da Precaução No Direito Ambiental. Disponível em < https://www.seer.furg.br/remea/article/view/2889/1644>. Acesso em 30/04/2021.

CRUZ, Branca Martins da. Desenvolvimento Sustentável e Responsabilidade Ambiental. Disponível em <http://revistas.lis.ulusiada.pt/index.php/lda/article/view/2106/2226>. Acesso em 10/04/2021.

COSTA, Vanessa Cristina S.P.A. da. ALVES, José Eustáquio Diniz. A Regulação das Emissões de Gases de Efeito Estufa no Brasil no Contexto da Governança Global do Clima. Disponível em <http://www.abep.org.br/~abeporgb/publicacoes/index.php/anais/article/viewFile/2247/2202>. Acesso em 17/05/2021.

FIORILLO, Celso Antonio Pacheco. RODRIGUES, Marcelo Abelha. NERY, Rosa Maria Andrade. O Princípio da Prevenção e a Utilização de Liminares no Direito Ambiental Brasileiro. Disponível em < https://bdjur.tjdft.jus.br/xmlui/bitstream/handle/tjdft/34945/o%20principio%20da%20preven%C3%A7ao%20e%20a%20utiliza%C3%A7ao%20de%20liminares%20no%20direito%20ambiental%20brasileiro%5B.pdf?sequence=1>. Acesso em 29/04/2021.

FRAGA, Fernando. Bolsonaro Promete Fim das Emissões de Gases de Efeito Estufa Até 2050. Disponível em < https://agenciabrasil.ebc.com.br/geral/noticia/2021-04/bolsonaro-promete-fim-das-emissoes-de-gases-de-efeito-estufa-ate-2050#:~:text=Compromisso%20foi%20anunciado%20na%20C%C3%BApula%20de%20L%C3%ADderes%20sobre%20o%20Clima&text=O%20presidente%20Jair%20Bolsonaro%20se,prevista%20no%20Acordo%20de%20Paris.>. Acesso em 26.04.2021.

JÚNIOR, Inio Duarte Fernandez. Responsabilidade Civil Ambiental: A Composição de Interesses a Contar da Identificação de Condutas Lesivas. Paco Editorial. 2015. Disponível em <https://books.google.com.br/books?hl=pt-BR&lr=&id=iiWSDgAAQBAJ&oi=fnd&pg=PT4&dq=responsabilidade+ambiental&ots=nkA_1-qS0z&sig=hEj0Yf8VxEGgzpVZfeRvQZOVONQ#v=onepage&q=responsabilidade%20ambiental&f=false>. Acesso em 04/05/2021.

LIMA, Átila Campos de. ANJOS, José Ângelo Sebastião Araújo dos. *Shale Gas*: Questões Ambientais de Sua Produção. Revista Eletrônica de Energia. Disponível em < https://revistas.unifacs.br/index.php/ree/article/view/3640/2817>. Acesso em 12/05/2021.

LIMA, Átila Campos de. ANJOS, José Ângelo Sebastião Araújo dos. *Shale Gas*: Riscos Ambientais de Sua Produção Para o Brasil. Revista gestão e sustentabilidade ambiental. Disponível em < http://portaldeperiodicos.unisul.br/index.php/gestao_ambiental/article/view/3353/2386>. Acesso em 13.05.2021.

LINS, Luiz dos Santos. SILVA, Raimundo Nonato Sousa. Responsabilidade Sócio-Ambiental ou Greenwash: Uma Avaliação com Base nos Relatórios de Sustentabilidade Ambiental. Disponível em <http://www.atena.org.br/revista/ojs-2.2.3-08/index.php/ufrj/article/view/472/461>. Acesso em 04.05.2021.

MARTINS, Rhodiney Vaz. GUERRA, Sinclair Mallet Guy. JUNGER, Alex Paubel. FACO, Júlio Francisco Blumetti. ASPECTOS GEOPOLÍTICOS E GEOESTRATÉGICOS DO SHALE GAS. South American Development Society Journal. Vol.:03. Nº.: 09. Ano: 2017. Disponível em <

http://www.sadsj.org/index.php/revista/article/view/111/95>. Acesso em 13.05.2021.

MOTTA, Ronaldo Seroa da. A Regulação das Emissões de Gases de Efeito Estufa no Brasil. Disponível em < http://repositorio.ipea.gov.br/bitstream/11058/1894/1/td_1492.pdf>. Acesso em 29.04.2021.

MUSSARA, Raíssa Moreira Lima Mendes. Carbon Capture and Storage: A Importância das Tecnologias Para Contratos no Setor de Energia. Disponível em < http://ditec.esaoabsp.com/2020/04/17/carbon-capture-and-storage-a-importancia-das-tecnologias-para-contratos-no-setor-de-energia/>. Acesso em 12/04/2021.

RCGI. Especialista alerta: “Não vamos atingir as metas de redução de emissões sem CCS”. Disponível em < https://www.rcgi.poli.usp.br/pt-br/especialista-alerta-nao-vamos-atingir-as-metas-de-reducao-de-emissoes-sem-ccs/>. Acesso em 17.05.2021.

REI, Fernando Cardozo Fernandes. GONÇALVES, Alcindo Fernandes. SOUZA, Luciano Pereira de. Acordo De Paris: Reflexões e Desafios Para o Regime Internacional de Mudanças Climáticas. Veredas do Direito. Disponível em < http://revista.domhelder.edu.br/index.php/veredas/article/view/996>. Acesso em 28.04.2021.

ROMEIRO, Viviane. Regulação da Captura e Armazenamento de Carbono no Brasil. Disponível em < http://myrtus.uspnet.usp.br/iee/sites/default/files/Viviane%20Romeiro%20Apresentacao%2020141031.pdf>. Acesso em 17.05.2021.

ROMEIRO, Viviane. PARENTE, Virgínia. Regulação das Mudanças Climáticas no Brasil e o Papel dos Governos Subnacionais. Disponível em < https://documentacao.socioambiental.org/noticias/anexo_noticia//20850_20110902_103740.pdf#page=42>. Acesso em 17.05.2021.

ROVERE, Emílio Lebre La. WILLS, William. PEREIRA, Amaro. DUBEUX. C.B.CUNHA, S.H.F. OLIVEIRA, B.C.P. WATANABE, Shigeru. LOUREIRO, S.M. GROTTERA, Carolina. Implicações Econômicas e Sociais de Cenários de Mitigação de Gases de Efeito Estufa no Brasil até 2030 Sumário Técnico.

Disponível em < https://hal.archives-ouvertes.fr/hal-01695230/document>. Acesso em 28/04/2021.

SANTOS, Marilin Mariano dos. MATAI, Patricia Helena Lara dos Santos. A Importância da Industrialização do Xisto Brasileiro Frente ao Cenário Energético Mundial. Disponível em < https://www.scielo.br/scielo.php?pid=S0370-44672010000400012&script=sci_arttext>. Acesso em 30/04/2021.

ZUÑEDA, Luiz. A Revolução Energética e Econômica do Gás de Xisto (*Shale Gas*) : Influências na Indústria Petroquímica Brasileira. Disponível em < https://www.lume.ufrgs.br/handle/10183/109485>. Acesso em 28/04/2021.