Environmental Impact Assessment of Carbon Capture and Storage: Social Perspectives and Environmental Restrictions for Natural Gas in Brazil*

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Abstract

This paper discusses the first step in the creation of an Environmental Impact Assessment (EIA) Protocol for Carbon Capture and Storage (CCS) activities in Brazil, considering the social perspective and environmental restrictions directly related to natural gas. The EIA process is always for the Environmental Licensing of activities that cause significant environmental degradation, which may be the case for CCS activities. However, in Brazil there is still no specific EIA protocol for these kinds of activities, which represents a complex and uncertain current scenario for nationally scaling up of CCS practices. An elaborate protocol entitled "Environmental Impact Assessment of CCS activities" has been developed, based on how CCS activities are regulated by environmental policies in other countries. This is the technical basis for Environmental Licensing of activities in the sector, covering the entire CCS cycle: planning, implementation, operation and decommissioning. For each of these stages, a specific EIA protocol will be applied to ensure the prevention, recovery from and mitigation and compensation of environmental impacts, including all social, physical and biological aspects. The specific EIA protocol for CCS activities is also expected to incorporate existing legal, technical and scientific requirements to add adequate environmental and social safeguards, as well as reducing deadlines, costs and uncertainties that are normally involved in the Environmental Licensing process. The first attempts to implement these environmental policies in Brazil are underway.

Introduction

The Environmental Impact Assessment (EIA) is a necessary support for the Environmental Licensing of Carbon Capture and Storage Activities (CCS) in Brazil. However, in Brazil there is still no specific EIA protocol for CCS activities, which represents a scenario of great complexity and uncertainties for the moment of scaling up of these activities in the national scenario. In this context, based on how CCS activities are regulated by environmental policies in other countries, the main contribution of this work is to demonstrate the first step of EIA structure for the Environmental Licensing of CCS activities specific to Brazil, based on the analysis of existing legislation, institutional and social aspects.

In October of 2017, the project entitled 'Environmental Impact Assessment of Carbon Capture and Storage in Brazil: definition and structuring of a specific EIA process based on legal analysis, environmental constraints, social impacts and institutional evaluation' was approved to perform in the Research Centre of Gas Innovation, supported by Royal Dutch Shell, São Paulo Research Foundation, Shell, and University of São Paulo. The aim of the project is to propose an Environmental Impact Assessment (EIA) structure, in the Brazilian context, for Carbon Capture and Storage activities that considers: (i) social perspective and environmental constraints and (ii) legal analysis and evaluation institutional competences.

However, this work will present some reflections already developed within the project 42, which are a small global history, focusing on Brazil in relation to the development of uses of technologies and fossil fuel. And secondly, discussions on the environmental programs for carbon capture and storage activities (CCS) focusing on Brazil.

Global and Brazilian Scenario

The 18th century is marked by the use of coal as an energy source, replacing, mainly and gradually, the firewood. The use of mineral coal boosted and subsidized what we call the First Industrial Revolution (1760-1830), a label attached by Thomas Ashton (1948). The use of coal as the main source of energy lasted until the mid-20th century, and its use today is still the center of discussions due to the emission of CO_2 into the atmosphere. However, the first world drilling of an oil well at a depth of 21 meters on the Absheron Peninsula (Bibi-Heybat region of Baku) in 1846, followed by the drilling of the first commercial oil well in the village of Titusville, Pennsylvania (Mir-Babayev, 2011; Brice, 2009). The United States, in 1859, inaugurated a new phase with the use of petroleum as main energy source, mainly from the second decade of the 20th century. The use of these two energy sources over the centuries has led to an increase in CO_2 concentration in the atmosphere.

In Brazil, the first research related to mineral fuels goes back to the first decades of the 19th century. During this period, the National Museum became the main institution that played the fundamental role of analyzing this material, with the predominance of 'stone coal', due to the growing interest of the government in its use as a source of energy for use in industry and steam engines. The innumerable investments of the imperial government to find coal and to exploit it, have led to negative data regarding the quality of the coal exploited here (Fernandes et. al, 2014; Lopes, 1995). The importation of coal for use in Brazil was restricted mainly from England mainly until the middle of 1910. The search for oil was another characteristic fact in the development and use of fossil fuels in Brazil. The search for oil was related as a second option over the first, coal. (Peyerl, 2017) The discovery of the first sub-commercial oil well, followed by the year 1941, when the first commercial oil well is discovered in Brazil, inaugurates a new phase related to investment and technology related to fossil fuels (Peyerl, 2017).

Emphasizing that, from 1850, Brazil's industrial development, dependent on export agriculture, was paralleled by improvements and changes, such as railroads, which needed alternatives to high fuel costs. In the first decades of the 20th century, governmental initiatives such as the Coal Mine Studies Commission (1904); and the Geological and Mineralogical Service of Brazil (1907) -, modified the Brazilian scenario, contributing to an industrialization process aimed at researching energy sources, mainly coal, oil and natural gas (Figueiroa, 1997; Peyerl, 2017).
At the same time, the use of fossil fuels as an energy source has led to the increase of CO_2 in the atmosphere, causing problems related to what we now call mainly climate change, causing different impacts in different areas, from environmental to social. The twenty-first century begins

with new approaches, discussions, technological development and incentives aimed at capturing and storing CO_2. It is mentioned the fact that, since 1920, some technologies were developed in order to separate the CO_2 found in natural gas reservoirs, and from 1930, some companies began to use the carbon capture, reducing the presence of this before even to get in touch with the atmosphere.

However, it is in the 1970s that we have new technological advances in CO_2 capture, which have contributed to the recovery of the oil field, known as Enhanced Oil Recovery (EOR). In the 1990s, the implementation of the United Nations Framework Convention on Climate Change (1992), the creation of the Kyoto Protocol (1997) and the Paris Agreement (2015) provided a new perspective for the future of international climate policy, with the purpose of reducing CO_2 emissions, reversing the accumulation of CO_2 in the atmosphere over the centuries, mainly by the use of fossil fuels (Oberthur, 1999; Markusson et. al, 2012). The 21st century thus begins with new approaches, discussions, technological development and incentives aimed at capturing and storing CO_2.

Environmental Programs for Licensing of Carbon Capture and Storage Activities (CCS)

Carbon Capture and Storage (CCS) activities represent an important way to avoid significant emissions of CO_2 from energy production systems based on fossil sources, minimizing climate changes in a global wide (Figure 1). These activities form the strategies of several countries engaged with the reduction of CO_2 emissions. For example, European Union (EU) has a strong legislation aimed to improve the effective operation of CCS, avoiding significant impacts and risks for social and environmental components associated with climate changes. Their current Regulatory Board was based on requirements Health & Safety, Emissions, Trading, Control of Hazardous Substances, Integrated Pollution Prevention and Control, Waste Management and Environmental Liability (Williamson and Zakkour, 2008), which compose the Impact Assessment framework for the licensing of CCS activities.

There is a huge potential to apply strategies of CO_2 reduction based on CCS activities in Brazil, considering, for instance, the Pre-Salt production scenario. However, there are no Impact Assessment framework designed specifically for CCS activities in Brazil, even if Brazilian legislation requires that CCS activity must be licensed (Environmental License) based on general Environmental Impact Assessment process (Conama, 1986; Brazil, 1989). Considering that, it is likely that the scale-up of CCS activities in Brazil will find some legal and technical constraints. Therefore, it is timely to look forward to the design of specifically Environmental Impact Assessment process for CCS activities, in order to improve security in business environment and avoid social and environmental impacts, and risks.

The main type of Environmental Impact Assessment can be defined by a set of logical procedures aimed to analyze the environmental feasibility of projects, supporting the decision making about Environmental License Process (IAIA, 1999; Morris and Thérivel, 2001; Glasson et al., 2005; Sánchez, 2006). In this case, the Environmental Impact Assessment is applied throughout all life cycle of project: planning, implementation, operation and decommissioning. In each of these steps, there are several Environmental Programs to avoid, mitigate and compensate social, biological and physical impacts, what the technical and scientific literature calls “mitigation hierarchy” (Mitchell, 1997).

Based on general CCS requirements described by Williamson and Zakkour (2008), the opportunities for environmental programs to avoid, mitigate and compensate environmental impacts of CCS activities are:

1. Planning: It is possible to assess the best locational and technological alternatives of the project, and to propose an Environmental Management Plan for next steps. The assumption is that when the appropriated alternative is chosen, significant impacts are avoided, performing a more streamlined Environmental Licensing. This step produces Environmental Impact Statement that is analyzed by Environmental Agency for emission of the prior license. After this, the requirements established by Environmental Agency, based on Environmental Impact Statement, must be considered in the detailing of project activity. After this phase, the project receives the installation license.
2. Implementation and Operation: actions planned are executed, complementing prevention, mitigation and compensation actions. At this moment, the significant impacts can be avoided by the implementation of appropriated alternatives (technological and locational) and by the management risks, can be mitigated by technology, and can be compensated by environmental and social programs.
3. Decommissioning: a long-term stewardship, after the end of storage activities, when a set of environmental programs ensure risk control and monitoring the closed site for a long period.

Method

In general, methodology of this work is based on a systematic review of the technical and scientific literature, workshops with specialists and articulation with IBAMA, which is responsible in Brazil for the AIA and for the Environmental Licensing of exploration, production and gas transportation activities. These activities will be implemented in two priority blocks of activities.

The first block of activities in the future will involve the elaboration of a specific protocol "Environmental Impact Assessment of CCS activities" as a technical basis for Environmental Licensing of activities in the sector, considering the entire life cycle of a CCS project: planning, implementation, operation and decommissioning. In each of these phases of the life cycle of a project, the application of a specific EIA Protocol will have as its main objective the prevention, mitigation, recovery and mitigation of environmental impacts, involving its social, physical and biological aspects. Thus, in establishing a specific EIA protocol for CCS activities, it is also expected to incorporate existing legal, technical and scientific requirements in such a way as to add adequate environmental and social security to activities, including reducing deadlines, costs and uncertainties that are normally involved in the Environmental Licensing process. The second block of activities involves the context of legal analysis and institutional evaluation. The methodology will be based on a systematic review of legal, regulatory and institutional literature, workshops with experts and government agencies, such as the Ministry of Mines and Energy, the Ministry of Environment, the Brazilian Agency responsible for CCS Environmental Licensing, among others.

It is intended to establish a normative proposal based on the existing requirements of the Brazilian legislation and the technical and scientific literature. This second part will propose recommendations on how CCS activities should be regulated within the context of Brazilian environmental policy, of national energy planning, specifying the main legal, regulatory and institutional aspects that a CCS framework in Brazil should encompass. It should be noted that this work is the first to be presented in relation to the work carried out by the project team and consists of primary data but over time will present more concise data.

Conclusions

In summary, this paper contributes in two points: - the historical diagnosis of fossil fuel uses in Brazil, the energy transitions through these past, positive and / or negative results of the CCS, can provide subsidies and data for future research related to the subject, together with the understanding of how facts related to the economy and policy directly interfere with the applicability of CO_2 capture and storage throughout history. Thus, it is observed that much of the initiatives and development are reflected in past attitudes, which we must carefully analyze so that new paths are traced with safety and visibility of an energy dependent world; and - to the improvement of CCS activities assuring the environmental protection and adding more rationality to the CCS mandatory environmental licensing process, which are going to be very opportune when the scale up of these activities in Brazil in the future.

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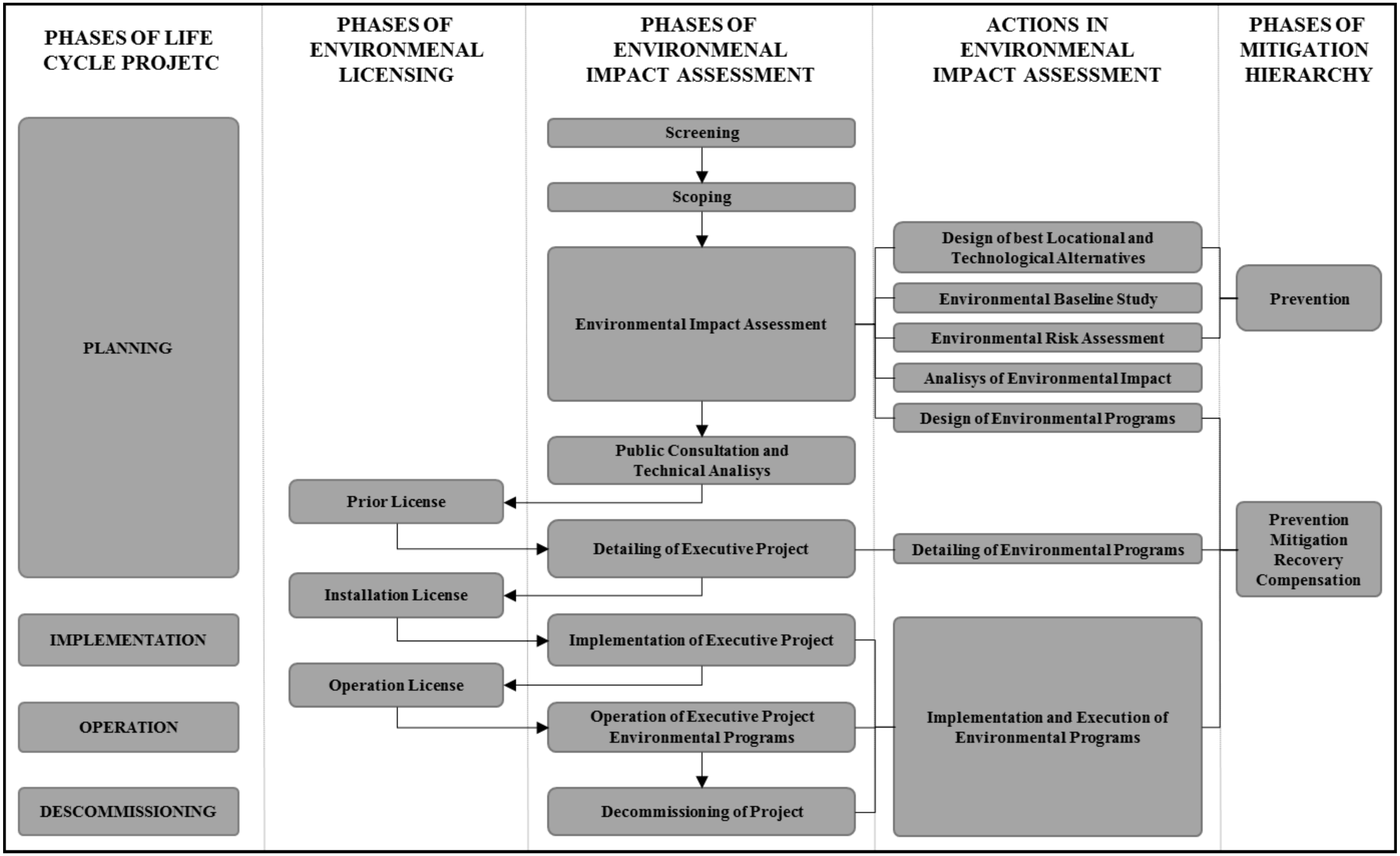

Figure 1. Environmental Impact Assessment of CCS – Phases – Project 42 (by the authors)