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CO2 Capture and Storage: Property Rights overview on Brazil

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Abstract**—** *Carbon Dioxide Capture and Storage (CCS) emerges as one of the possible alternatives for managing and reducing greenhouse gas emissions and consequently maintaining the temperature increase on the planet within acceptable limits. The definition of property rights and legal implications arising from it is understood as relevant along these lines. The present work aims to analyze how the legislation in force in Brazil treats the ownership rights of CO_2 in the context of CCS activities, especially in the storage phase. The methodology is based on the literature review and on deduction about the legislation; also, the qualitative method is adopted. The results show that at the current level of Brazilian legislation, the delimitation of the property rights under study will occur through political decisions; later, the law shall regulate.*

Keywords**— CO_2, CCS, public choices, property rights.**

I. INTRODUCTION

Given the increasingly clear evidence of climate change round the world, arising from human interference and the widespread use of fossil fuels, the technology known as carbon dioxide capture and Storage or Capture Carbon and Storage (CCS) has been gaining relative space as one of the possible alternatives for managing and reducing greenhouse gas emissions and consequently maintaining the Earth's temperature rise within acceptable limits. *Capture Carbon and Storage*

CCS involves capturing CO_2 from a stationary source and injecting it into a suitable storage location. Among the storage possibilities, more and more attention has been paid to the use of geological formations. Potential geological reservoirs, for example, include oil and gas fields.

In this context, in consideration of the cost of geological storage, the delimitation of property rights play an important role. For these costs, the amount of acquisition of the geological property rights of the reservoir, and the value of storage through the ownership of the injected CO_2 shall be stipulated. Determining property interests will also have implications for short- and long-term liability forecasts.

The present work aims to analyze how the current legislation defines the ownership rights of CO_2 in the scope of CCS activities, especially in the storage phase, in which there is an injection in geological formations on a permanent basis. To this end, the first part presents the general delimitations of property rights in the Brazilian legal system, and then briefly exposes the trajectory of the differentiation of the general property of the soil of the property of certain resources found in the subsoil and, finally, to deal specifically with the ownership of CO_2.

II. GENERAL DEFINITIONS OF PROPERTY RIGHTS IN BRAZIL

The legal issues related to property rights is a widely explored subject by the Brazilian doctrine. Starting from the concept of property found in the legal literature, Pontes de Miranda writes that "in a wide sense, property is the domain or any property right" (1955, p. 9 - free translation). In turn, Caio Mário da Silva Pereira explains that this definition "changes to the taste of economic, political, social and religious injunctions," being "admitted the survival of private property as essential to the characterization of the capitalist regime" and that it is the "real right par excellence, standard subjective right, or fundamental right" (2006, pp. 81-89 - free translation). For his part, Carlos Roberto Gonçalves states that "the right to property is the most important and most complete of real rights" (2013, p. 225).

Considering the determinations in the Brazilian law, Article 524 of the Brazilian Civil Code, "the law guarantees the owner the right to use, enjoy and dispose of his assets "to, throughout Title II of his Book II, to detail

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the theme property. It is worth noting that there is no clear normative conceptualization of this legal institute, which is defined by the doctrine by this characterization – the right to use, enjoy and dispose of the thing, and to claim it from those who unjustly detain it (PEREIRA, 2006, p. 91 - free translation). Let us move on to the analysis of such attributes.

First the right to use, that is, *the ius utendi*, according to Caio Mário da Silva Pereira (2006, p. 93 - free translation):

It consists of the ability to put the object at the service of the holder, without modification in its substance. The owner employs it for his own benefit or for a third-party. It is good for you. But of course, you can also stop using it by guarding it or keeping it inert. Use is not only to extract beneficial effect but also to have the object in condition to serve.

The right to enjoy *(or ius fruendi)*"is essentially realized with the perception of the fruits, whether the ones that naturally come from the thing, as well as the civil fruits" (PEREIRA, 2006, p. 94 - free translation). Maria Helena Diniz adds that "the owner of the principal will be the owner of the accessory" (2013, p. 135- free translation).

The third attribute is the right to dispose of, i.e., *ius abutendi,* thus defined as:

It is the most vivid domainal expression, by the greatest (…). Whoever has the thing is more owner than who uses it or enjoys it (...) involves the material disposition that streaks by destruction such as legal, that is, the power to alienate in any title – donation, sale exchange; it means still consuming the thing, transforming it, changing it; it also means destroying it, but only when it does not imply antisocial procedure (...) It also involves the power to encumber it of burden or to submit it to the service of others. (PEREIRA, 2006; pp., 94-95 - free translation).

There is also the right to retract the object: *the king vindicatio,* since "the right to property is thus endowed with a specific guardianship, founded on the right of pursuit the thing on wherever it is" (GONÇALVES, 2013, p. 231 - free translation). When claiming, the owner seeks his property from the hands of other people, takes it back from the one who owns it, but does not own it, just have its possession.

There are also four other characteristics of property systematized in the doctrine, as Maria Helena Diniz (2013, pp. 136-137 - free translation) quotes: exclusivity, fullness, perpetuity, and elasticity. Then, when dealing with the object of the property, the author states that it will be "everything that is not excluded from it by law"(DINIZ, 2013, p. 138 - free translation). It is these exclusions, or "restrictions on the right to property," that we will now analyze.

Following the absolutist tradition departing from the Roman law on which the classical doctrine on the property is based, Pontes de Miranda (1955, p. 16- free translation) states that "property is an absolute right and, for this reason, has *erga omnes* effectiveness." The author himself, however, later deals with his restrictions: "The domain is not unlimited. The law itself establishes limitations. The law contains rules of restriction and juristic act may restrict it" (PONTES DE MIRANDA,1955, p. 18).

A form of delimitation of the right to property in the Brazilian legal system is provided for in Article 5, item XXIII of the Constitution of the Republic and in Article 1228 of the Civil Code, addressing the existence of the social function of property as a limitation of the domainal power. According to Caio Mário da Silva Pereira (2006, p. 85 - free translation), the assumption of such positivity is that the goods are "given to the men not so that they extract the maximum benefit and well-being with the sacrifice of others, but rather so that they use them to the extent that they can perform their social function," since "it guarantees public order to each one in the use of their goods, in the normal uses for which they are intended. Yet in any circumstance, the social overlaps with the individual" (PEREIRA, 2006, p. 87 - free translation). Therefore, the whole basic attribute of the right to property – to use, to enjoy, to dispose of – "must be done ... within the legal limits and according to the social function of property" (GONÇALVES, 2013, p. 230 - free translation).

There is also, in our Constitution, special concern about the social function of rural property ownership, which provides for "a complex of measures aimed at promoting the better distribution of land, in order to meet the principles of social justice and to increase productivity" (PEREIRA, 2006, p. 104). In addition to the issue of social justice, Gustavo Elias Kallás Rezek (2011, p. 123 - free translation) states that also due to the relevance of agriculture to humanity, "the land can no longer be considered itself a non-propriety asset."

In classical Private Law, the owner of the soil possessed *all that is above it to the heavens, and all that is beneath it, even hell (usque ad inferos* and *usque ad coelos),* there being no limitation in this sense. At the time, at most, there was the perception that "others can use it as long as it is such a depth or at such a time that the owner has no interest in prohibiting it" (PONTES DE MIRANDA, 1955, p. 79 - free translation), which, in some way, persists to this day in the form that "the extension of airspace and subsoil is limited by the usefulness that the owner can provide" (GONÇALVES, 2013, p. 247 - free translation).

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III. DIFFERENTIATION OF LAND OWNERSHIP RIGHTS AND RESOURCES FOUND IN THE BRAZILIAN UNDERGROUND

With the historical growth of the economic and geopolitical relevance of ores and hydrocarbons (which are in underground lands), the absolutist principle of the property has undergone transformations and, has gained quite different contours in the different legal systems of the globe. In the Brazilian case, the property continues to cover the corresponding subsoil and surface; such property, however, does not include deposits, mines, and other mineral resources, as provided in Articles 1229 and 1230 of the Brazilian Civil Code (free translation):

Article 1229. The ownership of the soil covers that of the corresponding airspace and subsoil, in height and depth useful to its exercise, and the owner may not be against activities that are carried out, by third parties, at such height or depth, which has no legitimate interest in preventing them.
Article 1230. Land ownership does not cover deposits, mines, and other mineral resources, hydraulic energy potentials, archaeological monuments, and other assets referred to by special laws.

As noted, Article 1230, transcribed above, creates a material restriction on the right of ownership of the subsoil.

In turn, there is the model followed by the United States of America and Canada, whereby, according to Hirdan Katarina de Medeiros Costa and Carolina Arlota (2017, p. 209): "Each state adopts specific laws and, in general, establishes the rule of common law, which determines that the landowner is also the owner of the subsoil and of the hydrocarbons contained therein."

The pronounced Federalism of the USA does not mention the issue in the Federal Constitution and allows each Member State to delimit its own oil extraction standards. The U.S., however, is an exception to the global tendency of state governments and companies to detain the mineral resources of their territory (MEDEIROS COSTA; ARLOTA, 2017, p. 205).

In Brazil, the best norm to define the legal relationship between the state and mineral resources is the Constitution, as Fernando Facury Scaff (2014, p. 23 - free translation) explains:

The Federal Constitution of 1988 establishes that mineral resources, petroleum and hydraulic energy potentials are union assets (Article 20, VIII and IX), and the legislative competence (Article 22, IVe XIII) may be privately federal,[1] but there may be common competence in this matter (Article 23, XI). It also establishes that the legal regime for the exploitation of mineral resources and the potential for hydroelectric power will be that of authorization or concession (Article 176), with a monopoly of the Union in the exploitation of the oil activity (Article 176) and in research, mining and other activities related to nuclear ores and its derivatives (Article 21, XXIII and Article 177).

It is worth noting that, in addition to the property itself, the Federal Constitution determines, in its Article 177, that the research and mining of hydrocarbons and natural gas are a monopoly of the Union, as well explained by Hirdan Katarina Medeiros Costa and Carolina Arlota (2017, p. 215):

(...) the regime of monopoly of oil and natural gas provided for in Article 177 of the Constitution is aimed at the protection of national security. This protection justifies the State's performance as an economic agent. Thus, in addition to leaving an open mechanism of direct intervention, it provides, through a systematic interpretation, the commitment of the Public Power to establish policies with a view to making effective social rights constant throughout the Constitution. (...) it can be said that the constituent legislator raised the attempt of a model of social welfare and an interventionist State.

It is important to emphasize that the 1990s brought great changes in the economic order of Brazil and, with this, some normative inclusions that allow, under certain legally established conditions, the Union to hire private companies to carry out those monopolized activities.

However, it has not always been this way: if we historically divide the various policies of oil exploration in Brazil, we will perceive three very different phases. The first, regalist lasted throughout the colonial and imperial periods, and the Crown – formerly Portuguese and then Brazilian – was responsible for exploiting the mineral resources, from the precious metals of the eighteenth century to the oil of the late nineteenth century; also at the end of this phase, there were cases of concessions of mineral and oil exploration to foreigners in very specific geographical spaces and under very detailed conditions (MEDEIROS COSTA; ARLOTA, 2017, p. 210).

The phase of accession or land, present in the First Republic, was marked by the state absorption of *the principles of laissez faire*, leaving entirely up to the private sector to mine ores, also granting concessions to foreigners (MEDEIROS COSTA; ARLOTA, 2017, p. 210). Here, there was no perception of oil as a national strategic instrument – even because of the absence of the discovery of large deposits.

Yet it was in the late 1930s, from Vargas' provisional government to the Estado Novo, that the domainal phase of exploration came. The Varguista interventionism led to the creation of the National Petroleum Council and the National Department of Mineral

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Production, which, driven by the discoveries of new hydrocarbon reserves and the strong Venezuelan and Mexican nationalism, limited the possibility of exploitation to Brazilians (MEDEIROS COSTA; ARLOTA, 2017, p. 213).

Meanwhile, conflicts between countries that had natural reserves and foreign companies that had very disproportionate contractual advantages over the former were observed in international law. To measure them, the United Nations resolutions – especially that of no. 1803, 1962 – "were emphatic in reinforcing the principle of the sovereignty of states over their natural resources" (TORQUATO-FERNANDES, 2013, p. 14 - free translation). It declares:

1. The right of peoples and nations to permanent sovereignty over their wealth and natural resources shall be exercised in the interests of the national development and well-being of the people of the respective State;
2. The exploitation, development, and disposition of such resources, as well as the importation of foreign capital to affect them, shall comply with the rules and conditions that these peoples and nations freely deem necessary or desirable to authorize, allow or prohibit such activities (UNITED NATIONS, 1962).

Returning to the positive rights on the subsoil in Brazil, in addition to the Constitution (in its Article 20) and the Civil Code, it also corroborates Article 1 of the Minas Code in the same sense when determining that:

It is for the Union to manage mineral resources, the mineral production industry and the distribution, trade, and consumption of mineral products", as well as the Forest Code, which in item VIII of Article 3 defines it as "public utility:
(...)
b) infrastructure works for concessions and public transport services, road system, including the one necessary for urban land parceling approved by the municipalities, sanitation, as well as mining, except, in the latter case, the extraction of sand, clay, and gravel.

Thus, it must be understood that, in Brazil, the property of the subsoil, by itself, belongs, not to the Union, but only the pre-determinate natural resources, as exposed. Therefore:

This rule [the Constitution] does not declare that the entire subsurface system is of the Union. (...) the criterion is that mineral resources and hydraulic energy potentials, when used for exploration and use, will stand out from the property and belong to the Union, whether in the soil or underground. Therefore, are (public) goods of the Union (...) (SCAFF, 2015, p. 59 - free translation).

Turning once again to minerals and hydrocarbons, it is necessary to understand that such goods are not only scarce but exhaustible – that is, they are non-renewable natural resources. The legislative decision to include water energy in this area, therefore, is a political choice – taking into account the energy relevance of hydroelectric plants to Brazil – since hydropower is renewable natural resource (SCAFF, 2014, pp. 38-43).

IV. CAPTURED CO_2 PROPERTY

In the legal literature on property rights, there are few references related to the definitions of the property of what is permanently inserted underground. As extensively described above, the current definitions of the subsoil property right refer to potentially extractable preexisting subterranean natural resources, not on what could be "injected" or "installed" in it.

Among the few studies identified on the subject, the Doctoral Thesis by Viviane Romeiro-Conturbia (2014) stands out. It highlights the fact that the Federal Constitution does neither specify the extent and technical definition of soil and subsoil when referring to the ownership of mineral resources, nor if the substances re-injected underground would also be owned by the Union.

In this context, several challenges arise regarding the definition of CO_2 property rights, from its capture to its permanent storage underground, especially those related to the distribution or imputation of responsibilities to each agent in cases of leakage, environmental accidents, and other risks associated with the CCS steps.

The definition of such responsibilities requires, from the very start, the delimitation of ownership rights in transport and storage (permanent injection), as well as the possible transfer of this property between agents. Along these lines, the author makes an important contribution in describing and systematizing different scenarios, identifying the agents on whom such responsibilities may fall. The following aspects stand out from RomeiroConturbia (2014, p.126-7)::

I. CCS projects in which all the activities (capture, transport, and CO_2 storage) are managed by the same operator, and there is no transfer of OWNERSHIP of CO_2. For example, an oil company that captures CO_2 on an offshore platform, transports and stores the gas in a reservoir formation that has been granted, as is the case with the CCS Pre-Salt Lula Project. Another example could be an operator that captures CO_2 in a coal-fired power plant, transports gas through its own tanker trucks or third-party tanker trucks (but the operator still owns the CO_2 and possible liabilities), and stores CO_2 in a geological formation by its own means.

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II. CCS projects in which all the activities (capture, transport, and CO_2 storage) are managed by the same operator, with a transfer of OWNERSHIP of CO_2. For example, a coal-made power plant that captures and transports CO_2 but transfers OWNERSHIP of CO_2 to another company that would be responsible for storing it. The first company would serve only as a source of CO_2 for a second company to finally store that CO_2.

III. CCS projects in which all the activities (capture, transport and STORAGE of CO_2) are managed by different operators, with two transfers of CO_2 ownership. For example, a coal-made power plant (or even a cement or steel plan) that captures and transports CO_2 through short-range CO_2 tanker trucks or pipelines to a pipeline that will transport CO_2 over long distances to a given geological reservoir. In this case, there would be the transfer of ownership (a) of the company that *captures* CO_2 to the concessionaire responsible for transporting the CO_2 over long *distances with pipeline hubs* and (b) from such hub company to the company responsible for storing that CO_2 in a given geological reservoir. This company may be the same as the one that captured the CO_2 or another one/ a different one, but the significant legal act here is the transfer of ownership during the process.

In order to facilitate the understanding of these scenarios, Romeiro-Conturbia (2014, p. 127) presents Figure 1, which translates the possibilities of defining property rights::

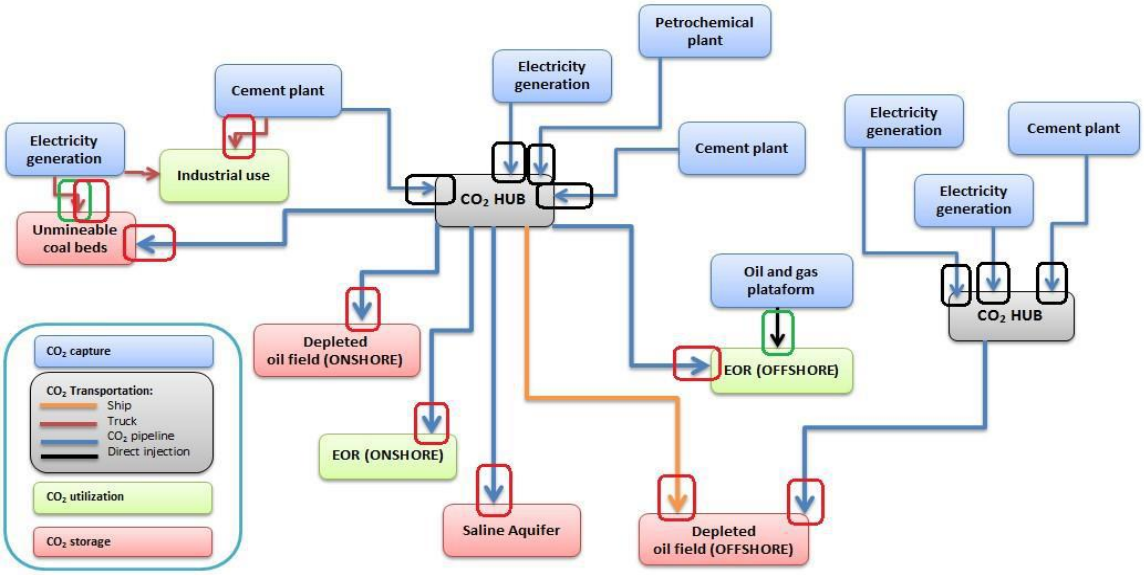

Fig.1: Possibilities for delimitation of ownership rights and their transfer in CCS projects.
Source: Romeiro-Conturbia (2014, p. 127).

As it turns out, there can be many possibilities of activities and agents involved in a CCS project (different stationary sources, different types of transport and different geological reservoirs). A geological reservoir could also store CO_2 from different projects, which can make the definition of responsibilities even more complex.

In this sense, to promote legal certainty and predictability of risks, transparency and clarity are necessary in the information regarding the areas with pipelines for transport and storage of CO_2. To this end, Romeiro-Conturbia (2014) proposes the creation of a kind of National Registry of Areas with Geological Storage of Carbon Dioxide or National Register of Geological Areas of Carbon (CNCO2), so as to provide and to disseminate relevant information about areas containing infrastructure (CO_2 pipelines) to transport CO_2 and areas containing stored CO_2. According to Romeiro-Conturbia (2014, p. 129), the registry would provide information on (free translation):

(i) existing pipelines to transport CO_2 in a respective area;
(ii) existing wells to store CO_2 in a respective area;
(iii) the estimated geographical boundary of an area containing stored CO_2; (iv) the amount of CO_2 stored;
(v) monitoring plans to track CO_2 behavior; (vi) contingent plans with actions to remedy any possible leakage or damage.

Despite the remarkable effort of Romeiro-Conturbia (2014) to systematize the steps and agents that compose the cycle of activities inherent to CCS activities, there is a legal gap regarding CO_2 ownership in the context described above. Consequently, little can be said about issues related to the right of CO_2 ownership in the context of CCS activities, highlighting the storage phase.

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Neither is it possible to make any assumptions towards capture, transport, and storage liabilities since its definition is related to CO_2 ownership. Therefore, the political decisions must be taken with a view to reflecting the delimitation of rights in specific legislation.

V. FINAL CONSIDERATIONS

As stated throughout this work, the definitions of property rights in Brazil are a subject widely debated by the Brazilian doctrine, whose definitions of public or private ownership face a series of intricacies, subject to what is found in the subsoil of the Brazilian territory. As seen, the Federal Constitution provides for differentiation between soil and subsoil property, especially as to the mineral resources found in it, which has consequences for the question presented here. That is, to whom would the captured CO_2 belong if it were to be permanently stored in geological formations?

As observed, the complexity of the question posed lies precisely in the fact that the Federal Constitution itself exceptionally highlights as the property of the Union the mineral resources found underground, which could indicate, in a first reading, that the ownership of the CO_2 stored underground would be transferred to the Union and, with it, possibly the responsibilities inherent to it.

On the other hand, as already stated before, the definitions related to the right of ownership of the subsoil currently in force refer to the preexisting natural resources in the subsoil, potentially extractable, and not on what could be "injected" or "installed," as is the case of CO_2 studied here.

Thus, considering the absence of legislation specific to the theme exposed, and in view of the constitutional determinations, it can be affirmed with relative conviction that there is a huge gray area regarding the right to property of the CO_2 injected permanently in a geological formation. This scenario demonstrates the legal and regulatory vacuum of CCS activities in Brazil and corroborates the need for in-depth studies and editions of a robust legislation to ensure the necessary conditions for the implementation of this technology in Brazil.

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