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Legal challenges of carbon capture and storage in the South China Sea region

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ABSTRACT

Carbon capture and storage (CCS) is one method to reduce CO_2 emissions to the atmosphere. As CCS has the greatest potential for greenhouse gas (GHG) emission reduction, it gains a wide currency in the developed countries. However, the technology for CCS does not spread at the international level especially to the developing countries like South China Sea states. As the CO_2 storage period is quite long and potential environmental risks involved, fully deployed CCS projects need not only the technological support but the appropriate legal and regulatory regime to safeguard CCS operations. This article offers a survey of CCS projects in the South China Sea region and discusses the legal challenges associated with CCS activities in state practice.

1. Introduction

Climate change is a major and long-term challenge to the entire world, but more so to the South China Sea region, due to its climate vulnerability, relatively poor institutional arrangements and large populations [1]. It is recognized that climate change represents an urgent and potentially irreversible threat to human societies, and thus requires the widest possible cooperation by all countries, and their participation in an effective and appropriate response [2]. It is commonly recognized that greenhouse gas emissions (GHG), especially carbon dioxide (CO_2) emissions are a main factor contributing to global warming. Though most of the GHG increase resulted from burning of fossil fuels, we currently have little alternative of fossil fuels to reduce GHG emissions for a number of decades [3]. Therefore, it becomes imminent how to find viable reduction alternatives to mitigate the potential risks of climate change and GHG emissions. Carbon capture and storage (CCS), the process of capturing as well as transporting CO_2 and pumping it into geologic formations to securely store it away from the atmosphere, is commonly recognized as one of the most viable methods for CO_2 emission reduction [4].

This technology involves three main steps. The first step is capturing CO_2 from large industrial point sources which account for a high percentage of CO_2 emissions, such as power plants, iron or steel producing facilities, etc. Then comes to the second stage, the captured CO_2 is compressed and then transported typically via tankers or by pipeline to an injection site. At last, the CO_2 is injected into a suitable storage location that isolates it from the atmosphere [5].

There are different types of storage options. Potential types include geological storage in underground formations such as depleted oil and gas fields, unminable coal beds and deep saline aquifers (for example, ocean storage in either the ocean water column or the deep seabed) and industrial fixation into inorganic carbonates [6]. It is noticeable that there are two ocean storage methods, one is injecting CO_2 into the deep ocean, in the water column, and the other is injecting CO_2 under the seabed. In the first method, CO_2 is dissolved at moderate depths of 1000–3000 m to form a dilute solution [7]. This method was banned by the London Protocol because of its instability and immaturity [8], ocean storage in this article only refers to the latter, the storage of CO_2 under the seabed. Ocean storage provides significant opportunities for those states which have considerable offshore storage capacity, such as Norway and Australia. If a choice between onshore and offshore storage is available, most states prefer the latter, because it can limit opposition from local communities living in proximity to the storage site or use pre-existing infrastructures in connection with offshore oil and gas operations, e.g., Norway and the United Kingdom [9].

According to an International Energy Agency (IEA) report, CCS can contribute around 13% of total energy-related CO_2 reductions by 2050 compared to a "do nothing" approach [10]. CCS technologies have been accepted by many countries. There are 16 large-scale CCS projects operating globally, together with a considerable number of demonstration projects worldwide, but these projects are mainly located in Europe, North America and Australia [11]. Very recently, some Asian countries also have realized the importance of CCS in reducing GHG emissions and began to make efforts in CCS development. Currently,

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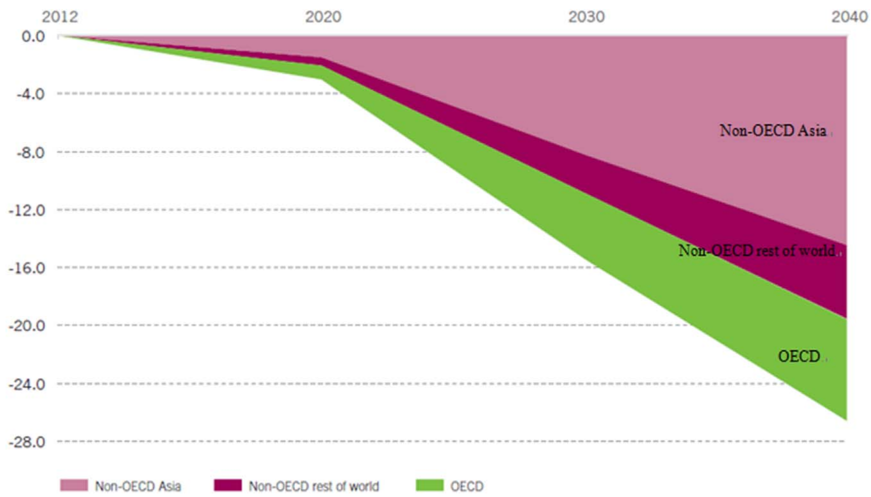

Fig. 1. Reduction in energy-related CO_2 emissions: 450 scenarios relative to current policies [18]. *Source*: Global CCS Institute, The Global Status of CCS: 2015, Summary Report.

South Korea, China, Japan and Indonesia have large-scale CCS projects or demonstration projects, but most Southeast Asian states adjacent to the South China Sea have little participation in the CCS projects [12].

Stable development of CCS technology requires appropriate policy and law frameworks to promote demonstration and deployment of CCS, and also to ensure it is undertaken in a safe and sustainable way. To this end, this article offers a survey of the legal and regulatory issues associated with CCS projects in eight South China Sea states: Cambodia, China, Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. There are different attitudes towards CCS among the South China Sea states. CCS in China is considered to be part of national projects such as “863 Program”, “973 Program” [13]. By contrast, CCS is not attractive in Cambodia because the country has contributed a minor share of global CO_2 emissions and has not yet set any CO_2 emission targets for the coming decades [14].

2. Potential CCS projects in the South China Sea region

In the past, CCS is less attractive to most South China Sea states than it to their developed counterparts, such as Australia, Canada and the US, for the reasons that technology is expensive and no emission targets have been set for these developing countries. According to the IEA report, the majority of the world's CO_2 emission reductions under a 1.5–2 °C scenario must be realized in developing (non-OECD) countries, primarily in Asia (see Fig. 1) [15]. As a result, the 2015 Paris Agreement achieved a universal agreement on the intended nationally determined contributions (INDCs), and that means not only developed states but also developing countries should take action to reach the 1.5–2 °C target [16]. Each South China Sea state has submitted the INDCs to the Secretariat of the Conference of the Parties to the UN Framework Convention on Climate Change (UNFCCC), and China, Malaysia, the Philippines, Singapore, Thailand, Vietnam have specific GHG emissions reduction commitment (see Appendix A) [17]. In order to meet INDCs commitment and balance the goals of energy security and environmental sustainability, CCS can help South China Sea states achieve these goals by enabling them to continue to utilize their indigenous fossil fuel reserves. It can be optimistically predicted that CCS will be more attractive to these states.

However, the most suitable basins for CO_2 storage are located on continental plates formed in mid-continent locations or near the edge of stable continental plates, therefore the storage sites worldwide are unequally distributed [19]. Due to this reason, two main points should be checked when considering the potential of a CCS project: capture opportunities and storage opportunities, that is to say, whether there is a suitably large stationary source of CO_2 to capture; and whether there is a suitable basin for sequestration [20].

China leads among developing countries that are active in the CCS sector; because of its large emissions and strong dependence on coal, it treats CCS as a particularly valuable tool. More than 3 billion *yuan* (RMB) has been invested in CCS research as early as 2008 [21]. Since the 10th Plan period (2001–2005), China has engaged in Research, Development and Demonstration (RD & D) activities for CCS through China's National Basic Research (973) and National High-Tech Research and Development (863) programs, as well as the National Science and Technology Support Program and other science projects. With continued economic growth, coal consumption increased by 44% since 2006 to 2.4 Gt in 2013 [22]. Consequently, CO_2 emissions grew by about 34% over the same period, reaching 8.3 Gt CO_2 [23]. Current academic research confirms that the geological formations of China have sufficient potential to store the captured CO_2 in the near, medium and long-term periods. In the near to medium term, it is expected that CO_2 will mainly be stored as part of CO_2-EOR activities [24]. In the medium to long-term, storage will mainly use saline aquifers [25]. The storage potential of saline aquifers onshore is estimated to be 1300 Gt CO_2, that of saline aquifers offshore 573 Gt CO_2 [26]. Cumulative CO_2 storage is projected to reach 160 Mt CO_2 by 2030 and 15 Gt CO_2 by 2050 [27]. Although China has sufficient potential to store the captured CO_2, initial results show that in some regions, industry may have high CO_2 emissions without a matching CO_2 disposal site [28]. For example, southern areas such as Guangdong Province are challenged by the absence of good prospective basins. Although some potential offshore storage locations exist in Southern China area, these are unlikely to be practical because of their great distance from both the people and industry in Guangdong Province [29]. While other regions have sites where CO_2 could potentially be stored, but these sites are not necessarily adjacent to industrial CO_2 emission sources, which makes it difficult to use this storage potential [30].

Indonesia has a heavily fossil-fuels based economy and has to be confronted by increasing CO_2 emissions from its oil and gas-power sectors. Most industrial CO_2 sources are located in Java and Sumatera,