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Carbon Capture, Utilization, and Storage Regulation in the Gulf Cooperation Council Countries: A Review on the Current Status

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1. Abstract

The development and deployment of Carbon Capture, Utilization, and Storage (CCUS) are expected to play an important role in global climate change mitigation. CCUS can be a critical greenhouse gas (GHG) mitigation measure for the United Nations Economic and Social Commission for West Asia (UNESCWA) member countries where carbon emissions are primarily generated from concentrated sources and use of CO₂ for enhanced oil recovery (EOR) is promising. As the first step to promote CCUS development in the ESCWA region, this report reviews CCUS related legal and regulatory systems in the Gulf Cooperation Council (GCC) countries to identify the gaps for stimulating large scale CCUS deployment in this region. In general, environmental regulations related to carbon capture and transportation are covered by existing regulations. New regulation for permanent storage needs to be developed to align CCUS with the Clean Development Mechanism (CDM). The integration of CCUS regulation with oil and gas regulation can be challenging due to potential transboundary CO₂ for EOR and lack of explicit oil and gas regulation for countries with highly nationalized oil and gas sector. Effective incentive mechanisms can be explored with early stage pilot projects. Regional collaboration of CCUS may start from capacity development and knowledge sharing.

2. Introduction

Carbon Capture and Storage (CCS) has great potential to contribute to global greenhouse gas (GHG) emission reductions. According to the International Energy Agency (IEA) publication Energy Technology Perspectives 2010 (ETP), CCS will need to contribute to 20% of total emission reductions by 2050 for GHG to be reduced in the most cost-efficient manner. To enable CCS to meet the one-fifth contribution, it will be necessary to deploy around 100 CCS projects by 2020, and over 3,000 projects by 2050. This enormous development requires a solid regulatory framework that collaborates in the global, regional, and national levels to simulate the urgently needed technical development and capital investment for CCS deployment.

Carbon Capture, Utilization, and Storage (CCUS) refers to the practice of injecting CO₂ in oil fields to enhance hydrocarbon production while storing the injected CO₂ permanently underground. CCUS can be quite relevant to countries in the MENA region for three reasons: (1) vast oil and gas fields provide excellent CO₂ storage sites in the order of 60Gt (Jeffery, 2010); (2) carbon storage via EOR may contribute to oil production while reducing CO₂ emissions.; and (3) CO₂ for EOR substitutes gas for EOR so increases the output of gas as a valuable product.

By decision 10/CMP.7 (UNFCCC, 2012), the Conference of the Parties (COP) adopted the modalities and procedures for CCS in geological formations as Clean Development Mechanism (CDM) project activities. In addition to regular CDM criteria, there are additional requirements for a CCS project to be qualified as a CDM project. For example, the accreditations and designation of operational entities (DOEs) for CCS projects have to encompass the entire CCS process, including capture, transportation, storage, closure, and post-closure; provide remedial measures for seepage; and include measures to address liability arrangements and fulfill the obligations on net reversal of storage. CCS projects are also subject to more thorough and complete environmental and social impact assessments that shall be updated constantly.

For non-Annex I countries to be eligible to act as hosts for CCS project activities, the country has to submit an agreement to the UNFCCC on the implementation of CCS projects in its territory. The country will also have to pass laws and regulations concerning various CCS-related aspects such as: site selection criteria, the

requirements imposed by CDM for CCS project activities, the right to store carbon dioxide and access rights to subsurface pore space; compensation and remediation measures; liability arrangements for permanent storage; provisions detailing the obligation to address a net reversal of storage, provided that the country accepts such an obligation.

In the GCC region, all countries have started the engagement in CCUS; with major activities found in the UAE, the KSA, and Qatar. The UAE government has identified CCS as a key component of national GHG mitigation plans in its national communications to the UNFCCC. As the major oil producing emirate of the country, the Abu Dhabi government is developing, through Masdar, a CCS network bringing CO₂ from emitters to the Abu Dhabi National Oil Company (ADNOC) for enhanced oil recovery (EOR). In addition to the completion of a two year CO₂-EOR pilot project in November 2011 at an onshore field, Masdar announced in early 2012 that it would proceed to tender for a CCS project with Emirates Steel Industries (ESI), handling 800,000 tons of carbon annually and connecting an ESI factory to an ADNOC oil field. Masdar also has a 60/40 joint venture with the British Petroleum (BP) in developing the Hydrogen Power Abu Dhabi (HPAD), a commercial-scale hydrogen-fuelled power plant incorporating carbon capture and storage. The project was placed on hold in January 2011 due to issues associated with negotiating prices for the CO₂ and electricity produced at the hydrogen plant with its two main customers: ADNOC and Abu Dhabi Water Electricity Authority (ADWEA). The Dubai Integrated Energy Strategy 2030 also calls for consideration of CCS-equipped coal power in the next ten years, and the Emirate of Ras Al Khaimah has announced feasibility studies for a CCS-equipped coal plant.

Saudi Arabia, as the leading oil producing country in the world, can increase oil production without the use of EOR. When needed, Saudi Aramco uses highly optimized and cost effective water flooding operations for EOR. Nevertheless, the country is developing the world's largest CO₂ purification and liquefaction plant in Jubail. The plant will bring 1,500 metric tons per day of raw CO₂ coming from two ethylene glycol plants to three SABIC-affiliated companies for enhanced methanol and urea production. The country is in the process of developing several similar CCS projects, including some pilot projects on CO₂ for EOR. The Qatar Fuel Additives Company will install a CO₂ capture plant in its methanol production plant by 2014. Qatar Petroleum has jointed venture with Shell and some academic institutions in establishing the Qatar Carbonates and Carbon Storage Research Centre (QCCSRC). Bahrain has a CCS project that captures flue gases from an existing petrochemical plant for urea and methanol production. In 2010, Kuwait launched a carbon project which will capture more than 150,000 tons of CO₂ annually from Equate, a large petrochemicals company, for food and beverage production. The current CCUS engagement of Oman is primarily focus on research and development of feasible CCUS technology. It can be noted that all current developments in the GCC region are initiated by the public sectors; with major effort focusing on feasibility validation of various stages of the CCUS value chain in the local context. Despite of the clear interest for CCUS in this region, it is recognized that large scale deployment of CCUS cannot be realized without the establishment of formal legislation and regulation.

3. The CCUS Regulatory Framework

IEA published the “CCS Model Regulatory Framework” in 2010 (IEA, 2010) and “A Policy Strategy for CCS” in 2012 (IEA, 2012). These two documents summarize the general guidelines and policy options for CCUS regulations. The key issues involved include:

- (1) CO₂ classification
The classification of CO₂ as hazardous, waste, pollutant, or commodity affects what regulatory system may apply to CCUS operations.
- (2) Property rights
The regulations on the ownerships of captured and stored CO₂, surface facility, subsurface pore spaces, intellectual property rights of CCUS technology, as well as access to CCUS facilities for CCUS operators and third parties.

- (3) Co-authorizations and preferential rights
The interactions between CCUS regulation and the regulations on CCUS-related activities such as EOR. The policy on the priority of concession rights for storage explorers.
- (4) Transboundary movements of CO₂
The regulations that deal with (1) CO₂ capture and storage in different jurisdictions; (2) transit of CO₂ crosses a third country; (3) cross border storages; (4) unintended cross border CO₂ migration; and (5) cross-border secondary effects from storage activities.
- (5) Incentives
The incentive to mobilize CCUS deployment as part of an integrated climate change mitigation policy.
- (6) Environmental risk, health, and public engagement
The incorporation of environmental, health, and safety regulation of CCUS operations and public engagement of CCUS deployment under existing regulations.
- (7) CO₂ impurity
The regulation of CO₂ stream from different sources for share use of transportation facility and better prediction of CO₂ migration in storage.
- (8) CO₂ capture specific regulation
Incorporation of CO₂ capture in industrial process, the permitting of capture facility, and the liability of damage.
- (9) CO₂ transportation specific regulation
The regulations on the liability of leaking as well as pipeline re-use, routing, corridor requirements, and the acquisition of right-of-way.
- (10) CO₂ storage specific regulation
The regulation of CO₂ storage is unique, complex, and involves large interactions with non-CCUS legislations. The key issues of concern include (IEA, 2010):
 - Authorization of storage site exploration activities
 - Regulating site selection and characterization activities
 - Project inspections
 - Monitoring, reporting, and verification requirements
 - Corrective measures and remediation measures
 - Liability during the project period
 - Authorization for storage site closure
 - Liability during the post-closure period
 - Financial contributions to post-closure stewardship
 - Regulation for CCS with EOR
- (11) Knowledge transfer and data sharing
The exchange of knowledge on CCUS technology and regulation, as well as the sharing of geological and other data that are relevant to CCUS.

Among all regulatory issues, the regulation for CCS with EOR, transboundary CCUS, and incentive design pose as major challenges to be addressed for CCUS deployment in GCC countries, as in this region CCS can be deployed with EOR; transboundary CCUS can be prevalent and may interact with existing transboundary oil and gas agreements; and industrial development tends to be driven predominantly by government initiatives.

For now, the perspective of the inclusion of CO₂ for EOR projects in CDM remains highly uncertain. While the COP has accepted measures toward carbon reductions through permanent storage as CDM activities, CO₂-EOR projects, though result in the storage of CO₂, have traditionally been optimized to minimize the use of

CO₂ injected as CO₂ has been the greatest expense associated with CO₂-EOR projects (IEA, Carbon Capture and Storage - Legal and Regulatory Review Edition 4, 2013). Meanwhile, the criteria for site characterization, selection, and CO₂ monitoring for optimal oil production with CO₂ for EOR vary by project. As a result, the standard CDM requirements for CCS may not apply directly to CO₂ for EOR projects.

For transboundary CCUS, there is currently little regulation of transboundary CCUS project activities under international law. Meanwhile, numerous multilateral and bilateral treaties and agreements addressing environmental protection, governance, resource-sharing and management, and territorial issues create a very complex framework within which transboundary CCS project activities would not operate effectively without proper guidance from an international transboundary CCUS regulatory framework (UNFCCC, 2012). On the country level, policies and strategies toward transboundary CCUS may interact with existing agreements on transboundary oil and gas agreements. The IEA CCS Model Regulatory Framework recommends harmonization of regulatory approaches related to transboundary CCS. It suggests either selecting one competent authority to manage the two permitting regimes for a project or, preferably, implementing joint regulatory responsibilities for transboundary operations. The IEA Framework introduces high level principles with no specifics on operation details.

Incentive design for CCUS has been one of the most critical issues related to CCS deployment. To stimulate CCS deployment, a proper incentive mechanism needs to be introduced in all stages of CCS (including capture, transport, storage, closure, and post-closure) to balance risk and liability. This includes market mechanisms (e.g. a carbon price) to incentivize CO₂ capture and storage, as well as regulatory criteria for closure and arrangements of post-closure liability. For GCC countries, the incentive for CCUS interacts with the risk and return associated with CO₂ for EOR and the agreements associated with transboundary CCUS deployment. As industrial development in the GCC countries tends to be driven predominantly by government initiatives, governments in this region may have higher flexibility in introducing both market-based and non-market based (e.g. subsidy) incentives to stimulate CCUS deployment.

4. Existing Legal and Regulatory Systems

When developing a CCS legal and regulatory framework, it is crucial to have a thorough understanding of existing laws that may be relevant, as CCS may be most easily regulated by modifying frameworks that are already in effect (IEA, 2010). The most relevant regulations for CCUS are legislation and regulations related to climate change, environmental protection, land use, energy (including oil and gas production and market regulation), and concessionship. For permanent storage, the regulation on nuclear waste management may be relevant. The CCUS regulation interacts with existing regulations in both international and domestic levels.

4.1 International Law and Commitment

There are eight international and regional conventions relevant to the regulation of CCUS in the GCC region:

International Conventions:

- (1) The 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (hereafter the 2006 IPCC Guidelines) provides guidance on estimating and reporting annual emissions by gas and by sector. The guidelines also apply to estimating and reporting of emissions at the capture, transport and injection phases of CCS, with transboundary CCS included.
- (2) The 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (hereafter the London Protocol) is relevant to offshore CO₂ transport and deposit. Annex I to the London Protocol was amended in 2006 to permit offshore CCS. Further amendment on article 6 was adopted in 2009 to permit transboundary movement of CO₂. The 2009 amendment has not yet in force.

- (3) The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (hereinafter referred to as the Basel Convention) regulates international trade in hazardous and other waste. In 1995 the Convention was amended to ban exports of hazardous waste from the Organization for Economic Co-operation and Development (OECD) countries to non-OECD countries for final disposal. The ban amendment has been ratified by 73 parties to the Convention, but has not entered into force.
- (4) The United Nations Convention on the Law of the Sea (UNCLOS) establishes an overarching framework that governs the world's oceans and the marine environment, including the seabed and subsoil. This framework limits the ability to explore for sub-seabed geological storage sites and prohibits the injection and permanent storage of CO₂ in international waters.
- (5) The International Convention for the Prevention of Pollution from Ships and its Protocol of 1978 (MARPOL) regulates the pollution by ships. In the context of CCUS, the transboundary shipment of CO₂ in gas cylinders or in liquefied form may be subject to the requirements set out in annex III to MARPOL (UNFCCC, 2012).
- (6) The International Law Commission (ILC) published the Draft articles on the Law of The Transboundary Aquifers (ILC draft articles) in 2008. The provisions regarding environmental impact assessment and pollution control may apply to transboundary CCUS in addition to CDM rules. Meanwhile, the principles and obligations governing shared utilization of aquifers may serve as the basis for multilateral or bilateral agreements for transboundary CCUS under the CDM.

Regional Conventions:

- (7) The Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution is the basic legal instrument binding Saudi Arabia, Oman, Qatar, Bahrain, UAE, Kuwait, Iraq and Iran to coordinate their activities towards protection of their common marine environment. The four protocols of the convention address respectively: Pollution by oil and other harmful substances in cases of emergency, marine pollution resulting from exploration and exploitation of the continental shelf, marine environment against pollution from land-based sources, and marine trans-boundary movements and disposal of hazardous wastes. The Kuwait regional Convention does not explicitly contain a prohibition on dumping of waste in the seabed and subsoil. However, parties are to ensure effective compliance with international rules to the control of this type of pollution.
- (8) The GCC Customs Union, established in 2003, enables free movement of goods among the GCC states without customs, while taking into consideration the implementation of the veterinary and agricultural quarantine regulations and the prohibited and restricted goods. Therefore, trade of CO₂ is prohibited within GCC countries when CO₂ is classified as either waste or pollutant in one of the countries that is related to the CCUS activity.

Table 1 summarizes the status of GCC countries' involvement in the CCUS related conventions (All GCC states are founding members of the two regional conventions).

Table 1. Status of GCC countries in Accession to CCUS-relevant International Agreements

Convention	Bahrain	Kuwait	Oman	Qatar	KSA	UAE
Kyoto Protocol	x 2006	x 2005	x 2005	x 2005	x 2005	x 2005
2009 Amended London Convention						
Basel Convention	x 1992	x 1993	x 1995	x 1996	x 1990	x 1992
UNCLOS	x	x	x	x	x	x

	1985	1986	1989	2002	1996	1993
MARPOL	x Annex I/II & V	x Annex I - VI	x Annex I - V	x Annex I - V	x Annex I - VI	x Annex I - V

MARPOL:

Annex I: Prevention of pollution by oil

Annex II: Control of pollution by noxious liquid substances

Annex III: Prevention of pollution by harmful substances in packaged form

Annex IV: Prevention of pollution by sewage from ships

Annex V: Prevention of pollution by garbage from ships

Annex VI: Prevention of air pollution from ships

For ESCWA countries that are not in the GCC region, other regional conventions can be relevant. For example, the Bamako Convention on the Ban on the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (hereinafter referred to as the Bamako Convention) is an agreement between the countries of the African Union which establishes a regime for the control of the trade in hazardous and other waste within Africa. The Bamako Convention may need to be amended to allow CCUS deployment in its member countries.

In general, the international conventions are moving towards allowing transboundary CCUS deployment and offshore CO₂ transport and storage. While regional conventions have not been amended to accommodate CCUS deployment, they tend to coverage to international conventions over time. It is expected that commercial CCUS deployment in GCC would happen after the amendments of international laws are in force as well as the alignment between existing domestic regulations and CCUS regulation are in place.

4.2 Country Analysis

The country analysis reviews domestic legislation and regulatory systems on climate change mitigation (including CCUS-specific regulation), environmental impact assessment, land use, and oil and gas production (including concessionship) to evaluate the levels of readiness and overlap of existing regulation for CCUS deployment. The review focuses on (1) CCUS specific regulation (if any) to identify gaps in existing legislation systems; and (2) CCUS related regulations, which include CO₂ classification, environmental impact assessment, property rights regulation for oil and gas industry, and development of incentives to mobilize CCUS. The oil and gas regulation analysis focuses primarily on the allocation of property rights for surface facilities and subsurface pore spaces as well as the access to facility by the third party. These subjects are highly relevant to CCUS deployment. Given that CCUS is highly relevant to EOR in GCC, the regulation may also exhibit similar pattern given the similarity of stakeholders involved.

The source of information for the national analysis are summarized as follows:

- National Communication to the UNFCCC: CCUS specific regulation (including capture, transportation, storage, CO₂ impurity, and CO₂ for EOR); incentives;
- National environmental law: Environmental Impact Assessment and CO₂ classification
- National Petroleum Law and National Land Use Law: property rights regulation of the oil and gas sector.
- Ongoing CCUS activities: incentives

Bahrain

- CCUS specific regulation
No CCUS specific regulation at this moment. The Standards of Air and Water Regulations (Order No. 10 of 1999) is the law that regulates air quality.
- CO₂ classification
No specification. CO₂ is not classified as hazardous, pollution or waste.

- Environmental impact assessment
Legislative Decree No. 21 of 1996, the Environment Act, is the major environmental law. Articles 20-22 of the Environment Act provide for a procedure of project approval from an Environmental authority for the issuance of a permit. The Industrial Safety Order (Order No. 6 of 2000) establishes general principles for occupational safety. Under the Development and Production Sharing Agreement (DPSA), the contractor must create an overall system for health, safety and the environment (HSE System), to be introduced over the course of the concession.
- Property rights regulation for the oil and gas sector
There are no specific regulations in relation to the construction and operation of pipelines. The National Oil and Gas Authority (NOGA) has the power to issue regulations. Property rights are generally agreed on concession. There are no specific regulations for third party access to pipelines and other hydrocarbon infrastructure. Special permission is required from NOGA for such access.
- Incentives
Bahrain has identified the development of investment institutions for low carbon initiatives as one of the key measures to mitigate greenhouse gas emissions. The government is also interested in introducing fee based mechanism (i.e. reduction of utility subsidy) to reduce carbon-intensive consumptions. Nevertheless the development of a carbon price is still not on the policy agenda. While private investment has not been engaged, the government has initiated CO₂ capture demonstration projects with public funding.

Kuwait

- CCUS specific Policy
No CCUS specific regulation at this moment. National Environmental Law No. 21 is regulating all environmental issues including air quality(Tortell, 2011).
- CO₂ classification
No specification. CO₂ is not classified as hazardous, pollution or waste.
- Environment Impact Assessment
Kuwait Environmental Protection Agency (EPA) bylaw No. 210/2001 includes clauses regarding the EIA studies of development and industrial projects including oil and gas as well as hazardous waste management(Tortell, 2011).
- Property rights regulation for the oil and gas sector
Kuwait's oil and gas sectors are highly nationalized. State-owned Kuwait Petroleum Company (KPC) is entrusted by Article 3 of Law No. 6 to develop and exploit Kuwait's hydrocarbon resources. KPC and its subsidiaries own and operate all oil and natural gas production facilities, transportation pipelines, storages, and associated infrastructure. There is no scope for private sector access to such pipelines and infrastructure. KPC and its subsidiaries are also responsible for the abandonment or decommissioning of physical structures used in oil and natural gas development.
- Incentives
Kuwait's strategy for greenhouse gas mitigation is focused on the areas of district cooling, green building, fuel switching, as well as development of solar and wind power (Kuwait Environmental Public Authority, 2012). Currently there is no plan to introduce market deregulation or tax based options to reduce CO₂ emissions. While private investment has not been engaged, the government has initiated CO₂ capture projects for demonstration with public funding.

Oman

- CCUS specific policy

No CCUS specific regulation at this moment. Ministerial Decision No. 118/04 on the Control of Air Pollution from Stationary Sources regulates the emission of pollutants, and for their treatment and disposal.

- CO₂ classification
No specification. CO₂ is not classified as hazardous, pollution or waste.
- Environment Impact Assessment
Oman's environmental regime is primarily regulated by the Law on the Conservation of the Environment and Combating of Pollution (Royal Decree No. 114/01), 2001. RD 63/85 and RD 71/89, are related to environmental assessments. R10/82 requires that an Environmental Impact Statement (EIS) be submitted for all new project developments, or major upgrades of existing facilities, that have the potential to cause pollution.
- Property rights regulation for the oil and gas sector
The Petroleum Law (Royal Decree No. 42/74), 1974, makes it mandatory to obtain prior approval before engaging in the exploration, extraction, exploitation, storage or distribution of petroleum or mineral resources. The Oil and Gas Law (amended of the Petroleum Law in 2011) is the current regulatory system of petroleum productions in Oman. Article 14 states that the Concession Agreement shall not grant the concession owner of any right of ownership in the concession area. Article 28 regulates the rights of way of pipelines. Article 29 specifies pipelines as well as pipeline corridors as public utility projects. Article 30 restricts pipelines for oil and gas use. Article 39 is related to environmental protection where concessionaires are requested "to reduce emissions of greenhouse gases in the Concession Area using the techniques and appropriate means to protect the environment".
- Incentives
The Omani government is in the process of identifying the country's greenhouse gas mitigation strategies.

Qatar

- CCUS specific Policy
No CCUS specific regulation at this moment. Law No. 30 of 2002 provides the basis for all of its environmental legislation, including the reduction of GHG emissions. The law seeks to offset the effects of pollution and to prevent environmental damage in general.
- CO₂ classification
No specification. CO₂ is not classified as hazardous, pollution or waste.
- Environment Impact Assessment
Law No. 30 outlines the basis of the current environmental protection policy in Qatar, and in particular states that undertaking and EIA is essential for development projects.
- Property rights regulation for the oil and gas sector
The state may grant land rights for the construction of pipelines and any associated infrastructure. Emiri Decision No. (13) of 1988 regarding Compulsory Acquisition for Public Benefit allows expropriation of land, and grants the state a compulsory acquisition power in order to facilitate land access. There is no independent gas distribution network within Qatar. Pipelines typically transport gas from source to specific projects. With the exception of the Dolphin pipeline, all Qatar's onshore and offshore oil pipelines are operated by Qatar Petroleum (QP) or QP-controlled joint venture companies. Approval for pipeline construction is required by the Ministry of Energy and Industry and the Ministry of the Environment. There is no mechanism by which third parties can compel the

owner and/or operator of a transportation pipeline (or any other associated infrastructure) to grant capacity or expand its facilities to provide third party access.

- Incentives and market development
The Qatari government has identified the reduction of non-productive combustion emissions from the oil and gas sector, as well as improving energy efficiency in the water and electricity sector. Currently there is no plan to introduce market deregulation or tax based options to reduce CO₂ emissions. While private investment has not been engaged, the government has initiated CO₂ capture projects for demonstration with public funding.

Saudi Arabia

- CCUS specific Policy
No CCUS specific regulation at this moment. Ambient Air Standard 2012 regulates air quality in Saudi Arabia. The Standard on Mobile Sources Emissions further regulates emissions from mobile subjects (e.g. vehicles).
- CO₂ classification
No specification. CO₂ is not classified as hazardous, pollution or waste.
- Environment Impact Assessment
General Environmental Law 28 Rajab 1422 H (2001) is the major environmental law of Saudi Arabia. Article 5 regulates environmental impact assessment for projects that may cause negative effects on the environment.
- Property rights regulation for the oil and gas sector
There is no comprehensive Petroleum law in Saudi Arabia as the oil and gas sector is nationalized. Saudi Aramco has the sole concession to develop the kingdom's oil, but it may subcontract service operations to foreign companies.
- Incentives and market development
Saudi Arabia has explicitly expressed the intention to deploy CCUS as one of its key measures in mitigating greenhouse emissions (Kingdom of Saudi Arabia, 2011). Currently there is no plan to introduce market deregulation or tax based options to reduce CO₂ emissions. The development of a carbon price is not on the policy agenda. While private investment has not been engaged, the government has initiated CO₂-EOR projects for demonstration with public funding.

United Arab Emirates (UAE)

- CCUS specific regulation
No CCUS regulation at this moment. The emirate of Abu Dhabi is evaluating policy framework for a domestic CCUS industry. Existing practice on transboundary oil and gas exploration and production may serve as useful reference to develop CCUS projects before formal policy is in place.
- CO₂ classification:
No specification. CO₂ is not classified as hazardous, pollution or waste.
- Environmental impact assessment, health, and public engagement:
Federal Law No. 24 requires that "certain environmental studies may be required for industrial facilities to apply for environmental permit or No Objection Certificate prior to the commencement of site activities". There are different pieces of legislation, regulations, orders and guidelines that touch on health and safety in general terms. The Abu Dhabi National Oil Company (ADNOC) acts as the de facto regulator for health, safety and environment for the Abu Dhabi oil and gas industry.

ADNOC has in place a Health, Safety and Environment Code of Practice requiring its group companies to develop and implement compatible programs.

- Property rights regulation for the oil and gas sector:
There is no comprehensive petroleum legislation in Abu Dhabi, the main oil producer of UAE, so no explicit co-authorizations would occur upon an introduction of a CCUS regulation. The ownership, organization and regulation of oil and gas transmission and distribution infrastructure are overseen at individual emirate level. There is no explicit regulation that permits third party access to pipelines and other infrastructure. Generally, the parties are free to negotiate the terms on which the oil or gas is to be transported, including fees charged for accessing the distribution network. Third-party access rights or rights to expand capacity may be granted as a matter of contract.
- Incentives and market development:
The UAE, as a non-Annex I country of the UNFCCC, is taking volunteer measures to reduce carbon emissions. The strategy of the country has been focusing primarily on developing alternative energy, introducing energy efficiency policy, and deploying CCS for EOR through government initiatives. The emirate of Abu Dhabi has started evaluating policy framework for a domestic CCUS industry, with a roadmap for technology deployment and rollout of commercial scale projects (UAE Ministry of Energy, 2012). The latest development indicates a more market oriented approach (vice government oriented) toward climate change mitigation where incentive is needed to attract private engagement. While private investment has not been formally engaged, the government has initiated CO₂-EOR projects for demonstration with public funding.

All GCC countries have no explicit regulations on transboundary industrial activities. Meanwhile, all GCC countries are in the process of developing new CCUS technologies. Regional collaboration on CCUS may be started with knowledge transfer and data sharing.

5. Regulatory Gaps

In the identification of regulatory gaps, it shall be noted that while some regulations cannot be found in GCC countries, the relevant issues are governed by implicit rules that are common knowledge to the participants of these activities. For example, the ownership of underground pore spaces normally belongs to the states in most GCC countries without being explicitly specified in relevant legal and regulatory systems. The lack of regulation can be attributed to a highly nationalized industry, where the national oil and gas company is normally entrusted to serve as a proxy of regulator. On the other hand, explicit CCUS policy is needed for the host countries to report GHG inventory and apply emission reductions for carbon credits under CDM. While it is possible for specific countries to deploy CCUS outside of the IPCC framework, it is assumed here that in general most countries are interested in aligning CCUS with CDM.

Following this assumption (that countries would aim to develop explicit CCUS regulation to align with the CDM protocol), Table 2 summarizes the regulatory gaps of CCUS legislation in GCC countries. In the Table, an “X” indicates a lack of both the implicit regulation and the explicit regulation; whereas an “-” indicates an existence of implicit regulation but a lack of the explicit regulation; and blank indicates close-to-no or no inadequacy. In general, countries get “X” when they have little experience or no activity in the development of the regulatory subject. They get “-” when they have worked with private investors using implicit regulation (via contracts); or they have relevant regulations that can be revised to incorporate CCUS regulatory requirements. The scores of UAE reflect the country’s regulatory gaps prior to the publication of its forthcoming CCUS policy.

Table 2 CCUS Regulatory Gaps in GCC Countries (X: inadequacy, - : minor inadequacy)

Regulatory domain	Bahrain	Kuwait	Oman	Qatar	KSA	UAE
CO ₂ classification	X	X	X	X	X	X
Ownership of surface	-	X		X	X	-

facility						
Transboundary movement of CO ₂	X	X	X	X	X	X
Environmental impact assessment						
CO ₂ impurity	X	X	X	X	X	X
CO ₂ capture regulation	-	X		X	X	-
CO ₂ transportation regulation	-	X		X	X	-
CO ₂ storage regulation*	X	X	X	X	X	X
Liability during the post-closure period	X	X	X	X	X	X
Regulation for CCS with EOR	X	X	X	X	X	X
Incentives	-	-	X	-	-	-

Note: CO₂ storage regulation include regulating site selection and characterization activities; project inspections; monitoring, reporting, and verification requirements; Corrective measures and remediation measures; authorization for storage site closure; liability during the project period; Financial contributions to post-closure stewardship

- CO₂ classification
No GCC countries have developed detailed classification for CO₂ that cover all purposes taking into account its environmental impact and transportation means.
- Ownership of surface facility
The Petroleum Law of Oman can be enhanced to allow the regulation of CCUS surface facility. Bahrain and UAE benefit from existing collaboration with private companies in oil and gas projects. Kuwait, Qatar, and Saudi Arabia need to develop explicit CCUS regulation to govern the ownership of surface facilities in the absence of Petroleum Law and implicit regulation.
- Transboundary movement of CO₂
There is no discussion among GCC countries about the regulation of transboundary movement of CO₂.
- Environmental impact assessment
The environmental laws of all GCC countries have clauses on environmental impact assessment.
- CO₂ impurity
All GCC countries restrict the use of pipeline for the transportation of oil and gas as well as hydrocarbon by-products. No regulation has been developed for the transportation of CO₂ streams from different sources.
- CO₂ capture regulation
The Petroleum Law of Oman can be enhanced to allow the regulation of CO₂ capture activities. Bahrain and UAE benefit from existing collaboration with private companies in oil and gas projects. Kuwait, Qatar, and Saudi Arabia need to develop explicit CCUS regulation to regulate CO₂ capture activities in the absence of Petroleum Law and implicit regulation.
- CO₂ transportation regulation
The Petroleum Law of Oman can be enhanced to allow the regulation of CO₂ transportation activities. Bahrain and UAE benefit from existing collaboration with private companies in oil and gas projects. Kuwait, Qatar, and Saudi Arabia need to develop explicit CCUS regulation to regulate CO₂ transportation activities in the absence of Petroleum Law and implicit regulation.

- CO₂ storage regulation
No legislation has been publicized by GCC countries for the regulation of permanence storage of CO₂.
- Liability during the post-closure period
The current international trend is to transfer liability in the post-closure period. This practice will not be a major issues for all GCC countries in terms of ownership of the subsurface pore spaces that they are by default owned by the states. However, regulations on other permanent storage issues such as insurance against post-closure leakage as well as cost for long term monitoring have yet been established.
- Regulation for CCS with EOR Incentives
No legislation has been publicized by GCC countries for the regulation of permanence storage of CO₂ for EOR. The domestic regulation of CO₂ for EOR may be developed in a manner that harmonizes with the international regulation of CO₂ for EOR once it is settled under UNFCCC.

6. Conclusion

CCS posts as an enormous opportunity for global carbon emission reduction. For ESCWA member countries, CCUS can be an important option for greenhouse gas mitigation given the region's vast geological formations for CO₂ storages; and the use of CO₂ for EOR. In the GCC region, oil production is primarily in the primary and secondary production phases; with EOR being gradually introduced to extend the life of oil fields. As EOR is not prevalent in all oil and gas fields in this region, large scale CCUS deployment in the GCC region cannot be achieved in the absence of proper regulations and incentives. This report reviews the existing regulatory system in the GCC countries for CCUS deployment. It is found that (1) environmental regulations related to carbon capture and transportation are covered by existing regulations; (2) new regulation for permanent storage needs to be developed to align CCUS with the Clean Development Mechanism (CDM); (3) the integration of CCUS regulation with oil and gas regulation can be challenging due to potential transboundary CO₂ for EOR and lack of explicit oil and gas regulation for highly nationalized industries; (4) effective incentive mechanisms can be explored with early stage pilot projects; and (5) Regional collaboration of CCUS may start from capacity development and knowledge sharing.

The review also provides implications for the development of CCUS regulation in the broad ESCWA region: (1) Collaboration of oil and gas regulation and CCUS regulation is critical especially for oil producing countries; (2) transboundary CCUS regulation may be best addressed with regional collaboration; (3) development of incentive mechanism can be critical when the capture cost of CO₂ is expensive and the carbon price in the European Trading Scheme is not sufficiently high; (4) existing and new international and regional convention such as the Bamako Convention for the African Union will need to be structured in a manner to incorporate CCUS activities.

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