



Strategic Analysis of the Global Status of Carbon Capture and Storage

Report 3: Country Studies
The United Arab Emirates

Final Report



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United Arab Emirates

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1. Executive summary

No integrated legislative framework is currently enacted in the UAE in relation to the capture and sequestration of CO₂ emissions.

There is, however, a large amount of government investment to support related projects which, alongside various related commercial partnerships, is aimed at capturing up to one third of the emirate of Abu Dhabi's CO₂ emissions by 2020.

2. Glossary

ADNOC	Abu Dhabi National Oil Company
CDM	Clean Development Mechanism
Environmental Law	Federal Law No 24 of 1999 Concerning the Protection and Development of the Environment
FEED	Front-end engineering design phase
GASCO	Abu Dhabi Gas Industries Ltd
LEED	Leadership in Energy and Environmental Design
MASDAR	Masdar Initiative or Abu Dhabi Future Energy Company
MIST	Masdar Institute of Science and Technology
MIT	Massachusetts Institute of Technology
MUBADALA	Mubadala Development Company

3. CO₂ pricing

3.1 Introduction

Although the UAE has acceded to the Kyoto Protocol to the UNFCCC, as a non Annex 1 country, it does not currently have binding GHG emissions reduction targets under international law. Although the UAE is reported to be one of the highest per capita producers of CO₂ in the world, at present it does not impose related restrictions on producers of GHG emissions.

3.2 Non-mandatory emission reduction schemes

While the UAE does not have any specific legislation in place to achieve a reduction in CO₂ emissions, it is investing heavily in the development of both CCS and alternative energy sources.

The UAE's largest emirate, Abu Dhabi, has committed more than \$15 billion to investment in renewable energy programs through the MASDAR Initiative. The MASDAR Initiative (or Abu Dhabi Future Energy Company) is a private joint stock company, established and wholly-owned by the Mubadala Development Company (MUBADALA) (MUBADALA, 2009). MASDAR focuses on the development and commercialization of technologies in renewable energy, energy efficiency, CO₂ management and monetisation, water usage and desalination.

MASDAR is currently developing a CO₂ capture and transmission network in Abu Dhabi. The network will capture CO₂ gas emitted from industrial plants for delivery via pipelines to oil reservoirs for enhanced oil recovery.

MASDAR is also developing a portfolio of GHG emissions reduction and monetisation projects in Abu Dhabi and the region. These create value by monetising GHG emission reductions under the provisions of the Kyoto Protocol's CDM.

MASDAR and the Abu Dhabi National Oil Company (ADNOC) have signed a framework agreement to develop a series of projects to reduce CO₂ emissions from Abu Dhabi's oil and gas facilities. As part of the agreement, MASDAR will monitor the life cycle of the CDM projects in ADNOC's portfolio taking them through the registration process with the CDM Executive Board, monitoring emissions reductions and securing the verification and delivery of carbon credits.

ADNOC currently has five CDM projects under development with the capacity to remove four million tons of annual CO₂ emissions. MASDAR is currently registering these projects with the CDM Executive Board (The Editor, 2009). The projects include:

- in Das Island, natural gas flaring is to be reduced by installing a new pipeline to recover the excess fuel and flash gases which will be reused as fuel. This will reduce CO₂ emissions as well as the need for fuel;
- the Takreer Project which will conserve previously flared gas streams at the Ruwais refinery at Takreer. The collected gases will be compressed and sent to the fuel gas system in order to partially replace the natural gas currently being imported from a nearby gas field and injected into the oil field;

- the FERTIL Project, which will be the first of its kind in the Arab world, will recover the CO₂ emissions from flue gases generated due to fuel burning, to convert ammonia into urea in FERTIL's Ammonia/Urea plant in Ruwais;
- the GASCO Project will install energy efficient seals on the ground flare systems of the gas processing complexes at Bab, Buhasa and Asab to reduce the fuel gas consumption needed to purge the flare header and avoid air entrance; and
- the GASCO Project will recover the previously flared waste gases generated from the gas processing complex at Habshan. The recovered gases will partially replace the imported fuel gas, thus CO₂ emissions will decrease and additional fuel will be available to the other consumers.

Masdar's main initiative is a project to take natural gas from the grid and convert it to hydrogen and CO₂. The hydrogen power plant will generate approximately 400 MW of low-carbon electricity. This project alone would provide more than 5 percent of all Abu Dhabi's current power generation capacity.

Up to 1.7 million tonnes of CO₂ per year will be transported to a producing oil field and used to replace the natural gas that is currently being injected into the oil field to maintain pressure. The process will release a significant amount of natural gas for other uses, either domestically or for export.

Elsewhere in the UAE, the state-run Dubai Multi Commodities Centre and London-listed carbon-credit company EcoSecurities have signed a deal intended to try and ensure that Dubai becomes the regional hub for trading carbon offsets.

The carbon credits market in the Middle East is still nascent and it is difficult to predict when this market will formally open (Webb & Said, 2007).

3.3 Greenhouse gas emission and energy use reporting schemes

The emirate of Dubai has issued a resolution on the implementation of green building specifications and standards, effective from January 2008. Under the resolution, all owners of residential and commercial buildings and properties in Dubai must comply with internationally recognised environmentally-friendly specifications (Arabianbusiness.com, 2007). This resolution made Dubai the first city in the Middle East and one of the first in the world to implement such a requirement. It requires all new construction projects to comply with internationally-agreed energy and water-efficiency requirements, to provide landscaping facilities, and to meet waste-efficiency and indoor and outdoor air quality requirements.

The Emirates Green Building Council was formed in 2006 with the goal of advancing green building principles for protecting the environment and ensuring sustainability in the UAE. The Council is based on the US Green Building Council, which certifies buildings according to its "Leadership in Energy and Environmental Design" (LEED) rating system.

4. Existing CCS initiatives

4.1 Introduction

Abu Dhabi, currently a significant CO₂ emitter, aims to capture and store one third of its emissions by 2020. However, no integrated legislative framework is currently enacted in the UAE in relation to the capture and sequestration of CO₂ emissions.

Masdar's CCS projects involve capturing CO₂ from the chimneys of three (as yet unbuilt) sites: a steel plant, an aluminium smelter and a hydrogen power station. The gas, transported across the desert inside a 300km pipeline, will be sold to the Abu Dhabi National Oil Company for enhanced oil recovery. The objective of the CCS network is to reduce Abu Dhabi's CO₂ footprint and to replace the use of vast amount of natural gas currently re-injected into oil reservoirs.

Feasibility studies have been conducted. The project is currently at the front-end engineering design (FEED) phase. The first phase of the CCS network is projected to capture around 6.5 million tons of CO₂ from power plants and industrial facilities in Abu Dhabi by 2013.

4.2 Government or government-business research facilities

The MASDAR Institute of Science and Technology (MIST) is an independent institute that is the Middle East's first graduate education and research university focused on developing "the next generation of solutions to the world's growing dependence on fossil fuels".

MIST was created by official decree from HH Sheikh Al Nuhayyan, Ruler of Abu Dhabi, on September 18, 2007, and it has been certified by the Abu Dhabi Education Council. Developed in cooperation with the Massachusetts Institute of Technology (MIT), MIST is an independent, not-for-profit, graduate institution. Its focus is on research in science and technology advances, to meet the MASDAR Institute's goal of diversifying Abu Dhabi's economy away from its current focus on petroleum production. There are currently 14 MIST faculty members at MIT and 100 students were expected in the 2009 entering class.

4.3 Government funding

The government of Abu Dhabi is putting up \$15 billion in seed capital, but both the CCS projects and MASDAR City are intended to be run on a commercial basis, in conjunction with other companies (Anonymous, 2008).

4.3.1 Research, development and commercialisation

Although the Abu Dhabi State is injecting significant capital into this project, it is being run with commercial partners from the initial stages.

4.4 Government-business joint ventures

Case study: MASDAR City

The MASDAR Initiative's partners include some of the world's largest energy companies and other institutions: BP, Shell, Occidental Petroleum, Total Exploration and Production, General Electric, Mitsubishi, Mitsui, Rolls Royce, Imperial College London, MIT and WWF (UAE Embassy, 2009). Stakeholders include post-combustion and pre-combustion power plants, an aluminium smelter and a steel mill.

MASDAR City has been designed by Foster + Partners as the world's first zero-carbon, zero-waste city. The 1,483-acre project will include commercial and manufacturing space dedicated to developing eco-friendly products, housing, a university, and the headquarters for MASDAR (Dilworth, 2007). The city will be surrounded by wind and photovoltaic farms, research fields and plantations, which will be built after the construction of the photovoltaic power plant is completed (Zawya, 2006).

4.5 Evaluation

While the use of CCS technology is not legislated for, the policies being formed by the emirate of Abu Dhabi are large in scale and backed both by government funding and industry knowledge. Masdar's Carbon Management Unit confirms that all the technologies which the initiative plans to use are already functioning separately in other countries, but the planned network will be the first of its kind.

5. Capture of CO₂

5.1 Introduction

The UAE has no specific legislation dealing with the capture of CO₂ emissions.

Abu Dhabi currently carries out a low level of CO₂ capture for industrial purposes. Usually CO₂ is used for ammonia and urea production in the fertilizer industry.

The MASDAR Initiative, in its initial stages, plans to capture about 5 million tons of CO₂, which is not a significant percentage of total emissions. By the year 2020, MASDAR aims to capture and store up to one third of Abu Dhabi's CO₂ emissions.

Hydrogen Power Abu Dhabi is a joint venture between Abu Dhabi's government-owned MASDAR and Hydrogen Energy, which in turn is a partnership between BP and Rio Tinto, the Anglo-Australian mining and metals company. Hydrogen Power Abu Dhabi will develop the FEED of an industrial-scale hydrogen-fired power generation project with CO₂ capture in Abu Dhabi.

However, rather than being captured, natural gas will be processed to create hydrogen and CO₂. The hydrogen fuel would generate low-carbon electricity, while the CO₂ will be pumped to oil fields for storage.

5.2 Integrated policy and legislation

5.2.1 Retrofitting

The CCS technology will first be deployed at factories that are as yet unbuilt. As such there are currently no plans to retrofit CCS technology to existing energy plants.

5.3 General policy and legislation with applicability to CO₂ capture

The UAE has both Federal and emirate level general environmental legislation in place. Federal Law No 24 of 1999 Concerning the Protection and Development of the Environment (Environmental Law) provides a general framework for environmental protection, including requirements for environmental impact assessments for specified projects; liability for land, air and water pollution; and liability and compensation for environmental damage.

Environmental liability in the UAE is based on the "polluter pays" principle, under which the person responsible bears the cost for environmental rehabilitation. The Federal Environment Agency is the Federal governmental body charged with enforcement of environmental standards and pollution control, as well as setting policy. The Minister of Health chairs the board of directors which oversees the agency's operation.

5.3.1 Planning requirements

Although there is no specific regulation, CCS projects may be subject to EIA requirements under the Environmental Law.

5.4 Evaluation

At present the UAE does not have specific integrated legislation or policies on the capture of CO₂.

6. Transport of CO₂

6.1 Introduction

Currently, no specific legislation has been passed relating to the transport of CO₂. The plans unveiled by MASDAR foresee CO₂ being moved across the UAE by means of a 300km pipeline.

6.2 General policy and legislation specific to transport of CO₂

The UAE's Environmental Law governs pollution prevention and control both on land and at sea, including: requirements for environmental impact assessments for specified projects; liability for land, air and water pollution; and liability and compensation for environmental damage.

The UAE relies on the "polluter pays" principle under which the person responsible bears the cost for environmental rehabilitation. The Federal Environment Agency is the Federal governmental body charged with enforcement of environmental standards and pollution control, as well as setting policy. The Minister of Health chairs the board of directors which oversees the agency's operation.

6.3 Evaluation

At present the UAE does not have specific integrated legislation or policies on the transport of CO₂. The single pipeline that is being designed should be in use by 2013.

7. Exploration of potential CO₂ storage sites

7.1 Introduction

It is planned that the captured CO₂ would be injected in producing oil fields to replace the natural gas currently being injected into oil fields, allowing the gas to be used to fuel Abu Dhabi or to be exported. Once the CCS network expands, the CO₂ could be permanently stored in the region's depleted oil fields.

In the first phase ending in 2013, around 6.5 million tons of CO₂ per year will be captured from three emission sources: a gas-fired power plant, an aluminium smelter and a steel mill (Anonymous, 2008a).

7.2 Integrated policy and legislation

At present, the UAE does not have any integrated legislation relating to the exploration of potential CO₂ sequestration sites. The focus of Masdar's Carbon Unit is to store the captured CO₂ in the country's oil fields. The CO₂ would permanently remain beneath the oil fields' naturally impervious seal (Masdar, 2009).

7.3 Evaluation

At present the UAE does not have specific integrated legislation on CO₂ sequestration exploration of CO₂. It is planned that the captured CO₂ would be injected in producing oil fields to replace the natural gas currently being injected into oil fields, allowing the gas to be used to fuel Abu Dhabi or to be exported. Once the CCS network expands, the CO₂ could be permanently stored in the region's depleted oil fields.

8. Injection and pre-closure of CO₂ storage formations

8.1 Introduction

The UAE currently does not have specific legislation on the injection and pre-closure of CO₂ sequestration formations. The state-run MASDAR envisages that, once the CO₂ is used to enhance oil recovery, the waste CO₂ would be stored permanently underground in depleted oil reservoirs.

If the scheme proves to be successful, the technology will be replicated and applied to other fields. The present project will be the first time that CO₂ capture from power plants, followed by application in an enhanced oil recovery operation, will have been used in a commercial situation. If applied to all oil fields in the UAE, 15 million tons of CO₂ a year could be sequestered in this way.

It is expected that the increased pressure from using CO₂ to enhance oil production could initially enable up to 100 million barrels of additional oil to be recovered (Hydrogen Energy, 2009). This is in addition to the gains made through saving natural gas, which is currently transported to the oil fields and utilised to maintain pressure. It is estimated that this enhanced oil recovery technique could result in Abu Dhabi's recoverable oil reserves increasing by up to two billion barrels.

8.2 General policy and legislation

The Federal Environmental Law provides a framework under which CCS-specific regulations could be adopted.

8.3 Evaluation of strengths and weaknesses of injection and pre-closure policies and legislation

The UAE currently does not have specific legislation on the injection and pre-closure of CO₂ sequestration formations. The state-run MASDAR envisages that, once the CO₂ is used to enhance oil recover, the waste CO₂ would be stored permanently underground in depleted oil reservoirs.

9. Post-closure and long-term storage of CO₂

9.1 Introduction

The Abu Dhabi government's plans for a CCS network are in their embryonic stages and, as such, long term storage has not yet been a material consideration. However, the use of depleted oil fields as a long term solution for CO₂ storage is at the forefront of MASDAR's policy.

9.2 General policy and legislation

The environmental legislation detailed at paragraph 6.2 would also apply to the storage of CO₂.

9.3 Evaluation

The UAE currently does not have specific legislation on post-closure and long term storage of CO₂. MADAR's proposals would, however, involve long term storage in depleted oil reserves.

10. Summary

The UAE in general and the emirate of Abu Dhabi in particular have demonstrated a firm commitment to CCS in principle. The projects spear-headed by MASDAR, the Abu Dhabi state-owned clean energy fund, are all in the planning stages and have yet to be implemented.

As a significant CO₂ emitter, the UAE has made a commitment to CCS technology in an attempt to realise economies and reduce CO₂ emissions. The level of investment and the broad network of strategic partnerships demonstrate a clear intention by Abu Dhabi to embrace CCS technology. The MASDAR Institute's stated target is the capture and storage up to one third of Abu Dhabi's CO₂ emissions by the year 2020. However, the embryonic stage of this initiative means that many important legislative decisions, which will be required to support and regulate the proposed schemes, are not yet in place.

10.1 Gaps in CCS policy and legislation

As mentioned above, whilst many of the emirates have policies to implement CCS initiatives, these are not currently underpinned with integrated legislation.

11. References

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