2022

June

Carbon Capture, Storage & Utilisation

CEO Roundtable White Paper

The Al-Attiyah Foundation

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Carbon capture and storage (CCS), or carbon capture, utilisation, and storage (CCUS), is a suite of technologies to capture CO2 from carbon-emitting processes and to store it safely for the long-term in underground rock formations, convert it into useful products or into stable minerals.

CCUS involves three steps aimed at reducing the release of anthropogenic CO2 emissions into the atmosphere. Carbon dioxide is captured from anthropogenic sources, then it is transported to the injection site and permanently stored in geological storage or it is utilised.

The Paris Agreement on climate action, and the Intergovernmental Panel on Climate Change (IPCC) report on the impacts of global warming of 1.5°C

CEO ROUNDTABLE WHITE PAPER

H.E. Abdullah Bin Hamad Al-Attiyah founded the CEO Roundtable Series as a platform for knowledge exchange and to encourage critical dialogue for the Foundation's Members, in the quest towards a sustainable energy future.

The quarterly events, which have been hosted in Qatar for six years, are highly anticipated networking sessions, as well as an opportunity for our Members' CEOs to examine essential matters of energy and sustainable development.

above pre-industrial levels, emphasise the importance of a range of different low carbon approaches in limiting dangerous climate change. CCUS is growing in importance as one of the technologies to mitigate the emissions of carbon dioxide into the atmosphere. CCUS features widely in the Nationally Determined Contributions (NDCs) submitted in terms of the Paris Agreement by several countries.

There have been several initiatives and projects aimed at demonstrating the application of CCUS technology under various conditions and to build technical capacity, especially in developing countries. The World Bank CCUS Trust Fund and the Asian Development CCUS Fund are just two notable examples that aim to provide sustained financial flow for CCUS demonstration projects.

- The CCUS Trust Fund was set up by the World Bank in 2009, with an initial US$8 million joint contribution from the Global CCUS Institute and the Norwegian Government. Norway has since contributed a further US$3 million. The Fund has supported seven country programmes, to date, in Botswana, China, Egypt, Jordan, Kosovo, South Africa, and the Maghreb region (Algeria, Morocco and Tunisia). Programmes are also under development in India and Indonesia.
- The Asian Development Bank (ADB) Carbon Capture and Storage Fund, a multi-partner trust fund, was established in July 2009, with the initial support of Australia under the Clean Energy Financing Partnership Facility. The fund aims to “accelerate the demonstration of carbon capture and storage (CCUS) technologies; identify, lower and/or eliminate general and country-specific technical, regulatory, institutional, financial, economic, environmental, and/or social barriers to CCUS technology demonstration; and identify, eliminate, or mitigate real or perceived risks in CCUS capture, transport, or storage technology demonstration.”

CCUS, although often still described as an “unproven” technology, is in fact quite mature in its typical applications, with separation of CO2 from other gases, its transport by pipeline, and injection into the subsurface reservoirs all being widely used standard processes since the 1970s. However, a combination of the three technologies is still required to ensure that CCUS achieves its potential, and at the scale needed to be an effective approach for climate change mitigation.

It is important to note that CCUS is forming part of the centre stage of an ongoing discourse on global transition to a future low carbon energy economy. In particular, the increasing interest in hydrogen as a low carbon energy carrier for industry, heating, and long-distance transport, is propelling further interest on CCUS, since hydrogen made from steam reforming of natural gas with CCUS is expected to be significantly cheaper than that made from electrolysis of water with low-carbon electricity. This is of particular interest for countries (especially in the Middle East) that have substantial sub-surface assets in the form of fossil fuels. One of the ways to monetise these assets is to convert those fossil fuels (especially natural gas) into hydrogen.

The existing mature technologies to convert natural gas into hydrogen, simultaneously produce carbon dioxide which needs to be captured.

Key Points Raised

- The technology for carbon capture is no longer novel but is based on well understood technology.
- Clear national or international policies that encourage faster adoption of the technology, such as subsidies, tax incentives or in particular cases definite and identifiable commercial incentives, are needed.
- There are definite opportunities for Qatar to take a lead in the production of low carbon LNG, blue hydrogen and blue ammonia.
- If added to existing electricity generation, carbon capture retrofitting would greatly reduce Qatar’s carbon footprint.

At the start of the Roundtable, the moderator invited His Excellency Abdullah bin Hamad Al-Attiyah to welcome members and guest speakers. Each speaker then gave a short presentation.

Ms. Martina Lyons outlined the IRENA energy transfer process. She noted that it is possible to abate about 20% of CO2 emissions by use of carbon capture processes. However, to implement these, an investment of US$ 2 trillion will be needed up to the year 2050. This would capture about 8 gigatonnes of CO2. Progress is very slow as there are only 0.04 giga tonnes of installed carbon capture capacity. In many applications, renewables as a process route out compete carbon capture. However, this is not true in the production of ammonia, hydrogen, and for iron, steel, and cement i.e., for hard to abate high temperature processes.

Mr. Braulio Pikman introduced a taxonomy for the process of producing carbon offsets (see Appendix 2). He noted that electrification of much of the transport sector (private cars, rail, and buses) will be necessary to reduce emissions. In many cases, carbon capture will be used to improve the economics of electrification. However, he also highlighted that the concentration of CO2 in the atmosphere had increased by 12% (up to 2020) compared to 20 years ago, further underscoring his point that reducing carbon emissions has become harder.

Mr. Andrea Zambianci used his presentation to highlight the CCUS opportunities available to Qatar. He stated that Qatar has the ability to generate significant revenue while also reducing the environmental impact of its fossil fuel activities through CCUS. He noted that Qatar has a wealth of experience in the use of syngas technology, and ammonia and methanol production. Consequently, the opportunities to produce blue hydrogen are present if carbon capture technology is used. This would ensure the long-term viability of the North Field as an asset.

Mr. Ian Kuwahara spoke of the challenges in establishing a significant number of CCUS plants by 2050. It is estimated that 7.6 gigatonnes of capacity will be needed. This is equivalent to constructing one plant of today's size, every day for the next 20 years.

He noted that in order to achieve such numbers, significant improvements in technology or scaling up are needed.

The floor was then opened to Foundation members and invited guests. The Foundation's Roundtables are held under the Chatham House rules meaning the below mentioned comments are not attributed to any individual speaker.

1. The Sleipner Field in Norway has been using carbon technology as part of natural gas production since 1995 and much expertise has been gleaned in this time period. In addition, the several international partners in this project have now released data on the long-term storage of carbon dioxide in this field.

2. The Northern Lights project forms part of a full-scale carbon capture and storage (CCS) project, which is one of the first industrial-scale, open-access projects in Europe to develop a value chain for CCS (see Appendix 1 for further details).

3. In electricity generation, the difference between precombustion and post combustion carbon capture has to be distinguished. Precombustion is dependent on turbine feed, whether natural gas, hydrogen or a combination of both. Small gains in efficiency are always being made. Post combustion relates to true carbon capture. This technology is well understood though gains in the efficiency of this process are always being made.

4. Many speakers raised the points that Qatar is well experienced in the production of hydrogen, ammonia, and methanol and also in the shipping of methanol and ammonia.

5. It was stated that the production of hydrogen by the steam-methane cracking process was well established worldwide and used extensively in Qatar.

GUEST SPEAKERS

Moderator:

Mr. Nawied Jabarkhyl
Correspondent News & Presenter, CGTN

Speaker:

Mr. Braulio Pikman
Technical Director, ERM

Speaker:

Mr. Ian Kuwahara
Director of Energy, and Industrial Innovation, VERRA

Speaker:

Ms. Martina Lyons
Programme Officer, IRENA

Speaker:

Mr. Andrea Zambianci
Fertiliser and Syngas Manager, Saipem

6. It was pointed out that the removal of carbon dioxide is an established process in the production of LNG (although this is routinely vented to atmosphere).

Opportunities for Qatar

The opportunities highlighted for Qatar consisted of the following:

- Qatar has an opportunity to become a world leader in the production of “blue” LNG, ammonia and methanol. Such products should produce a premium price of “non blue products” and obviate the need to purchase “carbon offsets” if required.
- Qatar has an opportunity to retrofit carbon capture to the existing fleet of electricity generators including those for the aluminium plant where the major emissions in the production of aluminium emanate.
- Guests also debated whether Qatar had secure spent reservoirs to store all the carbon dioxide that could be captured and agreed further information is required to make conclusions on the matter.

Conclusion

In his closing remarks, the moderator noted that lowering the cost of CCUS per tonne of carbon captured is essential for further adoption of the technology. However significant opportunities exist for CCUS if a clear set of international regulation can be agreed, such as carbon taxes and cross border tariffs. Qatar has significant experience and the assets to exploit business opportunities that already exist.

In closing, H.E. Abdullah bin Hamad Al-Attiyah thanked the speakers and guests for their attendance and contributions to the discussion and said he is very much looking forward to the next Roundtable that is scheduled for early September.

Appendix 1

1. Supported by the Norwegian government, the feasibility studies for Norway's flagship full-scale CCS project were carried out in 2016. The project involves CO2 capture from industrial sources in the Oslofjord region and its transportation and storage on the Norwegian Continental Shelf.

2. The Northern Lights project is planned to be developed by a consortium of three international oil majors.

3. The project partners reached an investment decision for the project in May 2020. The development and operation plan for the project, which is estimated to involve £550m ($680m) of initial investment, have also been handed over to Norway's Ministry of Petroleum and Energy.

4. The project will be capable of transporting and storing 1.5 million tonnes per annum (Mtpa) of CO2 in phase one starting in 2024. It can be further expanded up to 5Mtpa storage capacity in subsequent development phases.

5. The CO2 will be captured from industrial capture sources including, Fortum Oslo Varme's waste-to-energy plant at Klemetsrud and Norcem's cement factory in Breivik.

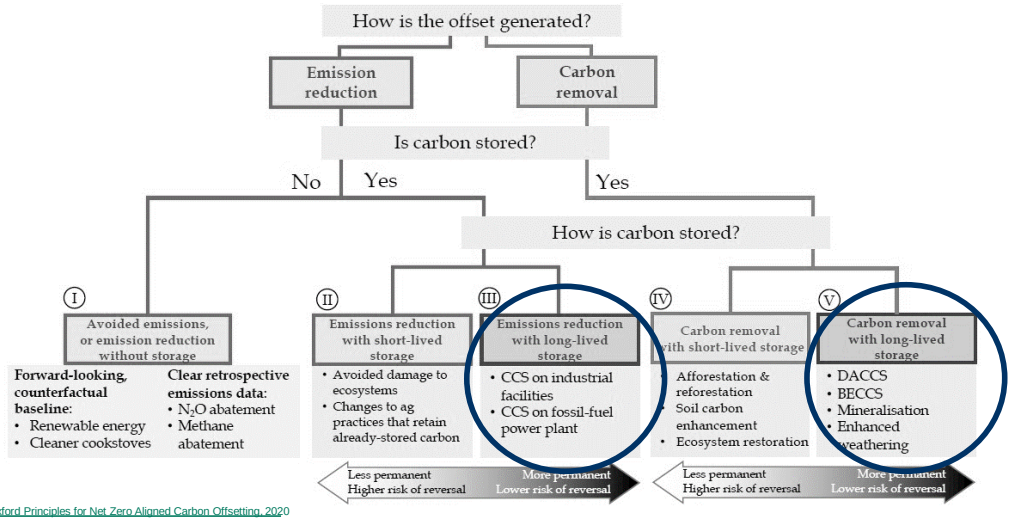
6. The captured CO2 will be compressed and liquefied at the source sites and the liquefied CO2 will be transported by ship to an onshore receiving terminal in the Naturgassparken industrial area in the municipality of Øygarden, on the Norwegian west coast. The CO2 receiving plant will be remotely operated from facilities at the Sture terminal in Øygarden and the subsea facilities from Oseberg A platform in the North Sea.

7. The liquefied CO2 from the onshore terminal will be transported through an offshore pipeline for injection and permanent storage in a reservoir approximately 2.5km beneath the seabed, located south of the Troll field in the North Sea.

Appendix 2

CCS in the Taxonomy of Carbon Offsets

Figure 1: *Taxonomy of Carbon Offsets*

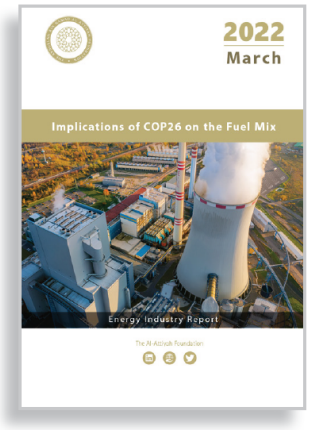


Source: The Oxford Principles for Net Zero Aligned Carbon Offsetting, 2020

General Business

11 PAST ISSUES

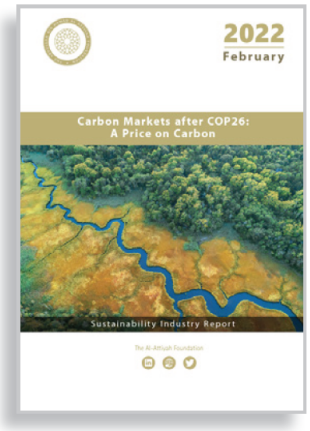
Have you missed a previous issue? All past issues of The Al-Attiyah Foundation's Research Series, both Energy and Sustainability Development, can be found on the Foundation's website at www.abhafoundation.org/publications



March – 2022

Implications of COP26 on the Fuel Mix

The outcomes from COP26 included major milestones such as the commitment to phase-down coal and fossil fuel financing, and the global pledge to reduce methane emissions by 30% by 2030. How will these pledges impact the sources of energy in the future?



February – 2022

Carbon Markets after COP26:A Price on Carbon

The Paris Agreement's Article 6, on carbon markets, was a crucial part of the COP26 negotiations. A price on carbon is a key tool for reducing global emissions in anefficient and fair way. But there were serious challenges in reaching a workable text, that would allow carbon markets to function effectively while avoiding doublecounting or encouraging unsustainable activities.

January – 2022

The Future of Gas in the EU's Energy Security

The European Union is currently seeing gas shortages and high prices, with declining domestic production and concerns over its relationship with Russia. Gas is also required as coal is being phased down. European countries vary in their attitudes to gas depending on domestic politics,resource position and energy mix.

Our partners collaborate with The Al-Attiyah Foundation on various projects and research within the themes of energy and sustainable development.

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