

Carbon Capture and Storage: An Artificial Lung Facing the Climate Crisis in Egypt

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Introduction

In recent years, the term “carbon neutrality” has topped international policy agendas and become a declared goal for many countries in their efforts to combat climate change. Carbon Capture and Storage (CCS) technology has emerged as one of the most prominent tools available to achieve this goal, especially for countries heavily dependent on traditional energy sources. According to the International Energy Agency (IEA), CCS technology can reduce more than 20% of the global emissions required by 2050 to achieve carbon neutrality. Meanwhile, world bank reports indicate that global investments in this field exceeded \$4 billion in 2022 and are expected to reach more than \$50 billion by 2035 as the energy transition accelerates. Internationally, projects under operation or development grew to more than 196 projects worldwide in 2023, with a total capacity exceeding 250 million tons of CO₂ annually. Among the most notable are the “Northern Lights” project in Norway, which targets storing 1.5 million tons annually, and the “Quest” complex in Canada, which has already stored more than 6 million tons since 2015.

Egypt between Industrial Growth and Environmental Commitments

Domestically, Egypt represents a special case that combines accelerated industrial growth on the one hand and increasing commitment to environmental agreements on the other. The cement, fertilizer and oil refining sectors contribute more than 35% of Egypt’s total industrial emissions, according to the Egyptian Ministry of Environment. With Egypt consuming over 6 billion cubic feet of gas daily for power generation and industry, reducing emissions through technologies such as CCS becomes a strategic necessity rather than a luxury. The importance of integrating CCS projects within Egypt’s energy and climate vision is evident-not only for compliance with international agreements, but also for enhancing its ability to attract green investments. For example, the blue hydrogen sector, which relies on CCS, is expected to contribute more than \$10 billion to Egypt’s GDP by 2030 if invested in properly.

Practical Experience and Challenges

From my professional experience as a petroleum engineer and researcher and during my work within the design and implementation team of a CCS project in Malaysia under the supervision of PETRONAS and the Malaysian Petroleum Authority, I participated in developing a work plan that included:

- A. Evaluating geologic sites suitable for storage.
- B. Designing separation and transportation systems.

C. Simulating subsurface CO₂ movement to ensure secure storage for decades ahead.

This experience highlighted both technical and economic challenges, as the cost of isolating and storing one ton of CO₂ averages \$40-80, which requires incentive policies and financial support to attract investors.

Egypt: Opportunities and Recommendations

What Egypt most needs today to apply this technology includes:

- a) Specialized infrastructure, including carbon separation units and transportation systems.
- b) Evaluation of geological formations in regions such as the Gulf of Suez and the Western Desert, which contain depleted fields suitable for storage.
- c) Public-private partnerships with global companies operating in Egypt such as ENI and BP, to develop pilot projects.

d) A clear legislative framework to regulate storage operations and encourage investment.

e) Building local capacity by training engineers and technicians in collaboration with international research centers and universities.

From this, it is clear that applying CCS technology in Egypt will not merely be an environmental project, but a strategic initiative with immense economic and scientific potential. It is a means to protect the environment, create thousands of jobs and promote innovation in the energy sector. With the acceleration of climate change, Egypt's adoption of this technology will represent a strong step confirming its ability to keep pace with global transformations and achieve a balance between development and environmental commitment.