# بسم الله الرحمن الرحيم

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تم رفع هذه الرسالة بواسطة / حسام الدين محمد مغربي

بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى مسئولية عن محتوى هذه الرسالة.

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# PRACTICAL TECHNICAL COMPARATIVE STUDY WITH ECONOMIC INDICATORS FOR CARBON DIOXIDE EMISSIONS SEQUESTRATION IN EGYPT, APPLICATION IN AN OIL FIELD IN WESTERN DESERT

By

**AHMED ABDEL-AZIZ MAHMOUD ELMEZAIN**

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
**MASTER OF SCIENCE**
in
**CHEMICAL ENGINEERING**

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
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Under the Supervision of

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Approved by the
Examining Committee

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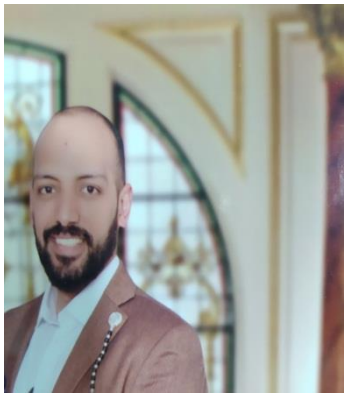
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## Title of Thesis:

PRACTICAL TECHNICAL COMPARATIVE STUDY WITH ECONOMIC INDICATORS FOR CARBON DIOXIDE EMISSIONS SEQUESTRATION IN EGYPT, APPLICATION IN AN OIL FIELD IN WESTERN DESERT

## Key Words:

Carbon Dioxide; sequestration; microalgae; enhanced oil recovery; injection

## Summary:

This thesis discussed firstly the environmental situation of $CO_2$ emissions and the global coalition to counteract the problem of climate change then a simple review about different pathways to sequester emitted $CO_2$, followed by a SWOT analysis to select best pathways applicable in Egypt, two pathways were adopted; biological sequestration and geological sequestration. For both pathways, technical model and economic calculations were proposed.

# Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Ahmed Abdel-Aziz Mahmoud El-Mezain Date: ../../2022

Signature:

# Dedication

I wish to dedicate this work to the humanity; everybody seeks to live in a cleaner environment, everybody keen to make whatever it should be to combat climate change. I'm happy to zoom in and speak to the Muslim community for whom I belong, they should bear on their shoulders – as they used to do in the previous eras- the target of driving humans towards peace and prosperity. I also wish to dedicate this work to my sincere wife who stands beside me in every situation through our life.

# Acknowledgments

The completion of this research couldn't have been possible without the full support and mercy of our great God, then the full expertise of my supervisors including both staff in Cairo University; Prof. Dr. Nabil Abdel-Monem and Dr. Hassan El-Shimi and Tanta university Dr. Mostafa El-Shobary and Dr. Rania El-Shnody. I'd like also to thank the examiners who joined the jury: Prof. Dr. Shakinaz El-Sheltawy and Prof. Dr. Nahed Attia for their support and cooperation.

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# Nomenclature

**BBL:** oil barrel
**BCF:** billion cubic feet
**Btu hr $^{-1}$ ft$^{-2}$ $^{o}$F$^{-1}$:** British Thermal unit/ (hour.square feet. degree fahrenheit)
**capex**: capital costs
**CBL** cement bond log
**CCS:** carbon capture and sequestration
**CCU:** carbon capture and utilization
**Carbon Dioxide**: Carbon Dioxide
**Company X**: Oil company in Egypt
**CRP**: Carbon Dioxide removal plant
**DCA:** decline curve analysis
**ECBM**: enhanced coal bed methane
**EOR/EGR:** enhanced oil recovery/ Enhanced gas recovery
**EPC**: engineering, procurement and construction
**EPRI:** Egyptian petroleum Research Instiute
**FIELD 2**: specific field in company X
**G/L**: gram per liter
**GDP**: gross domestic product
**GHG:** green house gases
**GT**: gigatonnes
**HCPV**: hydrocarbon pore volume
**InSAR**: Interferometric Synthetic Aperture Radar
**IOC**: international oil company
**IPCC:** the united nations intergovernmental parties of climate change
**KUSD:** thousand USA dollars
**L.E**. Egyptian pound
**MENA**: middel east and north africa
**MJ/m$^2$.day**: mega joule/ square meter.day
**mmscf/d**: million standard cubic feet per day
**MPA**: mega pascal
**MtCO$_2$e:** mega tonne Carbon Dioxide equivalent
**OOIP/OGIP**: original oil in place/ original gas in place respectively
**opex:** operational costs
**PBR**: photobioreactor
**PFD**: process flow diagram
**PSI:** pound per square inch
**PVC:** Polyvinyl Chloride
**R&D:** research and development
**SS:** stainless steel
**SWOT**: strength-weakness-opportunities-threats
**Tc**: critical temperature
**TRL**: technological readiness
**USIT;** ultra sonic imaging tool
**VDL** variable density log