Cyprus Organization for Standardization

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"Cyprus Role in European CCUS Standardization"

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Presentation Outline

- Introduction (Need for CO_2 handling)
- CCUS & European Standardization
- Cyprus relation with ISO/TC 265 & ISO 27914
- The Broader European Context
- The Strategic Opportunity for Cyprus
- Recommendations & Next Steps
- Technical CO2 sequestration examples

Introduction (Need for CO_2 handling)

The Problem:

Industrial Revolution **>** human activities **>** burning of fossil fuels (coal, oil, and natural gas), **>** released unprecedented amounts of CO_2 into the atmosphere.

The Consequence:

Rapid increase in CO_2 concentration intensifying the natural greenhouse effect, causing average temperature to rise.

{Global warming, > drives broader changes in climate patterns}

Atmospheric Concentration:

- Pre-industrial CO_2 levels were approximately **280 (ppm).**
- Today, surpassed **420 ppm**,

{A level not seen in millions of years}

International Consensus: The Paris Agreement

Is a legally binding international treaty on climate change with the aim to limit global warming < 2°C as compared to pre-industrial levels.

{Boost research towards reaching the goal}

Introduction (Need for CO_2 handling)

Role of CO_2 Sequestration in Climate Mitigation:

Achieving net-zero emissions requires a portfolio of solutions

- Transitioning to renewables (wind & solar) is not sufficient by itself
- CO_2 sequestration, must be used as part of a broader strategy

Decarbonizing Hard-to-Abate Industries

Some industrial sectors even if powered by 100% renewable energy would still release CO_2.

Power Plants: Electricity production through burning fossil fuels release CO_2

Cement Production: Calcination is the heating of limestone to produce clinker releases large quantities of CO_2.

Steel Manufacturing: The use of coal to reduce iron ore is fundamental step in steel manufacturing that releases CO_2.

Solution

CCUS = Carbon Capture, Utilization, and Storage.

CCUS & European Standardization

CCUS: Foundational Tool for Decarbonization

Is a suite of technologies designed to combat climate change by capturing carbon dioxide (CO_2) emissions from large point sources

Three stages:

1. Capture: Separate CO_2 from industrial processes using chemical or physical methods. => "filter-out" CO_2 before it is released.

2. Transport: Once captured, CO_2 is compressed to ***supercritical state*** and transported to a location for use or storage. Done via pipelines or by ship.

3. Utilization and Storage: After transport there are two possible outcomes

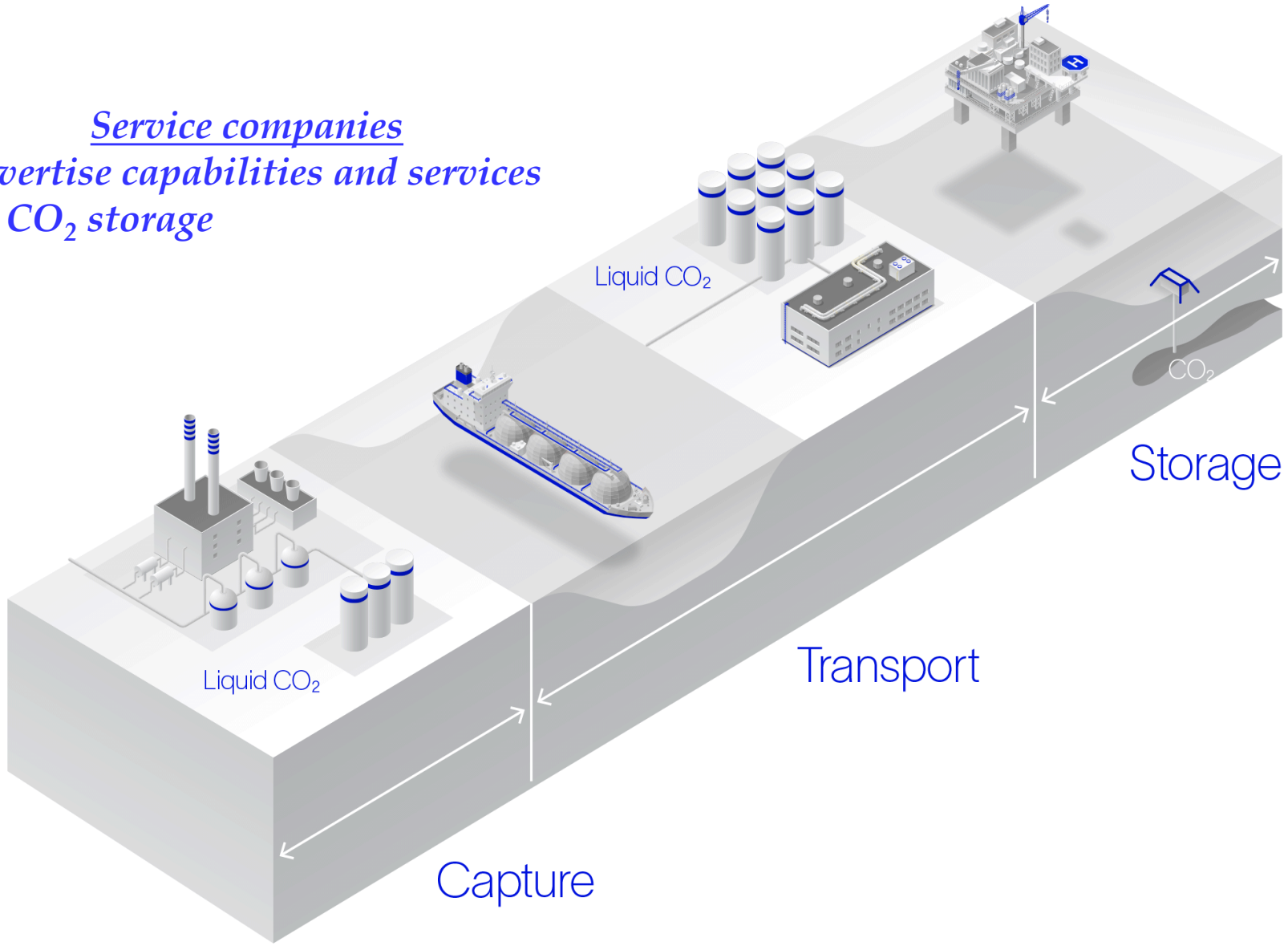
(A) The "U": Captured CO_2 is used as a raw material to create products. (fuels, chemicals, plastics, or in construction turning the waste into resource.

(B) The "S": CO_2 is injected deep underground into carefully selected and secure geological formations, such as depleted oil and gas reservoirs or saline aquifers with the aim to permanently lock it away from the atmosphere

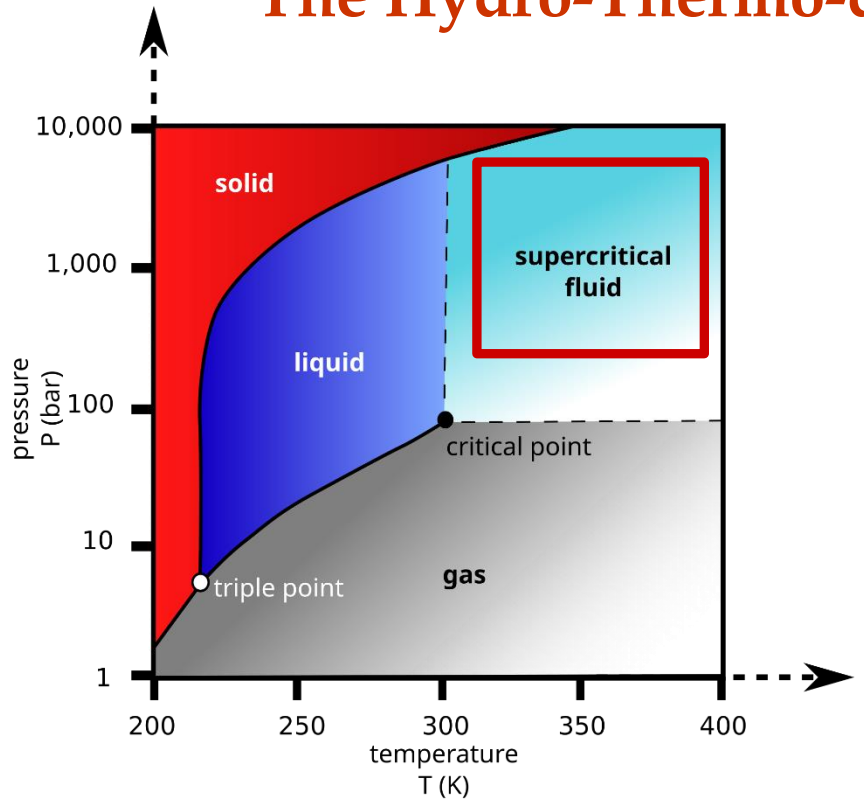
EnEarth: Prinos-Kavalla-Greece-2026

CCUS & European Standardization

Service companies
Advertise capabilities and services for CO_2 storage

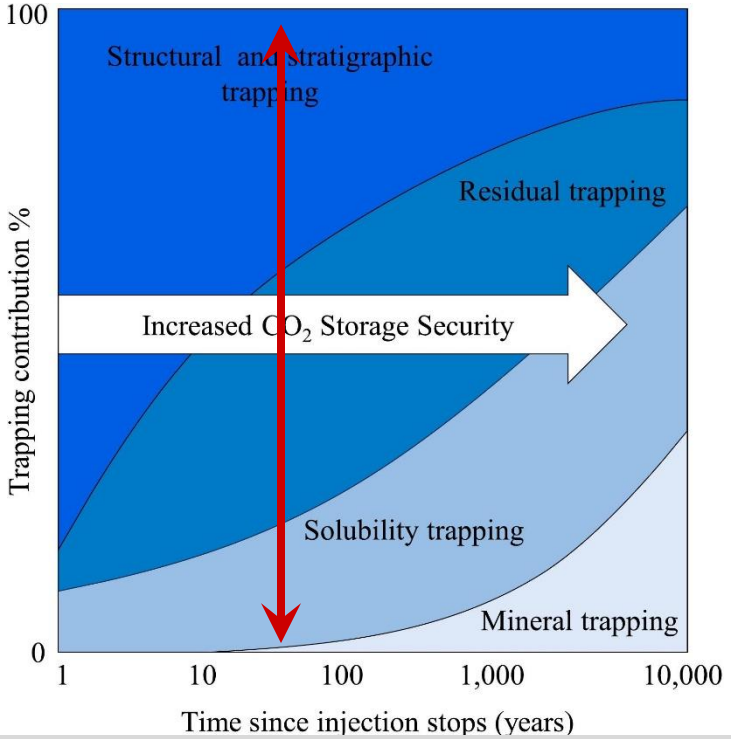


The Hydro-Thermo-dynamics of CO_2 Storage



Timescale: The **containment** must be effective on geological timescales, thousands of years or longer, to achieve the climate mitigation goals.

Structural & Stratigraphic trapping



CO_2 Critical Point (hybrid state):

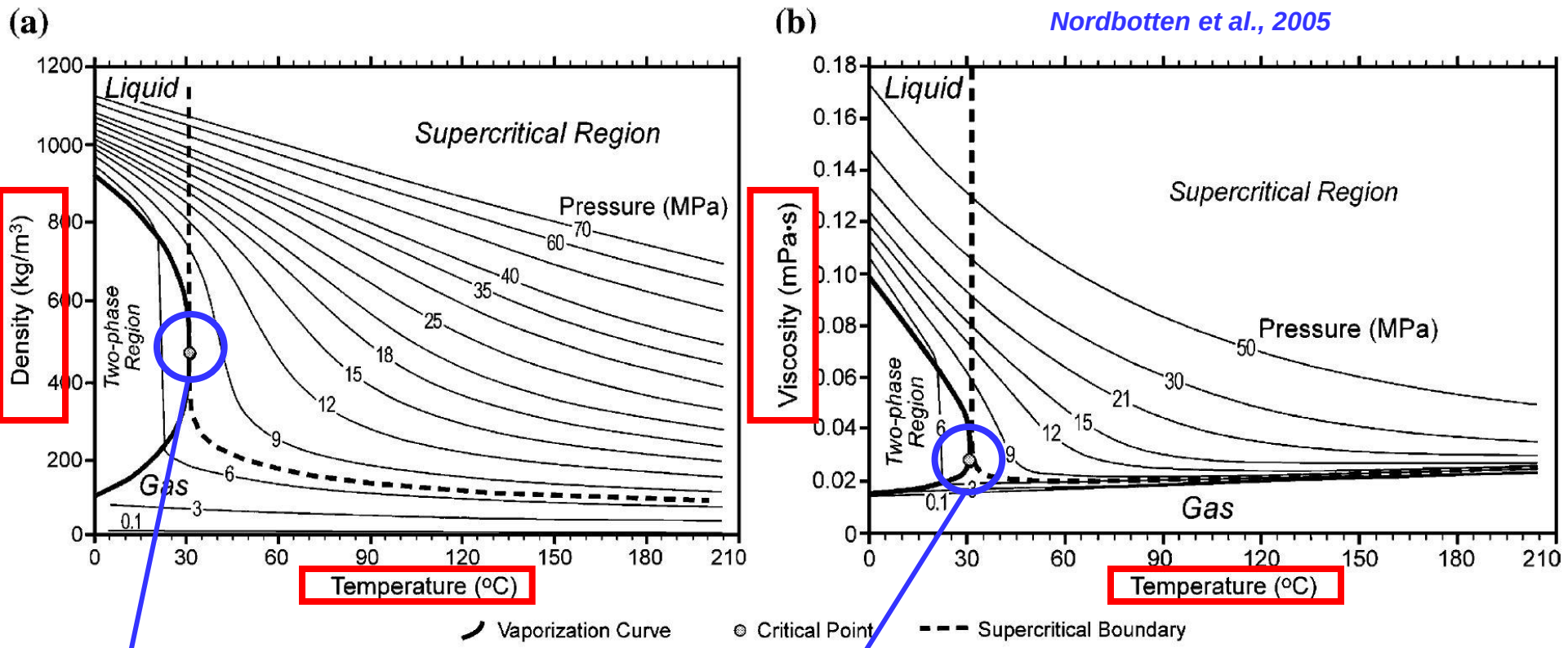
Critical Temperature: 31.1°C (87.9°F)

Critical Pressure: 73.8 bar (1,070 psi)

- ***Density*** similar to a liquid
- ***Viscosity*** and ***diffusivity*** similar to a gas

CO_2 State in During Storage

CO_2 Thermodynamics



Density = 479 kg/m³

Viscosity = 4.23 E $^{-5}$ kg/sec.m

CCUS & European Standardization

CEN / TC 474

CEN = European Committee for Standardization
TC = Technical Committee

Primary purpose: to create a unified set of European Standards for the developing CCUS industry in Europe.

Who: A committee of European technical experts and national delegates (including CYS).

What: The central authority for creating official safety and operational standards for CCUS.

Why: To build a safe, integrated, and competitive European market for carbon management.

CCUS & European Standardization

CEN / TC 474 Structure

Working Groups (WGs)

WG 1: CO_2 Streams and Quality

Definitions of composition and purity requirements for CO_2. It specifies ***acceptable levels of impurities*** for safe and efficient transportation and storage, particularly within ***pipelines and ship transport***.

WG 2: Pipeline Transportation

develops standards for ***design, construction, operation, and integrity management*** of onshore and offshore ***pipelines for CO_2 transport***.

WG 3: CO_2 Accounting

standardizing the methods for ***measuring, sampling, analyzing, and verifying the quantity*** and flow of CO_2 which is essential for ***commercial transactions***.

WG 4: Geological Storage

Creating standards for the ***selection, characterization, operation, monitoring, and closure of sites*** used for the ***long-term underground storage*** of CO_2.

CCUS & European Standardization

Cyprus Role in CEN / TC 474

Cyprus is not a passive observer that will adopt the standards once they are completed. Cyprus is an active member for their creation.

The CY Maritime Model: Ensure WG1 standards recognize shipping as a primary CO2 transport method, not just pipelines.

Customize the Technical Rules: Influence WG4 to develop standards that align with our specific geology and regional ambitions that is to participate in CCUS projects in the Eastern Mediterranean.

Build a Competitive Edge: Gain early insights to drive innovation and establish Cyprus as a key player in the CCUS value chain. “take no action”, forces adaptation to difficult frameworks creating competitive disadvantage.

CY Relation with ISO/TC 265

ISO/TC 265

Is the TC at the International Organization for Standardization responsible for CCUS with primary aim to develop and publish International Standards (ISO standards) .

1. **Establish a Global Common Language**
2. **Facilitate International Trade and Collaboration**
3. **Provide a Foundation for National Standards**

CY is an active member of CEN/TC 474, helps shape the European position that is then presented at ISO. Our influence is amplified through CEN, ensuring CY interests.

1. **Adoption (The Vienna Agreement)**
2. **Collaboration (Parallel Work)**
3. **Identifying Gaps (European "Homegrown" Standards)**

CY Relation with ISO 27914

ISO 27914: ***is the international standard that provides a comprehensive framework for the safe and secure long-term CO_2 geological storage providing requirements and recommendations for: (1) Site Screening and Selection, (2) Site Characterization and Assessment, (3) Design and Construction, (4) Operations, (5) Risk Management and (6) Closure.***

Cyprus-CEN/TC474 relation to ISO27914

Mandate: We are not just adopting the global ISO 27914 standard, but we are adapting it for Europe's stricter regulatory landscape.

Method: Working Group 4 (WG4) is conducting a gap analysis to identify and address weaknesses in the ISO standard relative to EU law.

Outcome: This work paves the way for a new European Standard (EN), potentially a "harmonized standard" that simplifies compliance across the EU.

The Cyprus Advantage:

- Shape technical rules to fit our regional geology.
- Define the market we plan to lead.
- Solidify our position as a regional hub for geological storage.

Broader CCUS Plans in Europe (1)

Europe's plans for CCUS are no longer just concepts! It's the technical foundation for a massive, continent-wide transformation.

There are three main pillars:

The Law (NZIA): Creates a mandatory market with a legally binding 50 million tons CO_2 storage target by 2030.

- Sets the legally binding target of 50 million tons of annual CO_2 injection capacity by 2030.
- Creates a guaranteed market for CO_2 storage.
- Assigns responsibility to oil and gas producers to contribute to this target.

The Economics EU−ETS: Puts a high price on carbon emissions, making investment in CCUS a financially viable alternative to paying penalties.

- Establishes a rising price on carbon emissions, making it expensive to pollute.
- Creates a powerful financial incentive, making it more profitable to capture CO_2 than to pay the penalty.
- Provides the fundamental business case that attracts private investment into CCUS.

Broader CCUS Plans in Europe (2)

3. The Strategy (ICMS): A clear roadmap to build a single, cross-border European market for CO_2 transport and storage.

- Defines the EU's single integrated European market for CO_2.
- Envisions cross-border "CO_2 value chains" connecting industrial regions with permanent storage sites.
- Aims to create seamless infrastructure for CO_2 transport and storage across the continent.

What This Means for Cyprus

Align with EU Strategy: Capitalize on the EU's explicit need for the ship-based CO_2 transport that CY national vision is built on.

Leverage Maritime Strengths: Use CY leadership in shipping and logistics to become an essential service provider in the European CO_2 transport market.

Define Markets: Actively participate in technical committees to help build a CCUS infrastructure that fits also to CY strengths.

Central Role in the Region: Secure a central role for the Eastern Mediterranean in EU projects, attracting investment and serving industries across the region.

The Strategic Opportunity for Cyprus

1. Industrial competitiveness: Offer a cost-effective path for heavy industries to manage and reduce emissions under the EU-ETS. Standardizing CCUS we ensure viable, cost-effective alternative to paying carbon/green taxes.

2. Economic Growth & Investments: Create a low-risk framework to attract major international investment in a regional CO_2 storage in Eastern Mediterranean.

3. Research-Innovation-Expertise: Provide a clear roadmap for universities and research centers to target high-impact, fundable research projects, developing specialized local expertise.

4. Climate Strategies & Action: Utilize the primary available technology to decarbonize "hard-to-abate" industrial sectors which is essential for Cyprus to meet its national and EU 2030/2050 climate targets. CCUS might be the only available viable technology to decarbonize industries in Cyprus.

5. Utilization of Dry Exploration Wells: Accelerate national projects by creating a framework to use existing geological data from exploration wells by using these data for qualifying CO_2 storage sites, might accelerate the development of a national storage project.

Recommendations for Next Steps

1. Resource the Front Line

Commit dedicated experts to actively shape the rules in the two most critical working groups: **WG1 (Shipping)** and **WG4 (Storage)**.

2. Unify Our National Strategy

Create a national task force (industry, government, academia) to define and shape Cyprus official position on maritime transport and geological storage requirements.

3. Shape the European Rulebook

Proactively contribute to the ongoing **gap analysis of ISO 27914**, ensuring the final European standard suits our regional model.

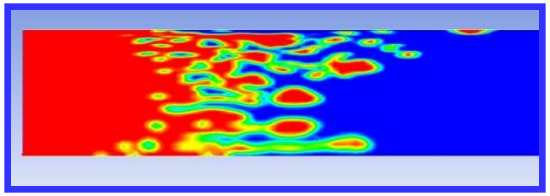
4. Prepare for Investment

Use insights from CEN / TC 474 to build a national roadmap that leverages our geological data and positions Cyprus as a CCUS player in the Eastern Mediterranean.

CFD Simulation Examples (CO_2 displacing brine)

2-phase interface creation

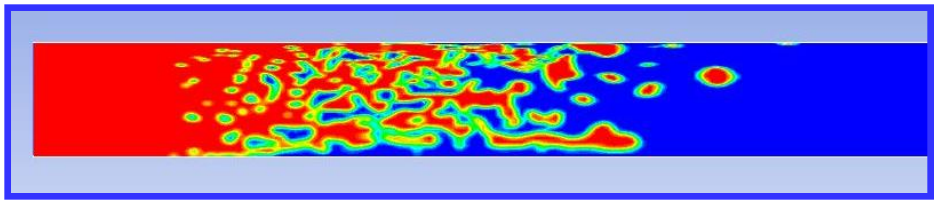
Viscous fingering



(A)

5 years

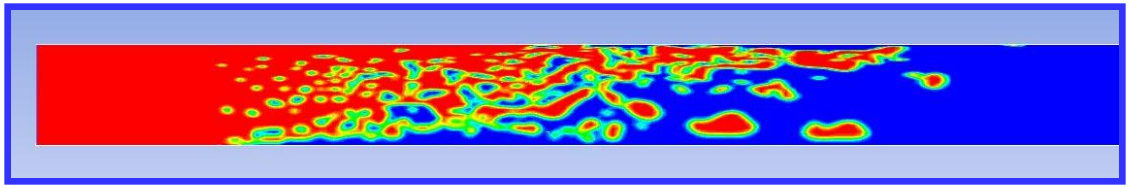
Viscous fingering



(B)

15 years

Viscous fingering, Shape form

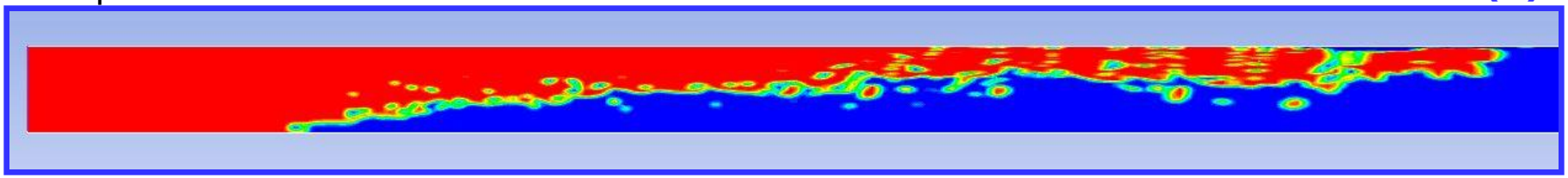


(C)

Early Times / / Material Dependent Terminology

Shape creation

>30 years (D)

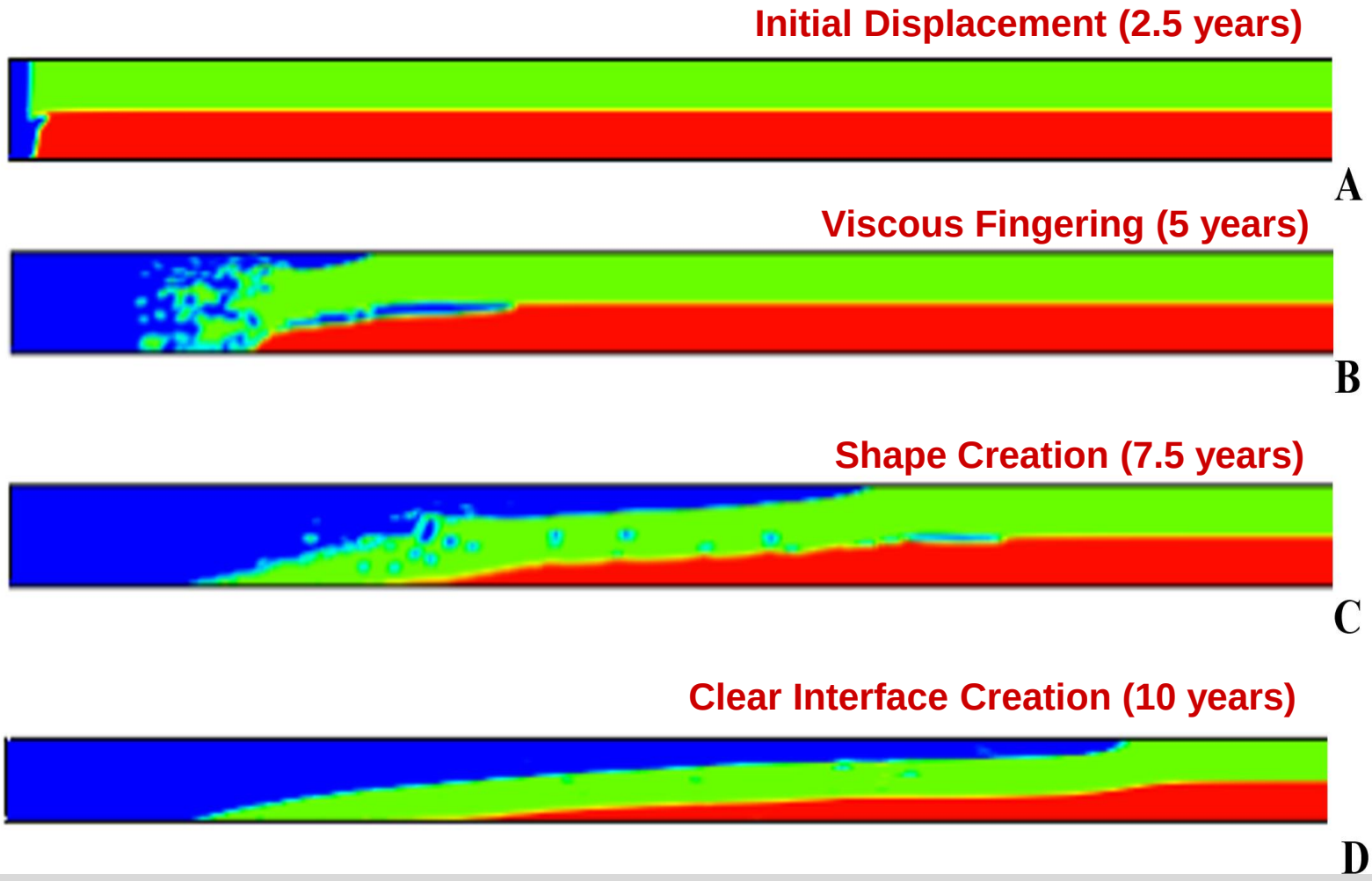


Clear Interface

(E)

CFD Simulation Examples (CO_2 displacing oil & brine)

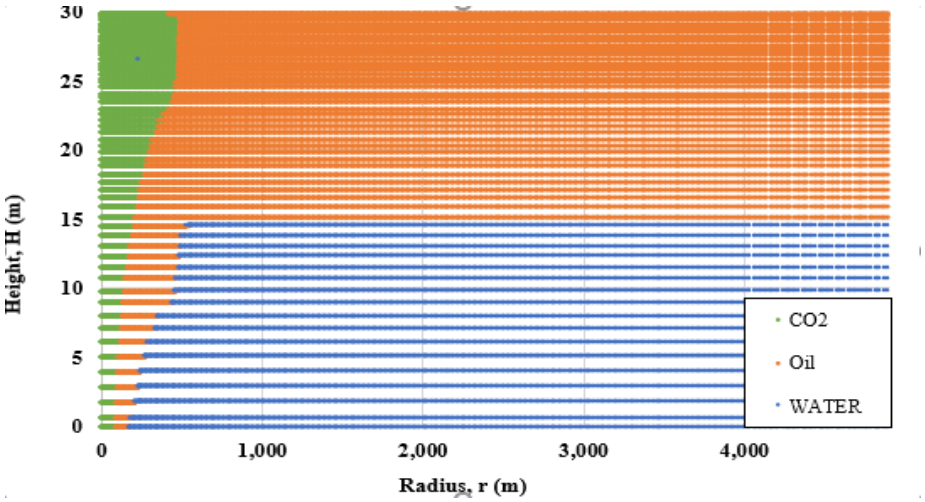
3-phase interface creation



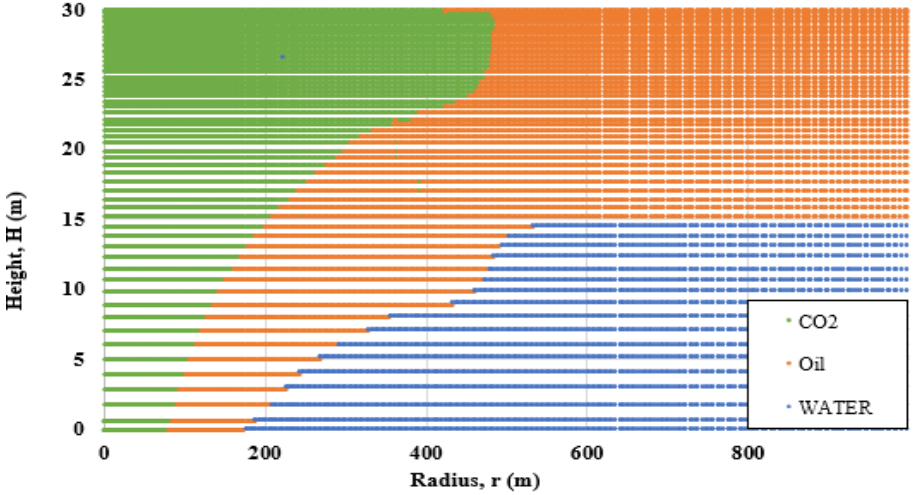
CFD Simulation Examples (CO_2 displacing oil & brine)

Modeling: 3-Phase Flow

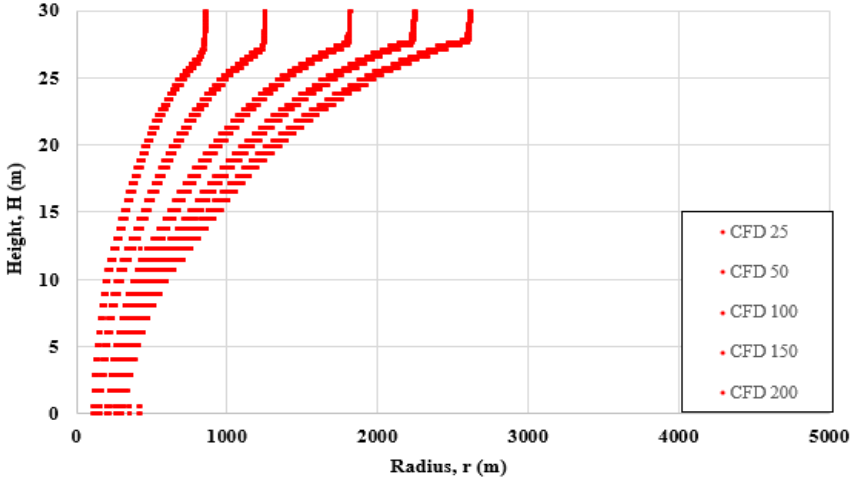
5 km domain (density)



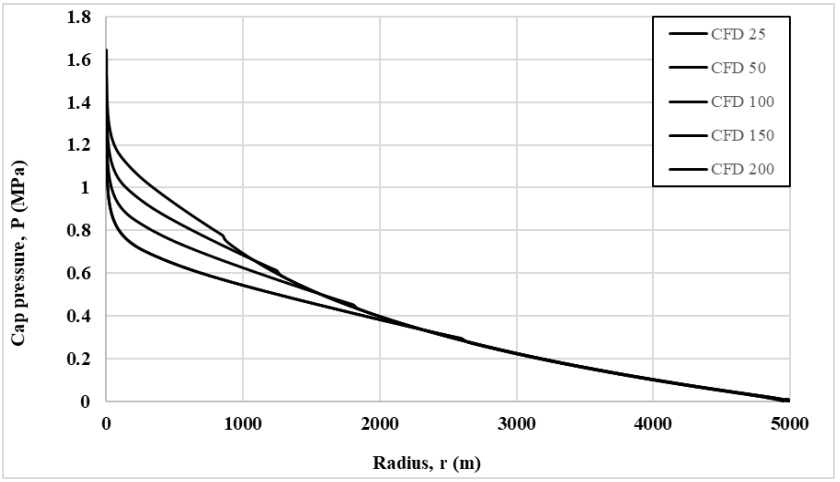
Zoom in 1km (density)



CO_2 plume evolution = Volume calculations



Caprock pressure = Safe containment



Thank You
For
Your Attention