

The Components of a Successful CCS Project

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CCS is strategic for several sectors



Existing energy infrastructure emissions



Hard to abate industries



Pathway for low-carbon hydrogen / ammonia



Direct air capture

Each year by **2050**

TODAY

50
MtCO₂

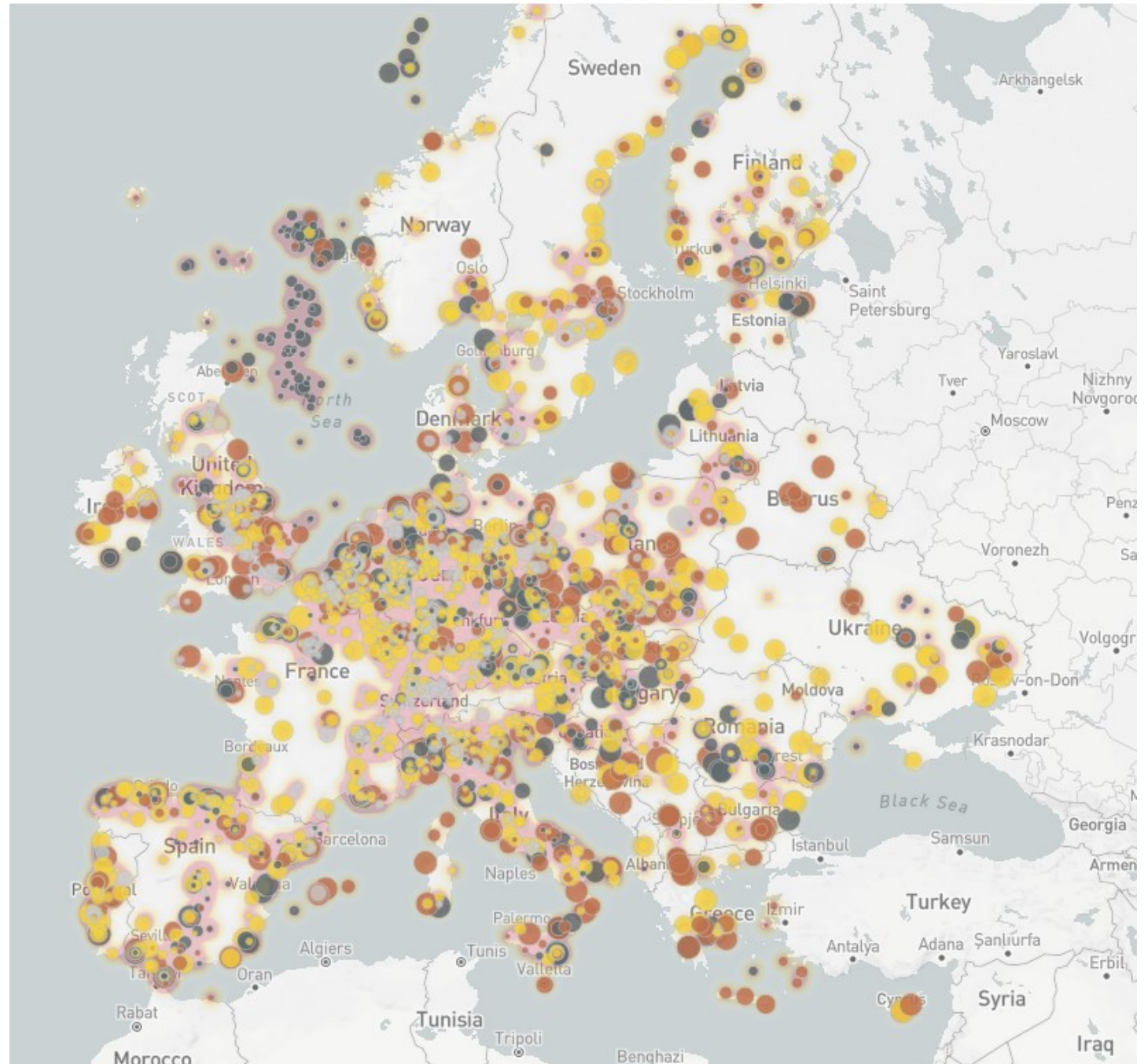
7,600
MtCO₂

15-20%
increase every year

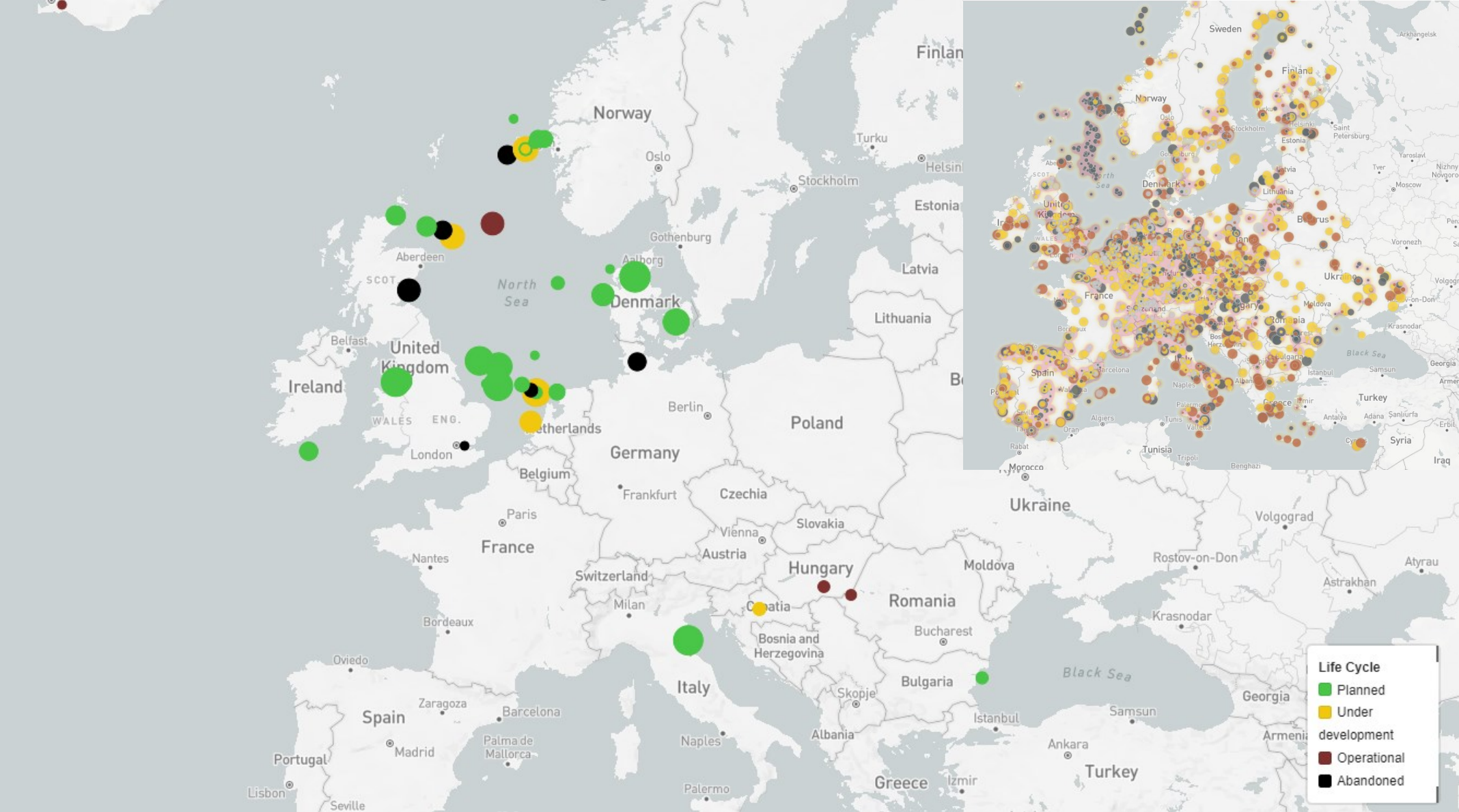
~1,000
active facilities by 2050

European CO₂ Emissions Footprint

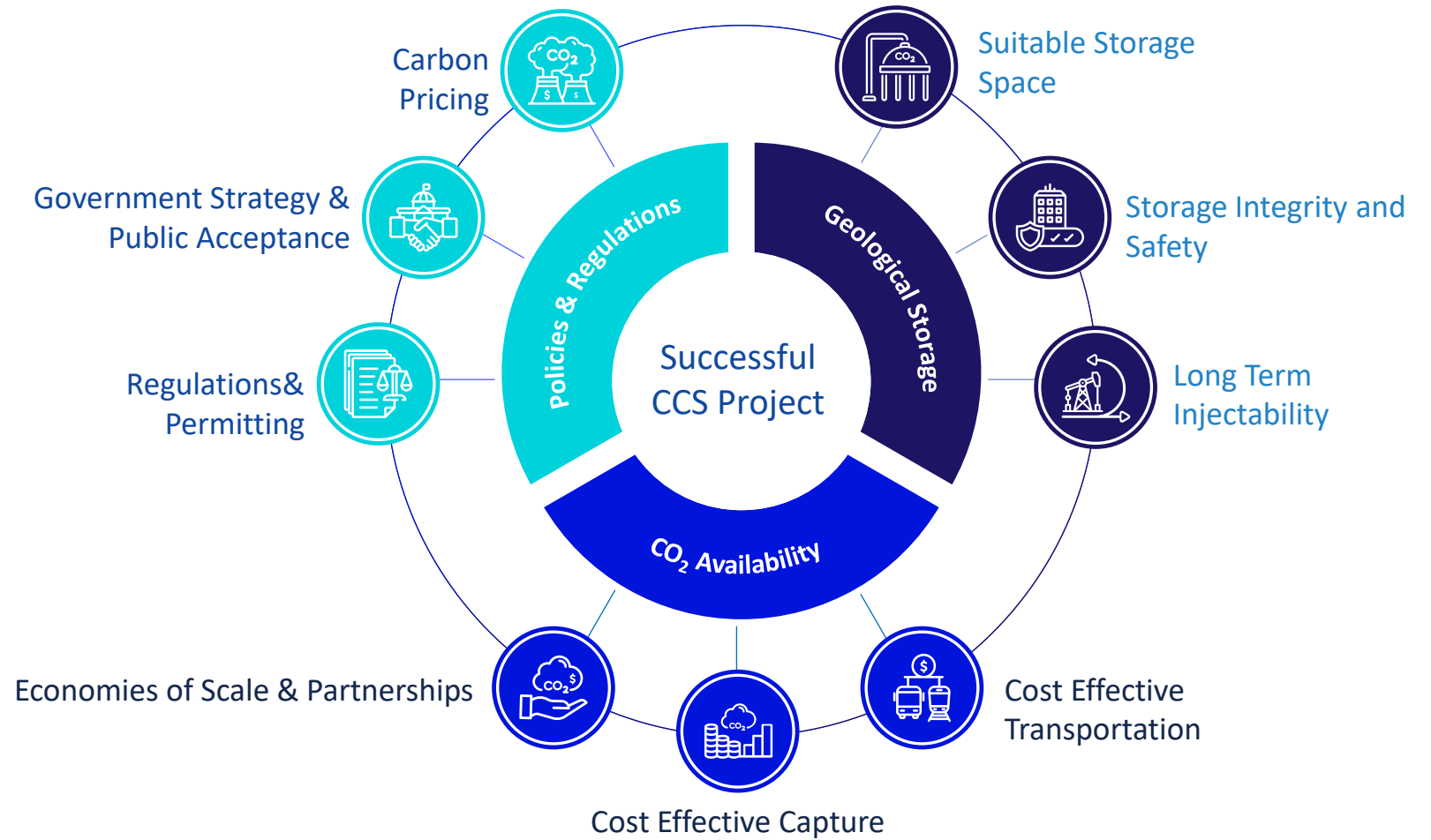
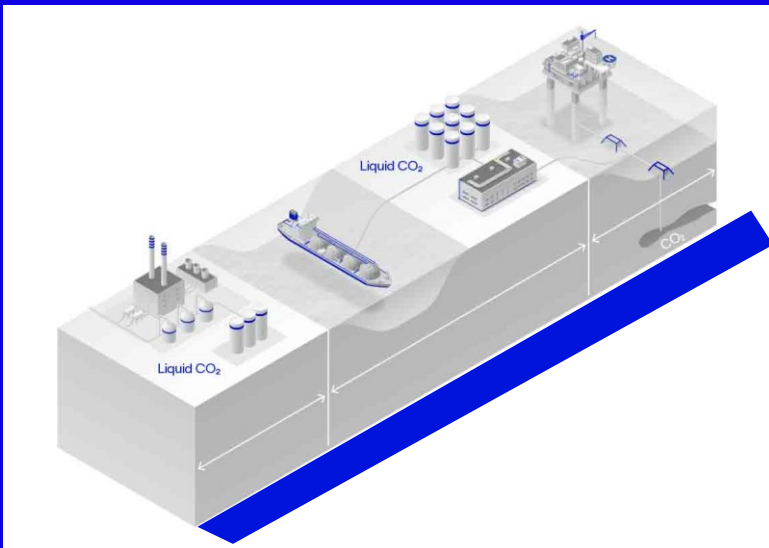
- Industry distributed across Europe – many looking for CO₂ storage
- Without considerable onshore storage – EU will struggle to meet its targets



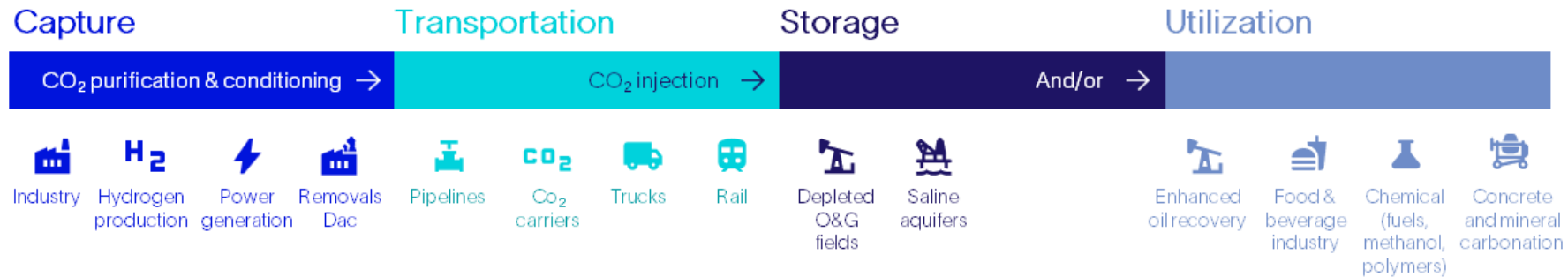
European Storage Projects



Components for a Successful CCS Project.



CCUS success requires the alignment of diverse stakeholders across a complex ecosystem



Emitters

Aiming to decarbonize industrial production. Most lack subsurface knowledge and do not intend to invest in storage assets

Oil & gas companies

Building strongholds around own scope 1 & 2 emissions

Pure play transportation & storage companies, midstream companies, landowners

Debottlenecking permitting processes (pipeline, storage); not accessing carbon credits; eventually carrying storage liabilities

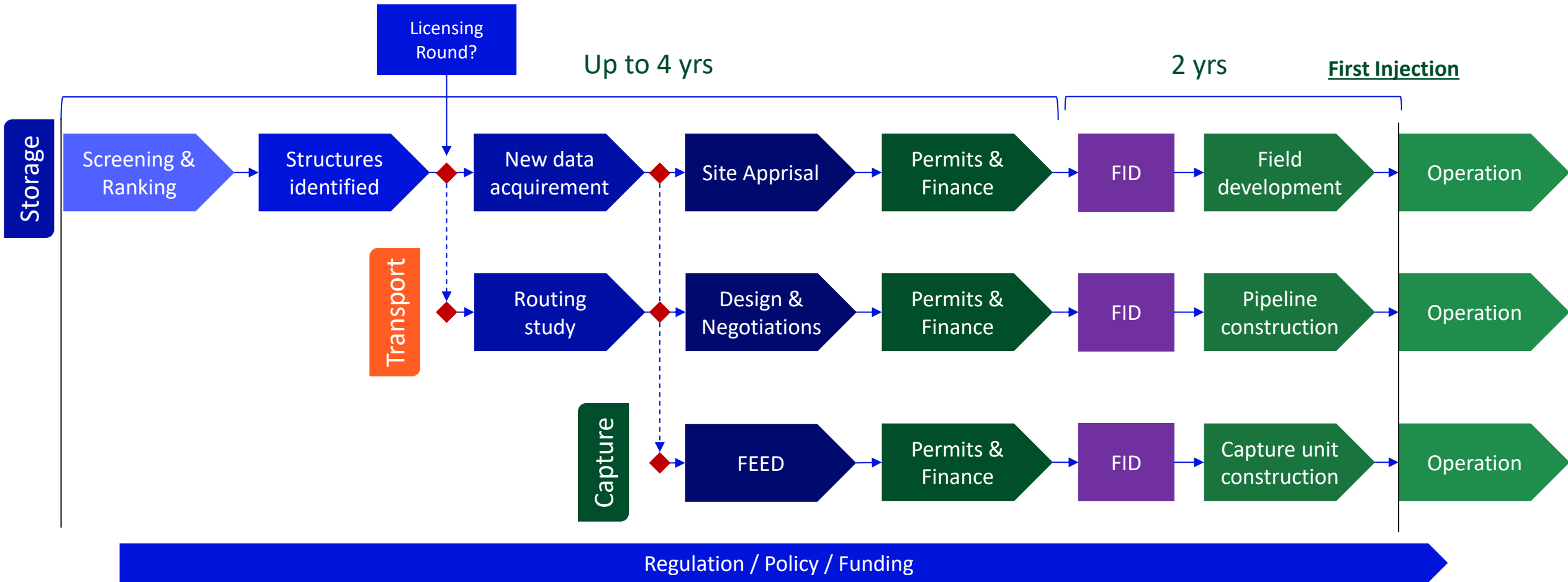
Project developers

Unlocking CCS through agile consortiums, yet often lacking balance sheet

Regulatory bodies & government support



Road Map of CCS Full Value Chain Development

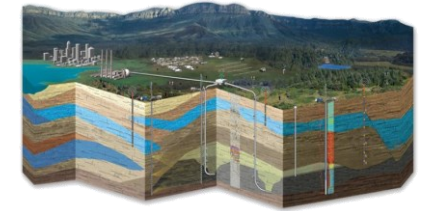
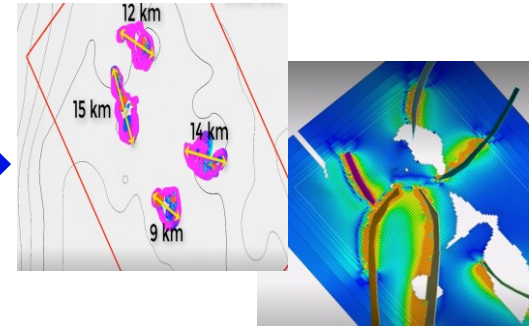
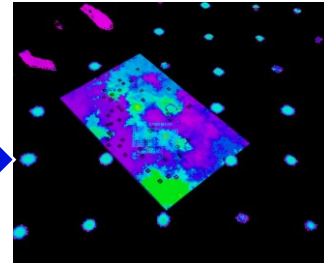
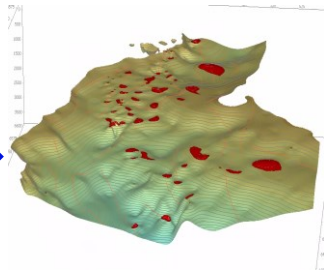
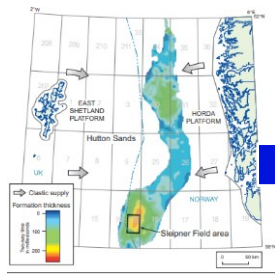


The path to a successful CCS project

Site Screening & Ranking

Site Evaluation & Design

Operations & Monitoring



Regional Data Audit

Site Identification & Ranking

Site Characterization

Performance Assessment
(Capacity, Injectivity, Containment)
Field Injection Plan, Risk Analysis, MMW Plan

Injection Operations & Closure/Post-closure

Published Data
National Repositories

Regional Models
Basin Simulations

Static Models
Geological Scenarios

Thermo-Hydro-Mechanical-Chemical (THMC)
Coupled Dynamic Modelling

Injection Operations
MMV Execution

Uncertainty Analysis

Case Study

CCS Site Screening in Paraná Basin within São Paulo State



ÁREA (km²)
248.219

POPULAÇÃO TOTAL
46.649.132,0

RANKING (emissões líquidas)
4°

EMISSÕES BRUTAS
ALOCADAS NO ESTADO

149,7 MtCO₂e

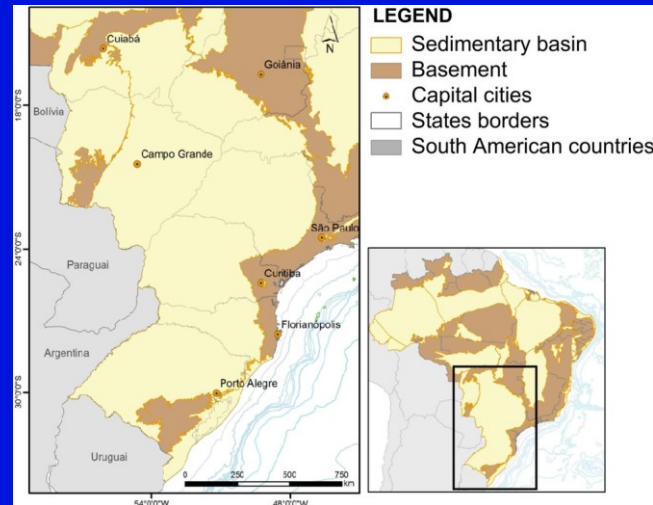
EMISSÕES BRUTAS DO
BRASIL

2.318,8 MtCO₂e

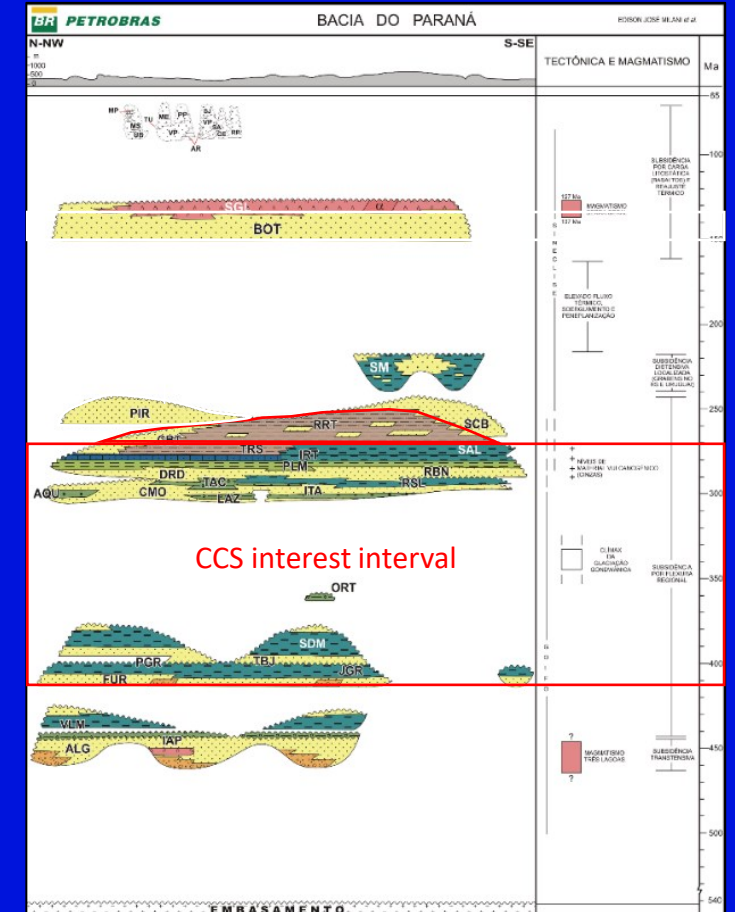
Source: SEEG BRASIL (2024).

Geological Review | Paraná Basin

- One of the largest intracratonic Brazilian basin
- General direction NE-SW
- Sediments are essentially siliciclastic
- Drinking water aquifers: Piramboia and Botucatu Fms.
- Known CCS potential from previous studies and project experiences.

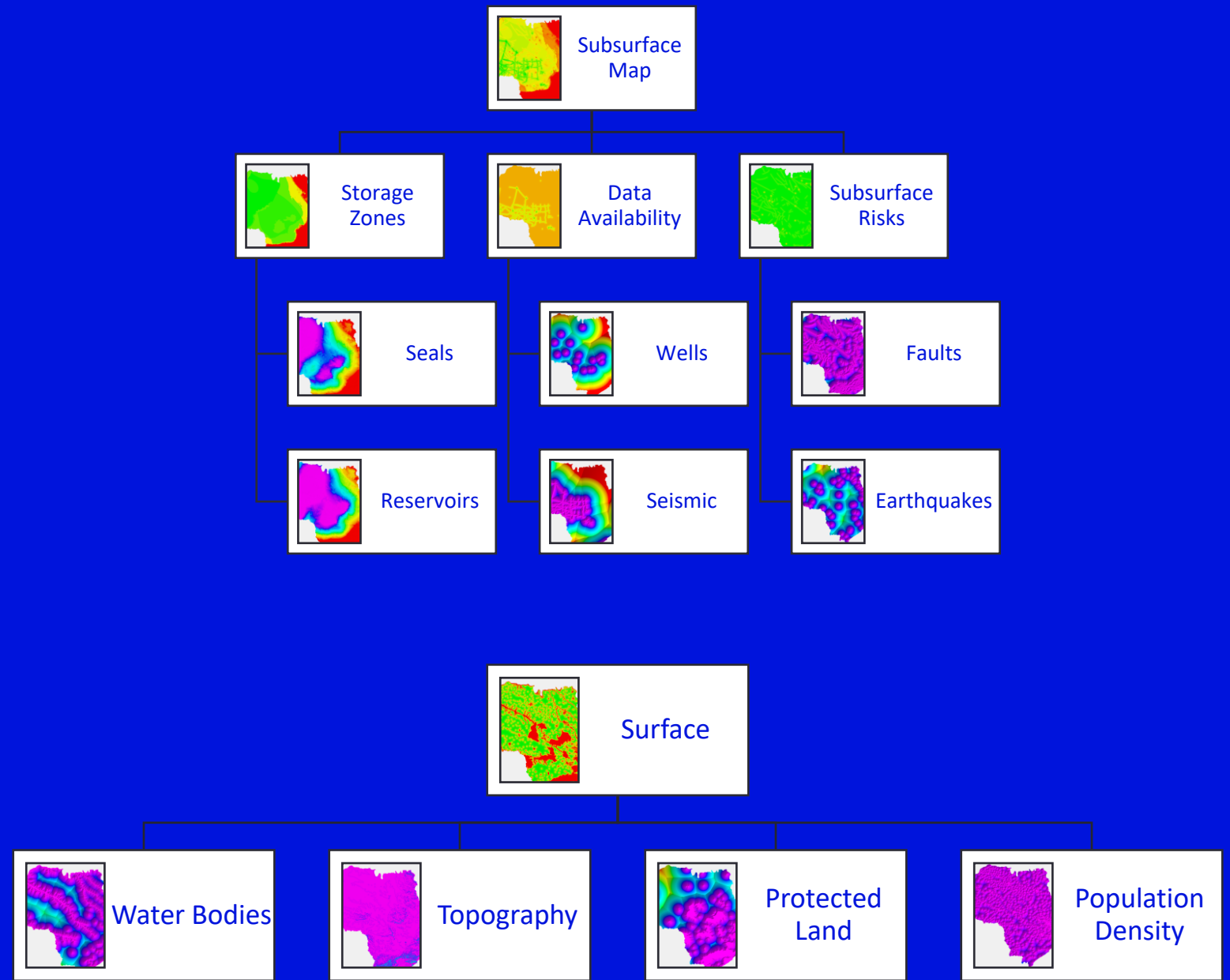


Furnas Fm.	Possible Reservoir	
Ponta Grossa Fm.	Possible Regional Seal	
Itarare Group	Possible Reservoir	Possible Seal
Aquidauana Fm.		
Rio Bonito Fm.	Possible Reservoir	
Palermo Fm.	Possible Regional Seal	
Irati Fm.		
Serra Alta Fm.		
Teresina Fm. Corumbatai Fm.		
Rio do Rastro Fm.	Possible Reservoir	Possible Seal

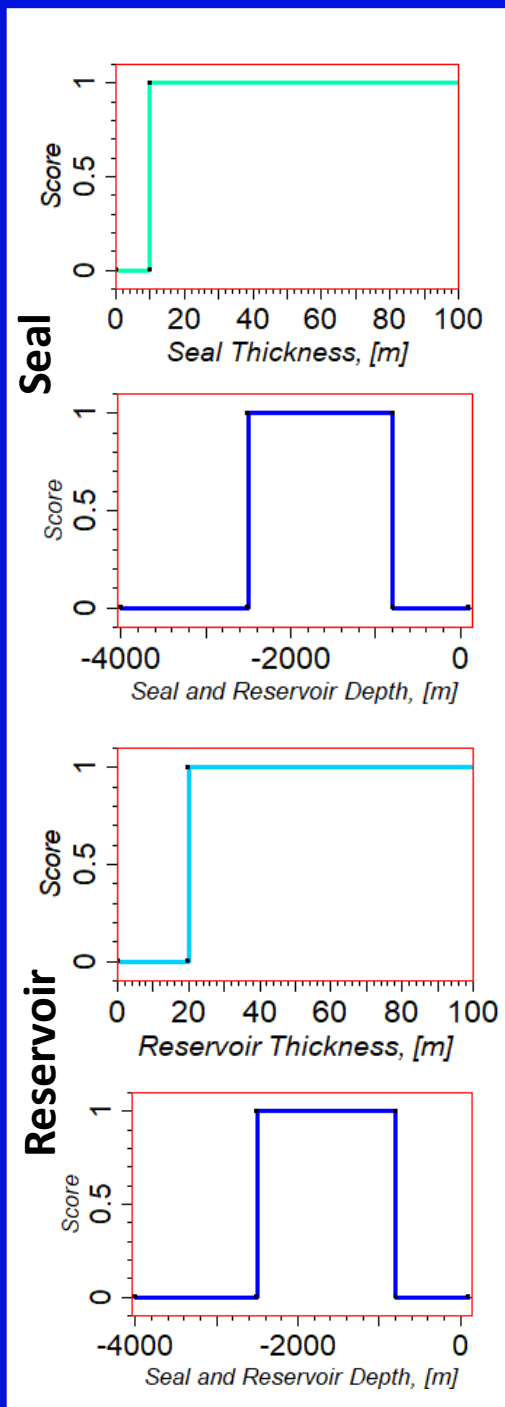


Play Chance Mapping

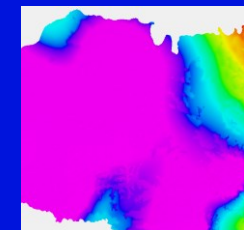
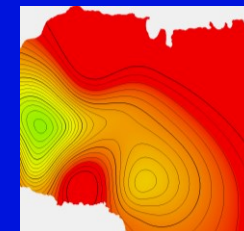
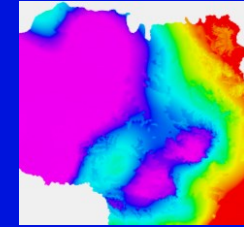
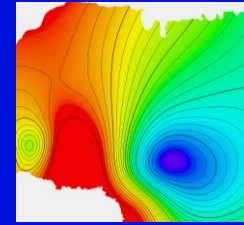
- A common method in O&G exploration which can also be applied to CCS.
- In the context of CCS, play chance mapping involves integrating data from various sources to create a probability map of the subsurface characteristics of the area. This map can then be used to identify areas with a high potential for storage of CO₂.



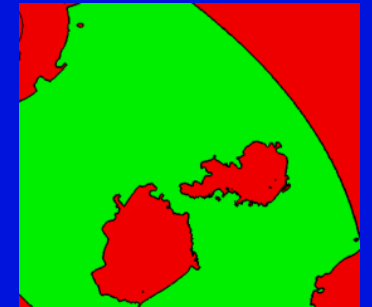
Play Chance Mapping Rationale



Transform of raw data

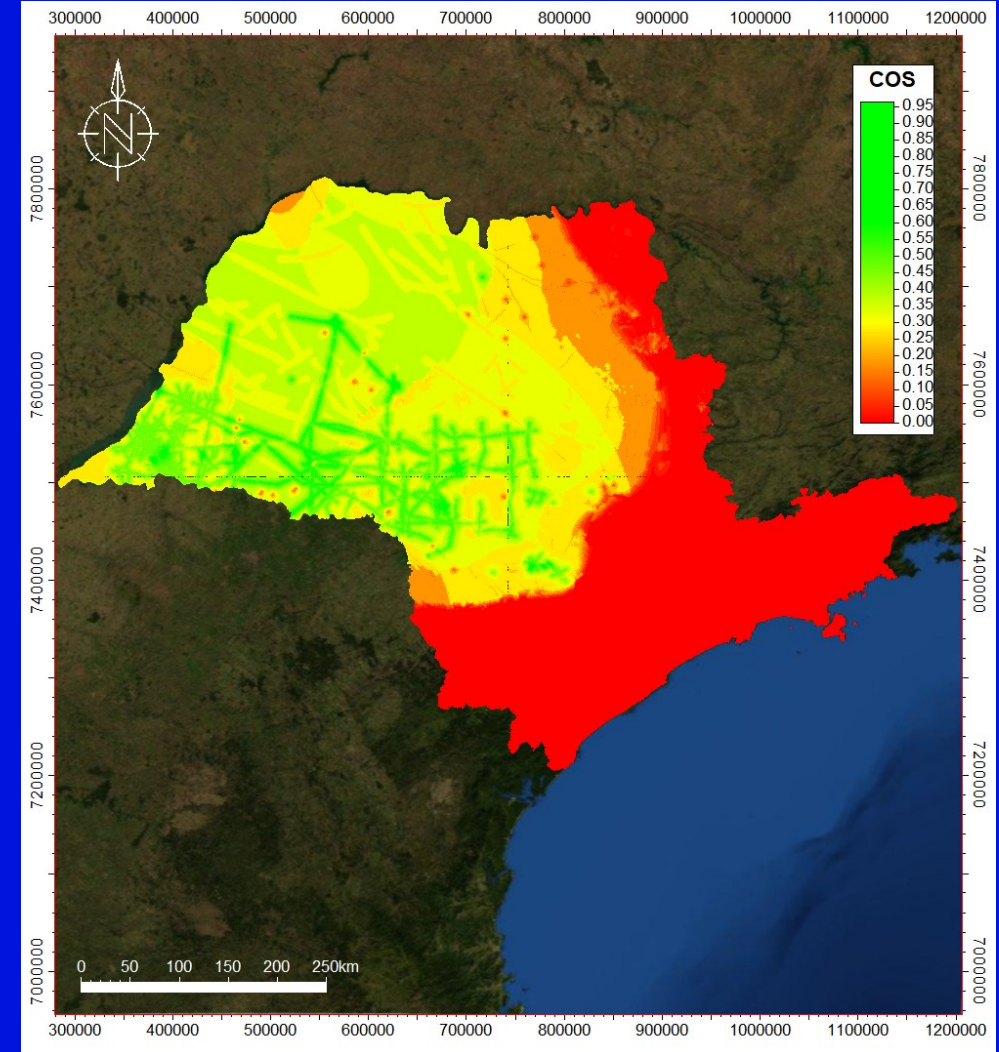
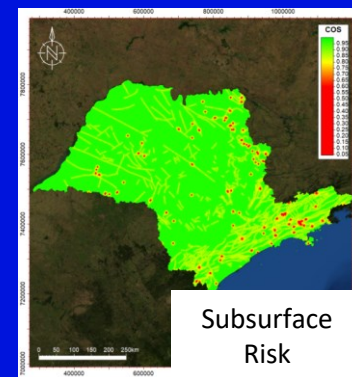
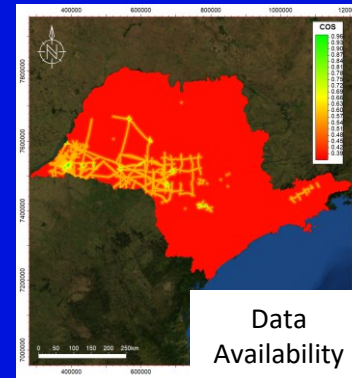
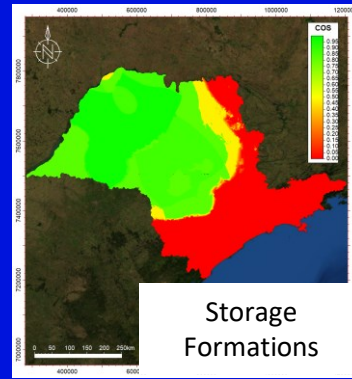


Play chance map for single reservoir zone



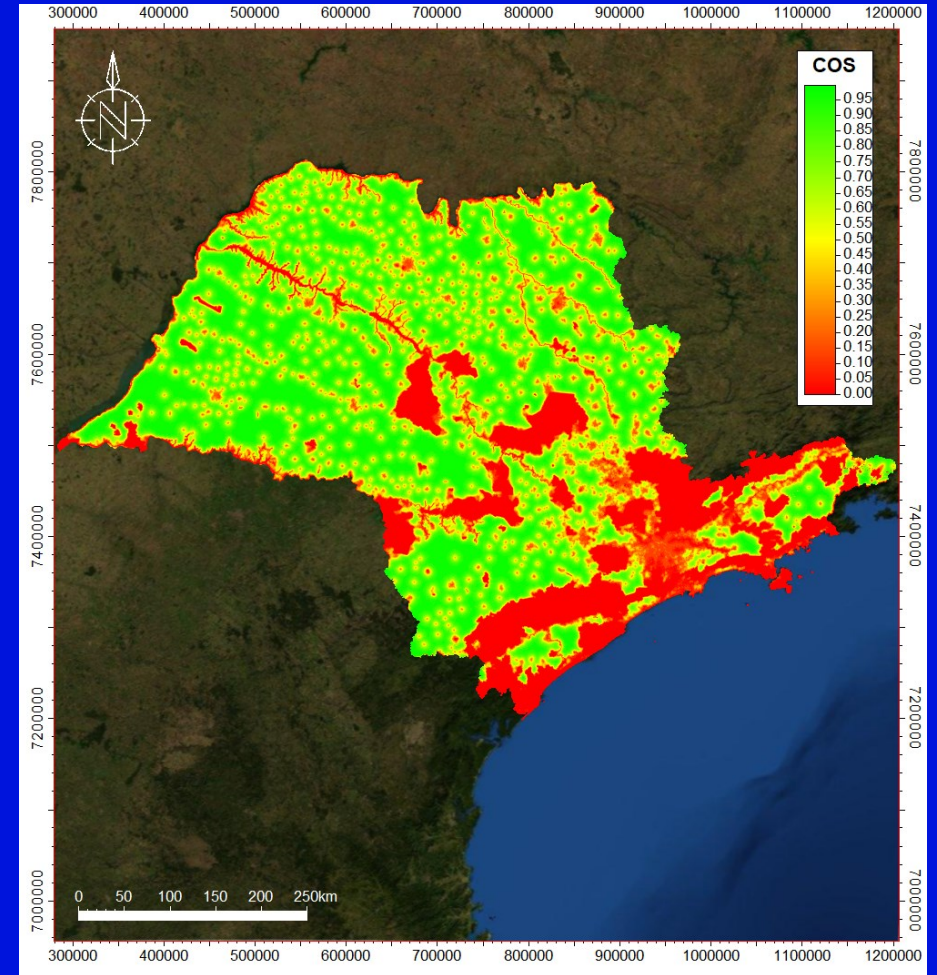
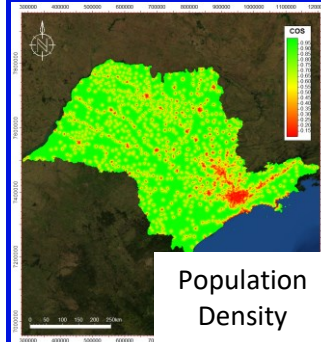
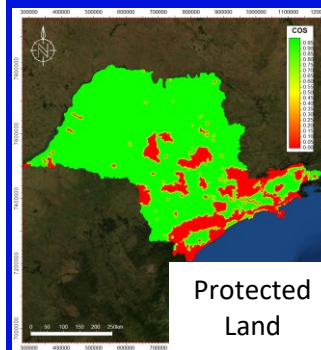
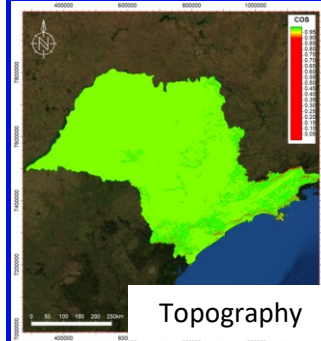
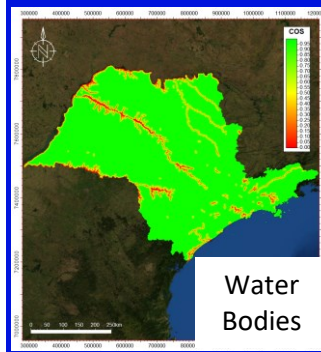
Final Subsurface Play Chance Map

- Highest COS (0.64–0.36) toward the state center/southwest region.
- Medium COS (0.36–0.24) toward the north and northeast.
- Very low COS to the east beyond the basin edge.



Final Surface Play Chance Map

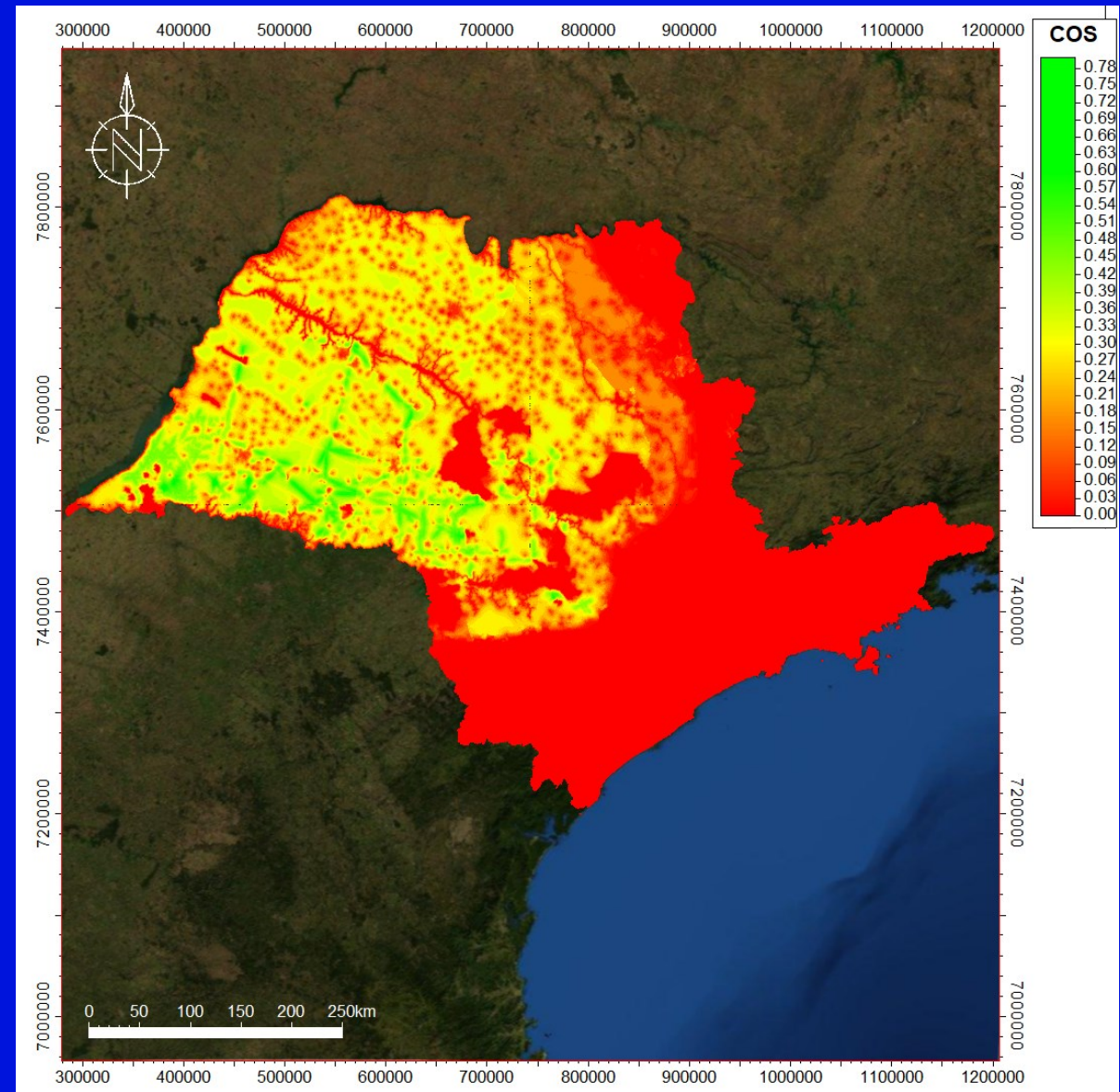
→ More favorable areas (1–0.60 COS) toward the continent and less favorable areas (0.59–0 COS) toward the coast and state center.



Combined Analysis

Combining the subsurface and surface maps, we concluded that the best regions have:

- Good storage and sealing formations, low subsurface risk, and data availability.
- Absence of water bodies, environmentally protected areas and densely populated regions.



Play Chance Analysis Conclusions

Analyzing the CCS potential in Paraná Basin within São Paulo State we can conclude:

- There are many regions with good CCS potential in São Paulo.
- The areas with low CCS potential are located beyond Paraná Basin edges, where the basement is too shallow, and the sedimentary record is too limited.
- The best CCS locations are the areas located towards São Paulo center and southwest region.



Conclusions

- Stakeholders in the value chain need to integrate and collaborate for CCS projects to reach the finish line
- Who are the natural integrators?
- Europe will need to develop onshore storage if it is to meet its Climate Change goals
- CCS projects start with validation of storage site
- Screening and Ranking Tools can be key enablers to initiate CCS