

# Geological Storage of CO<sub>2</sub> In California

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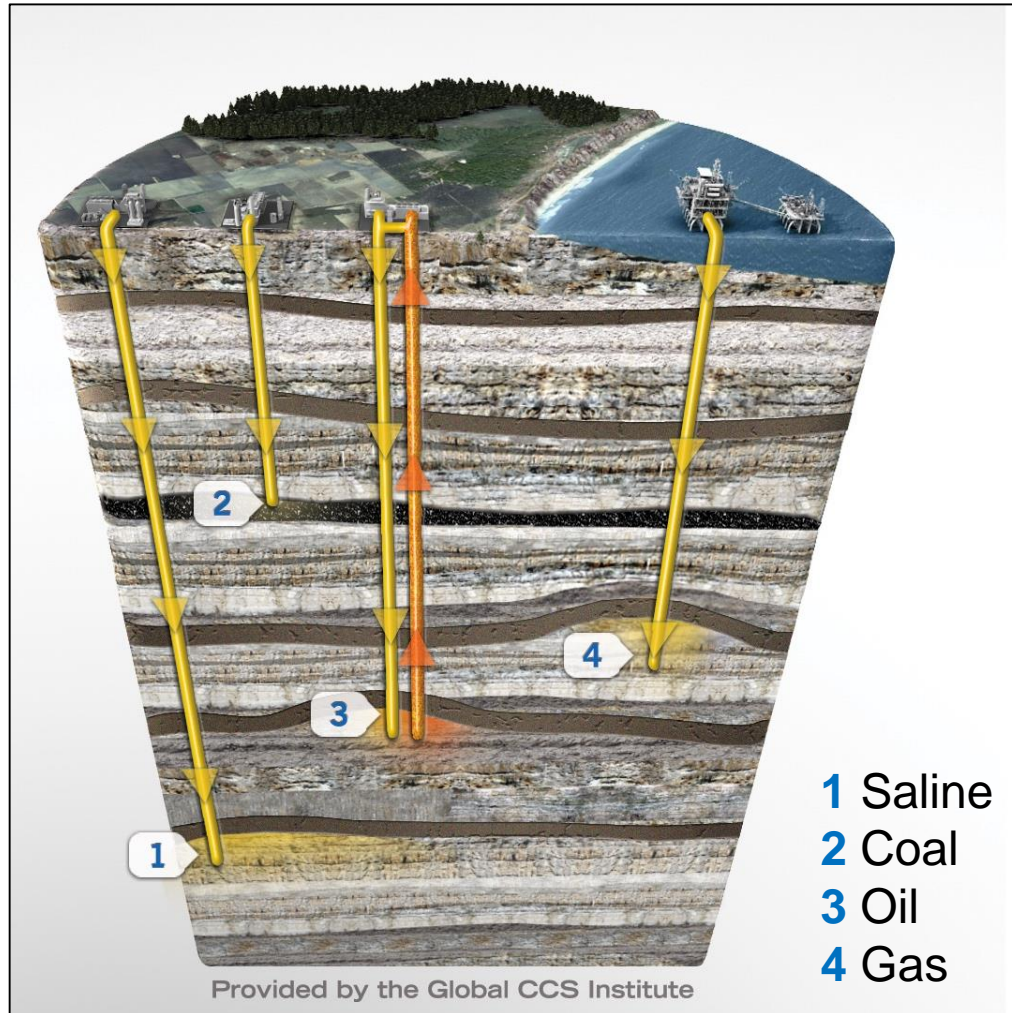
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ENERGY RESOURCES ENGINEERING

STANFORD UNIVERSITY, STANFORD, CA

August 2, 2021

# Geological Storage of CO<sub>2</sub>

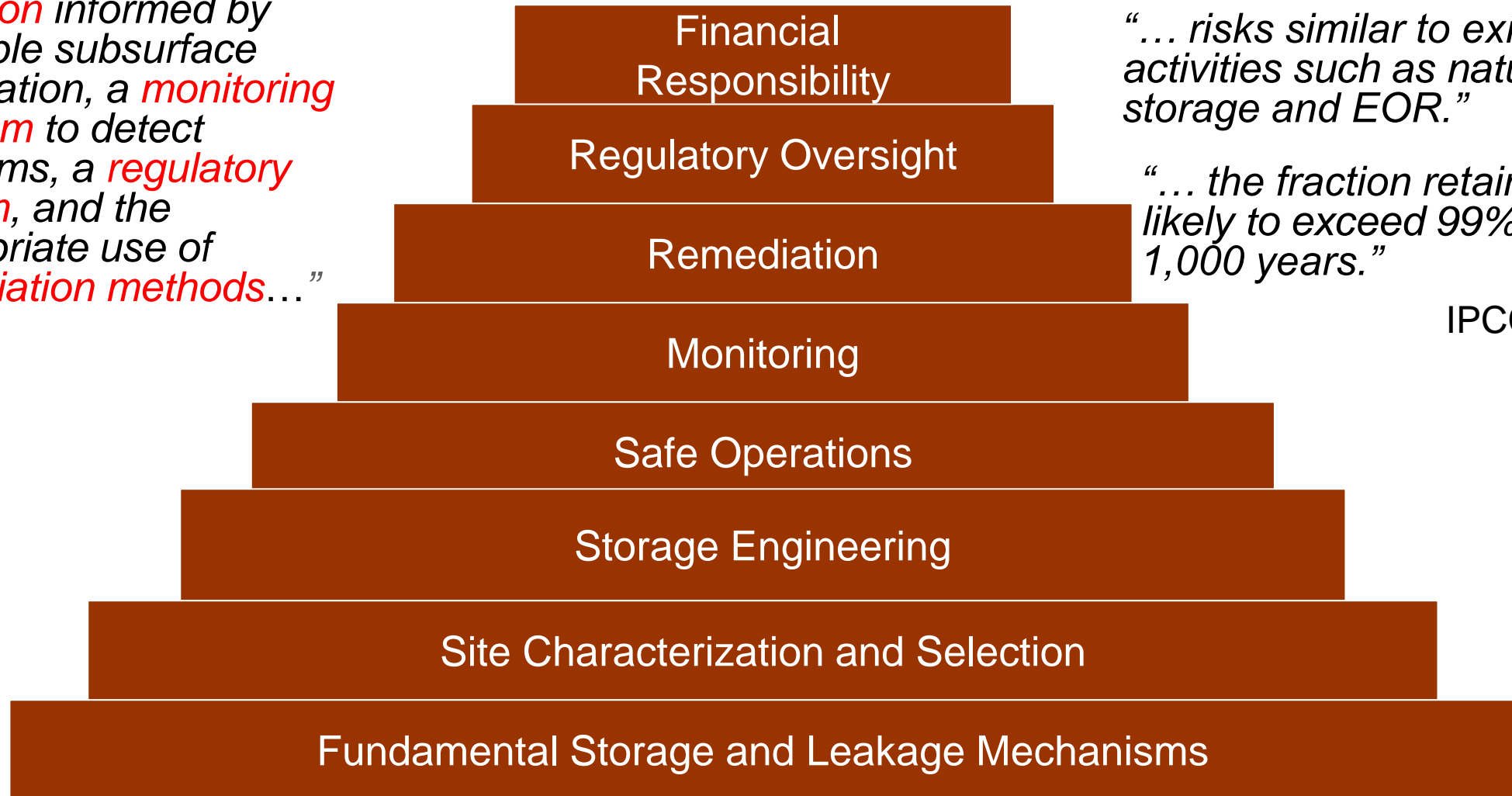


## What Makes A Good CO<sub>2</sub> Storage Site?

- Depth greater than about 3500 feet
- Salinity of greater than 10,000 ppm
- Thick and continuous shale rock to permanently trap CO<sub>2</sub> underground
- Large porous and permeable sandstone reservoir to contain the CO<sub>2</sub>
- Lack of active or transmissive faults
- Limited number of abandoned wells

# Key Elements of a Geological Storage Safety and Security Strategy

“ With *appropriate site selection* informed by available subsurface information, a *monitoring program* to detect problems, a *regulatory system*, and the appropriate use of *remediation methods...* ”



“ ... risks similar to existing activities such as natural gas storage and EOR.”

“ ... the fraction retained is likely to exceed 99% over 1,000 years.”

IPCC, 2005

# CO<sub>2</sub> Storage Potential In California Is Well Understood

WESTCARB  
Program (2003-2013)

U.S.G.S 2007-2013


LLNL, 2020

Stanford and EFI, 2020



**Regional Technology Implementation Plan for Carbon Capture, Utilization, and Storage in WESTCARB Region**

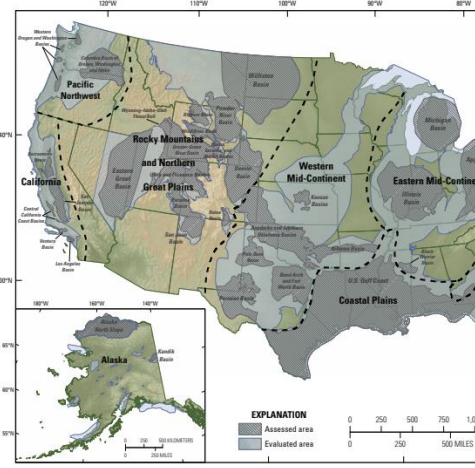
**STATUS ASSESSMENT – TOPICAL REPORT**

**National Assessment of Geologic Carbon Dioxide Storage Summary**

The U.S. Geological Survey (USGS) recently completed an evaluation of the technically accessible storage resource (TAS) for carbon dioxide (CO<sub>2</sub>) for 36 sedimentary basins in the onshore areas and State waters of the United States (fig. 1). The TAS is an estimate of the geologic storage resource that may be available for CO<sub>2</sub> injection and storage and is based on current geologic and hydrologic knowledge of the subsurface and current engineering practices. By using a geology-based probabilistic assessment methodology, the USGS assessment team members obtained a mean estimate of approximately 3,000 metric gigatons (Gt) of subsurface storage capacity that is technically accessible below waters; this amount is more than 50 times the amount of energy-related CO<sub>2</sub> emissions of 50 Gt in 2012.

In 2007, the Energy Independence and Security Act of 2007 (Public Law 110-140) directed the U.S. Geological Survey to conduct a national assessment of geologic storage capacity in consultation with the U.S. Environmental Protection Agency (EPA), the U.S. Department of Energy, and the U.S. Department of the Interior.

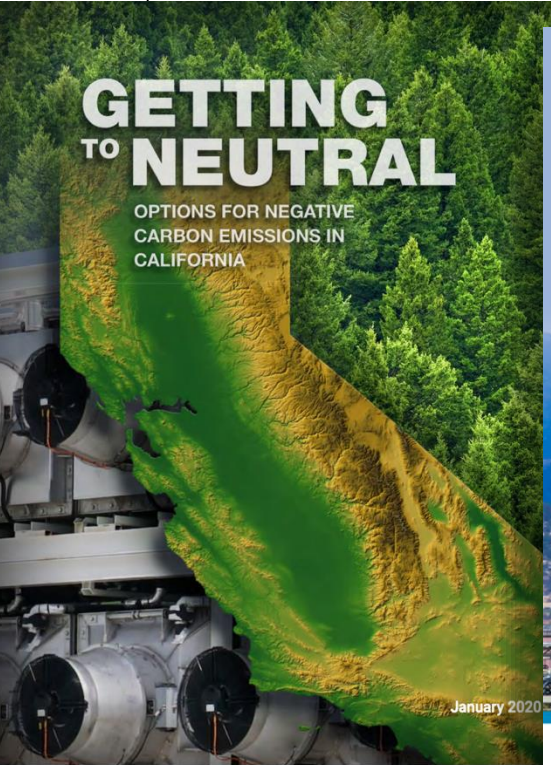


**EXPLANATION**  
Assessed area  
Evaluated area

0 250 500 750 1,000  
0 250 500 MILES

**GETTING TO NEUTRAL**


OPTIONS FOR NEGATIVE CARBON EMISSIONS IN CALIFORNIA



January 2020

**An Action Plan for Carbon Capture and Storage in California: Opportunities, Challenges, and Solutions**

SUMMARY FOR POLICYMAKERS

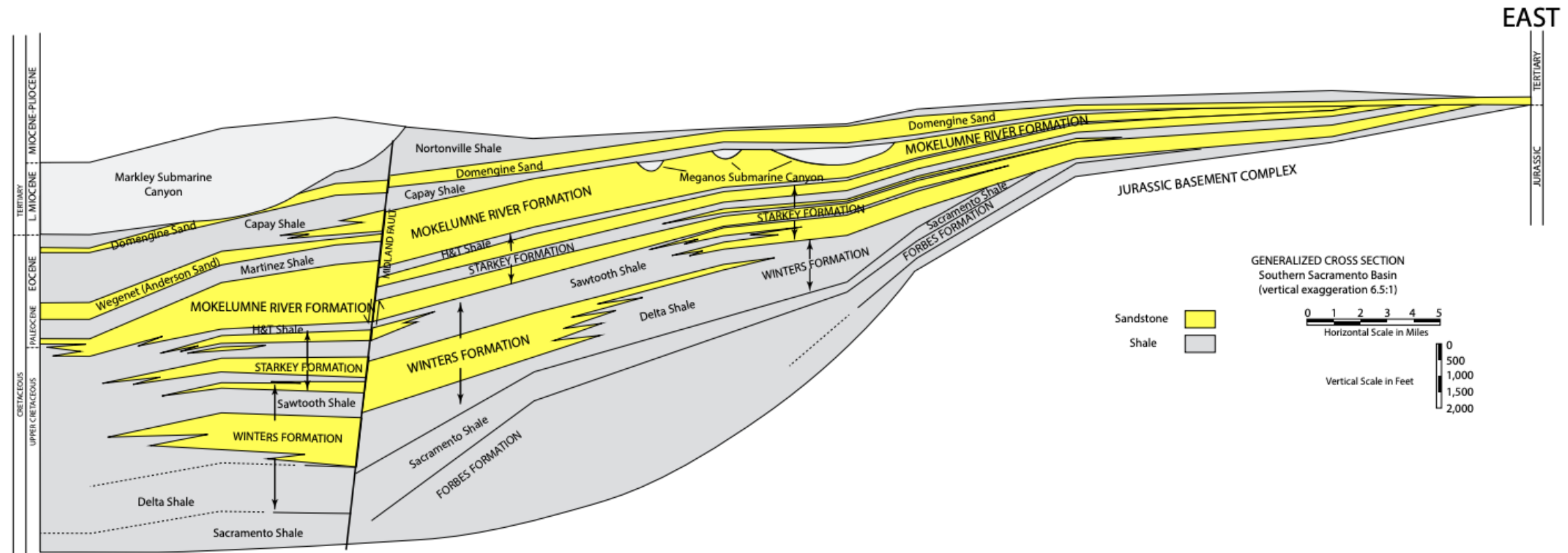


A joint study by:

ENERGY FUTURES INITIATIVE | Stanford | Precourt Institute for Energy | Stanford EARTH | Stanford Center for Carbon Storage

October 2020

# Cross Section of The Subsurface Geology In Northern California

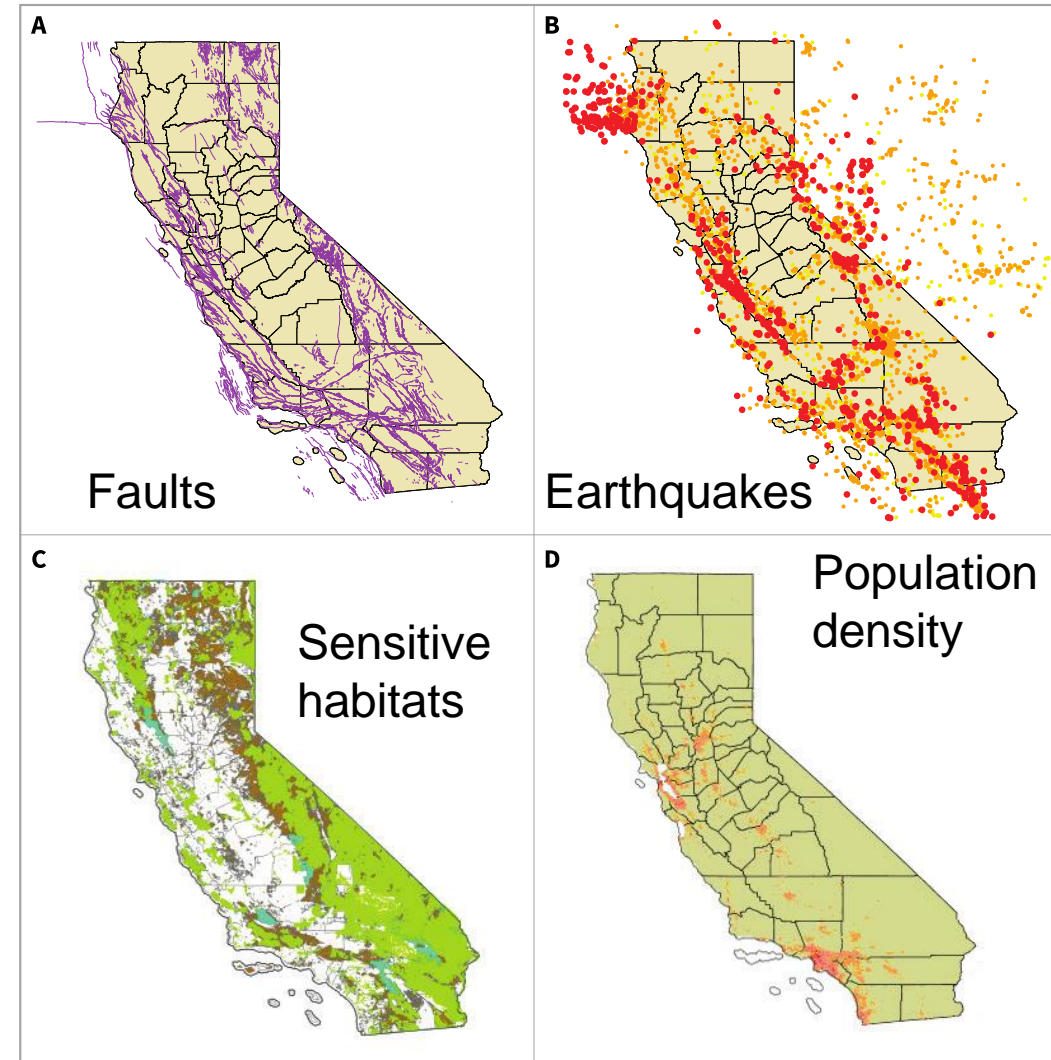


Gray rocks are shale seals and yellow rocks are potential CO<sub>2</sub> storage reservoirs.

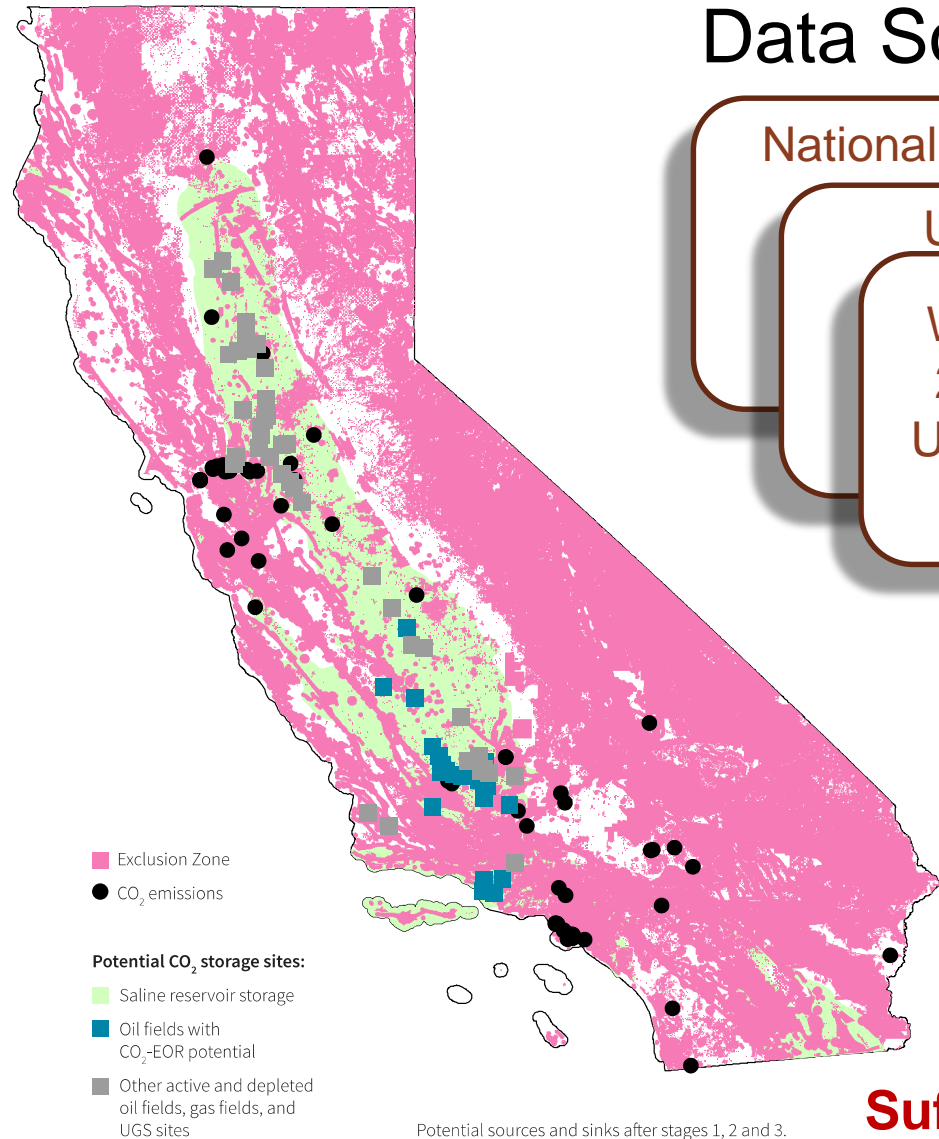
# Location of California's Storage Resources and Screening Criteria



Saline reservoirs (light green), oil and gas fields (green) and UGS sites (red) after applying qualifying criteria (stage 1)



# California Has Abundant and High Quality CO<sub>2</sub> Storage Resources

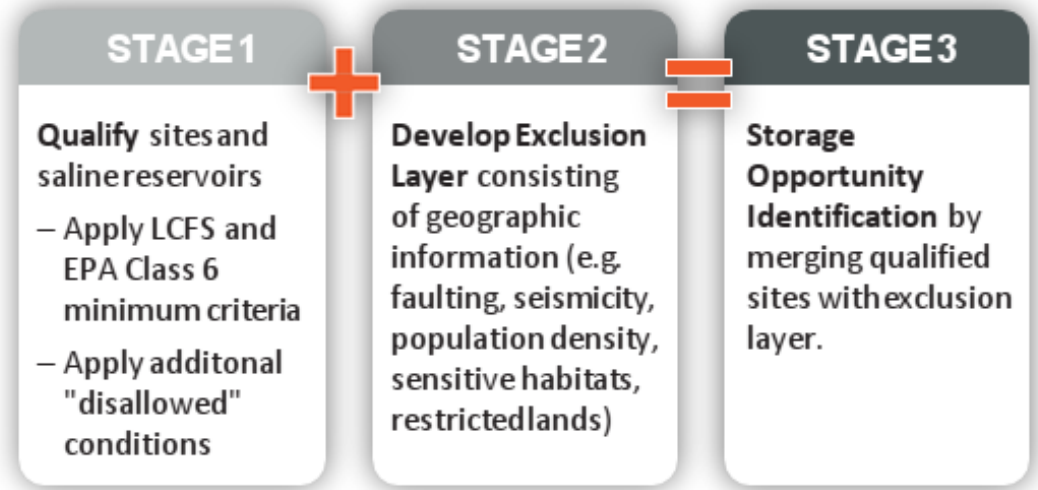


Potential sources and sinks after stages 1, 2 and 3.

## Data Sources

- National Labs
- U.S.G.S.
- WESTCARB 2003 - 2013
- U.S. DOE and CEC

## Screening Criteria

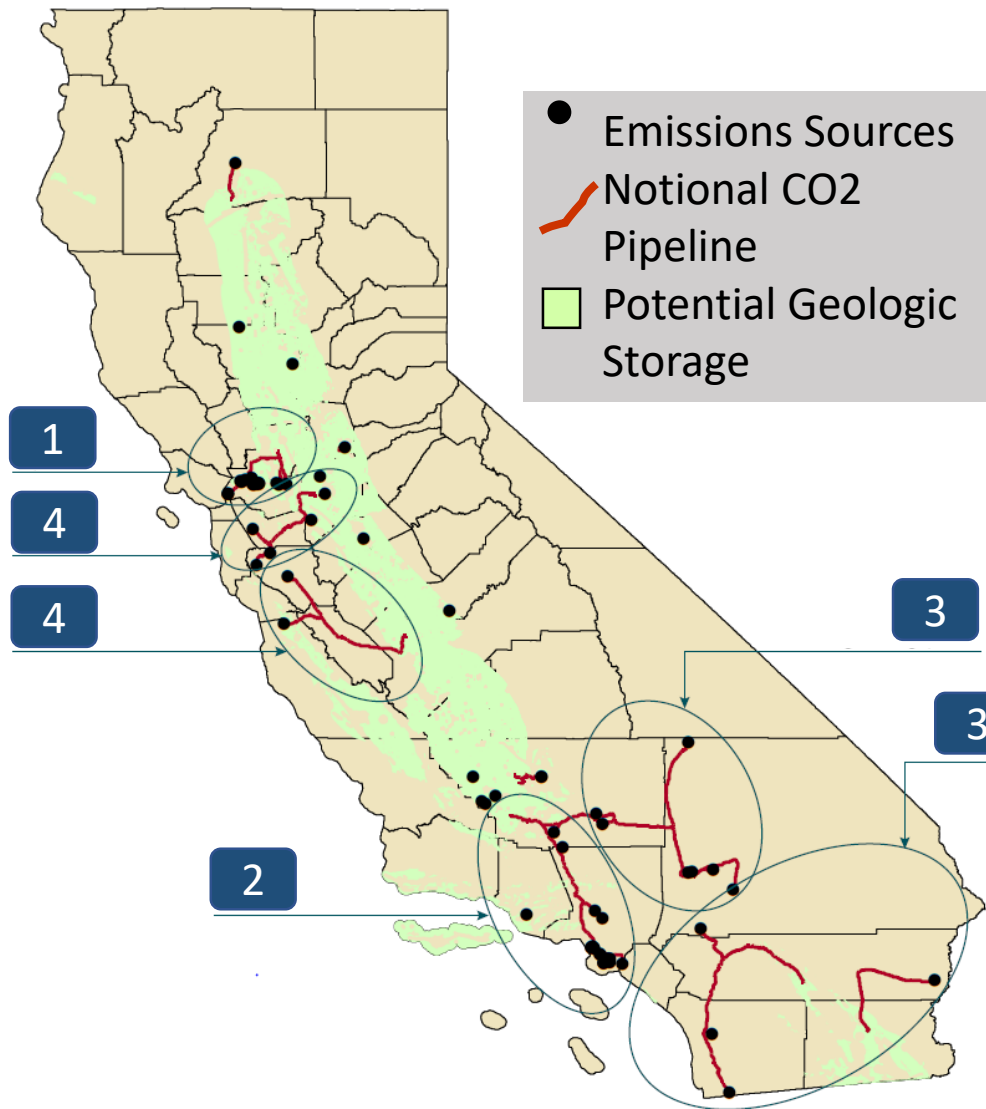


	Storage Capacity (GT CO <sub>2</sub> )	
Saline Formations	70	
Oil and Gas	Low	High
	1.1	2.1

**Sufficient for more than 1000 years of injection at 60 Mt/year.**  
Stanford University



# Source Sink Matching for 60 MtCO<sub>2</sub>/yr CCS



## Co-located capture and storage

- 3 ethanol plants, 6 NGCC, 6 CHPs and 1 cement plant

## 1. Northern California Gathering System and Storage Hub

- 8 hydrogen, 4 refineries, 5 CHPs, and 3 NGCC

## 2. Southern California Gathering System and Storage Hub

- 8 hydrogen, 5 refineries, 4 CHPs, 1 cement, and 5 NGCC

## 3. Desert and Salton Sea Gathering Systems

- 5 cement, 1 CHP, 6 NGCC

## 4. Central California and S. Bay Gathering System

- 1 cement, 5 NGCC