Carbon Capture and Storage

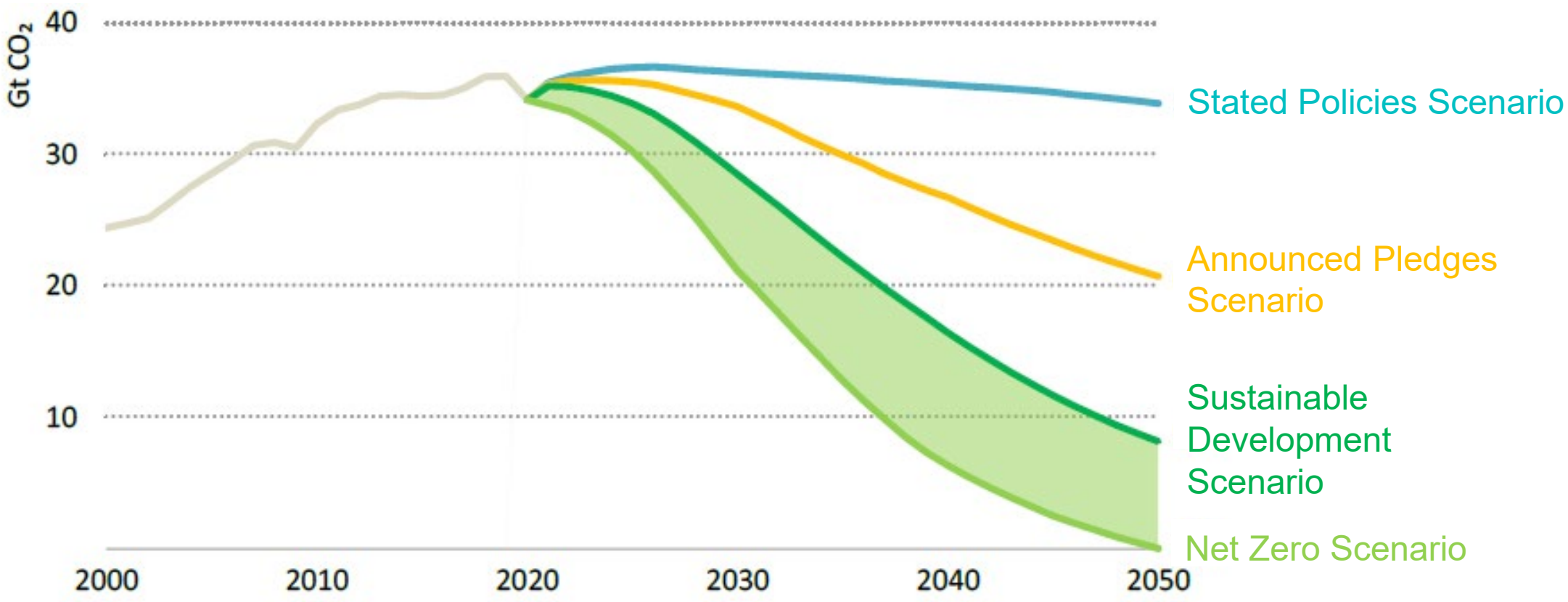
Sarah Saltzer

Stanford University

May 17, 2023

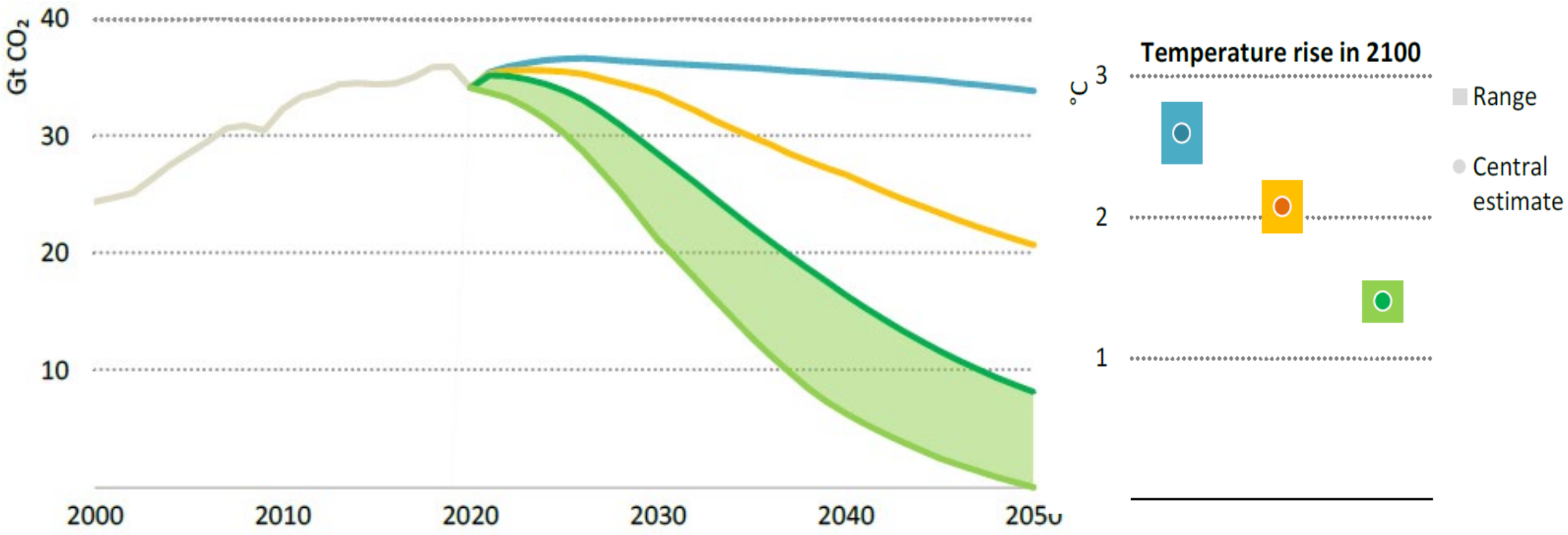
Climate change has become personal, local, painful, and expensive.

The IEA's 2050 Scenarios….



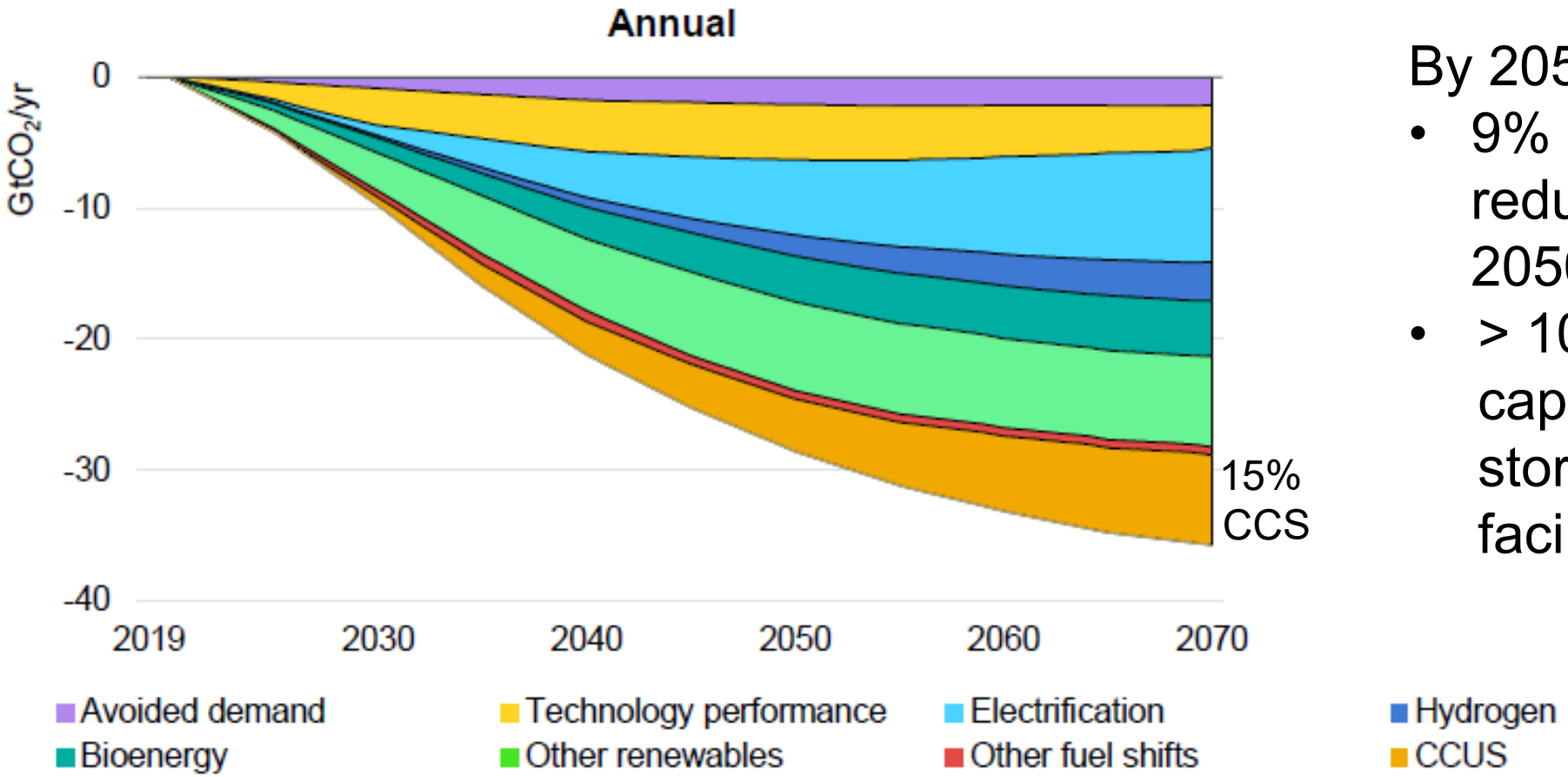
Source: IEA World Energy Outlook, 2021

The IEA's 2050 Scenarios....



Source: IEA World Energy Outlook, 2021

Emissions Reductions: Where does CCS fit in?

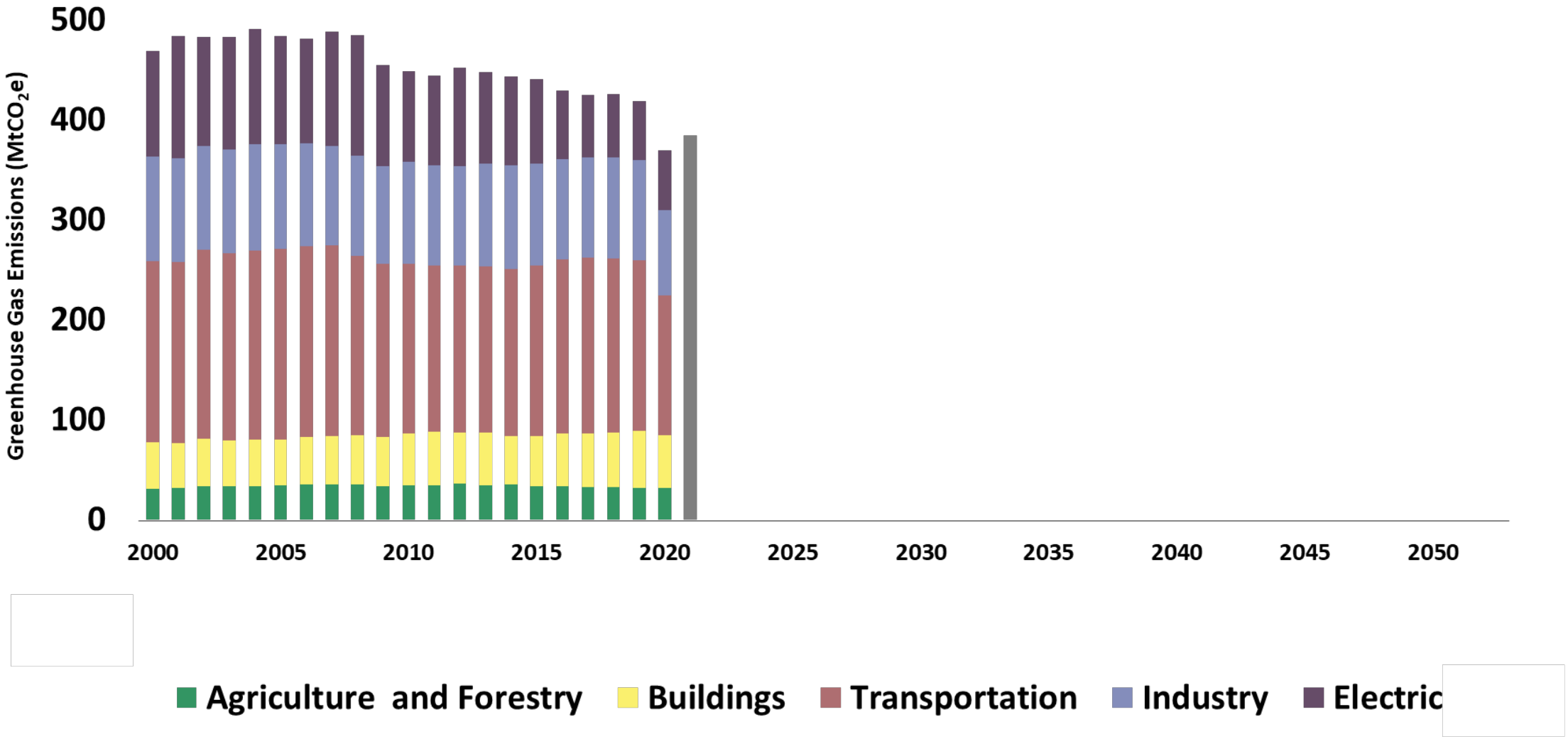


By 2050:

- 9% of emissions reductions by 2050
- > 100 Gt of CO_2 captured and stored ~2000 CCS facilities

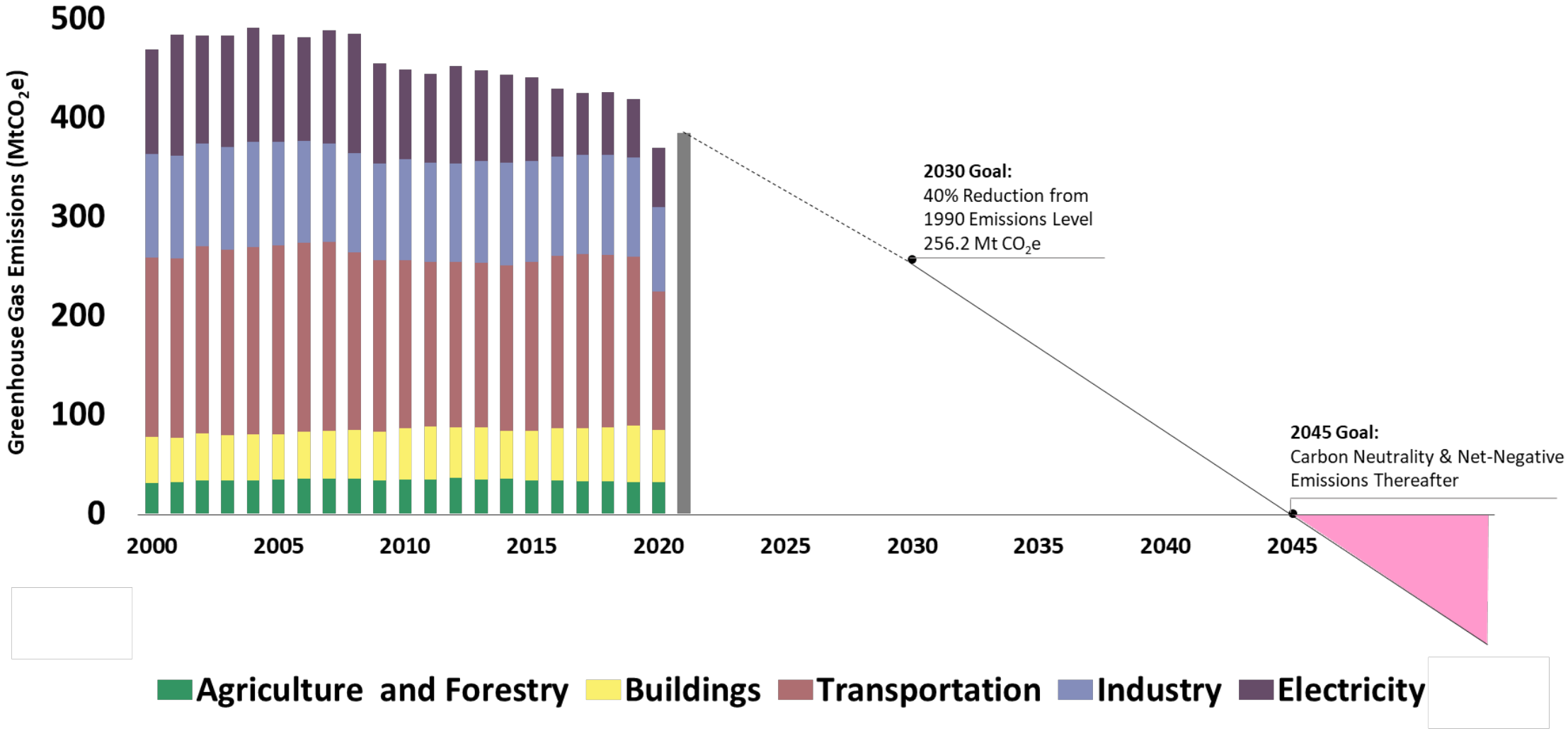
Source: IEA 2020, Sustainable Development Scenario (SDS)

California's Historic Emissions



Source: Adapted from CARB (2022)

California's Historic Emissions and Future Targets



Source: Adapted from CARB (2022)

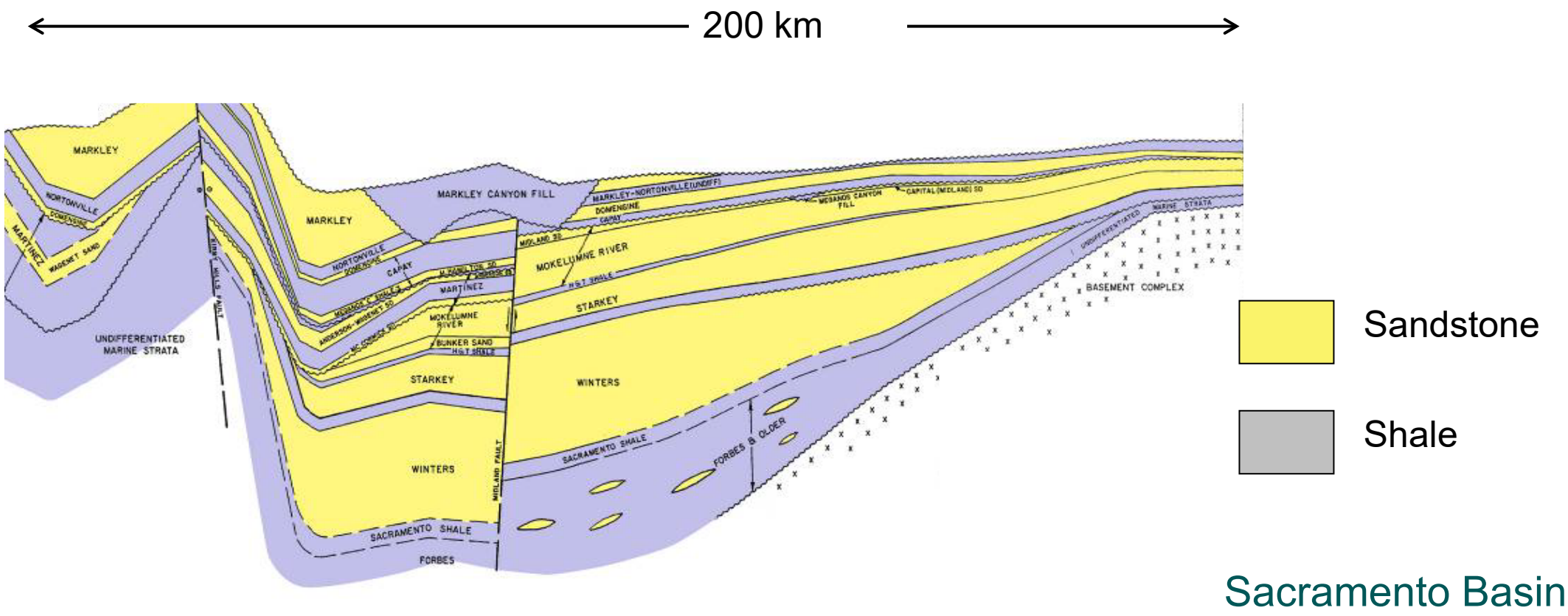
What is CCS?

Capture

Transportation

Storage

A Typical Sedimentary Basin



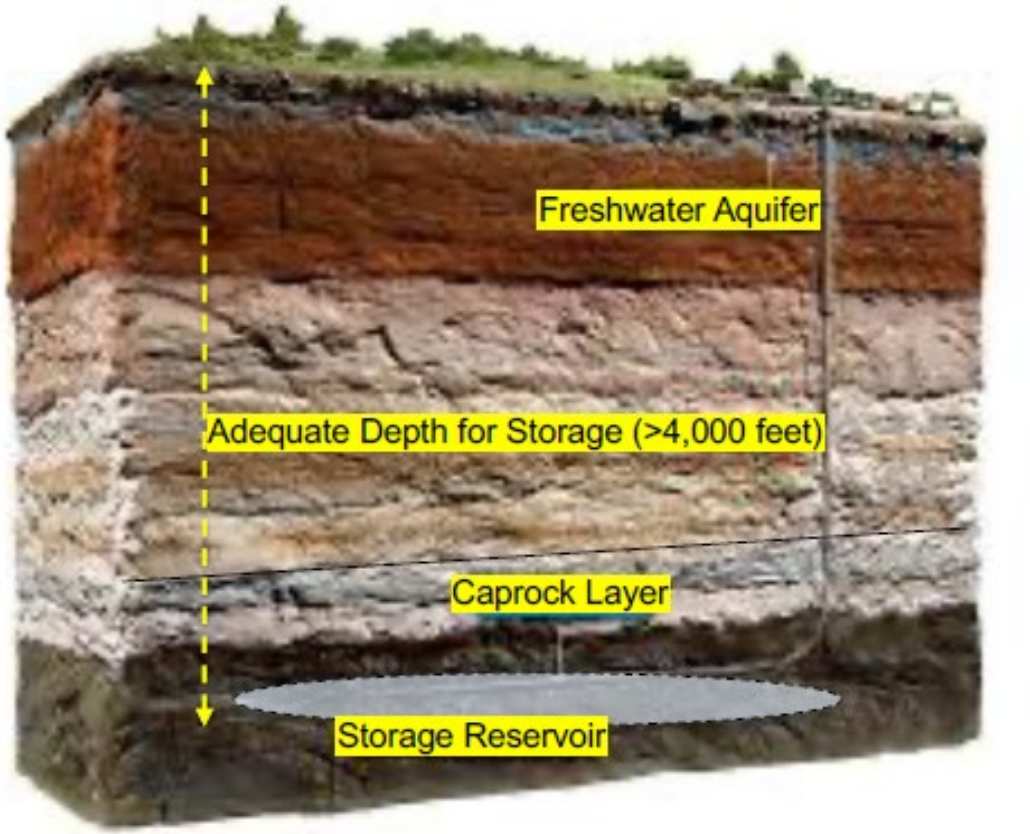
Example of a sedimentary basin with alternating layers of coarse and fine textured sedimentary rocks.

Criteria for Geologic Storage of CO_2

Candidate sites must possess specific characteristics to qualify, including:

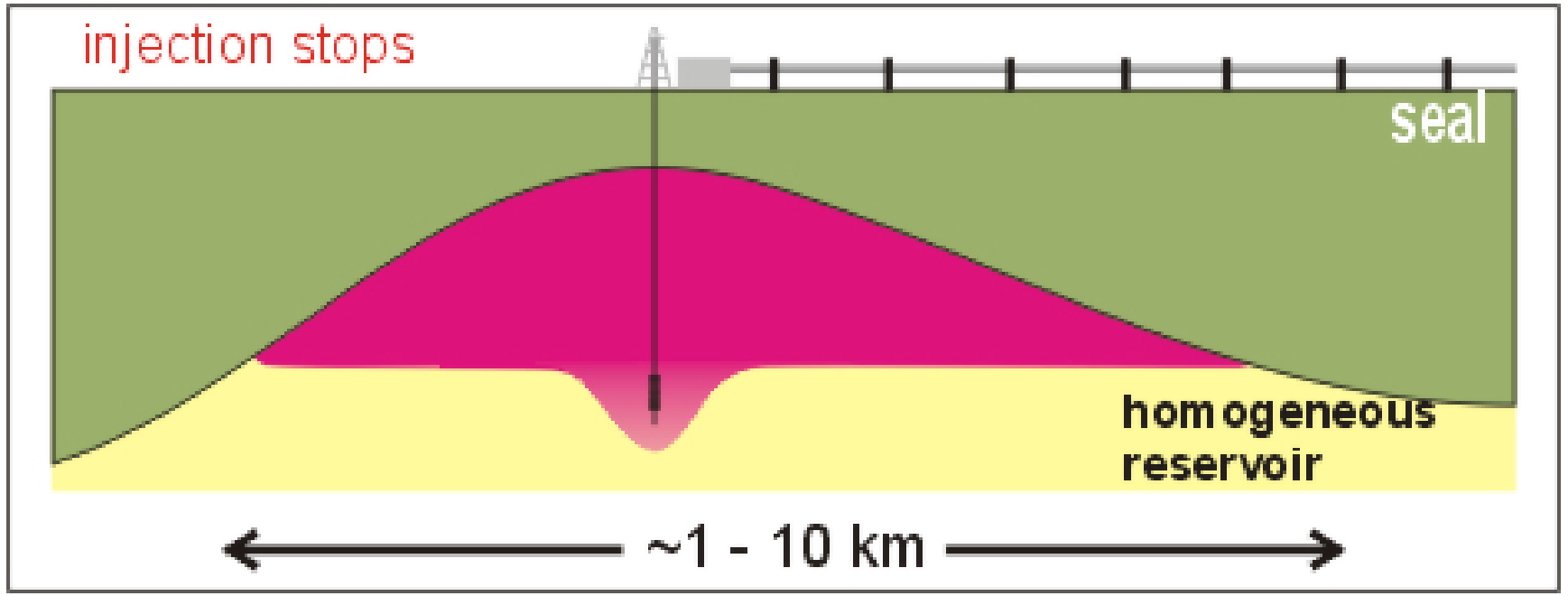
- Adequate depth (reservoir pressure)
- Overlying impermeable layers (caprocks)
- Separation from drinking water sources
- Adequate porosity and permeability
- Seismic stability

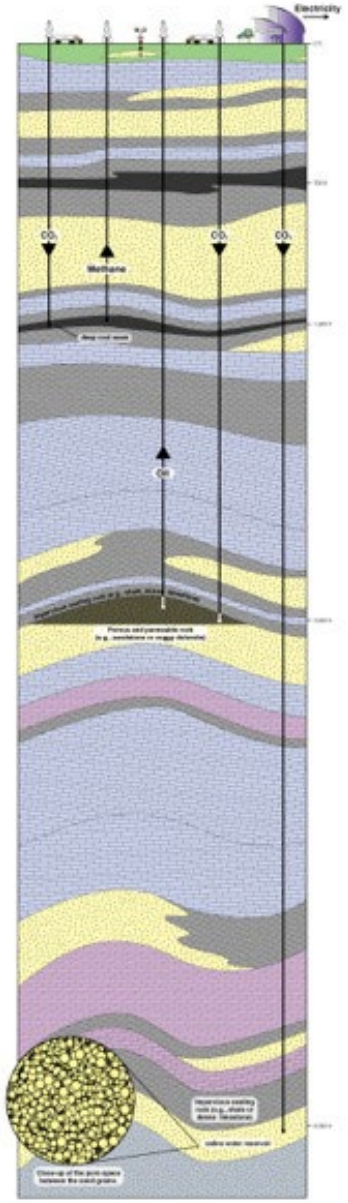
Regulations require constant monitoring systems be maintained



Basic Concept of Geological Storage of CO_2

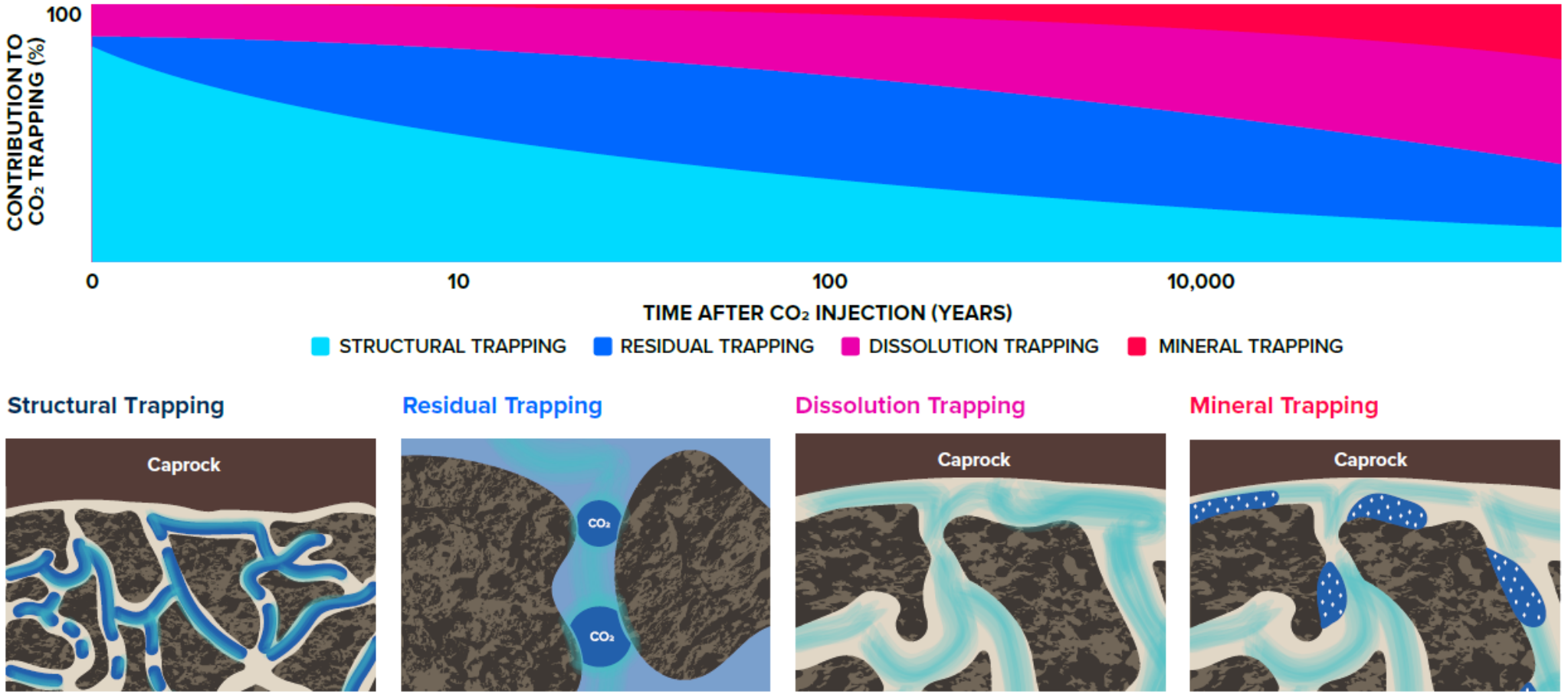
- CO_2 injected at high pressure at depths of about 1 mile or deeper into rocks with tiny pore spaces
- Trapping beneath seals of low permeability rocks





Courtesy of John Bradshaw

Geologic Trapping Mechanisms for CO2

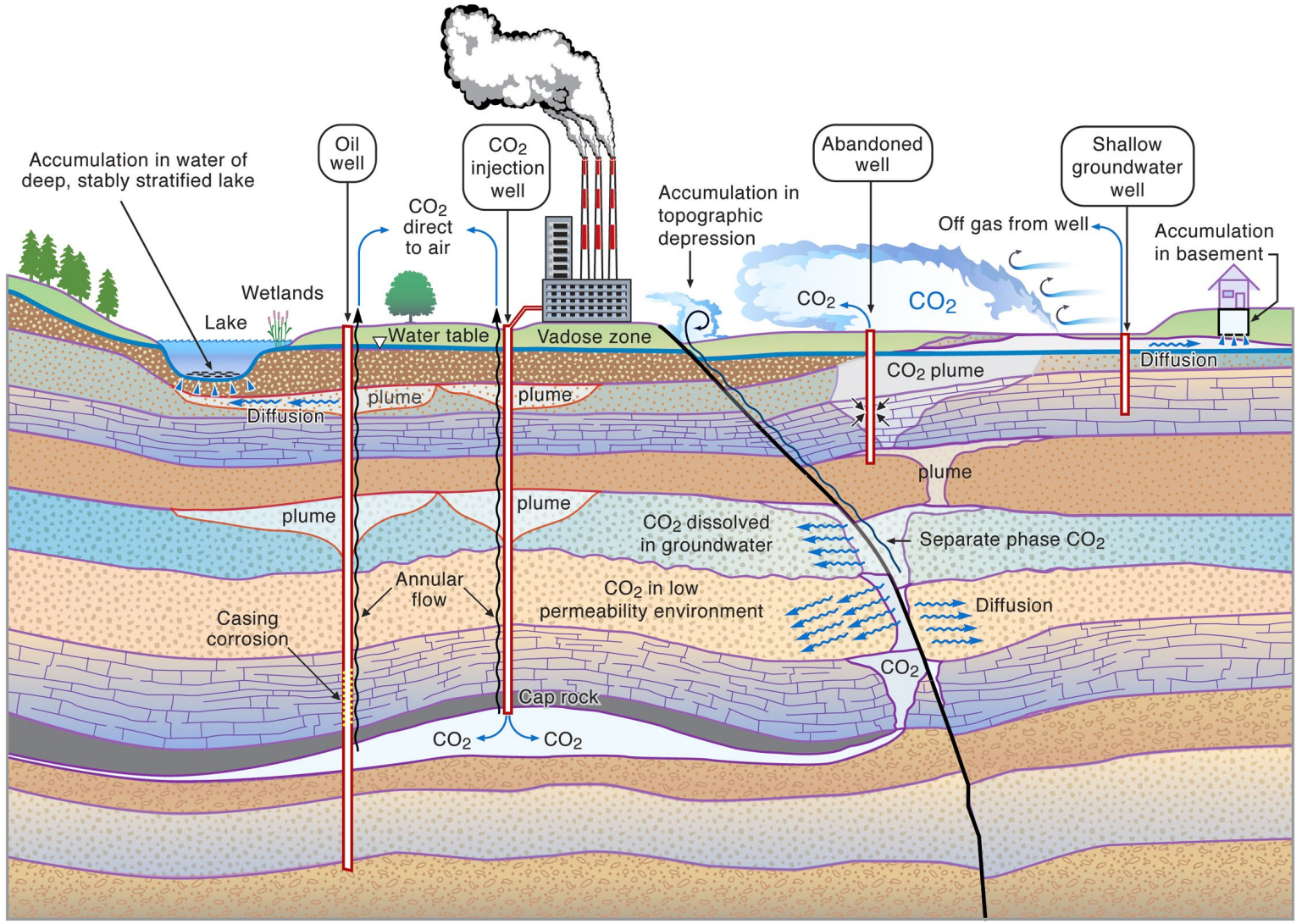


Source: Global CCS Institute, 2021

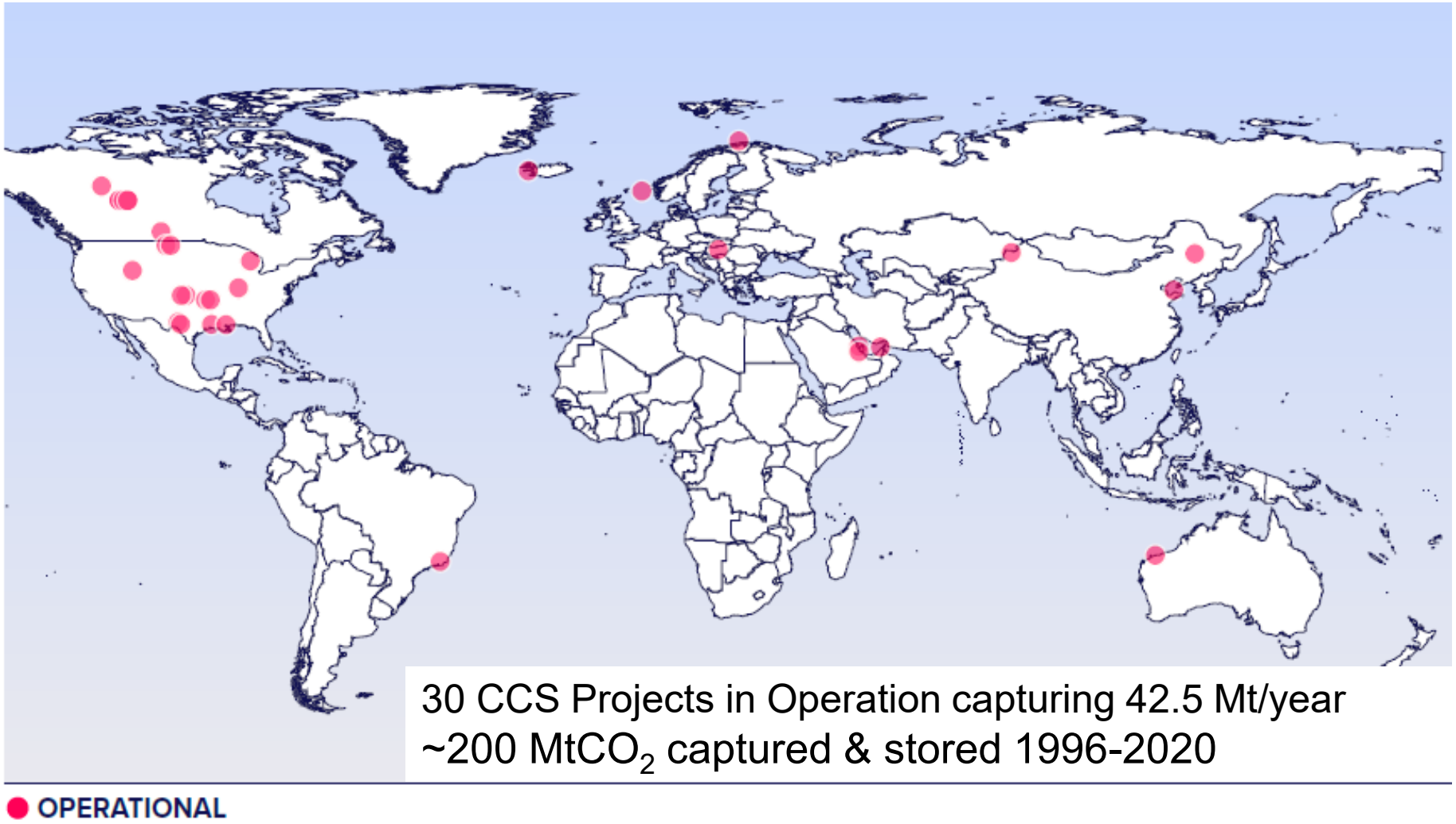
Health, Safety and Environmental Risks

1. Groundwater quality degradation
2. Induced seismicity
3. Release to atmosphere (via wells, faults, and other pathways)

Regulations and proper management can mitigate these risks.

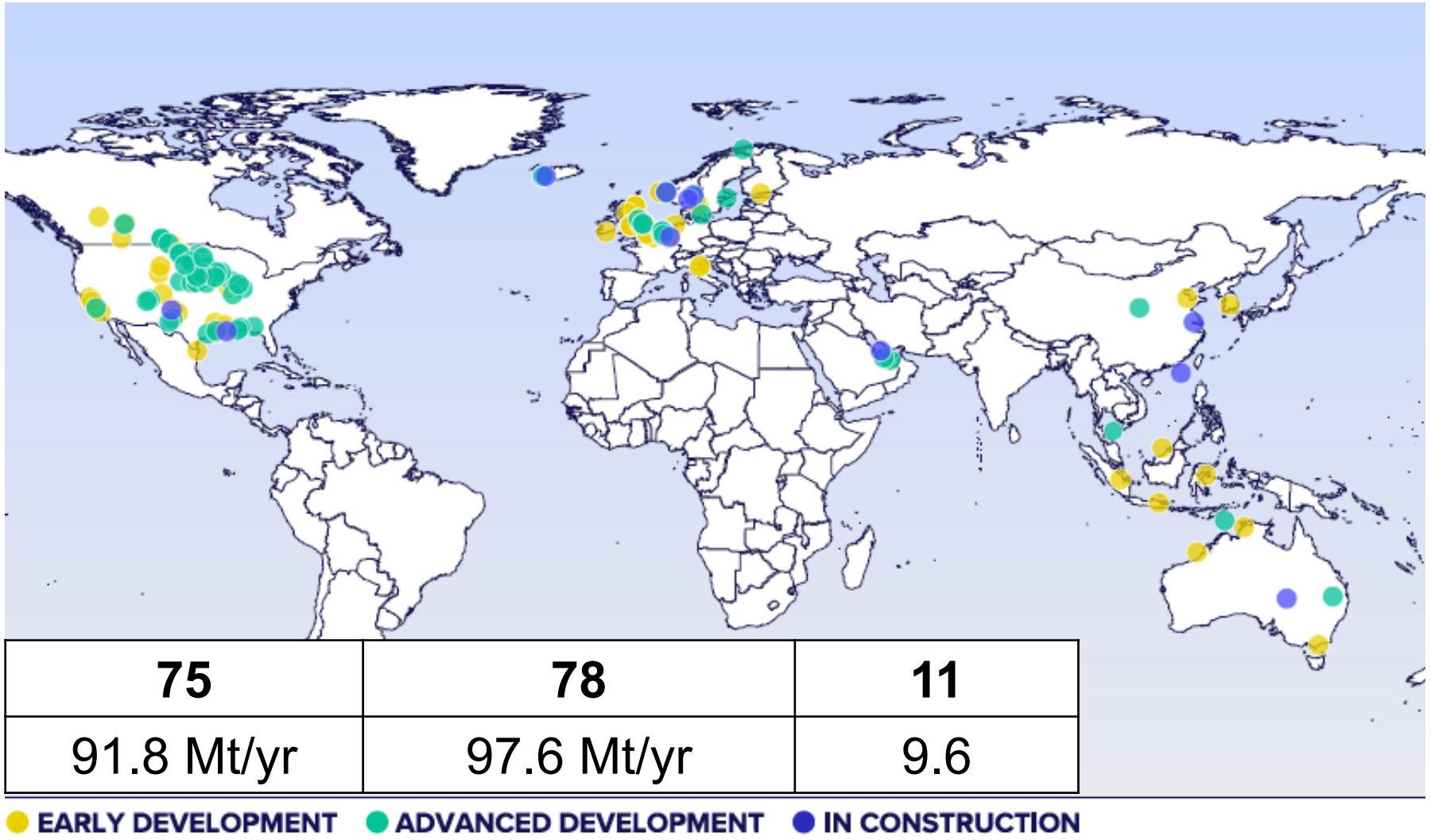


CCS Facilities Around the World (2022)



Source: Global CCS Institute, 2022

CCS Facilities Around the World (2022)



75	78	11
91.8 Mt/yr	97.6 Mt/yr	9.6

Source: Global CCS Institute, 2022

Social Equity and Community Benefits

Local Economic Activity

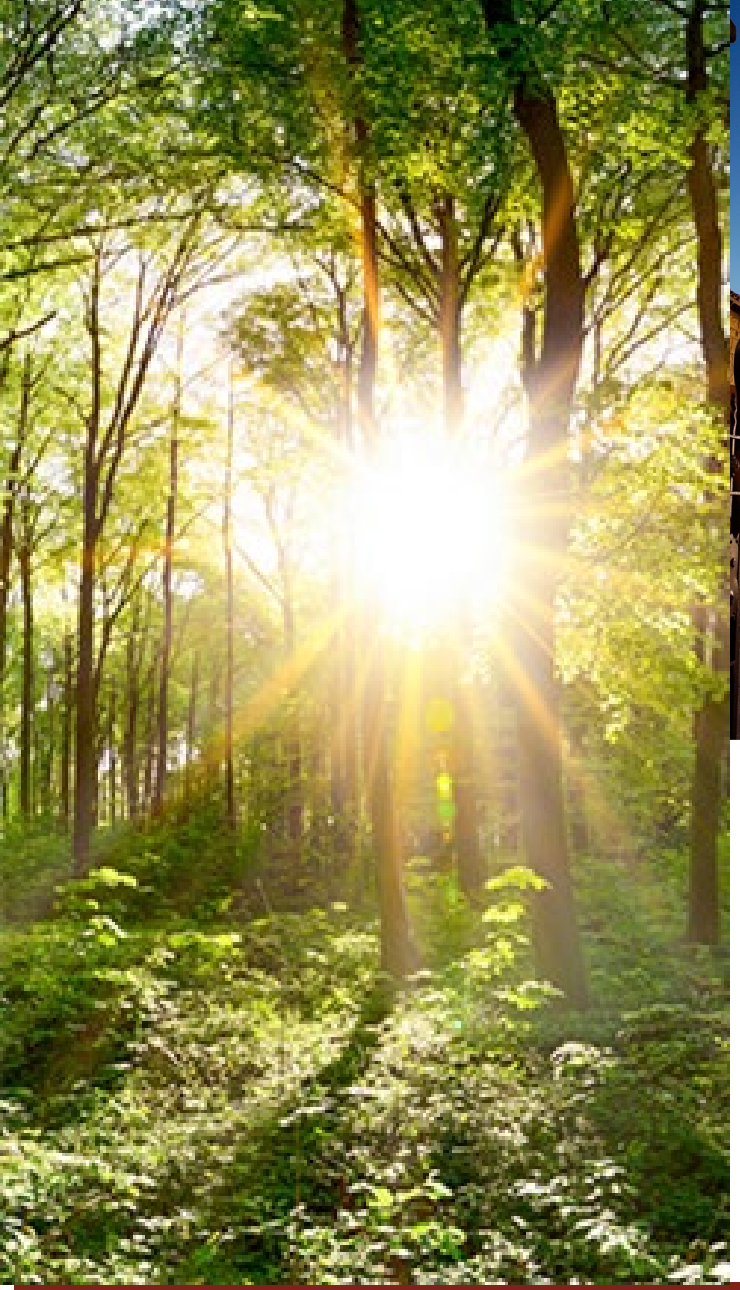
- CCS projects can **stimulate local economic activity**, including new construction, operations, and maintenance jobs
- **Multiplier effects across the supply chain can drive additional economic benefits**

Job Creation and Preservation

- The economic benefits associated with **job training** could provide new employment opportunities in the low carbon economy
- CCS activities support **employment** for skill sets which may otherwise become obsolete in a clean energy transition

Summary

- According to the IEA:
  - CCS is required to abate 15% of global emissions by 2070
  - > 100 Gt of CO_2 captured and stored by 2050
  - ~2000 CCS facilities by 2050
- California has excellent geology for storage of CO_2 and the potential to store over 70 Gt of CO_2
- Potential co-benefits include:
  - Local economic activity
  - Job creation and preservation



Questions?

Sarah.saltzer@stanford.edu