CO_2 Removal (CDR) in United States and California Plans

September 20th, 2024

Kim Mayfield (LLNL)

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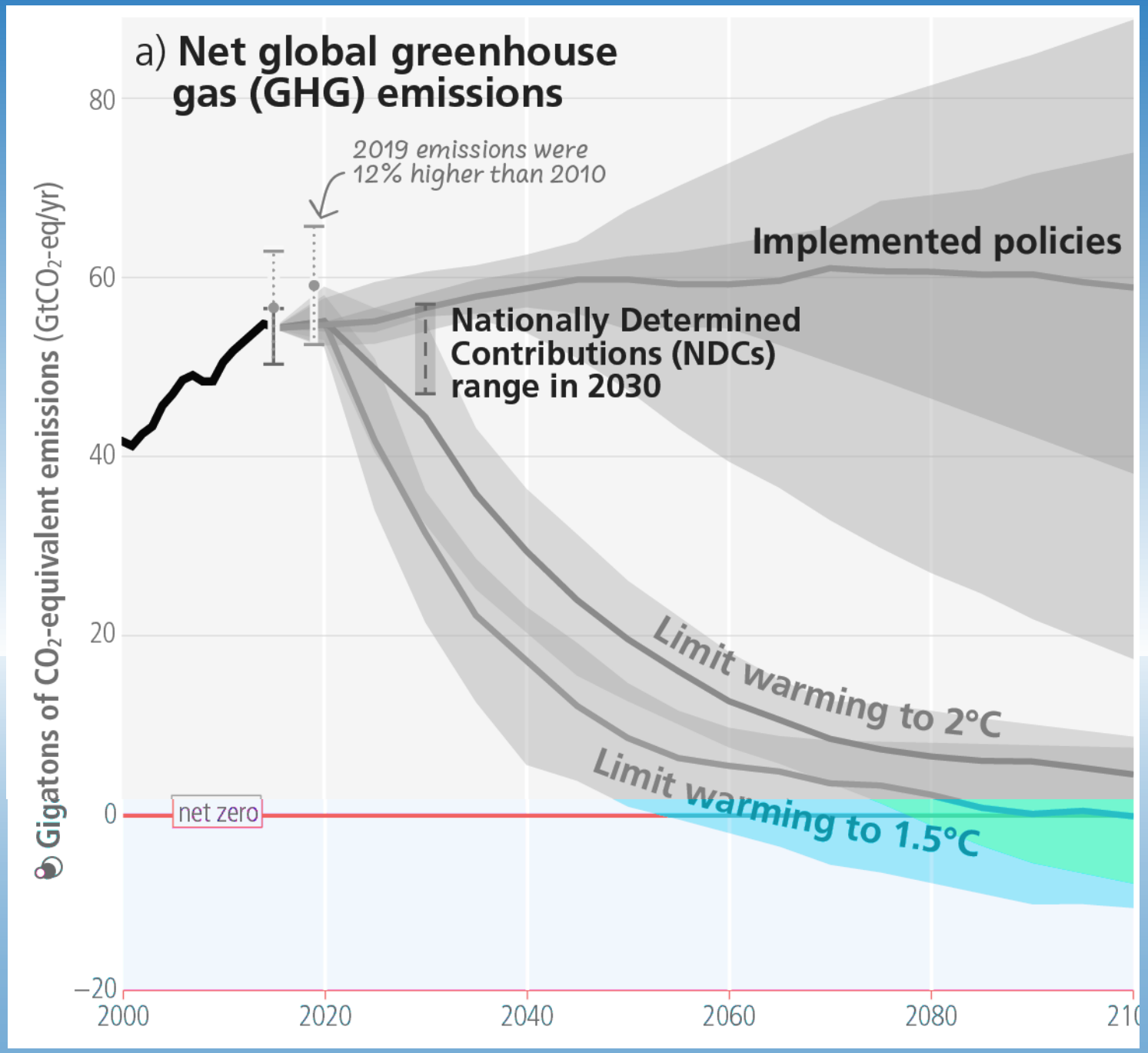
why bother with CO_2 removal?

- Rapid, deep and immediate reductions <u>now</u>!
- 1.5 °C now requires going carbon negative
  - i.e. CO_2 removal (CDR)



“It’s me.

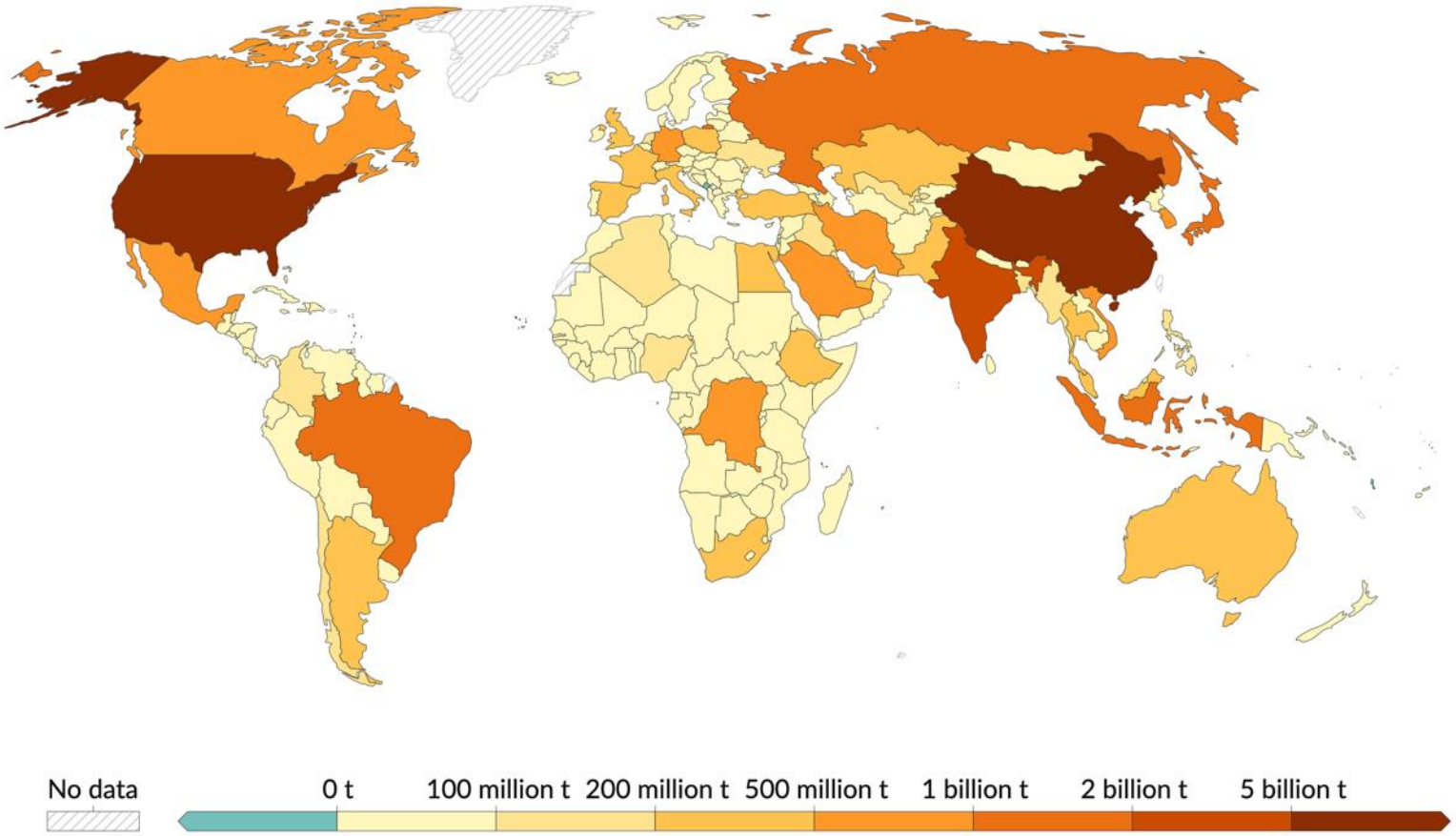
Hi, I’m the problem.

It’s me.”

Annual CO_2 emissions including land-use change, 2022

Our World in Data

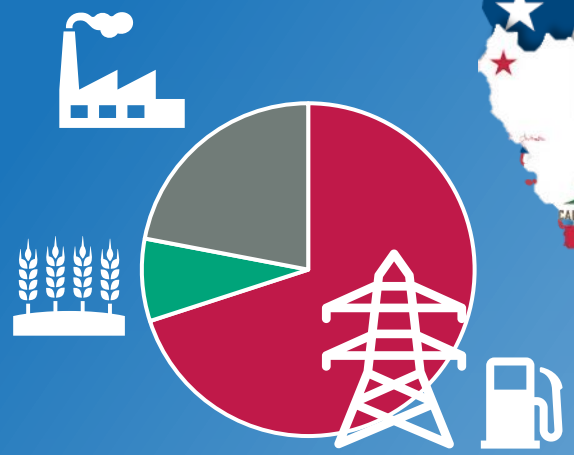
Emissions include those from fossil fuels and industry[1], and land-use change. They are measured in tonnes.



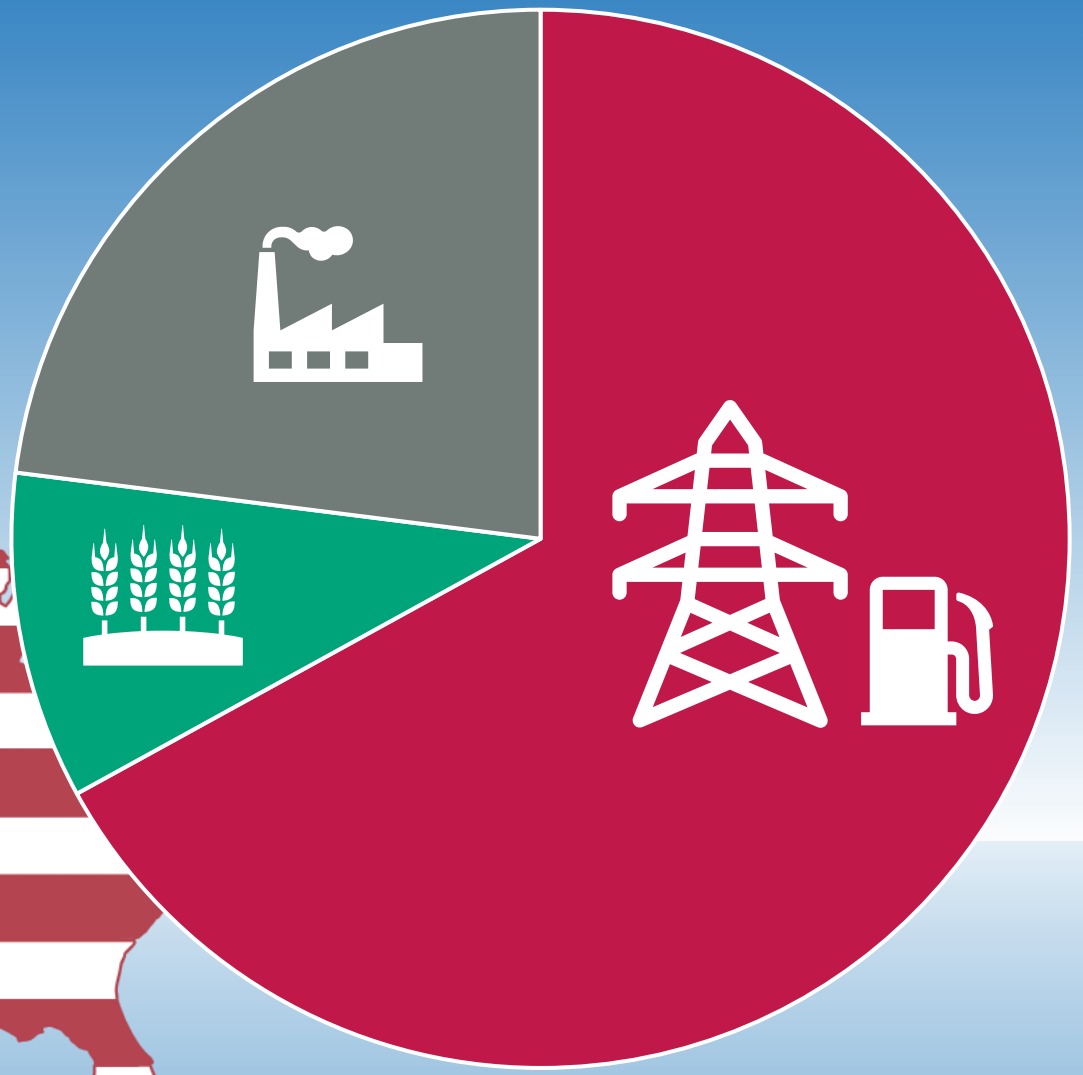
Data source: Global Carbon Budget (2023) OurWorldinData.org/co2-and-greenhouse-gas-emissions | CC BY

Note: Emissions from land-use change can be positive or negative depending on whether carbon is emitted or sequestered.

1. Fossil emissions: Fossil emissions measure the quantity of carbon dioxide (CO_2) emitted from the burning of fossil fuels, and directly from industrial processes such as cement and steel production. Fossil CO_2 includes emissions from coal, oil, gas, flaring, cement, steel, and other industrial processes. Fossil emissions do not include land use change, deforestation, soils, or vegetation.



381.3 MMT CO_{2eq}



6,343.2 MMT CO_{2eq}

Nationally, what do we need to do to reach ‘net zero?’

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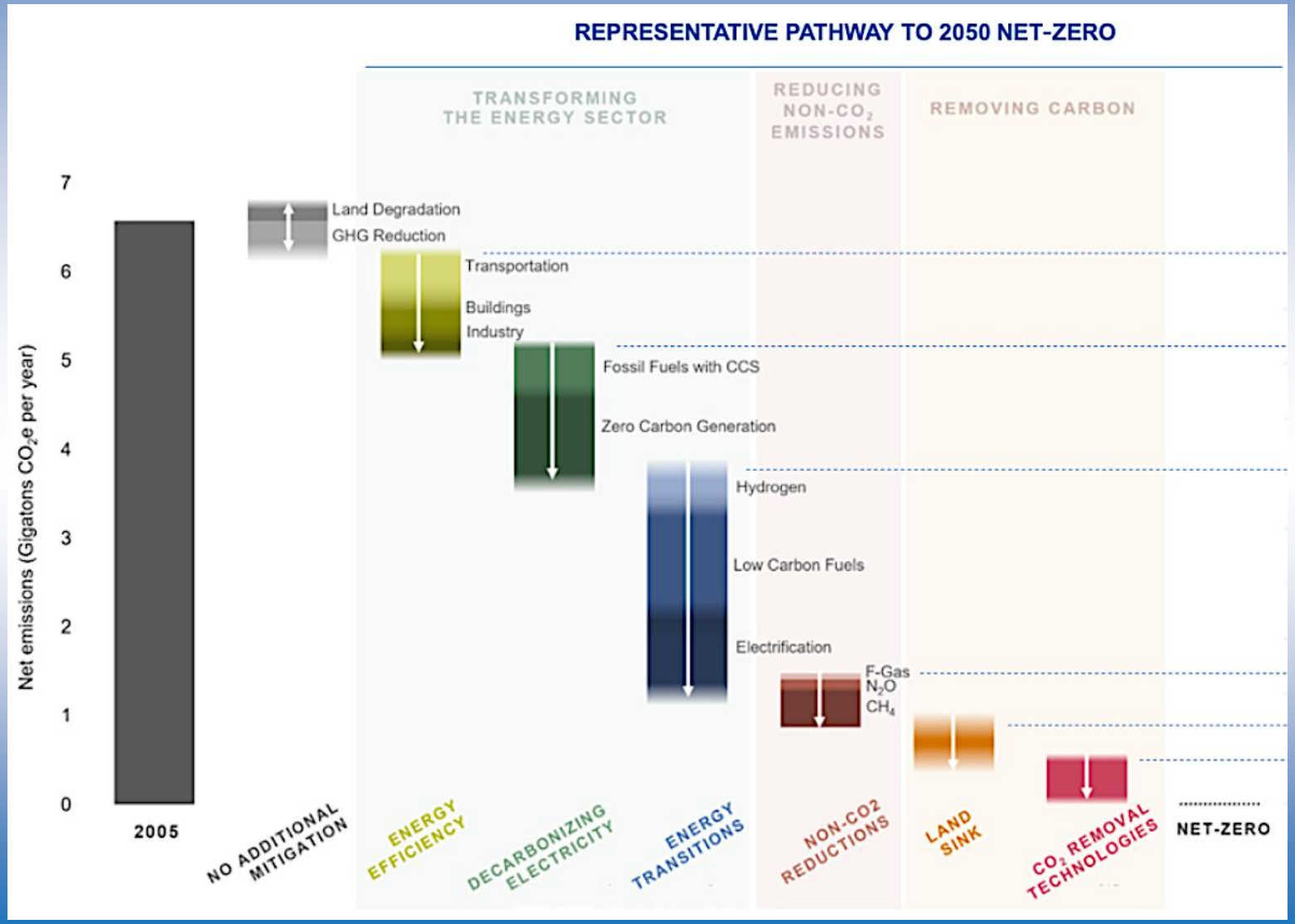
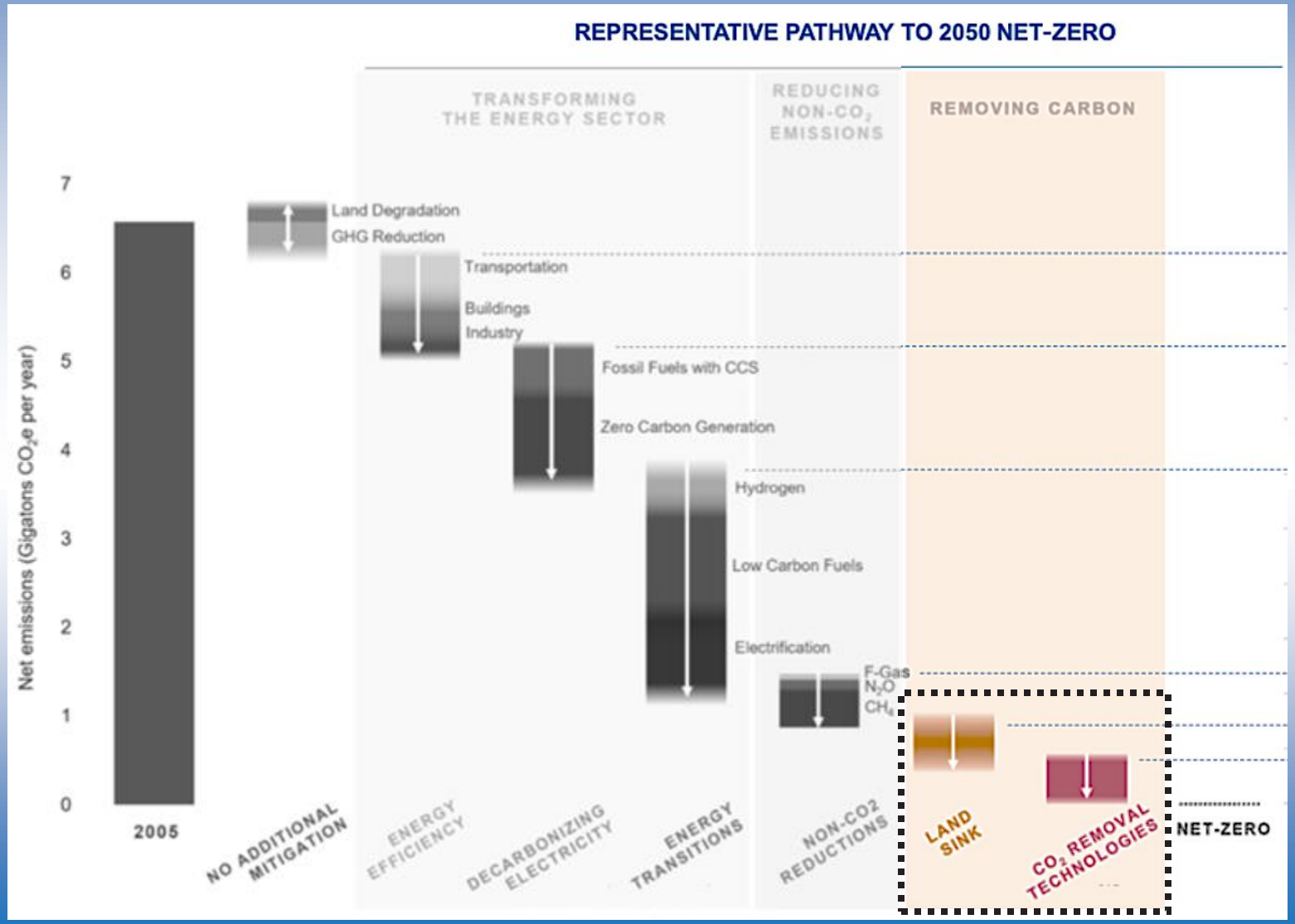
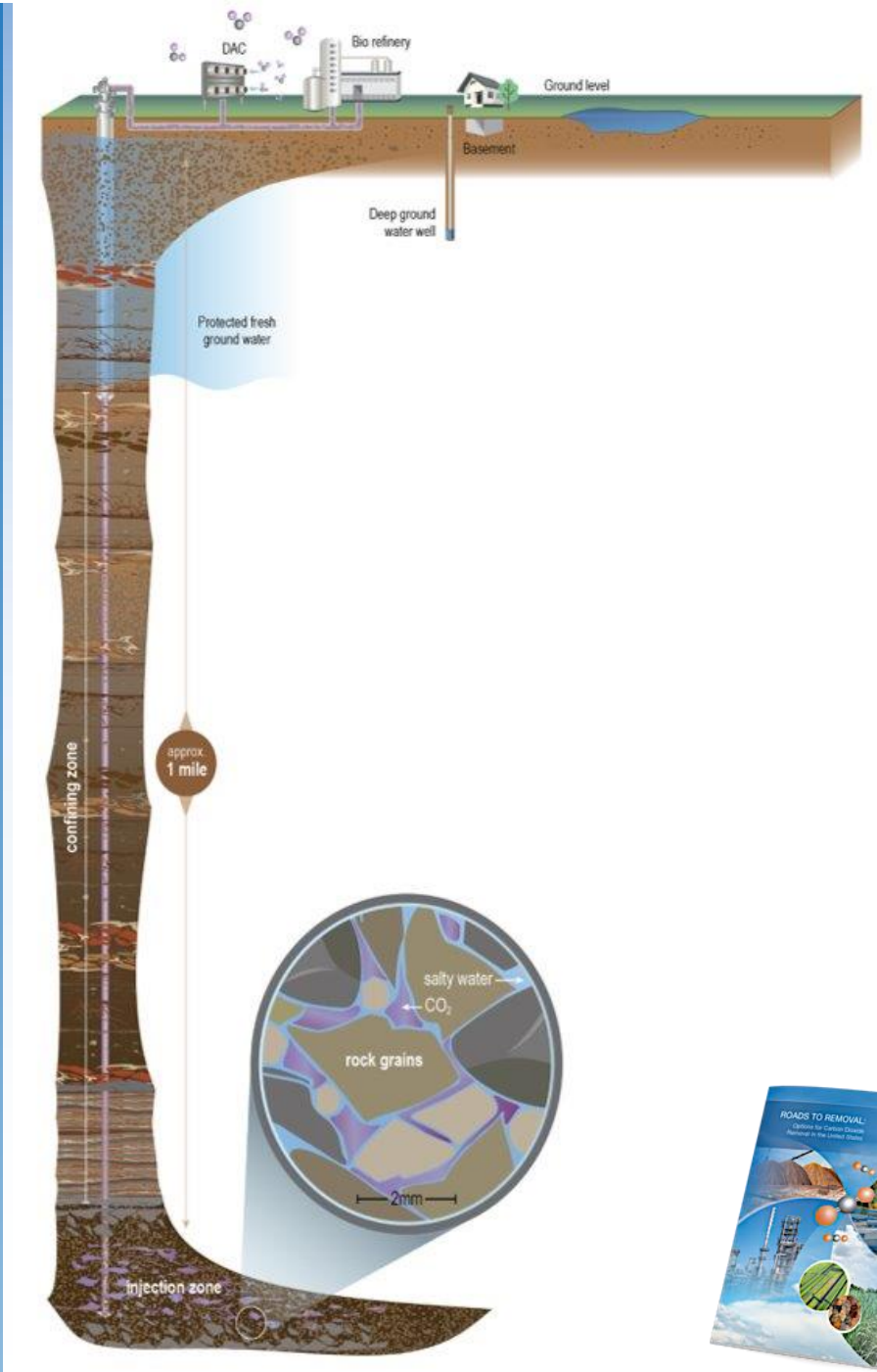


CO_2 Removal (CDR) Needed for Final 10 – 20%



After you remove CO_2, you have to store it somewhere…

- Deep, porous rock layers
  - Way, way below aquifers
  - Only when there is a ‘caprock’



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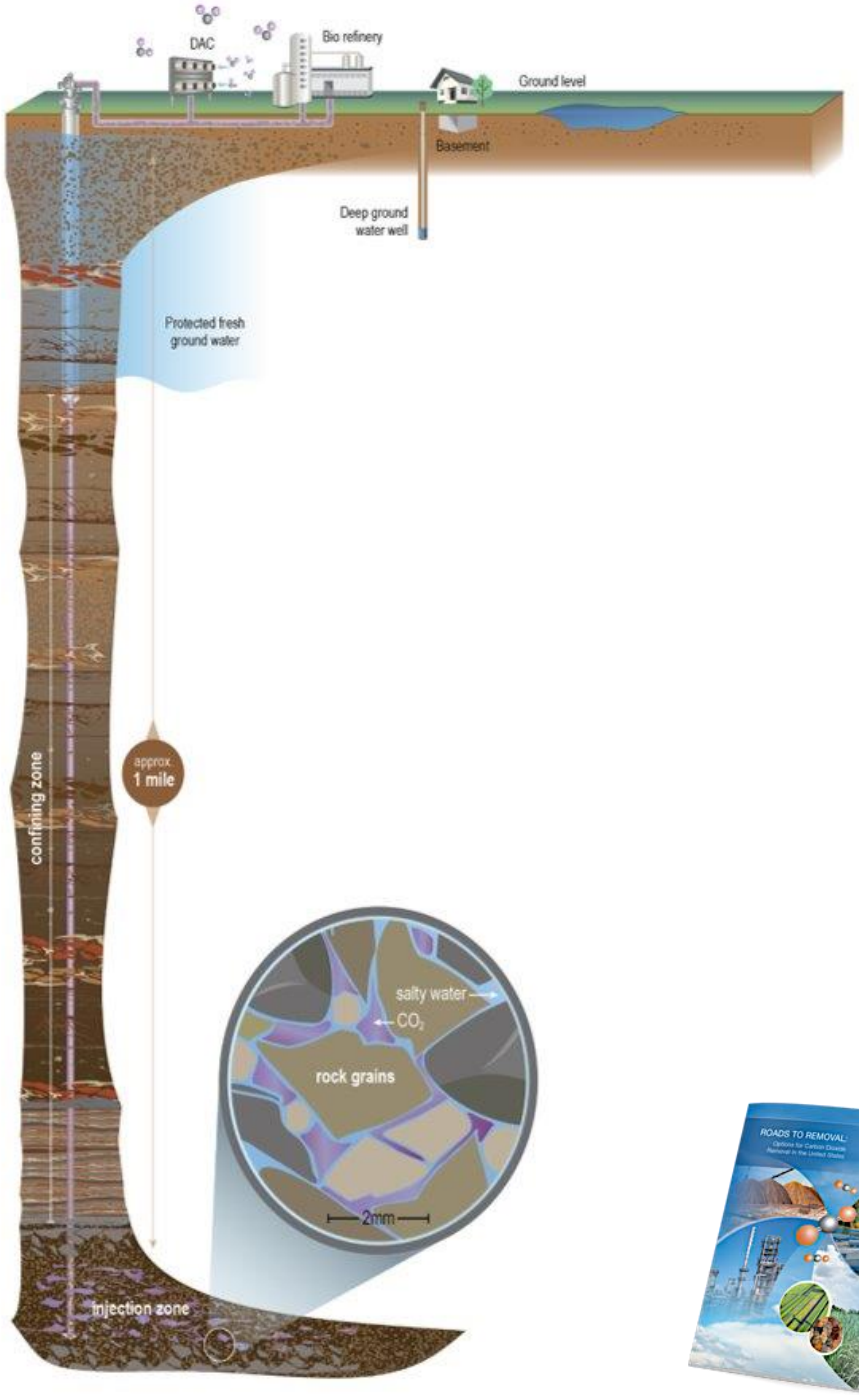
- Current projects, globally, can store ~40 million tonnes CO_2

- We need 100 billion tonnes CO_2 storage by 2060 to reach 2 °C



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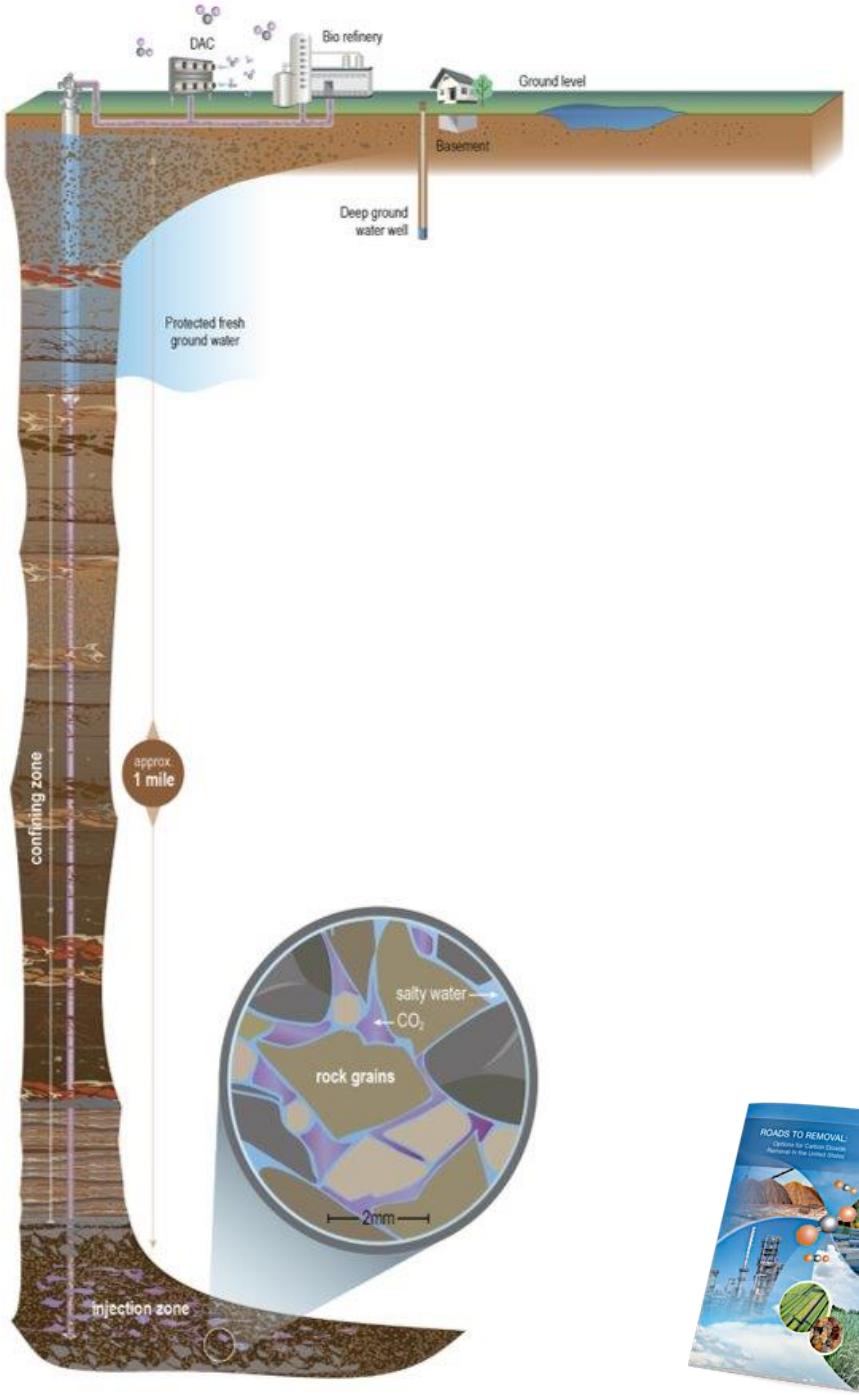
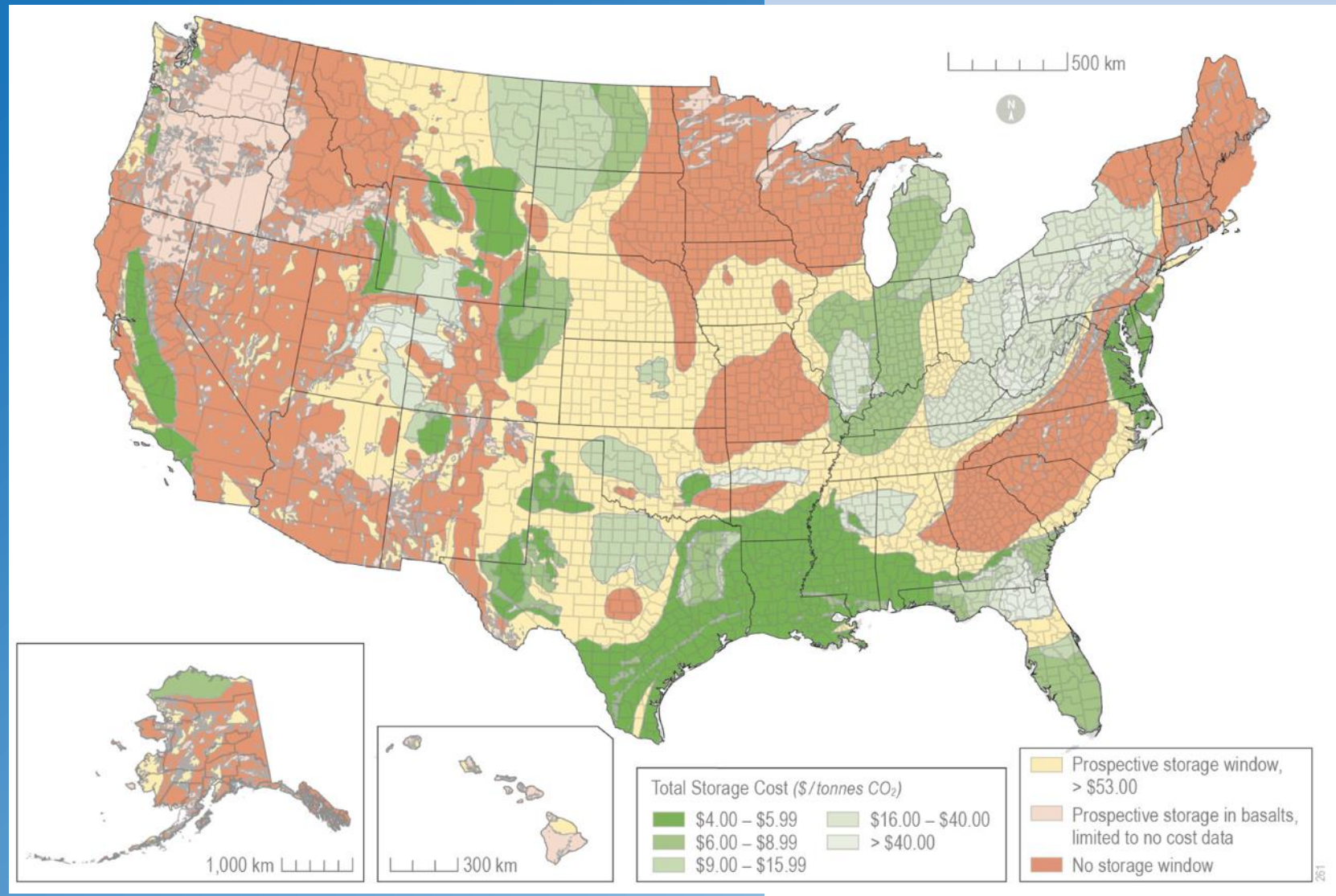
- Silver lining: the US can do 3,000 billion tonnes alone!

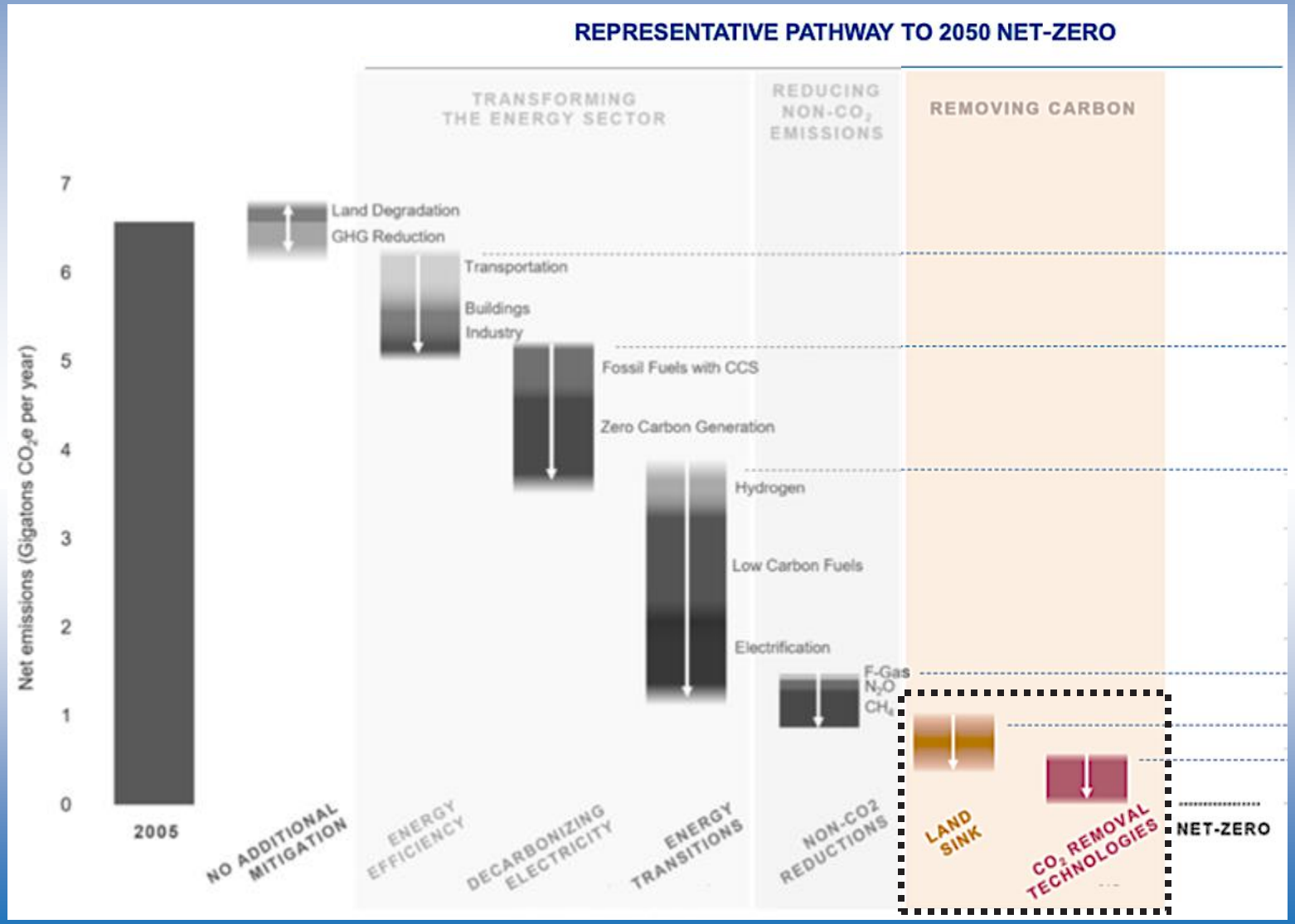


The US Can do 3,000 billion tonnes of CO_2 Storage alone

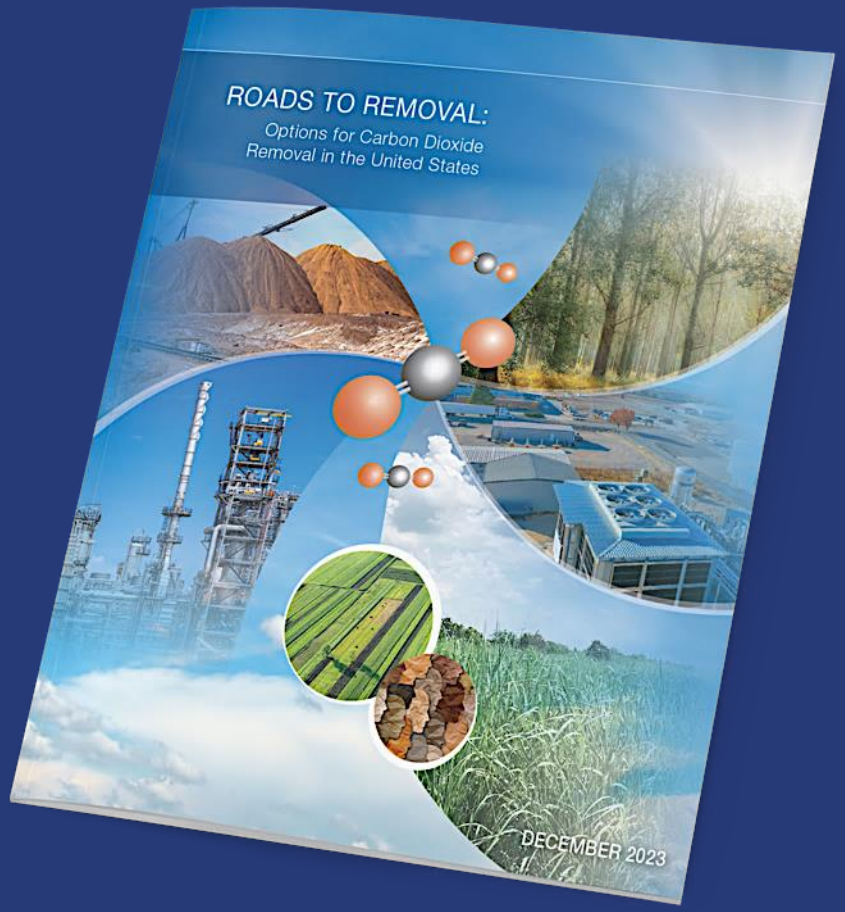
- California can store 0.6 billion
- Only storage in the west
  - Transportation challenges

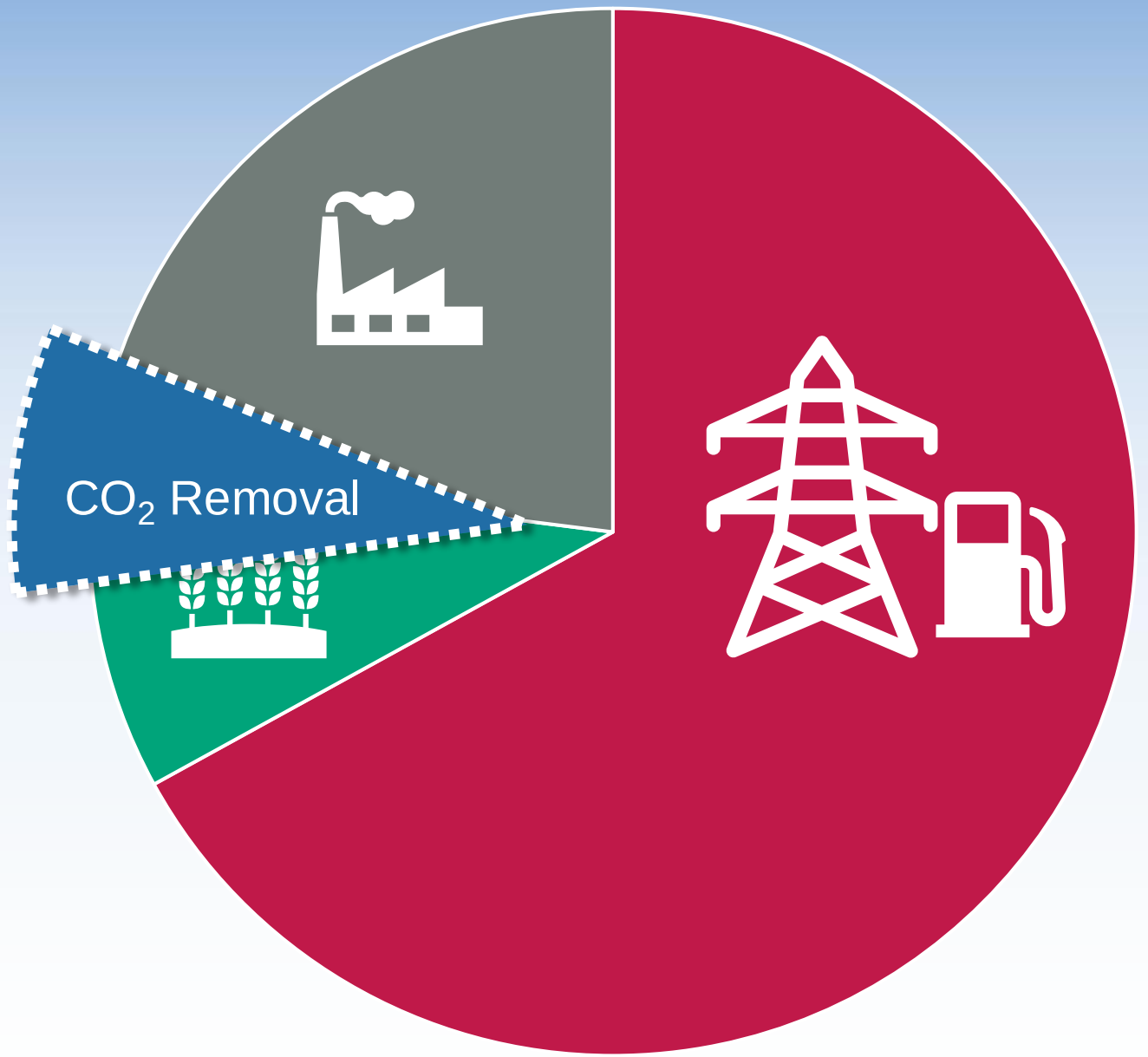


The US Needs to Remove ~1 Billion Tonnes of CO_2



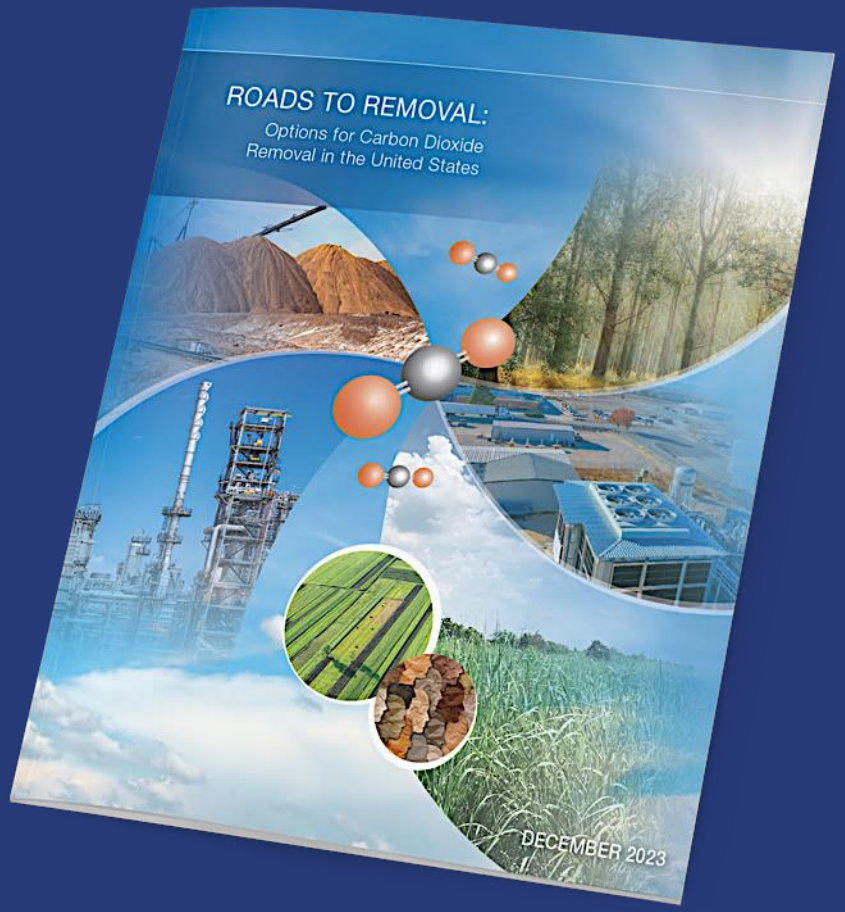
The US Needs to Remove 1 Billion Tonnes of CO_2 per Year by 2050



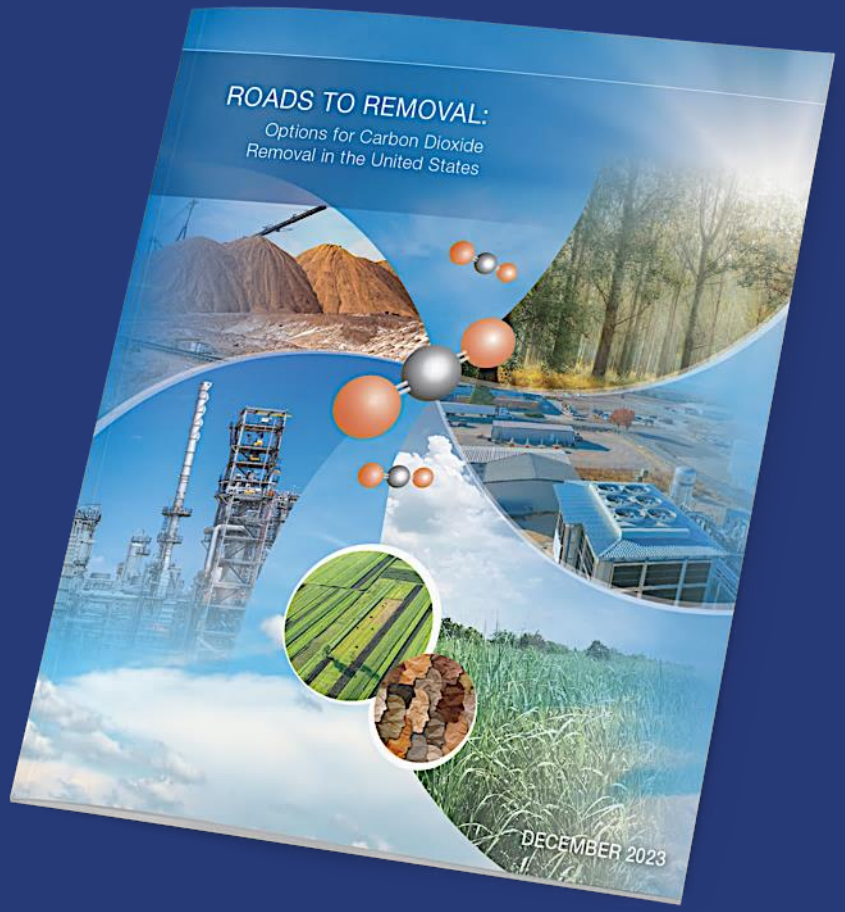


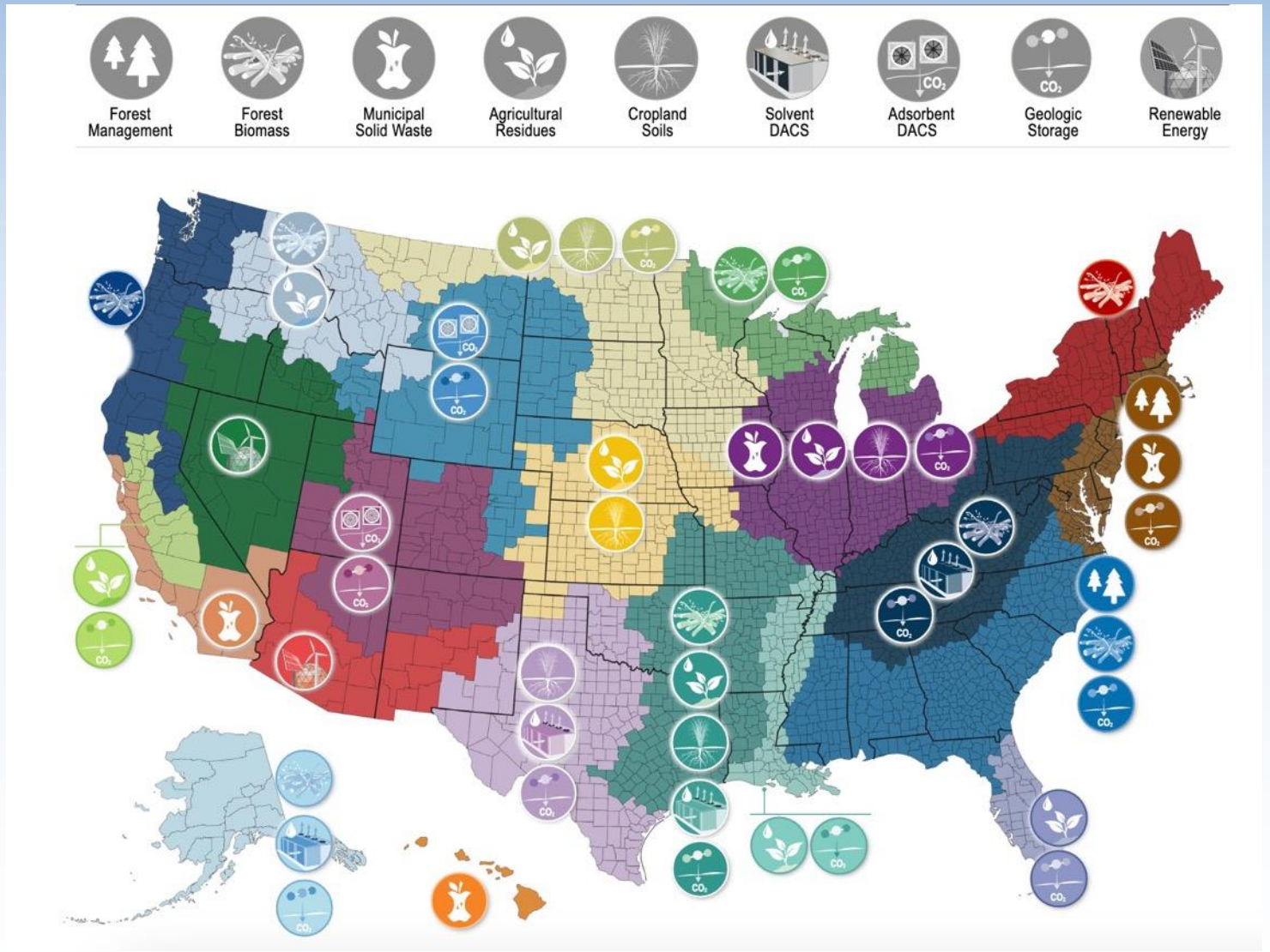
6.34 Billion Tonnes CO_{2eq} per year

Can the US Remove 1 Billion Tonnes per year?



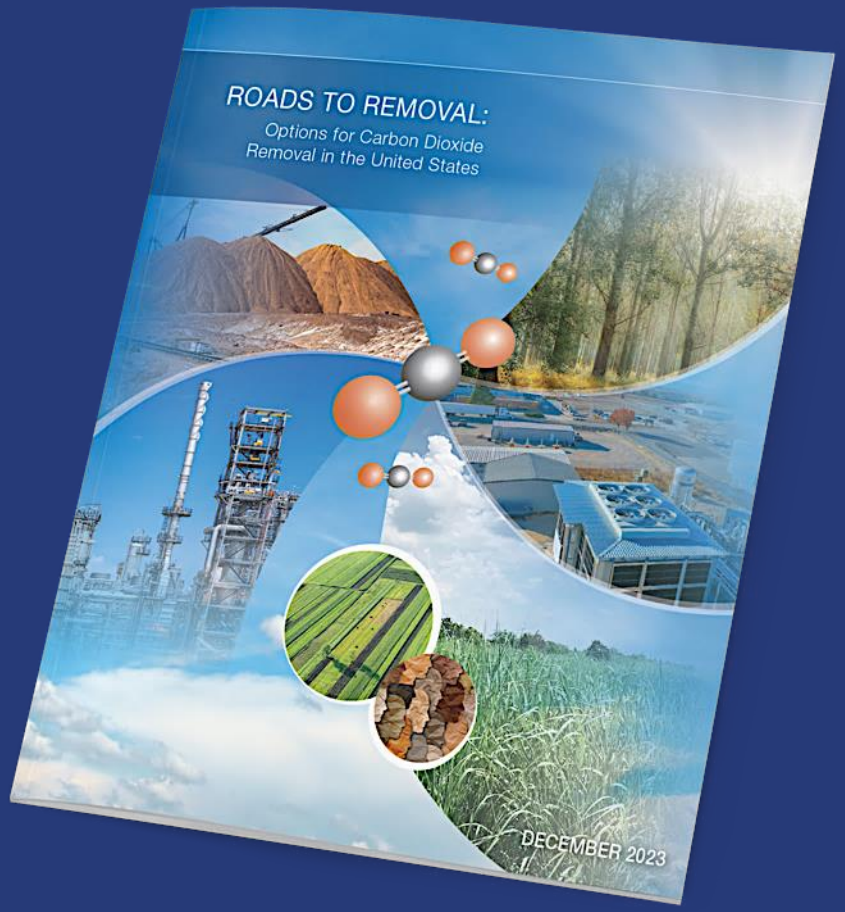
Yes, We Can.

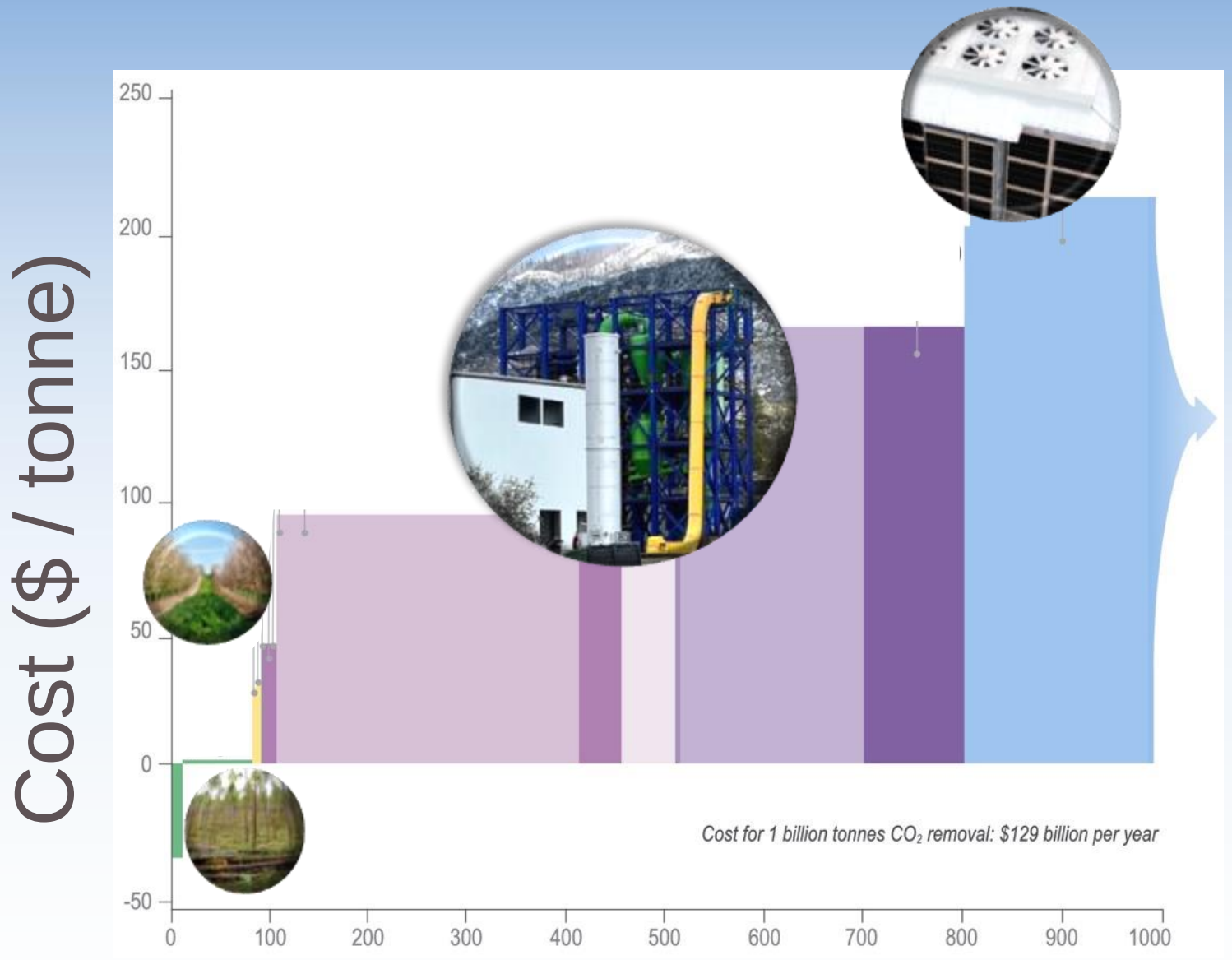

ROADS TO REMOVAL:
Options for Carbon Dioxide Removal in the United States
DECEMBER 2023


Forest Management
Forest Biomass
Municipal Solid Waste
Agricultural Residues
Cropland Soils
Solvent DACS
Adsorbent DACS
Geologic Storage
Renewable Energy

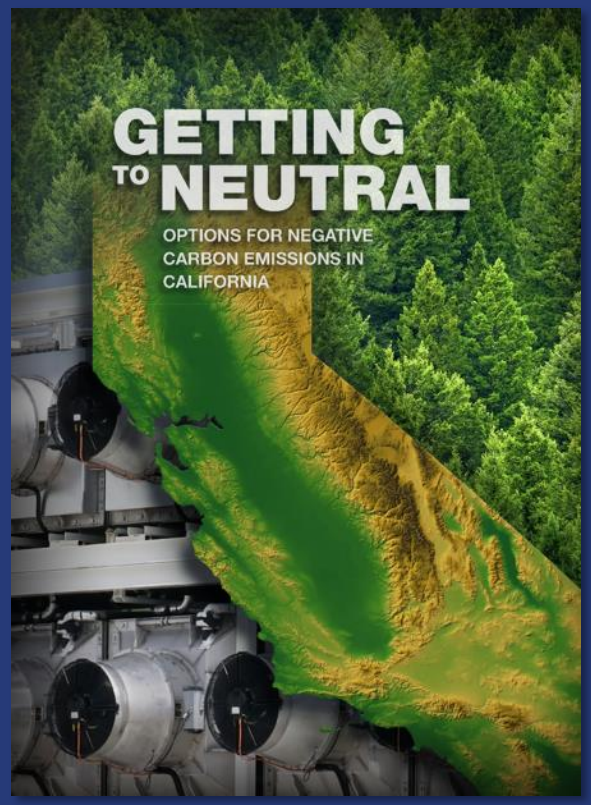
Yes, We Can.

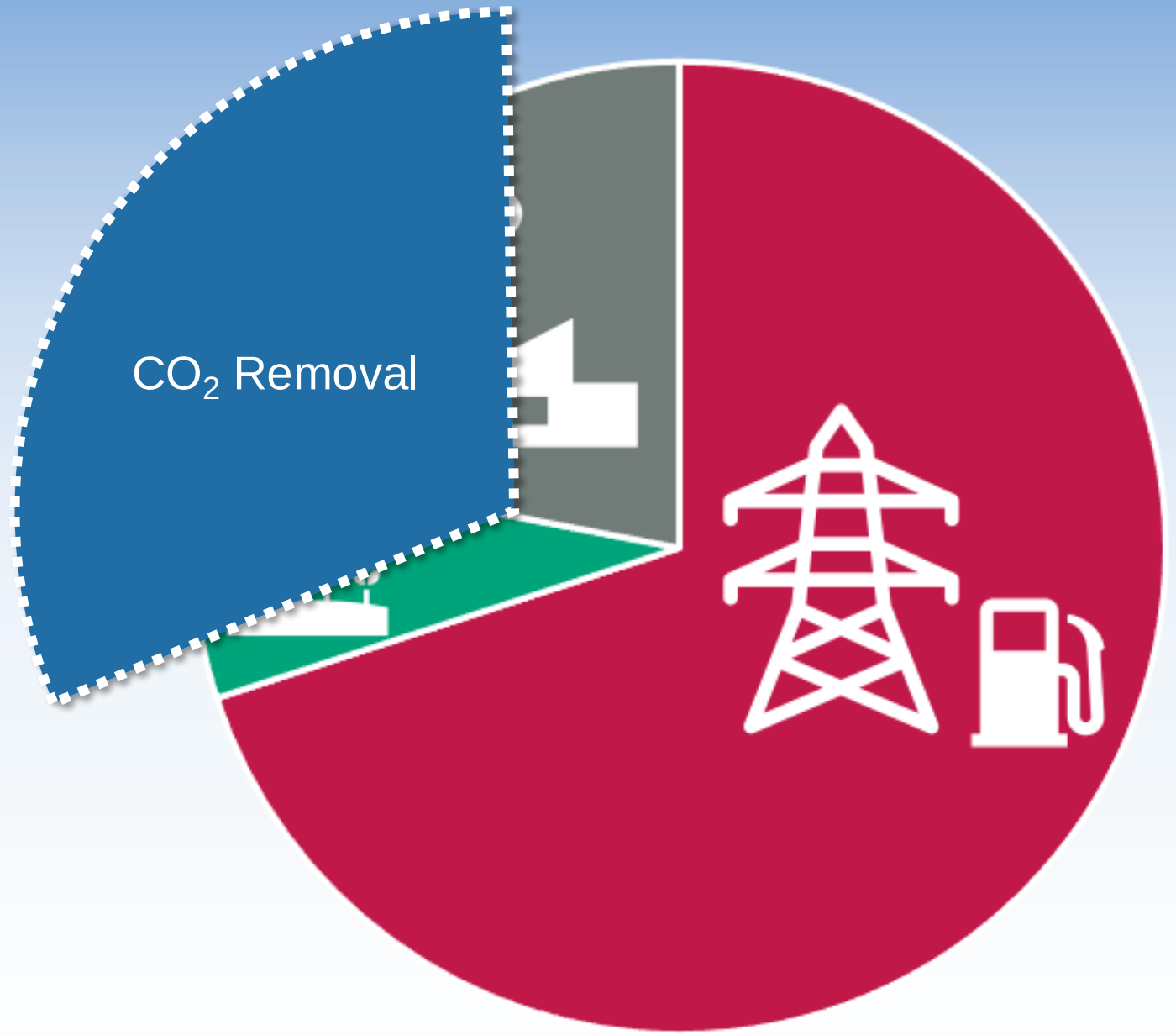
~$130 Billion/year
(<0.5% of US GDP)





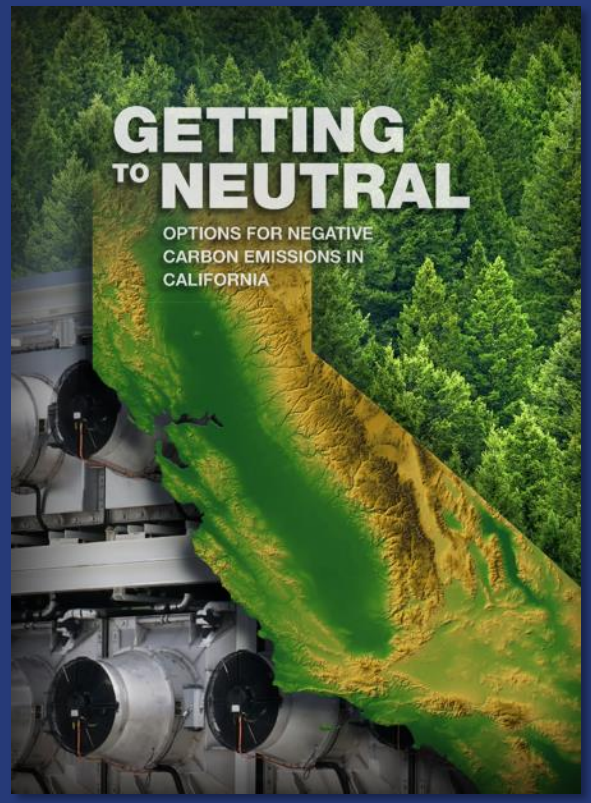
California Wants to Remove 125 Million Tonnes of CO_2 per Year by 2045



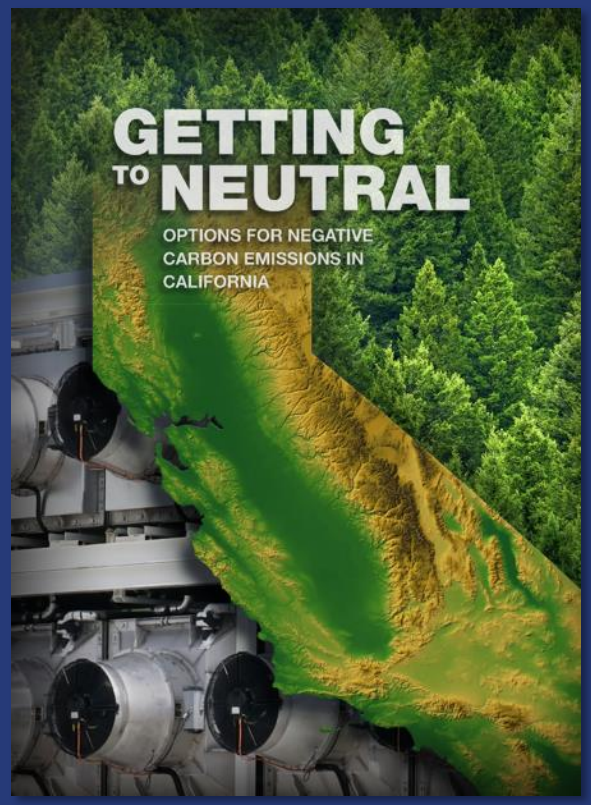


381.3 Million Tonnes CO_{2eq} per year

Can California Remove 125 Million Tonnes per Year?



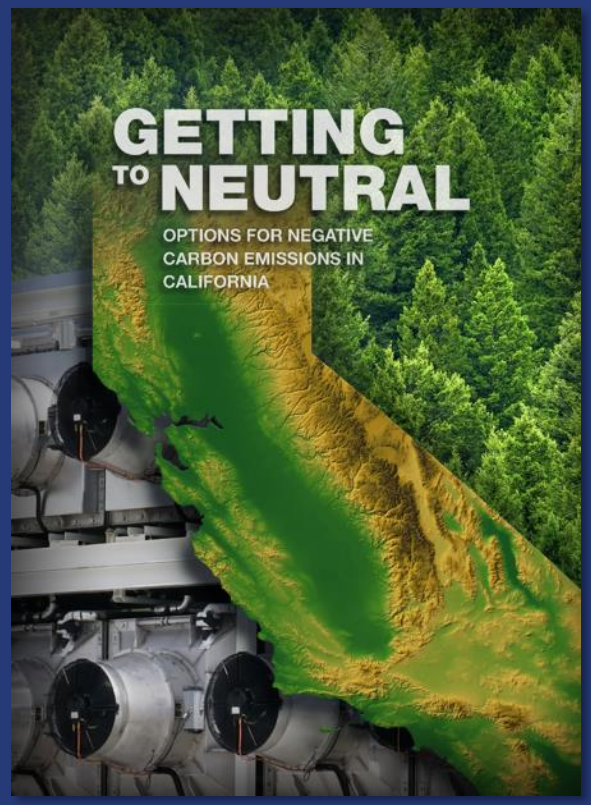
Yes, We Can.

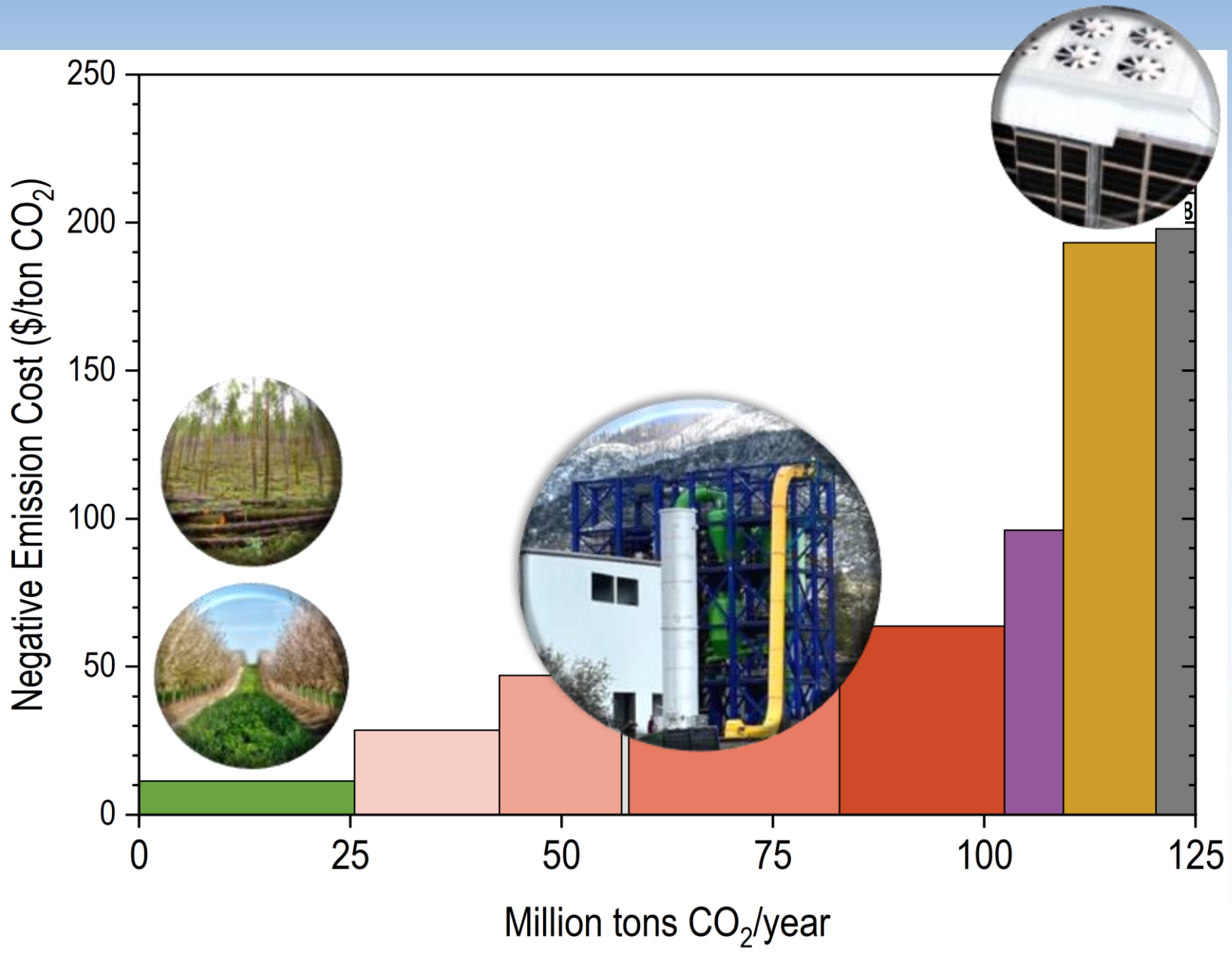

GETTING
TO NEUTRAL
OPTIONS FOR NEGATIVE
CARBON EMISSIONS IN
CALIFORNIA


CO_2
CO_2
CO_2

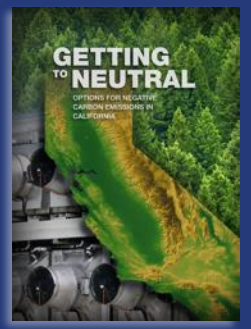
Yes, We Can.

<$10 Billion/year
(0.4% of US GDP)





How is CA doing on this goal?



AB 1279 : California Climate Crisis Act

Net Zero Gas Emissions ASAP, but no later than 2045

SB 905

Create CDR and CCUS Program in California

2020 2022 2023 2024

Forest Fuels Initiatives

First Direct Air Capture (DAC) Pilot Opens in Tracy, CA

DOE Funds CA DAC Hubs

For More Map: cdr.fyi/carbon-removal-map

In Summary...

State of the Science:

- We need to **decarbonize now**,
- We also need to **start removing CO_2**

- US and California can accomplish
  - 10 - 20% of CDR needs with ecological CDR
  - 80% with geologic CO_2 storage

Thank You

For More: Roads2Removal.org