Roads to Removal

A Comprehensive Assessment of Carbon Dioxide Removal Options in the United States

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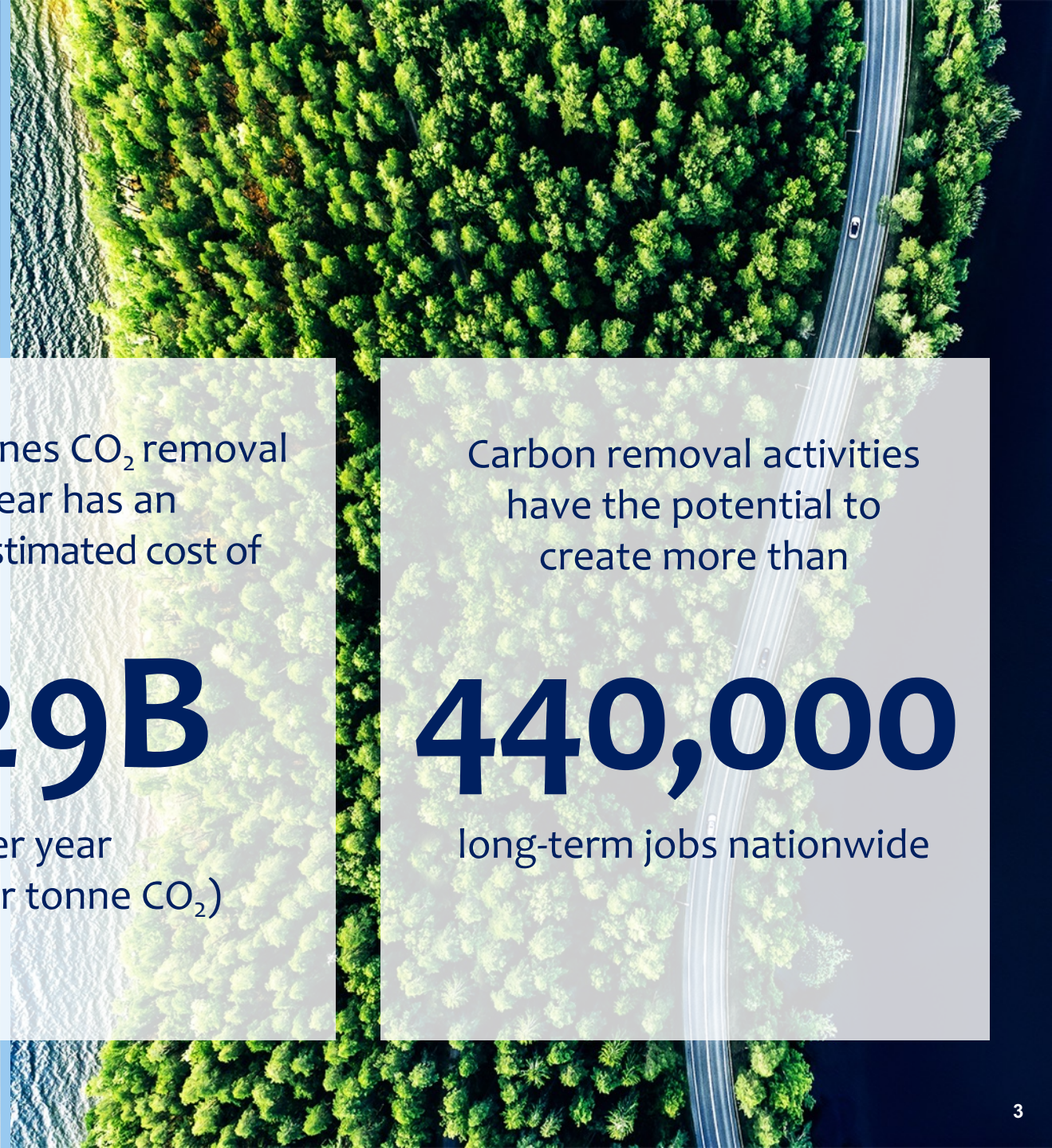
(+ many more)

THE CALIFORNIA REPORT

THE UNITED STATES REPORT

Achieving US national carbon removal goals is possible



The United States can remove at least

1B

tonnes of CO_2 per year by 2050 using demonstrated technologies

1 billion tonnes CO_2 removal per year has an average estimated cost of

$129B

per year ($129 per tonne CO_2)

Carbon removal activities have the potential to create more than

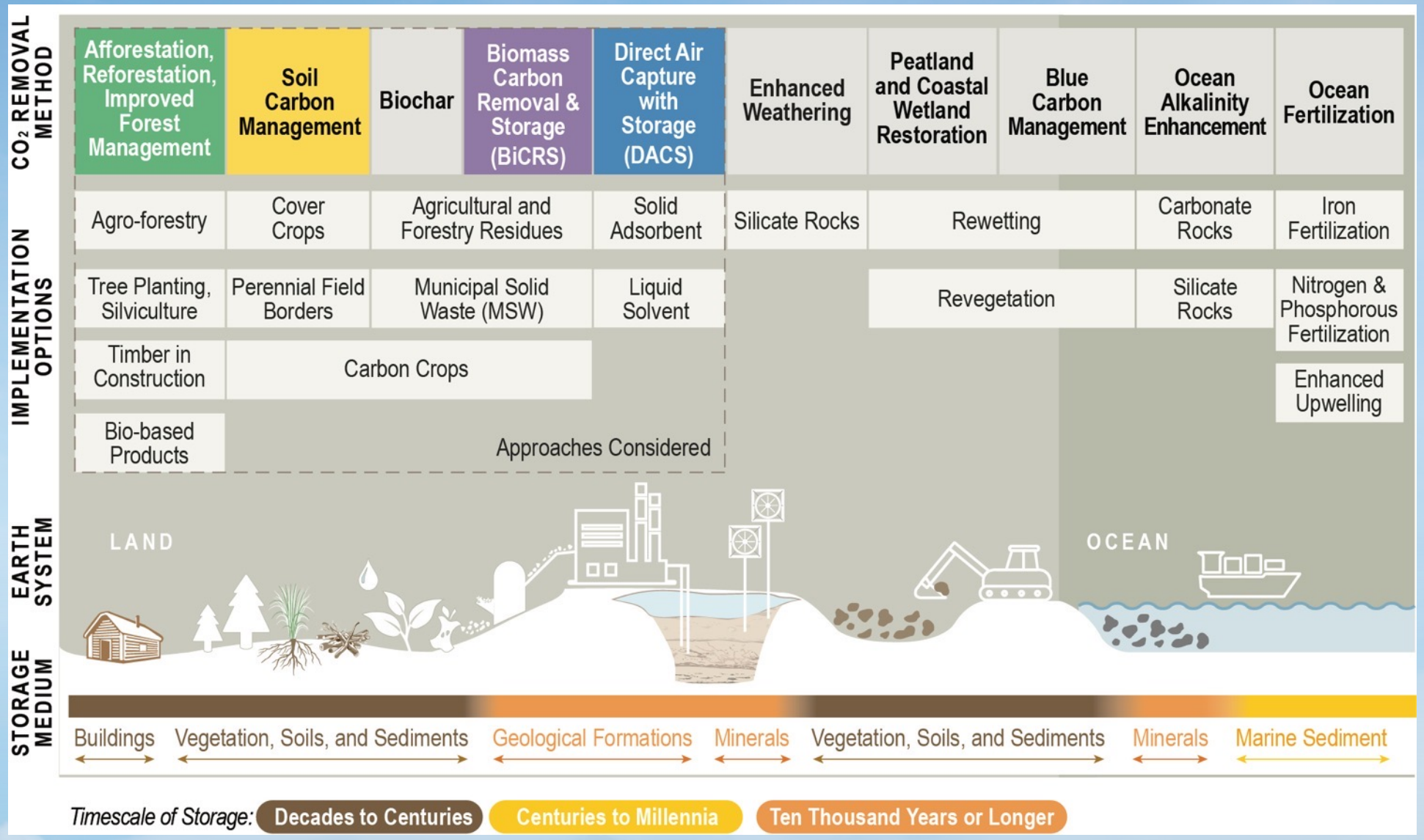
440,000

long-term jobs nationwide

Our analysis focused on *mature* tech

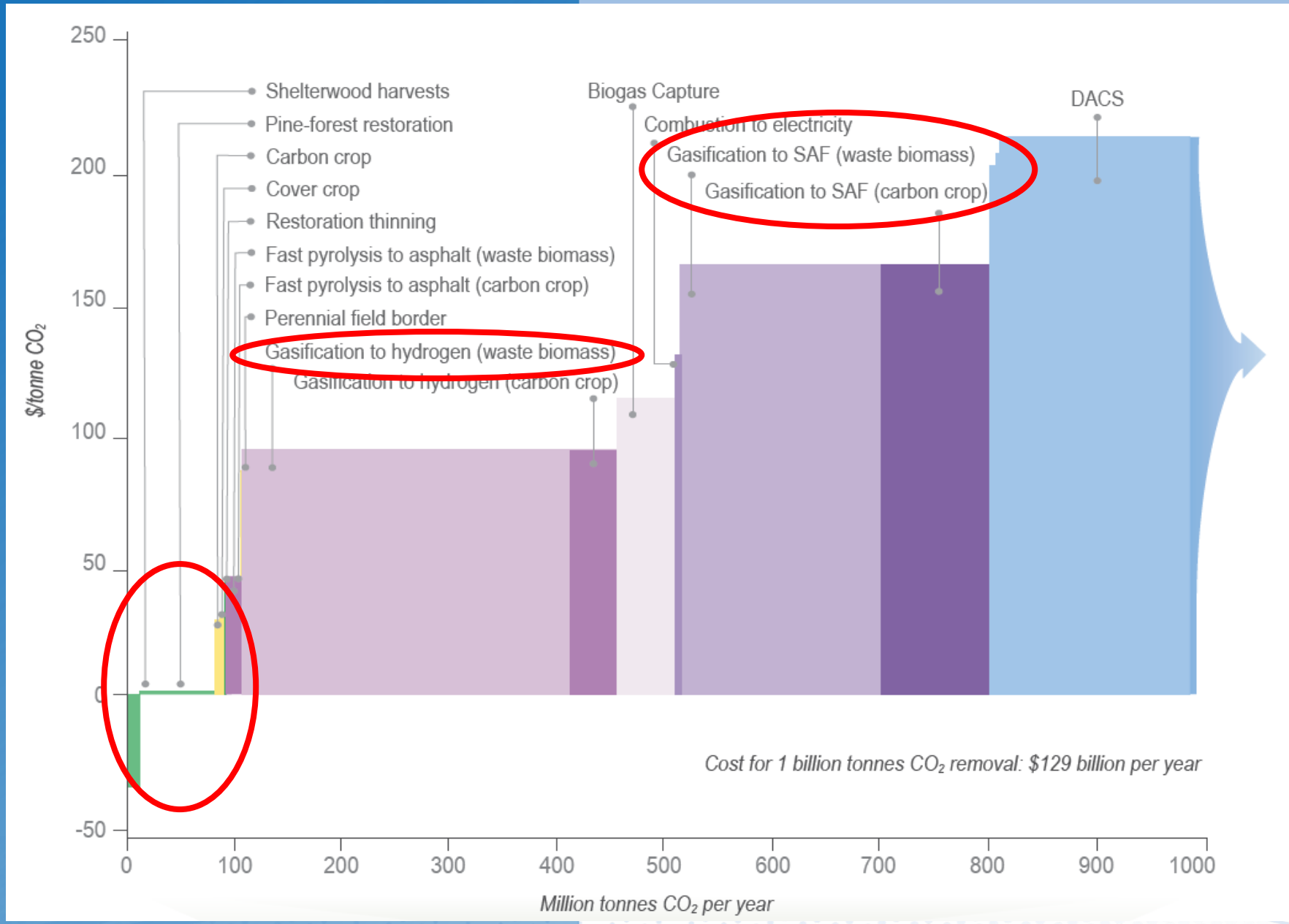
***Must be 'true' negative emissions*

***Only 'mature technologies'*



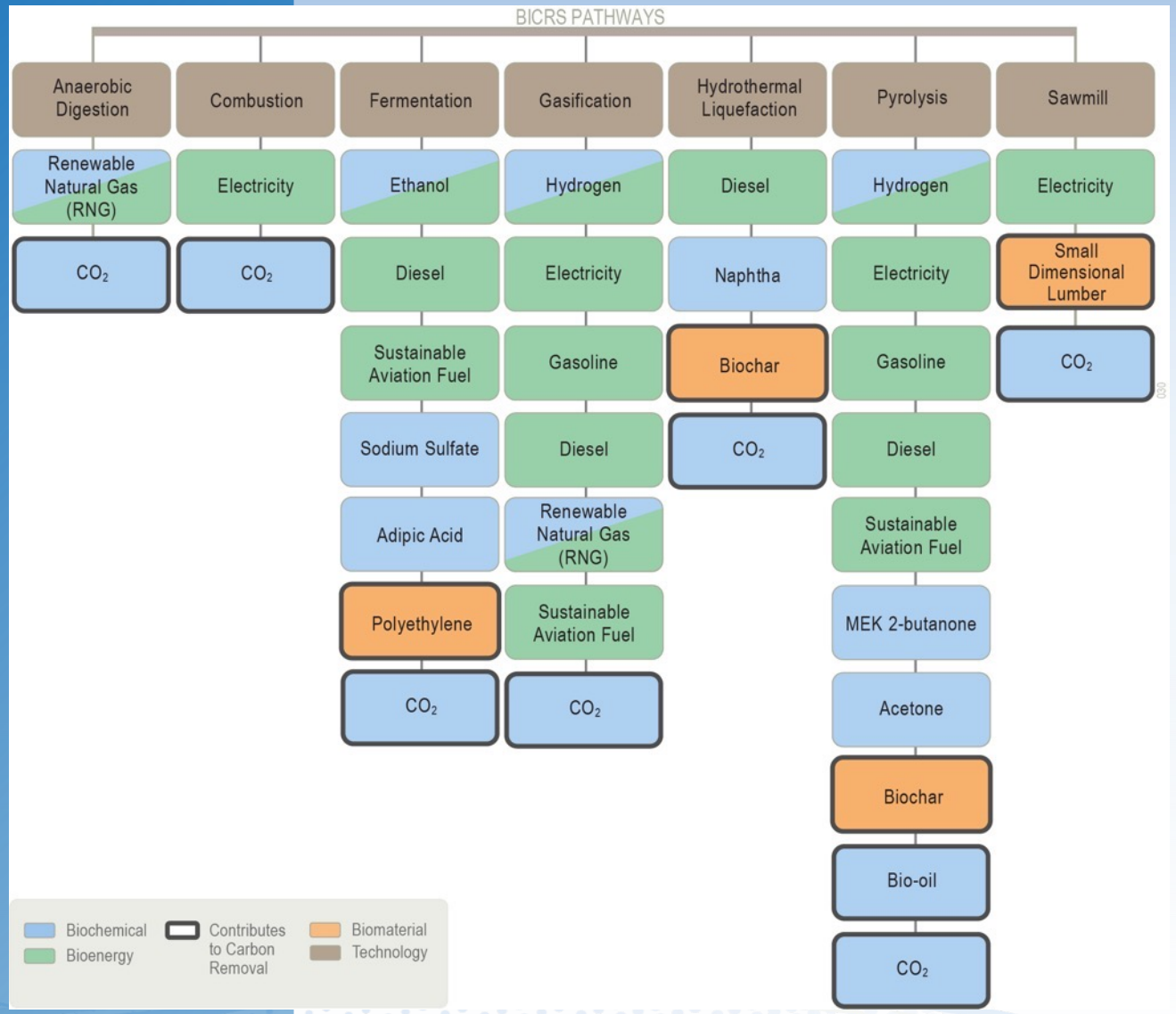
What will it cost?

- We have more CO_2 removal capacity that we need
- 'Extra' removal capacity allows each region to make choices that match local needs…
- Converting waste biomass to H_2 is a large, affordable option



Using organic wastes, we can remove millions of tonnes of CO_2 per year

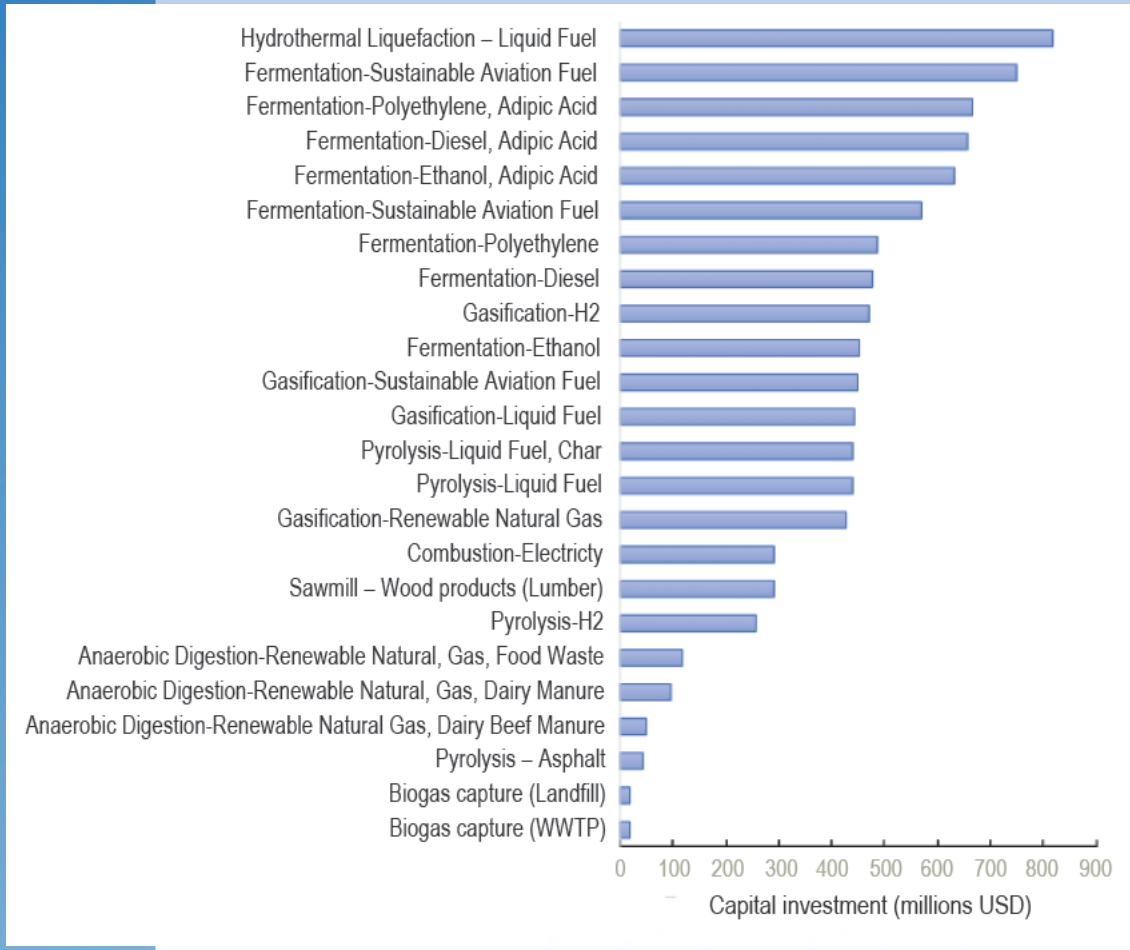
- Targeted areas with biomass (feedstock), good geologic storage, & regional co-benefits
- Avoided land where we grow food
- In-depth technical-economic analysis for 27 mature biomass conversion pathways
- Would require ~300 new biorefineries across the USA



27 unique biomass conversion pathways

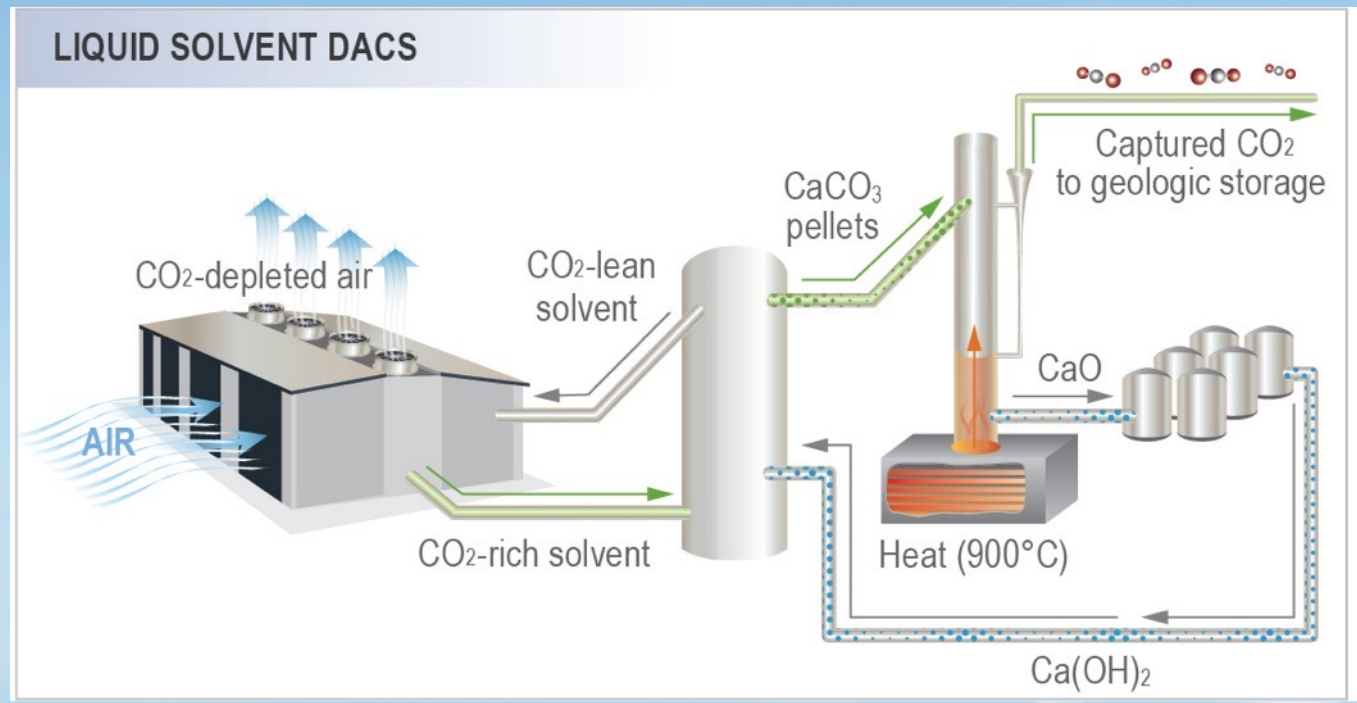
Carbon capture from biomass is a key part of solution to meet US climate goals

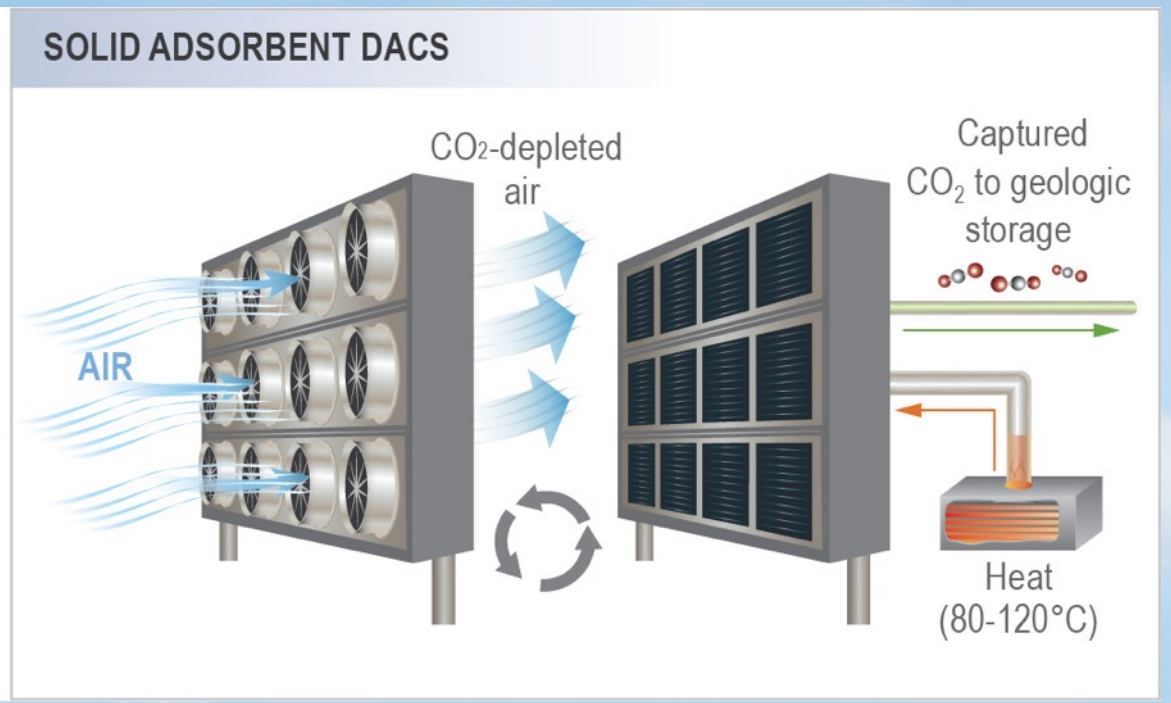
- 800 million tonnes of CO_2 removal per year from 300+ biorefineries
- 34 million tonnes of hydrogen production, 150 TWh of electricity production, 1.4 million tonnes biochar production
- cost < $100 per tonne



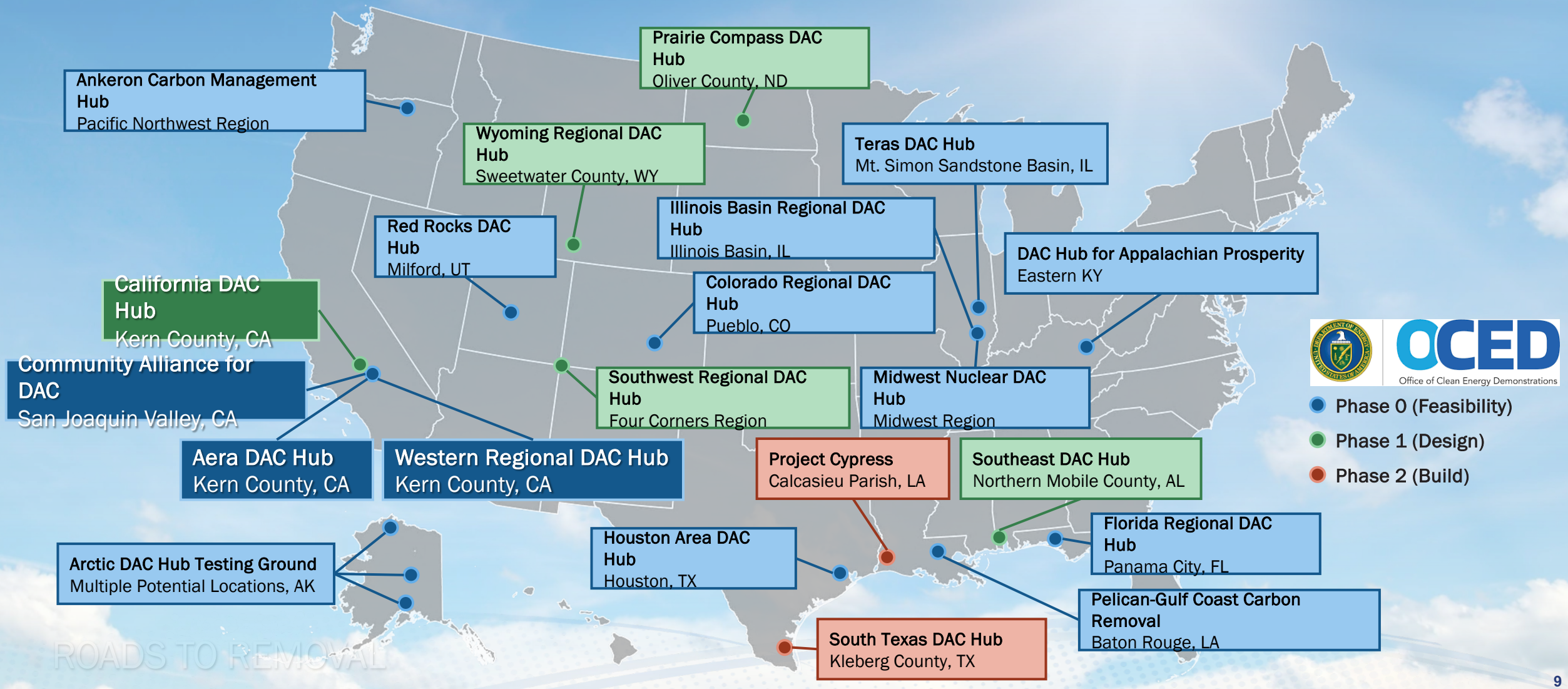
- BiCRS capital investment costs are significant

Direct air capture uses engineered materials and systems to remove CO_2 from the atmosphere

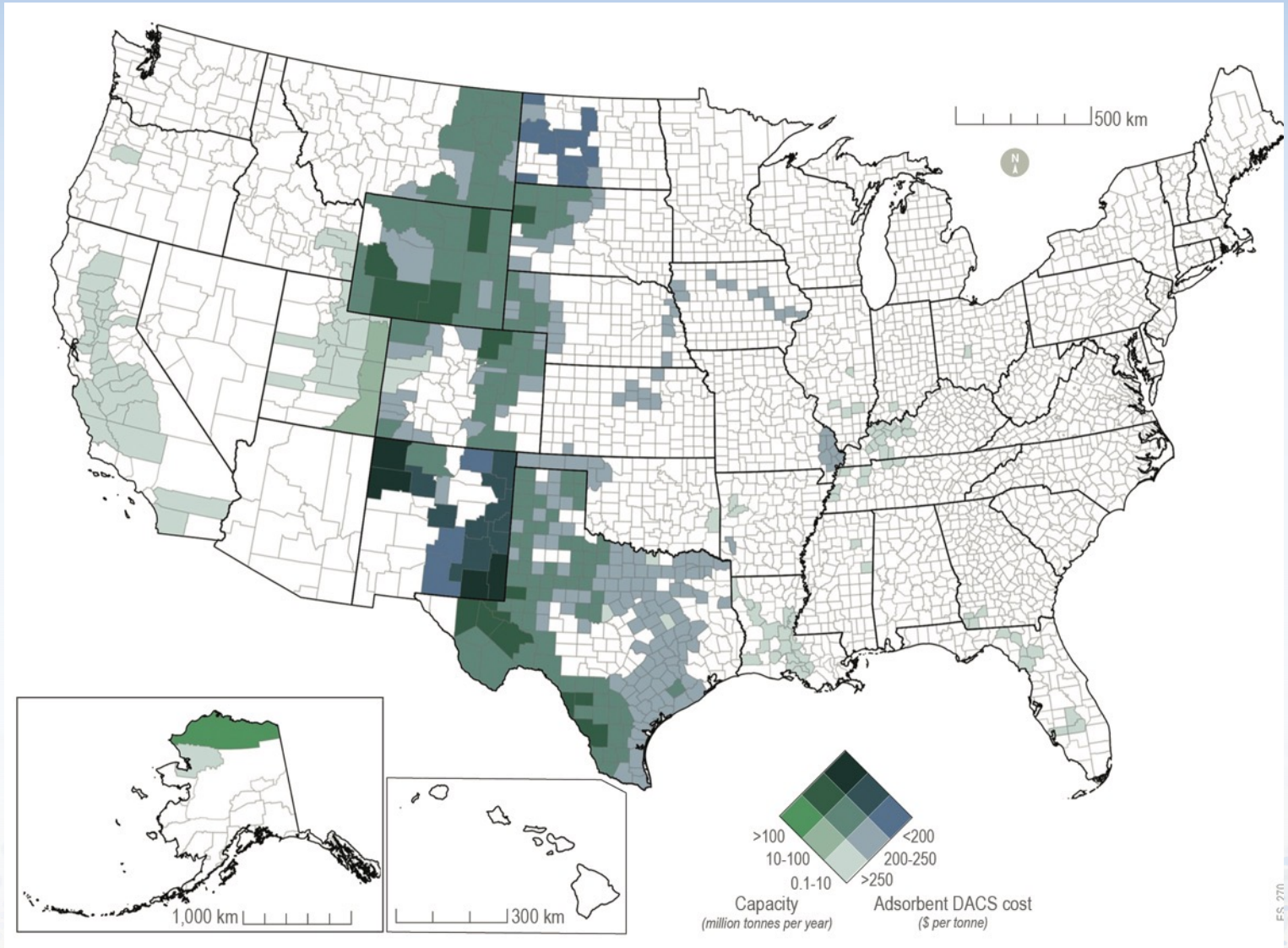




The USA has invested in many DAC demonstration projects

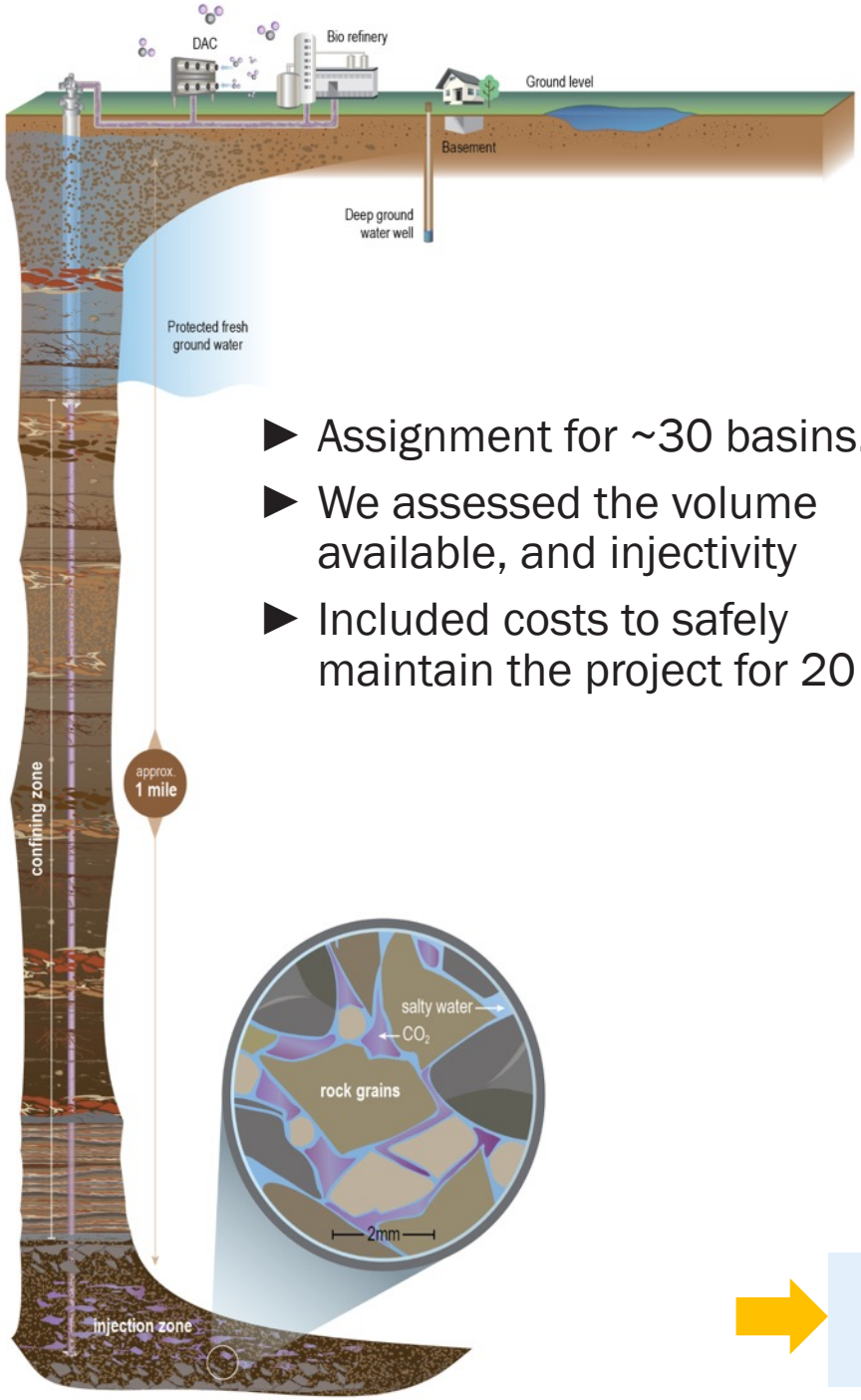


Direct air capture (DAC): Best land is near regions of high energy and CO_2 storage

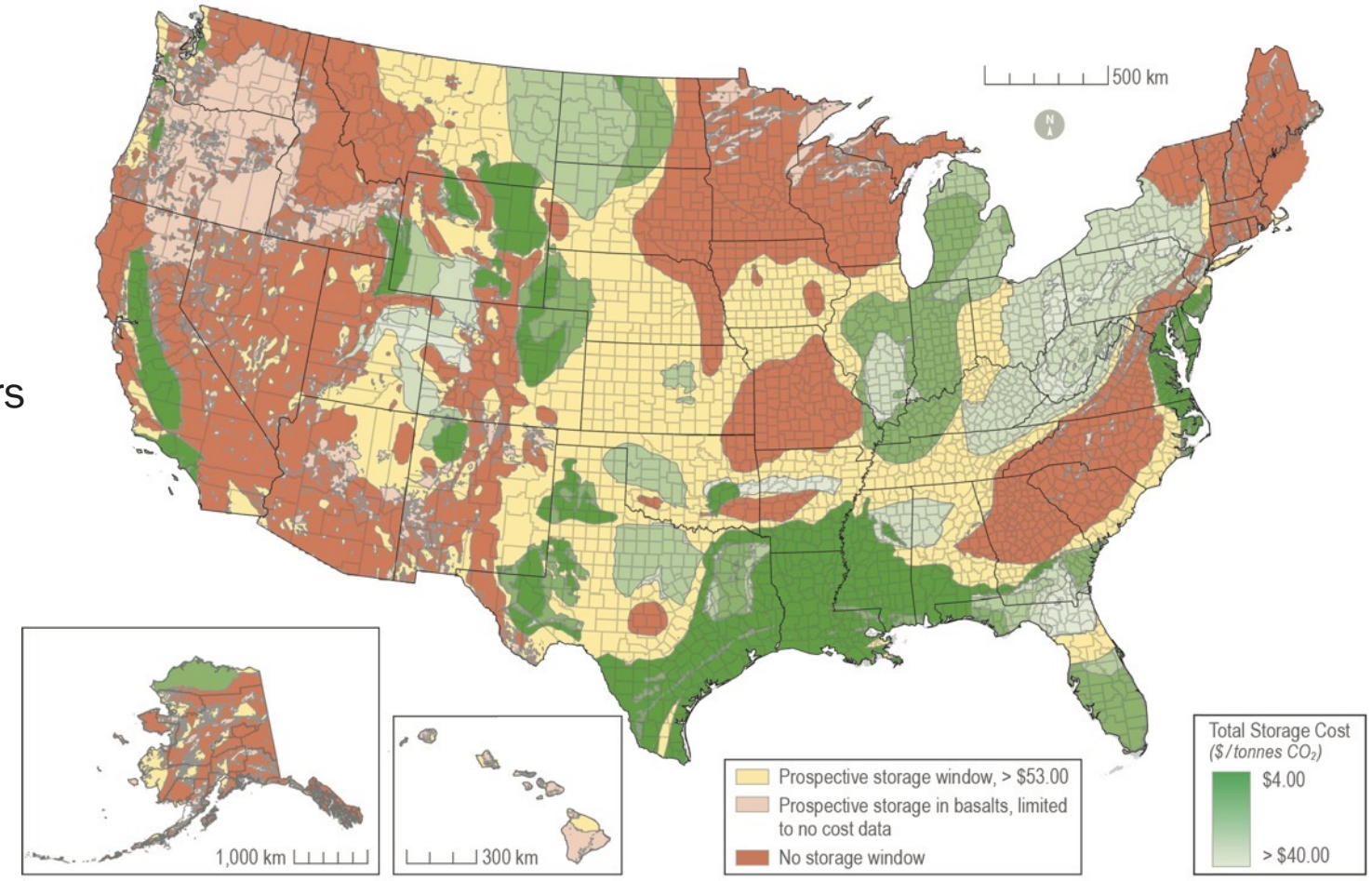


- DAC can remove over 9 billion tonnes of CO_2 per year, at \$200 - \$250/tonne CO_2.
- West Texas, Upper and Lower Rocky Mountains, and parts of the Upper and Lower Midwest have the largest potential for DACS deployment with renewable energy
- Priority regions for DACS have nearby geologic storage and land for renewable energy

We have plenty of reliable geologic storage

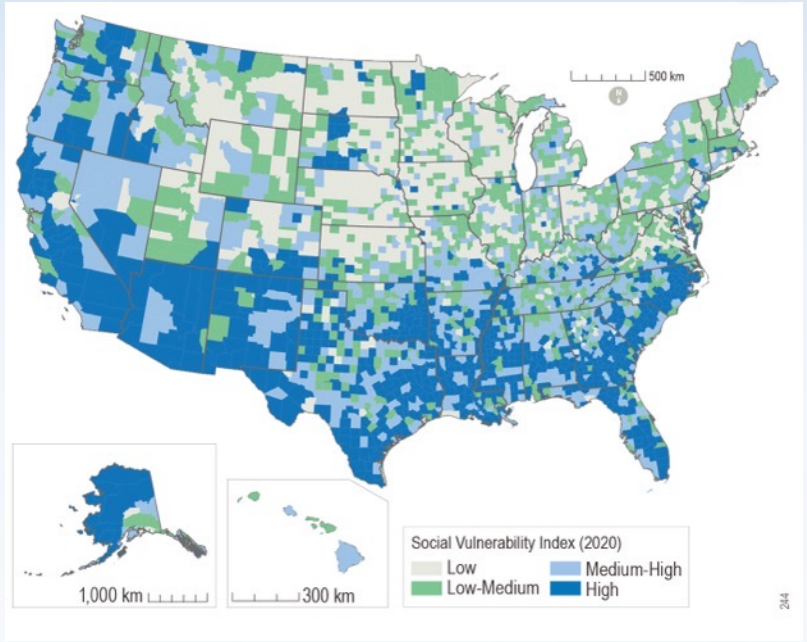


- Assignment for ~30 basins.
- We assessed the volume available, and injectivity
- Included costs to safely maintain the project for 20 yrs

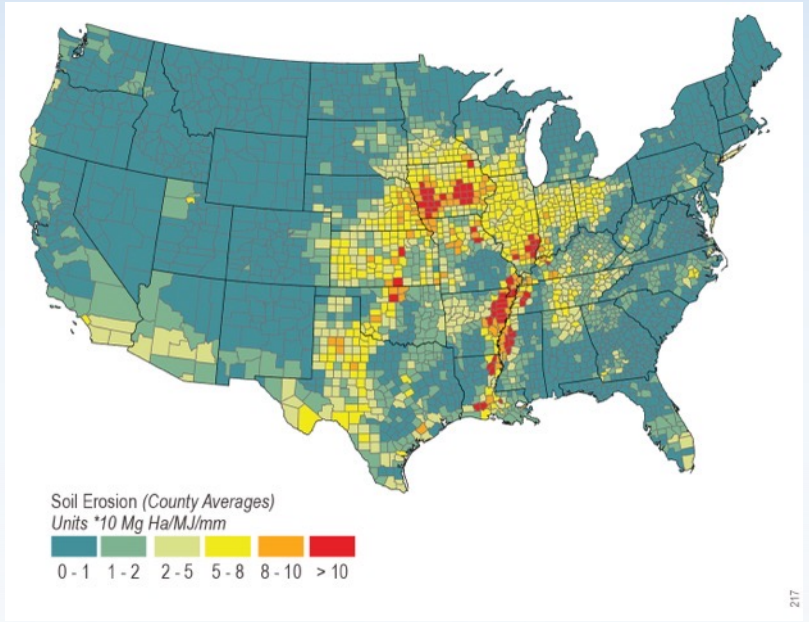


More than half the land area in the United States has potential for safe, affordable (<$40/tonne) CO_2 geologic storage

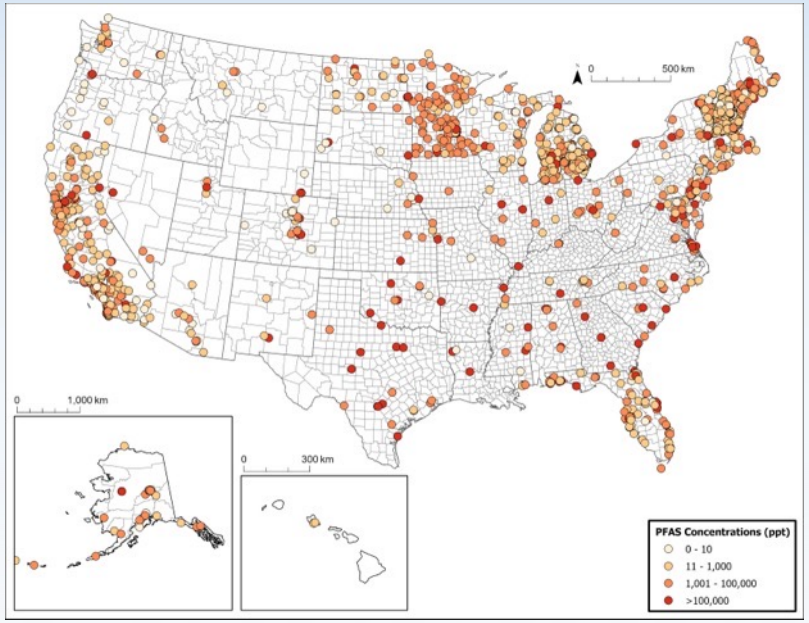
EEEJ Analysis: where can CO_2 removal approaches benefit the environment, communities, or both?



Social vulnerability index

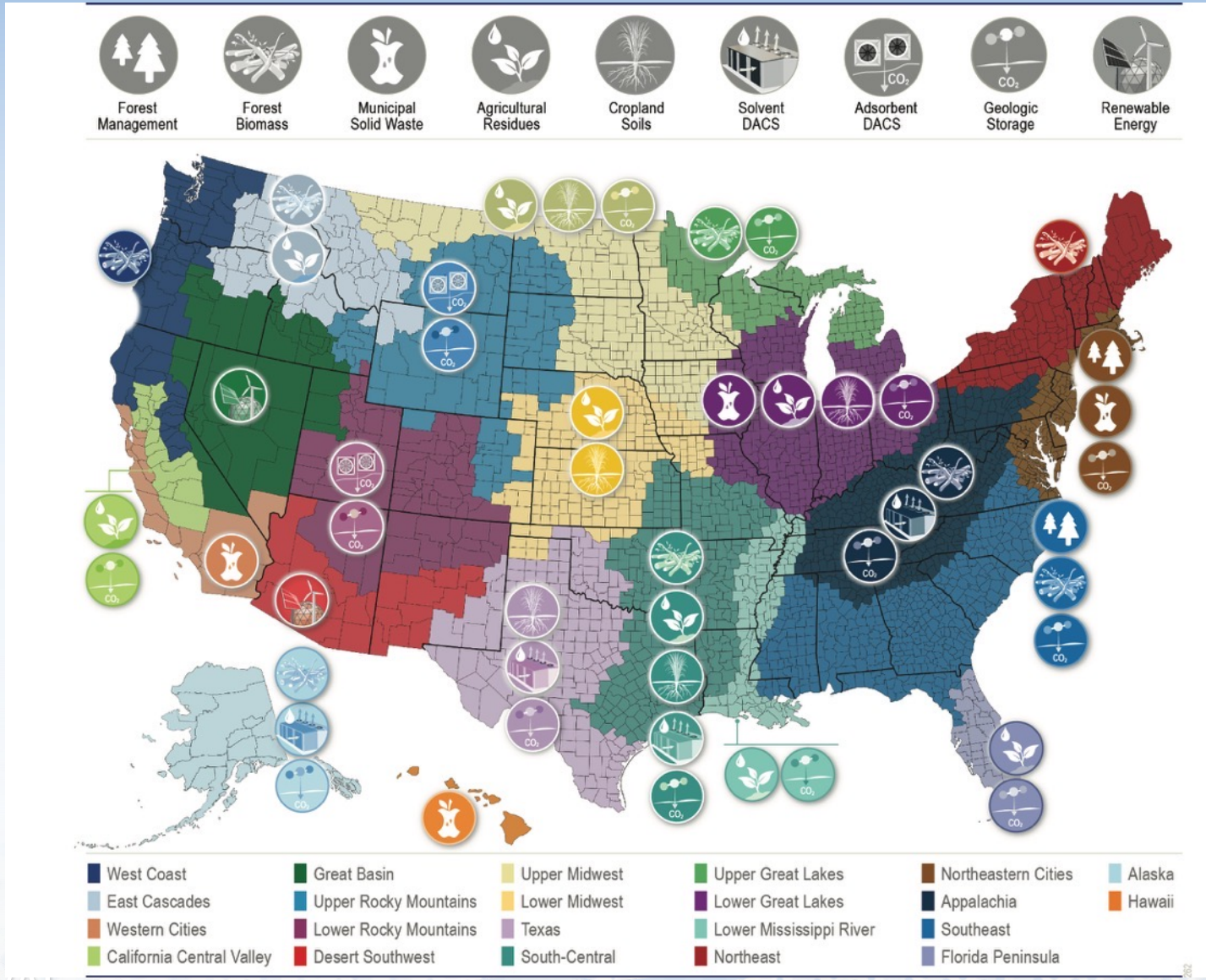


Soil erosion



PFAS concentrations

Every US Region Has a Story and an Opportunity



THANKS

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