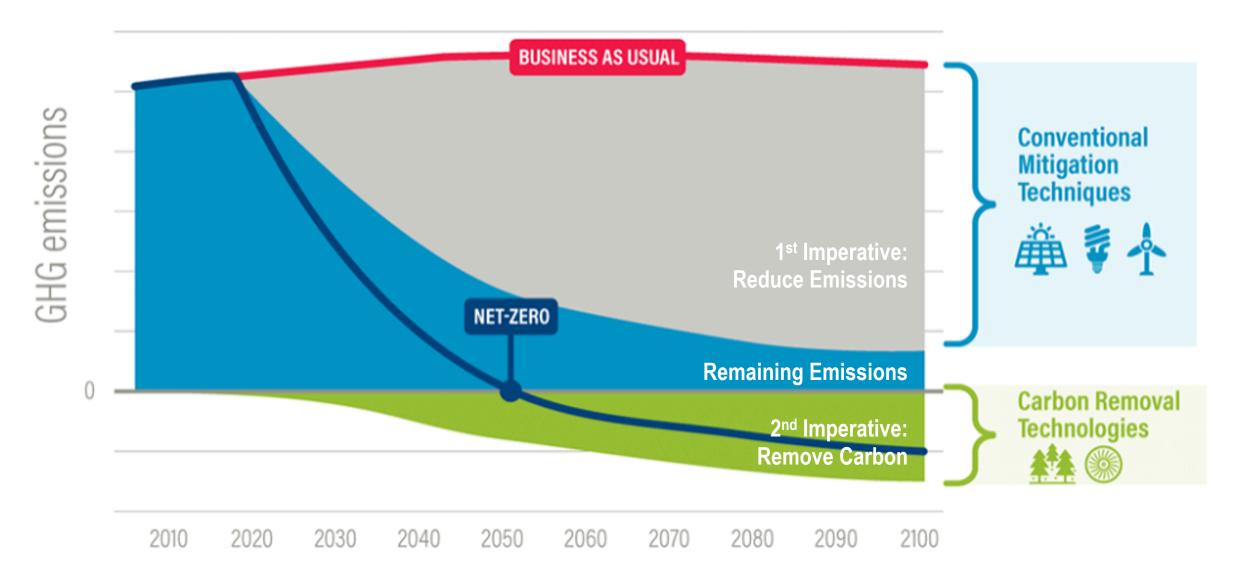
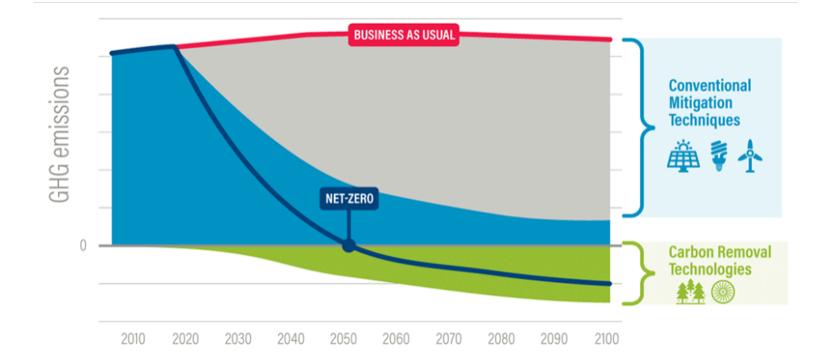


CarbonShot

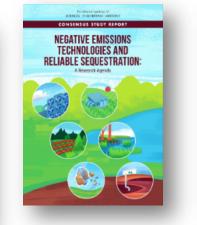
Creating Options for Carbon Removal at Scale in the United States

NET ZERO: REDUCE EMISSIONS + REMOVE CARBON













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WORKING PAPER

CARBONSHOT: FEDERAL POLICY OPTIONS FOR CARBON REMOVAL IN THE UNITED STATES

JAMES MULLIGAN, ALEXANDER RUDEE, KATIE LEBLING, KELLY LEVIN, JAMES ANDERSON, AND BEN CHRISTENSEN

EXECUTIVE SUMMARY

Highlights The United States needs to make large-acale Investments is carbon renoval in the coming years If the country is to achieve carbon neutrality by middentary.

 This working paper identifies a consolidated set of high-priority, near-term, federal policy options for advancing terrestrial carbon removal.

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CONTENTS

Abbreviations

Direct Air Capture.

Carbon Mineralization ...

Agricultural Soll Carbon Management.

Introduction The Restaration

Excubic Summary

Advancing a broad set of natural carbon capture and technological carbon tensoral pathways carb restored, utilizes the risk sponse that score full to said to the invest analysis, and interase carolisative seconds the invest analysis, and interase carolisative seconds

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CARBONSHOT: FEDERAL POLICY ASSESSMENT

Objective:

Provide a clear set of highpriority, near-term federal policy options to advance carbon removal capabilities and deployment in the United States

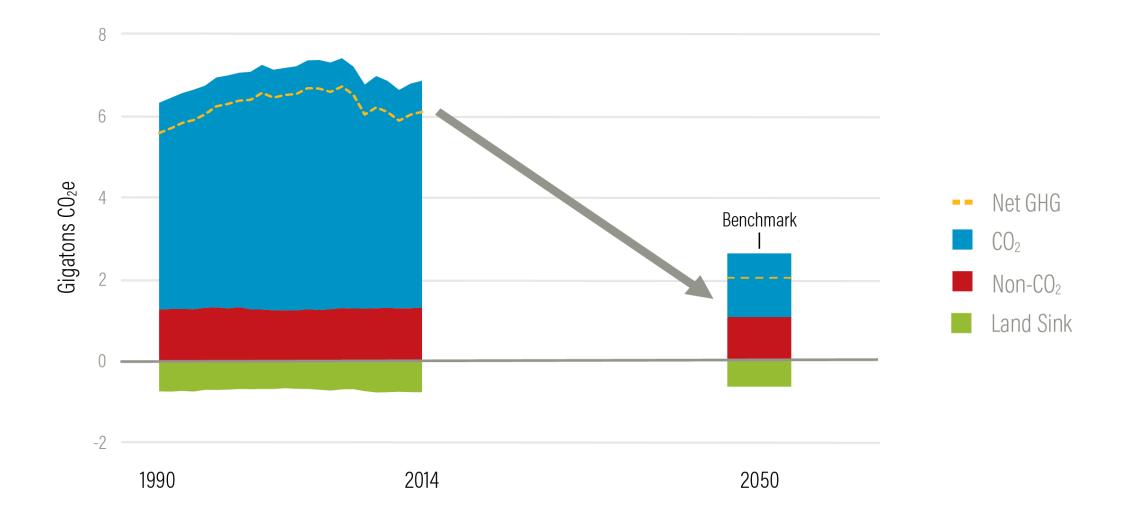
Benchmark the required scale

Map the options—natural and technological

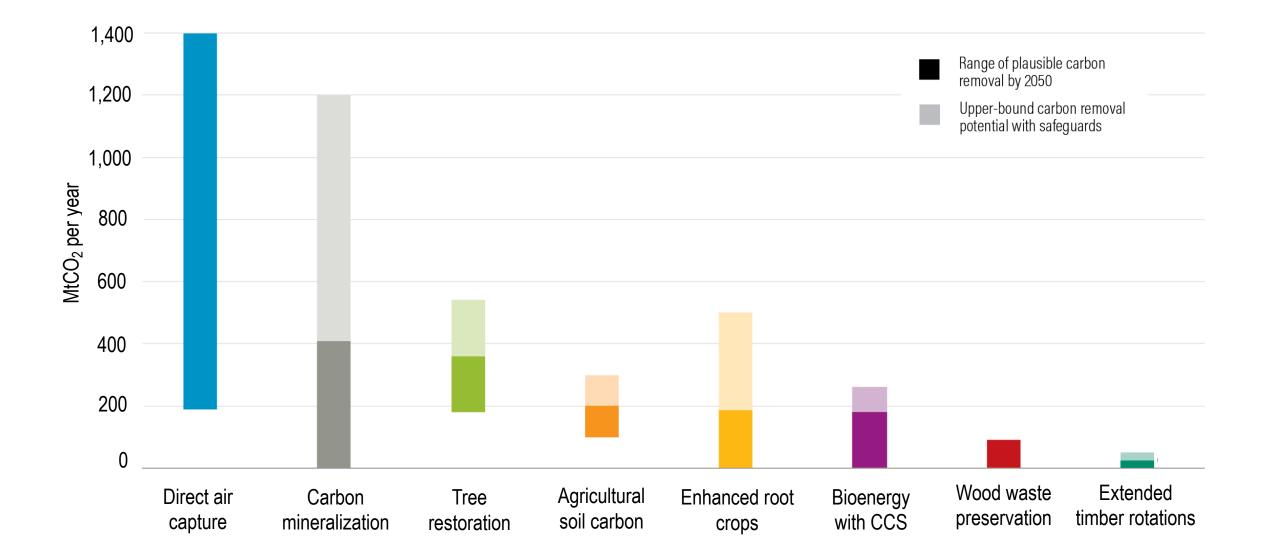
Develop & apply a set of prioritization principles for policy design

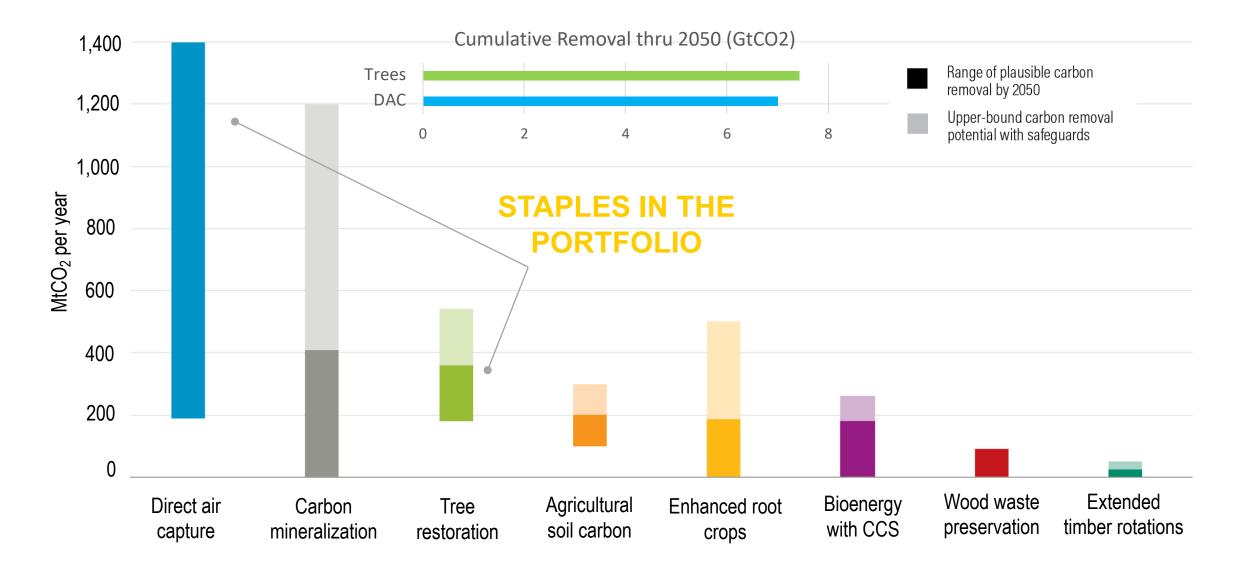
Construct deployment scenarios & evaluate portfolios of carbon removal options

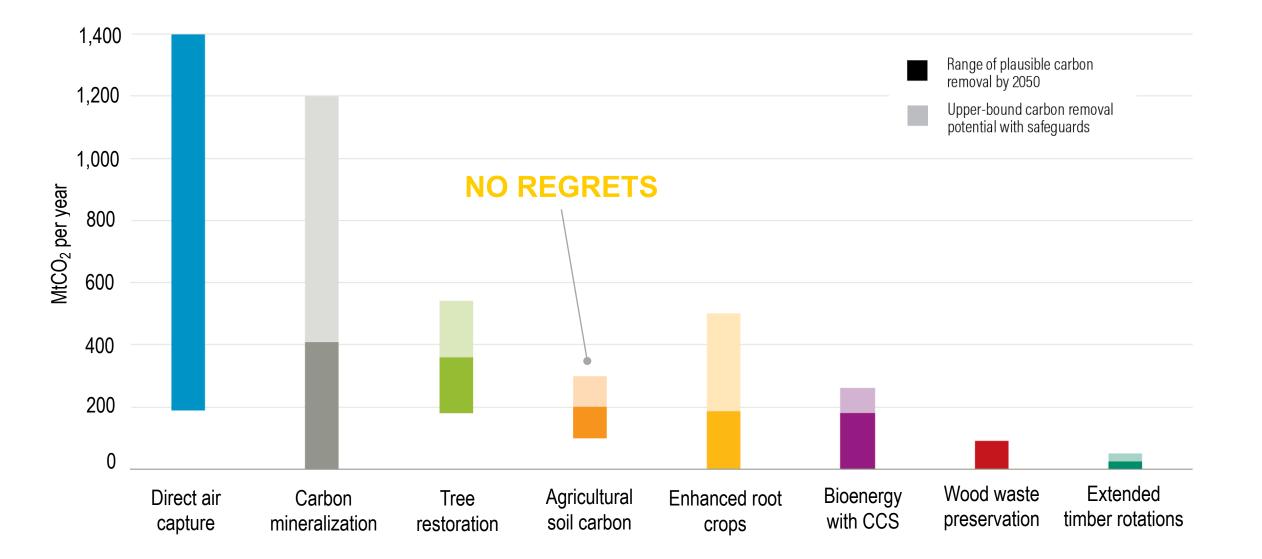
BENCHMARK FOR U.S. CARBON REMOVAL BY 2050: 2 GIGATONS

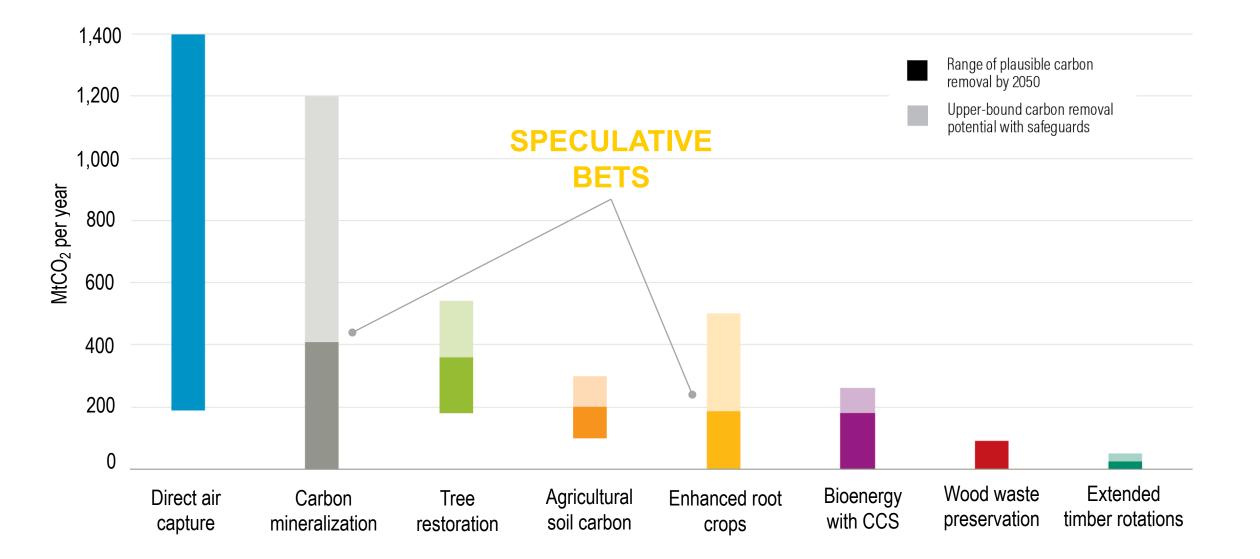


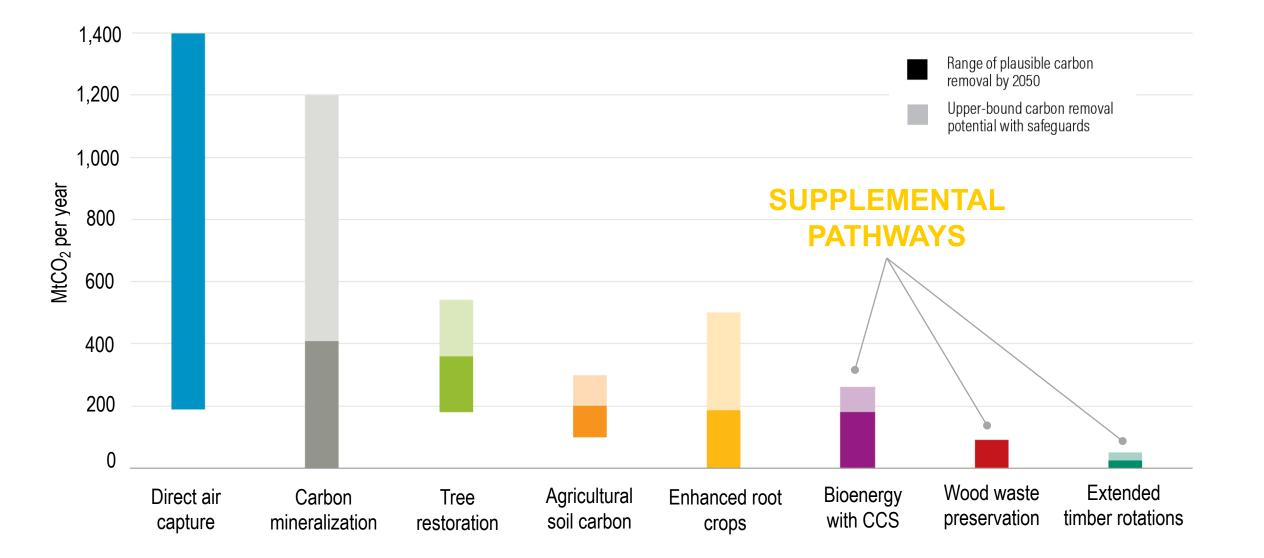
MAPPING OPTIONS: ESTIMATED CARBON REMOVAL POTENTIAL BY 2050

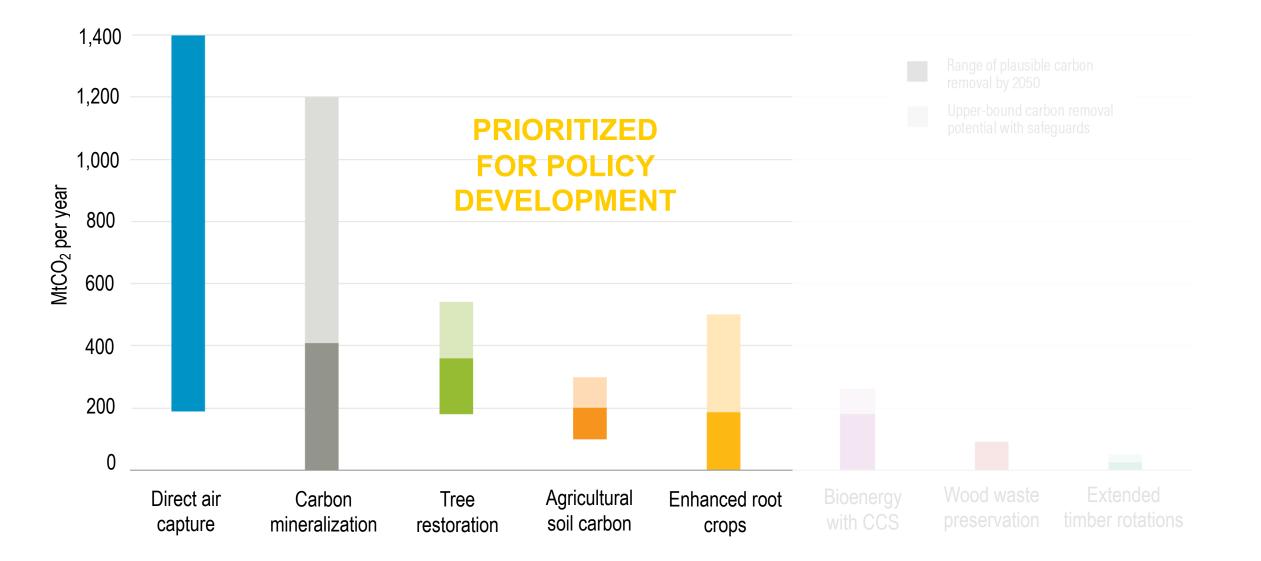












PRINCIPLED POLICY DESIGN

Address major barriers to deployment or deploymentreadiness Adopt & adapt existing policy models rather than create new ones

> Maximize return on investment

Design for rapid scale-up rather than incremental gains 01 FEDERAL SUBSIDY FOR RESTORING TREES TO THE LANDSCAPE

02 DIRECT AIR CAPTURE TECHNOLOGY DEVELOPMENT PROGRAM

03 ON-FARM INNOVATION PROGRAM

04 EMERGING CDR TECHNOLOGY RD&D PROGRAM

- Tax credit, cost-share, and/or state grants
- \$4-\$4.5 billion per year over 20 years
- Activate 3rd party intermediaries
- Safeguards for ecological appropriateness, additionality, tree survival

02 DIRECT AIR CAPTURE TECHNOLOGY DEVELOPMENT PROGRAM

- Public RD&D:
 - \$150m per year (\$60-\$240m)

Private sector deployment experience:
 45Q credit value to \$180/ton for DAC

03 ON-FARM INNOVATION PROGRAM

- Cost-share & technical assistance for soil health practices paired with monitoring & research
- 10m acres to provide needed statistical power
- \$500m per year over 10 years
- Soil monitoring in National Resources Inventory

- \$25m per year for ex-situ carbon mineralization
- \$40-\$50m per year for enhanced root crops
- Resource a broader CDR innovation agenda (see EFI's RD&D Initiative & Management Plan)

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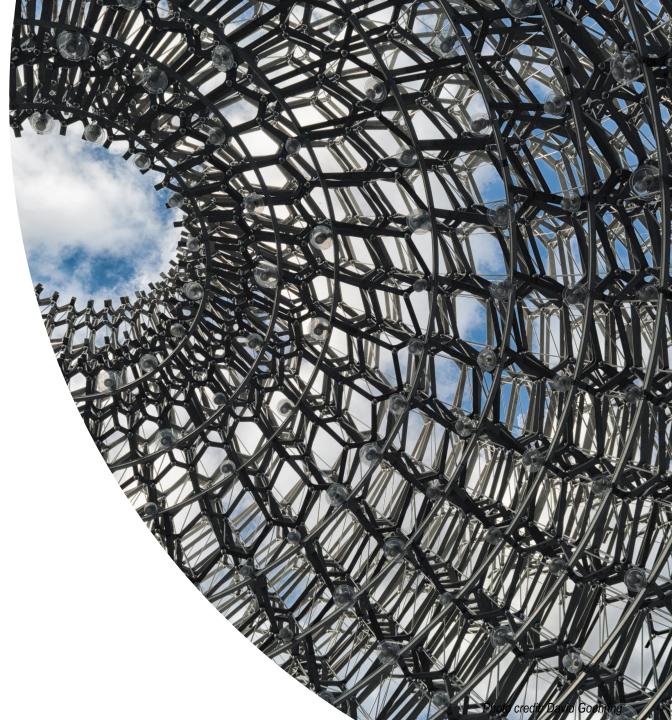
BALANCE OF NEW FEDERAL INVESTMENT (2020-2030)

AVERAGE \$6 BILLION PER YEAR

GE ION AR	Tree restoration	Direct air capture
		Agricultural soil carbon
		Speculative bets

ENABLING ENVIRONMENT

- Abundant low-carbon energy
- Lifecycle assessment
- Land use efficiency
- CO₂ pipelines
- Geologic storage of CO₂
- CO₂ utilization technology & markets
- Natural carbon capture monitoring





Earth Observing System 2019

Sampling Networks	Remote Sensing	Practice Monitoring	Data Systems
 Increase Forest Inventory & Analysis (FIA) sampling frequency Institute soil carbon sampling through National Resources Inventory (NRI)* 	 Make GEDI mission permanent to collect repeated national lidar data Integrate lidar data or digital aerial photography with FIA to improve spatial and temporal resolution of forest stock change estimates* Assess impact of forest degradation on carbon stocks using new parameters in satellite data Create a regularly-updated national 	 Collect and make available more temporally and spatially granular data from USDA surveys—including Census of Agriculture and Conservation Effects Assessment Project (CEAP) 	 Create a federal platform to aggregate and store data on natural carbon fluxes and land management practices*





soil carbon map





Sampling Networks

- Increase Forest Inventory & Analysis (FIA) sampling frequency
- Institute soil carbon sampling through National Resources Inventory (NRI)*

Remote Sensing

- Make GEDI mission permanent to collect repeated national lidar data
- Integrate lidar data or digital aerial photography with FIA to improve spatial and temporal resolution of forest stock change estimates*
- Assess impact of forest degradation on carbon stocks using new parameters in satellite data
- Create a regularly-updated national soil carbon map

ractice Monitoring

Collect and make available more temporally and spatially granular data from USDA surveys—including Census of Agriculture and Conservation Effects Assessment Project (CEAP)

Data Systems

Create a federal platform to aggregate and store data on natural carbon fluxes and land management practices*

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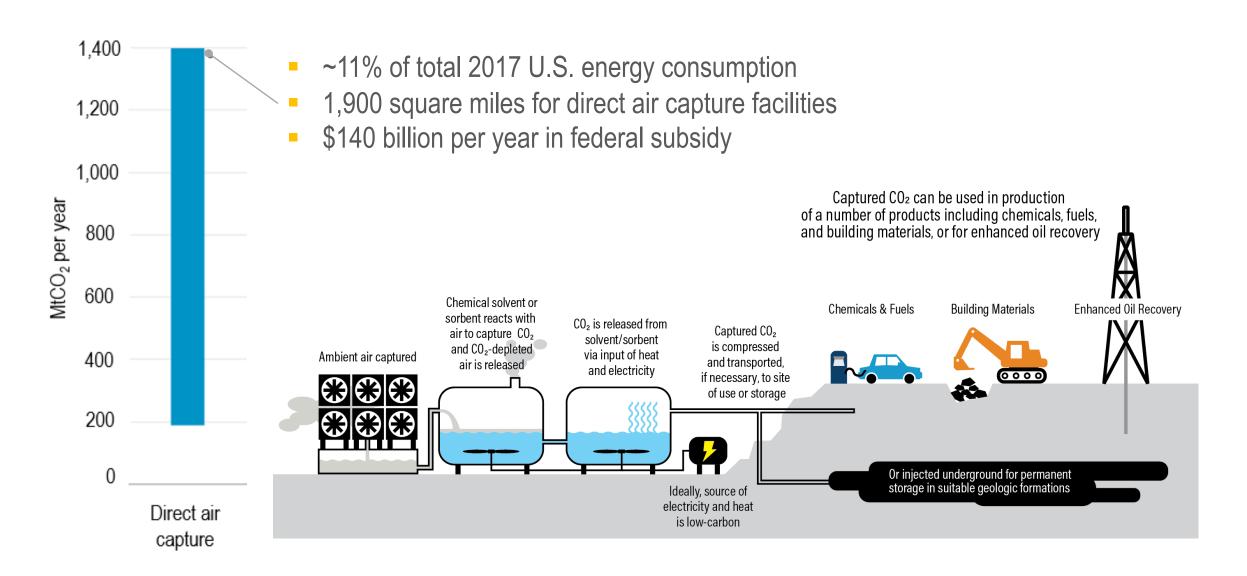


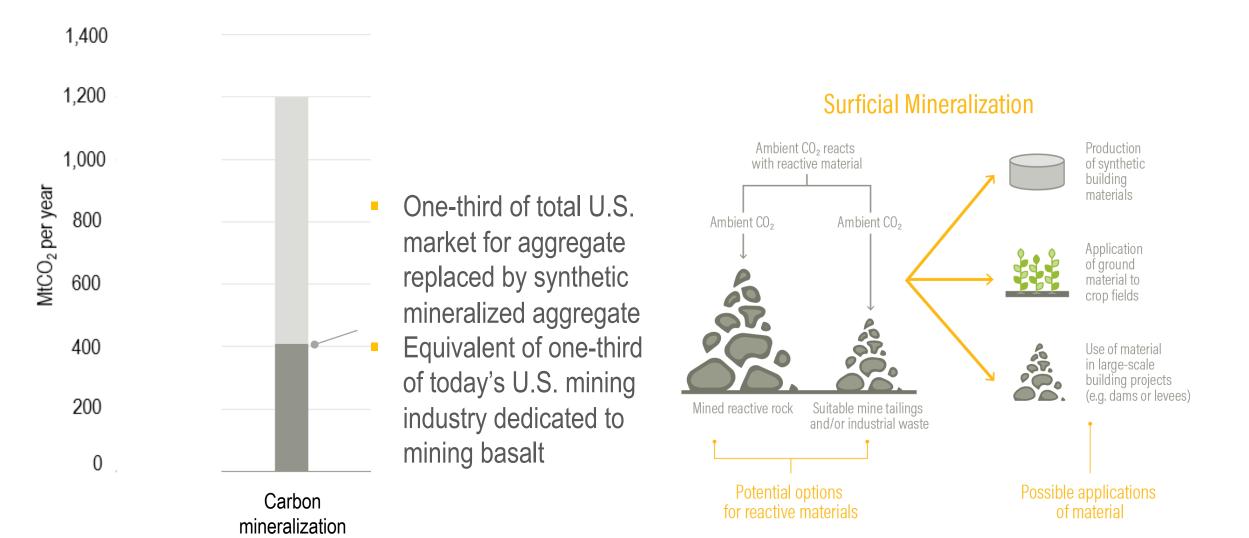


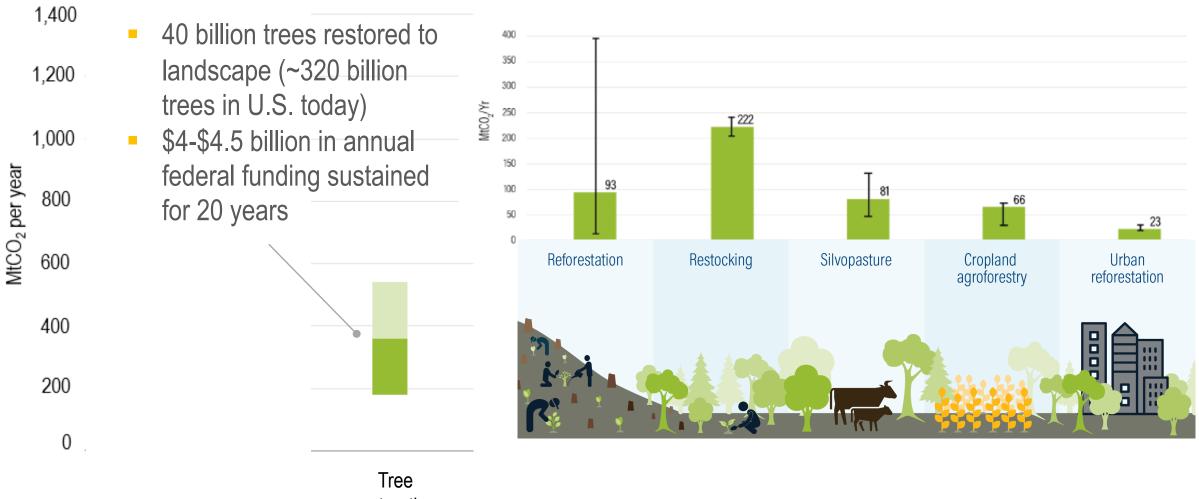
Alex Rudee alexander.rudee@wri.org

wri.org/carbonremoval

Back-up Slides







restoration

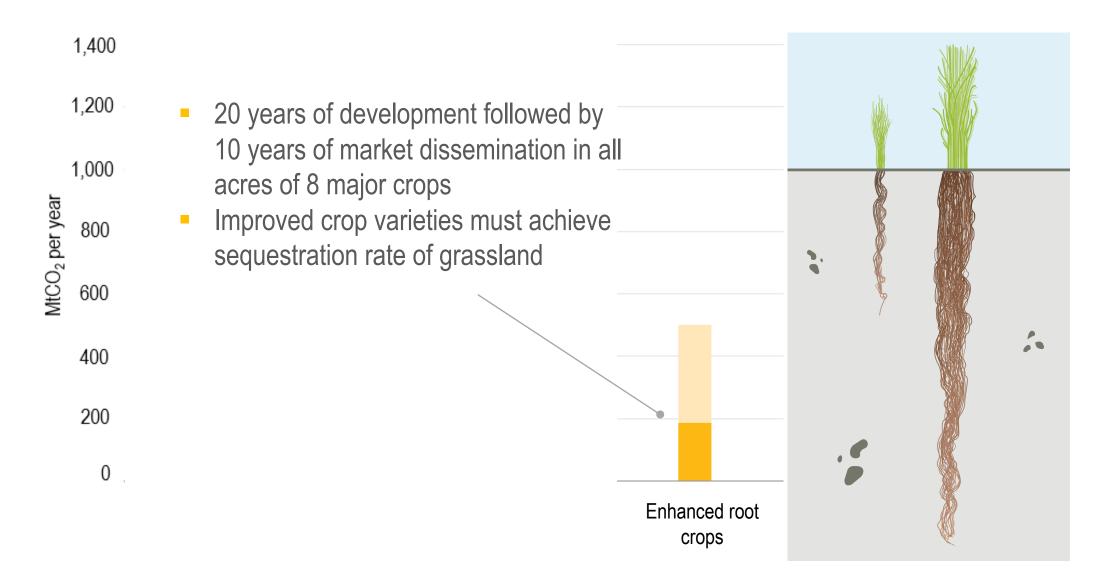
1,400 1,200 Cover crops Conservation tillage Two-thirds of all agricultural 1,000 acres successfully adopt soil MtCO2 per year 800 carbon practices Grassland restoration Legumes in pasture Requires adding 20 million 600 acres each year starting in 2030 400 200 0 Agricultural

EMERGING Grazing optimization Biochar Deep soil inversion

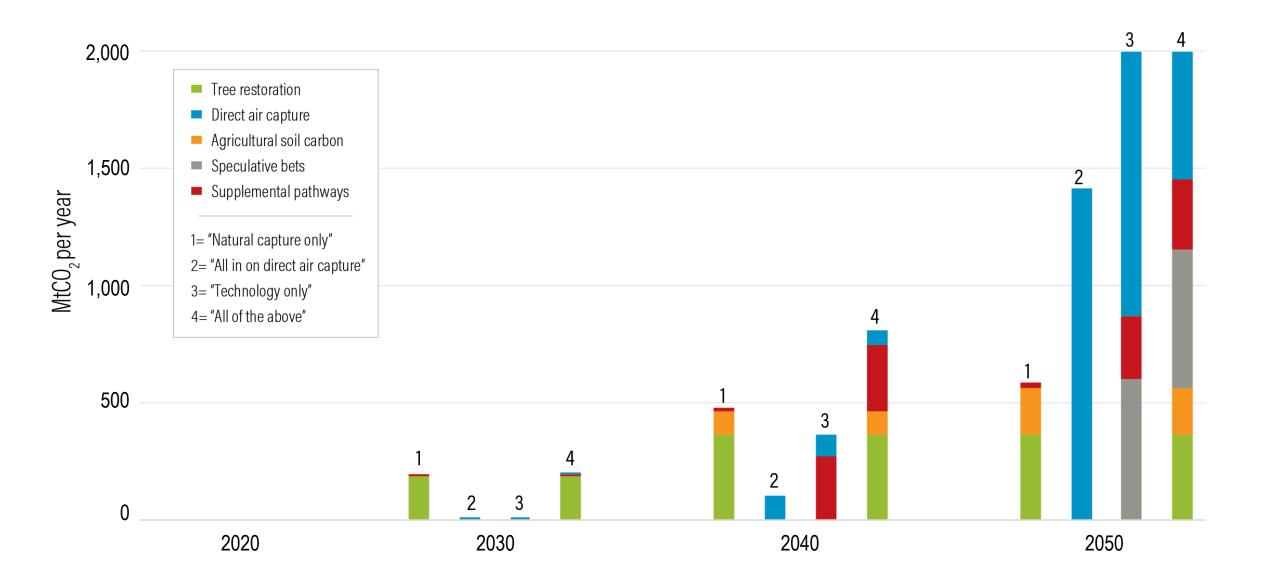
Crop rotations

Compost amendment

soil carbon



DEPLOYMENT SCENARIOS



5 INSIGHTS FROM PORTFOLIO PLANNING

01 Natural capture pathways rack up cumulative removals
02 Technological carbon removal is a requirement for 2Gt
03 An "All of the Above" portfolio reduces cost & risk

04 The largest contributions in 2050 come from pathways that need extensive RD&D before they can scale05 All pathways are immediately actionable

