

ROADS to REMOVAL

Options for Carbon Dioxide Removal in the United States



First-of-its-kind national study identifies county-by-county opportunities in all 50 states that, if fully implemented, could result in the removal of 1 billion metric tonnes of CO₂ and 440,000 new jobs.

Key Findings

Pennsylvania can remove CO₂ by capturing carbon from forest and municipal wastes, and via geologic CO₂ storage—available throughout much of the state.

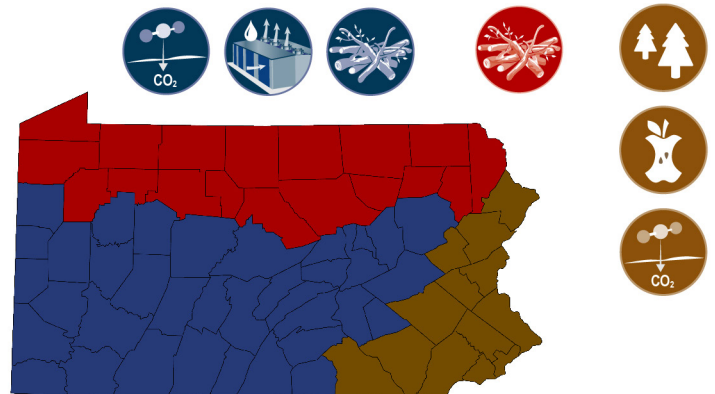
Near Term Opportunities

- Forest management in the central and western portions of PA can help store additional carbon in tree biomass.
- Expanding cover cropping can enhance carbon storage in cropland soils.

Longer Term Investments

- Direct Air Capture and Storage (DACs) could be powered using local gas resources in Western Pennsylvania.
- Geologic CO₂ storage capacity is available throughout most of Pennsylvania, using existing skilled carbon management workforce.

PENNSYLVANIA OPPORTUNITIES



- Excellent co-location opportunities for biomass processing and geologic storage
- Regions with previous oil production in Western Pennsylvania could refocus on geologic CO₂ storage.
- Municipal solid waste from major urban centers is available for biomass carbon removal and storage, easing waste management pressures

BY THE NUMBERS – CO₂ Removal Capacity in Pennsylvania

Cropland Soil Management

0.8M tonnes CO₂ removed by 2050

< \$40/tonne CO₂

1.2M tonnes CO₂e by 2050 total climate benefit (avoided + removed)

Biomass Carbon Removal and Storage

22.5M/yr tonnes CO₂ removed (via gasification to H₂)

\$74.90/tonne CO₂

13.6M dry tonnes of biomass

Environmental, Equity and Energy Justice

Western Pennsylvania

- has ample CDR socioeconomic opportunities
- an existing skilled, yet underemployed workforce (Allegheny & Mercer counties are in the top **5%** and **1%** for manufacturing & electricity generation job losses.)

Eastern Pennsylvania

- has abundant agricultural resources (could be managed to improve local environmental quality & public health.)
- Lancaster county is in the top **1%** for N pollution. (could benefit from anaerobic digestion or high-temperature liquefaction.)

By implementing methods that remove CO₂ from the air, communities big and small can create new jobs, improve air and water quality, increase our resilience to a changing climate, and protect life and property.

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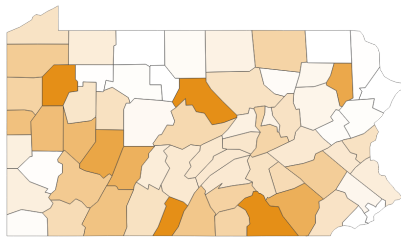


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COUNTY-LEVEL RESULTS



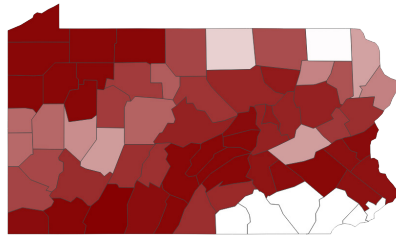
Cropland Soil Management



Tonnes CDR by 2050



Geologic Storage

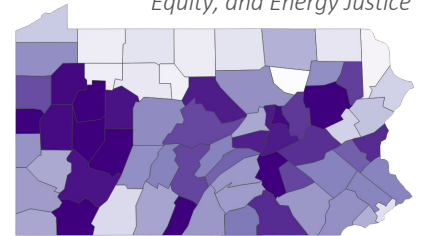


Tonnes CDR by 2050



Environmental, Equity, and Energy Justice

CO₂ removal potential weighted by indices of Social Vulnerability and Environmental, Equity, and Energy Justice



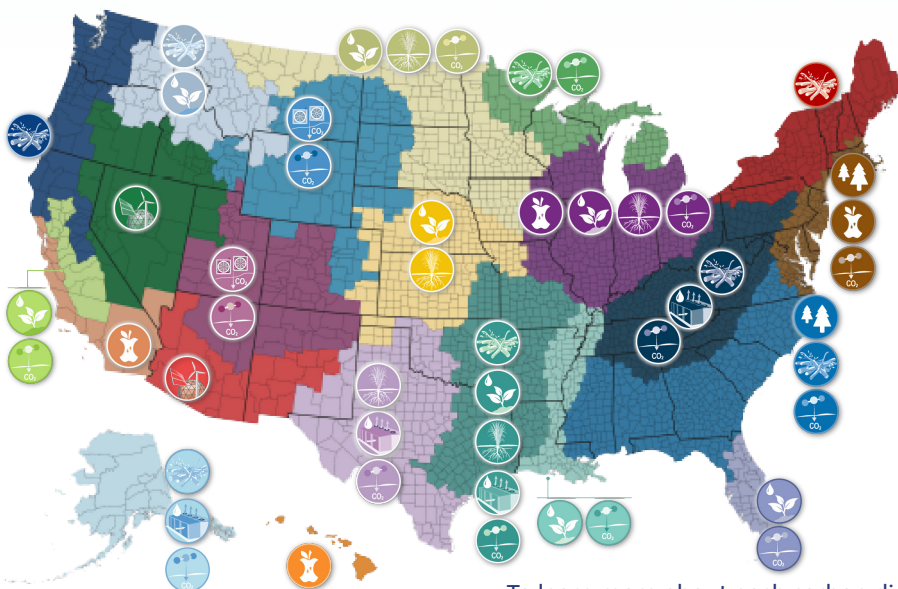
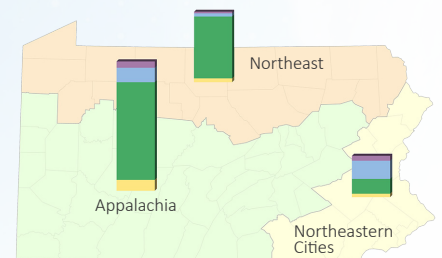
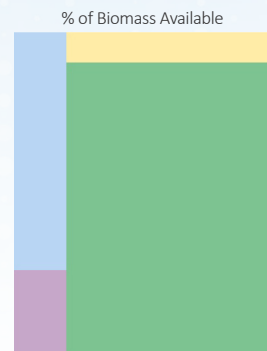
Sum of EEEJ-CDR opportunities

Low Opportunity High

- Cover cropping and perennial carbon crops, particularly in Lancaster county, would benefit soil health, reduce erosion and NO₃ leaching and promote CO₂ removal.
- Forest management in Northern Pennsylvania can provide both employment and tree-based carbon storage opportunities.
- Geologic carbon storage, particularly in Western Pennsylvania, can provide job opportunities for those impacted by closures of fossil energy facilities.



BiCRS



Roads to Removal Partners:

- Lawrence Livermore National Laboratory
- Oak Ridge National Laboratory
- Lawrence Berkeley National Laboratory
- University of Texas at Austin
- North Carolina State University
- University of California, Berkeley
- Colorado State University
- Indiana University Indianapolis
- Yale University
- University of New Hampshire
- Iowa State University
- Michigan State University
- University of Pennsylvania

EVERY REGION HAS A STORY.

EVERY REGION HAS AN OPPORTUNITY.

To learn more about each carbon dioxide removal pathway go to Roads2Removal.org