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New report outlines opportunities to remove CO2 at the gigaton scale

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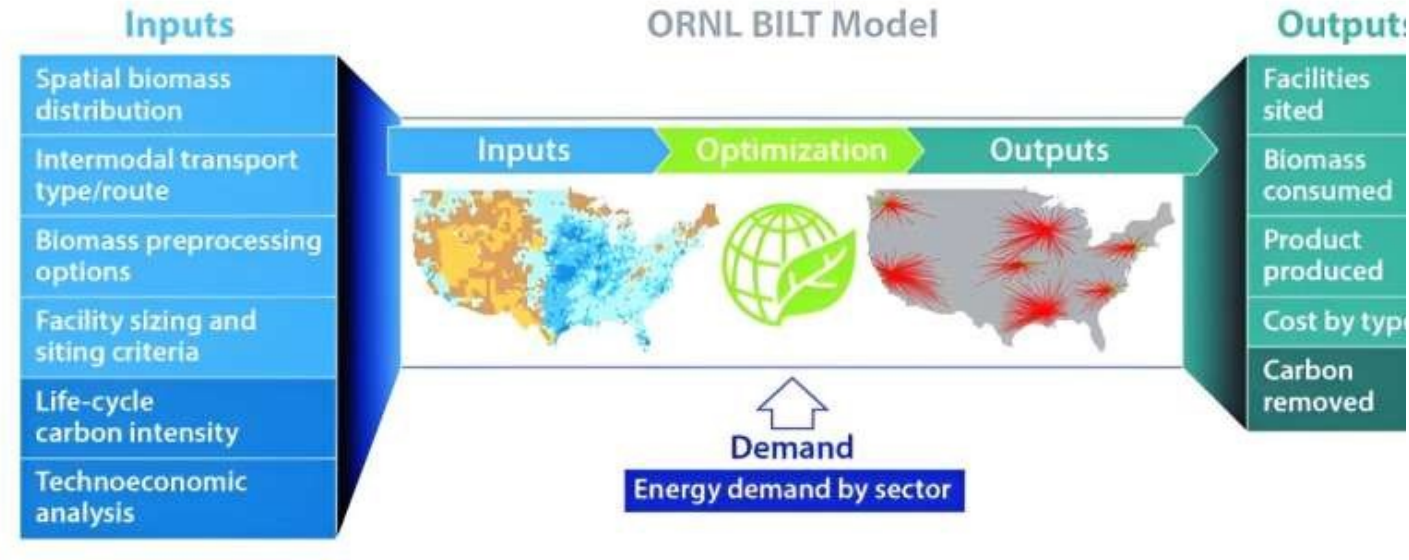

ORNL's Biocarbon, Infrastructure, Logistics and Transportation, or BILT, model was used to analyze biomass reso available to support carbon removal potential in the "Roads to Removal" report. Credit: Brett Hopwood/ORNL, U.S Dept. of Energy

Scientists from more than a dozen institutions have completed a first-of-its-kind high-resolution assessment of carbon dioxide removal potential in the United States, charting a path to achieve net-zero greenhouse gas economy by 2050.

The report, "Roads to Removal: Options for Carbon Dioxide Removal in the United States," concludes that with today's technologies, removing 1 billion metric tons of CO_2 per year is achievable by 2050, with a cost of roughly $130 billion annually, or about 0.5% of current gross domestic product.

Oak Ridge National Laboratory contributed its expertise in biomass resource analysis to the rep

The study includes an integrated analysis of CO_2 removal, or CDR, techniques and resources t are currently available, along with the costs that will be incurred on the path to net-zero for the nation's climate security and resilience.

In 2022, the U.S. government established a 2050 goal to reach net-zero emissions by decarbonizing the economy, removing CO_2 from the atmosphere and storing it at the gigaton sc at least a billion tons per year.

Reaching that goal will require increasing the uptake of carbon in forests and in working agricul lands, converting waste biomass into fuels and CO_2 and using purpose-built machines to remov CO_2 directly from the air. This ensemble of lowest-cost approaches for CO_2 removal would crea more than 440,000 long-term jobs and can be achieved using renewable energy sources, with currently available land and belowground geologic storage. The granular analysis provided in th report gives decision-makers across the United States a lens for location-specific opportunities, enabling them to make decisions that best fit the places where they live.

The report provides a supply analysis built from measurements of economic feasibility and CDR technical potential with the highest resolution data available. Unlike previous analyses, which us integrated assessment or top-down models, the methods used in "Roads to Removal" rely on bottom-up calculations and use the most current estimates for resource demands, costs and impacts of potential CO_2 removal approaches by county.

"Roads to Removal" identifies specific opportunities by location for soil and forest management biomass conversion and direct air capture technologies, as well as geological resources. It provides information on various CDR transportation pathways as well as crosscutting regional a environmental justice considerations. These analyses will be useful for weighing alternatives an local benefits for specific CDR projects.

Informing biomass options with ORNL analysis

ORNL scientists contributed their biomass resource expertise to support the report's findings regarding potential natural carbon sequestration and biofuels production, said Matthew Langhol of ORNL's Bioresource Science and Engineering group. The report relies on data from the Billio Ton Report series, which ORNL produces for the Department of Energy. The billion-Ton series h found the nation could produce at least 1 billion dry tons of biomass resources annually without adversely affecting the environment.

The ORNL team supplied data and simulations around different scenarios for the "Roads to Removal" report's "Biomass Carbon Removal and Storage" chapter. The chapter relies on ORN Biocarbon Infrastructure, Logistics and Transportation model, or BILT, which helps determine th

optimal allocation of different biomass resources to various end uses.

"BILT informs decisions about the different things you can do with biomass, such as what types available at the county level, which pathways are best to pursue and where to build what's neec including infrastructure like refineries," said Ingrid Busch of ORNL's Transportation Analytics an Decision Science group. "We developed a tool that's very diverse and can be applied to a lot of different problems, including the wide array of pathways identified in the report."

Altogether, "Roads to Removal" examines land-based CDR methods that could be expected to remove at least 10 million tons of CO_2 equivalents per year.

One example is a potential scenario in which farmers produce switchgrass, a plant well suited a biomass, on agricultural lands less suited for food production. ORNL researchers informed wha that could mean for pulling more CO2from the atmosphere and storing it belowground in soils.

The report highlights CDR opportunities in 22 regions of the country. It was jointly commissione the DOE Office of Energy Efficiency and Renewable Energy's Bioenergy Technologies Office, th Advanced Research Projects Agency—Energy, and the Office of Fossil Energy and Carbon Management, with additional support from the ClimateWorks Foundation. The project is headec Lawrence Livermore National Laboratory and supported by 13 academic and scientific institutio

"We were happy to be a part of such a big multilab collaboration demonstrating the potential to leverage the nation's portfolio of biomass resources toward decarbonization goals," Langholtz s

The report examines the breadth of strategies where it was possible to make reliable estimates what it will take to apply them, from land management to the latest technological options. The c of every step of the solution was evaluated, from collecting waste biomass, to transporting CO_2 storing CO_2 deep underground. The analysis enables interested counties, states, community stakeholders and CDR practitioners to work together to decide where, when and how much of e approach fits into their local needs.

Enabling local, informed decision-making

"'Roads to Removal' enables local, informed decision-making and shows us that we can prevail our quest to reverse climate pollution," said LLNL scientist Jennifer Pett-Ridge, the report's leac author. "Every geographical region has a unique story, as well as an opportunity to help take enough CO_2 out of the air and meet our net-zero emissions goal by 2050."

The report "shows that to achieve the billion-ton scale of carbon dioxide removal needed by 20 to achieve net-zero goals, the United States must use all removal methods available—oceans,

forests, cropland soils, biomass and minerals and chemicals through direct air capture—to mak happen," said Jennifer Wilcox, principal deputy assistant secretary for Fossil Energy and Carbo Management at DOE. "The Roads to Removal report is a critical tool that climate practitioners c now use to better understand the key factors and pathways involved in removing CO_2 from the at the scale necessary to meet our national commitments."

Unique to "Roads to Removal" are new energy, equity and environmental justice optimization indices designed to help identify counties with the greatest opportunities for co-benefits and minimal risks.

"Community consideration is paramount to the scalability of CDR; when residents are excited a projects, they are much more likely to get off the ground in a timely and affordable fashion," saic LLNL scientist and co-author Kim Mayfield. "In this report, we identify highly vulnerable counties that could maximally benefit from CDR management approaches in forests and agricultural soils We also identify counties experiencing inequitable job losses in traditional energy sectors; these counties may become early adopters of innovative CDR approaches such as biomass for carbo removal and storage and direct air capture, which can put underemployed skilled residents bac work."

Other collaborating institutions include Lawrence Berkeley National Laboratory, the University o Texas at Austin's Bureau of Economic Geology; North Carolina State University, the University California Berkeley; Colorado State University, Indiana University, Yale University, the University New Hampshire, Iowa State University, Michigan State University and the University of Pennsylvania.

More information: Roads to Removal: Options for Carbon Dioxide Removal in the United States. roads2removal.org/

Provided by Oak Ridge National Laboratory

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