

All the carbon counts

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Policies that turn forests into valuable carbon storage units would likely preserve forests and lower costs of cutting atmospheric carbon dioxide.

Cutting down forests for agriculture vents excess carbon dioxide into the air just as industrial activities and the burning of fossil fuels do. But whether policies to stabilize greenhouse gases in the atmosphere should include this terrestrial source of carbon dioxide is under debate.

According to a new study this week in *Science*, failing to include land use changes in such policies could lead to massive deforestation and higher costs for limiting carbon emissions.

The results also suggest improved agricultural technology will be as important as new energy technologies in a carbon-limited future.

To understand the effects of economic forces from [climate policy](#) on terrestrial carbon and land use changes, researchers with the Joint Global Change Research Institute in College Park, Md., a collaboration between the Department of Energy's Pacific Northwest National Laboratory and the University of Maryland, used an integrated assessment model called MiniCAM to compare different scenarios. This computer model incorporates economics, energy, agriculture, land-use changes, emissions and concentrations of [greenhouse gases](#) in order to understand the way that human decisions interact with natural processes that control climate.

For this study, the researchers set the highest concentration that [carbon dioxide](#) could reach. Then they compared two ways to stay within that limit: in one, they taxed terrestrial [carbon emissions](#) and industrial and fossil fuel emissions all at the same rate. In the other, they only taxed emissions from industry and [fossil fuels](#).

Ignoring terrestrial carbon led to nearly complete loss of unmanaged forests by 2100, largely as a result of massive expansions of bioenergy crops -- those planted to reduce the use of fossil fuels -- replacing forests. However, placing a value on terrestrial carbon emissions led to increased forest cover, while bioenergy still expanded considerably compared to today.

"When society tries to limit carbon dioxide concentrations, if terrestrial carbon emissions aren't valued but fossil fuel and industrial emissions are, economic forces could create very strong pressures to deforest," said PNNL scientist Marshall Wise, the study leader.

In addition, the cost to reduce global emissions in a world that valued terrestrial, fossil fuel, and industrial sources dropped to half that of the world in which only fossil fuel and industrial entities paid to emit carbon. This suggests that storing carbon in forests, agricultural areas, and other ecosystems is an important and cost-effective part of a bigger

carbon dioxide emissions control strategy that includes dramatic changes to the global energy system.

This study also shows that continual improvement in agricultural crop productivity for crops like corn, wheat, barley, and rice will be required to best make use of limited cropland. This suggests improvements to agriculture technology could be as important as improvements to energy technology in controlling [carbon emissions](#).

"If society wants to stabilize carbon dioxide concentrations at low levels, then we can't ignore the two thousand billion tons that are out there in terrestrial systems," said PNNL economist James Edmonds at the JGCRI.

More information: M. Wise, K. Calvin, A. Thomson, L. Clarke, B. Bond-Lamberty, R. Sands, S. J. Smith, A. Janetos, J. Edmonds, Implications of Limiting CO₂ Concentrations on Land Use and Energy, *Science*, May 29, 2009, DOI 10.1126/science.1168475 , www.sciencemag.org/

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