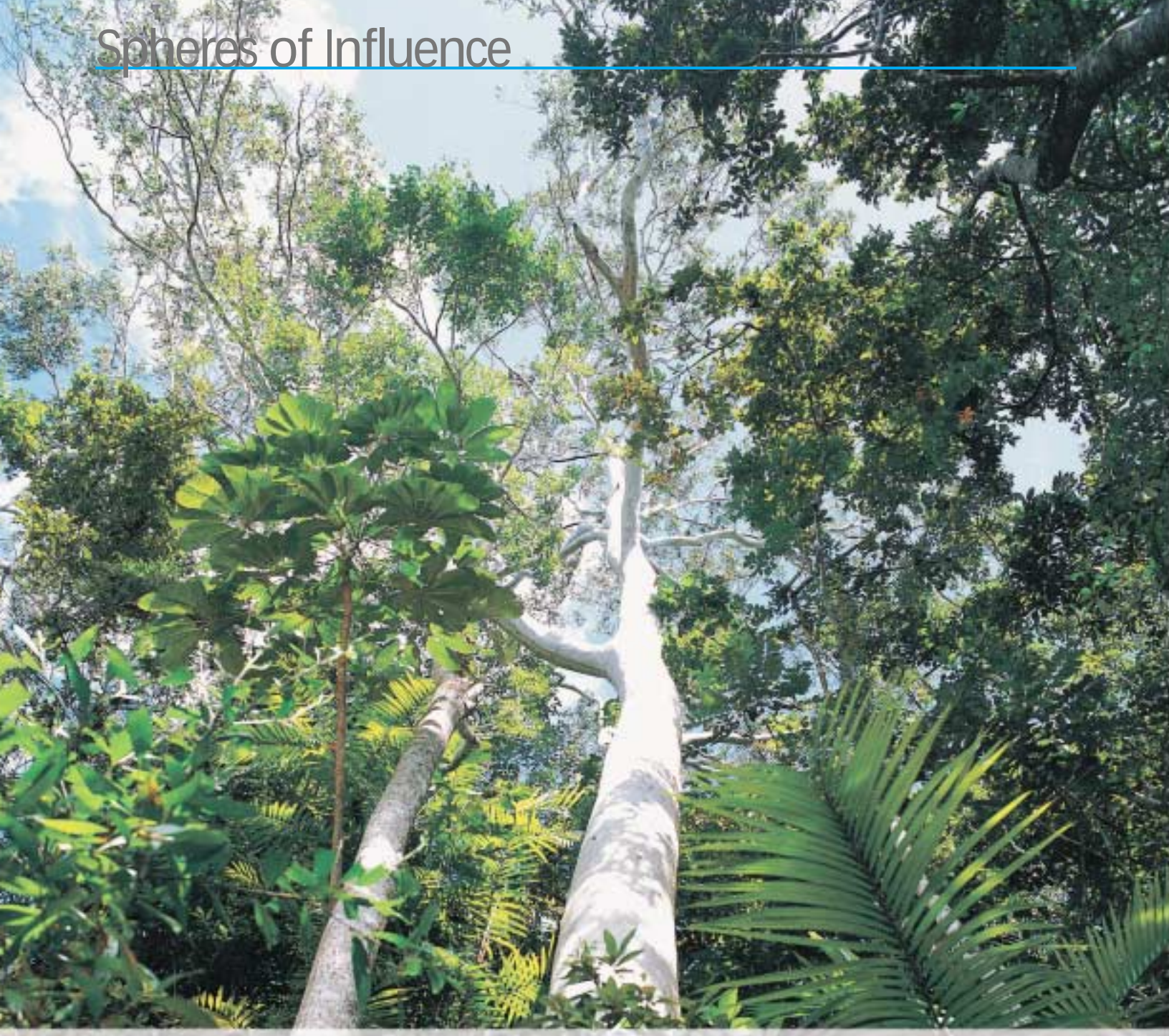


Green Trees for Greenhouse Gases: A Fair Trade-Off?

Deep in northeast Bolivia along the border with Brazil lies a 4-million-acre tract of rain forest called the Noel Kempff Mercado National Park. Home to over 700 species of birds and exotic animals such as the jaguar, howler monkey, and giant anteater, the park was once a prime candidate for the kind of slash-and-burn agriculture decimating tropical forests around the world. But in a remarkable twist of fate, the park is now protected for the next 30 years under an agreement signed by the Bolivian government, The Nature Conservancy, and a Columbus, Ohio–based utility company called American Electric Power (AEP).

What does a rain forest in Bolivia have that an American utility company wants to preserve? The answer is elemental: carbon. While forests retain carbon in plants, detritus, and soils, power plants—including AEP's—spew it into the air as carbon dioxide (CO_2), the main greenhouse gas behind global warming. Industrial CO_2 emissions aren't currently regulated by federal law, but a number of companies are trying to do something about the problem voluntarily. AEP's carbon sequestration program in Bolivia was launched through its involvement with the Climate Challenge Program, a voluntary greenhouse gas reduction effort between the U.S. Department of Energy (DOE) and the electric utility industry. According to AEP's calculations, the $9.5 million they would spend to pay for park rangers and other expenses associated with maintaining the forest and thereby protecting the carbon contained within its biota was far less than would have been spent installing equipment to block CO_2 emissions from its own plants. "And if we wind up saving some tropical species and indigenous cultures along the way, then so much the better," says Dale Heydlauff, AEP's vice president of environmental affairs.

Carbon Sinks Take Root

Many scientists see sequestering carbon in biotic "sinks" such as forests and farmlands in the terrestrial biosphere as a win–win proposition for the environment—"a way to improve the atmosphere while doing things you ought to be doing anyway, like protecting natural resources and promoting sustainable development," says Gregg Marland, a research scientist and expert in carbon sequestration at Oak Ridge National Laboratory in Tennessee.

Because atmospheric CO_2 is distributed worldwide, it shouldn't matter if the gas is blocked from being released from the end of a pipe or sequestered in the biosphere as long as there is a net global reduction of it in the atmosphere. Scientists have long suggested that trees—newly planted or never cut down in the first place—could soak up excess CO_2, but the concept didn't take root with policy makers until 1988, when a report titled *The Prospect of Solving the CO_2 Problem through Global Reforestation* was drafted by Marland while he was working with the DOE's Office of Energy Research. This pivotal document suggested that carbon sinks, like emissions reductions, could be credited under an international framework to reduce greenhouse gases. The controversial idea was discussed during the 1992 Earth Summit in Rio de Janeiro, Brazil, and formed the basis of a carbon crediting system incorporated into the Kyoto Protocol on greenhouse gas emissions during the last hours of negotiations in Kyoto, Japan, in 1997 [see sidebar, p. A126].

Carbon sequestration under the Kyoto Protocol falls under land use, land use change, and forestry (LULUCF) activities. The clearest stakeholder consensus concerning how to define these activities is found in Article 3.3 of the protocol, which states that domestic afforestation (planting trees where none existed previously) and reforestation can be counted toward compliance with a country's emissions reduction target, while emissions from deforestation would count against that target. In addition, the language of the protocol stipulates that LULUCF activities can only be credited if they are "human-induced." According to Marland, this qualifier is intended to ensure that countries aren't credited for growth in terrestrial sinks resulting from rising levels of atmospheric CO_2, which ironically acts as a kind of plant fertilizer.

The problem is that negotiators can't decide what "human-induced" actually includes. A clear example might include planting trees on farmland. But other examples, such as the case of a scrub forest left to grow naturally on abandoned property, are not as obvious and are still heavily debated. In addition to the practices described under Article 3.3, a number of countries including the United States and Canada would like to see credit opportunities expanded to include a much wider range of activities. These additional land use activities are still being negotiated and considered under Article 3.4.

An example of the kind of land use activity that might be counted under Article 3.4 is "no-till" farming, which limits carbon releases because soils aren't stirred up during planting. Support for carbon sinks is avid among corn and soybean growers, who already use no-till farming because it is good for their crops and who stand to get paid carbon credits (possibly by the federal government) under Article 3.4 as an incidental bonus.

One of the most difficult and unresolved questions concerns how credits for carbon sinks will be traded among parties to the protocol. Marland suggests the system will involve payments made by polluters to private or public organizations responsible for protecting carbon sinks such as forests or farmlands. The payments themselves would have to be sanctioned by the governments involved, as it is the governments and not the individual industries that are held to the terms of the Kyoto Protocol.

Breakdown at The Hague

As any climate change negotiator will tell you, applying carbon sinks toward an emissions reduction agreement is exquisitely complicated. "Each piece of a sinks program is as difficult as any previous international environmental agreement we've ever worked on," says Eileen Claussen, president of the Pew Center on Global Climate Changen in Arlington, Virginia, a nonprofit organization dedicated to educating the public and policy makers on climate change. "Putting the pieces together in a single agreement raises the complexity by a few orders of magnitude," she says. "These issues go to the heart of a nation's economy and the way it manages its natural resources."

Illustrating this complexity, the most recent meeting of Kyoto delegates, held at The Hague, The Netherlands, in November 2000, collapsed over the issue of carbon sinks, delivering what many see as a deathblow to the already beleaguered agreement. At the meeting, the United States pushed hard for rights to apply its vast forests toward its emissions reduction target, something European Union (EU) countries, which aren't heavily forested, perceived as a ploy to obtain carbon credits without having to do anything. Dan Lashof, a staff scientist with the Natural Resources Defense Council in Washington, D.C., says the United States created the impression among some negotiators in the EU and elsewhere that it was trying to benefit from activities that might otherwise be regarded as "business as usual" and

incidental to the Kyoto Protocol itself, such as preserving forestland.

Claussen agrees this was indeed the case, but offers that the U.S. negotiators—hamstrung by congressional skeptics who think complying with the Kyoto Protocol would be prohibitively expensive—had little choice but to seek ways to comply with the treaty at the lowest possible cost. "It all came down to this view among negotiators that the only way to sell this thing to the Congress is to show them that we can do it for free, which is a joke," says Claussen. "We need to acknowledge there are going to be costs associated with this."

Meanwhile, some developing countries expressed their own reservations. Their fear is that a system that makes them the guardians of carbon stocks (or masses of carbon contained in any biotic reservoir) paid for by polluters in developed countries could not only deny them sovereignty over their own lands but also limit opportunities for technology transfer from the developed world in an arrangement that emphasizes natural resource preservation over sustainable industrial development.

According to Marland, sharp disagreements over sinks activities beyond forestry also crippled the talks. "Article 3.4 is where things continued to fall apart in The Hague," he says. "The U.S. delegates were insisting that they get something out of Article 3.4, but the Europeans (who lack the large agricultural lands that would be relevant under Article 3.4) are trying to limit this as much as possible."

Bring On the Accountants

The critical question regarding sinks hinges on whether a ton of carbon sequestered in the biosphere equals a ton of carbon saved from release by reduced fossil fuel combustion. Establishing an accounting scheme that treats these two units equally is a significant challenge. At issue are a host of ecological and statistical questions, differing local land use practices, cultural factors, verifiability, and even basic definitions. For instance, a survey conducted by Gyde H. Lund, a forestry consultant based in Manassas, Virginia, identified over 300 unique definitions of "forest," many with their own values for parameters such as tree height and density.

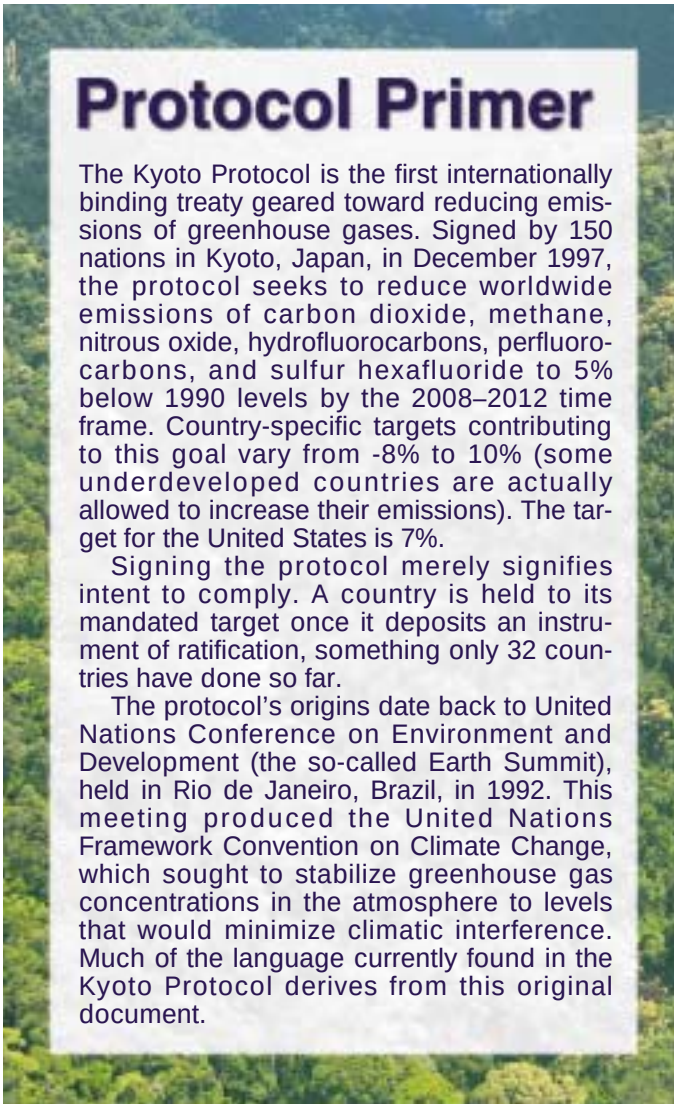
Several major issues complicate the accounting process. For example, how can one be sure that any given sink is actually permanent? Unlike emissions reductions in the industrial sector, which arguably might be considered permanent, carbon in the biosphere could be released at some point in the future, for example through fires or deliberate human activity. This raises all sorts of questions. "Say a farmer gets flooded out, or his crops develop a disease, and he needs to plow the crop and apply a clean seedbed for a few years," says Jon Dogget, senior director of governmental relations at the American Farm Bureau, a trade organization based in Washington, D.C. "Does that farmer then become responsible for removing the carbon? How are you going to deal with that?"

A further problem is "leakage," which refers to the possibility that blocking carbon releases by LULUCF activities in one location might simply accelerate their release somewhere else. Even Heydlauff admits leakage could undermine the success of its program in Bolivia. "Leakage is the Achilles' heel to all these projects," he says. "We have a good leakage prevention program in Bolivia, but I can't prove that timber production isn't shifting to Peru, Paraguay, or Brazil. The only way to prevent that from happening is to have a global program with careful emissions inventories adjusted to represent changes in carbon stock."

According to Marland, global carbon releases from burning fossil fuels can be estimated to an accuracy of perhaps ± 10%. This is because fossil fuels, being a traded commodity, are carefully tracked by industry. Sandra Brown, a senior program officer for Winrock International, a nonprofit international development organization headquartered in Morrilton, Arizona, says that comparable accuracy for carbon stock measurements can also be achieved as long as the financial and human resources are available to carry out the measurements and statistically robust study plans are employed. "It all comes down to how much money you have," she says. "You can estimate changes in carbon stock directly by quantifying forest parameters and then going back and doing your statistical analyses on the changes at a later point in time. Forest ecologists have been using these techniques for decades."

Nevertheless, a majority of scientists believe that there still could be considerable uncertainty in carbon measurements. In fact, a host of extraneous variables need to be considered in order to estimate carbon fluctuations on a global scale. For instance, timber products retain carbon; it is not all released as emissions when forests are cut down. And the energy required to produce timber substitutes such as concrete and steel may actually result in more carbon releases to the environment than would be saved by preserving a forest.

Some also question whether it is possible to estimate changes in global carbon stock when the baseline numbers are so high. For instance, in contrast to the 6.3 billion tons of carbon released yearly from burning fossil fuels, plants retain about 600



Protocol Primer

The Kyoto Protocol is the first internationally binding treaty geared toward reducing emissions of greenhouse gases. Signed by 150 nations in Kyoto, Japan, in December 1997, the protocol seeks to reduce worldwide emissions of carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride to 5% below 1990 levels by the 2008–2012 time frame. Country-specific targets contributing to this goal vary from -8% to 10% (some underdeveloped countries are actually allowed to increase their emissions). The target for the United States is 7%.

Signing the protocol merely signifies intent to comply. A country is held to its mandated target once it deposits an instrument of ratification, something only 32 countries have done so far.

The protocol's origins date back to United Nations Conference on Environment and Development (the so-called Earth Summit), held in Rio de Janeiro, Brazil, in 1992. This meeting produced the United Nations Framework Convention on Climate Change, which sought to stabilize greenhouse gas concentrations in the atmosphere to levels that would minimize climatic interference. Much of the language currently found in the Kyoto Protocol derives from this original document.

Digital Vision

billion tons of carbon and soils retain another 1,600 billion tons. Measuring the aggregate impact of thousands of small-scale projects against this enormous baseline is likely to be characterized by a high degree of statistical uncertainty.

An example of the kind of solution that might be applied to this uncertainty is one suggested by the Intergovernmental Panel on Climate Change, the scientific panel that prepared a special report on land use and land use change for the negotiators. The panel proposed that credits or debits for land use changes might be applied within the context of the uncertainty in their measurements. To illustrate, say a change in carbon stock resulting from a particular land use initiative could be measured to within ± 40% at a 90% confidence level. Under such a scenario, credits and debits might be applied not to the mean of the estimated amounts of carbon sequestered but to the mean less 40%, or the value for which the statistical confidence is highest.

Even if the accounting issues can be resolved, stakeholders also wonder whether there is sufficient infrastructure to monitor changes in carbon stock and verify compliance. To estimate carbon levels with acceptable accuracy requires frequent, extensive, and potentially costly periods of sampling. For example, AEP's researchers in Bolivia not only use ground sampling to measure changes in biomass, they also plan to employ Winrock International to fly over the park on a frequent basis and generate aerial videography that will be fed into a computer to calculate carbon estimates. However, AEP is in a fairly unique position—it has a lot of money. In contrast, the majority of forestry and agricultural businesses around the world are small-scale operations, even in the United States, where more than 95% of all farms are family-owned. Training and coordinating individuals to monitor carbon levels on private lands could be difficult to do.

Brown, while acknowledging the challenges involved, suggests that the growth of carbon sequestration initiatives will be matched by consortiums of small-scale farmers and businesses who will take on the responsibility of measuring carbon, especially considering that carbon credits will become paid commodities. "You can envision a half a dozen farmers getting together and spreading sampling points across all their fields," she says. "There will be people out there who know how do this and are willing to sell their services."

On the Brighter Side . . .

Despite the seemingly overwhelming challenges, many stakeholders believe carbon sinks will comprise an important element in the fight against global warming. Creative solutions are emerging from a number of sectors, and it's likely, Claussen says, that with continued time, study, and dialogue a workable mechanism can be established.

For example, the Colombian delegation to The Hague suggested that credits for carbon sequestration might be rented to developed countries rather than sold to them. This approach, described by one negotiator as "an elegant solution," could reduce developing country concerns over sovereignty, improve carbon stock accounting, and buy developed countries some time to develop innovative industrial technologies to reduce emissions.

But no clear mechanism for how such a rental system might work has been established. It's likely that the transaction would be between the entity that maintains the sink and the entity that is renting it. Marland says that, as the credits are rented, they would obviously expire at some point. This introduces problems associated with the permanence of the sink that have yet to be worked out.

Mitch Dubensky, director of forests and environment at the Washington, D.C.–based American Forest and Paper Association, says, "Carbon sequestration is an opportunity for developing countries to promote sustainable development and sustainable forestry. Leakage and permanence will have to be managed through project design—that is, working with local communities to manage protected forests in ways that retain carbon while providing indigenous people with a livelihood." Sustainable industries such as tourism and harvesting of nut crops would allow the people that live around the forest to profit off the forest while protecting the carbon sink it provides.

Domestic Initiatives

While the debate over carbon sinks in the context of the Kyoto Protocol continues to rage, a number of domestic initiatives are quietly beginning to emerge. For example, in addition to the DOE's Climate Challenge Program, two states have recently enacted legislation mandating that newly sited power plants cut their CO_2 emissions—in Oregon emissions must drop by 17% and in Massachusetts by up to 3%. Both states have allowed companies to explore the option of offsetting their releases by planting trees. Sonia Hammel, director of air policy and planning at the Massachusetts Energy Facilities Siting Board, says board members are wary of the tree-planting option and have ceased accepting applications for new tree programs but have grandfathered in existing programs and are reviewing the data carefully.

In addition, two bills proposed by Senator Sam Brownback (R–Kansas) also contain carbon sinks initiatives. One is a domestic carbon bill (S2540) under which farmers could receive "conservation payments" from the federal government if they enhance carbon storage by alternative agricultural methods, for example no-till farming. The other (S2982) is a bill that provides U.S. companies with tax credits for enhancing carbon storage abroad.

According to a staffer with Senator Brownback, neither of these bills contains a trading mechanism that would allow polluters to offset their emissions with land use practices. This option, which forms the basis of LULUCF activities under the Kyoto Protocol, is currently seen as too controversial for a federal domestic program. "We're just looking for ways to encourage carbon sinks, not ways to allow polluters to gain emissions credits by planting trees," says the staffer, who acknowledges that "we're likely to see that option develop down the road."

In the meantime, Kyoto negotiators are gearing up for another round of discussions in Bonn, Germany, in May of 2001, and it's likely that the continuing debate over carbon sinks will dominate the agenda. The goal is to reach some resolution on the issue before the next ministerial meeting of Kyoto delegates in Marrakech, Morocco, next November. "No one denies the technical challenges here," says one negotiator, who wished not to be identified. "It's not like we're trying to pull a fast one on the environmentalists. We believe that the system can only work with good accounting. If you can prove carbon sequestration, then fine, you get a credit. If you can't, you don't get anything."

Lashof adds that many environmentalists will accept sinks as a viable aspect of an emissions reduction framework, but says that the approach must be predicated on a few basic principles. "First, a role for sinks needs to be limited," he says. "Second, people shouldn't be able to get credit for what they're already doing—the goal should be to reduce greenhouse gases beyond levels that would exist without the protocol. And third, the issue of permanence needs to be addressed. We need an accounting system that ensures carbon sequestration isn't just a temporary measure."

Charles W. Schmidt