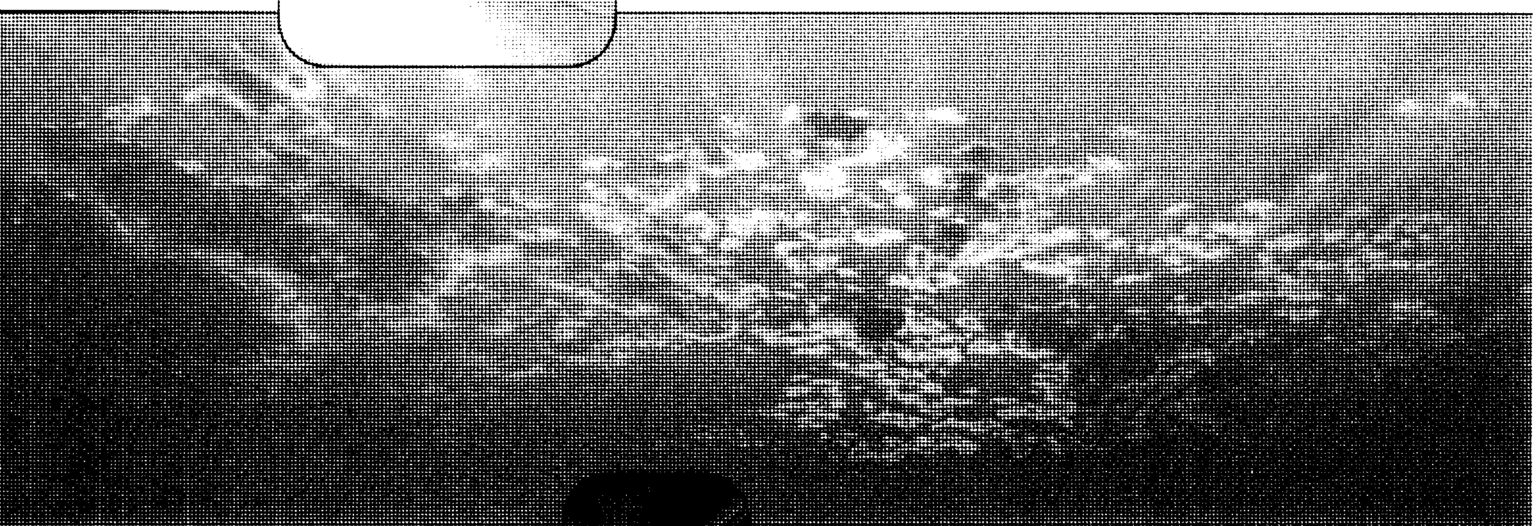
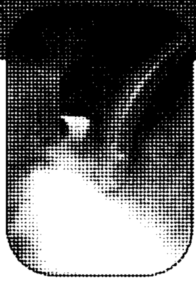
PHOTOGRAPHERS ASPEN—NICHOLAS DEVORE III

JOINT

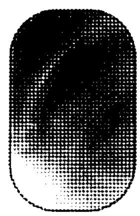
An Effective Strategy for





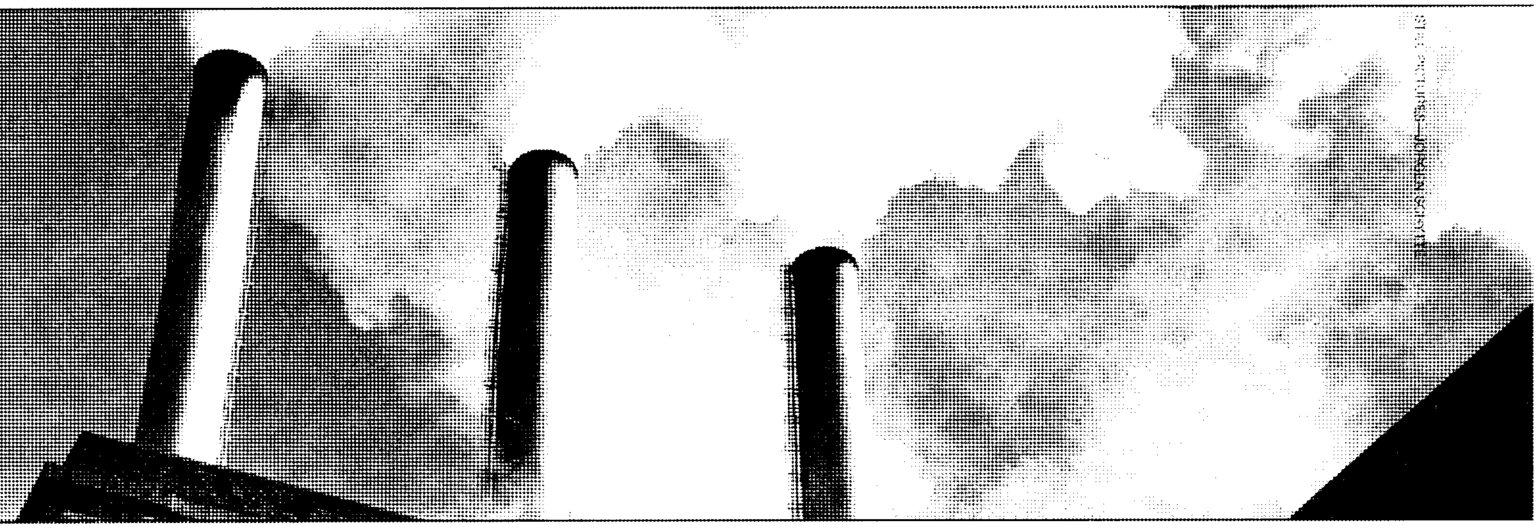
By
L. D. Danny Harvey
&
Elizabeth J. Bush

Many see the United Nations Framework Convention on Climate Change (FCCC) as the first in a series of international treaties and agreements designed to tackle the threat of global warming. Although it includes neither quantitative emissions reduction targets nor firm timetables, the convention articulates many key principles that should guide future action to reduce global emissions of greenhouse gases. In particular, the FCCC acknowledges the historical role played by industrialized countries in the buildup of greenhouse gases and the need for them to take the lead in reducing emissions. Furthermore, it commits industrialized countries to provide developing countries with financial and technical assistance so that they can limit the growth of their emissions.[1] Projections show the energy sectors of developing countries expanding rapidly over the next few decades to match the pace of industrialization. This growth will bring with it large increases in emissions of greenhouse gases if nothing is done to dramatically increase the efficiency with which



IMPLEMENTATION

Combating Global Warming?



In December of this year, delegates to the third Conference of the Parties to the United Nations Framework Convention on Climate Change (FCCC) will gather in Kyoto, Japan, to complete negotiations on new targets for carbon dioxide emissions reductions. These targets will represent a significant strengthening of FCCC's current terms, bringing the parties one step closer to achieving the convention's ultimate objective—the stabilization of greenhouse gas concentrations at a level that will prevent dangerous anthropogenic interference with the climate system. In preparation for this meeting, *Environment*'s November issue will focus exclusively on the subject of climate change. That special issue will feature a historical overview of the various political players involved in the negotiations and the motivating factors behind the positions they have adopted; an exploration of public perceptions of climate change and how they have evolved over time; and in-depth analyses of the latest three-volume scientific assessment released by the Intergovernmental Panel on Climate Change.

This article by L. D. Danny Harvey and Elizabeth J. Bush sets the stage admirably. Joint implementation (JI) is one of the most controversial and hotly debated components of the strategy to combat climate change. Even as supporters trumpet its promise and multiple benefits, critics continue to voice strong concerns about its equity and practicality and to question its cost-effectiveness. Can JI deliver what it promises? Harvey and Bush examine the fundamental underlying assumptions and offer a critical assessment.

Commentary on this article will be appearing in the November issue, but in keeping with *Environment*'s editorial policy, we also invite our readers to respond to the views expressed here.

—The Executive Editors

energy is used and to stimulate the use of renewable energy sources. The FCCC implicitly acknowledges these projections by allowing nations that have emissions reduction commitments to implement policies and measures *jointly* with other parties.[2] This approach, known as joint implementation (JI), is one component of the strategy to combat climate change. It allows countries with higher emissions reduction costs to invest in cheaper measures elsewhere. As a reward for investing, these countries will receive partial credit for any emissions reduction that is achieved.

Currently, the international community is participating in a JI pilot phase, initiated by the delegates to the first meeting of the Conference of the Parties to the FCCC, which was held in Berlin in the spring of 1995. During this pilot phase, scheduled to end in the year 2000, no emissions credits will be awarded but nations will get the chance to experiment with JI activities and assess their potential. At this juncture in the development of an international JI regime, it makes good sense to examine some of the fundamental assumptions behind the approach and some of the practical difficulties associated with it. A close look at these issues makes it clear that JI will have great difficulty delivering the benefits it promises. Furthermore, pursuing joint implementation could undermine efforts to meet the FCCC's ultimate objective—the stabilization of greenhouse gas concentrations at a level that will prevent dangerous anthropogenic interference with the climate system.

JI—The Basics

The first step in setting up any kind of JI project is to get both national governments involved to agree to participate. From that point on, though, it is assumed that the private sector will play a key role in implementing the project. This presumes that countries will have incentives such as a domestic carbon tax or some type of regulation in place to induce domestic emitters of greenhouse gases to reduce their own emissions. These incentives would motivate private sector emitters to invest in joint implementation projects whenever the cost per unit of avoided emissions is smaller than the cost they would incur in reducing their own emissions.[3]

In theory, a JI regime could be designed to cover all greenhouse gases. To date, however, most JI projects have focused on carbon dioxide because such emissions are easily quantified.

The fundamental premise behind JI is that the costs of emissions reduction are substantially smaller in developing countries (and in some of the former centrally planned countries) than in industrialized countries. Power generation, industrial processes, and commercial and residential energy use are substantially less efficient in developing countries. For this reason, some expect that a given expenditure on emissions reduction will have more effect in these countries than in industrialized nations.[4] Developing countries also have less infrastructure in place than do industrialized nations. As they build the infrastructure they will need to meet future energy demands, developing countries will have an opportunity to incorporate directly new, highly efficient technologies.[5] In industrialized nations, most future capital investments will go instead toward the gradual replacement of existing facilities, a much slower process through which to introduce new technologies. Proponents of joint implementation believe that in these differences lie the seeds of a great opportunity for lowering the overall cost of reducing emissions.

In theory, a JI regime could be designed to cover all greenhouse gases. This appears to have been the intent behind the FCCC.[6] To date, however, most JI projects have focused on carbon dioxide because of its importance as a greenhouse gas and because such emissions are easily quantified. In addition to more typical emission reduction measures such as fuel switching, JI projects have also focused on creating carbon storage sinks. This is usually done by preserving forests that would otherwise be destroyed or reforesting previously deforested land. (Forests draw carbon from the atmosphere and store it as biomass, thereby offsetting some of the carbon emissions resulting from the use of fossil fuels.) Carbon storage is much less expensive than many direct emission reduction measures, with storage in tropical forests being much cheaper than that in middle-latitude forests.[7]

The prospect of JI as one of the mechanisms for achieving the objectives of the FCCC has sparked a lively debate about its advantages and disadvantages, who should participate in joint implementation projects, what kinds of projects should be eligible, and how they should be credited. Supporters cite what they see as several key benefits.[8] First, they contend, joint implementation will lower the cost of obtaining a given emission reduction. This has the second benefit of making JI a potentially important mechanism for getting private sources to invest in emission reductions, which will be especially important in a time of dwindling government resources. Third, they believe that JI will introduce greater policy flexibility. Such flexibility could possibly facilitate the negotiation of tougher reduction targets for industrialized countries because it would permit them to partially fulfill their targets through JI projects. Lastly, they believe that joint implementation could help accomplish the kind of technology transfers and investments in capacity building required if developing countries are to bypass inefficient and carbon-intensive energy technologies and adopt cleaner, more advanced alternatives. This could hasten progress toward sustainable development.

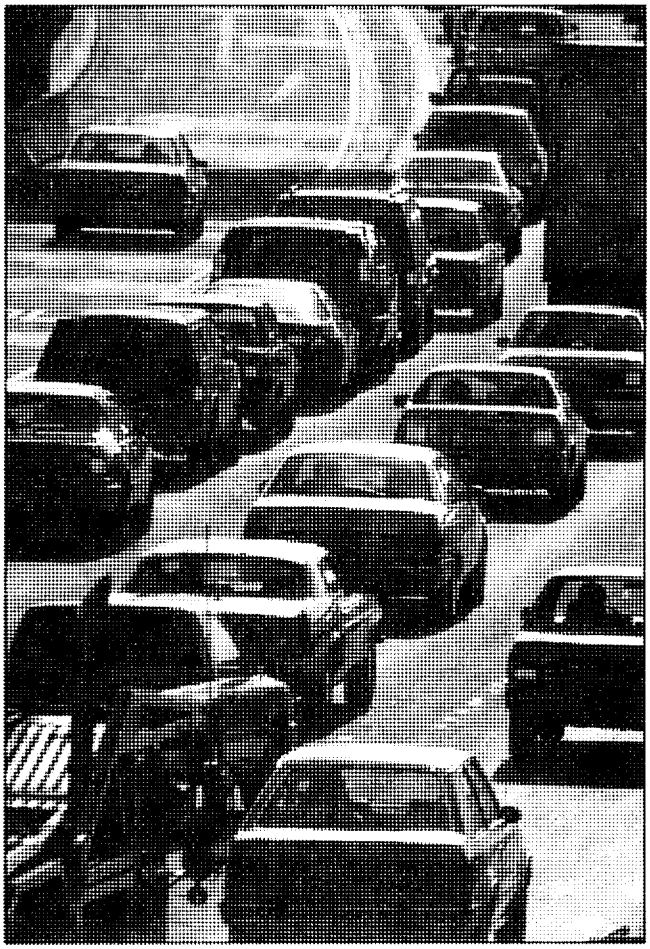
This plethora of apparent benefits has won joint implementation the vigorous support of industrialized countries and a wide spectrum of industries. Some developing countries have also responded optimistically, but a number of others have been strongly critical. Reaction has been equally mixed among environmental nongovernmental organizations (NGOs). While some NGOs support joint implementation, others have voiced concerns about equity and practicality and raised questions about JI's true cost-effectiveness.[9] In spite of this opposition, however, the international community has gone ahead and taken several important steps toward developing a joint implementation regime.

The pilot phase began in the spring of 1995. In March 1995, the Joint Implementation Network, based in Groningen, the Netherlands, launched *Joint Implementation Quarterly* at the request of the Dutch government to help people keep abreast of new and ongoing pilot projects. Today, a web site funded by the U.S. Department of Energy and a consortium of U.S. utilities (http://www.ji.org) offers information about specific projects and JI in general. By June 1996, 12 countries had incorporated joint implementation into their formal national climate action plans.[10] The United States alone had approved 24 pilot projects by April 1997. Costa Rica, one of several developing nations actively pursuing JI, has even considered establishing its own Carbon Fund. This fund would create a portfolio of large and small forestry and renewable energy projects. Investors could purchase tradable, certified carbon offsets from the fund without becoming directly involved in projects themselves.[11] Table 1 on page 18 lists most of the pilot projects that had been completed or approved as of early 1997. As the table shows, 40 percent of these projects involve carbon storage in forests, 28 percent supply-side and end-use energy efficiency improvements, 16 percent renewable energy technologies, 8 percent fuel switching, and 8 percent measures to capture methane. (For more detailed discussions of three of these projects, see the boxes on pages 19, 20, and 37.)

Given the intense interest in joint implementation, it makes sense to take a critical look at its underlying assumptions. The following discussion explores three central questions: Will JI work as intended? Is it equitable? And how big a difference can it make?

Will It Work?

The question of whether or not joint implementation can work is paramount. If it cannot, then the issues of its equity and overall importance are moot. To answer this question, it is necessary to first get a sense of how effective JI projects will be in reducing carbon dioxide emissions. Second, the likelihood that joint implementation represents a globally cost-effective solution to global warming mitigation must be assessed. Lastly, a determination must be made about whether JI can be designed to function as a truly effective mechanism of technology transfer.



Near-Term Effectiveness

Assessments of joint implementation's effectiveness in reducing carbon dioxide emissions revolve around one central question—that is, how to determine that credits will be awarded solely on the basis of real emission reductions (or enhanced carbon uptake) that would not otherwise have occurred.

Under the FCCC, the only nations with specific emission reduction commitments are the Annex I countries—the 24 nations that belonged to the Organisation for Economic Cooperation and Development (OECD) in 1992, six countries from the former Soviet Union, and five other East European nations. These nations have informally committed themselves to lowering their net emissions of greenhouse gases to 1990 levels by the year 2000. The FCCC recognizes a second group of nations, which is made up solely of the 24

Table 1. Joint implementation projects completed or approved as of early 1997

Investing country	Host country	Project type	Location/Project title
United States	Belize	Forest management	Rio Bravo
United States	Costa Rica	Wind energy	Plantas Eólicas S.A.
United States	Costa Rica	Forest protection	ECOLAND
United States	Costa Rica	Forest protection/expansion	CARFIX
United States	Czech Republic	Coal-to-natural gas efficiency upgrade	Decin
United States	Honduras	Rural solar electricity	ENERSOL
United States	Russia	Reforestation	Saratov
United States	Costa Rica	Reforestation	Klinki Forestry
United States	Nicaragua	Geothermal power	El Hoyo-Monte Galán
United States	Costa Rica	Wind energy	Aéroenergía S.A.
United States	Costa Rica	Reforestation	BIODIVERSIFIX
United States	Russia	Methane capture from pipelines	Rusagas
United States	Honduras	Biogas power	Bio-Gen
United States	Costa Rica	Hydroelectric power	Dona Julia
United States	Costa Rica	Wind energy	Tierras Morenas
Netherlands	Malaysia	Reforestation	
Netherlands	Ecuador	Reforestation	
Netherlands	Uganda	Reforestation	
Netherlands	Czech Republic	Reforestation	
Netherlands	Russia	Capture of landfill methane	Daskovka
Netherlands	Russia	Energy-efficient greenhouse	Tyumen, Siberia
Netherlands	Hungary	Diesel-to-gas bus conversion	
Netherlands	Hungary	Municipal energy efficiency	
Norway	Mexico	Energy-efficient lighting	ILUMEX
Japan	China	Ironworks efficiency upgrade	

NOTE: Many other projects are in various pre-approval stages.
SOURCE: Compiled by the authors from various issues of *Joint Implementation Quarterly.*

OECD members: the Annex II countries. The Annex II countries are the only ones committed under the terms of the convention to providing the developing countries with financial resources and technology.

If two Annex I countries undertook a joint implementation project, assigning credits would be a relatively easy task. The investing country and the host country could verify the emission reductions between themselves once the project was completed and compute the number of credits to be awarded. The size of the credit would not matter because these two countries would just be transferring some emission reduction between themselves. For this reason, JI projects between two Annex I countries are much less controversial than projects involving developing countries; the amount of credit transferred from one country to the other does not affect the Annex I countries' combined reduction target. JI projects between Annex I countries and developing countries are entirely different, however. In these cases, the size of the credit will be extremely important. This is because the FCCC allows developing countries to increase their emissions of greenhouse gases. This makes it extremely difficult to determine the baseline emissions level—the level emissions would have been if a given JI project had not been undertaken. To compute the credit the investing country will receive, it is necessary to know both the baseline emissions level and what the emissions level will be after the project is completed. Figuring out these two levels can be a difficult and controversial task.

Determining the baseline emissions level for some projects, like those that involve fuel switching or the development of renewable energy sources to replace conventional power sources, is relatively straightforward. This task becomes much more complicated with projects that would yield net economic benefits—so-called "negative cost" or "no-regrets" options—to the host country. Because these types of projects generate benefits other than emissions reductions, it is possible that the host country would have undertaken them without foreign assistance.[12] It is wrong to argue that projects that generate such other benefits should not qualify for joint implementation financing on this basis alone, however. There are many reasons why a government might not be able to undertake a project that it would under optimal circumstances—lack of information, lack of capital, and lack of institutional capability, just to name a few.[13] Such circumstances make it difficult to decide whether or not the case without the project should form part of the baseline.[14]

Even after a JI project has been accepted and a baseline emissions level established, accurately and fully accounting for the change in emissions associated with it can still be a daunting task. Projects that improve energy efficiency have two indirect effects that reduce the emission savings. The first is a decrease in the effective cost of energy because it is used more efficiently. The second is a decrease in the unit price of energy because of reduced demand.[15] Conversely, projects like ILUMEX, which involves increasing the use of compact fluorescent lights, act to increase emissions savings (see the box on page 20). In the case of forestry projects, accounting for the change in emissions entails a completely different set of challenges because these projects involve the irregular and uncertain absorption of carbon from the atmosphere.

Ultimately, even if all the issues mentioned above are resolved, the potential for abuse and "leakage" remains.[16] Leakage would occur if, as some critics fear, investors in JI projects deliberately overstate the baseline emissions level or otherwise exaggerate the expected level of abatement to increase the value of the credit. Leakage would also happen if an investor just shifted emissions elsewhere instead of actually reducing them.

Determining the baseline emissions level becomes much more complicated with projects that would yield net economic benefits to the host country.

These concerns highlight the need for a legal framework to assign liability and cancel credits in the event that a JI project fails to achieve the expected level of emissions abatement. This framework could handle leakage and other uncertainties by first estimating the probability that a given project is additional and that it will achieve the stated emission savings, and then reducing the emission credit accordingly.[17] Developing such a framework, however, will entail

THE CARFIX PROJECT

The U.S. government approved the CARFIX project, a forest protection and expansion scheme proposed by the United States Agency for International Development, in 1995. The approval of the Costa Rican Office for Joint Implementation followed soon thereafter. The project is taking place in Costa Rica's Central Volcanic Mountain Range Conservation Area, which the United Nations Educational, Scientific and Cultural Organization designated as a World Biosphere Reserve in 1988. FUNDECOR, a Costa Rican nonprofit organization, and the Costa Rican National Park System jointly manage the area. The project involves stabilizing the existing forest area and creating additional forest cover in the biosphere reserve's buffer zone. Supporters of the project claimed that, without joint implementation funding, deforestation posed a serious threat to the long-term health of the buffer zone. Investors expect to sequester approximately 2 million additional metric tons of carbon over a 25-year period, beginning in 1996. To determine the baseline level for calculating carbon sequestration, CARFIX planners used data on deforestation rates within critical areas of the biosphere reserve. Currently, the price per metric ton of carbon dioxide offset is set at \$2.73 (U.S.). In addition to the carbon sequestration, investors in the CARFIX project believe that sustainable management of parts of the forest will also benefit the local community. The people living in the area can also expect to derive other indirect benefits from the project, such as enhanced protection of local water resources and tourism promotion. Investors from the United States anticipate being able to use their purchased offsets for domestic purposes. Landsat imagery and geographic information systems technology will be used once every three years, along with on-the-ground verification of annual growth in biomass, to verify the carbon sequestration.

THE ILUMEX PROJECT

The ILUMEX project, an end-use energy efficiency project, involves residential lighting in Mexico, which is almost entirely supplied by incandescent lamps. Since 1990, however, the national utility has been promoting the use of compact fluorescent lights (CFLs) through a series of small-scale projects. CFLs use 75 percent less energy and last 10 to 13 times longer than incandescent bulbs. The *Proyecto de Uso Racional de Iluminación en Mexico* (ILUMEX) began in the spring of 1995. Organizers hope to eventually distribute 1.7 million CFLs throughout the cities of Monterrey and Guadalajara. The lamps are offered to customers at subsidized prices, and sales are promoted through an extensive advertising and public education campaign. A parallel goal, however, is to determine the capacity of Mexico's national utility to implement demand-side management.

ILUMEX will directly reduce carbon dioxide emissions by 700,000 metric tons over the project's lifespan. Some of the project's indirect effects (such as increased use of lighting) could reduce the direct benefits, however. Other indirect effects (such as additional purchases of CFLs through regular commercial channels) could substantially increase the benefits. Estimates show the project costing a total of $23 million. Currently, the Mexican government has allocated $10 million to meet expenses. The Global Environment Facility ($10 million) and Norway ($3 million) have contributed the extra funds.

If the ILUMEX project were extended to other areas in Mexico, its net cost would likely decrease rapidly for two reasons: First, the project is experimental in nature; second, the direct cost of reducing carbon dioxide emissions through the use of CFLs is negative (the energy cost saving over the 6 year lifespan of a CFL ($17.67 at the typical cost of electricity in Mexico of $0.04 per kilowatt hour) exceeds the cost of a CFL, which is $10.00).

creating a set of standard international guidelines for project assessment. This effort is likely to involve protracted political negotiations when and if the time comes that credits are transferred between two nations that each have reduction targets. On a parallel note, the need to develop a methodology for assessing additionality and indirect or uncertain emission effects will require effective monitoring and verification of JI projects.[18]

In the Long Term

Over the long term, joint implementation could have an indirect effect on carbon dioxide emissions in two ways—through its impact on the conditions that influence population growth and its impact on the rate of technological development in industrialized countries.

Given a certain level of affluence and technology, a society's greenhouse gas emissions will be larger the greater its population. JI projects are intended to address the emissions problem, but the overall nature of JI could also have an indirect effect on conditions that influence population growth. A beneficial effect would occur in cases where JI projects focus on providing energy to satisfy basic human needs (food, shelter, sanitation, education, and health care). As more of these needs are met, the standard of living improves. And as standards of living improve, fertility rates tend to decrease.[19] If, however, the lure of funds for particular JI projects motivates developing countries to divert scarce resources away from investments in basic human needs, joint implementation could prove to have a counterproductive influence over the long term.[20]

In keeping with the principle that satisfying basic human needs is a key part of the long-term greenhouse gas abatement strategy, JI projects are generally expected to suit the host country's development needs and priorities. Ideally, joint implementation funding would be directed toward increasing end-use energy efficiency and promoting dispersed, small-scale energy sources. Multilateral lending, however, has tended to favor large energy projects that emphasize expanding capacity instead of smaller, more decentralized projects that improve energy efficiency or shift the supply toward renewables.[21] As we have discussed extensively elsewhere,[22] JI is not the best tool for promoting development directed toward satisfying basic human needs.

If in the future lending patterns changed, a very decentralized regime composed of many smaller projects instead of a few large ones would be created. Under such a regime, it would be much more difficult to determine emission reductions and verify results. This scenario offers another reason why JI might not be the right approach to adopt. To be sure, many of the pilot projects listed in Table 1 involve small-scale, decentralized renewable energy production. Two of them (ILUMEX and the Decin project) even address end-use energy efficiency specifically. However, the companies implementing these projects are, almost by definition, innovative and progressive. In other words, they are not the typical multilateral donor.

There is, however, another issue to be considered. If JI ever became widespread, companies would have a strong economic incentive to participate in emissions reduction schemes (unlike today, where participation is voluntary). This increases the likelihood that more large-scale, central-

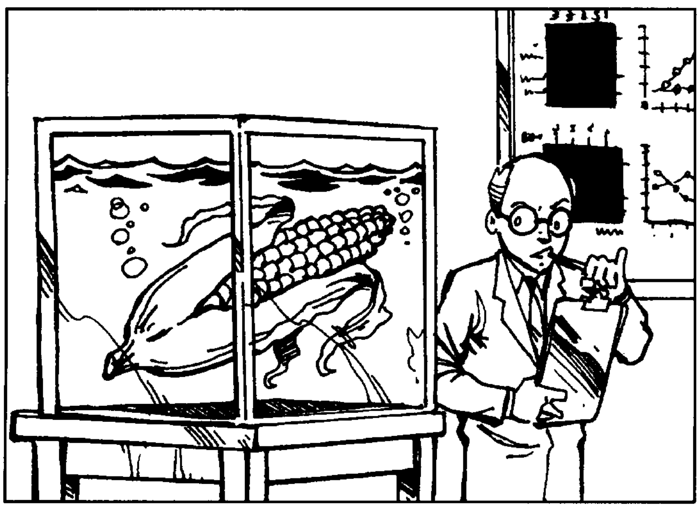
(continued on page 36)

DOING THEIR PART

This December, representatives of governments around the world will meet in Kyoto, Japan, to discuss setting limits for greenhouse gas emissions after the year 2000. Like the Framework Convention on Climate Change (FCCC) that was signed in 1992, the new agreement will probably place caps on the emissions of developed countries but impose no set requirements on developing countries. This apparently unequal treatment has drawn a lot of criticism from business and labor leaders in the developed world. Last February, for instance, the president of the United Mine Workers of America complained that it was unfair to let "fast-growing developing countries such as China, India, Korea, Mexico, and Brazil off the hook." It turns out, however, that large developing countries have actually done *more* to trim their greenhouse gas emissions than the developed countries have. At least that's the conclusion of a new report by Walter V. Reid, vice president for program at the World Resources Institute in Washington, D.C., and José Goldemberg, a professor at the University of São Paulo in Brazil. According to their report, fuel price reforms, efforts to promote energy efficiency and renewable energy sources, and joint implementation projects should lead to greater percentage emissions reductions in developing countries than in developed countries—and perhaps to greater absolute reductions as well. As things now stand, only two major developed countries—the United Kingdom and Germany—are likely to meet their obligation under the FCCC to reduce emissions to 1990 levels by 2000. (U.S. emissions are projected to be 13 percent higher than in 1990.) What may be clouding our view of developing countries' progress in this area, say Reid and Goldemberg, is the fact that they adopted emissions reduction policies for other reasons, such as improving respiratory health or eliminating dependence on energy imports. But less carbon is less carbon, whatever the motivation. (For more on the issues to be discussed at Kyoto, see the article on joint implementation on page 14 of this issue as well as *Environment*'s November issue, which will be devoted to climate change.)
—*Climate Notes*, July. (R.N.)

THE FELINE'S FEAST

Rose thought she was doing the humane and caring thing by feeding the collection of stray cats populating one of the many parks in San Francisco, California. Despite the best of intentions, however, actions like Rose's have been harshly criticized by biologists and wildlife experts for perpetuating the growing problem of predation. Estimates suggest the number of feral (semiwild) cats exceeds 30 million in the United States alone. This burgeoning population is in part encouraged by the efforts of organizations like Alley Cat Allies and Forgotten Felines. Rather than euthanizing the animals, these groups trap unadoptable strays, test them for diseases, vaccinate, sterilize, and then release them back into the wild, where Rose and other "caregivers" throughout the country continue to feed them. While protecting the cat population, this practice does nothing to combat the problem of predation. Studies of semi-domesticated cats' activities show that even well-fed cats continue to hunt. Many conservation biologists claim that feral cats' predatory activities are behind the dramatic reduction they have observed in the populations of birds, small mammals, and reptiles—the principle targets for cat predation. "We know there are millions of free-ranging cats in this country," says Scott Craven, a University of Wisconsin biologist, "and if each individual cat averages one or two animals each year [from species] that are already in jeopardy—millions of cats times even a small number of prey becomes really significant." It is true that the practice of feeding stray cats, commonly at stations located in national parks, has resulted in a predatory density unknown in nature. But organizations like the San Diego-based Feral Cat Coalition claim that cats have become scapegoats for the environmental impacts of landscaping and real estate development. Both the Humane Society of the United States and People for the Ethical Treatment of Animals, however, oppose the practice of releasing trapped feral cats. "The best thing to do is bring [the cats] in and find them homes if we can," says Susan Hagood, the Humane Society's wildlife-issues specialist. —*Audubon*, July-August. (N.B.)



GREEN GENOMES

Botanists seem to be one step closer to getting their shot at mapping the genomes of key plant species as support grows in the U.S. Senate for the Plant Genome Initiative. The initiative would focus on establishing the gene sequences for several related cereals, including rice, wheat, and corn, and would be funded through the National Science Foundation. Observers believe that the initiative's current broader scope (it was originally designed to target just corn) reflects in part the findings of a report released in June by a federal panel chaired by Ronald L. Phillips, chief scientist at the U.S. Department of Agriculture's National Research Initiative. That report recommended the United States team up with Japan and other nations to sequence the rice genome. The rice genome, smaller than that for either corn or wheat, could be used as a "baseline genome" for comparisons across species. The likely price tag for the broader Plant Genome Initiative if it passes congressional muster: more than $10 million. —*Science*, July 11. (K.G.)

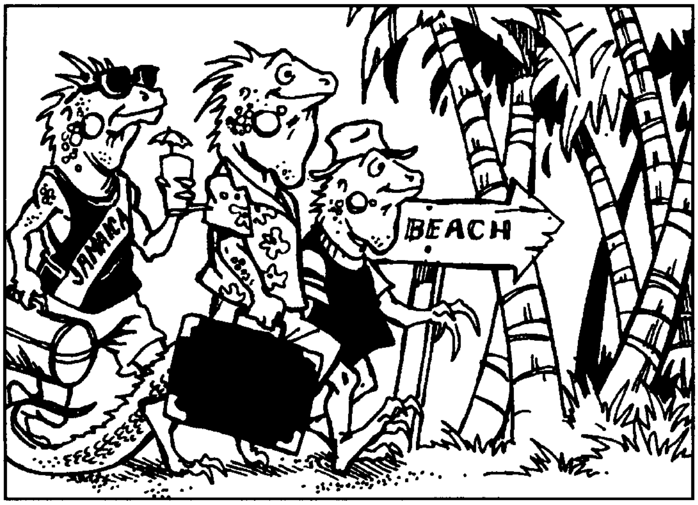
WHAT'S THE MISSION?

It used to be that zoo cages were constructed to protect humans from the animals. These days, however, perhaps it should be the other way around. At Quebec's Granby Zoo, for instance, an endangered female rhino recently died from inhaling a plastic cake wrapping thrown to her by a visitor. In 1989, Gus, one of Granby's chimpanzees, died of a heart attack. Gus had become a regular smoker, thanks to the steady supply of cigarettes tossed into his cage. Human-borne viruses and bacteria also threaten a zoo's population because the animals have no natural defense against human diseases such as German measles or even the common cold. These threats have led to a marked change in the rationale for maintaining zoos throughout the world. The claim that zoos offer people a unique chance to learn about animals has been largely discounted by the proliferation of nature programs on television, which allow viewers to observe even the rarest species in their natural habitats. As a result, conservation is increasingly being seen as the principal mission of zoos. Gerald Durrell, a visionary

conservationist who died in 1995, established the model for such an institution nearly 40 years ago. His Jersey Zoo (now known as the Jersey Wildlife Preservation Trust) located in the English Channel Islands concentrates on preserving endangered species whose habitats have been severely degraded by human activity. As Durrell wrote in 1990, "zoos now (at least the best and most responsible ones) are saving creatures from extinction, breeding them, giving them breathing space to renew their numbers, and then putting them back into the wild."
—*The Toronto Star*, July 5. (N.B.)

FALLING SHORT OF THE GOAL

Canada's attempt to stabilize its greenhouse gas emissions at 1990 levels by the year 2000 (as it is obligated to do under the Framework Convention on Climate Change) appears to have met largely with failure. In November 1996, Environment Minister Sergio Marchi reported that Canada's emissions had increased more than 9 percent by the end of 1995 and that current measures were inadequate to meet the target level. Canada's National Action Programme on Climate Change and its main initiative, the Voluntary Challenge and Registry (VCR), have borne the brunt of the criticism for the lack of performance. The VCR program, begun in 1994, gives Canadian companies responsible for greenhouse gas emissions the chance to tackle the problem without government regulations. Two independent reviews of VCR conducted by the Pembina Institute for Appropriate Development in Canada indicate that the program has essentially been ineffectual. In its first report, released in 1995, the institute considered the 60 most comprehensive corporate action plans submitted to VCR, assessed them against 56 criteria, and awarded a score from 0 to 100. Only 3 of the 60 plans scored higher than 50, and the average mark was 27. The institute's second report, published in 1996, reviewed 73 corporate action plans and also evaluated corporate commitments to take at least one action in the future to reduce emissions. The average mark these plans received this time around increased—but by only 5 points. Furthermore, only 15 of the 73 companies reviewed provided an estimate for their gross greenhouse gas emissions in the year 2000 that either equaled or was below their 1990 levels. The Pembina Institute has concluded that without economic incentives or government regulations to enforce emission reductions, there is little indication that Canadian companies will take the necessary steps to address the climate change threat.
—*Alternatives Journal*, Summer. (N.B.)



IMMIGRANT IGUANAS

Until 1990, researchers believed that iguanas had disappeared from Jamaica, and they pointed to the Indian mongoose as the culprit. Farmers misguidedly introduced the mongeese more than 50 years earlier in an attempt to control the rat population. But because they failed to take into account one crucial difference between the two animals' activity patterns, the mongeese ended up decimating Jamaica's reptile population instead. (Rats are nocturnal; mongeese hunt at dawn and dusk.) In 1990, against all odds, researchers discovered a small group of iguanas living in the Hellshire Hills near Kingston. Now, through a joint project between the Fort Worth Zoo in Texas and

Kingston's Hope Zoo, scientists are attempting to strengthen the iguanas' numbers by doing something entirely new—releasing zoo-raised iguanas into the wild. The first release of four 6-month olds took place in July. Rick Hudson, assistant curator at the Fort Worth Zoo herpetarium, explains that iguanas are actually the perfect candidates for such releases because unlike other species, "they don't need any head-start training." California condors, for instance, must be coached to avoid power lines and Wyoming's black-footed ferrets need to be taught to avoid coyotes and badgers. To try to boost the program's chances of success, authorities have increased mongoose trapping efforts and are making a concerted attempt to keep farmers out of the iguanas' core habitat, which Hudson describes as "one of the last really pristine examples of tropical dry forest in the Caribbean."
—*Science*, July 11. (K.G.)

TWO YEARS *AFTER* THE MAST

Lyme disease, an infectious disease caused by a bacterium that is carried by certain species of ticks, is spreading rapidly in the United States: As many as 14,000 cases have been reported annually since 1990, although the true number is probably higher. Because there is as yet no approved vaccine against the disease, the best way to avoid getting it is not to come in contact with the ticks. That, say a growing number of ecologists, requires knowing more about the interactions between the ticks and their hosts. Larval ticks hatch in midsummer, and after feeding on a host (often a white-footed mouse) for two to three days, molt into nymphs the size of poppy seeds and remain quiescent until early the following summer. At that time, the nymphs feed again, and three months later molt into adult ticks. In midautumn, the adults seek a new host (usually a white-tailed deer or other large mammal) on which to feed and mate. Larval ticks usually do not possess the Lyme disease bacterium at birth but can acquire it during their first feeding. Once acquired, the bacterium remains with the tick throughout its subsequent stages. Given the tick's life cycle, ecologists say, people should be particularly careful about going into tick-infested areas in early summer and midautumn. (Early summer is probably the most dangerous time because that is when the nymphs are active and they are difficult to see because they are so small.) Recent research has disclosed another important factor in the Lyme disease equation, however—the quantity of acorns produced by oak trees two autumns earlier. Large crops of acorns (a phenomenon known as "masting") attract deer and mice, leading to outbreaks of larval ticks in oak forests the following summer. One year later, when the larvae have entered the nymph stage, the risk of being bitten and possibly infected is especially high in these areas. Other areas, such as maple forests and open fields, are also riskier because migrating mice tend to carry the Lyme disease bacterium into them as well. The ultimate aim of studying tick ecology is to be able to predict where and when people are likely to contract Lyme disease—and to give them warning well in advance.
—*American Scientist*, July-August. (R.N.)

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