Global demand for energy continues to rise, and the bulk of that increase will come from non-OECD (Organisation for Economic Co-operation and Development) countries. Correspondingly, the necessary investments in energy-producing and -consuming technologies must take place there as well, although new low- and no-carbon energy sources (such as nuclear and renewables) will be more costly than conventional sources. In OECD countries, we may be willing to bear higher carbon prices but non-OECD countries are already hard-pressed to afford current fossil fuel technology, much less subsidize low- and no-carbon energy sources.

Investing in RD&D, conservation, and physical, energy-related capital must begin immediately. Any delay means greater atmospheric concentrations in the coming years. Unfortunately, we cannot wave a magic wand and will this process to commence. Rather, we must follow a slow and arduous path to develop and implement the many public policies, domestic and international, that will remove barriers and enable investment.

We must buy some badly needed time and, fortunately, we have a very good option, namely the 15 to 20 percent of global CO_2 emissions that come from deforestation in tropical countries. While it is now widely known that China and the United States are the two largest CO_2 emitters, the next two are Brazil and Indonesia, due to widespread deforestation.

Reducing CO_2 emissions by reducing deforestation can be accomplished with targeted domestic policies that alter the economics of land use to make a standing forest more valuable than alternative uses of the land. Using the growing international carbon market and the nascent U.S. market to monetize the carbon contained in standing forests will provide the economic incentives needed to alter land-use decisions.

In principle, such land-use decisions could be changed very quickly, giving rise to rapid reductions in CO_2 emissions. These large-scale reductions in forest-related CO_2 are sure to become ever more valuable in light of the hard work ahead to achieve the needed fossil-based reductions in the decades ahead. ■

An Overview of the Economic Benefits of Cooperatives and Individual Fishing Quota Systems

James N. Sanchirico

In July, RFF University Fellow James Sanchirico testified before the U.S. Senate Committee on Commerce, Science, and Transportation Subcommittee for Oceans, Atmosphere, Fisheries, and Coast Guard. This article is based on his full testimony, which is available on our website.

The marine species residing in U.S. territorial waters and the men and women who make their livelihood from them are at a critical juncture. Without secure access to the resource, individual "fishers" compete with each other to capture as much of it as possible.

Cooperating under so-called rule of capture incentives, whereby the catch is not owned until onboard a vessel, results in a competition for fish that leads to low wages, dangerous working conditions, low-valued products, excess harvesting and fish processing capacity, and ever-shorter fishing seasons. Economically depressed fisheries are vulnerable to short-term thinking and risk-taking, and fishery participants cannot afford to invest in long-term sustainability.

This outcome is in nobody's best interest. In other words, it's a classic tragedy of the commons.

These conditions are not fated, however. Policies that address the rule of capture incentives include fishing cooperatives and individual fishing quota systems (IFQs). In each policy, the allocation of catch shares reduces the incentives to invest in the "race for fish." Participants have a greater certainty about their catch levels and the ability to buy and sell shares provides flexibility for

participants to adjust the scale of their operations.

Around the world, fisheries managed with IFQs or cooperatives experience sustainable profit rates that range from 20 to 60 percent. These overall economic benefits are indicative of both cost savings and revenue increases. They derive from ownership of the catch shares and the ability to transfer the shares from one fishing participant to another.

Benefits from ownership include the reduced incentive to race for fish, which results in longer fishing seasons and a slower pace of fishing. The slowed pace improves the ability of vessels to optimize on-board processing facilities, resulting in increases in the amount of product sold on the market per pound of fish caught. Essentially, the incentives shift from maximizing the quantity of fish caught to maximizing the value of the catch.

Additional benefits can be gained from the transferability of the catch shares. Typically, fisheries managed under an IFQ system see a reduced number of vessels as excess capacity is removed from the fishery, and participants utilize the additional flexibility to determine the optimal scale of their operations. Higher-cost (and thus less-efficient) vessels will find it more profitable to sell or trade their shares than to fish them, and so the total allowable catch will be caught at the lowest possible cost.

One of the most powerful forces of change created by catch-share programs is a constituency whose wealth is a function of the health of the marine environment. Wealth creation, in turn, can lead to improved stewardship, sustainability, and further innovation to increase value. ■

Taking a Closer Look at the Cost of Air and Water Pollution in China

Sandra A. Hoffmann

In recent months, the press has been filled with stories of the extraordinary efforts the Chinese government made to assure that environmental conditions met world approval during the 2008 Olympics. Earlier this summer, the city of Qingdao mobilized thousands of people to clean up an algal bloom that choked the coastline and threatened Olympic sailing competitions. In Beijing and neighboring cities, factories were closed to a surrounding distance of 300 kilometers. In Beijing itself, government vehicle traffic was cut by 70 percent and private vehicles were already put under an alternate driving-day restriction, two moves that were expected to reduce 40 percent of the 3.3 million vehicles on its streets. Such unparalleled actions paid off—at least temporarily: the air over Beijing cleared a few days before the Olympic opening day.

But, of course, the real impact of pollution in China has less to do with the Olympics than with the sustained exposure that the Chinese population faces. China's remarkable economic growth over the past 25 years, spurred by massive industrialization, has had severe environmental consequences. Fine particulate levels (PM 10) in major Chinese cities are roughly twice World Health Organization guidelines and three to four times those typically seen in U.S. or European cities. In meeting rising energy demands, China has become the world's largest emitter of sulfur dioxide. Water supply and quality, which are strongly affected by both industrial pollution and biological waste, have been a focus of public concern in the past few years.

China has made strides toward implementation of more effective environmental quality management. Significant progress was made during the 1980s and 1990s, but those advances have slowed in the past decade. For example, energy efficiency—which increased markedly from 7.5 tons of coal per 10,000 yuan of GDP in the 1980s to roughly 2.5 tons in the late 1990s—has stagnated since then. Likewise, urban air quality improved in the 1980s and 1990s but has stalled in the past decade, due in no small part to the rise in car ownership, up 31 percent between 1990 and 2003.

Despite this gloomy recent performance, China is in a good position to move more aggressively to address these environmental quality problems. Rapid industrialization has provided the financial resources to take advantage not only of modern pollution control technologies but also decades of experience throughout the world with designing more effective pollution control policies. The challenge ahead is finding means of efficiently controlling pollution without unduly slowing the economic growth that lifted an estimated 400 million people above the extreme poverty line between 1980 and 2000.

Efficient pollution policy requires information. RFF Senior Fellow Alan Krupnick and I are working with a team of scientists and economists from the World Bank, Norway, and China to model the health and productivity