

AIR TRADE:
PROMISES—AND PITFALLS—IN THE COMING CARBON MARKET

by

Lissa Harris

A.B. Philosophy
Smith College, 1998

M.P.S. Natural Resources
Cornell University, 2004

SUBMITTED TO THE PROGRAM IN WRITING AND HUMANISTIC STUDIES IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN SCIENCE WRITING
AT THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SEPTEMBER 2008

©2008 Lissa Harris. All rights reserved.

The author hereby grants to MIT permission to reproduce
and to distribute publicly paper and electronic copies of this
thesis document in whole or in part in any medium now
known or hereafter created.

Signature of Author: _____

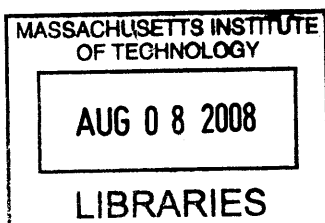
Graduate Program in Science Writing
July 31, 2008

Certified by: _____

Thomas Levenson
Associate Professor, Graduate Program in Science Writing
Thesis Advisor

Accepted by: _____

Robert Kanigel
Professor of Science Writing
Director, Graduate Program in Science Writing



ARCHIVES

AIR TRADE:
PROMISES—AND PITFALLS—IN THE COMING CARBON MARKET

by

Lissa Harris

SUBMITTED TO THE PROGRAM IN WRITING AND HUMANISTIC STUDIES
ON JULY 28, 2008 IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF SCIENCE IN SCIENCE WRITING

ABSTRACT

Market mechanisms for controlling pollution and other environmental problems, once considered experimental, have recently become favored tools for regulation, both in the U.S. and abroad. In the last several years, a \$64 billion global market for carbon dioxide permits and offsets has emerged out of international dealmaking on climate change. The carbon market has become a force to be reckoned with in international trade, and created many stakeholders with vested interests in the design of the market and its governing regulations. Driven by the international finance community and clamor from the general public for action on global warming, U.S. legislators are under increasing pressure to adopt similar measures. And as action by the U.S. seems more likely, industries that would likely be targeted by climate change legislation are becoming less obstructionist, increasingly seeking influence over the direction of regulation rather than attempting to block it altogether.

Given current trends in business, finance and politics, it is likely that in the near future, the U.S. will adopt carbon pricing as a means to decrease carbon emissions and attempt to halt the progress of climate change. However, with so many stakeholders in the debate, designing the market will be a contentious and highly politicized process. Because of both scientific uncertainty and political factors, there is great potential for market failures, from miscounted emissions to perverse incentives to social inequity. This thesis examines some of the market designs that have been proposed, along with reasons why the carbon market is likely to fail to live up to its greatest promise.

Thesis Supervisor: Thomas Levenson

Title: Associate Professor of Science Writing

“Economic science is chiefly valuable, neither as an intellectual gymnastics nor even as a means of winning truth for its own sake, but as a handmaid of ethics and a servant of practice.”

-Arthur Pigou

“Admit it, you’d be disappointed in the financial industry if it didn’t find a way to profit off of global warming.”

-Rob Carrick

Behold the savior of Earth: a small brown pea. Confronted with what increasingly seems like the worst environmental disaster of this—or any—century, we will fight back with lentils. This is the story Gord Kurbis has called from Winnipeg, Manitoba to tell.

Not that he puts it that way, exactly. He is too polite and too Canadian, and has spent too many years drafting dense agricultural policy papers, to indulge in sweeping hyperbole on the redemptive powers of the lentil, like a showboating evangelist of the Church of the Holy Legume. Nevertheless, he does believe that lentils fight global warming (or, as the press has begun to say more soothingly, “climate change”). As do chickpeas, beans, peas and all things leguminous.

In an age when green sells, it’s a smart message. Canada’s farmers export more lentils and peas than those of any other country. Unabashed cheerleaders for the humble legume—or pulse, as they call it everywhere north of the border—Pulse Canada lobbies on behalf of farmers and market the virtues of beans. “Pulses are one of the most sustainable, low energy-input, low water-input, and low greenhouse gas emission sources

of protein in the world,” the Pulse Canada website proclaims, amid bucolic pictures of green-furrowed fields and gently lit close-ups of beans.

When Kurbis was growing up in Sanford, just south of Winnipeg, his parents grew flax, wheat and barley on 160 acres (a “hobby farm,” Kurbis calls it; the size of the average Manitoba farm is almost a thousand acres). Kurbis opted to study economics rather than drive a tractor, but never left his roots far behind; his 2000 master’s thesis from the University of Manitoba was on fish farming. Last fall, Pulse Canada chose him to head their environmental program.

In particular, they hired him to get coal-burning power companies in Alberta to pay farmers for growing lentils, peas and beans. For every acre of lentils grown on the plains of south-central Canada, Kurbis says, a certain amount of carbon dioxide per year works its way into the soil, leaving that much less floating around the troposphere to double-glaze the planet. Pulse Canada has made it a high research priority to figure out just how much; if they can measure it, they can sell it.

The idea of using markets to fight climate change is gaining traction all over the world—most recently, in the Canadian province of Alberta, where the first government-regulated carbon market in North America recently began trading permits for pollution. This year, Alberta power plants faced a new requirement that they must reduce the amount of carbon dioxide they put out for each unit of electricity generated—a so-called intensity reduction target—by 12 percent below 2005 levels. Each year that they miss the target, the plants face a choice: either they can pay fines of \$15 for every ton in violation of the limit, or they can buy offsets from the burgeoning ranks of eco-entrepreneurs in the Alberta carbon market.

Already, the Alberta commission that oversees the market has approved over a dozen activities to count as carbon offsets, from planting trees to farming with low-impact “no-till” practices to building methane-fueled generators over manure lagoons. If Kurbis can convince the Alberta authorities that there is a scientific case to justify it, legume-farming may be added to a growing list of activities that count as “carbon offsets” in the brand-new Alberta carbon market.

Kurbis thinks Pulse Canada has a good shot at capturing some of the power companies’ largesse. “I think there’s a little more empirical work that may be required for us to have the sort of scientific veracity that would be required to come up with a credit. We’re almost there,” he says.

On one hand, the idea that beans will save us from global catastrophe sounds desperately inadequate, a David with no hope of defeating Goliath. On the other hand, bean-growing is only one of a thousand weapons that have been proposed to fight the coming apocalypse—and hardly the most ludicrous one, at that. Some of them involve paying people to do nothing at all. Some are an environmental shell game, using one international law to flout another. The most promising ones have yet to be invented.

What all the weapons in humanity’s ragbag environmental arsenal have in common is that to be put into action, they all depend on one critical thing: a price for carbon. In theory, treating the right to pollute as a commodity that could be bought and sold would have two effects. First, it would make carbon-based energy more expensive, giving people an incentive to conserve or switch energy sources. Second, it would create a mechanism for capturing money that could be invested in solutions to the climate crisis.

In practice, say critics, successfully harnessing the market to drive action against climate change depends on getting the price right, getting the right people to pay it, and spending it on the right things—each a vastly difficult proposition.

Today, in the U.S., the right to emit a ton of carbon dioxide into the atmosphere costs nothing. In Europe, where traders have been buying and selling the right to pollute since 2005, it costs roughly \$40. From one perspective, the European carbon market created by the Kyoto treaty, in which 36 nations pledged to reduce their carbon emissions, has been a tremendous success. Over \$7 billion a year is being diverted from carbon-intensive energy and invested in clean technology in the developing world, through Kyoto's Clean Development Mechanism (CDM).

From another angle, the Kyoto experiment has failed spectacularly. The costs of carbon permits have been absorbed not by power companies, but by ordinary citizens. Some of the “clean technology” funded by the CDM has turned out to be an extremely dubious investment. The most damning indictment of all is that so far, Kyoto hasn't made much of a dent in Continental carbon emissions.

This much seems certain: Despite the naysayers, carbon emissions in the U.S. will soon come with a price. And while industries and individuals alike will struggle to cope with the changes that will ripple through the market, a new breed of entrepreneurs, like Kurbis's bean farmers, will discover innovative ways to prosper in a carbon-constrained world. The question is not whether we are going to pay for the right to pollute. It is: Will it work?

To an economist, a price is much more than the cost of getting something. It is a piece of information, a shape-shifting quantity that reacts more swiftly to a changing world than even the sharpest of investors. Because prices reflect the collective wisdom of the market—predictions that are sometimes insightful, and sometimes merely self-fulfilling—they can be used to predict the future, sometimes with astonishing accuracy.

And while a price reflects the world, it can also be an engine for changing it. In the last few years, driven by high demand for ethanol and a poor growing season, the price of corn has more than doubled, causing ripple effects in the price of everything from gas to pork chops. In a development that would make the eco-optimist Mark Sagoff proud, runaway corn prices are beginning to fuel human ingenuity—at least in small ways. A *Wall Street Journal* article from last October reported that ketchup maker Heinz, stymied by the rising price of corn syrup, had doubled the size of its seed research team in an effort to breed a sweeter tomato.

A price on carbon would impose costs that would spread even more pervasively throughout our economic lives. But it would do more than drive up the nation's electricity bills. It would put the fiendishly complex engine of the U.S. economy to work on the carbon problem, like a vast computer working through an algorithm.

Around the turn of the last century, a British welfare economist named Arthur Pigou had a critical insight about prices that redefined how economists thought about the natural world. Pigou's big idea was that the free market—so good at efficiently distributing human happiness under the right conditions—fails spectacularly to solve problems like environmental pollution, in which the price of a destructive activity to

those that engage in it is less than its cost to society at large. But if the government can accurately measure the difference between the two—dubbed, in econ-speak, a “negative externality”—it can intervene to solve the problem, by forcing the polluter to pay the full social cost. What matters most in the effort to harness market forces to serve the common good is getting the price right. If we can force the price of carbon to match what global warming will cost us as a society, a Pigovian would say, we can crack the problem of climate change.

Like most theories, this one has its weak spots. For one thing, carbon is not corn. Whether spewed from a smokestack or belched by a herd of cattle, a ton of carbon dioxide can't be used, touched, moved from place to place, or even always accurately measured. More than anything, carbon in the marketplace is like money itself: a useful collective delusion, dependent for its very existence on heavy government regulation and the willingness of the market to believe in its value. The relationship between money and the purchasing power it represents is abstract; not since the 1971 collapse of the Bretton Woods system have U.S. banks guaranteed a measure of gold behind every paper dollar. Like money, carbon permits would stand for a quantity that is intangible by nature, influenced as much by the tinkering of regulators as by actual abundance or scarcity. And because carbon-measuring is subject to intense political pressure, carbon permits would be even more susceptible than currency to abuse and speculation.

There is also the matter of figuring out what climate change will cost us—a task even more difficult than keeping track of each ton of carbon emitted. A 2006 report by British economist Nicholas Stern estimated the cost of unchecked global warming to be

at least 5 percent, and as much as 20 percent, of the combined GDPs of the nations of the world.

Success or failure depends on the design of the market. And there are many, many ways we can get it wrong.

Harvard economist Gregory Mankiw seems an unlikely advocate for putting a price on carbon. A close advisor to the current Bush administration, Mankiw chaired the President's Council of Economic Advisors from 2003 to 2005. A deeply conservative thinker, he has championed the Bush tax cuts, argued for privatizing Social Security and opposed raising the minimum wage for the janitors on his own campus—positions that earn him little love from progressives. His *Principles of Economics* is the bestselling introductory economics textbook in the world.

But the carbon debate makes for strange bedfellows. In October of 2006, Mankiw wrote an editorial for the *Wall Street Journal* that he called a “Manifesto for the Pigou Club,” tongue only half in cheek. In it, he proposed raising the gas tax by \$1 a gallon over the next ten years, using the \$100 billion in revenue it would generate to tackle a laundry list of national problems, including climate change.

The Pigou Club is strictly virtual; it's a list Mankiw keeps on his blog of fellow carbon-tax advocates. Every time he comes across an economist or other public intellectual calling out for a tax on carbon, he adds their name to the list. Members

include former Fed chair Alan Greenspan, *New York Times* columnist Paul Krugman and environmental economics *eminence grise* William Nordhaus.

The members of the Pigou Club see cap-and-trade programs like the European carbon market, with offsets and tradeable permits, as a second-best solution. To most economists, cap-and-trade is fraught with unnecessary complexity and requiring whole new government organizations to implement. A better solution, they say, would be a tax. And if that weren't the dirtiest word in American politics, they might have their way, according to Pigou Clubber Gregory Metcalf.

“Almost any economist who has worked on this issue prefers a tax to a cap-and-trade approach,” said Metcalf, from his office at the National Bureau of Economic Research in Cambridge, Massachusetts. Like most economists, Metcalf would be happier having the IRS handle a new corporate tax form or two than with the prospect of building a brand-new bureaucracy for the creation, auction, distribution, banking and ongoing management of billions of tons' worth of carbon permits. The policy analysts at the Congressional Budget Office agree—a February report by the CBO compared a tax to several potential cap-and-trade designs, and concluded that a tax would get the job done more cheaply and efficiently.

Adding to the (admittedly limited) appeal of a carbon tax is a growing popular disdain for green profiteering, Wall Street-style. This May, *Wired* magazine ran a deliberately provocative cover story on the environment, “Inconvenient Truths,” that scathingly dismissed European-style carbon trading as “hand-waving at best, outright scams at worst.”

“A carbon tax would eliminate three classes of parasites that have evolved to fill niches created by the global climate protocol: cynical marketers intent on greenwashing, blinkered bureaucrats shoveling indulgences to powerful incumbents, and deal-happy Wall Streeters looking for a shiny new billion-dollar trading toy,” grumped *Wired* contributing editor Spencer Reiss. Which raises the question: Without the parasites, who would be left standing to support the tax?

The environment and the average American citizen might well be better served by a tax, or at least by a cap-and-trade system somehow insulated from pork-barrel politicking. But for better or for worse, the notion of pricing carbon has advanced as far as it has in American political discourse largely because of “parasites”—the marketers, bureaucrats and Wall Streeters who have begun to see parallels between the green movement and their own self-interest, and whose willing participation is critical to any effort to get a market-based solution to climate change started. If Washington is moving slowly toward a carbon-constrained future, it is because powerful interests in business and finance are already marching ahead of them.

On October 30, 2007, most of the nation’s top carbon market players, and a fair number from abroad, were gathered at the Jacob Javits Center in New York for Point Carbon’s conference on the state of the North American carbon market. Like most good corporate seminars, this one began with a pep talk. The oddly boyish 56-year-old first up at the podium was Congressman Jay Inslee, Democratic representative from Washington, and he was, as usual, in full voice.

“This will be the largest driver of economic growth America has seen since the Internet,” he said, radiating crisp enthusiasm, and looking every inch the pol who could

earn a 100 percent rating from the Sierra Club and still get reelected three times in a swing district. “The bad news is, ice is melting in the Arctic. The good news is, the ice of resistance is melting in Washington.”

On this bright October morning, Inslee’s gladhanding ebullience was just what the hundreds of delegates from across North America and Europe wanted to hear. Many of them veterans of the green finance movement, they had been waiting ten years for American politicians to realize that there was money to be made in fighting global warming. Hardly a bunch of crunchy environmentalists, they had paid \$995 apiece for the privilege of being in attendance that day, and only a few academic-looking NGO types could be seen amid the sea of grey and black suits.

The future Inslee was selling from the podium feels a lot nearer today than it did in 1997, when the first international carbon talks were held in Kyoto. The debate over whether to cap carbon dioxide emissions is beginning to show signs of going mainstream, as industry players who have historically been opposed to any sort of regulation begin to see the benefits of getting a seat at the table when regulations are drawn up. International petroleum industry heavyweight BP has been a loud supporter of the carbon market for some years. In 2006, power-plant company Entergy broke ranks with its peers and came out in favor of carbon regulation, filing an amicus brief in support of 12 states who sued the EPA to force the agency to regulate carbon dioxide under the Clean Air Act. State and regional initiatives are beginning to create a patchwork of shifting regulations across the country, prompting large industry players to call for federal oversight, for simplicity’s sake.

This February, several investment banks announced that they believed the US would cap carbon dioxide emissions soon: the ponderous names on that list include Citigroup, J.P. Morgan Chase & Co., Morgan Stanley and Bank of America. Before lending a dime to would-be coal power plant builders, Bank of America announced, they will factor in a likely carbon price of between \$20 and \$40 a ton. (To put that price in perspective: according to the EPA, an average coal-fired power plant puts out over four and a half million tons each year.)

But perhaps the most telling indicator is that, for the first time, both front-runners in the 2008 Presidential election support a cap-and-trade carbon market. John McCain and Barack Obama's ideas for how to fix global warming differ in the details, but the basic approach is the same. On the legislative side, half a dozen different cap-and-trade bills (and a few carbon tax bills) are currently circling in a holding pattern around the House and Senate, awaiting a new administration.

Even as the warnings about the effects of climate change grow ever more dire, the market cheerleaders cheer louder. Predictions of carbon market growth are feverish—seemingly the only thing that is this dismal year. With no help from the government, a small and entirely voluntary US market in carbon permits and offsets has grown substantially in recent years, more than doubling from about 10.2 million metric tons of carbon dioxide traded in 2006 to 22.9 million metric tons in 2007.

In 2007, according to the federal Energy Information Administration, U.S. carbon dioxide emissions from fossil-fuel sources amounted to 5,984 million metric tons. At \$40 a ton—roughly the current price of carbon permits on the European market—the right to pollute at current levels in the U.S. would approach \$240 billion in value. A recent report

by New Carbon Finance puts the value of the US carbon market at \$1 trillion by 2020, with carbon prices hitting \$40 a ton even sooner. To some market observers, this looks like a cost to the U.S. economy; to others, it's a huge opportunity for profit.

Among carbon market advocates, it is an article of faith that environmentalism and profit will go hand in hand. To hear Inslee tell it, the market will be a win for the economy and the environment. We're going to save the planet, and it's going to make us rich. How could it possibly go wrong?

"We need to lead on this, both because it's a moral responsibility and it's an economic opportunity, and I think that's the American character," said the Congressman, beaming. "I don't have grandkids yet—this is a sore point with my son and daughter-in-law. But you're helping them out, my prospective grandkids. And by the way, we're gonna make a buck on this, too."

In no year since the Industrial Revolution began, setting off a two-centuries-long rise in atmospheric carbon levels, have the smokestacks of the planet emitted one iota less carbon dioxide than they did the year before. Global carbon emissions are increasing so fast that just getting them to level off would be a momentous achievement. Even the rate of increase is increasing. In the face of history, optimism like Inslee's seems incomprehensively naive.

Then again, we've done it before. Or something like it, anyway.

In 1990, President George H. W. Bush signed a series of amendments to the Clean Air Act. Chief among them was a provision for controlling sulfur dioxide: a new kind of regulation, and a radical departure from the kind of command-and-control environmental legislation that had dominated the politics of pollution since the 1970s. Sulfur dioxide causes acid rain and forms tiny particles in the air, contributing to thousands of deaths from lung cancer, heart attacks and asthma in the U.S. each year.

In effect, the 1990 amendments created a right to pollute, and at the same time set strict limits on that right. The idea was that scarcity would make the new rights valuable. Once the right to emit sulfur dioxide came at a price, a market for pollution permits would emerge naturally that would clean up smokestacks across the Midwest better than an army of EPA inspectors could, at a fraction of the cost.

Under the new law, a few hundred of the oldest, dirtiest coal-fired power plants in the country would have to reduce their emissions of sulfur dioxide to a level below that of 1985. In 2000, the Act would take full force, compelling almost all electricity producers to enter the regulated sulfur dioxide market, while holding them to their 1985 emission levels. If a plant couldn't reduce its emissions enough, it would have to buy permits from its cleaner peers, who were allowed to sell any reductions they made above and beyond their mandate on the open market.

This new market, the brainchild of economists, gained enthusiastic support from some forward-thinking advocates of green capitalism, notably the Environmental Defense Fund. But for the most part, environmentalists and industry were on the same side: They hated it.

Many environmentalists were pessimistic about the impact the program would have on emissions. Some were deeply offended by the very idea of pollution permit trading, which they saw as a way for companies to buy their way out of acting responsibly.

“These schemes often grant corporations new ways to circumvent environmental concerns, even as the same firms pose as the new champions of the environment,” progressive activist Brian Tokar wrote in 1996. “Replacing our society's meager attempts to restrain and regulate corporate excesses with market mechanisms can only further the degradation of the natural world and threaten the health and well-being of all the earth's inhabitants.”

Though there were plenty of utilitarian worries about the practical effects of letting companies buy their competitors' permits, many of the arguments against pollution trading had an almost religious cast to them. Harvard government professor Michael Sandel railed against the indecency of the idea in an op-ed for the *New York Times* in 1997. “Turning pollution into a commodity to be bought and sold removes the moral stigma that is properly associated with it,” he wrote.

In a 1992 editorial, *The Nation* called it simply “the stink market.”

If environmentalists were skeptical, industry was apoplectic. Power companies took the news of the legislation's passage gloomily, predicting industry-wide costs in the billions of dollars and issuing dire warnings that consumers would end up footing the bill. “Our interest is in having our customers protected from having to pay for cleaning up other people's plants,” Florida Power and Light Company spokesman Gary Mehalik

grouse to the *New York Times*, shortly after the legislation cleared the Senate in April of 1990.

Neither side was right. As an experiment, the sulfur dioxide market was wildly successful, achieving greater reductions in pollution than predicted, and at lower costs. Many plants installed scrubbers in their smokestacks to cut down on emissions, a technology that was spurred along by the infusion of cash from the market. Others simply paid for permits from cleaner plants, effectively subsidizing their good behavior.

And, just as economists predicted, the blindly calculating machine of the market found other solutions. The deregulation of the railroads in the 1980s had caused shipping rates to plunge, making low-sulfur coal trucked across the country from Wyoming an economic option for many plants—an unforeseen solution, and one that would have been tough to bring about without a market-based program.

By reducing emissions by the cheapest means available instead of requiring a scrubber on every smokestack, the sulfur dioxide market wrung most of the inefficiency out of the cost of regulation. The EPA estimated that the program saved American consumers \$1 billion, compared to the cost of enforcing non-market-based regulations.

“The allowance trading program has had exceptionally positive welfare effects, with estimated benefits being as much as ten times greater than costs,” wrote Robert Stavins in a 2005 *Choices Magazine* article on the success of the program.

The sulfur dioxide market is still going strong. So far, it has slashed millions of tons of emissions, cleared up the acid rain that was destroying Northeastern lakes and forests, and probably saved thousands of lives.

If it had not been for the sulfur dioxide market, there might never have been a carbon market. Despite the fact that the U.S. has never signed on to the Kyoto Protocol, our successful experiment in cap-and-trade served as a blueprint for its architects. The drafters of the Kyoto plan—who included U.S. negotiators intent on market-based solutions—were inspired by the success of the U.S. sulfur dioxide program, and used it as a model for constructing the new carbon market. From a purely pragmatic perspective, many of the Kyoto players saw a market mechanism like cap-and-trade as the only way to get the U.S. to sign on at all. By the time it became clear that the Americans were pulling out, the deal was already inked. In 2005, despite the U.S. dropout, the European Union began putting the Kyoto accord into action by issuing tradable allowances for 2.2 billion tons of carbon to over 11,000 industrial polluters.

As an experiment in how to reengineer international economies without destroying them, the European market has been a tremendous success. The growth of the market itself has been explosive, doubling in value last year from about \$30 billion to over \$60 billion. Most critically, no coal can be burned in Europe, no electricity consumed, and no gas burned, without *someone* paying about \$40 for every ton of carbon dioxide emitted.

But by the most important measure of success—whether or not carbon emissions have been substantially reduced as a result—Kyoto has been a disappointment. In mid-2006, the price of carbon crashed, the victim of overzealous permit allocators who gave out far more carbon permits than companies actually needed to cover their emissions.

Many of the Kyoto nations have fallen behind their emissions targets; last year, Bloomberg News reported that Japan, Italy and Spain would have to buy \$33 billion worth of carbon offsets to make up for overshooting their goals in the first round of trading. Canada, one of the first countries to sign onto Kyoto, abandoned the agreement in all but name in 2006 in favor of setting its own weaker emissions targets, and has suffered few consequences from the international community.

The European market is still a work in progress, and its advocates say that it will become more potent as future caps on allowed emissions tighten. Still, it is worth asking: Why has Kyoto largely failed where the stink market succeeded? There are many reasons, some of them rooted in the science behind the carbon cycle, others stemming from the circular logic of markets and the vicissitudes of international politics. The builders of the U.S. carbon market will have to contend with all of them. Along the way, they will wrestle with the intractable task—as Stanford Program on Energy and Sustainable Development director David Victor pithily put it, in a June interview with the *International Herald Tribune*—of how to dole out “enough pork to get people to the meal” without wasting too much public money.

Figuring out how tight a cap to set will not be trivial. In the sulfur dioxide market, the EPA based their cap on solid scientific estimates of pollution-related deaths and the economic effects of acid rain. The targets for the carbon market will be far more arbitrary, because the uncertainty around exactly how carbon dioxide affects warming, and how warming affects human welfare in turn, are far greater. Europe has set their cap, for no particular scientific reason, at 8 percent below 1990 levels by the end of 2012—a goal they may well miss despite its modest proportions.

The question of which industries to regulate is also going to loom large. With sulfur dioxide, it was easy: coal-burning power plants account for about half of all man-made emissions, and were an obvious target for regulation. Carbon dioxide and its fellow greenhouse gases have many more sources. For instance, a 2006 report from the United Nations estimated that agriculture accounts for almost a fifth of global greenhouse gas emissions, much of it from methane produced by cows and other livestock. Agricultural emissions aren't regulated in the European market, and any effort to require U.S. farmers to buy carbon permits would undoubtedly meet with fierce political opposition.

But the most obvious difference between the stink market and the carbon regime that will probably soon come to American shores is the issue of carbon offsets. Derided by critics as environmental snake oil, offsets are now attracting the same kind of brickbats the concept of pollution permits faced when it was new.

There is some sound science behind the idea of using activities like agriculture, tree planting and the destruction of potent greenhouse gases to put a little bit of red ink on the carbon balance sheet. Looking ahead to future technology, the idea of sequestering large volumes of carbon in underground reservoirs has a lot of promise. But as with everything else in the carbon market, the devil is in the details. The question of how to count offsets is both a practical and moral dilemma that vastly multiplies the accounting problems of the new regime, and threatens to destroy the credibility of the market.

Taken at face value, offsets are a great idea. If the goal is reducing overall emissions, it is eminently reasonable to let polluters pass the buck to other market players who can reduce emissions cheaper than they can. If it works right, the system creates a

wealth of funding for technologies that reduce global carbon emissions, and rewards the cheapest methods first.

In practice, the offset system does more than reduce carbon and reward innovation. It creates a highly politicized process for doling out government-regulated cash, ripe for manipulation by powerful interests. And it creates a wide array of stakeholders who—once they've gotten a piece of the carbon pie—may become impossible to dispel.

For example, on December 21, 2006, the *New York Times* reported that a Chinese refrigerant factory was being paid \$500 million by European carbon offset buyers for an incinerator that cost the company \$5 million to build. The technology involved, which accounts for about 20 percent of the carbon offsets registered under the aegis of the European carbon market's Clean Development Mechanism, has set off flurries of outrage among close observers of the market, and not merely because of its outrageous price tag.

HFC-23 is a byproduct, a waste gas given off in the production of another gas called HCFC-22, which is used in air conditioners. As a greenhouse gas, HFC-23 is 11,700 times as potent as carbon dioxide; burning it off as it exits the factory yields enormous (and lucrative) reductions in carbon dioxide equivalent, far more easily than reducing carbon emissions directly. The science is solid: destroying HFC-23, by burning it off as it exits a factory pipe, yields great and immediate benefits to the environment.

But although the benefits of destroying the gas are clear, the companies that do it are using one international law to undermine another.

The refrigerant HCFC-22 contributes to the destruction of the ozone layer, and is banned under the Montreal Protocol, which China ratified in 1991. Under the terms of

Montreal, its production in China should be phased out completely by 2040. But the Kyoto Protocol's carbon offset program creates a perverse incentive for Chinese factories to keep producing HCFC-22, regardless of the overall environmental costs. If the profit made from selling HFC-23 offsets is great enough to justify running the factory in the first place, the carbon offsets are entirely fictional—the chemical would never have been produced without the offset program paying to “destroy” it.

Proving that the carbon credits produced by HFC-23 offsets are real is difficult. On the other hand, so is proving that they're not. Ultimately, they are worth money because the United Nations says they are. Were the United Nations Framework Convention on Climate Change (UNFCCC) to decide tomorrow that HFC-23 offsets were not credible, they would become no more than scraps of paper stating that greenhouse gases had been reduced.

The protocol that states that HFC-23 offsets will “count” in the European market is only one of nearly a hundred issued by the Clean Development Mechanism Executive Board of the UNFCCC, each with its own conditions for approval. The offset protocols are in a constant state of change as new ones are added and old ones are refined, and their adoption is subject to intense politicking; last December, at the UN climate talks in Bali, a fierce battle erupted over whether preserving existing forests in developing countries would count as offsets in the market.

Assessing the credibility of offsets before writing them into the market, thus, is critical. Recognizing this, most proponents of offset schemes spend much money and effort on making sure the science behind their pet carbon-reduction technology is sound.

Unfortunately—as the HFC-23 example shows only too well—the accounting of offsets can be extremely murky, even when the science is clear.

Over a cup of coffee in Somerville's Davis Square, Anja Kollmuss dissects the trouble with any offset proposal. Kollmuss, a policy analyst at the Stockholm Environment Institute in Cambridge, evaluates carbon offsets for a living. To make sure potential carbon offsets are real, she says, you have to have more than good science. You have to look at each offset project in the context of the market that created it. For each project, you have to ask: Is it additional? (That is, would it have existed anyway, even without carbon-credit payments.) Are the reductions it creates permanent? (If you plant a forest, it does the planet little good if you come back in ten years and set it on fire.) Is there leakage? (This last is a sort of butterfly-flaps-its-wings-in-China issue, a measure of whether your project will cause unforeseen negative effects somewhere else in the market.)

“There's a couple of very intrinsic problems with carbon offsets that cannot be easily addressed,” she said. “The interests of the buyers and sellers are aligned in a way that undermines the goal of reducing emissions. It's in both parties' interest to get as much credit out of a project as possible.”

Kollmuss is used to being the skunk at the party; she goes to many of the carbon-finance conferences and is a familiar face to offset brokers. At the Point Carbon conference in New York, Kollmuss got into an argument over the value of offsets with a German broker and a representative of a London-based forestry company. It was friendly banter over a few glasses of wine, but the gulf between the can-do optimism of the market players and the skepticism of the market critic was palpable.

“Additionality is really a problem that cannot easily be solved,” she said. “You have to prove the counterfactual.” Proving the counterfactual—it’s a phrase she returns to over and over, shaking her head at the difficulty of measuring, in tons of carbon, the difference between the world as it is and the world that would have existed without a particular offset project.

If calculating additionality is a vexing task, the related problem of leakage is even more so. Leakage occurs when the context of the market causes effects on carbon emissions that lie outside the boundaries of a particular project. Because leakage involves links between seemingly unrelated entities in the global economy, and because by its nature it falls outside the ordinary accounting for a project intended to reduce emissions, it is extremely pernicious to measure.

For instance, a market for carbon offsets might reward landowners for protecting existing forests. Within the boundaries of the project, the accounting is straightforward: if the value of the carbon payments is enough to persuade the landowner to shift from logging to protection, the project meets the test of additionality. But if the creation of the market causes the price of lumber to rise, the market could increase logging pressure on other forests not covered by the regulatory scheme, resulting in no real-world decrease in carbon emissions.

To study whether an agricultural offset might be creating leakage, you need to analyze land use on a spectacularly broad scale, weighing the impact of carbon prices on the wide array of options available to farmers and other landholders to see if the market truly rewards the best uses of the land. Recently, Princeton researcher Timothy

Searchinger did just that for the burgeoning market in biofuels, publishing his results this February in *Science*.

All else being equal, replacing petroleum-based gasoline with corn-based ethanol is a win for carbon emissions, because the carbon released at the tailpipe is somewhat mitigated by the carbon used by the plant during its growing season. But without calculating the ripple effects of the federal government's efforts to promote ethanol on land use and other industries, it's impossible to say whether ethanol is helping or harming the cause of fighting climate change. Searchinger and his fellow researchers set out to measure how the biofuels market affects land use. To his dismay, Searchinger found that high corn prices resulting from ethanol quotas and subsidies were pushing forests and grasslands under the plow, releasing millions of tons of stored carbon and replacing a low-impact land use with a high-intensity crop. Far from helping alleviate the carbon problem, he discovered, supposedly "green" biofuels are actually making it worse.

There is already a growing voluntary market for agricultural offsets in the U.S., and the farmers that provide them are angling to be involved when a federally-regulated carbon market emerges here. But if the most environmentally-sound land uses aren't rewarded by the carbon market, farmers could be rewarded for land-use practices that are actually counterproductive to the goals of the market. Whether that's actually happening is an open question, and Searchinger says that the right kinds of studies on carbon offsets simply haven't been done.

"To estimate leakage right, you have to do something at least on the order of complexity we did. And I don't think people have," he said. "I mostly see people saying, 'You need to look at leakage,' but not actually doing it."

Many carbon market advocates acknowledge that offsets are an imperfect system at best. But perfection, they say, is not the point. Arguably, the goal of getting the market off the ground at all is more important than quibbling over every last iota of carbon.

In 2003—two years before Europe issued its first carbon allowance—the Chicago Climate Exchange opened for business. Their mission: brokering deals between companies seeking to reduce their emissions and offset providers who sell credits into the system. Under the terms of CCX agreements, participating companies make a legally binding pledge to account for all their emissions, and abide by a cap-and-trade agreement. Carbon offset providers—which include farmers, foresters and renewable-energy generators—can sell permits into the system based on scientific standards set by CCX. Anyone can buy the permits, which environmental groups sometimes do in order to reduce the number of “active” permits in the system.

The cost of polluting a ton of carbon dioxide on the CCX is currently a little less than \$4. At that rate, if you’re an average US citizen, about \$80 will absolve you of your yearly carbon sins.

The growing ranks of providers who deliver offsets to the CCX hope that their early investment in a fledgling industry will pay off once the market goes federal. If the market goes global, their profits could skyrocket.

“The value of carbon in Europe is about \$40 a ton. In the US, it’s \$4 a ton,” said USDA agricultural economist Don Reicosky. “When we become globally connected, the

price in the U.S. will jump to the price in Europe. If the farmers are right there, they'll make a killing.”

At \$4 a ton, a grain farmer practicing no-till farming and selling the credits to the CCX can make about \$3 an acre—a tiny fraction of the per-acre value of the crop. For now, few farmers are staking their financial security on the carbon-offset market. But a tenfold increase in the price of carbon could turn agricultural offsets from a curiosity to a commodity.

Right now, grain farmer Dale Enerson of the North Dakota Farmers Union is irritated with the press. In January, *Washington Post* reporter David Fahrenthold wrote a story about the House of Representatives' \$89,000 stab at achieving carbon-neutrality, in which environmentalists lambasted Congress for paying farmers thousands of dollars to practice farming techniques they would have adopted anyway. “Value Of U.S. House's Carbon Offsets is Murky,” the headline read.

“That guy. We could tell from the questions he was asking us, he had his mind made up that agricultural offsets were worthless,” he griped. “We got lambasted because we sold 5,000 tons of [carbon offsets]. And we were proud to do it. And we catch hell from the *Washington Post*, that this was a worthless exercise.”

Long before CCX started, and without any help from carbon financiers, Enerson began adopting no-till farming practices on his 1600-acre farm in Western North Dakota. No-till has long been recognized as an environmentally-friendly practice that helps control erosion and promote soil fertility. It also increases the soil's capacity to trap and store carbon dioxide from the atmosphere—a fact of soil science that has recently begun

to attract attention from folks to whom wheat and corn are bid-ask spreads on a computer screen.

When the U.S. carbon market launches in earnest, Enerson intends to be there. In 2006, he started an offsets trading program for the North Dakota Farmers' Union. He now heads the offset program for the National Farmers' Union, which contracts with the Chicago Climate Exchange to provide carbon offsets through no-till, grassland, rangeland and forestry projects.

Every day, Enerson fires up his computer, logs on to the CCX trading site, and makes deals with unseen buyers over the price of thousands of tons of carbon offsets produced by NFU farmers. He's become something of an armchair speculator, watching the price of offsets pogo up and down in response to the vagaries of the U.S. presidential race. On Super Tuesday, when it became clear that all three front-runners supported cap-and-trade, the CCX traded 1.2 million tons of carbon in a single day.

Not every farmer in the heartland is convinced of the value of changing the way they farm to satisfy the demands of day traders in Chicago, even for pay. Participation in the program is growing, but the payments are still so small that they're not going to convince many farmers who aren't already interested in no-till practices to adopt them. That means that, like Enerson, a lot of farmers in the market would have done no-till even without CCX's help. And that, in turn, means the farmers would probably fail the test of additionality.

“We always get these questions about whether agricultural offsets are additional and whether they're permanent, and we like to think they meet the test of both,” said Enerson.

But even if the accountants can't prove his farmers wouldn't have done no-till anyway, Enerson believes, quibbling about strict measures of additionality for agricultural offsets misses the point. For many critics of offsets, the worry over additionality taps into a kind of visceral disgust for paying people to do nothing. Enerson is getting tired of this kind of criticism. To his view, there's nothing wrong with a market that rewards farmers for good behavior.

"If I'm storing four-tenths of a ton of carbon dioxide per acre per year, what's wrong with getting paid for it?" he said. "It's difficult for people who don't understand this idea yet—but the whole idea of cap-and-trade puts a value on environmental services."

In thinking of offset programs as a way to create new green incentives rather than as items on a global balance sheet, Enerson is taking a broader view of the carbon market. He's not alone in that. To many observers of the emerging market, it is more important simply to get going on the problem than to get every last bean counted.

At six o'clock, on the second day of Point Carbon's North American Carbon Market conference, the few hundred delegates left in the room were beginning to show signs of fatigue. It had been a long day, and not a minute of it wasted. Dozens of industry analysts, bankers, traders, academics, industry lobbyists, carbon offset project developers and government officials had duly barged through their allotted fifteen minutes apiece, whipping through PowerPoint slides with fearsome speed. A couple of obligatory anti-capitalists had infiltrated a session on carbon policy, and managed to unroll their homemade protest banner before being shown the door, their ejection only a minor

wobble in the brisk schedule. In the hallway, stray conference-goers were busy networking, trading business cards and glossy brochures with fervent efficiency.

Only James Cameron stood between the remaining delegates and the spread of hors d'oeuvres and fruit skewers in the exhibition hall next door. Tall and dignified, in a pinstripe suit that carefully straddled the line between stylishness and ostentation, the British barrister took the podium. Mercifully, Cameron was not there to hurl more charts and data into the audience; with the soothing, measured authority of a courtroom defender delivering summary remarks, he began telling a story.

Notebooks went back into briefcases. Collars were subtly loosened. People eased back in their seats and a quiet calm fell over the room.

“I had an exchange with a BBC reporter I respect,” he said. “He said, ‘You people’—meaning you people in the carbon markets—‘are just not getting your message across, that you are a force for good in the world.’”

Cameron, a former international lawyer, is now vice chairman of the investment banking group Climate Change Capital. By way of illustrating his point, he singled out the most controversial offset program in the Kyoto market: HFC-23.

Many critics, both inside and outside the market, were worried about the Chinese refrigerant factories and the threat they posed to the credibility of the market at large. But Cameron saw it in another light. The carbon market is not just about providing incentives for offsets and energy efficiency, he said. It is also creating new business alliances between Chinese factories and European power plants, relationships that will bear fruit in an age that requires increasing levels of international cooperation and goodwill.

“You are making a transaction that binds you. It’s stronger than a money transaction,” he said. “You are solving a shared problem, a problem that reveals your common humanity. That’s really worth something. The carbon market is a kind of proxy for the cooperation we are going to need to solve the problems of climate change.”

Critics who decry offsets as bunk are missing the point, he said.

“There is no way that investment should be seen as a morally inferior choice,” he said. “There’s a prize here really worth striving towards that is both environmental and economic. If you can create wealth worth having, you’ve also left the world in a better situation.”

Cameron is right on this point: There is no doubt that the carbon market will create wealth. The question is, for whom?

Among the biggest winners in the European carbon market to date have been power companies—a big clue as to why the energy industry is beginning to embrace the carbon market. At the start of Phase I of the Kyoto market, in 2005, European governments literally gave away billions of dollars’ worth of free carbon permits to utility companies within their borders, to get the market started. Though they didn’t have to pay for the initial permits, utilities raised their consumer rates anyway, allowing them to pocket over \$7 billion a year in extra profits from the new market system.

Pigou Club economists like Metcalf, who advocate taxes over cap-and-trade schemes, often worry about the tendency of regulators to give away permits, allowing

companies to profit hugely at the expense of consumers. “It’s a perverse system,” he said. “The value of the permits ends up in the pockets of shareholders. That’s what we saw in Europe. The permits were given to the energy sector, and they passed the permit prices on to consumers in the form of higher prices, but passed the profits on to shareholders. It was a windfall.”

As a result, those shouldering the biggest financial burdens in Europe’s climate experiment are those least able to pay—ordinary citizens. If governments continue to placate powerful industries with free (and increasingly valuable) permits, it’s a pattern that could repeat itself in other markets and other industries. Already, market analysts worry that similar profiteering will happen when airlines fall under European regulation in 2011.

The fallout from European free permits is a clear object lesson in how not to build a fair and equitable market. The obvious solution—other than a tax—would be to auction all of the permits, and spend the resulting revenue on tax cuts or programs that help offset consumers’ increasing energy costs. But so far, it’s unclear whether the U.S. will learn from Europe’s mistakes.

The front runner among the climate-change bills in Congress this year, the Lieberman-Warner Climate Security Act, called for auctioning only about a quarter of allowances to start—a giveaway that the nonpartisan policy wonks of the Congressional Budget Office have characterized as a windfall for industry at the expense of low-income households. Though the percentage would increase over time, it wouldn’t hit 100 percent until 2036. Presidential candidate John McCain co-sponsored an early draft of the bill,

and both Hillary Clinton and Barack Obama came out in support of it during their presidential campaigns.

Environmentalists were split over the bill. Fringe environmental group Friends of the Earth has called its massive allowance giveaways “obscene.” More mainstream organizations like the Natural Resources Defense Council and the Environmental Defense Fund lined up to support the bill, seeing it as their best shot at getting anything passed.

For now, the point is moot. On June 6, the Climate Security Act failed to get the required 60 Senate votes needed to advance it to debate, thereby resigning it to the dustbin for at least another year. But since the Bush administration has shown little interest in climate legislation, the failure of advocates to get even a bill loaded with industry concessions passed was neither surprising nor particularly significant.

Next year, when a new President moves into the White House, the debate will become far more meaningful—and more difficult, as legislators become less and less able to credibly blame a hostile Presidential administration for their own failure to come up with an acceptable compromise on the issue. Whether some of the less prominent (and less porky) bills in Congress will receive a closer look, under a friendlier administrative climate, remains to be seen.

But unless a lot changes on Capitol Hill after November, it’s unlikely that voices like Metcalf’s, calling for simpler tax solutions to the carbon problem, will get much of a hearing in the coming climate wars. It’s not for lack of trying. Last year, Metcalf wrote a paper for the World Resources Institute that outlines plans for a carbon tax that is “distributionally neutral”—meaning that it is not borne disproportionately by the lower

rungs of the income ladder. The paper got noticed by a few people in Washington, and it got him a meeting with Representative John Larson, Democrat of Connecticut.

Last August, with Metcalf's advice, Larson filed a carbon tax bill, the American Energy Security Trust Fund Act. Larson's bill would tax carbon dioxide at an initial rate of \$15 a ton, to increase each year thereafter. By 2017, the tax would be up to about \$130 a ton. Most of the money collected would be spent on income tax rebates. Utility companies would almost certainly raise their rates in response to the tax, but in lower-income homes, the costs would be offset by income tax breaks.

Such a bill, in order to become law, would have to survive two very different challenges. On the one hand, industry lobbyists determined to wrangle free carbon permits out of Congress would seek to crush it in favor of friendlier alternatives. On the other—like any legislation that sought to deal with global warming in any credible way—it would raise the specter of even greater increases in energy costs, attracting the ire of the general public. From the tenor of the current debate, it seems that the only way to jump-start a carbon market in the U.S. is through relentless realpolitik: bribing industry support with massive pork, pressuring environmentalists to accept weak solutions over no solutions, and shoving through deeply inequitable legislation that could undermine the emerging public consensus on climate action.

While Metcalf and his peers worry about the seemingly impossible task of leveling the playing field between U.S. industry and U.S. taxpayers, other economists are thinking even bigger, coming up with grand schemes to counter the massive global inequalities produced by both climate change and its market solutions. One of the more interesting propositions is an idea that takes its inspiration from both a classic problem in

environmental economics, and an unconventional solution from north of the Arctic Circle.

A student of the London School of Economics, In the 1960s, English economist Ronald Coase became a household name among economists by challenging the welfare economics of Pigou, arguing persuasively that environmental problems are just the fallout of badly defined property rights. Coase's insight made it clear that a tax is not the only way use markets to fend off environmental damage. Under the right conditions, he said, simply assigning ownership will allow the market to sort out the problem.

Market failures occur, said Coase, when property rights are unclear. Take, for example, a stream that flows past a factory before passing a house downstream. Say the factory has the legal right to pollute the stream. If the pollution bothers the homeowner, she should be willing to pay the factory to stop. On the other hand, if she owns the rights to the stream, the factory ought to be willing to pay her to accept the pollution or move elsewhere. If property rights are clear and the two parties can bargain, the government need not intervene to tax the pollution at all.

In theory, it doesn't even matter whether the polluter or the homeowner owns the rights to the stream—either way, Coase's theory predicts, the price paid to clean up or prevent the pollution will be just enough to offset the harm done.

If the assumptions required for an efficient carbon tax (the kind Arnold Pigou would have endorsed) are daunting: that there is enough information to set a good price, and that government policymakers will always act in the best interests of society—those for getting a fair outcome from property rights are even more so. One of the primary conditions for the stream-dwellers being able to haggle successfully over the pollution

price, according to Coase, is that the cost of haggling itself should be minimal. If the stream has hundreds of houses and dozens of factories, haggling becomes prohibitively difficult, and transaction costs balloon. If the problem involves future generations, there can be no haggling that includes everybody.

With a resource that can't be easily owned, and billions of present and future individuals who have a stake in the outcome, the carbon problem presents some of the worst property-rights headaches of any economic issue. That hasn't prevented clever economists from coming up with some truly bizarre solutions.

Maverick economist Bob Costanza has a stellar track record for crazy ideas that sound less and less crazy the longer you spend talking to him about them. Director of the Gund Institute for Ecological Economics at the University of Vermont, Costanza was first author on a 1997 paper in *Nature* that put a value on the world's collective ecosystem services: \$33 trillion, nearly double the global GNP at the time. Cited in other research nearly 1000 times, the paper remains one of the most highly referenced papers in environment and ecology over the last decade. Five years later, he came out with another ecological economics eye-opener, a paper in *Science* that estimated the average payoffs for investing in the environment at 100 to 1 *annually*. The only problem: it's very hard for the investor to recapture those profits.

The reason is that whether the investor is a person, a business, or even a nation, those benefits tend to flow into the common pot, leaving the good Samaritan clutching the bill. If the U.S. invests in fighting climate change, for instance, China benefits for free at the expense of American citizens. But what if the carbon market assigned everyone on the planet property rights to the sky? Giving everyone a financial stake in the fight

against climate change could create massive global incentives to take action. That's Costanza's latest crazy idea.

“Getting carbon into the economic incentives that everybody faces, and making the market tell the truth about carbon, is a very important thing to do,” he said, on the telephone from his office in Burlington, Vermont. “It's not a question of privatizing these assets, they're public goods. But we do need to assign property rights.”

With a group of fellow luminaries from the green-capitalist world, Costanza is drafting the plans for a global public trust, dubbed the Earth Atmospheric Trust, that would collect the proceeds from auctioning pollution permits, and distribute them to every single citizen on Earth. Because the payments would be the same for each citizen, the poorest people on the planet—who are also the likeliest to be hurt by the effects of climate change—would end up benefiting most.

Though the idea may seem quixotic, it is not entirely without precedent. The model for the EAT, surprisingly, is a money-for-oil program championed by one of climate change's most notorious naysayers: Alaska Senator Ted Stevens.

Created by the Alaska legislature in 1976, the Alaska Permanent Fund is a trust that collects 25 percent of the proceeds from oil and gas revenues in the form of a tax. Every year, its independent board of trustees pays a dividend to every man, woman and child in Alaska who isn't a felon and has lived there for at least a year. Last year's dividend was \$1,654. Except for the dividends and operating expenses, it stays untouched. The pot of money has ballooned to \$40 billion, and there it sits, possibly to be spent in a glorious bonanza once the oil runs out. Elected officials that propose spending

it on highways and such, or otherwise threaten its Brobdignagian integrity, face political suicide.

The Earth Atmospheric Trust would function much the same way, collecting revenue from auctioning carbon pollution permits and holding it in a massive trust, overseen by an international board of directors. The beauty of the idea is that instead of using government spending as an imperfect device for offsetting the social costs of paying for carbon, the trust would simply, literally pay all of society for their trouble.

Costanza takes the history of the Alaska Permanent Fund as evidence that public ownership goes a long way toward protecting public resources. Without the protection of a trust, “you’re still subjecting the whole system to political vagaries,” he said. “If you try to privatize public goods, they tend to become monopolies, and they have all the problems of monopolies, including underproduction and overpricing.”

Unfortunately, the planet is a massively more complex and populated place than Alaska. The Achilles’ heel of the EAT is the sheer level of international cooperation required to pull it off.

Faced with skepticism about the odds of accomplishing something so ambitious as a trust fund for every citizen on Earth, Costanza is about as optimistic as he feels he has to be. “It’s a non-zero probability. I can’t say it’s a high probability,” he said wryly. “I think there’s growing consensus that something has to be done.”

The biggest challenge in the carbon problem, and the most critical way in which it differs from the much more tractable sulfur, is that it's not a minor pollutant that can be scrubbed or filtered out of a smokestack. Burning wood, petroleum, coal, ethanol or any other carbon-based fuel releases vast amounts of carbon dioxide, by necessity. Currently, the link between carbon and energy—and, by extension, the humming of international economies—is extremely tight. To lower emissions substantially, either switching from carbon-based fuels to wind, solar or other types of energy will have to occur on a truly massive scale, or new technologies for carbon sequestration will have to be invented. That we will be able to do this—on either a national or a global scale—is essentially an article of faith, no matter how high the price goes.

On the other hand, the power of the carbon price is its pervasive impact. Because almost all energy use creates carbon dioxide emissions, everything that can conceivably be bought and sold carries an invisible social cost—the cost of its tiny contribution to global climate change. If the costs of climate change were made visible, and reflected in the price of goods, ripple effects would spread throughout every sector of the economy.

“Whether a television, train journey or house purchase, every product or service needs to include the cost of greenhouse gas emission reduction in its price,” wrote Chris Mottershead, BP’s advisor on energy and the environment, in a 2006 report produced by the Smith Institute, a British think tank. “The necessary economy-wide climate policy will affect every product and service; those who make the transition, making their products and services climate-friendly, will prosper and grow, and those who do not will decline.”

This vision of a “true-cost” economy—a world economy that absorbs the costs of environmental damage, instead of allowing them to languish outside the market—is an extremely compelling one for environmentalists of a certain bent. It is where the true promise of the carbon market lies. And it may be that in order to get there, proponents of a carbon-constrained world will have to agree not to make the perfect the enemy of the good. A certain amount of will undoubtedly creep into any solution that can garner broad enough support to pass: social inequity, industry pork, dubious offsets and government mismanagement will probably all be part of the coming new world order.

Ultimately, given the vast scope of the problem, it doesn’t matter how we get the market started, said Michael Greenstone, an economist at MIT.

“The main thing we need is a positive price on carbon. Until there’s a price on carbon, there’s going to be overproduction of greenhouse gases, and that’s going to lead to climate change,” he said. “The particular way in which we get there—cap-and-trade or tax—is really secondary to creating the political will.”

That is, with uncertainty permeating every level of the carbon market—from figuring out how emission levels affect climate change to wrestling with the problems of accounting for offsets—the task of building global institutions that can handle the problem might be more important than getting the price right. If the U.S. can muster the fortitude to create and enforce a national price on carbon, we will have made progress. If we can help craft a way forward for the international community that China and India are willing to swallow, there might be hope for the planet.

And yet, if we fail in the long run to get the numbers right, we will find ourselves—to use a bit of dry economics-speak—with a non-optimal solution on our

hands. In the case of climate change, “non-optimal” could mean the loss of our prime agricultural lands, the flooding and destruction of our coastal cities, the drying up of our rivers and reservoirs, and the devastation of our natural ecosystems.

Economics is fundamentally a discipline for optimists. It tends to assume that there is no problem that cannot be solved by putting a high enough bounty on it. The truth is that our capacity for substituting money for all sorts of other things—natural resources, technology, international cooperation—has never been challenged so brutally and directly as it is now, by the global problem of climate change. It seems vanishingly unlikely that we will be able to derail the catastrophic effects of a warming planet just by issuing a few pieces of paper and declaring that they are worth something. But to paraphrase Winston Churchill’s famous line on democracy, it’s the worst idea except all those other ones that have been tried.

Bibliography

Bailey, Ronald. "Carbon Taxes Versus Carbon Markets: What's the Best Way to Limit Emissions?" *Reason*, May 24, 2007.

Ball, Jeffrey. "Wall Street Shows Skepticism Over Coal." *Wall Street Journal*, February 4, 2008.

Ball, Jeffrey. "Bank of America Puts a Price on Carbon." *Wall Street Journal's* Environmental Capital blog, February 13, 2008. Available at <http://blogs.wsj.com/environmentalcapital/2008/02/13/bank-of-america-puts-a-price-on-carbon/>.

Bill, Peter, ed. "The Green Shift: Environmental Policies to Match a Changing Public Climate." Smith Institute report, London, UK, 2006.

Bradsher, Keith. "Outsize Profits, And Questions, In Effort to Cut Warming Gases." *New York Times*, December 21, 2006.

Brahic, Catherine. "Greening U.S. Likely To Create Huge Carbon Market." *New Scientist*, February 15, 2008.

"Canadian Pulse Research Strategy." Pulse Canada report, 2001.

Carr, Mathew and Saijel Kishan. "Europe Fails Kyoto Standards as Trading Scheme Helps Polluters." Bloomberg News Service, July 17, 2006.

Carrick, Rob. "Go Clean, Invest Green." *Trade By Numbers*, May 2008.

Coase, Ronald. "The Problem of Social Cost." *Journal of Law and Economics* 3 (1960): 1-44.

Costanza, Robert et al. "The Value of the World's Ecosystem Services and Natural Capital." *Nature* 387 (1997): 253-60.

Duff-Brown, Beth. "Canada Proposes Bill on Gas Emissions." *Washington Post*, October 26, 2006.

Eilperin, Julie. "Senate Leaders Pull Measure on Climate." *Washington Post*, June 7, 2008. A3.

Fahrenthold, David. "Value of U.S. House's Carbon Offsets Is Murky." *Washington Post*, January 28, 2008.

Gross, Daniel. "Raise the Gasoline Tax? Funny, It Doesn't Sound Republican." *New York Times*, October 8, 2006.

Jargon, Julie. "Seeking Sweet Savings: As Ethanol Boosts Corn Price, Heinz Develops New Tomatoes To Reduce Syrup in Its Ketchup." *Wall Street Journal*, October 2, 2007, Page B1.

Kanter, James. "Europe's Carbon Market Holds Lessons for the U.S." *International Herald Tribune*, June 18, 2008.

Kollmuss, Anja and Benjamin Bowell. "Voluntary Offsets For Air-Travel Carbon Emissions: Evaluations and Recommendations of Voluntary Offset Companies." Tufts Climate Initiative. White paper, January 2007. Available at <http://www.tufts.edu/tie/tci/carbonoffsets>.

Lancaster, Robin. "The Credit For Destruction." *Carbon Finance*, February 15, 2007.

Lemke, R.L., Z. Zhong, C.A. Campbell and R. Zentner. "Can Pulse Crops Play a Role in Mitigating Greenhouse Gases from North American Agriculture?" *Agronomy Journal*, 99.6 (2007) 1719-1725.

Mankiw, Gregory. "The Pigou Club Manifesto." *Wall Street Journal*, October 20, 2006.

Metcalf, Gilbert. "A Green Employment Tax Swap: Using a Carbon Tax to Finance Payroll Tax Relief." World Resources Initiative. White paper, May 2007. Available at <http://www.wri.org/publication/green-employment-tax-swap>.

Pigou, Arthur. *Memorials of Alfred Marshall*. Macmillan, London, 1925.

Pigou, Arthur. *Wealth and Welfare*. , Macmillan, London, 1912.

Pooley, Eric. "Why the Climate Bill Failed." *Time*, June 9, 2008.

Reiss, Spencer. "Carbon Credits Were a Great Idea, But the Benefits Are Illusory." *Wired*, May 19, 2008.

Rix, Kristian and Mathew Carr. "Japan, Spain, Italy Face \$33 Billion Kyoto Payments." *Bloomberg News*, November 30, 2007.

Sandel, Michael. "It's Immoral to Buy the Right to Pollute." *New York Times*, December 15, 1997.

Searchinger, Timothy et al. "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change." *Science*, 319.5867 (2008): 1238-1240.

Stavins, Robert. "Lessons Learned from SO2 Allowance Trading." *Choices*, January 2005.

Stern, Nicholas. "The Stern Review on the Economics of Climate Change." UK Treasury. Report, October 30, 2006.

"The Stink Market." Editorial, *The Nation*, June 1992.

Szabo, Michael. "China Dominates, Africa Emerges in Carbon Market." Reuters News Service, May 7, 2008.

Tokar, Brian. "Trading Away the Earth: Pollution Credits and the Perils of 'Free-Market Environmentalism.'" *Dollars and Sense*, March 1996.

Wald, Matthew. "Industry Wary of Clean-Air Bill." *New York Times*, April 5, 1990.

Wallser, Maggie. "Carbon footprint." *Encyclopedia of Earth*. Last updated April 22, 2008. Available at http://www.eoearth.org/article/Carbon_footprint.

Wynn, Gerard. "EU Looks to Curb Utility Windfall Carbon Profits." Reuters News Service, May 4, 2007.

Government and finance websites

Alaska Permanent Fund Corporation (financial data and history of the Alaska Permanent Fund): <http://www.apfc.org>

Carbon Offset Solutions (clearinghouse for information on the Alberta carbon market and offset protocols): <http://www.carbonoffsetsolutions.ca>

Chicago Climate Exchange (current and historical data on U.S. voluntary carbon market): <http://www.chicagoclimatex.com>

Environmental Protection Agency (data on sulfur dioxide market and U.S. power plant emissions): <http://www.epa.gov>

European Climate Exchange (current and historical data on EU carbon market): <http://www.europeanclimateexchange.com>

United Nations Framework Convention on Climate Change (information on the regulations governing the Kyoto market, including CDM offset protocols): <http://unfccc.int>

U.S. Energy Information Administration (data on U.S. carbon emissions): <http://www.eia.doe.gov>

Interviews and speeches

Cameron, James, Climate Change Capital. Speech at Point Carbon conference, New York, NY, October 31, 2007.

Costanza, Robert, University of Vermont. Interview by the author, telephone, December 12, 2007.

Enerson, Dale, North Dakota Farmers' Union. Interview by the author, telephone, March 14, 2008.

Greenstone, Michael, MIT. Interview by the author, telephone, March 25, 2008.

Inslee, Jay, U.S. House of Representatives, D-Wa. Speech at Point Carbon conference, New York, NY, October 30, 2007.

Kollmuss, Anja, Stockholm Environment Institute. Interview by the author, Somerville, Massachusetts, October 15, 2007.

Kurbis, Gord, Pulse Canada. Interview by the author, telephone, March 3, 2008.

Metcalf, Gilbert, National Bureau of Economic Research. Interview by the author, Cambridge, MA, March 20, 2008.

Riecosky, Don, USDA. Interview by the author, telephone, February 11, 2008.

Searchinger, Timothy, Princeton University. Interview by the author, telephone, March 12, 2008.