MAKING ENVIRONMENTAL MARKETS WORK:

LESSONS FROM EARLY EXPERIENCE WITH SULFUR, CARBON, WETLANDS, AND OTHER RELATED MARKETS

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http://www.forest-trends.org
Washington, D.C.
August 25, 2004
Prepared for the Katoomba Group Meeting in Locarno, Switzerland, Fall 2003

FOREST TRENDS

Forest Trends is a non-profit organization that advances sustainable forestry and forestry's contribution to community livelihoods worldwide. It aims to expand the focus of forestry beyond timber and promotes markets for ecosystem services provided by forests such as watershed protection, biodiversity and carbon storage. Forest Trends analyzes strategic market and policy issues, catalyzes connections between forward-looking producers, communities, and investors and develops new financial tools to help markets work for conservation and people. It was created in 1999 by an international group of leaders from forest industry, environmental NGOs and investment institutions.

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ABSTRACT

Ever since the passage of the 1990 amendments to the US Clean Air act and the creation of a market in sulfur dioxide (SO2), it has become clear that market mechanisms can be effectively used to achieve environmental policies. But markets are neither infallible nor automatic. They have blind spots and they need to be designed effectively if they are to effectively achieve environmental ends. This paper defines markets as regular gatherings of people for the purpose of buying and selling goods or services. Such markets are distinguished from public payments to private landowners for ecosystem services, or private deals between a few buyers and sellers. It then provides a brief overview of several existing and proposed environmental markets, including: the Acid Rain market in the US, the Emissions Trading Scheme in the UK, the proposed Emissions Trading System for the European Union, the US market in greenhouse gases proposed by Senators McCain and Lieberman, the US market in wetlands mitigation credits, and the renewable energy market in Texas. From these the paper attempts to draw some lessons and conclusions.

The paper argues that although markets can help maintain, provide, and distribute environmental goods and services, they require government will, government power, and established legal institutions to do so effectively. This is for two reasons: First, many environmental markets operate by taking goods and services that were previously public in the economic sense of the term, setting limits on their use, and allowing property or usage rights to be traded. Limiting the use of public good can only really be achieved equitably via a consensus agreement of all current users, or through the enforcement of government regulations and government power. Secondly, markets require secure property rights if they are to function; and strong governments and legal institutions are necessary in order to create, maintain, and protect property rights. The lack of a strong global system of government is proposed as one reason why global environmental markets (such as those envisaged by the Kyoto Protocol) are so difficult to achieve. Instead, the paper argues that global environmental markets will likely develop as a result of the organic aggregation of national or regional environmental markets.

In addition to government intervention and a robust system for allocating and protecting property rights, the paper borrows from McMillan (2002) and lists several other factors that are essential for the proper operation of environmental markets. These include equity and the involvement of relevant stakeholders, trust among market participants, easy access to market information, competition, and some understanding of possible market externalities.

THE BIRTH OF ENVIRONMENTAL MARKETS

With the stroke of a pen in 1990, the US government created a new market –as well as a new way of protecting the environment– literally and figuratively out of thin air. With its "cap-and-trade" program in sulfur dioxide (SO_2), one of the gases responsible for acid rain, the US became one of the first, perhaps even the first, country to use market mechanisms as a way of addressing environmental problems on a national scale. More importantly, the US SO_2 program proved that when it comes to protecting the environment, the regulatory power of government could be seamlessly blended with the remarkable ability of markets to efficiently allocate resources. The success of the US Acid Rain market invited imitation and unleashed a whole new era of market-based environmentalism that could, one day, sweep the globe.

Already markets are being created in everything from greenhouse gases and renewable energy, to wetlands, water, and woodpeckers. If the past is any indication, we could soon begin to see markets being used to incorporate the value of an even wider variety of environmental goods and services into our economic system. Such a change would amount to the incorporation of environmental externalities into our economic system on a massive scale. If and when this happens, this trend could affect every economic transaction that people in developed countries now take for granted; from heating their houses and buying their groceries, to using electricity, turning on the water taps, and driving their cars. This change will also impact the resource-utilization decisions, as well as potential sources of income, for developing countries.

But success is not guaranteed. Markets are tools, tools that are inappropriate for some situations, and tools that, when used incorrectly, can backfire. As the saying goes, to a man with a hammer, everything starts to look like a nail. We need to guard against such overuse and misuse of markets. We need to take a step back, to pause and ask ourselves: What have we learned from existing environmental markets? What mistakes have been made? How should environmental markets be designed? What secondary or even tertiary impacts will they have? What roles do government, business people, and non-profits play in the establishment and operation of these markets? And— perhaps most importantly— what do today's markets teach us about designing those of tomorrow?

Forest Trends has already made numerous important contributions to this debate. Papers such as "Developing Markets for the Ecosystem Services of Forests" by Powell, White, and Landell-Mills have explored some of the basic opportunities and issues raised by the growing number of attempts to buy and sell a variety of forest services. They divided the sale of forest services into three categories: self-organized deals; open trading schemes; and public payment schemes. This paper focuses entirely on formal ongoing markets involving multiple buyers and sellers in which price is determined by multiple transactions. It does not address simple public sector payment systems or direct private buyer-seller deals. The premise here is that a market is a regular gathering of people (whether in person, on the internet, or via other forms of communication) for the purpose of buying and selling goods and/or services. The emphasis is on the term regular.

This is not to say that what Powell et al. call self-organized private deals and public payment schemes are not important. In fact, in many cases, these sorts of deals will turn out to be better and more appropriate methods of defining the value of environmental goods and services than broader, more regular markets. However, where regular markets are possible, they bring with them many benefits: they allow for ongoing price discovery; they are continuous and replicable; they can affect large amounts of people and businesses; and they can more effectively internalize environmental costs into the economic system than is sometimes possible with single one-off deals. Additionally, as the European Union prepares to launch the world's largest environmental market in 2005, it is timely to look at some of the lessons that regular ongoing markets and open trading schemes can provide.

However one defines the term, one lesson is already clear: markets—contrary to widely held beliefs—are neither miraculous panacea nor unmitigated evil with respect to the environment, they are simply tools whose benefits depend on how they are used. This means that in the future, as markets become ever more popular approaches to environmental problems, it becomes increasingly important that we learn to use them well. Furthering such study and introspection is the purpose of this paper.

Taking it from the Top

Markets are venerable and old human creations. No one knows exactly how and where they first began—probably because they are older than recorded history—but there is evidence that ever since humans have aggregated in communities of more than a few dozen people, markets have helped them better allocate their resources and obtain the food and shelter they need to survive. Markets are at least as old as writing and, in fact, may have been co-developed at the same time and for the same reasons as both writing and arithmetic: The earliest examples of writing we have so far discovered (symbols baked into clay found in the fertile crescent of current-day Iraq) were tallies of livestock, grains, and oil; ancient inventories probably used to keep track of marketable goods. Likewise, the oldest evidence of the use of arithmetic (also from the fertile crescent) was used to compute costs and facilitate the buying and selling of goods. Reading, writing, arithmetic, and money all appear to have co-evolved together.

Markets have endured because they are extremely effective ways of allocating scarce resources; whether it be land, goods, or labor. They work by enabling us to aggregate vast amounts of opinion and information in an elegant and simple fashion. From the point of view of the consumer, markets take a bewildering array of facts, figures, and information regarding things like the cost of land, labor, time, inputs, transportation—and everything else that goes into the production and delivery of a good or service—and turn it into a price: a number that enables consumers to judge relative value and make buying decisions. Markets serve producers too. By aggregating information on people's buying behavior, they help producers decide whether providing a given good or service makes economic sense.

But markets are not infallible. They are often misused, they make mistakes, and they have blind spots. One major such market failure involves the environment. More often than not the costs of environmental protection and preservation do not make it into the market signals that drive our everyday economic decisions. They are what economists have for centuries called "economic externalities"; their value is not incorporated into economic decision-making. In part, the problem stems from the fact that many environmental goods and services are public goods, available for all to use freely.[1] Adam Smith—the father of market theory—clearly understood that markets cannot deal with true public goods. He eloquently argued that some of these public goods can and must remain the purview of governments.

Three hundred years later we still believe that governments, not markets, must intervene in the management of public goods. But as our understanding of markets has evolved, we have come to realize that governments can effectively use markets to help them effectively manage public goods such as environmental protection. As early as 1968, economists such as J.H. Dales argued that "If it is feasible to establish a market to implement a policy, no policy-maker can afford to do without one" (Dales, 1968 cited in McMillan, 2002). The point he and others were making was not that markets should supplant government regulation, but rather that well-designed markets could be used as complements to government regulation.

Trading Sulfur Dioxide

The truth of Dales' statement has been neatly borne out by the grandfather of environmental markets: the US market in sulfur dioxide. Although the US has been regulating air pollution since at least 1955, it wasn't until 1990, when Congress passed a series of amendments to the Clean Air Act (itself first written in 1963) that the market began to be seen as a powerful weapon in the war on air pollution.

The 1990 Clean Air Act brought markets into the picture by incorporating two radical—some would say revolutionary—provisions: First it stated that by 2010 the US would reduce emissions of sulfur dioxide to 10 million tons below 1980 levels. This provision effectively set more or less arbitrary limits on an environmental public good (the ability of the atmosphere to absorb SO_2) that was previously considered limitless. Then the law stated that the country's largest emitters of SO_2 would require permits for each ton of SO_2 they put out into the atmosphere. It then issued these tradable permits to large-scale emitters based on historic emissions. With the creation and distribution of a

[1] Economists define public goods as those that have two basic characteristics: non-rival consumption and non-excludability. Non-rival consumption, as defined by the MIT Dictionary of Modern Economics (Pearce (ed.), 1983 and 1986) means that one person's consumption of a good or service does not reduce its availability to anyone else. Non-excludability means that once the good is provided, the producer is unable to prevent anyone else from consuming it. Both these characteristics can prevent private markets from functioning properly since a seller would be unable to ensure that only those individuals who paid for the good could obtain it. After all, since the good can be obtained and used without payments—sometimes without anyone knowing it is being used— no one would be willing to pay for it.

new form of property right—this claim on the now governmentally limited ability of the atmosphere to absorb SO_2—a market was born.

As soon as the law passed, market forces went to work and emissions of SO_2 began declining. According to information provided by the US Environmental Protection Agency (EPA), in the first year of the program's implementation, 1995, total SO_2 emissions nationwide dropped by more than 3 million tons (Progress Report, EPA Acid Rain Program, 1999). Likewise, beginning in 1995, the largest utilities in the US (263 of which are closely tracked by the EPA) reduced their emissions of SO_2 by about 5 million tons (more than 50 percent) from their 1980 levels. Interestingly enough, it was the trading that generated the greatest reductions: In 1990, when Congress first mandated the cap, the largest power plants in the US were emitting about 8.7 million tons of SO_2. By 1994—even before the 1990 laws came into effect—that figure had dropped to 7.4 million tons. But then, in 1995, when trading in SO_2 allowances began officially, their emissions plummeted to 4.5 million tons, even though power generation continued to increase (Progress Report, EPA Acid Rain Program, 1999).

From the perspective of environmental markets, the success of the SO_2 market is interesting not only because it effectively reduced emissions, but also because it highlights the relative roles of governments and markets in addressing environmental problems. In the case of SO_2, the government did what only it could do: it regulated a public good, set limits on its use, and generated the property rights that enabled a market to work. The market, in turn, did what it does best: it allocated a now scarce resource (the ability to emit) efficiently and helped determine the lowest price at which the desired emissions reductions could be achieved. Had government tried to allocate the emissions permits, it almost certainly would have done so less efficiently. Likewise, had government attempted to set a price on each SO_2 emission (e.g. by means of a tax), chances are the price would have been either too high (thereby needlessly damaging economic growth), or too low (thereby failing to achieve the needed reductions). Markets are better than governments at "discovering" the most appropriate price for an environmental property right; and they do so every second of every trading day.

There were other benefits as well. By not establishing how companies should achieve the reductions —or even where—, the 1990 Clean Air Act allowed businesses to obtain their SO_2 emissions reductions in the cheapest possible way. If this meant installing scrubbers, shutting down inefficient plants, switching fuel sources from coal to natural gas, paying someone else to do any of these, or a combination of all of the above, this was left up to the companies themselves. Finally, the law provided regulatory certainty (at least with respect to SO_2) and therefore encouraged long-term investment by industry.

A comparison between the 1990 amendments and previous Clean Air acts is also illustrative: Previous legislation saw the atmosphere as a collective public good that was being infringed upon (i.e. polluted). The role of government, it was believed, was to establish and enforce a set of pollution rules, regulate pollution, and, where necessary, dissuade pollution by extracting a fine. The process is

often referred to as "command and control", but it could more exactly be called "regulate, monitor, and punish". This is entirely in accordance with the traditional views of a government's role in administering public goods: governments are needed to regulate and administer those public goods and services where markets fear or fail to tread.

In contrast, the Clean Air Act of 1990 saw the same public good, the same need of government to regulate it, but recognized that markets could play a useful role in determining the details surrounding the application and cost of this regulation. Even in the 1990 amendments to the Clean Air Act the central role still belonged to the US government. Today as in Adam Smith's time, markets can not, will not, and should not set limits on the use of a public good. What was different about the SO_2 market, however, was that it recognized what Dales and others had foreseen: even though governments are the only entity capable of establishing limits on the use of a public good, markets can be used to determine how best to apply these limits.

Proof that such a division of labor can be effective comes from the fact that the SO_2 markets have managed to reduce emissions better, faster, and cheaper than was ever thought possible.

EMERGENCE OF CARBON MARKETS

From SO_2 to CO_2

Armed with the experience of SO_2 markets in the US, the world has now embarked on a larger, more ambitious, and more complicated experiment in the use of markets to manage an environmental public good. In this case, the problem being tackled is global climate change, and the focus is on controlling emissions of carbon dioxide (CO_2) and the other so-called "greenhouse gases". In contrast to the US SO_2 market, however, the problem is not being tackled by any one national government, but rather by means of an international environmental treaty known as the UN Framework Convention on Climate Change and its Kyoto Protocol.

The rationale for this approach is sound—climate change is a global problem that needs to be tackled globally—but from the perspective of environmental markets, the global approach brings with it some unique problems. Before delving into these, however, it is useful to recall the history.

The Kyoto process began officially in 1992, when many of the world's governments, after years of acrimonious negotiations, signed the UN's Framework Convention on Climate change. This treaty called on the governments to work together to combat climate change by limiting their emissions of greenhouse gases such as CO_2. The exact nature of those limits and how they were to be reached was left up to subsequent negotiations. The second round of discussions—which turned out to be even more acrimonious than the first—culminated in the signing of the Convention's Kyoto Protocol at the end of 1997. The Protocol called on many of the world's most developed countries to reduce their emissions of greenhouse gases to 5 percent below 1990 levels by 2008-2012 (within this, each developed country was given a specific target). With the protocol signed, all that was needed was for

countries representing 55 percent of global greenhouse gas emissions to ratify it, and it would enter into force. As this article was being written, at the end of 2003, the world was waiting for Russia to ratify before the Protocol could enter into force.

The Kyoto Protocol may not be international law, but it has already had a profound effect on international environmental markets. First, and most importantly, the Protocol signals the intention of the world's governments to limit emissions of greenhouse gases; to, in effect, regulate the global public good that is the atmosphere's ability to absorb greenhouse gases. It also sets emissions reduction targets for countries and groups of countries. These provisions alone have helped spur the creation of one of the world's largest and most robust environmental markets: the market in greenhouse gas emissions.

Secondly, and of lesser real importance, the Protocol explicitly allows for the limited use of market mechanisms through three coherent—if exceedingly complicated—instruments known as "joint implementation", the "clean development mechanism", and "emissions trading". The details of these mechanisms are beyond the scope of this paper. Suffice it to say that they recognize the value of markets in combating climate change and set a series of rules whereby countries can trade emissions allocations and emissions reductions amongst themselves. Still, because of their bureaucratic complexities and the fact that their approach to allocating environmental property rights is politically curtailed, the use of these mechanisms and the markets they establish may turn out to be less interesting in the long-run than what is happening at other levels and through other Kyoto-related mechanisms.

Indeed, the real impact of the Framework Convention on Climate Change on environmental markets became apparent long before the Kyoto Protocol was even signed, let alone ratified.

Shortly after the Climate Change Convention entered into force in March of 1994, there emerged an unsanctioned "gray" market in greenhouse gases. NatSource, a prominent energy-trading firm that was an active participant in these gray markets, estimates that between 1996 (before the Kyoto Protocol came into being) and 2001 some 55 million tons of CO_2 equivalent (CO_2e[2]) had been traded between companies (Natsource 2002). Since the trades ranged from $.60 and $3.00 a ton and since NatSource did not include the substantial amount of CO_2e that has been traded ***within*** companies in its calculations, it is safe to assume that more than $100 million worth of CO_2e was traded between 1996 and 2001. The buyers and sellers of this carbon were mostly energy companies, utilities, and oil and gas producers.

Just as with the SO_2 markets in the US, as soon as it became clear that global governments would begin regulating the atmosphere's ability to absorb greenhouse gases, makeshift markets emerged to allocate a newly scarce resource. These markets, however, unlike those for SO_2 in the US, emerged

[2] CO2e is the standardized unit used to measure emissions of greenhouse gases. It uses calculations devised by the Intergovernmental Panel on Climate Change (IPCC) to determine the likely impact of any greenhouse gas as compared to carbon dioxide. Using these calculations, one ton of methane emissions is worth 4 tons of CO2e.

more slowly and with considerably more uncertainty because the locus of power to enforce regulation and issue property rights remained (and still remains) unclear. Questions abound. For instance, can the UN monitor, regulate, and enforce the use of a global public good? Will nation-states accept such a lessening of national sovereignty? And, if not, will national governments sign onto Kyoto and truly enforce emissions reductions as Kyoto requires? And if they do, will they establish markets to achieve their Kyoto targets? And, if so, how will these national or regional emissions trading markets interact with each other?

Some of these questions are now in the process of being answered, but the point remains: In contrast to the US SO_2 markets, where the power and willingness of the US government to regulate and enforce emissions reductions was unquestioned, the ability of the UN (or even cooperating global governments) to set limits and manage a global public good is anything but clear. As a result, the creation of a truly global market in greenhouse gases remains elusive.

**Instead, what appears to be happening is that markets are emerging organically as a result of Kyoto, but they are doing so at the highest effective point of true sovereignty: at the national and regional levels where governments' willingness and ability to regulate public goods (as well as create new forms of property rights) are more clearly defined. For that reason, I would argue that it is these national and regional emissions trading schemes, and not the Kyoto-sanctioned "mechanisms for flexibility", that will ultimately lead to the creation of global markets in greenhouse gases.

To better understand how this is happening and what it says about market creation, this paper will look at four Kyoto-related emissions trading schemes: the emissions trading system in the UK (UK ETS) which began operating in April of 2002; the European Emissions Trading System (EU ETS) set to begin operating in 2005; the Chicago Climate Exchange (CCX) which began trading in 2003; and the US Emissions Trading system as proposed by a law put forward by Joe Lieberman (Democratic Senator from Connecticut) and John McCain (Republican Senator from Arizona).

The UK Emissions Trading System

The British trading system (known officially as the UK Emissions Trading Scheme, or ETS) is extremely complicated and difficult to explain.[3] At its simplest level it has two main components: First, as of April 2000, companies in the UK have been subject to a large "Climate Change Levy", a tax on the use of energy that is expected to amount to £1 billion pounds a year. In exchange for an 80 percent reduction on this tax, some companies have entered into specific Climate Change Agreements with the government. These agreements force them to meet specific greenhouse gas emissions targets. If they don't meet these targets, they don't get their tax rebates (worth millions of dollars a year).

[3] Those interested can find more information at http://www.defra.gov.uk/environment/climatechange/trading/ukets.htm

The second component of the system is based on absolute greenhouse gas emissions reductions against 1998-2000 levels agreed upon by a small number of companies. These companies have entered the system voluntarily, spurred on by incentive payments of £250 million pounds ($395 million dollars) offered by the government. These incentives were auctioned off (in a sort of reverse auction) to willing participants in March of 2002. Once in the system, however, companies that receive these incentives need to meet their targets or else face stiff penalties.

Trading comes in because both the voluntary participants and the climate change levy participants can use emissions trading to meet their respective targets. There are an estimated 6,000 companies that can participate in the market in order to obtain reductions under the Climate Change Levy scheme, and there are 34 companies (including large multinationals like Shell, British Airways and Barclays Bank) that have entered into the system voluntarily in order to receive the government's incentive money. The market began in April of 2002 and by April of 2003 it was estimated that around 1 million tons of CO_2 emissions had changed hands (Robson 2003). As could have been expected, the 34 companies that entered the scheme voluntarily dominated the selling activity, while most of the buying came from the companies who entered as a result of the climate change levy. Still, according to some market participants, the UK ETS has already seen more liquidity than was initially expected (with trades taking place most days and carbon changing hands for anywhere between £4 and £12 pounds per ton of CO_2)[4].

The EU Emissions Trading System

Following on from the UK lead, the European Union (EU) recently approved a plan for a region-wide Emissions Trading System (ETS) that is expected to begin operating in early 2005. The scheme is intended to help the EU meet its Kyoto target of reducing its greenhouse gas emissions to an average of 8 percent below 1990 levels between 2008 and 2012. To do this, it will set caps on CO_2 emissions from large sources in five industrial sectors: power, heat and steam generation, oil refining, iron and steel, pulp and paper, and building materials. These sources are believed to account for around 46 percent of the EU's CO_2 emissions.[5]

Although the scheme is in principle a straightforward cap-and-trade system not unlike the acid rain trading scheme in the US, it is complicated by the fact that each EU member state will determine its own caps as well as how and to whom the emissions allowances (the property rights in this scheme) will be allocated. Also, under the so-called "bubble arrangement" each European country has a different emissions target–ranging from a decrease of carbon emissions of about 28 percent for Luxembourg to an increase of emissions of about 27 percent for Portugal. This could, to put it mildly, make the discussions surrounding the allocation of emissions allowances politically difficult.

[4] Personal interviews with carbon traders in the UK; also see "The UK Carbon Market – the verdict" by George Meyrick and Mark Nicholls in May 2003 issue of *Environmental Finance*

[5] For more on the EU ETS see http://europa.eu.int/comm/environment/climat/emission.htm

It is expected that in the first instance, most of the allowances will be allocated free of charge (grandfathered), but even so, the allocation decisions could have serious implications for the competitiveness of affected companies. It is therefore not surprising that the national allocation plans (which countries will submit to the EU's executive arm, the European Commission, by March of 2004) have rapidly become one of the most contentious issues in these discussions.

In essence, these plans will distribute billions of euros-worth of greenhouse gas emissions allowances and could amount to massive government windfalls for some companies. Observers have already begun speculating on which companies will be the biggest winners and losers under the scheme. An analysis by Dresdner Kleinwort Wasserstein (DKW) has one European electricity generator gaining 17 percent of it market capitalization under one scenario (a CO_2 price of €7.50 a ton and free allocation of allowances) and losing 29 percent of its value under another (CO_2 at €20 a ton and an unfavorable allocation of allowances) (Nicholls 2003; Dresdner Kleinwort Wasserstein 2003).

The Chicago Climate Exchange (CCX)

Although it is clearly the laggard in this regard, there is also some movement on the creation of carbon markets in the US. The most developed such market is the Chicago Climate Exchange (CCX), a voluntary trading scheme that was created by a private company in Chicago called Environmental Financial Products Ltd.. The scheme is voluntary and the US has yet to ratify the Kyoto Protocol, so it is not "Kyoto-compliant", but trading on this market began in late 2003. It works in the following way: the CCX has convinced a number of companies, businesses, non-profits, and others to voluntarily cap their emissions of greenhouse gases at a modest 2 percent below 1999 levels starting in 2002. Thereafter, the target will decline steadily (by 1 percent per year). Based on these voluntary targets, the CCX then allows the companies that are emitting more than their target to buy credits from those that emit less (or from qualified reduction projects). In essence, the CCX serves as a market where participants can exchange voluntary carbon reductions, either with other participants, or with providers of approved credits inside or outside the US.

The CCX has already convinced a number of important Midwestern firms to participate in this prototype market (including the likes of Cinergy, Alliant; DuPont, Ford Motor Company) as well as agricultural cooperatives such as Agrilliance and Growmark; non-profits such as The Nature Conservancy, and emissions brokers such as NatSource and CO_2e.com. According to people working at the CCX, the exchange already includes companies that emit some 250 million tons of CO_2, or about one half the total emissions of the UK.

Currently the CCX is busy signing up more participants, enrolling individual emission reduction projects, and strengthening their auditing and verification systems. The creators of the CCX hope that their market will eventually become the first US-based trading platform for carbon credits and that, one day, it will be able to exchange credits with other emissions trading schemes, such as those of Europe and the UK (CCX Staff, Personal Communication, and CCX Website).The McCain-Lieberman Bill

In early January of 2003, US Senators Joe Lieberman (Democratic Senator from Connecticut) and John McCain (Republican Senator from Arizona) unveiled proposed legislation that calls for the establishment of a carbon market in the US (Senator Lieberman Press Office, 2003). The bill calls on the US EPA to set caps on the greenhouse gas emissions from the electricity generation, transportation, industrial, and commercial economic sectors as defined by the EPA's "Inventory of US Greenhouse Gas Emissions and Sinks". The caps, however, would not apply to entities that emit less than 10,000 metric tons of CO_2 equivalent (CO_2e) a year and would not apply to individual car or homeowners, or to the agricultural sector. Still, the bill would cover roughly 85 percent of overall greenhouse gas emissions in the US.

The bill sets two targets for the affected sectors: First, by 2010 the bill would seek to bring the emissions of affected sectors down to 5896 million metric tons of CO_2e (the levels they were at in 2000). Then, by 2016, the bill would have this target go down to 5123 million metric tons of CO_2e (the levels they were at in 1990).

To achieve these targets, the bill establishes a trading mechanism similar to the Acid Rain trading system described above. In other words, all the covered entities would be given greenhouse gas emission credits and they would be required to have a credit for every metric ton of emissions they produce. For the transportation sector, each petroleum refiner or importer would be required to submit an allowance for each unit of petroleum product sold that will produce a metric ton of greenhouse gas emissions. The conversion factor between a unit of petroleum and a unit of emissions would be set by the EPA. This provision would essentially bring the US transportation and petroleum sector into the market in a way that no other carbon trading system currently does. In order to allocate the credits, the bill calls on the Secretary of Commerce to determine the amount of credits that would be given away to the participants, as well as the amount that would be left for public auction. To guide this allocation, the bill sets out a number of "allocation factors."

One of the more interesting aspects of the Lieberman-McCain bill (as it stood at the end of 2003) is that it would allow the market participants to satisfy up to 15 percent of their emission reduction requirements by "submitting tradable allowances from another nation's market in greenhouse gases, submitting a registered net increase in sequestration, or submitting emissions reductions that were registered by a person that is not a registered entity." This provision would essentially open up the US carbon market to non-governmental organizations, individuals, traders, and companies reducing emissions through the UK, European, or other similar carbon markets.

According to a summary of the bill, trading would be accomplished through the use of the greenhouse gas emissions registry established by the Energy bill that the Senate passed in 2002. Companies that achieved a "verifiable emissions reduction" would be allowed to include that reduction in the registry and trade it on the open market. To enable "non-regulated" companies to participate in the trading, the bill would require that these companies report their emissions to the registry. The bill sets the penalty for emissions not covered by an allowance at three times the market value of an allowance.

Although the Lieberman-McCain bill is still nothing more than a proposal and is unlikely to become law anytime soon, it is considered relevant because it is being proposed by two very powerful and influential Senators, both of which have been Presidential candidates. Additionally, both McCain and Lieberman are tenacious politicians and it is expected that they will continue putting versions of this bill before the US Congress until they get it passed. By way of example, it took Senator McCain more than a decade to get his bill on campaign finance reform passed into law.

From the National to the Global

In addition to the carbon markets being created or discussed in the UK, Europe, and the US, similar markets are also emerging in Australia, Canada, Japan, and a number of other countries. It is therefore safe to say that most –if not all– the countries that face emissions reduction targets as a result of their ratification of the Kyoto Protocol will one day have a national or regional market in greenhouse gases. What is less clear, however, is whether and how these national/regional markets will one day trade amongst each other and therefore coalesce into a *de facto* global carbon market.

Creating a global carbon markets makes economic and scientific sense: Climate change is global and an emission of a greenhouse gas in China has the same effect as one in Chile or the United States. For this reason, emissions reductions should be made wherever they can be most cheaply achieved, regardless of where that is. Markets can help make these allocation decisions, but they will be hampered if they are limited in their geographic scope. The bigger the scope of the market, the more allocation options there are, and the more options there are, the more effective (at least in theory) the allocations are likely to be. Markets want to be global and carbon markets are no exception.)

The problem is that carbon markets rely on the creation and allocation of a new form of property rights by sovereign governments. And, since there is no real global government with the power to undertake such creation and allocation, the job will necessarily be undertaken at the national/regional level. At some point these markets will likely need (and want) to figure out ways to interact and exchange emissions. For this to happen, however, there will be a need for common emissions standards and rules. The Kyoto Protocol goes some ways towards providing such standards, but it artificially sets limits on who gets credits and how these credits can be traded. This will have to be changed before a truly global carbon market develops.

In many ways, carbon markets are like currency markets. Their value and operation depends first on a unit of value created by sovereign governments and, second, on the common global perception of the relative value (and credit) of the issuing entity and their government. As such, carbon markets (as well as any other global environmental markets) will be subject to the same issues of country risk, liquidity, and relative value that today affect currency markets.

This does not mean that global carbon markets will never develop, it just means that they will take time and will emerge organically from the interactions between national and regional carbon markets

(similar to the interaction between international currency and stock markets), rather than from any of the "mechanisms for flexibility" written into the Kyoto Protocol.

BEYOND CARBON: FROM WETLANDS AND WOODPECKERS TO RENEWABLE ENERGY

Carbon dioxide and sulfur dioxide are not the only environmental goods and services that have been managed by using markets. In the United States alone, environmental markets have emerged to cover water, wetlands, and even endangered species. To better understand the different ways that markets can be used to achieve environmental goals, a few examples of these will be explored in turn.

Wetlands Mitigation

In 1972 the US Congress passed the Clean Water Act, one of several environmental laws signed in time for the world's first official Earth Day that same year. In order to protect America's rapidly disappearing rivers, swamps, lakes, and other wetlands, the Clean Water Act sets limits on how these bodies of water could be developed. The process was simple: After the Clean Water Act it became illegal to dredge, fill, or otherwise damage a wetland without a specific permit from the US government, specifically from the US Army Corps of Engineers. The idea was that, before granting such a permit, the Corps of Engineers would determine, first, whether the damage was avoidable and, secondly – assuming the damage was warranted and unavoidable– whether it could be minimized or mitigated.

Though the Clean Water Act was, at first glance, a straightforward command-and-control style law, markets became involved because of the way the rules for mitigation were implemented. As it turned out, though the Clean Water Act in principle gave the Corps of Engineers the power to halt development projects that were going to damage wetlands, in practice the Corps rarely said "no" to any such projects. Instead, it usually gave developers the permit to damage a wetland on the condition that they could compensate for this damage by creating, enhancing, restoring, and –in some very rare cases– protecting a similar wetland, with similar functions and values, somewhere else.

It was these mitigation provisions that ultimately ended up creating the environmental market in wetlands or, to be more precise, in the mitigation of damage to wetlands. As a result of the Clean Water Act, in order to obtain permits to develop on wetlands sites, developers became willing to pay for projects designed to create or restore wetlands in a way that would satisfy the Corps of Engineers. And, once the demand was there, all kinds of businesses emerged to fill the demand.

The resulting market has turned out to be larger than anyone imagined. According to a report by the National Research Council (a part of the National Academy of Sciences), between 1993 and 2000, permits were issued to allow the damage of approximately 24,000 acres of wetlands. In return,

developers promised to create, enhance, restore, or protect some 42,000 acres of wetlands. It is unclear how much developers are paying to fulfill their obligations –or even whether this mitigation is actually being accomplished– but a report by the US General Accounting Office (GAO), analyzed some wetlands mitigation arrangements and found that in order to mitigate for over 1,440 acres of adversely affected wetlands, developers had paid as much as $64.2 million. If these figures are correct, the average cost of the wetlands mitigation analyzed by the GAO was approximately $44,583 an acre. Coupling this number with the estimates provided by the National Research Council, we can estimate that between 1993 and 2000 there may have been as much as $1.07 billion dollars worth of wetlands mitigation transactions in the US. Or, to put it another way, on an average year, approximately $152.9 million dollars are transacted in wetlands mitigation.

But beyond the amount of money changing hands as a result of trading in wetlands mitigation, what is interesting about the system is that it sets a value –around $44,000 an acre– on preserved wetlands. This allows the value of the wetland's ecological goods and services to enter the economic system. By virtue of this market, one small environmental externality has been partially internalized.

From the perspective of environmental markets, the wetlands phenomenon is somewhat different from the SO_2 and CO_2 markets: What is being traded isn't so much the right to pollute, but rather, in a complicated and oblique fashion, the right to develop. Other similar environmental markets based on the right to develop have emerged across the US, and in various countries around the world. For instance, New Zealand has a market in the right to exploit fisheries, Puerto Rico has a market in the right to develop beachfront property, Chile has a market in watershed development rights, and several US states have markets in the right to damage endangered species that range from California's coastal gnatcatcher and the Alabama gopher tortoise, to the Red cockaded woodpecker.[6] In all cases, the mechanism relies on government's ability to limit and allow development.

Markets to Achieve Environmental Targets: Renewable Energy in Texas

But pollution rights and development rights aren't the only way that environmental markets can be created. Around the world the push for renewable energy has helped create a market that can best be described as one that trades in environmental targets or responsibilities.

In one particularly salient example, the case of Texas, it works like this: In 1999 the then-Governor of Texas, current US President George W. Bush, signed into law a bill that set a renewable energy target for the state. This law called on Texas to produce 2000 megawatts of new renewable energy by 2009.

Although this is less than 3 percent of the energy currently generated in Texas, at the time it was still more than was required in renewable energy by any other state. Renewable energy targets, like environmental targets, are nothing new. What set the Texas law apart was that it decided to legally

[6] For more on these markets see "A Bull Market in Woodpeckers" by Ricardo Bayon, Milken Institute Review, First Quarter 2002.

allocate the responsibility for achieving this target to all energy producers in the state. In other words, as a result of the law, energy producers in Texas need to prove each year that they are doing their share (determined as a percentage of total energy production) to meet the 2000 MW target. They do this by showing that they have government-issued renewable energy credits (RECs) for the total renewable energy required of them. These credits are tradable and, if an electricity provider doesn't have the necessary credits, it can either buy them from someone who does, or pay steep fines.

So far, the system has been a remarkable success. Texas went from being one of the states with the least renewable energy production in the US, to being one of the country's leaders in wind energy production. And, although trading in RECs only began officially in January of 2002, by the end of that year the state had installed nearly 1000 Megawatts –half its target– of new renewable energy. Everyone is confident Texas will meet its 2000 MW target well in advance of the 2009 deadline.

Alhough the Texas market in RECs is not directly related to markets in environmental goods and services, it is interesting in that it uses markets to help the government achieve a policy-driven environmental target. In a sense, the system in Texas involves trading in a government-mandated responsibility/liability for meeting a policy goal. Similar markets exist throughout the world and could be more extensively used to help achieve environmental goals.

THE LESSONS

The above discussion of environmental markets is not intended to be either exhaustive or particularly detailed. Instead, it is meant to be illustrative; to provide an overview of some existing environmental markets in order to draw some lessons on the use and creation of these markets.

The Potential/Important Role of Markets

The first lesson is not only the simplest, it is also the most profound: markets can play an important role in helping protect the environment and achieving the goals of environmental policies. The corollary to this statement is that market design is important. How a market is designed will to a large extent determine its effectiveness. Though this concept may appear obvious to some, it bears repeating for it is still being challenged in certain circles.

Government Participation is Crucial

The second lesson can be somewhat counter-intuitive: For environmental markets to work, government participation is crucial. Without strong sovereign governments that are willing and able to set limits on the use of environmental goods and services (or allocate responsibilities for achieving a policy goal), markets cannot develop. And beyond setting limits on the use of an environmental good or service, the government has to be willing and able to grant, protect, and uphold property rights (or environmental responsibilities as the case may be) for the market to function. For

something to be traded it must first be owned. And ownership depends on government structures. It is by the will and the legal structures established by governments that property rights are established and maintained.

As Hernando de Soto points out in his seminal book on the issue, *The Mystery of Capital*, property rights are more than simply a piece of paper. They require property registries, legal systems that protect rights and settle disputes, and police systems that enforce these rights. "Property titles," he writes, "are only the visible tip of a growing formal property iceberg. The rest of the iceberg is now an enormous man-made facility for drawing out the economic potential of assets… without property, mankind cannot convert the fruits of its labor into fungible, liquid forms that can be differentiated, combined, divided, and invested to produce surplus value… [Property] is an instrument of thought, representing assets in such a way that people's minds can work on them to generate surplus value." (de Soto 2000).

Many countries have working "property icebergs" with formal legal systems, credible enforcement mechanisms, titling systems, mapping facilities, etc. In these countries, environmental markets (that is, regular trading mechanisms) can be easily (relatively speaking) created by simply defining new forms of property rights for environmental goods and services, establishing the relevant registries, and allowing trading. In countries where such working property/legal systems do not exist, markets will be more difficult to create and may not function as effectively. Though it may sound obvious, the point bears repeating: environmental markets require strong sovereign governments that are both willing and able to enforce contracts and protect property rights. Markets in environmental goods and services cannot exist without some sort of government decision (even if it is tacit) to grant ownership over an environmental good or service.

For the developing world, this might mean that true environmental markets are difficult, if not impossible, to establish in countries with weak institutions and weak regulatory regimes. For them, one-off deals and public payments for services may be the way to go.

Likewise, at the international level, the implication of this lesson is that global markets in environmental goods and services are difficult to create in the absence of a global "leviathan" (to borrow the Hobbesian term) capable of granting and enforcing property rights at the global level. Again, this may help explain some of the difficulties faced by the global market in greenhouse gases as envisaged by the Kyoto Protocol. Global markets can be approximated by means of the organic aggregation of national/regional markets –and this appears to be happening with the creation of the UK and European Emissions Trading Schemes– but such a process is difficult, takes time, and requires international agreement on issues such as: the definition of what is being traded, the relative values of similar commodities, the relative trustworthiness of various governments, among others.

Potential of Voluntary Markets

Another lesson of environmental markets is that, although they require government participation and strong legal/regulatory institutions to work well, they can be started –in fact they often are started– without official government backing. The Chicago Climate exchange is a perfect example of this. The US government has not ratified Kyoto (indeed, it has said it **will not** ratify Kyoto), but companies are voluntarily trading carbon credits through the Chicago Climate Exchange. Other factors –including public perceptions of the importance of global warming as well as business perceptions about the likelihood of eventual regulation of greenhouse gases sometime in the future, not to mention the high-profile proponents of the CCX– have brought buyers and sellers together into a functioning market. Government backing certainly helps, but it is not a *sine qua non* for some forms of environmental markets.

Having said this, there are some interesting differences between the CCX and the UK or European Emissions Trading Systems. One ton of CO_2e is reportedly trading on the CCX for about $1. The same ton is already trading for between €7 to €15 Euros –more than ten times the Chicago price– on the precursor markets to the European ETS and the UK ETS. In other words, the markets perceive a ton of reductions in Europe as several times more valuable than the same ton in the US. In part this reflects the less stringent nature of the reductions required by the CCX, but it also reflects its voluntary nature and the fact that the US government has refused to provide the exchange with either muscle or teeth.

The Devil Is in the Allocation

The fourth lesson of existing markets is that, if creating new forms of environmental property rights is hard, allocating them is even harder. In fact, deciding how these rights are to be allocated is perhaps the most important (and arguably the most difficult) aspect of designing an environmental market.

From the perspective of equity and fairness, property rights over a public good or service should be allocated equally to everyone with a stake in that good or service. In this vein, US author and entrepreneur Peter Barnes has called for the creation of a "Sky Trust" that would collect money from the sale of carbon credits in the US, and then use the money it collects to provide an equal dividend to every American citizen (U.S. Sky Trust 2004). In addition to being equitable, this approach can help overcome the initial resistance to a cap-and-trade system that would ultimately increase the perceived costs of a good or service that was previously obtained for free. Such an approach may be equitable, but historically governments have found it more politically expedient to give environmental property rights away for free based on past usage (a process known as "grandfathering"), or to sell them with the proceeds going into government coffers. The former approach minimizes political resistance from those currently using the free public good, while the latter increases government revenue.

Therein lies the problem with many environmental markets as currently instituted (including the US SO_2 trading program, the EU ETS, and the emissions trading system proposed by the McCain-Lieberman bill): At some point people will likely realize that their public goods are becoming private or government property and may demand different allocation mechanisms. And, even if people don't realize that their environment is being privatized, an allocation system that gives the credits away based on past usage gives the broader public very little stake in the emerging environmental markets Not only do people ultimately pay the extra costs of reducing emissions (by way of higher prices for goods and services), they get very little immediate compensation in return (their environment may get better, but that is hard to see or measure). In the US this debate is already emerging in terms of the allocation of electromagnetic spectrum (the airwaves that allow the signals from radio, television, cell phones, and other such devices to travel great distances). Originally, access to the airwaves (to transmit TV and radio signals) was given away by the US government to companies willing to provide these services. More recently, as more companies have become interested in using that electromagnetic spectrum, there has been some discussion of whether or not the government should auction or sell the right to use those airwaves instead of giving them away. Auctions of airwaves for cell phone services in both the US and Europe have raised billions and billions of dollars for governments.

There is also some discussion about how the proceeds of such a sale should be used. (in theory, access to the airwaves belongs to all the people in the country so some have argued that the proceeds of the sale should be distributed to all a country's citizens). This debate surrounding the electromagnetic spectrum has yet to be resolved, but it should be watched by those interested in environmental markets because similar debates could bedevil environmental markets in the future.[7]

An ideal system would freely grandfather the permits for the first few years (thus helping overcome intense political pressure from polluting industries and providing some time for the economy to adjust), but would later transition into a system where property rights are allocated equitably to all those with traditional rights or stakes in the environmental good or service (thus giving the broader public a more equitable stake in the market).

Rights, Responsibilites, or Risks?

The fifth lesson of environmental markets is that they can be created around a variety of mechanisms: not only the right to a good or service, or the right to develop a public good, but also the responsibility for achieving an environmental benefit, or even –and this hasn't been discussed in this paper– the liability for an environmental risk. In short, when defining an environmental market and its related system of property rights, we need to ask ourselves what is being traded and what is being owned.

[7] For more information on this topic see: http://www.newamerica.net/index.cfm?pg=program&ProgID=3

The simplest and most common way to create an environmental market may be to set limits on a public good and institute a "cap-and-trade" mechanism, but it is not the only available option. As in Texas, one can also trade in environmental responsibilities for achieving a government-mandated target. For instance, a government can decide to protect a watershed by setting protection targets (in money, acres, or some other unit) and allocating the tradable responsibility for achieving these targets to businesses and/or individuals. Markets in responsibility, like markets in grain, can help allocate the item being traded cost-effectively.

Beyond rights and responsibilities, there is also the possibility that trading could one day emerge in environmental risks. Currently there is no example of a market in environmental risk –at least not directly– but risk is becoming an increasingly important and element in traditional markets, so it is reasonable to assume that it might one day play a key role in the design of future environmental markets. A market in environmental risk could take on several forms: it could resemble an insurance market, where risks are pooled and spread out across a society; or it could take the form of a derivative instrument[8] (such as existing weather derivatives), where people and businesses use bets to hedge against perceived risks.

Either way, such markets would not only help assess and internalize perceptions of environmental risk into the economic system, they might also help channel money towards environmental protection. Admittedly, much remains to be done before such markets can emerge, but as our understanding of risk and risk management evolve, they could become increasingly important environmental markets.

OTHER FACTORS

John McMillan, an expert in the design and evolution of markets, believes that there are five key elements that are needed for markets to work smoothly: an abundant flow of information; solid property rights that are protected; trust; competition; and some consideration for the side-effects of markets on third parties (essentially the market externalities)(McMillan 2002). Environmental markets are, more or less, subject to the same criteria. We have looked at the issue of property rights in some detail because it underpins one of the most interesting and difficult aspects of creating an environmental market. But the other factors also matter.

[8] Derivatives are contracts whose value is based on the performance of another, underlying financial asset, index, or other investment. In common parlance, they are bets on measurable indicators. Today there are derivatives based on the performance of stocks and indexes (commonly referred to as options, puts, or calls), but also on more esoteric items such as the weather. Derivatives can be used to manage risk by essentially betting against oneself. In that way, a person or business can lose money if things go well, but minimize a loss if things go badly.

Information

McMillan states that "building channels for the flow of information, both to help buyers and sellers to get together and to allow buyers to verify the quality of what they are purchasing, is a major part of market design… Unevenly distributed information can make a market work inefficiently" (McMillan 2002). The problem is one of transaction costs. If buyers and sellers can't easily find each other, the cost of each transaction increases. And, if the transaction cost increases beyond a certain point, the market will not allocate resources efficiently. The transaction cost will distort the market signals. By the same token, if buyers cannot easily compare the price and/or quality of products they are buying, they might be tempted to buy from the seller they know best, or the seller that is most readily available, even if there might be sellers offering better quality or better prices elsewhere. In other words, the most effective transactions may not take place in markets where information about goods and prices is difficult (i.e. costly) to obtain.

For those interested in designing environmental markets, this means that some effort and thought needs to be given not only to the systems that allow buyers and sellers to connect, but also to those that allow buyers to easily access information on the price and quality of the items being traded. For some environmental goods and services this will mean developing better understanding of their biophysical properties (e.g. a better understanding of how forest protection affects water flows), while for others it may mean setting goals and standardizing the unit to be traded (e.g. limiting emissions and trading one ton of SO_2 emissions), or creating assessment/certification mechanisms to enable buyers to quickly gauge the quality of the good/service being purchased. In countries where the Internet is widely used, it may provide an ideal, low-cost vehicle for sharing information and for bringing buyers and sellers together. The use of auctions for rapidly obtaining and sharing information on price, supply, and demand also needs to be explored.

Trust

Information is important, but in and of itself it is not enough to sustain effective markets. Besides information, markets require trust; trust that the items being bought will be safe and work as expected, and trust that contracts will be upheld. Indeed, the word credit (so essential to today's economic system) comes from the Latin word "credere" which means "to trust" or "to believe". And trust and belief are truly at the heart of most market transactions. Without trust you would not buy from anyone you didn't know, you would not extend credit, provide loans, accept checks, credit cards, or even cash; you would not buy stocks, take out insurance, or even leave money in a bank. Without a certain level of trust there can be no economic system as we know it, and certainly no markets.

To encourage trust, those designing environmental markets need to think in terms of information disclosure, third party monitoring, verification and certification of information, as well as laws that punish fraud, encourage the standardized disclosure of information, and provide recourse for those who feel that they have been cheated. If a market is being designed in a place where trust is not

apparent, or where the mechanisms for encouraging trust do not exist, a special emphasis needs to be placed on this aspect of market design.

Competition

Thirdly, markets require competition if they are to work effectively. Markets with only one seller (a monopoly) and markets with only one buyer (a monopsony) are not effective because they limit either the buyers' or the sellers' choices and they give all the power to one side or another of the transaction. Because of this, prices are either higher or lower than the optimum. Just as countries have laws against the creation of monopolies, so too must environmental markets guard against placing too much power in the hands of either buyers or sellers.

To give but one example, assume that you are establishing a market to protect a watershed and you decide to force water users to buy "watershed protection rights" from those parties protecting the forest upstream. If that forest is controlled by only one seller, the price of those watershed protection rights is likely to be higher than what would be ideal to conserve the forest and promote the efficient use of water. In such a case, an effort should be made to create a market without such an obvious monopoly.

Equity Market Externalities)

Finally, McMillan points out that all markets have externalities and that these externalities sometimes have unintended (and inequitable) consequences for third parties. Environmental markets are themselves attempts to deal with one of these externalities, but that does not mean that they are themselves free of unintended consequences. In fact, most existing environmental markets have one large, problematic, and only partially intended consequence: they raise the price of various economic goods. This need not be a problem in and of itself (in fact, it may be the point: to internalize the cost of an environmental externality), but it could put additional pressure on the poorest people within a given economic system. Such pressure could, in turn, become political pressure that can jeopardize the long-term viability of the environmental market. Already we have seen intimations of this in places like Bolivia, where the proposed privatization of water services lead to political unrest that almost toppled (and eventually contributed to the toppling of) the government.

For this reason, the issue of equity in the allocations of environmental property rights is central. If done correctly it can help mitigate some of the market's unintended consequences and give the poorest of the poor a stake in the market. If done callously and without regard to fairness, on the other hand, it may invalidate the market's original aims.

Additionally, some markets may concentrate pollution to those areas where the costs of abatement are highest (those that pay for reductions elsewhere), or where limits on emissions are less strict. This could have unintended consequences for the people living in and around these areas. This could be mollified by ensuring that people living near areas of high pollution know and understand what is

happening (the principle of prior informed consent), have a say in the matter, and benefit somehow (either via jobs or payments, etc.) from any trading that takes place.

CONCLUSIONS

History and experience have shown us that markets –done right– are powerful tools for aggregating information and allocating scarce resources. As the world's environmental goods and services become increasingly scarce, it is only logical that markets will be used to manage and protect these resources more effectively. But markets, like all tools, require good design and proper usage. As environmental markets develop, it is important that we learn from their usage and that we make any necessary adjustments.

Bearing in mind this caveat, however, it is important that we continue experimenting with the use of markets to manage environmental goods and services. Trial, error, learning and reflection do not imply an end to experimentation. If anything, we need to increase the scope and range of our experiments. For markets are the antitheses of perfection. They sometimes allow us to approximate perfection, but never on the first try. They only work because they allow people to try one thing, fail, and then try another. Markets are iterative and learning processes. If we are going to use markets to protect the environment, we need to create more environmental markets (with an eye for good design) and then make adjustments as we go along. In short, we need to keep trying.

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