ENVIRONMENTAL DAMAGE VALUATION AND COST BENEFIT NEWS

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WATER

ENVIRONMENTAL GROUPS PROTEST ALTERATION OF U.S. ARMY CORPS COST BENEFIT ANALYSIS

Donald C. Sweeney II has been a regional economist with the U.S. Army Corps of Engineers since February 1978, and served as a supervisory economist in the St. Louis District. He received numerous awards for public service. From March 1993 until June of 1998, he was the technical manager of the economics work group for the Upper Mississippi River, Illinois Waterway Navigation System Feasibility Study, a six year, more than $50 million investigation of up to $4 billion in improvements to this navigation system. According to Sweeny the results of the study were deliberately altered by senior officials to produce a favorable recommendation for immediate large-scale expensive improvements

A benefit-cost analysis initially indicated that expensive, large-scale, structural changes to the navigation system (essentially doubling the length of seven system locks) were not warranted for the foreseeable future. Measures the navigation industry could undertake itself, or relatively inexpensive small-scale Federal measures, were the only actions economically warranted. However, pressure to alter the analysis was applied by top officials. A September 1998 release was postponed, and new personnel were put in charge of the study. In July of 1999, the Corps announced that a "new" economic analysis showed that immediate, expensive, major structural changes to the navigation system were now justified.

Based upon Sweeney's accusations Environmental Defense, American Rivers, the Izaac Walton League, the National Wildlife Federation, and the Sierra Club sent letters to three top US government officials asking for "immediate and vigorous response" to serious distortions in the economic analysis as well as a cancellation of the lock extension, or, at least, suspension and further independent review.

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The Upper Mississippi River and Illinois Waterway Navigation System Feasibility Study area encompasses a navigation system that includes 43 locks located at 37 dams. It stretches from Minneapolis-St. Paul MN to the confluence of the Mississippi and Ohio Rivers near Cairo, IL. The dams create pools in the rivers with sufficient depths to permit navigation. The locks allow transit between the pools created by the dams. All but four of the locks in this system are 600 feet long or less, while most modern towboats push fifteen barges at a time in a tow that extends nearly 1,200 feet long. As a result, many tows must routinely break apart into two smaller units to move through the locks in a time-consuming two-step process, adding roughly 45 minutes to an hour for each tow that must undergo this two-step process. At certain times of the year with heavy barge traffic, this results in some traffic congestion at certain locks, with the delays in processing tows increasing unit costs.

A "typical" movement of a barge from the Upper Mississippi River system to a southern Louisiana destination and back again currently requires approximately a month for the round trip. This typical round trip had approximately a $9.00 per ton cost in 1994 dollars. A measure to reduce congestion at Lock and Dam 25 near Winfield, MO , which handles 35 million tons of cargo per year, by an average of five hours per tow would cut 1.5% from the time required to move a typical barge from origin to destination and back again.

If there are other potential barge users willing to consume this increased productivity at roughly the going rate of $9.00 per ton, then this increased productivity permits the movement of an additional 500,000 tons through Lock 25. This would yield an annual economic benefit of approximately $4.5 million, computed as the product of the observed willingness to pay ($9.00 per ton) and the increased productivity of the system, (500,000 tons). These are rough numbers used for example only and do not reflect the actual more sophisticated analysis generated through a model.

At current traffic levels there is broad agreement among economists that expensive, large-scale measures like providing larger locks to process tows are not economically justified. The study was needed due to the expectation that the demand for barge transportation would grow over time, leading to increased congestion and transportation costs.

In general, the investigated alternatives are grouped into three broad categories: relatively inexpensive small-scale structural actions, such as providing mooring buoys at the locks or extending guidewalls along the lock approaches that only somewhat improve the efficiency of moving barges through a lock; relatively expensive large-scale structural measures, such as doubling the length of some of the 600 foot long locks thereby eliminating the need for two-step lockages; and very low cost operational changes to the existing system, such as scheduling tows to reduce congestion.

Based upon flows in 1991 and 1992 private consultants predicted the most likely growth rate for future traffic. A system model that incorporated the elasticity of demand for barge transportation known as “SEM, ESSENCE”, or the “St. Louis Model” was created. A parameter termed "N" defines the shape of the demand curve for individual origin, destination, and commodity-specific potential system movements. The greater N is for a given potential movement, the more elastic is the demand for barge transportation, the better the alternatives to barge transportation appear, and the lower the likely real growth in future barge traffic without system improvements.

In the original ESSENCE model, the N value for grain and other raw agricultural products, which are by far the most important commodities by volume, was estimated at 2.0. All other commodities were given an N value of 1.0. Even assuming the optimistic most likely demand predictions with these N values, the estimated costs of doubling the length of any subset of system locks or constructing new 1,200 foot long chambers any time in the foreseeable future exceeded the estimated benefits substantially. Even much lower N values led to the same conclusion. This model was subject to repeated independent technical review.

One of the means by which tows can themselves reduce the time it takes to proceed through a lock is to receive help from other tows also waiting for lockage, which would cut the time it takes to transit a lock by an average of 18 minutes for up-bound tows and 23 minutes for down-bound tows, or roughly 20 minutes overall. The addition of nearby mooring cells would further facilitate the practice. Six mooring cells could be constructed at each lock at an estimated cost of $1.1 million per lock. Larger locks, on the other hand, reduce transit times per lock by approximately 55 minutes, a net gain of 23 minutes.

The ESSENCE model estimates that tows would provide each other self-help whenever the congestion at a lock reached 12 tows waiting for lockage. As late as November 1998, the economic analysis indicated that self-help alone would fully address the future transportation needs of the system. However, on January 14, 1999, officials ordered that the model limit the percentage of time barge companies would use industry self- help.

Original cost estimates using traditional lock construction techniques put the cost at approximately $380 million per lock or $1.9 billion for five locks.

As is the case with almost any construction cost estimate, all Corps of Engineers projection typically include a "contingency" factor for potential cost overruns related to unforeseen conditions encountered during construction, based upon historical experience. The Corps typically uses a 25% factor. The contingency cost was increased in this study to

35% in response to Independent Technical Review and expert comments because construction cost estimates relied on novel construction techniques. This contingency factor was subsequently reduced to 25% due to pressure applied by top-level officials.

On November 18, 1999 the analysis of extending five locks had a net positive economic benefit of $8.686 million per year, $7.122 million (82%) of which involved rehabilitation cost savings.

Despite all the changes directed by top Army Corps of Engineers officials, this analysis also showed that the alternatives that had the highest net positive benefits still involved postponing the start of construction of lock extensions until 2011. However, through March 1998 engineering analyses reported no saved rehabilitation cost savings from expanded locks. Sometime thereafter, in contrast to extensive engineering and economic analyses that found no major rehabilitation for major components would be required until at least 2033, the analysis was altered by upper level officials so that rehabilitation would be required on many locks in 2015.

In addition, the benefit cost analyses did not incorporate most environmental costs. In January 1999 Ken Barr estimated system environmental costs at $10.5 million per year for the extension of 5 Mississippi River locks and the two Illinois River locks. The total net economic benefits for this alternative, not counting these environmental costs, is $11.026 million indicating fairly trivial net average annual benefits for extension of seven locks of $526,000, after subtracting the environmental costs.

Top Army Corps of Engineer officials repeatedly rejected the advice of many economists, and continually attempted to transfer management, production and review of economic products in an effort to find economists who would justify large-scale improvements. By September 1998, the economic panel was essentially shelved and a new group was instructed to use an N value of 1.2 for grain, despite a consensus against such a number among economists.

Despite all these changes, and despite the use of overestimates for projected increases in traffic, the total net economic benefits of a large project are vanishingly small. Even with all the above changes, the alternative that would maximize net economic benefits would still be to postpone the start of lock expansion until at least 2011. That alternative would also allow experience to verify if traffic is in fact growing sufficient to justify lock extension at that time.

In addition, a recent report by Taxpayers for Common Sense and the National Wildlife Federation ranked a $96 million project designed to stabilize a boating channel on North Carolina's Outer Banks through jetties as the fifth worst Corps ;project in the nation because it could accelerate erosion on the Pea Island national Wildlife Refuge.

Due to the allegations the Pentagon launched a probe of the study. On March 30, 2000 Environmental Defense initiated the formal process necessary to sue the Corps for operating the Missouri River in such a way as to jeopardize three federally protected endangered species--the piping plover, least tern and pallid sturgeon. On that same day Army Secretary Louis Caldera announced reforms to reaffirm civilian control of the Corps. However, three Republican committeemen urged Defense Secretary William Cohen to suspend the reforms. Then, in May, an obscure rider attached to a farm budget bill blocked all future efforts to reform management practices

http://www.environmentaldefense.org/pubs/NewsReleases/2000/feb/e_corpsresponse.html
http://www.environmentaldefense.org/programs/ecosystems/mississippi/index.html
Environmental Defense 257 Park Avenue South, New York, NY 10010 http://www.edf.org/programs/ecosystems/mississippi/ms_affidavit.html (800) 684-3322February 17, 2000

MEASURING THE VALUE OF HEALTH IMPROVEMENTS FROM GREAT LAKES CLEANUP

"Measuring the Value of Health Improvements from Great Lakes Cleanup", by Dallas Burtraw and Alan Krupnick does not break new ground, but provides a marvelous introduction to the subject, and compiles useful information which should be of interest to anyone looking at water pollution policy. The authors point out that today all of the Great Lakes States issue consumption advisories for sport fish. Advisories are triggered by mercury and certain halogenated organic compounds such as polychlorinated biphenyls (PCBs), DDT and its metabolites (DDD and DDE), dieldrin, dioxins and chlordane. The EPA has identified 15 pollutants that are of concern including pesticides, metal compounds, chlorinated organic compounds and nitrogen compounds.

Concentrations of these compounds in tissues of large, predatory species such as lake trout and salmon range as high as 100,000 times concentrations in surrounding water. These chemicals can then be passed on to humans who eat the fish. Schantz et al. (1996) for instance found that individuals who consumed Great Lakes sport fish for more than 15 years had two to four times more pollutants in their blood serum than non-fish eaters. Jensen (1987) concluded that PCB's in blood serum increased with age and with the number of meals in which fish was consumed per year.

These pollutants are associated with deleterious effects on many target organs in humans and animals, including the liver, kidney, nervous system, endocrine system, reproductive organs and immunological system. Since humans do not

metabolize these compounds easily, they are stored in tissues.

When a woman becomes pregnant the compounds are readily transferred across the placenta to the developing fetus. In addition, as a result of consuming contaminated fish, high levels of PCBs and DDT have been measured in the breast milk of some Great Lakes residents. Hence, children of exposed mothers are especially susceptible. Some of these substances may be developmental toxicants. Subtle abnormalities (e.g., poorer motor reflex, impaired visual recognition) as well as lower birth weight and smaller head circumference have been reported in the children of women exposed to PCBs on the job. These symptoms have also been reported in children of women who were regular consumers of Great Lake sport fish prior to and during pregnancies, compared to a nonexposed group. They are also confirmed by differences in the level of PCBs measured in umbilical cord blood. A recent re-examination of children participating in one of the largest studies (Lake Michigan Maternal/Infant Cohort Study) found that the neurodevelopmental deficits observed in infancy persisted in the form of lower IQ scores, reading level, poorer memory, and attention span. A small literature has also found effects of PCBs in blood serum, and fish consumption rates on the immune system. Humphrey (1988) concluded that higher blood serum PCBs in pregnant women were associated with a greater rate of infectious illnesses in their infants and Tryphonas (1995) found a correlation between infection incidence and fish consumption in pregnancy.

Within the past several years, studies published in medical journals pointed to a decline in the male sperm count and fertility over time, and shorter menstrual cycles associated with more frequent fish consumption. Also, studies found a direct effect of reduced conception success as a result of larger Great Lakes fish consumption in male partners. Some studies have identified certain chemicals--termed "endocrine disrupters"--as a culprit, although this issue is highly contentious, and EPA has convened a special panel to consider it. Exposure to certain chemicals prior to or during pregnancy may affect the development of the reproductive system of the fetus, leading to reproductive impairments later in life. Finally, several types of cancer have been associated with occupational exposure to PCBs, although causality has not been established.

The benefits associated with a reduction in exposure to these chemicals depend on how the chemicals affect the reproductive process. The value placed on current fertility can be represented by the willingness to pay of potential parents for an increased probability of a successful pregnancy. Similarly, the value placed on future fertility can be estimated by the willingness to pay of parents for normal reproductive ability in their children.

When estimating the willingness to pay to reduce current reproductive impairment, information based on couples' actions in addition to stated survey responses may be utilized. One source of data is expenditures by infertile couples on infertility treatments. Infertility is defined as the inability to conceive after 12 months of intercourse without contraception. Using this definition, the rate of infertility for U.S. couples between the ages of 15 and 44 was about 7.9% in 1988. Charges for a single episode of in vitro fertilization (IVF) have been estimated to be roughly $8,000. Couples also expend effort on infertility treatments, composed of both money and any number of nonpecuniary items including the couple's time. There is also uncertainty associated with the success of infertility treatments

One study used a contingent valuation (CV) survey in which respondents were asked several different hypothetical questions related to IVF treatment (Neumann and Johannesson, 1994). On average, respondents were willing to pay $17,730 for IVF treatment having a 10% chance of success. Across all respondents (fertile and infertile) individuals were willing to make a one-time payment of $865 for insurance providing IVF if needed. The study also found that the average willingness-to-pay (WTP) would be $32 per year in taxes for a public policy initiative giving 1,200 couples per year a 10% chance of successful fertilization. The respondents also identified a program resulting in 300 IVF babies as equivalent to one reducing auto deaths by 35 per year.

The cost of low birth weight has been estimated only through cost of illness analyses. One study found that the incremental health care, education and child care cost of the 3.5 to 4 million children aged 0 to 15 born with low birth weight (2,500 grams or less, about 7% of all children in that age group) was between $5.5 and $6 billion (Lewit et al., 1995).

DIRECT COSTS OF LOW BIRTH WEIGHT TO AGE 15 (1988)

Age Group	Cost Type	Mean Cost per Low Birth Weight Child	Number of Low Birth Weight Children	Total Cost
Infancy	Health Care	$15,000	271,000	$4,000,000,000
1-2	All	N.A.	500,000	Not estimated
3-5	Health Care	290	820,000	$240,000,000
3-5	Child Care	180	820,000	$150,000,000
6-10	Health Care	470	1,300,000	$610,000,000
6-15	Special Education	150	2,400,000	$360,000,000
11-15	Grade Repetition	45	1,100,000	$50,000,000
Total			4,000,000	$5,400,000,000

Using similar methods, the cost of 17 major birth defects and cerebral palsy was estimated by another study to be $8 billion in 1992 (Waitzman et al., 1996). Cost estimates were based on direct medical and special service costs and indirect costs of increased mortality and morbidity. Medical costs included inpatient, outpatient and long-term care costs. Special services were comprised of developmental services such as day care centers and counseling and special education. Mortality and

morbidity costs were represented by lost productivity. The total cost of a birth defect was defined as the sum of all components discounted at 5%. These studies can only provide a lower bound estimate of true costs.

One other study examined the cost of mercury exposure by using estimated costs of compensating education and IQ loss (in terms of lower earnings and labor market participation), plus medical costs (Rowe, 1995). There are no studies that relate fetal mercury studies to IQ loss, although IQ deficits are likely to be associated with the psychomotor retardation observed from mercury exposure. Rowe assumed a relationship between predicted psychomotor retardation and IQ loss, and calculated the present value costs at a 3% discount rate associated with IQ point loss. Finally it applied a willingness-to-pay to cost-of-illness ratio of 2 in order to reflect unmeasured aspects in calculating total damages from mercury. The central estimate per case was $289,000 (1992 dollars).

The traditional approach to valuing cancer is to apply a willingness-to-pay estimate associated with accidental deaths to an estimate of the reduced annual deaths associated with a change in pollution exposure. But there are several problems that should be considered. First, there is a long latency period for cancer between exposure to potential carcinogens and the manifestation of disease and deaths. If people value current health more than future health, this suggests that the willingness-to-pay estimates from accidental death studies should be revised downward for cancer fatalities.

A related concern is that older people with fewer years of life expectancy are primarily the people affected by cancer (about 70% of cancer mortality occurs in individuals over 65 years of age). Studies of the willingness to pay to avoid accidental death at work and elsewhere apply to individuals who average about 40 years old. Several analyses indicate that the value of a statistical life falls somewhat for older individuals. In addition, work by psychologists on risk rankings suggests that people might be willing to pay more to avoid death from a "dreaded" disease, like cancer, than to avoid other ways to meet the grim reaper (like auto accidents).

To value morbidity associated with cancer researchers have relied primarily on cost-of- illness approaches. Hartunian (1981) estimated average direct costs per cancer patient to be $49,000, including medical and administrative costs. Indirect costs, including changes in earnings and the provision of household services associated with nonfatal cancers were estimated by Rowe (1995) to be $87,000. The total cost of illness for nonfatal cancers is the sum of direct and indirect costs, or approximately $136,000. Rowe (1995) amends this by applying a willingness-to-pay to cost-of-illness ratio of 1.5, resulting in an estimate of $204,000 per case.

The most common approach to valuing air pollution damages is to apply a value of a statistical life to the change in the number of statistical deaths predicted to result from a change in particulate concentrations. A key choice is the value to apply. Estimates drawn from labor market studies range from $1 million -to $9 million. The upper end of the range exceeds values drawn from contingent valuation studies of accidental death risks. Contingent valuation studies may be somewhat more appropriate for valuing mortality risks in the environmental health context. One example is the Jones-Lee study (1985) which asked about willingness-to-pay for riding on busses from a company with a better safety record than another. Jones-Lee found that an adjustment which would lower the value of a statistical life is appropriate for individuals in older age groups, who are the primary subjects of premature mortality resulting from particulates. They show a declining ratio of willingness to pay with age for 70 year olds to 40 year olds of about 80%. Moore and Viscusi (1988) show a steeper decline in willingness-to-pay, with the ratio of 70 to 40 year olds being about 40%. Accounting for these considerations in a recent examination focused specifically on particulates, Burtraw, Krupnick et al. (1997) used a probability distribution to indicate the range of possible values, with a mean of $3.1 million.

In the recent Regulatory Impact Analysis (RIA) for Ozone and Particulate National Ambient Air Quality Standards (1997), the EPA used a value of $4.8 million ($1990) for the "high" value of a statistical life applied to deaths related to particulate exposure. However, they have also identified an adjustment to account for the age of the affected population and other problems with the underlying basis of the $4.8 million figure, suggesting a "low" value of $2 million might be more appropriate. EPA's RIA used a discounted life-year approach. Working with the estimate of $2 million per statistical life EPA derived a value for a life-year of $120,000.

The mismatch between accidental deaths and deaths from cancer or particulate exposures has raised serious concerns about the appropriateness of using traditional valuation techniques. The research frontier involves expressing excess deaths in terms of changes in life expectancy and using survey research to estimate the WTP today of people to increase their life expectancy (mostly from risk reductions late in life). One controversial study has estimated that the WTP today for a "treatment" increasing life expectancy by one year beginning at age 75 (where life expectancy is 10 years normally, but would be extended in this scenario to 11 years), is about $1,500 over the adult population in Sweden. According to Johannesson and Johansson (1997) this implies a value of statistical life of $70,000-$130,000. Until this literature matures, the preferable approach is to treat these values as probability distributions and to explore the sensitivity of results to alternative values in these distributions.

A crucial step in valuation is the aggregation from measures of individual willingness-to-pay to a measure for society. In

the most common applications, individuals are treated anonymously. No person's welfare is weighted more heavily than anyone else's, and health effects that are valued are treated consistently without regard to an individual's income or social status. However, there are some applications where equity considerations might suggest that differences among individuals should matter in valuation. In particular the age and prior health status of individuals are factors that decision-makers might want to consider. These factors are relevant for efficiency as much as for equity. A disease that struck a 23 year old would be viewed differently than a disease that struck a 65 year old for two reasons. First, a higher number of healthy life years would be lost in the former case, and second many of those years are viewed as especially precious in part because of responsibilities in child-rearing.

The Global Burden of Disease, a 1996 study by the Murray and Lopez of the Harvard School of Public Health and the World Health Organization is a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 along with projection to 2020. It can potentially be used to introduce equity considerations and to value morbidity. As part of the study, researchers convened focus groups of health professionals and other individuals from around the world to discuss the relative severity of a wide variety of disabilities. Each participant was asked two questions. One concerned extending life for people in a given health state versus extending life for healthy people, the second concerned giving health back to people in a given health status versus extending life for healthy people. Through a deliberative process the inconsistencies in the answers to these questions were explored, along with the implications of their decisions.

A sample of the resulting weights that were assigned to different types of disability is reported in the table. These weights reflect a judgement about the relative severity of disabilities on a scale that culminates in a weight of 1 given to death. This type of measure could be used as an index over many different health outcomes which, when paired with cost information, would permit the conduct of a cost-effectiveness analysis over dissimilar health outcomes. The table provides evidence that such comparisons can be made in a consistent and replicable fashion. They following table is derived from the Murray and Lopez study

Disability Class	Severity Weights	Indicator Conditions
1	0.00-.0.02	weight-for-height less than 2 standard deviations, vitiligo on face
2	0.02-0.12	diarrhea, severe sore throat, severe anemia
3	0.12-0.24	radius fracture, infertility, erectile dysfunction, arthritis, angina
4	.024-0.36	below knee amputation, deafness
5	0.36-0.50	mild mental retardation, Down syndrome, rectovaginal fistula
6	0.50-0.70	unipolar depression, blindness, paraplegia
7	0.70-1.00	active psychosis, dementia, severe migraine, quadriplegia

A summary of values used for a few illustrative health endpoints are provided below

Sample of Values Used in Health Benefits Valuation

Endpoint	Monetary Value	Unit $	Original Study or Source
Cardiac hospital admission	14,000.00	1992	N.A.
Respiratory hospital admission	6,306.00	1989	Krupnick & Cropper (1989)
Restricted activity day	51.38	1990	Krupnick and Kopp (1989)
Adult chronic bronchitis	210,000.00	1989	Viscusi et al (1991) Krupnick & Cropper (1989)
Acute cough	1.26 7.00 13.84	1990	Dicke et. al. (1987) Tolley et. al. (1986) Loehman et. al. (1979)
Phlegm day	3.77 10.00 36.44	1990	Dicke et. al. (1987) Tolley et. al. (1986)
Eye irritation day	15.72 15.72 34.88	1990	Tolley et. al. (1986)
Child chronic bronchitis	132.00	1989	Krupnick & Cropper (1989)
Minor respiratory-related restricted activity day	22.00	1990	Krupnick and Kopp (1989)
Respiratory restricted activity day	45.00	1990	Harrison & Nichols (1990)
Asthma attack	31.00	1990	Rowe & Chestnut (1985)

Dallas Burtraw and Alan Krupnick, "Measuring the Value of Health Improvements from Great Lakes Cleanup" Discussion Paper 99-34, April 1999, 1616 P Street, NW, Washington, DC 20036, Telephone 202-328-5000, Fax 202-939-3460, http://www.rff.org

MTBE

On March 20th Carol Browner, administrator of the US EPA moved to unilaterally control MTBE through the Toxic Substances Control Act while at the same time asking Congress to erase provisions of the Clean Air Act of 1990 promoting MTBE. MTBE is added to fuel to increase its oxygen content, and thus reduce carbon monoxide and ozone levels caused by auto emissions. The use of MTBE, skyrocketed after the Clean Air Act of 1990 mandated the use of oxygenates in certain smoggy parts of the country. However, the chemical is a suspected carcinogen with a repugnant odor and taste that can render water undrinkable even in small concentrations.

A Blue Ribbon Panel was appointed by The Environmental Protection Agency (EPA) on November 30, 1998 to study the chemical, and in July, 1999 recommended a complete phase out of MTBE "as quickly as possible without sacrificing the gains we've made in achieving cleaner air" because its threat to water outweighs its clean air benefits. Congress is now mulling a bill which would eliminate the mandate for oxygenates in gasoline. A number of states, including Maine and California, have since banned the chemical after it was found leeching into drinking water supplies. A December 1997 advisory recommended control levels that prevent adverse taste and odor (i.e. 20 40 parts per billion).

An October 1998 report by the California Environmental

Protection Agency's Office of Environmental Health Hazard Assessment found "evidence for the carcinogenicity" of MTBE. The report notes that the cancer evidence is based on several findings from animal studies,", but points out that critics have questioned the interpretation of the findings. The study points out that epidemiological studies of the carcinogenic effects are not available, but cites cancer observations in animal studies both by oral and inhalation routes. Specifically, tumors have been observe in rats of both sexes and a statistically significant increase in cell tumors of the testes. Studies also have found increased kidney tumors in male rats exposed to MTBE by inhalation and increases in leukemias and lymphomas in female rats exposed to MTBE orally. Animal studies were also mentioned by 60 Minutes, which also noted that people cannot cook with, drink, or shower with MTBE contaminated water, which smells like turpentine. One cup of MTBE in a five gallon tank makes it undrinkable. One of every 10 gallons of gasoline contains MTBE. Other effects noted by humans exposed to MTBE have been asthma, sinus problems, skin rashes, and severe headaches.

Among the worst examples of MTBE pollution so far are South Tahoe, California, where about half the drinking water wells have been contaminated; Santa Monica, California, where 80% of the public water supply has been contaminated, and Glenville, California, where one well had MTBE concentrations 20,000 times greater than recommended limits according to a 60 Minutes report. All three of the cities now have to import water from elsewhere at costs of up to $3 million a year. In Maine, more than 5,000 private drinking water wells were found contaminated, forcing residents to hook into municipal water lines. Several lawsuits around the country name gasoline operators as defendants in MTBE contamination cases.

Unfortunately, MTBE has been found to have a long lifespan in groundwater and is costly to clean up. Even though MTBE is long lasting it also travels fast.

Estimated costs for cleaning up MTBE are around $1 million per well, because current cleanup technologies for the chemical are limited. A number of energy companies, including Shell Oil, are sponsoring research into microbial treatment - the cheapest MTBE remediation technology currently available. Other methods include absorption using activated carbon, photooxidation through ultra violet light, and chemical oxidation using substances like hydrogen peroxide. Because of the financial and technological hurdles, many contaminated areas have yet to be cleaned up - and are instead simply sectioned off to reduce spreading while more cost-effective treatments are found.

Costs at South Lake Tahoe and Santa Monica exceed $22 million. Glenville California has become a ghost town, according to 60 Minutes and residents are finding it impossible to sell their homes. Banks completely abandoned the area.

Reuters News Service, "MTBE's Threat to Water Could Be Long-lasting" January 14, 2000 from http://www.planetark.org/ and Garden State Environews http://www.gsenet.org

60 Minutes, January 16, 2000

http://www.epa.gov

LAND

U.S. VOWS TO WAGE WAR AGAINST TREE-MUNCHING BEETLE

On January 31st the Clinton administration vowed to step up its offensive against an infestation of tree-eating beetles that led to the destruction of 4,300 trees in New York City and 1,200 in Chicago alone last year. The U.S. Department of Agriculture said it will test an insecticide in the two cities this spring. The chemical will be injected into the soil or directly into trees and poison Asian long-horned beetles that attempt to make their homes in healthy trees. Officials are optimistic that the tests will provide an alternative to tree removal. The pest has infested hardwood trees in more than a half-dozen U.S. states.

Officials believe the Asian long-horned beetle arrived in larvae form in wooden crates from China. The large, flying black-and-white spotted beetle with long antennae kills by attacking the circulatory systems of trees. Economists estimate that there would be up to $138 billion in damage to the U.S. economy if the beetle were to spread nationwide. Lumber and maple sugar industries are particularly vulnerable.

Reuters Limited. "U.S. Vows to Wage War Against Tree-Munching Beetle" February 1, 2000 via http://www.planetark.org/

CARVING OUT SOME SPACE: A GUIDE TO LAND PRESERVATION STRATEGIES

In "Carving Out Some Space: A Guide to Land Preservation Strategies" and "The Law and Economics of Habitat Conservation: Lessons from an Analysis of Easement Acquisitions" James Boyd, Kathryn Caballero, and R. David Simpson discuss the ways in which the legal instruments used to conserve habitat are still evolving. They divide the costs of implementing any conservation policy between transaction and opportunity costs. The transaction cost is the amount of time, money, and effort needed to establish, monitor, and enforce such a policy. The opportunity cost is the difference between the value of land in its "highest and best" private use

and its value when employed in ways compatible with conservation. No policy can avoid the cost of foregone development.

Policies used for conservation include the following:

> Purchase of full property interests, a "fee-simple" acquisition, requiring a purchaser to pay full value for the seller's use of the land. This arrangement can result in "overkill" if, the price includes the value of agricultural or low-intensity activities that are compatible with conservation. On the other hand, it obviates the need to specify future management practices and engage in expensive monitoring.
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> Tax credits and penalties result in at least some of the opportunity costs of conservation being shared among other taxpayers, who must either make up for revenue short-falls through higher taxes and fees or make do with fewer public services. However, private landowners have an incentive to overrepresent the value of the lands they devote to conservation, to the extent that they receive tax breaks for doing so. Tax-based incentives also require monitoring in order to confirm that the taxpayer is maintaining the land.
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> Tradable development rights (TDRs) distribute "rights" to some fraction of land in an area. Anyone who wishes to develop land in excess of the amount of TDRs they own must purchase additional rights. The opportunity cost of these programs is minimized because the land set aside for conservation has the least value for alternative uses. Transaction costs may be low to the extent that private markets work relatively efficiently, but monitoring and enforcement costs are incurred.
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> Regulation that prohibits development may appear to be costless at first glance, however, it can prevent the development of properties to their highest and best use, and landowners from earning income from future development. It is for this reason that many consider such regulations to be "takings" of property. Regulation entails monitoring and enforcement costs. Unlike TDRs and tax incentives, it has the virtue of being able to target specific habitat types. Regulation seems to be efficient since it eliminates the need for intervening institutions such as markets or tax assessment and collection. The specificity of regulation can also be its greatest drawback
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> Purchase of a conservation easement -- in exchange for payment (or a tax deduction) a purchaser receives assurances that a landowner will not develop designated land any further.

Easements possess several advantages. First, partial interest in a piece of land is less costly to acquire than full ownership. Second, they impose few administrative burdens. Third, they necessitate few, if any, changes in environmental and property statutes. Finally, because they involve voluntary transactions, easements are more politically palatable than regulation. However, the money saved up-front in acquisition costs must be balanced against the higher, long-term costs associated with monitoring and enforcing the division of ownership rights.

The value of an easement is the difference in the value before and after imposition of development restrictions, or the discounted present value of the annual cash flows as developed and current flows, if any, from such activities as agriculture. The authors provide a hypothetical example is provided where development would increase income from $100,000 to $200,000 per year. Given a 20% probability of development in five years the value of the easement if $89,000, while an 80% probability results in a value of $356,000. A 20% probability of development in 15 years, on the other hand results in a value of $24,880.

Recent State and Federal policy initiatives in Florida are focused on the restoration of damaged Everglades ecosystems. Part of this program includes the acquisition and modification of lands to improve water flows and reduce nutrient loadings. Another important initiative has been the state's Preservation 2000 program, financed over 10 years with a $3 billion land preservation fund which requires state land-buying agencies to use alternatives to fee simple acquisition.

Florida has also been the focus of studies regarding the need for habitat conservation which provide a scientifically-based assessment of the amount and distribution of land use protections necessary to provide minimum conservation goals for the state's rare plant and wildlife communities. The authors conclude that approximately 13% of the state's privately owned lands should be kept in their current condition in order to achieve conservation targets.

The Taxpayer Relief Act of 1997 provides a tax "exclusion" for property owners who donate a conservation easement worth at least 30% of the property's total value, which ensures that the easement donation is substantive. However, the exclusion is not available unless the property is within a 25 mile radius of a metropolitan statistical area, national park, or national wilderness area, or within 10 miles of an urban national forest.

Easements are still relatively rare and the particulars of each are unique. Thus, there is no typical "market price" on which to base tax deductions. To avoid fraud, tax authorities allow deductions only for donations of land made to bona fide conservation organizations. Regulations on appraisers and penalties for excessive appraisals also constrain abuses. Overappraisal can be difficult to prove. The Federal Tax Code penalizes excessive donations only if the appraisal is off by more than 100%.

Typically, easement valuations range from 20% of the land's estimated total value to upwards of 90%. Appraisals must determine the highest and best use of the land and take into account 1) regulatory restrictions such as zoning; 2) economic and demographic factors which affect the probability of development; and 3) the potentially positive effects of the restriction on the value of neighboring parcels owned by the landowner. The value of the easement is not a function of the easement's social value.

The Florida easements purchased by the state water management districts range in value from 28 percent to 60

percent of the properties' total value. In Stotler v. Commissioner, a tax court granted a 91 percent reduction in value for an easement attached to a coastal property. The case went to court, and the court supported the landowner plaintiff, because the IRS assigned no value to development potential in its appraisal.

The St. John's River Water Management District provided particularly careful documentation and analysis of appraisals used to support four of their easement acquisitions. In all cases, appraisals were conducted by at least two appraisers. In general, the properties were broken into distinct land parcels differentiated by land type (e.g., forest, wetland, residential). The different types of land within a given property were appraised separately. Thus, comparable sales of wetlands were applied to the estimation of that fraction of the property that was currently in, or likely to remain, wetland. When forestry income is being generated from the property, harvesting income is estimated and deducted from the property's value if logging is restricted by the easement. Similar adjustments were made for hunting income. In one case, an adjustment was made to take into account an increase in agricultural production costs that would arise from the presence of the easement.

In one case, the appraisers' estimates of easement value differed by only 1.5%. In another, however, the estimates differed by 56%. Finding no comparable land sales in Florida, the appraisers made frequent reference to easement purchases in Pennsylvania that equaled between 50% and 59% of the properties' full value. Several of the appraisers compared zoned land values to non-zoned land values in other counties and concluded that comparable zoning restrictions in Florida led to reductions in property value of between 30% and 92%, with an average of roughly 55%. One appraiser chose to value the easement in question at a relatively modest 35% of the fee-simple value because the property was "extremely limited from the standpoint of present economic development potential." These attempts to frame the value of easements indicate the difficulty and relatively ad hoc nature of the process. The authors feel that a 35% reduction in land value for a property with "extremely limited" development potential seems quite large.

In one case, a property's "muck content," rather than the presence of an easement, was judged to significantly limit its future development. That appraiser adjusted the property's value downward by only 3% due to the extinguishment of residential development rights.

According to a 1994 estimate by the Lancaster, County Agricultural Preserve Board, costs associated with surveying, appraisal, title searches, title insurance, and other actions necessary to record an easement averaged $83 per acre on properties where the easement's cost itself was on average $20,000 an acre.

James Boyd, Kathryn Caballero and R. David Simpson "The Law and Economics of Habitat Conservation: Lessons from an Analysis of Easement Acquisitions" Resources for the Future Discussion Paper 99-32 April 1999, 1616 P Street, NW, Washington, DC 20036, (202) 328-5000 Fax 202-939-3460 http://www.rff.org

James Boyd, Kathryn Caballero, and R. David Simpson "Carving Out Some Space: A Guide to Land Preservation Strategies" by James Boyd, Kathryn Caballero, and R. David Simpson *RESOURCES*, Summer, 1999, Issue 136

IT BLOCKS CAT ODORS, AND MAYBE RADIATION

At a recycling plant for spent nuclear fuel rods in West Valley New York, an "army" of nearly 1,000 scientists and engineers has spent 18 years and $1.5 billion so far on a cleanup involving custom-designed robots and remote-controlled ovens that bake liquid wastes into glass cylinders at the 3,300 acre site. Now they are testing "the ultimate in low technology: a mineral better known as a prime ingredient in cat litter."

A deep trench is being dug and buried with zeolite, a family of 48 minerals, in order to sop up radioactive material tainting the groundwater. The groundwater has been seeping toward a stream that feeds Lake Erie ever since acid ate through a concrete and steel foundation several decades ago. The most abundant mineral, clinoptilolite, has a strong affinity for strontium 90. Engineers hope that the zeolite will not have to be replaced for a relatively long time, eliminating the need for costly pumping and treating of groundwater, and that over time that the strontium will decay and lose much of its radioactivity.

The method is a variant of a new toxic cleanup method allowing groundwater to pass through underground berms of materials that can catch or break down chemicals. Another variant uses buried walls of ion filings to remove dry cleaning fluid from ground water.

Dr. Alan Rabideau, an associate professor of engineering at the State University of New York at Buffalo conducted successful lab tests in the spring of 1999. A field test began in December. If successful the method could be used at other nuclear waste sites

Several years ago, West Valley Nuclear Services began drilling wells and pumping contaminated water through filters to capture the strontium 90, but the method costs nearly $400,000 a year, and creates a new batch of radioactive waste. The total cost of the new process is expected to be less than $1.5 million. A mine in eastern Oregon supplies the mineral at $180 a ton.

Andrew C. Revkin "It Blocks Cat Odors, And Maybe Radiation: Material Used in Litter Is Tested In Sopping Up Nuclear Contaminants" *The New York Times* February 24, 2000 pages B1 & B6

DEVELOPERS PAY HEAVILY IN DISPUTE OVER MALL

Real estate interests battling over the proposed development of the Long Wharf Mall have spent more than $1.3 million in lobbying and $500,000 in contributions to federal and state political campaigns since 1997.

New England Development and the Fusco Corporation have contributed about $61,000 to recent state campaigns -- nearly two-thirds on Governor John Rowland's re-election effort and $260,000 on lobbying. Westfield America, a developer seeking to protect its own suburban Connecticut malls has opposed the New Haven project by giving at least $425,000 in "soft money" to national and Congressional party organizations. Critics say the contributions have prevented serious consideration of the project's potential environmental, traffic and economic problems

Associated Press February 21, 2000

INNOVATIVE APPROACHES TO LAND USE

At the "Economic Analysis and Land Use Policy," seminar sponsored by the EPA Sven-Erik Kaiser pointed out that the EPA Brownfields Program, is working with more than 300 communities in assessing, cleaning up and redeveloping brownfields sites. The program has leveraged over $1.5 billion in public-private funds, and supported the creation of more than 5,000 jobs, using grants, tax incentives, revolving loan funds and job training programs. The term "brownfields" is defined as abandoned, idle, or underused industrial or commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination problems, or, more simply: properties where re-use is complicated by environmental contamination issues.

The wider universe of brownfields sites includes: 1,300 federal "Superfund" sites, on the National Priority List; 11,000 that are potential Superfund sites; 30,000 sites that were potential Superfund sites but were determined to be inappropriate for Superfund listing; 70,000 sites in state hazardous waste site listings; 3,600 sites that are subject to Resource Conservation and Recovery Act regulations that require special federal or state permitting for treatment, movement or storage; 300,000 underground storage tank sites; and 42,000 solid waste facilities. This totals up to approximately 430,000. After screening out for overlap and duplicate permits, the total is approximately 380,000 sites. However, if we account for the fact that cities under-report by almost 50%, then the total goes back up to 500,000 or 600,000 total sites. A Cleveland State University professor estimated that if all of the brownfields properties in the Great Lakes area were cleaned up, there would be enough real estate to accommodate growth for 100 years.

The EPA brownfields program is designed to facilitate clean-up by awarding grants, changing regulations, funding research, and working with other agencies and organizations. EPA funded a recent report that looked at 107 redeveloped brownfields sites and examined the costs of clean-up, the sources of funding for clean-up, how the funding was used, the re-uses to which the properties were put, the effects of the clean-up and re-use, and the populations impacted. The reports findings included the following:

the average size of the site was five acres;
the average cost of assessment per site was approximately $50,000
the average cost of clean-up was approximately $50,000 per acre;
for every dollar of public monies spent on brownfields redevelopment, $2.50 of private monies were contributed; and
job creation costs, mostly from job creation programs, were approximately $14,000, which is low compared to the environmental benefits.

In addition, a greenspace study currently in progress is indicating that an acre of brownfields redevelopment saves three acres of greenfields from development.

The EPA website for brownfields redevelopment, is www.epa.gov/brownfields.

Sven-Erik Kaiser, US EPA Brownfields Program "Innovative Approaches to Land Use" developed for the US Environmental Protection Agency Office of Economy and Environment and National Center for Environmental Research and Quality Assurance's workshop, "Economic Analysis and Land Use Policy," held December 2, 1999 at the Doubletree Hotel Park Terrace in Washington, DC available at http://www.epa.gov/economics edited by Shi-Ling Hsu Environmental Law Institute 1616 P Street NW, Washington, D.C. 20036

AIR

CARMAKERS TO PUT 'SMOG-EATING' RADIATORS IN SOME MODELS

After some initial disappointments, Engelhard's smog eating radiator known as PremAir is finding its way into new cars. It will first be used in all Volvo S80 sedans and the ultra-low-emission Nissan Sentra CA sold only in California. It is a coating applied to standard automotive radiators. Engelhard claims that a radiator coated with the PremAir catalyst can capture as much a 75% of the ground-level ozone, the main component of smog, converting it to ordinary oxygen. The company will not identify the composition of the coating, but it does say that it includes a nonprecious-metal catalyst that acts in much the same way as the precious metals in catalytic converters to force a chemical reaction and

neutralize pollution.

Roland Hwang, a transportation analyst with the Union of Concerned Scientists (UCS) in Berkeley California said results would vary widely depending on whether there was any ozone present to be broken down. He said that "we see the Engelhard catalyst as a bit of a gimmick". The UCS prefers pollution prevention.

PremAir was first announced in 1995 (see EDV&CBN July, 1995). Engelhard initially contended that widespread use in Los Angeles would do more for the city's air quality than the combined benefits of electric cars, reformulated gasoline and reduced driving – and its stock soared 66% over three months. The company later said that testing had shown that environmental benefits were "less than originally projected" and the stock dropped. Ford abandoned its involvement in 1996 after concluding that the coating was "a pretty expensive way to get a small benefit". PremAir's promise was further clouded by an SEC investigation of Engelhard executives who had sold $19 million worth of company stock in 1995 before the share price dropped.

One reason that interest in PremAir has revived is that estimated costs have fallen from $500 a car in 1995 to less than $50 today largely because earlier versions used platinum which is very expensive. Another reason for the interest is the strict clean air standards in California and other states. A 1998 addition to California Air Resources Board rules granted low-emission vehicle credits to auto manufacturers able to demonstrate effectiveness. The rules require on-board monitoring of emissions-control equipment which is lacking in Volvo's current version of the system. Carmakers have to guarantee results for seven years or 70,000 miles.

Volvo, now a division of Ford, estimates that particularly on hot, smoggy days, PremAir could actually consume more ozone than the car generates. Ford is reconsidering the system it rejected for other models. Engelhard claims that it could make electric cars negative pollution vehicles.

Jim Motavalli "Carmakers to Put 'Smog-Eating' Radiators in Some Models" The New York Times January 14, 2000 page F1

GENERAL

EXPERIENCE WITH MARKET-BASED ENVIRONMENTAL POLICY INSTRUMENTS

Market-based instruments are regulations that encourage behavior through market signals rather than explicit directives regarding pollution control levels or methods. These instruments, such as tradable permits or pollution charges encourage firms (and/or individuals) to undertake pollution control efforts that are in their own interests, and that collectively meet policy goals.

In theory, if properly designed and implemented, market-based instruments allow any desired level of pollution cleanup to be realized at the lowest overall cost to society, by providing incentives for the greatest reductions in pollution to those firms that can achieve these reductions most cheaply. Rather than equalizing pollution levels among firms (as with uniform emission standards), market-based instruments equalize the incremental amount that firms spend to reduce pollution—their marginal cost

Market-based instruments fall within four major categories: pollution charges; tradable permits; market barrier reductions; and government subsidy reductions

Pollution charge systems assess a fee or tax on the amount of pollution that a firm or source generates. They can be categorized as: effluent charges; deposit-refund systems; user charges; insurance premia; sales taxes; administrative charges; and tax differentiation.

Tradable permits can achieve the same cost-minimizing allocation of the control burden as a charge system, while avoiding the problem of uncertain responses by firms. Under a tradable permit system, an allowable overall level of pollution is established and allocated among firms in the form of permits. Firms that keep their emission levels below their allotted level may sell their surplus permits to other firms or use them to offset excess emissions in other parts of their facilities.

Market barrier reductions can also serve as market-based policy instruments. Three types of market barrier reductions stand out: (1) *market creation*, such as measures that facilitate the voluntary exchange of water rights; (2) *liability rules* that encourage firms to consider the potential environmental damages of their decisions; and (3) *information programs*, such as product labeling requirements.

Government subsidy reductions are the fourth category of market-based instruments. Many subsidies promote economically inefficient and environmentally unsound practices.

Pollution Charges

Seven countries in western Europe have implemented emissions fees to reduce air pollution. As of 1999, Denmark, Finland, Italy, the Netherlands, Norway, and Sweden levied carbon taxes. Finland's carbon tax, the world's first, was introduced in 1990. Claims have been made that the Swedish and Norwegian taxes have reduced carbon emissions, but in all the Nordic countries, except Finland, tax exemptions have made effective carbon tax rates significantly lower than nominal rates, thereby increasing skepticism regarding the efficacy of these policies.

Norway, Sweden, France, Denmark, Italy, and Galicia tax sulfur emissions or the sulfur content of fuels. The Swedish tax seems to have reduced sulfur emissions, not surprising

given that it was set at twice the marginal cost of abatement in 1996. France, Italy, Sweden, and Galicia tax nitrogen oxide emissions, but only the Swedish tax has been found to reduced emissions. In the first two years of the program, total emissions from monitored plants fell by 40%

Effluent charges have also been used in Western Europe for water pollution. The Netherlands assesses effluent charges on industrial wastewater, apparently with some success. Germany and France also have instituted such charges.

Many formerly communist transitional economies view air and water pollution charges as important means to efficiently restructure environmental management and regulatory systems. Charges have been implemented in the context of eliminating state subsidies, implementing budget constraints for state-owned and other enterprises, improved monitoring and enforcement of environmental regulations, privatization, and preparation for EU accession. Although effluent fees have been implemented throughout the region, Poland is the only country in which the fees appear to have reduced emissions. In 1991 Poland increased fees for airborne pollutants to 20 times their levels under Communist rule, so that they are now among the highest in the world. Fee revenues are $450-$500 million annually. In other parts of the region effluent charges have been ineffective because: (1) charges have been eroded by high inflation; (2) fees have been set below marginal abatement costs; (3) pollution limits—the point above which emissions are assessed a penalty rate—are typically set too high to influence firm behavior; (4) tax rates are often the result of implicit or explicit negotiation between industries and governments; (5) many countries set upper bounds on pollution charge liabilities; (6) unprofitable enterprises are often exempted; and (7) monitoring and enforcement has been inadequate.

A number of developing countries have utilized effluent charges, albeit typically at levels too low to induce behavioral changes. For example, China places levies on 29 pollutants in wastewater, industrial waste gases, and various forms of industrial solid and radioactive waste. One study indicates that these effluent charges have helped reduce water pollution intensity. The fees are a major source of revenue for environmental projects. The Philippines instituted environmental fees for wastewater discharge from industrial sources in 1997, but the program is active in only one area of the country. Likewise, Malaysia has used effluent fees, paired with licensing, to control pollution from the palm oil industry; and the fee system apparently has been effective. South Korea imposes charges for emissions in excess of regulatory limits on ten air pollutants and fifteen water pollutants, and Japan assesses a minor charge on industrial SO2 emissions. Colombia implemented a pilot program of water effluent charges after experiencing no success in pollution reduction with command and control regulations. Industrial polluters pay effluent fees based on BOD and TSS. Although emission decreases have been recorded since the program came into existence, it is difficult to separate the effect of the charges from that of voluntary agreements. The municipality of Quito, Ecuador has implemented a water effluent charge system, whereby enterprises discharging organic content and TSS above national standards pay a per-unit charge equal to the cost of municipal treatment. In addition, Quito assesses fines on mobile air pollution sources, including cars, trucks, and buses. The fines are set above the cost of installing low-emissions technology or obtaining a tune-up.

Policies intended to reflect the social costs of waste disposal provide incentives for illegal dumping. This dilemma can be resolved with a front-end charge (deposit) combined with a refund payable when the substance is turned in for recycling or disposal. In some respects, bottle bills assessing such deposits seem to have accomplished their objectives; in Michigan, for example, 95% of containers were returned one year after the program was implemented; and in Oregon, littering was reduced and long-run savings in waste management costs were achieved. But, by charging the same amount for each type of container material, these programs do not encourage consumers to choose containers with the lowest product life-cycle costs (including disposal expenses).

Glass container deposit-refund systems are widely used in more developed countries. Non-glass systems include a plastic shopping bag deposit-refund system in Italy, and a small chemicals container system in Denmark. In addition, Austria's deposit-refund system includes flourescent light bulbs and refrigerators, and, in 1975, Sweden instituted a deposit-refund system to encourage proper disposal of old vehicles.

Japan's beer bottle deposit-refund program involves a levy paid by wholesale dealers, retail shops, and consumers, which is refunded at each distribution stage upon bottle collection. Mexico requires the return of car batteries for deposit refund at the wholesale level. Taiwan has a deposit-refund system for polyethylene terephthalate soft drink bottles; South Korea for beverage containers, tires, batteries, and lubricants; and the Czech Republic for glass and polyethylene bottles. Voluntary deposit-refunds are used in Barbados, Bolivia, Brazil, Chile, Colombia, Ecuador, Jamaica, Mexico and Venezuela.

The few rigorous studies on the benefits and costs of bottle bills have found that social desirability depends critically on the value assigned to the time it takes consumers to return empty containers and the willingness to pay for reduced liter. By requiring consumers to separate containers and deliver them to redemption centers, deposit-refund systems can foster net welfare losses. Deposit-refund systems are most likely to be appropriate where: (1) the objective is one of reducing illegal disposal, as opposed to such objectives as general reductions in the waste stream or increased recycling; and (2) there is a significant asymmetry between *ex ante* (legal) and

ex post (illegal or post-littering) clean-up costs. Thus, deposit refund systems may be among the best options to address disposal problems associated with containerizable hazardous waste, such as lead.

Tradeable Permits

Beginning in 1974, EPA experimented with "emissions trading" as part of the Clean Air Act's program for improving local air quality through the control of volatile organic compounds (VOCs), CO, SO2 , particulates, and NOx. Firms that reduced emissions below the level required by law received "credits" usable against higher emissions elsewhere. Companies could employ the concepts of "netting" or "bubbles" to trade emissions reductions among sources within the firm. The "offset" program, which began in 1976, allows firms wishing to establish new sources in areas that are not in compliance with standards to offset new emissions by reducing existing emissions. This can be accomplished through internal sources or through agreements with other firms. Under a "banking" program, firms may store earned emission credits for future use.

Companies such as Armco, DuPont, USX, and 3M have traded emissions credits, and a market for transfers has long since developed. Despite the limited scope of EPA's trading programs they may have saved between $5 billion and $12 billion over time.

The U.S. lead trading program was designed to allow gasoline refiners greater flexibility in meeting emission standards at a time when the lead-content of gasoline was reduced. In 1982, EPA authorized inter-refinery trading of lead credits, a major purpose of which was to lessen the financial burden on smaller refineries, which were believed to have significantly higher compliance costs. In 1985, EPA allowed refineries to bank lead credits. In each year of the program, more than 60% of the lead added to gasoline was associated with traded lead credits, until the program was terminated at the end of 1987, when the lead phasedown was completed. The lead program was clearly successful in meeting its targets. The level of trading activity and the rate at which refiners reduced production of leaded gasoline suggest that the program was relatively cost-effective. EPA estimated savings from lead trading of approximately 20% over programs that did not provide for banking, saving about $250 million per year.

An "experimental program" to protect the Dillon Reservoir in Colorado, the major source of water for Denver, demonstrated how tradable permits could be used to reduce nonpoint-source water pollution. Nitrogen and phosphorus loading threatened to turn the reservoir eutrophic, despite the fact that point sources from surrounding communities were controlled to best-available technology standards. A program implemented in 1984 allowed publicly owned sewage treatment works to finance the control of nonpoint sources in lieu of upgrading their own treated effluents to drinking water standards. EPA estimated that the plan could save over $1 million per year, due to differences in the marginal costs of control between nonpoint sources and the sewage treatment facilities. However, very limited trading occurred, for a variety of reasons, including: implementation of other regulations that reduced non-point source runoff; lower than expected cost for installation of additional treatment facilities; and relatively high regional precipitation that diluted concentrations in the reservoir.

In 1995 countries that had ratified the Framework Convention on Climate Change (FCCC) established a pilot phase for "activities implemented jointly" (AIJ), whereby industrialized nations or firms within those nations can finance projects in other countries to reduce net emissions of greenhouse gases and thereby attempt to meet their own greenhouse gas (GHG) A commitments." According to one source, 133 AIJ projects had been accepted, approved, and endorsed by designated national authorities for the host and investing countries by September, 1999. The 94 AIJ projects that had been approved under the FCCC by mid-1999 produced CO2 -equivalent reductions of 13 tons to 57 million tons based upon average investments of approximately $6 million.

A market in tradable permits was used in the United States to help comply with the Montreal Protocol, an international agreement aimed at slowing the rate of ozone depletion. The Protocol called for reductions in the use of CFCs and halons, placing limits on both the production and consumption of CFCs by issuing allowances. Because different types of CFCs are likely to have different effects, each CFC is assigned a different weight. If a firm wishes to produce a given amount of CFC, it must have an allowance to do so. Through mid-1991, there were 34 participants in the market and 80 trades. Relatively low transaction costs associated with trading in the CFC market suggest that the system was relatively cost-effective. Production quotas for ozone-depleting substances (ODS) were transferred within and among European Union (EU) countries between 1991 and 1994, until production was nearly phased out. During that period, there were 19 transfers (all but two of which were intrafirm), accounting for 13% of the EU's allowable ODS production.

A centerpiece of the U.S. Clean Air Act Amendments of 1990 is a tradable permit system that regulates SO2 emissions, the primary precursor of acid rain. Title IV of the Act reduces sulfur dioxide and nitrous oxide emissions by 10 million tons and 2 million tons respectively from 1980 levels. The first phase of sulfur dioxide emissions reductions was started in 1995, with a second phase of reduction to be started this year. In Phase I, individual emissions limits were assigned to the 263 most SO2-emission intensive generating units at 110 plants operated by 61 electric utilities, largely at coal-fired power plants east of the Mississippi River. After January 1, 1995, these utilities could emit sulfur dioxide only if they had

adequate allowances to cover their emissions.

A robust market of bilateral SO2 permit trading has emerged, resulting in cost savings of about $1 billion annually compared with command-and-control regulatory alternatives. Although trading was limited in the early years, it increased significantly over time. Concerns have been expressed that state regulatory authorities would hamper trading in order to protect their domestic coal industries, and some research indicates that state public utility commission cost-recovery rules have provided poor guidance for compliance activities. Other analysis suggests that this has not been a major problem. Similarly, in contrast to early assertions that the structure of EPA's small permit auction market would cause problems, the evidence now indicates that this has had little or no effect on the vastly more important bilateral trading market.

The South Coast Air Quality Management District launched a tradable permit program in January, 1994, to reduce nitrogen oxide and sulfur dioxide emissions in the Los Angeles area. One prospective analysis predicted 42% cost savings, amounting to $58 million annually. As of June 1996, 353 participants in this Regional Clean Air Incentives Market program, had traded more than 100,000 tons of nitrogen oxide (NOx) and SO2 emissions, at a value of over $10 million.

Since 1991, Chile has had an auctioning system in place for bus licenses to address congestion-related pollution in Santiago. Deregulation of Santiago's urban public bus system in the late 1970s had resulted in significant congestion and increasing traffic-related emissions. Congestion has apparently been reduced by these measures, with emissions reduced proportionately, although actual emission reductions have not been measured. Chile also has implemented a tradeable permit system for total suspended particulates (TSP) from stationary sources in the Santiago area. Initial allocations were based on 1992 emissions, and new sources must offset all incremental emissions. Trading began in 1995. Emissions have decreased due to the introduction of natural gas as an alternative fuel, but the volume of emissions trading has been low. Regulatory uncertainty, high transaction costs, inadequate enforcement, and market concentration may be partly to blame for the low trading volume.

In Denmark, the Ministry of Environment fixes annual emissions ceilings in the power generation industry as a whole, and leaves allocation of the annual ceilings to the country's two power plant consortia. In the Netherlands, electric power producers face emission standards for SO2 and NOx, but can comply through cost-sharing arrangements, whereby plants with higher abatement costs are compensated. The system has resulted primarily in intra-firm trading, with estimated savings of $245 million.

In Germany, the transfer of emission reduction obligations among firms in air quality non-attainment areas is allowed. Since 1974, firms have been allowed to locate new plants in non-attainment areas, provided they replace existing plants in the same area. The "replaced" plant need not be owned by the same firm. Since 1983, existing plant renovations can also be used to offset new plant emissions in non-attainment areas. The cost savings associated with these rules have been very limited. Germany began a pilot project on tradable permits for VOC emissions among small vehicle refinishing shops in 1998. Since 1991, an experimental program has been carried out in Chorzów, one of Poland's most polluted municipalities. The Chorzów pilot project allowed the city's steel mill and power plant to negotiate collective emissions reductions for particulates, SO2, carbon monoxide, and hydrocarbons.

Market Barrier Reductions

Liability rules can provide strong incentives for firms to consider potential environmental damages. In theory, a liability rule can be cost effective because technologies or practices are not specified. The U.S. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 established retroactive liability for companies that are found responsible for contaminating a site. Similarly, the Oil Pollution Act makes firms liable for cleanup costs, natural resource damages, and third party damages caused by oil spills onto surface waters; and the Clean Water Act makes responsible parties liable for cleanup costs arising from spills of hazardous substances.

The Nordic countries have strict environmental liability rules. Sweden has held polluters strictly liable for full damage compensation since 1986; and Norway and Finland enforce strict liability for environmental damage. Germany, Belgium, France, and the Netherlands enforce strict liability for a variety of polluting activities. Among developing nations, Trinidad and Tobago has established a voluntary policy of full compensation for environmental damages, but has not legislated mandatory corporate liability. Mexico has established strict liability of parties who degrade the environment. However, in Latin American and Caribbean countries, as in many developing nations, lack of resources among executive and judiciary institutions makes enforcement of these rights relatively uncommon.

The U.S. Energy Policy and Conservation Act of 1975 specifies that certain appliances and equipment carry labels with information on products' energy efficiency and estimated annual energy costs. Today, energy efficient products can display an *"EnergyStar"* label. By 1997, over 13,000 product models carried the *Energy Star* label. The European Union established an "Eco-label" in 1993, initially intended to replace proliferating (and possibly trade-restricting) national labels. By 1999, the Eco-label had been applied to 200 products. The German "Eco-Angel" label program, the world's first, began in 1977. More than 4,200 products in dozens of sectors have received the label. Hungary's eco-label

was introduced in 1995. The Nordic Swan has been applied in Norway, Sweden, Finland, and Iceland since 1989, and now covers 1,000 products. The market share of eco-labeled laundry detergents in Sweden increased from zero in 1990 to 80% by 1997, but analysts see no major improvement in environmental quality as a result of the switch.

Government Subsidy Reductions

According to the World Bank (1997), subsidies to energy, road transportation, water use, and agriculture in developing and transition economies totaled over $240 billion per year in the 1990s, representing a substantial improvement over the 1980s. A significant increase in energy prices toward efficient levels in transition economies is one important change underlying this trend. A second factor has been reduced protection of inefficient (and ecologically harmful) domestic industries, due to greater acceptance of free trade.

China has reduced energy subsidies drastically since the mid 1980s. For example, subsidy rates for coal, which fueled more than 70% of China's energy production as of 1994, fell from 61% in 1984 to 11% in 1995. Through development of private coal mining and removal of price controls, nearly 80% of China's coal sold at unsubsidized international prices by 1995. In the late 1970s, fertilizer subsidies accounted for fully 4% of the national budget of Bangladesh; the government began reducing subsidies in 1978, and completely deregulated retail fertilizer prices in 1983. Direct subsidies for pesticides in Indonesia, which in the early 1980s were as high as 85%, were phased out between 1986 and 1989; domestic pesticide production was reduced by one-half between 1985 and 1990, and imports fell to one-third the level witnessed in the mid-1980s. Ecuador has completely phased out subsidies on agricultural inputs (pesticide and fertilizer), fuel oil, and motor fuels, with the exception of diesel. Likewise, India, Mexico, South Africa, Saudi Arabia, Brazil, and Jamaica cut fuel subsidies significantly in the mid-1990s.

Conclusions

Stavins concludes that the evidence demonstrates that market-based instruments can achieve major cost savings while accomplishing their environmental objectives. Flexibility, simplicity, monitoring and enforcement, and the capabilities of the private sector to make markets of this sort work are important factors in determining success. Among the lessons learned are the following:

> First, where the cost of abating pollution differs widely among sources, a market-based system is likely to have greater gains, relative to conventional, command-and-control regulations. SO2 abatement cost heterogeneity was great, because of differences in ages of plants and their proximity to sources of low-sulfur coal. But where abatement costs are more uniform across sources, the political costs of enacting an allowance trading approach are less likely to be justifiable.
>
> Second, the greater is the degree of mixing of pollutants in the receiving area, the more attractive will a market-based system be, because taxes or tradeable permits, for example, can lead to localized "hot spots" with relatively high levels of ambient pollution.
>
> Third, the efficiency of price-based (tax) systems compared with quantity-based (tradeable permit) systems depends on the pattern of costs and benefits. If uncertainty about marginal abatement costs is significant, and if marginal abatement costs are quite flat and marginal benefits of abatement fall relatively quickly, then a quantity instrument will be more efficient than a price instrument
>
> Fourth, the long-term cost-effectiveness of taxes versus tradeable permits is affected by their relative responsiveness to change. If rates of economic growth are rapid, a fixed tax leads to an increase in aggregate emissions, whereas with a fixed supply of permits there is no change in aggregate emissions. In the context of general price inflation, a unit tax decreases in real terms, and so emissions levels increase; whereas with a permit system, there is no change in aggregate emissions. In the presence of exogenous technological change in pollution abatement, a tax system leads to an increase in control levels, i.e. a decrease in aggregate emissions, while a permit system maintains emissions, with a fall in permit prices.
>
> Fifth, tradeable permits will work best when transaction costs are low. Experience shows that if properly designed, private markets will tend to render transaction costs minimal.
>
> Finally, considerations of political feasibility point to the wisdom of proposing market-based instruments when they can be used to facilitate aggregate emissions reductions, as opposed to cost-effective reallocations of the status quo burden.

The report concludes with a set of comprehensive tables organized by type of instrument, listing regulated substances by country with information on rates and uses of revenues.

Robert N. Stavins "Experience with Market-Based Environmental Policy Instruments", Discussion Paper 00-09, January 2000, Resources For the Future, 1616 P Street, NW, Washington, DC 20036 (202) 328-5000 http://www.rff.org

WETLANDS PROTECTION RULES

The Army Corps of Engineers has finalized sweeping regulations aimed at safeguarding thousands of acres of wetlands from commercial and residential development. Developers and construction groups have criticized the effort, charging that the regulations will cost them hundreds of millions of dollars. The "Foundation for Environmental and Economic Progress" said the Corps is guilty of "empire-building" and that it has grievously overstated the impact of national permits, which essentially rubber-stamp projects that affect 10 acres or less of wetlands. The Corps calculates that the new regulations will cost $20 million per year and add roughly $6 million to its annual budget.

Michael Grunwald "Wetlands Protection Rules Due" *The Washington Post* http://www.washingtonpost.com March 3, 2000 page A1 from Smart Growth News

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Please visit our new website located at http://www.damagevaluation.com. The site features comprehensive updated links to sites for environmental economics, other economic fields, data sources, environmental organizations, government agencies, conferences, research institutes, real estate information, sociopolitical trends, shopping bots, and more. We also offer interactive contingent valuation surveys, an Environmental Economics Glossary, and back issues of EDV&CBN. Here are some other treasures on the net. Let us know about your sites

READINGS IN ENVIRONMENTAL ECONOMICS

Readings in the Field of Natural Resource & Environmental Economics by Alexander S. P. Pfaff and Robert N. Stavins, available through http://www.rff.org is a comprehensive and well organized bibliography, an excellent unnatural resource.

WWW.ECOSYSTEMVALUATION.ORG

Dennis King, University of Maryland and Marisa Mazzotta, University of Rhode Island announced the opening of http://www.ecosystemvaluation.org, a website that explains to non-economists how economists attempt to assign values to ecosystem services. It contains descriptions and illustrations of specific valuation methods and explains how they can be used. One section deals with monetary (dollar-based) valuation methods and another with non-monetary (relative) valuation methods. There are also links to other useful websites and to data sources.

MULTIMEDIA PRESENTATIONS

According to a recent EPA study on the Benefits and Costs of the Clean Air Act reducing air pollution may be more than a health benefit. It also may be a sound economic investment.

(See Environmental News Network ENN Multimedia Earthwatch Radio (2:04) http://www.enn.com/enn-multimedia-archive/2000/01/01272000/eart_9453.asp "A Clean Investment")

Businesses that benefit the environment do better financially than those that don't, according to a recent report by the World Wide Fund for Nature. Large corporations are "going green", and this new evidence of their success could encourage others to follow suit.

(Environmental News Network Multimedia EcoWatch/London Radio Service http://www.enn.com/enn-multimedia-archive/2000/02/02012000/lrs_9597.asp "Green Pays" (5:12)

INTERNATIONAL TOXICITY ESTIMATES FOR RISK

The International Toxicity Estimates for Risk (ITER) database, at http://www.tera.org/iter now contains 545 chemicals, including data and links to all of the USEPA's Integrated Risk Information System (IRIS) risk values. It also includes all of the Health Canada risk values under the Canadian Environmental Protection Act (CEPA) that are currently available, and many of the Agency for Toxic Substances and Disease Registry's (ATSDR) chronic minimal risk levels (MRLs).

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SUBSCRIPTION INFORMATION

Recent court decisions, proposed legislation, and regulatory orders indicate that measures of costs, benefits, and risks will be required in the future to justify public and private actions. EDV&CBN is an indispensable source of information for estimating these parameters. You need Environmental Damage Valuation and Cost Benefit News because regulations are changed every day, courts continually set precedents, and new data or estimation techniques lead to revisions in accepted wisdom. EDV&CBN will bring you the latest information on valuation of damages from the courts, from government agencies, from the academic literature, and from unpublished studies. We will search daily newspapers, academic journals, legal publications, court decisions, professional newsletters, commissioned studies, and on-line services to provide you with the latest information in this rapidly changing field. We will cover valuation estimates from a wider range of journals than most busy professionals can track by themselves. We strive to serve as a bridge between academic researchers and soldiers on the front line of valuation battles, conveying vital information to each.

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