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Reconciling Anthropocentrism and Biocentrism Through Adaptive Management: The Case of the Waste Isolation Pilot Plant and Public Risk Perception

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Environmental policy issues often cannot be resolved owing to differences between anthropocentrists who adhere to neoclassical economic principles and biocentrists who argue in favor of a broad conception of sustainable development. This article examines the two perspectives in the context of radioactive waste management by presenting a case study involving public risk perception of the Waste Isolation Pilot Plant (WIPP). WIPP is a mining program undertaken by the U.S. Department of Energy's Office of Environmental Management to demonstrate the safe transportation and disposal of transuranic waste, a by-product of nuclear weapons production. The authors conclude that U.S. waste management programs such as WIPP can garner support only if a means for genuine, meaningful public participation is provided through adaptive management principles that "bridge the gap," to the extent possible, between anthropocentric and biocentric perspectives.

Many commentators have argued in recent years that contentious issues of environmental public policy can be resolved by providing "a powerful center around which environmental and human advocates can unite" (Peterson, 1997, p. 3). This optimistic assessment suggests that middle ground can be carved out to reconcile two competing schools of thought locked in a debate over the appropriate course of action for directing continued economic development while also pursuing effective environmental resource management. Often, this effort travels under the name of "sustainable development," a trendy and frequently misunderstood concept of intergenerational equity. Sustainable development is an idea that seeks to protect the natural environment for future generations while fostering economic growth in the present. One of the most famous definitions of sustainable development came from a 1987 report of the World Commission on the Environment and Development, the "Brundtland Report," named for the chairperson, the prime minister of Norway. According to the Brundtland Report, sustainable development is defined as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (*From One Earth to One World*, 1997, p. 8). Similarly, in

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"Agenda 21," a major document adopted by almost all countries of the world at the famous 1992 United Nations Conference on the Environment and Development (UNCED) held in Rio de Janeiro, Brazil, the goal of sustainability is "to ensure socially responsible economic development while protecting the resources base and the environment for future generations" (Beckerman, 1998, p. 463). On its face, the concept presents a logically compelling plea for common sense in environmental decision making.

The problem is that proponents of continued industrial development, on one hand, and members of the public who consider themselves environmentalists, on the other hand, approach sustainability from diametrically opposed perspectives. Members of the former group subscribe to a notion of rights and obligations that stresses anthropocentric individuality and favors utility calculations based on assumptions propagated by neoclassical economists. Neoclassical economists contend that virtually all individual and social choices can be quantified and translated into comparative units of measurement that are easily understood, valued, and traded according to relatively fixed economic principles. The task for neoclassical economists, therefore, is to identify relevant choices, quantify and translate them into appropriate units of measurement, account for periodic fluctuations in market forces, and evaluate the outcomes. Even market failures that result in unintended consequences, such as free riders and negative externalities, can be predicted, to some extent (Buchanan, 1991; Costanza, Cumberland, Daly, Goodland, & Norgaard, 1997, p. 39; Ferguson, 1969; Henry, 1990; Marshall, 1890; Pigou, 1952).

Environmentalists are troubled by neoclassical economists' presumption of relative certainty in evaluating individual and social choices. Instead, members of the environmental community argue in favor of what might best be called "ecological economics." This position suggests that environmental questions are not always amenable to traditional methods of neoclassical economic analysis requiring market valuation techniques and substitutions because some resources, once they have been diminished, are irreplaceable by virtue of their rare or unique features. Instead, ecological economists champion community-based values, examining questions involving the natural environment from a biocentric (or ecocentric) perspective that sometimes strikes policy makers, who often adhere to neoclassical economic principles, as impossibly naive, vague, and quixotic. (Although not every ecological economist is necessarily a biocentrist, the ecological economic position is closer to biocentrism than the position advocated by mainstream, neoclassical economists.)

The central question in this debate on environmental values is whether the perspectives of these two groups can be reconciled in an effort to develop consistent, coherent, effective public policy to regulate uses and protection of the natural environment. In short, can the

anthropocentric perspective of neoclassical economists exist side by side with the biocentric perspective of ecological economists and other members of the environmental community? This is a complex question, with no easy answers. To address the problem, however, this article examines one issue in the area of radioactive waste management. The development of the Waste Isolation Pilot Plant (WIPP) presents a powerful case study of the anthropocentric-biocentric debate because it is a pilot program designed to use environmentally acceptable management practices to dispose of a material that is anything but environmentally acceptable to large segments of the population. At its core, WIPP is a mining program undertaken by the U.S. Department of Energy's (DOE's) Office of Environmental Management to demonstrate the safe disposal of transuranic (TRU) waste, a medium-level radioactive by-product of nuclear weapons production, including contaminated tools, clothing, and debris. Originating in the late 1970s, WIPP is a long-term pilot program that accepted its first waste shipment in March 1999, after almost two decades of research and development as well as numerous technical, scientific, legal, and political delays. Understanding the two perspectives on WIPP may shed light on the general anthropocentric-biocentric debate and may be an incremental step in reconciling the two views through adaptive management practices.

The Scope of the WIPP Program

In 1979, DOE began developing WIPP 26 miles east of Carlsbad, New Mexico. Constructed over an 8-year period from 1980 through 1988, the facility is located in an arid, desert region in the southeastern part of the state. The department chose the site for a variety of reasons, primarily because it was located in a sparsely populated area and because a large salt mine lay 850 feet beneath the surface of the desert. Geologists have concluded that salt mines are superb geological structures for storing radioactive waste owing to the relative ease of mining salt as well as the stability of the material. Moreover, the presence of salt generally indicates that water is absent—a key feature in ensuring the integrity of waste drums buried there. As early as the 1950s, the National Academy of Sciences recommended that radioactive waste be disposed of in salt domes to take advantage of these features (DOE, 1999, p. 3). DOE plans to entomb TRU waste in drifts within a 3,000-foot salt mine and then permit the salt to collapse and “self-seal” around the waste, permanently encapsulating the material (DOE, 1994, p. 1).

As of 1993, approximately 60,000 cubic meters of TRU waste were stored at 10 DOE facilities throughout the United States. Much of the waste was stored in 55-gallon steel drums and buried in earthen berms.

Most drums were buried in this fashion at least since the 1980s, when analysis indicated that perhaps 20% to 30% of the drums were leaking. DOE officials expect the WIPP "test phase" to last 20 years, after which time the facility will be closed and decommissioned. If the test phase goes well, TRU waste may be buried in similar facilities constructed in the future (League of Women Voters, 1993, pp. 116-117).

DOE pioneered many state-of-the-art technologies in its quest to ensure the safe transportation and disposal of TRU waste at WIPP. One area that the department focused on early in the development phase was the design of a durable, reliable shipping cask. After years of testing that began in 1980, DOE created the Transuranic Transport Model-II, or TRUPACT-II. TRUPACT-II casks are 8 feet in diameter and 10 feet high. To ensure strength and integrity, they are doubly contained, nonvented, and constructed of stainless steel. A 10-inch layer of thick, rigid polyurethane foam is sandwiched between the outer vessel and the cask's stainless-steel outer skin. The casks are designed to hold 14 drums of TRU waste, each weighing approximately 500 pounds ("Foam Protects Waste Containers From Shock," 1991, p. 1).

To gain certification from the U.S. Nuclear Regulatory Commission, DOE performed a series of tests on TRUPACT-II containers to ensure their engineering integrity. In one test, the department dropped a TRUPACT-II from a height of 30 feet onto an unyielding surface, striking the container's weakest point. Similarly, the department performed a puncture test by dropping the container 40 inches onto a steel bar at least 8 inches long and 6 inches in diameter, again striking the container at its weakest point. DOE also performed a thermal test by exposing the casks to a jet fuel fire that reached a temperature of 1,475 degrees Fahrenheit for a minimum of 30 minutes. Finally, DOE subjected a new, undamaged cask to an amount of pressure equivalent to being immersed under 50 feet of water. According to DOE officials, in each case the TRUPACT-II casks maintained their structural integrity (National Safety Council, Environmental Health Center, 1998, p. 2).

The department also experimented with a satellite tracking system for trailers hauling TRUPACT-II casks to WIPP. The vehicles used to transport TRUPACT-II casks are conventional diesel tractor-trailers that can transport up to three containers at a time. Inside the truck cab, a computer keyboard links the vehicle to a satellite tracking system, TRANSCOM, that enables DOE to know the exact location of the vehicle as it travels around the country. TRANSCOM relays a signal from the truck to the DOE control center in Oak Ridge, Tennessee, where the shipments are tracked on a series of computer-generated maps. If the truck leaves the designated route or stops moving without providing an explanation, the control center operator follows up in an effort to identify and correct the problem. Authorized state, tribal, and federal

officials have the capability to monitor TRANSCOM operations at all times (National Safety Council, Environmental Health Center, 1998, p. 1). DOE also provides safe parking areas for trucks in the event that adverse weather delays shipments along all routes. Moreover, the department has the ability to repair or replace tractors en route within 8 hours or less of a breakdown. These safety precautions are designed to minimize the possibility of sabotage or radiation releases during shipment.

Because of concerns among residents along the transportation corridor, DOE has established many emergency preparedness and response procedures. Certified state inspectors thoroughly check transport vehicles, their cargoes, and drivers before each trip. Drivers are required to stop the truck at least once every 2 hours or 100 miles, whichever occurs first, and check the condition of the vehicle as well as the condition of the TRUPACT-II casks (National Safety Council, Environmental Health Center, 1998, p. 1).

Despite these efforts, accidents can occur; accordingly, the department has devised a series of training programs to prepare for contingencies. The States Tribal Education Program (STEP) trained more than 11,000 emergency response personnel between 1988 and 1996, even though the shipping campaign had not yet commenced. DOE offers six STEP courses. First Responder Training is an 8-hour session designed to prepare initial emergency response personnel, including fire and police departments and medical personnel. The second course, First Responder Refresher Course, is a 4-hour recap and update for personnel who feel the need to remain current on emergency response procedures. Other courses include Command and Control, a 2-day course designed for persons who will be in charge of the scene at a WIPP transportation accident site. The department's 12-hour Train-the-Trainer course is for state-certified inspectors to learn how to incorporate WIPP-specific information from the First Responder course into their existing hazardous materials training courses. The Mitigation Course is designed to train state health, safety, environmental, and radiological professionals on how to monitor radiological conditions after an accident and assist DOE in cleaning up a contaminated accident site. Finally, an 8-hour Medical Management course teaches hospital emergency room doctors and nurses who may treat a patient contaminated with radioactive material about appropriate medical procedures (DOE, n.d., p. 102).

Even after adopting these, and other, safeguards, DOE has experienced difficulties in opening WIPP. From the inception of the program, the siting, development, and operation of the facility has been mired in litigation, political controversy, cost overruns, and start-up delays (Rosenbaum, 1998, pp. 275-276). The Energy Research and Development Administration, DOE's predecessor agency, originally selected the site as a successor to the now-defunct Lyons, Kansas, TRU waste

disposal site. Since that time, WIPP has endured many metamorphoses, including changes in purpose and attempts to cancel it altogether. In 1981, DOE issued a Record of Decision (ROD) for the first phase of WIPP development and construction. In 1990, after the facility had been constructed, the department issued a second ROD, this time calling for the continuation of WIPP development. After preparing environmental impact statements pursuant to the National Environmental Policy Act, DOE was ready to begin accepting TRU waste shipments at WIPP (DOE, 1997, p. 118). Yet, the program was stalled. Although the department set numerous deadlines for accepting waste, WIPP did not receive the first shipment until March 26, 1999—11 years after construction was completed (New Mexico WIPP Transportation Safety Program, 1999, p. 1).

Public Risk Perception and the WIPP Facility

Despite DOE's safety precautions and testing, WIPP has been controversial because the public generally does not see the benefits of the facility. Moreover, the public mistrusts DOE and often raises the question of whether nuclear weapons should be generated in the first place. Many citizens see bureaucrats and scientists as elite forces that exclude citizens from making decisions that affect their day-to-day lives in a pluralistic, democratic political system. The department's confrontational, "command-and-control" approach in the past has created an atmosphere of thinly veiled hostility on the part of many citizens and environmental groups.

A New Mexico Supreme Court case focused attention on whether public fears about WIPP shipments were reasonable in light of DOE's safety precautions and emergency response procedures. On November 14, 1988, the city of Santa Fe condemned part of a ranch owned by John and Leмония Komis to construct a highway leading from the Los Alamos National Laboratory (LANL), located north of the New Mexico capitol, Santa Fe, to WIPP. The city condemned 43.431 acres of the property to construct a bypass around the city. Without the bypass, federal officials would be forced to route TRU waste through the city limits. The Komis family sued to prevent partial condemnation because it diminished the value of their remaining property. Following a jury trial, the couple was awarded \$884,192.00 in damages. The total amount included \$489,582.50 for the value of the acreage, \$60,794.50 for severance damages to the "buffer zone" along the taken land, and an additional \$337,815.00 for severance damages due to the perception of the increased risks associated with planned TRU waste shipments.

At trial, the Komises' land valuation expert testified that the loss of value to the remaining portion of the ranch owing to public risk

perception was \$1 million, or \$662,185 more than the amount later awarded by the jury. The city was not permitted to introduce evidence concerning the safety of the WIPP transportation system. Both parties appealed the decision, and the Court of Appeals certified the case to the New Mexico Supreme Court on January 10, 1992. (Under N.M.S.A. §35-5-14(c) (2), the Court of Appeals may send a case directly to the New Mexico Supreme Court if the issue involves a significant question of law or pertains to a substantial public interest.)

Judge Franchini, writing for a majority of the high court, stated that,

the underlying issue that forms the basis of the trial court's rulings is whether in a partial condemnation action a property owner is entitled to receive compensation for the diminution of value to the remainder of the property caused by public perception. (*City of Santa Fe v. Komis*, 1992, p. 659)

Relying on a series of cases involving placement of electric power lines, the court held that in a partial condemnation case, the diminution in market value of a property owner's remaining land owing to public fear of waste transportation is compensable, regardless of whether the fear is reasonable. Had the city been allowed to introduce evidence of the safety features of the WIPP transportation system, the outcome might have been different. It is worth noting that the court allowed the Komises to introduce into evidence a videotape titled, *The WIPP Trail: A Nation's Crisis Dumped on New Mexico*, despite the city's objections that the prejudicial value of the tape, which was narrated by entertainer-environmentalist Robert Redford, outweighed its probative value (Whitmore, 1994, p. 542).

Two Perspectives on Public Risk Perception of WIPP Shipments

As one might expect, the anthropocentric school of environmental management that subscribes to neoclassical economic principles views the *Komis* case and public risk perception in a different light than does the biocentric school. According to the former group, the analysis of public risk perception involves a straightforward interpretation of the law using the tools of legal reasoning (*stare decisis* principles and the like) as well as traditional cost-benefit analysis and other neoclassical economic tools. Biocentrists, however, refer to a different series of propositions contained in the literature on environmental ethics, thereby eschewing neoclassical legal and economic analyses. The two schools do not even speak the same language.

ANTHROPOCENTRISM

The legal argument. The anthropocentric perspective on WIPP and public risk perception casts the debate in terms of neoclassical legal and economic arguments. Thus, according to anthropocentrists, in reaching its decision in *Komis*, the New Mexico Supreme Court properly examined a series of court cases involving electromagnetic fields (EMF) generated by power lines. Although the city of Santa Fe did not challenge the use of these cases, the question of whether EMF injuries constitute compensable damages has been debated by many courts throughout the country since the issue of public perception of power line risks first arose in a 1914 case, *Alabama Power Company v. Keystone Lime* (1914). In *Keystone Lime*, the Alabama Supreme Court developed what subsequently became known as the *minority view* in these cases. It held that irrational fears of the effects of power lines could not serve as the basis for awarding diminution of value in partial condemnation cases. In its decision, the court stated that the law

cannot allow any compensation on account of any claimed depreciation of such remaining land which is due to the *mere fears of some of the people*, which are founded in reality upon their lack of knowledge of the real effect of the [power] line, and which human experience shows are not justified by the facts. We have discussed this subject at length, because the subject is now and will continue to be of great importance to the people of the state. (*Alabama Power Company v. Keystone Lime*, 1914, p. 836, emphasis added)

The court also emphasized the benefits conferred on society by the placement of power lines and drew parallels between power lines and new or unfamiliar technological innovations such as the automobile. The justices noted that “many things now daily upon our streets were, when they were first introduced, objects of terror to those who knew nothing about them” (*Alabama Power Company v. Keystone Lime*, 1914, p. 837). Similarly, electricity, “properly controlled, is not only of great practical value, but its use, under proper control, is attendant with as few dangers to life as any other agency which human ingenuity has been able to place at our disposal” (*Alabama Power Company v. Keystone Lime*, 1914, p. 835). Later Alabama cases supported this view, and some courts have observed that the holding may be even more applicable today as the rate of technological innovation increases. The *Keystone Lime* holding is deemed the *minority view* for good reason; currently, only Alabama, Illinois, and West Virginia follow this approach (Schutt, 1996, p. 131).

A second approach taken by courts in power line cases is called the *intermediate view*, and essentially inserts a reasonableness standard into the valuation. In one commentator’s words, if “the public’s fear is

reasonable, or at least not completely unreasonable, a damages award is permissible when the fear depresses market value" (Schutt, 1996, p. 133). Ironically, the question of whose fear is irrelevant in these cases. Many jurisdictions require expert testimony to offer evidence that general fears exist among the population; the landowner's personal or idiosyncratic fears are not admissible (Schutt, 1996, p. 133).

A Nebraska case, *Wahlgren v. Loup River Public Power District* (1941), best illustrates the intermediate approach. In that case, the Nebraska Supreme Court held that "general fear, or fear which is not connected with an incident or knowledge of present or potential danger, cannot be made the basis upon which to predicate depreciation in the market value of land." Compensable fears, on the other hand, include those that are "grounded in authentic observation and experience, or in scientific investigation" (*Wahlgren v. Loup River Public Power District*, 1941, p. 835). The Ninth Circuit Court of Appeals also followed this view. In *United States v. 760.807 Acres of Land* (1984), the court held that precedent "precludes severance damages based wholly on speculation and conjecture," and thus the holding in the case "is consistent with the holding of most state courts that fears must be 'reasonable' or 'founded on practical experience' in order to be compensable" (*United States v. 760.807 Acres of Land*, 1984, p. 1447). The court's headcount notwithstanding, only 12 states follow the intermediate approach, and 3 others follow some variant thereof (Schutt, 1996, p. 135).

The majority of state courts and several federal circuits have held that the reasonableness of the fear is irrelevant in determining damages in partial condemnations for power line placements (Schutt, 1996, p. 136). If the landowner can prove the existence of public fear through expert testimony, he or she generally wins on this issue. Some courts have held that public fears should be assumed to be reasonable by virtue of their existence (see, for example, *Florida Power & Light Company v. Jennings*, 1963). In 1993, the New York Court of Appeals succinctly summarized the reasoning behind the majority view when it noted that,

the issue in a just compensation proceeding is whether or not the market value has been adversely affected. This consequence may be present even if the public's fear is unreasonable. Whether the danger is a scientifically genuine or verifiable fact should be irrelevant to the central issue of its market value impact. (Schutt, 1996, p. 138, quoting *Criscuola v. Power Authority of New York*, 1993).

On its face, the majority view appears to satisfy constitutional requirements for just compensation in partial condemnation cases. Although the public's fear may not be based on objective factual criteria, the diminution in value of the land certainly is real. One analyst of general "stigma damages" has observed that

courts refusing to consider public fears, reasonable or not, cannot fully compensate for the loss experienced by the property owner in cases where a hazardous waste site depresses local property values. Fears of hazardous waste held by the public are real. (Gibson, 1995, p. 433)

The economic argument. The anthropocentric argument extends the analysis beyond a discussion of legal cases to consider the economic consequences of public risk perception in radioactive waste transportation scenarios. For example, in his economic analysis of power line cases, commentator David Zachary Kaufman (1990) has argued that the minority view, which does not permit recovery for loss in value owing to public fears, is economically inferior because the loss in land value is transferred at no cost to the utility. Inaccurate "price signals" permit utilities to condemn land at levels that do not match a societally optimal level (p. 730). The intermediate view fails for the same reason. In Kaufman's words,

if the amount of risk is held constant, and the risk neutral assumption is changed to an assumption that people are risk-averse, the amount of market value lost due to fear is increased. In other words, if the prospective buyer's fears increase, regardless of the reasonableness of the change in the level of fear, market value will decrease. (p. 735)

The majority view, Kaufman contended, is the best approach because the existence of any fear that decreases the market value of the remaining land, once proven, will be compensated.

The problem with this approach is that allowing evidence of public fear to be admitted in court, regardless of reasonableness, creates strict liability (Schutt, 1996, p. 142). Thus, although cases involving WIPP shipments share some common characteristics with power line placement cases (such as an affected population with close proximity, yet wide distribution, and a close public association with technology, resulting in increased danger from "invisible forces"), anthropocentrists might argue that the analogy is flawed. Radioactive waste transportation cases have more in common with cases involving other societally necessary, yet unpopular, activities.

Some analysts of power line cases champion the majority rule because they mistakenly conclude that utilities should compensate landowners for power line condemnations; afterward, the utilities can recoup expenses (with low transaction costs) by increasing the rate base as part of their "cost of service" (Thiemann, 1996, p. 1398). According to this line of reasoning, utilities can effect an equitable transfer of costs from those burdened (landowners with ongoing stigma damages) to those who benefit (ratepayers). With a slight addition to the ratepayers' electric bills, an appropriate transfer of costs is accomplished, and sound public

policy is served. Although this sounds logical and economically efficient, recent history in utility rate regulation indicates significant problems in effecting such transfers.

Because electric utilities often exercise monopoly power and are heavily regulated in most states, costs that these companies wish to pass on to ratepayers must first be approved by, at a minimum, the state public service commission. Moreover, depending on the political and economic climate, automatic approval is by no means assured. During the 1980s, public service commissions around the country disallowed billions of dollars that utility companies invested in constructing new (and ultimately unnecessary) plants and equipment, particularly when nuclear facilities were involved. These disallowances raised the cost of capital for some companies and pushed others to seek bankruptcy protection. Two analysts call this situation "the inevitable consequence of routine applications of traditional utility law doctrines to unusual patterns of fact" (Pierce & Gellhorn, 1994, p. 21). In deciding that risk perception issues involving radioactive waste transportation are analogous to power line placement, the *Komis* court seems to have engaged in exactly this type of fallacious reasoning. The New Mexico Supreme Court's difficulties in resolving *Komis* are not surprising given the problems that courts often experience in understanding and managing public risk. As law professor Peter Huber (1985) has noted, "the judicial system is, for a variety of reasons, incapable of engaging in the aggregate calculus of risk created and risk averted that progressive public risk management requires." In other words, public risk management sometimes requires decision makers to shift costs and benefits in the interests of a larger whole, whereas the judicial system is designed first and foremost to protect the interests of individual litigants. This often leads to tension in risk management cases (p. 278).

Moreover, transporting radioactive waste in compliance with regulations promulgated by the U.S. Department of Transportation and the U.S. Nuclear Regulatory Commission is an expensive enterprise. A single cross-country, highway shipment of route-controlled quantity material such as spent nuclear fuel can cost upward of \$10,000. Shipments of cesium-137 capsules formerly used in irradiation facilities were sent from a facility in Virginia to DOE's Hanford Reservation in Washington State during the 1990s. Costs generally exceeded \$10,000 per round-trip shipment (Claussen, 1997).

Costs also can skyrocket quickly, especially in the wake of public dissent. One commentator, Michael Gerrard, has observed that the costs to all parties are substantial owing to the many actors involved. In addition, opportunity costs associated with implementing a large-scale, controversial effort often prove to be burdensome for the parties. "Siting controversies can be very costly and time-consuming for all concerned," he wrote in a 1994 article.

They require large amounts of energy and attention of talented professionals (such as engineers, designers, managers, and attorneys) on all sides of the battle—developers, opponents, and regulators. Time spent waging such battles cannot be spent on other, possibly more productive endeavors (Gerrard, 1994a, p. 521; see also Gerrard, 1994b, pp. 31-32)

If Gerrard's observation is accurate for siting controversies, it is even more so for transportation-routing controversies because transporters cannot point to increased local revenues or employment as a means of mitigating the perceived risk for local communities. In the view of many parties living along a transportation corridor, they have little to gain and much at stake. Accordingly, their opposition can be especially vehement. For these reasons, anthropocentric economists often contend that radioactive waste transportation is an example of "market failure," a situation in which the need will not be met through market activity and private contract; consequently, important societal goals will not be achieved.

A classic example of market failure is national defense. If each person in the nation paid what he or she believed was an appropriate amount to guard against foreign aggression, many rational actors would choose a "free ride." They would anticipate that other people place a higher value on security and would pick up the shortfall. Defense requirements are large in scale and usually confer remote benefits that are difficult to quantify without relying on nonmarket valuation techniques.

The same market failure analysis can be applied to radioactive waste transportation, according to the anthropocentric perspective on neoclassical economics. When asked if they would be willing to allow trucks carrying nuclear materials to rumble past their homes, schools, and businesses, most people probably would say no; they would place an inordinately high price on their acquiescence. The perceived risks are high, and the benefits are low. If power line cases are used as the appropriate precedent for cases involving public perception of risks associated with radioactive waste transportation, opponents have a good point. Damages would depend on the fears, reasonable or unreasonable, of the public about the possibilities, however remote, that an accident would release radiation into the natural environment.

Alternatively, the analogy of national defense as a market failure situation in which government must step in and control societally necessary, but unpopular, activities probably would limit the importance of unreasonable public fears in evaluating risk perception cases. Government undertakes many activities in the interest of national security that require the public to forgo individual claims based on health and safety concerns. In a market failure situation, therefore, government acts as a supplier of societally necessary goods and services. Because government is not acting in accordance with market principles, applying market valuations to its activities may be inappropriate.

The market failure argument has additional components that should be examined. Some analysts of stigma damages argue that such an award allows for a "double recovery." If a property owner is awarded damages owing to the stigma attached to "contaminated" property and the contamination is subsequently improved, the owner receives a windfall because the property value probably will return to its precontamination level (Beers, 1996, p. 867).

According to neoclassical economists, capitalization (cash flow, or income stream analysis) is one valuation approach that may avoid the problem of market failure. Damages, including those attributable to stigma, are calculated, according to one commentator, by examining what the

likely income stream [the investment] will produce and the eventual appreciation that may occur with the decline of the stigma. By assuming the kind of return that an investor would expect, a value can then be calculated from the price that the investor would be willing to pay for the property. (Beers, 1996, p. 859)

This type of treatment would be particularly appropriate in the case of nuclear waste transportation, in which the specter of risk is intermittent and is limited to the duration of the transportation program. The WIPP facility, for example, has a projected program life of 20 years. Presumably, after that time, TRU waste will no longer be shipped past the Komis property. If the Komises are spared environmental catastrophe in the interim, and assuming that the highway reverts to "normal" traffic, the value of the land theoretically will rise to the level it would have had but for the WIPP transportation stigma. If that is the case, then a "fair" estimate of damages would be something akin to a 30-year Treasury bond rate on the differential, discounted to present value.

The anthropocentric argument frames the issue as a straight valuation issue using neoclassical economics. Thus, for analytic purposes, the diminution of value of the Komises' property owing to physical damage as a result of negative public risk perception can be estimated at \$1 million, the value they asserted at trial. Using this framework, for each year LANL shipped waste to WIPP, the Komises would be entitled to approximately \$60,000, assuming a 6% rate of return. Payments over 20 years, discounted to present value, would amount to a lump-sum payment of \$668,185. The "principal" would then be returned to the owners absent the "contamination," or the stigma thereof.

Accordingly, if the goal were to compensate the Komises for the value they lost in lieu of providing them with a remedial windfall, a preferable approach would be to create an annuity with benefits that would transfer with ownership of the property. The annuity would last for 20 years and would compensate landowners only for that period during which

the loss occurred. At the end of the stigma, annuity payments would end, thus assuring greater equity in compensating parties for the harm they actually suffered.

For anthropocentrists, therefore, the concept of “just” compensation is elastic. Courts do not compensate owners for the value of land that has idiosyncratic or sentimental value simply because, for example, it was a legacy from an earlier generation. Subjective value is too difficult to quantify; hence, courts require “objective” indicators to determine fair market value, to the extent possible. In theory, specific performance might provide a “fair” means of compensation, although this merely shifts the burden without solving the problem. If the Komises’s property values were not diminished, someone else’s property would be affected, assuming that waste shipments eventually commenced along the route from LANL to WIPP (Muris, 1982, p. 1053).

Instead of examining power line cases, anthropocentrists suggest that a preferable analogy for the post-*Komis* courts to use might be one provided by cases in which communities have opposed siting and operating medical facilities owing to fear that pestilence would ensue. In the 16th century, the public argued against siting smallpox hospitals in their communities; today, they argue against AIDS hospices (Bernstein, 1990, p. 1). Even during the height of the tuberculosis epidemic of the early 20th century, courts refused to award damages to neighbors of clinics based on “mere disturbance of market value” (Bernstein, 1990, p. 5, quoting *City of Northfield v. Board of Chosen Freeholders*, 1915). Dismayed property owners next sought legislative solutions through zoning ordinances and other statutory mechanisms, which generally were struck down on constitutional grounds. Although public debate on this point subsided over time, the AIDS epidemic engendered renewed opposition to caregiving facilities in the 1980s (Bernstein, 1990, p. 6). Hysteria about AIDS triggered cases in which patently irrational fears were deemed sufficient cause to discriminate. The trial judge in one case involving the refusal to give an AIDS victim a manicure held that “risk of death, however minimal, cannot be accepted or tolerated” (Bernstein, 1990, p. 10, quoting *Jasperson v. Jessica’s Nail Clinic*, 1989).

In his article “The Victims of NIMBY,” Michael Gerrard (1994a) discussed the significance of organized community opposition to waste facilities as well as social service institutions. “Communities that successfully block the siting of facilities they do not want are, of course, the most visible beneficiaries of local opposition,” he observed.

In the case of waste disposal facilities, these communities have avoided the health and environmental risks, and the threatened loss in property values, tourism, and community image that can accompany a disposal facility. These benefits are more affected by distance from the facility than by municipal borders. The communities that exclude low-income housing

and social service facilities may preserve their property values, although the evidence seems to show that social service facilities such as group homes have little or no detrimental impact on neighboring property values. These communities also receive psychic gratification, though sometimes based on racial animus or other impulses that society as a whole regards as repugnant. (p. 517)

A closer examination of the majority rule suggests that some courts may not consider economic efficiency or even equity but the “worthiness” of the cause and the relative ability of the parties to pay. Attorneys defending against stigma damages might do well to emphasize the societal importance of the program activity supported by the transportation. Public opinion surveys show a strong correlation between public support for a shipping campaign and knowledge about why the material must be shipped (Jenkins-Smith, Silva, Fromer, & Conwell, 1995, p. 5). According to anthropocentrists, to the extent that the courts’ balancing of societal needs mirrors public risk perceptions, evidence about societal benefits could tip the balance.

To be sure, a truck carrying radioactive waste does not stir compassion in the hearts of most citizens, as might the plight of homeless or sick persons. Nonetheless, according to the anthropocentric perspective, waste transportation as a source of public fear has more in common with social service operations than it does with waste disposal sites. The actual risks to public health and the natural environment from transportation activities are minuscule—degrees of magnitude smaller than threats posed by hazardous waste dumps or incinerators. No stigma attaches to neighboring properties after the transportation has concluded; thus, it should trigger no fear of lasting environmental damage. Although no comprehensive surveys on this subject have been undertaken, anecdotal evidence suggests that radioactive waste transportation, like the placement of social service facilities, may have no actual effect on nearby real estate prices.

According to anthropocentrists, the waste transportation/societal necessity analogy also may hold true in siting cases in which the purpose of the facility is unrelated to nursing the afflicted, such as group homes for ex-convicts or drug addicts and homeless shelters. In these cases, a measurable impact may exist (especially in light of high recidivism rates for parolees), but courts generally have been unsympathetic to community opposition (Gerrard, 1994a, p. 500). Moreover, opponents of group-home siting may encounter an obstacle that power line and waste transportation foes do not—the Fair Housing Act, which has been used by the government to sue affluent neighbors who oppose such facilities (Gerrard, 1994a, p. 501). This solution has eased courts’ struggles with balancing individual and societal needs, and it points to one solution to

problems arising in a post-*Komis* world: legislative guidance through appropriate statutory relief.

Yet, problems with market failure situations extend far beyond the difficulties in quantifying stigma damages, externalities, and the like. For a century, neoclassical economists have attempted to account for market failures by quantifying the costs and incorporating their data into economic calculations through various nonmarket valuation plans. In many cases, these plans have been cited as justification for government intervention into market economics (Pigou, 1952). From the perspective of biocentrists, however, nonmarket valuation efforts are suspect for other, more fundamental reasons. Neoclassicists assume that after a dollar value is placed on nonmarket attributes, the market-pricing system can still be used to ensure maximum efficiency in resource allocation. In cases in which resources must be expended against the resource-holder's desires, compensation can be paid to maximize utility. Biocentrists reject these notions owing to a disagreement with the assumptions of neoclassical economists that all resources can and should be valued using ideas of compensation and substitutability, as we shall see (Gowdy & O'Hara, 1997; Stern, 1997).

BIOCENTRISM

In analogizing radioactive waste transportation cases to questions of national defense and opposition to siting social service institutions instead of relying on power line cases, anthropocentrists argue that nuclear waste transportation is an example of a societally necessary market failure. This argument seems valid to many lawyers, economists, and social scientists, but it strikes biocentrists as especially myopic. Members of the public looking beyond the *Komis* case raise an underlying philosophical question (whether or not they realize its philosophical implications) about the effect of "societally necessary" activities such as radioactive waste transportation on current and future generations of Americans. Given the current generation's reliance on nuclear power and other sources that generate radioactive waste, at its heart this is a conservation issue. Instead of engaging in activities that might pollute the natural environment today or in the near future, the argument suggests, the current generation should consider alternatives that create less risk.

From an economist's perspective of "weak" sustainability—that is, using the tenets of mainstream, neoclassical economics, such as supply and demand—one method for reconciling environmentalists and developers might be to consider sustainable development as "an obligation to conduct ourselves so that we leave to the future the option or the capacity to be as well off as we are" (Solow, 1998, p. 451). This perspective

initially sounds persuasive because it suggests that no further precision is possible in addressing public policy questions stretching thousands of years into the future. It also appeals to our understanding of neoclassical economics in which public policy issues are translated into units that can be measured by comparing costs and benefits to arrive at a calculation of utility based on the "invisible hand" of the marketplace (momentarily setting aside problems associated with a market failure). In short, this is a debate concerning trade-offs between the needs of a current generation and the needs of future generations in a world in which scarce, finite resources are the order of the day.

This view of sustainability so persuasively argued by neoclassical economists, including Nobel Laureate Robert Solow (1998), suffers from a problem that Bryan Norton (1998), a philosopher of science at the Georgia Institute of Technology, calls a "Grand Simplification." According to Norton and other biocentrists, ethical questions of intergenerational equity cannot be reduced solely to economic questions because such a reduction glosses over important distinctions, implying that "all we need do is to avoid impoverishing the future by over-spending and under-saving, which can be achieved simply by maintaining a fair savings rate," in the neoclassical economist's parlance (Norton, 1998, p. 11). By implying that sustainability is amenable to economic calculations alone, neoclassical economists assume that environmental resources are fungible; that is, they can be used interchangeably without regard to their potentially unique characteristics. They assume that the utility of natural resources can be calculated without regard to the nature and quality of those resources, but such an assumption does not recognize the possibility that some resources can and should be esteemed above others, nor does it adequately consider market failure circumstances. As John Rawls (1971) observes in *A Theory of Justice*, the problem with utility calculations is that "the weights in the additive function that represents the utility principle are identical for all individuals, and it is natural to take them as one" (p. 182).

Neoclassical economists suffer from the same problems that plague all utilitarians, according to Norton (1998). By calculating costs and benefits without weighing preferences or attempting to differentiate between the characteristics of resources (other than relying on measures of "efficiency" and "inefficiency" in comparing fungible goods), they beg the question of evaluating what is being preserved for future generations. Moreover, neoclassical economists assume that the availability of society's opportunities will remain constant over time, but this, too, is part of their Grand Simplification (pp. 10-11). If a greater volume of waste results in an area of the environment that is potentially uninhabitable for thousands of years and may damage innumerable organisms, utility calculations based on a notion of fungibility are of little use. The public will not accept arguments about societal necessity that use

economic terms exclusively. In the eyes of many citizens, economists, like political actors and scientists, are elite decision makers who seek to exclude public input from “expert” calculations of social utility.

Neoclassical economists’ arguments concerning trade-offs also raise three related problems that should not be ignored in making a case of societal necessity. First, if the current generation has a duty to preserve the natural environment for future generations, the nature and scope of that duty is unclear. It is one thing to say that the current generation owes a duty to its children or even its grandchildren. Because many people live to see and enjoy the lives of their children and grandchildren, they may be persuaded to forgo benefits today for the promise of conserving resources for their immediate progeny. The “distance” problem of how far into the future the duty extends is compounded when we consider the lives of 3, 4, 5, 10, or 20 generations hence. A person who might willingly sacrifice resources to benefit his or her direct heirs may be disinclined to endure shortages in hopes that his or her descendants in 100 years—or 1,000 years—will enjoy their lives.

This also raises the problem of ignorance, which increases as we extend the time of our future obligations. Who knows what people of the future will need? Perhaps their value systems will be different than our own. A generation living 1,000 years from now might develop a new technology that renders radioactive waste harmless or even beneficial to the natural environment. That same generation might develop nuclear fusion, which creates no dangerous by-products. In addition, the current generation cannot even put a face on these as-yet-unborn individuals because, to some extent, decisions made today will determine whether those individuals are born in the first place. The metaphysical questions become almost impossible to contemplate when we reflect on duties we owe to people who have not been born and may never exist.

Finally, there remains the “typology of effects problem,” in Norton’s words (1998, p. 6). One type of environmental effect may be minimized over time as a period of recovery ensues. Thus, it would be difficult to say that someone harmed future generations even if a specific act such as destroying a tree or destroying numerous trees in an old growth forest occurred, especially if a new sapling were planted as mature trees were cut. By the time future generations are alive, the sapling may have replaced the mature tree that was cut. On the other hand, when the damage that occurs is so pervasive and systemic, the damage may be impossible to identify much less mitigate. This happens when entire rainforests are destroyed, resulting in rapid extinction of species, changes in the climate, and other large-scale environmental deviations that we may not fully understand. To suggest that engaging in both acts threatens future generations in the same or a similar way confuses the type of damage that has occurred. Similarly, spilling a canister that allows a minuscule amount of radioactive material to escape is a different type of act than

the act of burying hundreds of drums in salt domes in the desert, some of which may rupture and irradiate the earth around the disposal site. In the former case, a period of recovery can mitigate the damage to future generations. In the latter case, the damage may be so pervasive that it will take thousands of years to overcome environmental contamination.

This criticism of neoclassical economics leads us to ask whether other perspectives on the current generation's obligations to the future might offer acceptable alternatives. Proponents of ecological economics coupled with intrinsic value theory, for example, introduce a larger conceptual framework for discussing intergenerational equity than is possible using neoclassical economic theory alone. Despite the utility in using one or both of these perspectives to enrich this discussion, their value to public policy is limited for a number of reasons. Even members of the public who consider themselves environmentalists might reject a radical biocentric ethic that posits environmental rights for nonhuman organisms. Therefore, in this context, we will not consider the theory of intrinsic worth—the nonanthropocentric idea that the ecosystem is valuable in and of itself and thus should be protected just as we would afford protection to human beings. Although this theory holds some merit, it simply is too radical for most policy makers to consider. It is difficult enough to convince individuals to curb their appetites today in the expectation of preserving resources for future generations without also arguing that the ecosystem has intrinsic value separate from its utility for mankind (Devall & Sessions, 1998, pp. 221-226).

A more moderate approach to questions of sustainability—the idea of “strong” sustainability—can be found in the work of ecological economists such as Herman E. Daly, the father of “steady-state” economics. According to Daly (1989), neoclassical economists fail to understand environmental issues that concern the public because they confuse human-centered capital with natural capital. Policy makers who do not distinguish between the two types fail to account for the depreciation of natural capital, which means that future generations will not have “the option or the capacity to be as well off as we are,” in Solow's (1998) words. As natural capital is depleted, future generations are harmed. It is tantamount to touching the principal instead of the interest. When the principal is diminished, future interest income diminishes as well. In short, some resources are irreplaceable, and their disappearance is irreversible, despite the assumptions of neoclassical economists. Thus, Daly (1989) argues that “green” accounting systems should be used to figure in the depreciation of natural capital, which then allows us to see the true value of what we leave to future generations. In Daly's opinion, qualitative improvement (development) is distinct from quantitative increases (growth). “Growth of the economic organism means larger jaws and a bigger digestive tract,” he has observed. “Development means more

complete digestion and wise purposes. Limits to growth do not imply limits to development" (p. 11).

The crux of the issue, according to economist David Stern (1997), is that neoclassical economics assumes that all resources are amenable to substitution, either in the form of trading one resource for another or through compensation. Yet, natural resources are different, he argues. The problem is that only under "certain technical conditions . . . is maintenance of an aggregate capital stock sufficient to maintain welfare in the face of declining natural resource stock." In other words, when natural resources are depleted, substitution is almost always impossible. The rippling, downstream effects on the ecosystem are "unknown and unknowable" (p. 166).

In the context of nuclear waste management, Daly and Stern no doubt would counsel policy makers to consider the depreciation in the natural environment resulting from continued generation of radioactive waste. In calculating our future obligations, policy makers must recognize the diminution in value of a world in which dependence on nuclear power potentially fouls the environment and nuclear waste management remains a problem that requires significant amounts of labor and financial resources to manage. Thus, public fears about possible contamination have to be considered before waste transportation can be accomplished. As we discussed earlier in this article, investing in a Treasury bond or an annuity is one method of ensuring that funds are available to compensate citizens who suffer tangible economic damage owing to fears about waste transportation. But this alone is insufficient.

Notice that Daly (1989) assumes that the basic assumptions of neoclassical economics are viable concepts. He does not dispute the legitimacy of using these assumptions; he merely wants to refine their calculations so that the economic value of depreciating natural capital can be determined with greater specificity. Norton (1998, p. 6) observes that ecological economists such as Daly (1989) have "backed into the Grand Simplification" because they continue to rely on the presuppositions of mainstream, neoclassical economists without exploring other moral and conceptual options. Again, because the public is forced to accept the valuations of experts without having an opportunity for substantive input, their acceptance of the decision may be limited.

Conclusion: Reconciling Anthropocentrism and Biocentrism Through Adaptive Management

The ideas embodied in normative sustainability—which encompass notions of adaptive management coupled with insights afforded by

policy science and environmental ethics—provide yet another alternative to neoclassical economics and may provide the key to lessening public opposition to WIPP shipments, in some cases. The insight of adaptive management is that environmental questions should be considered using a dynamic, systems theory approach. Originating in the work of Aldo Leopold, C. S. Holling, Bryan G. Norton, and scientists working in the 1970s, among others, adaptive management theory recognizes that ecosystems are constantly in flux and that any public policies implemented by human beings probably will result in surprises and unexpected occurrences unforeseen by policy makers (see, for example, Holling, 1978; Leopold, 1949; Norton, 1991). Adaptive management, therefore, champions an experimental approach that allows policy makers to learn from their mistakes and apply those lessons to future projects. These principles also allow for public input throughout the process of operating a waste management facility and shipping waste—from cradle to grave.

Another principle of adaptive management is that it requires policy makers to examine natural systems at “multiple scales of time and space” (Norton & Steinemann, 1998, p. 7). Because individual human beings make economic choices in a comparatively short time, usually measured in years or, at most, decades, their time scale is far different than longer periods—epochs or geologic time, which can be measured in millennia as well as millions of years. In Norton’s (1995) words, human actions are “geared to short-term changes that occur in economic time,” which means that human beings often fail to perceive the “spill-over impacts on the larger scale of environmental systems” (p. 230).

Proponents of adaptive management suggest that policy makers adopt a multiscale, multicriteria system of environmental evaluation that will serve as a conceptual basis for a richer theory of sustainable development than is possible using mainstream, neoclassical economics. This approach requires decision makers to consider public policies from several scalar and temporal perspectives. Although such analyses may be more time-consuming in the short term, they can assuage public fears owing to their comprehensive treatment of risk based on many factors other than utility calculations employed in traditional cost-benefit analysis.

According to adaptive management theorists, on the larger scale of the current generation’s obligations to the next two or three generations, neoclassical economic theory is insufficient because it fails to consider all long-term considerations beyond “economic time” except by discounting future benefits or cost flows. For biocentrists, such discounting, once again, assumes that resources are more or less fungible—a dubious proposition, in their eyes. The insight about economic time also is important in discussions about WIPP because the program involves a material that has a half-life of thousands of years (League of Women Voters, 1993,

pp. 116-117). According to proponents of adaptive management, policy makers should consider a layered approach in which additional considerations are factored into their decision-making process. Not only are the costs and effects of using short-term waste management options part of the mix, but the issue of developing a fully functional, national nuclear waste management system that handles waste for many decades and hundreds of years becomes the paramount objective (assuming that TRU waste is still generated in the first place). When public policy issues are considered in this context, questions about the safety and effectiveness of geologic disposal must be reevaluated, especially in light of technological developments that have occurred since the beginning of America's experiments with radioactive waste transportation and disposal. Such a reevaluation may necessitate reexamining the WIPP design to consider a variety of alternatives, including the possibility of not generating TRU waste in the first place or, alternatively, retrieving already-buried TRU waste in the event that new technologies allow for improved treatment at some later time.

Finally, in considering the largest time scale, policy makers who embrace adaptive management principles seek to establish a process for considering the consequences of continuing to produce a material that will remain dangerous to living organisms for thousands of years (assuming no unforeseen technological breakthroughs in coming decades or centuries). Notice the phrasing—"establish a process." This is not tantamount to formulating a policy itself. The desire to develop a detailed plan, enshrine it into law, and regulate the activities of parties who work to implement the plan pursuant to the law is understandable because it appears to reduce uncertainties in an endeavor filled with uncertainties. Yet, this approach ensures that policy makers are vulnerable to charges of rigidity and insensitivity to community concerns, to say nothing of the probability that contingencies will arise that require major changes to the original plan.

This new process would necessarily involve the public. As long as citizens remain uneducated about the possible consequences of a proposed action and believe that important decisions are forced on them, they will be opposed to whatever plans are developed—no matter how scientifically sound such plans may be. Only when the public is consulted at every step will they accept radioactive waste transportation as societally necessary. This means that DOE and other federal agencies must allow the public real, sustained, ongoing input into all decisions. Although many features of the nuclear waste system will be technical and require expert analysis of feasibility and other scientific matters, this does not preclude citizen review and oversight of scientific activities. As long as the public realizes that the "no action" alternative is not an option in every situation, hard choices will be made with an eye toward greater public acceptance.

Critics of this process approach to adaptive management argue that even if such an effort to “muddle through” environmental policy decisions reflects the incremental nature of the U.S. political system, it raises troubling issues, especially for the natural environment (Lindblom, 1999). Incremental processes focus on short-term individual rights and decisions at the expense of community values (Paehlke, 1997). Thus, the process approach to public participation may resemble a reiteration of neoclassical economics in political terms (Lester & Stewart, 2000, p. 93). Some commentators have labeled this problem the “collective action” dilemma (Heywood, 1994, pp. 184-193; Ostrom, 1998; Tarrow, 1994; Traugott, 1995). Garrett Hardin discussed this dilemma in a famous 1968 article on the “tragedy of the commons.”

According to Hardin (1968), individual users of a publicly owned resource (a “common pool resource,” in the language of neoclassical economists) have an incentive to use as much of the resource as they can, even to the point of exhausting the resource, to satisfy their individual desires with little regard for future uses by other parties. Unfortunately, by taking such a short-term view of their actions, these individuals risk destroying the resource for everyone in the long term. Hardin’s article is a useful explanation of why people engage in behavior that harms the natural environment. With its process approach to issues that can be handled in short election cycles, the American political system emphasizes the importance of individual rights and liberties—often at the expense of the long-term collective welfare (Hardin, 1968).

Moreover, even if a biocentrist agrees that participation in a process for public input is valuable, one might ask whether the no-action alternative should be the preferred method of handling TRU waste, regardless of the level of public participation. Although a persuasive case might be made for pursuing a decentralized alternative to transporting TRU waste to WIPP, DOE indicated in its final environmental impact statement for radioactive and hazardous waste that the preferred option for TRU waste was a more centralized strategy using a pilot program. The postprogram analysis, after WIPP is decommissioned in 2019, will provide more empirical data on whether TRU waste should be transported or left where it is generated (DOE, 1997).

In the face of the department’s decision to move forward with WIPP, biocentrists must choose whether to stand on abstract principle and refuse to challenge neoclassical economists’ assumptions or whether to lobby for improved opportunities for public participation. If they choose the latter, public participation may become a key ingredient in the success of the pilot program. Involving the public in a continuing process of consultation and review does not ensure an end to all public opposition to WIPP shipments (especially when private property rights are affected), nor does it answer all questions of intergenerational equity. Trade-offs between the present and the future must still be made.

Ignorance of future generations' concerns will not be lessened. Questions of how far into the future the current generation's obligations stretch and the typology of effects problem will still exist.

The advantage in adopting an approach rooted in adaptive management, however, is that it establishes an outlet for all parties to participate in decisions that affect their lives and the lives of their progeny. As time goes on, they will continue to participate, and, perhaps, community consensus on radioactive waste disposal will change in response to changing societal values as well as new technological innovations. Whatever else happens, policy makers can develop national radioactive waste disposal policies with more public support than they received in the past. Moreover, because the decision-making process continues over time, new developments can be factored into the policy process.

Critics might argue that "the saving grace of sustainability is mostly a myth fostered in high places such as the U.S. law schools that talk comfortably of developing 'strategies' " to meet a variety of environmental objectives (Rodgers, 1994, p. 995). This criticism raises a valid point. The risk in embracing any theory is that one too readily accepts the model but not the reality of day-to-day environmental management. Theories of sustainability present ideas that many policy makers find too nebulous and fuzzy to accept. It is well and good as an academic exercise to posit a multiscalar, multicriteria system of environmental evaluation, but what would such a system look like—and how would it be implemented? As one commentator has observed, "it seems high time, therefore, for somebody to spell out why, if the Emperor of Sustainable Development has any clothes at all, they are pretty threadbare" (Beckerman, 1998, p. 462).

As persuasive as these criticisms of sustainability and adaptive management seem to be, they ignore both difficulties inherent in promoting unfettered economic growth without depleting natural resources as well as the problem of ensuring public acceptance of waste management activities as societally necessary. Accepting sustainability opens the doors for policy makers to consider alternative approaches to environmental management, thereby breaking the cycle of agency action and public opposition that seems so endemic to national nuclear waste management programs. In the words of one proponent of sustainability,

Those who argue that this interpretation is extreme and the suggested guidelines for sustainable development are utopian (or draconian, depending on your point of view) have an obligation to refute the analysis. If the basic argument is sound, the real utopians—dreamers of the impossible—are those who still support the material growth ethic and maintenance of our economic status quo. (Rees, 1990, p. 23)

The promise that adaptive management might result in greater public acceptance of waste management decisions seems almost impossibly

optimistic. Consequently, a skeptic might legitimately ask whether public input into radioactive waste transportation issues is necessary or desirable given the apathy exhibited by so many Americans. Many members of the public neither know, nor care to know, about the world around them. As long as they are entertained and reasonably well off financially, they remain complacent and politically somnambulant. A smaller group of citizens, however, is politically active and seeks the right to know about hazards and risks in their communities. This latter group benefits from a revitalized public consultation process based on adaptive management principles.

According to John D. Graham (1998) of the Harvard Center for Risk Analysis, environmental activists increasingly are insisting that the public be given an opportunity to take part in decisions involving potential threats to public health and safety. In the past, according to Dr. Graham, "environmental advocacy organizations have resisted the use of risk analysis for moral, technical, and/or tactical reasons," but this approach is changing rapidly. Organizations such as the Environmental Defense Fund (EDF) have developed "an aggressive, forward-looking approach to the use of risk analysis in favor of environmental protection." Accordingly, federal agencies would be well-advised to establish a good working relationship with EDF and other advocacy groups in lieu of adopting a confrontational stance that usually leads to litigation and negative media attention for the agency (p. 1).

Biocentrists sometimes hesitate to engage in public participation for programs such as WIPP for fear of being co-opted and thereby losing their credibility within the environmental community. These are valid concerns. The record of many federal agencies in allowing for public participation through open forums that produce meaningful results has been abysmal, to put it bluntly. Nonetheless, public participation need not be rejected out of hand by either anthropocentrists or biocentrists just because past experiences proved to be failures. The literature on the need for, and possibility of, meaningful, ongoing, public participation in federal agency programs is varied and extensive (see, for example, Arnstein, 1969; Creighton, 1980; Ortolano, 1997, pp. 402-421).

The goals of public participation must be clear at the outset of any program. First, citizens must be given an opportunity to be heard. This will help the agency understand why the community opposes the program, and it will allow for the development of new strategies and mitigation measures, as necessary. The agency benefits by establishing the legitimacy of its decision-making process and fulfilling legal requirements for notice and comment. The public benefits by voicing concerns that may serve as the basis for further action and subsequent lobbying in the political process (Parenteau, 1988, pp. 4-6).

Biocentrists often greet outlets for citizen participation with skepticism, and rightly so. According to a well-known article by S. R. Arnstein

(1969), citizen participation can be viewed as a ladder. At the bottom of the ladder is the category of nonparticipation in which an agency attempts to coerce community members into accepting the agency's decision. Above this category is tokenism, the notion that an agency allows citizens to participate in meetings and submit written materials for the record, but the testimony and documents have little or no effect on the agency's final decision. The final category, citizen power, allows for citizens and agencies to develop partnerships ranging from negotiations through citizen vetoes over agency plans and programs. The problem in the past has been an agency's unwillingness to allow for citizen power. In cases in which citizens have been allowed to participate, the process has been token, at best. If agencies are to change this mistrust and engender support, they must move up this ladder of participation.

Involving the public to a greater degree in environmental management decisions at the federal agency level is not as far fetched as it may sound. Recognizing the existence of a burgeoning right-to-know movement, for example, the U.S. Environmental Protection Agency (EPA), which often has sought to involve activists in the policy process, recently developed the Center for Environmental Information and Statistics (CEIS). CEIS is designed to provide industry and environmentalists with data to make informed assessments of EPA's activities and programs. This can be accomplished by placing information online, which already has been done using data from comparative risk analyses and the Toxics Release Inventory. Moreover, information often is listed on the agency's Integrated Risk Information System (IRIS) database (Fairley, 1997, p. 20). Although still in its infancy, CEIS promises to teach other federal agencies, including DOE, how to involve the public in policy-making decisions and how to provide useful information on agency plans and programs, presumably before litigation ensues in most cases.

The suggestions contained in this article are designed to improve public risk perceptions of radioactive waste shipments to the WIPP facility in New Mexico, but adaptive management principles are broad and can apply to many federal programs. If courts will analogize cases involving public risk perception and private property valuations for radioactive waste shipments to precedents that raise issues of societal necessity in market failure situations, this action will improve DOE's ability to ship waste to WIPP in the short term. Yet, this is only the first step in improving public risk perception, and it does little to address the concerns of biocentrists. Only by accepting the concepts of sustainable development and adaptive management and allowing the public to participate in the decision-making process can federal agencies possibly prevent continued public opposition to unpopular activities. In turn, the improved relationship between a federal agency and the public may provide an incremental step toward reconciling the differences between anthropocentrists who adhere to neoclassical economics and biocentrists

who argue in favor of ecological economics and a broader conception of sustainability. The difficulty in designing and implementing a program based on adaptive management principles does not obviate the need for such a program; it merely underscores the necessity of reconciling anthropocentric and biocentric perspectives in the public policy arena.

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