Cows are Better than Condos, *or* How Economists Help Solve Environmental Problems

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ABSTRACT

This essay explores three case studies that illustrate the exemplary use of economic analysis in environmental decision-making. These include: 1) the creation of a market in tradable grazing rights in the American West; 2) a cost analysis that facilitated a negotiated rulemaking at a power plant in Arizona; and 3) a conception of production-based pollution allowances that led to an agreement for regulating Intel microprocessor production plants. The paper argues that cost–benefit analysis may be less useful than other kinds of economic analysis that can guide and inform rather than judge and second-guess the outcome of negotiated and collaborative decision-making.

KEY WORDS

Environmental policy, cost–benefit analysis

Nobel laureate Kenneth Arrow, writing together with a group of economists, has declared, 'Benefit–cost analysis should be required for all regulatory decisions'.[1] In a Policy Forum published in the journal *Science*, these economists have written, 'economic efficiency, measured as the difference between benefits and costs, ought to be one of the fundamental criteria for evaluating proposed environmental, health, and safety regulations'. The other criterion would be fairness or distributive equity, since 'policies inevitably involve winners and losers, even when aggregate benefits exceed aggregate costs'.[2] Policy analysis will 'identify important distributional consequences', but it must 'focus primarily on the overall relation of benefits and costs'.[3] Redistributive goals are often better pursued by separate policies, for example, direct transfers to the poor.

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A problem for the efficiency criterion, as these economists recognise, is that people often base their views on beliefs rather than benefits. In other words, people judge environmental policies in terms of goals, values, or principles that may have nothing to do with what they think benefits them. As commentators frequently point out, people tend to evaluate a policy from a public or principled point of view – from the perspective of ideals or commitments – rather than in terms of its welfare effects.[4] Ideal-regarding principles, aesthetic judgments, etc., since they do not refer to the well-being of the individual, are irrelevant to the estimation of benefits. As economist Paul Milgrom has pointed out, to be relevant to economics, preferences must 'reflect only … personal economic motives and not altruistic motives, or sense of duty, or moral obligation'.[5]

According to Arrow et al., 'Benefit–cost analysis is premised on the notion that the values to be assigned to program effects – favorable or unfavorable – should be those of the affected individuals, not the values held by economists, moral philosophers, environmentalists, or others'.[6] In this passage, Arrow and co-authors suggest that only the welfare consequences – values that affect the wellbeing of individuals – should count in policy analysis. Aesthetic judgments, ethical convictions, and religious commitments, insofar as they do not reflect changes in welfare, are irrelevant. Arrow et al. dismiss the ideal-regarding and ethical commitments not just of philosophers and environmentalists. If economists had principled beliefs or ideals, these, too, would also be irrelevant to the welfare calculus on which environmental policy should be based.

WHAT IS THE ALTERNATIVE TO COST–BENEFIT ANALYSIS?

In step with the Progressive movement prominent more than a century ago, economists like Arrow hope to find in scientific calculation of benefits an alternative to what they regard as the inferior course, namely, political negotiation. Edith Stokey and Richard Zeckhauser, for example, argue that cost–benefit analysis provides a scientific, objective basis for policy making, while a political process, which may reflect principled and ideological commitments, is uncontrollable. 'The benefits and costs accruing to all … will be counted on a dollar-for-dollar basis. Benefit–cost analysis is a methodology with which we pursue efficiency and which has the effect of limiting the vagaries of the political process'.[7] Centralised planning based on scientific evaluation of welfare effects provides an objective, neutral basis for public policy that political processes lack.

What is the alternative the alternative to the cost–benefit approach? 'Without cost–benefit analysis', Herman Leonard and Richard Zeckhauser have written, 'we would be forced to rely on an unpredictable political process. That process frequently leads to stalemate and reliance on the status quo; at other times it careens in response to popular perceptions and whims of the moment'.[8] Economist Barry Field has made the same point. He has written, 'It is the politician's

job to compromise or seek advantage', while economists 'produce studies that are … as objective as possible'.[9]

Many economists, however, do not dismiss democratic negotiation and deliberation as irredeemably ideological and unscientific. These economists look for ways to inform or serve the political process rather than – as the cost–benefit approach essentially does – to second-guess and replace it. Economists who take a kinder view of the political process may have been persuaded by Ronald Coase, Peter Drucker, and others that co-operation rather than competition – organisation rather than optimisation – defines a modern economy.[10] The role for economists is not to find in every environmental problem or controversy a 'market failure' that requires a cost–benefit remedy. Rather, the role of the economist is to build and to strengthen the institutions – the processes of organisation, cooperation, and exchange – that enable individuals or their representatives to participate in and become accountable for the decisions that affect them.[11]

Important and successful alternatives economists have proposed to cost–benefit analysis involve arrangements – from 'cap and trade' markets for pollution allowances to collaborative agreements among stakeholder groups – to allow those affected by a policy to engage more effectively in the process of shaping it. Many of the most helpful, cost-effective, and sensible reforms in environmental policy have resulted from the suggestions of economists about how society, by altering incentive structures, can better reach its goals. The goals of environmental law plainly do not include economic efficiency or net benefits maximisation. Not a single statute in the United States, at least, proposes economic efficiency as a criterion and many environmental statutes preclude it. Rather, the goals of society, for example, clean air and water, the protection of species, and the maintenance of wild and scenic areas, are intelligible to those without (but perhaps less so to those with) advanced degrees in policy analysis. The question society must answer is how and where it can pursue its objectives most effectively, i.e., at the lowest political and economic cost. Economists often provide ideas and analyses society relies upon to pursue social goals in cost-effective ways. This is different from stating *ex cathedra* what those goals should be – e.g., efficiency, net benefits maximisation, and so on.

Economists have proposed many innovations to improve social processes of decision making, including well-known and by now well-proven arrangements, such as pollution offsets and banking, risk 'bubbles', transferable development rights, tradable pollution allowances ('cap-and-trade' strategies), environmental audits of industry, labelling requirements (e.g., California's Proposition 65), Toxic Release Inventories and other 'benchmarking' information strategies,[12] liability schemes, subsidies for technological research, and other decentralised strategies to serve social goals. These innovations have been well enough characterised in the literature and need no elaboration here.[13]

This essay offers three brief case studies to show how economists have successfully tried not to supplant but to strengthen and inform social and political processes of environmental decision-making. Economists have shown how opposing groups and individuals can accommodate, insofar as possible, the values, beliefs, and principles that divide them. The following case studies illustrate kinds of economic analyses that may prove more useful than cost–benefit balancing to the formation of environmental policy.

THE WAR ON THE RANGE

For over a century, ranchers have grazed sheep and cattle on public lands in the American West. As a result of the Taylor Grazing Act of 1934 and subsequent legislation, ranchers have operated under a complex set of regulations and fees that nobody believes makes sense. The Taylor Act assigned to qualifying ranches ('base properties') a number of AUMs ('animal unit months', i.e., forage for a cow and a calf for a month), based on a conception of the carrying capacity of a given parcel of public range. The Bureau of Land Management (BLM) administers about 10 million AUMs, the Forest Service about 8 million. In Montana, an AUM averages about 20 acres; the national average is somewhat less. Grazing occurs on about 260 million acres of public range and forest.[14] The rancher pays the government rent of about $1.35 per AUM on his allotment.[15] The BLM and the Forest Service in 1998 took in about $20 million in grazing fees. These agencies spend an estimated $75 to over $200 million annually to administer the program.[16] In managing this system of grazing permits, the government spends perhaps about $10 for every $1 it takes in. Even if the BLM charged the full market value of AUMs, proceeds would cover only one-third the costs of administering the program.[17]

For 50 years, environmental groups argued that the AUM system did little to restore and much to damage the ecology of the western range. According to *Sierra Magazine*, cattle 'trample whatever hasn't been eaten, crumble riverbanks, foul water, and otherwise make life miserable and sometimes impossible for the plants, birds, fish, and amphibians dependent on these rivers of life'.[18] Organisations such as the National Wildlife Federation and the Natural Resource Defense Council contend that taxpayers subsidise this devastation because the government charges for AUMs only a fraction of what they are worth. The market prices of AUMs, as they transfer with the sale of ranches, range from $36 per AUM in Wyoming to $89 in New Mexico. While these prices appear much greater than the dollar or two the rancher returns to the government, the rancher arguably pays for them in the purchase price of the associated ranch.

As early as 1963, Delworth Gardner, a leading agricultural economist, proposed that the government create 'perpetual permits covering redesignated allotments … and issue them to ranchers … in exchange for those now in use'.

Gardner explains: 'These permits would be similar to any other piece of property that can be bought and sold in a free market'.[19] Those who valued the permits most – whether ranchers, sheepherders, hunters, or environmentalists – could then purchase them, thus redirecting the use of the public lands through voluntary, non-coercive exchange. Many economists supported this analysis adding evidence to show that environmentalists would probably retire the ecologically most fragile parts of the range by purchasing the rights from cattlemen.[20]

Leading environmentalists, including many of those most fiercely opposed to ranching interests, accepted this economic analysis. Dave Forman, founder of the radical Earth First! movement, likewise called for a programme to 'buy out grazing permittees'. He observed, 'The butting-heads battles with ranchers over grazing in Wilderness is bad for all involved. The most practical and fairest way … is to buy 'em out'.[21] Johanna Wald, a senior attorney with the National Resources Defense Council (NRDC), who won a landmark case against the BLM (*NRDC v. Morton*, 1976), approved an approach based on 'incentives and markets'. If grazing rights were privatised, environmentalists 'will have market options, like buying out all or a portion of a rancher's permit'.[22]

Two Views From the Same Window

Conflicts over the use of the public range have grown more intense in the last decade as the demography of the West has dramatically changed. Ranchers, loggers, and others who exploit natural resources see themselves as an embattled minority representing a small and dwindling part of the economy. As one writer, Sharman Russell, describes the rural valley in southwestern New Mexico where she lives,

> In these last ten years, we have grown from a small community of farmers and ranchers to a larger community of farmers, ranchers, retirees, school teachers, entrepreneurs, small gardeners, and others. We are increasingly polarized. 'Cowboys' on one side. 'Environmentalists' on the other.[23]

According to Russell, ranchers and environmentalists see two different landscapes when they look out the same window. Ranchers see land that is healthy – in far better condition than fifty years ago – the productivity of which has improved over their lifetimes. They have been good stewards of the public domain. Environmentalists,

> read from a history book that vividly paints the West that was *before* the cattle came: grass up to a horse's belly, perennial rivers alive with beaver and trout, a wolf's resonant howl in the distance. … We backpack in the Gila Wilderness and find our camping sites littered with cow pies. We worry about things like the growing desertification of the West and the destruction of wildlife habitat. We see degradation.[24]

These contrasting aesthetic and ethical perceptions – each of which can be backed up by scientific studies – produced an impasse. In a 1994 opinion piece, Andy Kerr, a prominent environmental activist, argued, 'In the long run, environmentalists have more people, more power, and more money than do the Elite Welfare Ranchers'. He added, 'Their battle is "better" grazing. Our battle must be no grazing'.[25] Ranchers feel threatened by environmental regulations, such as the Endangered Species Act, and by the environmental movement. Many or most ranchers believe that they can hardly survive economically in any case, largely because of foreign competition and low meat prices, though they hang on to protect what they regard as their heritage and way of life.

While the economic transformation of the West, as Andy Kerr observed, brings environmentalists people, money, and power, it also brings tremendous residential and commercial development. The choice is often not between ranching and wild land – the two landscapes seen out the window – but between ranching and retirement villages, golf courses, resorts, manufacturing campuses, research parks, and so on. As one rancher pointed out, 'The subdivisions stop when they reach our property, and then there's this big swath of open space'.[26] The values of ranchers and environmentalists may not seem all that different – better grazing might be an acceptable compromise – if the realistic alternative to grazing is a wave of residential development and commercial sprawl.

Economists and other analysts, alarmed by a polarisation between ranchers and environmentalists that had begun to find expression in violence, wondered if a different sort of social structure could achieve agreements rather than aggravate antagonisms. The underlying problem, according to resource economist Robert Nelson, who teaches at the University of Maryland, lay in the amorphous nature of grazing rights. By practice and expectation over many decades, rights to AUMs had become vested in the associated ranches and transferred with them; indeed, they added so significantly to the value of the ranch that they could be used as collateral for mortgages. On the other hand, the rancher could not transfer the right other than by selling the ranch, and the right to the range could be used only for grazing. An environmental group who wished to purchase AUMs, even from a willing seller, to retire them in order to preserve ecological values could not do so. According to the 1978 Public Rangelands Improvement Act, a rancher could lose his permit if he failed to graze 90 percent of his allotted animals.

Nelson, who served for many years in the policy office of the Department of Interior, reiterated that a regime of well-defined transferable property rights would allow environmentalists to retire grazing permits in those places where they believe grazing is ecologically the most destructive. Nelson wrote:

> For decades ranchers have pressed for a more formal establishment of their tenure status on federal rangelands. Today some prominent members of the environmental movement are reaching similar conclusions. The delineation of formal rights

> to use would promote a more responsible environmental management and federal rangeland resource use. The lack of any clear rights on the federal rangelands has resulted in blurred lines of responsibility which have been as harmful to the environment as they have been to the conduct of the livestock business.[27]

Leaders and activists from both environmental and cattlemen groups welcomed in principle the idea that ranchers could own grazing rights in fee simple and treat them as transferable like any other property right. The winner-take-all or zero-sum confrontation between ranchers and environmentalists could give way to voluntary exchanges that encourage cooperation and accommodation. The rancher and the environmentalist who look out the window, then, might come to see the same landscape.

Reform on the Range

By the middle 1990s, environmentalists such as Andy Kerr and Dave Foreman, who had been hostile critics of cattlemen, began to advocate a free-market or voluntary approach to conservation. In a lengthy analysis published in *Wild Earth* magazine in 1998, Kerr praised the buyout option even though it recognised that ranchers have a property right in their permits to graze cattle and sheep on public land. Kerr argued that the government loses so much on administering the grazing program, it would save hundreds of millions of dollars if it bought back the AUMs at fair market value, i.e., at whatever marginal price a rancher demanded. Kerr reasoned that under the current graze-it-or-lose-it approach, stockmen have no choice but to run cattle on public land, and environmentalists have 'no option but to exercise traditional environmental protection strategies in the areas of administrative reform, judicial enforcement, and legislative change'. These methods 'can cause social and political stress and are not always successful. To take advantage of the voluntary retirement option, some conservationists – and some ranchers – would need to rethink their traditional strategies'.[28]

During the Clinton Administration, then Secretary of Interior Bruce Babbitt introduced administrative amendments that opened the way to grazing permit trading by deleting the term 'engaged in the livestock business' from the regulation governing who could own a grazing permit.[29] This opening to voluntary buyouts of AUMs has been pursued on a restrained, case-by-case basis. Every example is its own story. In one instance, the Grand Canyon Trust, a conservancy group, purchased a base property in part to retire associated grazing rights on the Grand-Staircase-Escalante National Monument. As property-owner, the Trust would be accountable for the condition of the associated range.

Environmental activists were quick to see that with ownership comes accountability. The buyer who then owns the AUMs may become responsible for

the subsequent condition of the land. This may lead to cooperative arrangements with stockmen. For example, if a rancher sells his AUMs on the public range to a conservancy group, he might sell the ranch to developers, since they are willing to pay the most for it. Environmentalists who wish to preserve the open landscape, then, may have an incentive not to get rid of cattle but to subsidise or otherwise keep the rancher on the land. The Nature Conservancy, when it announced its purchase of the Dug-Out Ranch near Canyon Lands National Park, said the ranch would continue in the livestock business. The organisation sought to 'move beyond the rangeland conflict and into collaborative efforts with livestock operators'. A Conservancy spokesperson noted that 'cows are better than condos, and increasingly in the west, this is the only choice we face'.[30]

VISIBILITY AT THE GRAND CANYON

Environmentalism in the American West is often directed at preserving a magnificent landscape against the encroachment of commercial, industrial, and residential development. Perhaps the greatest symbol of the landscape of the West can be seen at the Grand Canyon – if, indeed, one can see it. During many summer days, prevailing winds dramatically impair visibility in the Grand Canyon by transporting emissions from the Los Angeles basin and other urban and industrial areas to the west. During the winter, when visibility in the Canyon is at its best, it is far from perfect, many environmentalists have charged, because occasional surface winds moving east to west brought sulphur emissions – the precursor of smog – from the Navajo Generating Station (NGS) located only 12 miles east of the Grand Canyon National Park.[31]

In 1977, Congress had amended the Clean Air Act (CAA) to require that the EPA promulgate regulations to assure 'reasonable progress' toward preventing 'any future, and the remedying of any existing, impairment of visibility' in the national parks. This amendment responded to complaints about pollution in areas such as the Grand Canyon, where, according to press accounts at the time, 'the spectacular scenery is dulled by a murky, polluted haze … . Occasionally, the air is so foul that the daily quota of 12,000 visitors can hardly see to the bottom of the mile-deep gorge'.[32] In 1982, the Environmental Defense Fund sued EPA to force it to regulate NGS emissions under the 1977 CAA amendments to improve visibility especially during the winter at the Canyon.

NGS, which burns a maximum of 24,000 tons of coal a day, was built near Page, Arizona between 1971 and 1976. It had installed no pollution-control equipment because the air in the area is so clean that the marginal increase in sulphur dioxide did not threaten human health.[33] When NGS received its construction permit, however, it understood it would have to retrofit later with some kind of scrubber technology. A study the National Park Service (NPS) released in 1987 found that on some winter days, NGS contributed up to 70

percent of the sulphates detected in the air over the Canyon. Although the National Research Council and other groups challenged this finding on scientific grounds – air transport models are notoriously inexact – it galvanised public opinion.[34] Public opinion, the 1977 CAA Amendments, and legal pressure by environmental groups made it inevitable that the EPA would require NGS to do something. Leadership within EPA, particularly in the program office for Air and Radiation, moreover, saw in the controversy over NGS an excellent opportunity to bring industry and environmental groups together to work out a collaborative agreement.

The Economic Analysis of Visibility

Economic analysis affected the regulatory history of NGS in two ways. First, since visibility need not affect human health, regulations to protect visibility may consider costs and perhaps even balance costs and benefits. Accordingly, EPA could try to measure the benefits of increased visibility at the Grand Canyon in economic terms. Second, EPA needed to determine how much incremental control of NGS emissions actually cost. This would establish a supply-side price for marginal improvements.

EPA was obliged to estimate the benefits of regulation because an executive order promulgated during the Reagan administration required major environmental regulations to pass a cost–benefit test. EPA in addition had to respond to rules issued by the Office of Management and Budget (OMB) and later by the Competitiveness Council that required the quantification of benefits associated with major environmental rulemakings. The attempt to quantify the benefits associated with greater visibility in national parks began in the early 1980s and comprised much of the early research in contingent valuation (CV) methodology.[35] Economists understood that many citizens believed that pollution in places like the Grand Canyon is wrong. Therefore, these citizens could be said to benefit from environmental protection, even if they never visited the places in question. CV methods seek to measure as willingness to pay (WTP) moral beliefs, aesthetic judgments, and spiritual concerns redescribed as ‘existence’ or ‘non-use’ values.

By 1990, CV research had shown that people cared about environmental quality even in those places they did not ever plan to visit. Motivated by religious, aesthetic, and ethical judgments and convictions, many respondents to CV questionnaires reported significant WTP for the protection of visibility from industrial pollution; the totals could be staggering when aggregated across all households in the nation. By revealing stupendous hypothetical WTP for ‘bequest’, ‘option’, and ‘existence’ values, the CV approach offered EPA the numbers it needed to get a regulation by the Competitiveness Council. A CV analysis gave ‘juice’ to regulations headed to OMB for cost–benefit review.[36]

To meet the OMB cost–benefit requirement, EPA relied on an extensive and expensive CV study it commissioned (with NPS) in 1988 to quantify the benefits associated with visibility improvement (or protection) in national parks in the Southwest and elsewhere. In this study, respondents were shown photographs that represented a range of summertime visibility in different national parks. Answers to the survey instrument indicated that respondents who did not plan to visit the park – whose values were wholly disinterested – were on average willing to pay about $24 for a given improvement in visibility (155 km to 259 km) and $21 to prevent that much degradation. The analysts excluded outlying bids that, if included, would have raised the average bid by a third.[37]

EPA somehow extrapolated these numbers to the Grand Canyon wintertime scenario; it then 'applied the option, bequest, and preservation values to the entire population of the United States'.[38] Not surprisingly, the annualised WTP for improved visibility at the Grand Canyon – as much as $190 million for a 70 percent and $250 million for a 90 percent reduction in emissions – was found to be well in excess of the costs. CV surveys such as this one provide the numbers environmentalists need to counter industry claims. These methods perform this feat by redescribing ethical beliefs as economic benefits for which people are willing to pay, thus turning moral and aesthetic judgments into data for economic analysis. To be sure, CV surveys are costly, but EPA officials saw past that problem. 'You get the numbers you are willing to pay for', one said.[39]

Duelling Cost–Benefit Analyses

When the operators of NGS learned that EPA was preparing to quantify the benefits associated with regulating emissions, they saw the political need to commission their own analysis, which they tailored specifically to the Grand Canyon case.[40] As in the EPA study, respondents were shown photographs of different visibility conditions – although on the basis of a daily rather than seasonal variation. Like the EPA study, the NGS assessment produced many outlier bids, so the manner of handling these made a huge difference in both instances. The NGS consultants found that when they trimmed outliers according to the method they used, WTP for visibility improvements (or to prevent degradation) differed by an order of magnitude from that of the EPA-funded study. According to one summary, 'the NGS benefits analysis estimated that first-year (1995) benefits would be $1.4 million for the 70% control option and $2.3 million for the 90% control option'.[41] This was less than a tenth of the EPA estimates.

Leland Deck, who as an EPA economist served as the lead technical analyst for the NGS negotiation, has written a detailed and thoughtful review of the usefulness of benefits estimation in determining the regulatory outcome at the Grand Canyon. He observed that the differences between the two duelling

benefit analyses were never resolved. 'Ultimately the parties agreed to disagree about the benefits estimates', and they worked together instead on discovering how they could make the most reductions in emissions at the lowest cost. In other words, both sides abandoned cost–benefit analysis for cost-effectiveness analysis or, more, precisely, knee-of-the-curve analysis. They consulted engineers to find ways to reduce emissions inexpensively and thus to push the 'knee' of the expense curve as far out as possible on the pollution-control axis.

Deck asked why the two benefit analyses came to such dramatically different conclusions. He noted that the two studies represented the state of the art; contingent valuation had been very well developed in this area. Deck wrote that by the early 1990s, there was already 'a long history of available visibility valuation studies'.[42] The disagreement might have arisen, Deck conjectured, because the non-use benefits associated with environmental goods are hard to measure, because of structural differences in the way the studies were designed and implemented, or even because 'of the influence of the sponsor'.[43] It would be interesting to see if two groups of economists tasked with the same benefits estimation but working independently of each other and for sponsors with opposing interests would ever arrive at anything like the same estimates. In this instance, 'the competing estimates effectively became a standoff'.[44] The bad news was that benefits analyses were attempted. The good news was that they cancelled each other out.

The Contribution of Costs

While economists working for EPA and those working for NGS disagreed radically in their estimates of the benefits of regulation, they easily worked out whatever disagreements they had about the costs. They found, among other things, that owing to the 'lumpiness' of available scrubber technologies, the marginal cost of reducing emissions from 70 percent to 90 percent was actually less than the average cost per unit of the reductions to 70 percent. While one usually assumes that emission reductions become more expensive as they increase, in this instance, the more effective technology cost little more than a less effective one, so that the marginal cost curve declined. This economic information suggested that NGS could accede to a 90 percent reduction, thus accommodating environmentalists, without a significant additional expense.

Scrubbers that remove sulphur often have to be shut down for servicing; during these periods, emissions will increase. If NGS had to maintain a 90 percent reduction every moment – or as an average per hour, day, or even month – it would have to purchase at a cost of billions of dollars back-up scrubbers that could take over when the its main scrubbers were serviced. On the other hand, if the emissions were averaged over a year, then there would be no need to purchase back-ups, because the plant could make up the difference by getting

more than 90 percent reductions at some times to compensate for less at others. If servicing took place mostly during the summer – or at other times when winds blew from the west – this would not impact visibility at the Grand Canyon.

This interesting cost profile suggested the basis for a win–win compromise. If environmentalists agreed to yearly averaging, NGS might purchase scrubbers to reduce emissions by 90 percent while avoiding the need to install back-up scrubbers. The problem, however, was that each side distrusted the other and insisted on its own benefits analysis. How could EPA broker a political compromise to keep industry and environmental groups from tying each other up in lobbying and litigation? How could EPA get the opposing sides to collaborate rather than fight in Congress, OMB, and the courts?

EPA found a brilliant strategy to move antagonism to collaboration. It threatened to impose a regulation that would be disastrous for both sides if the stakeholders did not come up with their own compromise. In 1991, the agency proposed a 70 percent level of control, which antagonised environmentalists, who insisted on 90 percent. It also proposed thirty-day averaging, which would require NGS to purchase back-up scrubbers for each of three units, which the electric utility regarded as an impossible expense. The Assistant Administrator for Air then brought representatives of concerned environmental and industry groups together under the threat – equally terrifying to both – that if they did not come up with a win–win alternative, EPA would impose this lose–lose regulation.

Since the default regulation EPA threatened to impose was equally anathema to both sides, the stakeholders had an incentive to collaborate. As they investigated the costs of pollution control, they found that because of the way scrubber units are built, it would cost very little more to achieve a 90 percent reduction than a 70 percent reduction, although back-up scrubbers would cost billions of dollars in order to meet short-term averaging requirements. By controlling pollutants down to 90 percent, moreover, NGS would produce sulphur emissions credits it could sell in the emerging market that had been created for them. After two months of intense negotiations in which information about costs – not benefits – proved decisive, the parties agreed on a regulation that would achieve a 90 percent reduction calculated at an annual average basis. On October 3, 1991, EPA formally adopted the compromise plan as its final rule.

President George Bush, in well-publicised ceremony at the Grand Canyon, signed the rule into law. A front-page article in the New York Times hailed EPA's use of negotiations as an alternative to 'the lawsuit system'.[45] In fact, some disgruntled power consumers did sue, but the Ninth Circuit Court dismissed their petition, noting that 'the Final Rule is the result of a site-specific informal rulemaking process that included virtually unprecedented cooperation between the governmental agency and the affected parties'.[46] The way to include the interests of the affected parties is to bring them or their representatives together

in stakeholder negotiations and give them an incentive to work something out. Economists serve this process by providing information – particularly about costs – so that collaboration can succeed where calculation fails.

PROJECT XL

The Clean Air Act was written with industries like coal-burning power plants such as the NGS in mind. These industries rely on large-scale mature technologies, for example, boilers, coke ovens, refineries, smelters, and so on, which are the principal point sources of pollution. A major goal of the statute is to force the operators of these plants to install the best available pollution-control technology and continually to develop better and cheaper means and methods of reducing emissions. An improved method or mechanism for controlling pollution on one smokestack, smelter, coke oven, refinery, etc., might be required of others. The trick was to give industry incentives – such as marketable pollution permits – to develop new technology rather than to suppress it.

During the decades since 1970, however, American industry has become more and more integrated into a global manufacturing and marketing system in which competitive advantage results primarily from introducing new processes and products. A company such as 3M, for example, which manufactures high-tech goods from adhesives, batteries, and ceramics to fuel cells, imaging equipment, and optical fibres, survives by innovating. This company like many others tries to live by the rule that a third of its products by sales should not be any more than four years old.[47] Accordingly, it must constantly change its manufacturing processes, often in the course of developing a product, and this is not consistent with filing scores of permit requests for different kinds of emissions, preparing cost–benefit analyses, and waiting years for approvals.

In response to the challenge of regulating companies such as 3M that require timely permitting if they are to operate in this country, the Clinton administration developed Project XL to give industries 'the flexibility to develop alternative strategies that will replace current regulatory requirements, while producing even greater environmental benefits'.[48] Project XL requires a stakeholder committee – including local, state, and federal officials, industry representatives, and representatives of citizen and non-governmental organisations – to develop and then oversee the implementation of Final Project Agreements. These Agreements set forth the steps an industrial facility will take to mitigate its effect on the environment and assure its standing with the local community. The Agreement requires that a company or facility demonstrate a superior environmental performance – including less pollution – than it would have achieved under current regulation. In return, the facility as a whole would be considered as a single source – all of its emissions would be placed, as it were, under a

'bubble' – and the operators could decide how to keep the total output well under allowable levels. This would free the industry from the necessity of filing for a permit for every new process and from having to install control technologies that might otherwise have been mandated. Indeed, a facility can be approved in advance for changes in flows of emissions as long as the totals in general kinds for the plant as a whole remain within the agreed-upon limit.

At least three difficulties have limited the number of Project XL success stories. First, the negotiation process among federal, state, and local agencies, the stakeholder committee, and the company can easily become more involved, time-consuming, and demanding than conventional permitting. Indeed, lengthy negotiations involving an XL application by 3M for one of its major plants proved intractable, adversarial, and fruitless. According to one careful account, both EPA and 3M took calculated positions and engaged in strategic bargaining not collaborative problem-solving. 'In the end, this was not conducive to a deal'.[49]

Second, Project XL presupposes or requires environmental performance superior to that required by conventional regulation. This baseline – the emissions conventional regulation might permit – is hard to establish in industries that have to innovate, to change processes, and to switch among flows of materials and emissions in response to market conditions. The difficulty of determining a baseline – the default level of emissions the industry had to improve upon – proved intractable in the 3M case.

Third, while environmental groups, such as the National Resource Defense Fund (NRDC), are often asked to participate in the stakeholder process, they have little incentive to do so, at least insofar as they regard all pollution as wrong and oppose any level of industrial emissions. Strategically speaking, they may do better not to participate in but to challenge any collaborative agreement as dangerous to human health and the environment. Environmental groups had an incentive to collaborate in the NGS permitting process because EPA established a 'default' option so disastrous to both sides that industry representatives and environmentalists and had to agree on something better. Perhaps EPA should have threatened to permit an independent company to operate a horrendous incinerator near the 3M site – anathema to both sides – if negotiations failed.

Absent such a threat, the NRDC, which did not join the 3M stakeholder process, prepared a detailed and bitter challenge to the proposed agreement that emerged from it. Why allow industry to poison the air for profit? Can one trust a stakeholder process that industry alone has the resources to dominate? Since Project XL has no clear legislative basis, EPA and 3M had to worry about an NRDC legal challenge. Concerned with the possibility of litigation, which would undo whatever advantages in speed the XL process offered, EPA and 3M gave up what was in any case a contentious and frustrating effort.[50]

Intel – A Success Story

In spite of its difficulties, Project XL can claim several successes. In the late 1990s, Intel proposed to build at its Ocotillo Campus in a suburb of Phoenix, Arizona, two major fabrication facilities for its Pentium microprocessor chip. Microprocessor design and manufacture can be understood in effect as an on-going experiment in which engineers constantly change manufacturing methods in view of the results. A microchip manufacturer finds troubling the idea that routine changes in manufacturing processes might be subject to months of review by county, state, and federal authorities. Intel, which also operates fabrication plants in Ireland and Israel, publicly stated that lengthy permitting requirements for every process change led the company to 'seriously question whether it could remain committed to the construction and expansion of our U.S. sites'.[51]

Intel applied to EPA for an XL permit that would 'bubble' its entire 720-acre Ocotillo site as a single source and allow the company to do as it liked as long as its total emissions remained under the caps in broad categories – such as volatile organic compounds, particulate matter, hazardous air pollutants, nitrogen oxide, and carbon monoxide. According to one technical publication, the manufacture of a six-inch wafer of microprocessors can require 20 pounds of various chemicals and more than 3,000 cubic feet of gases, all subject to scores of changes each year.[52] Intel wanted a single agreement to be administered by a lead regulatory authority rather than a variety of pacts with ten county, state, and federal agencies. A 15-member stakeholder counsel of industry representatives, officials from local, state, and federal regulatory agencies, and local citizens met over a hundred times starting in January 1996, educating each other about the technical aspects of microchip production and emissions reduction and control.

The Final Project Agreement that emerged from the lengthy and stressful stakeholder negotiation held Intel to strict requirements. The negotiators determined that in the absence of historical data – the planned facilities were new – they would consider the baseline against which to measure superior performance the theoretical maximums allowed a 'minor source' by the Clean Air Act. Intel agreed to cap emissions at less than half the allowable levels – 100 tons per year – of carbon monoxide, nitrogen oxide, and volatile organic compounds. The company committed itself to emit only 5 tons sulphur dioxide and particulate matter and ten tons of organic and of inorganic hazardous air pollutants, as compared with far greater allowances under conventional regulation, e.g., 250 tons of sulphur dioxide. Intel undertook to build and maintain a $25 million water treatment facility for the town and, of course, to furnish computers to the local schools. After the agreement was formalised, Intel constructed two large fabricating plants, one completed in 1998, the second in 2001. They produce Pentium microchips.

Cars, trucks, and other non-point sources of pollution, such as lawn mowers and barbecues, are overwhelmingly responsible for air pollution problems in the Phoenix air shed as in many other urban areas. According to the Intel website, its Arizona facilities produced in 2001 about the same amount of volatile organic compounds as 680 cars and the same amount of carbon monoxide as 80 cars. As one study states, 'The company agreed to an air permit with, on balance, much more stringent emissions limits than the what the alternative, a regular Maricopa County permit, would have required'.[53] The NRDC issued a press release complaining that the agreement did not go far enough to protect health and the environment, but the group did not threaten to sue. It would have exhausted a good deal of political capital to force all microchip manufacturing overseas.

The Wampler Factor

The principal problem confronting the stakeholder group involved determining a baseline in comparison to which Intel would be required to do better. Intel suggested that the baseline be set at current regulatory requirements for a new minor pollution source in Maricopa County. It had designed the size of its facilities, indeed, with the 'minor source' designation in mind, which allowed the industry to be subject strictly to state and county rather than federal requirements. Critics pointed out, however, that microchip manufacture is generally a cleaner activity than refining, smelting, electric generation, and other industries and so should be held to a much higher standard. A more relevant baseline might be taken from the environmental performance of Intel and other microchip manufacturers. Intel might be required not only to come well under minor source standards but to improve on its own past performance and that of the industry generally.

Accordingly, the Final Project Agreement allowed Intel to increase its emissions up to the overall cap only if it increased production proportionately. The stakeholder group wanted to preclude the possibility that Intel might produce fewer, 'dirtier' chips under the overall cap, while encouraging them to produce more, cleaner ones by improving the chip-to-emission ratio. This production-based standard has been called the 'Wampler Factor' and credited to David Wampler, an economist in the EPA regional office.[54] The stakeholder group encountered a conceptual difficulty in determining how to measure the quantity of microprocessors produced, e.g., whether to use the number of chips or wafers, the computing power (which doubled every 18 months), the revenue, or some other yardstick. The Final Project Agreement in this matter as in most others states a complex technical formula; it is characterised in the footnote.[55]

Economists who have studied the Intel XL project point out that the crucial economic analysis did not attempt to measure the benefits of microchip production generally or of the existence of a domestic microprocessor industry. Instead, economic analysis proved most helpful in establishing a baseline – such as the

production-to-emission ratio – and in suggesting ways to limit abatement, compliance, and transaction costs. Intel appeared most concerned about the transaction costs that would make it prohibitive to file for permits for every change in chemical processing, since microprocessor manufacture may require 30 or 40 such changes per year. It was also worried about having to install enormously expensive control devices on temporary and relatively insignificant sources. Thus, the appeal of the campus-wide 'bubble' – a concept originally suggested by economists – lay in the flexibility it allowed to offset emissions under a general cap rather than have to deal with each source separately. The company was willing to make significant concessions concerning the total allowable emission level to preserve flexibility in its treatment of individual sources that contributed to that total.

In a perceptive study, three economists conclude that the main benefit to be considered lay in the overall cost reduction – primarily a reduction in transaction costs – to Intel. These economists summarise, 'In Intel's case, where production processes are constantly changing during a one-year chip development process, the firm faces the prospect of costly delays every time it had to modify its production process'.[56] Intel did well to invest in the initially higher transaction cost of a stakeholder negotiation rather than bear the ongoing expense and uncertain prospects of conventional regulation. It certainly had to avoid the expense involved in preparing cost–benefit analyses to justify each change it might make in its emissions, product line, and chemical processes.

CONCLUSION

What is the alternative to cost–benefit analysis? In many instances, the alternative may involve economic concepts and analyses of other kinds. In the case studies this paper has briefly described, economists played crucial roles in the successful resolution of environmental disputes. Economists contribute to environmental policy making primarily in three ways. First, they help set up institutional arrangements, such as markets in tradable grazing permits, that enable traditional antagonists to gain the benefits of exchange. With exchange comes trust and collaboration. Second, economists may suggest useful concepts that help society measure environmental progress. One such concept, which deserves more attention than it receives, defines the 'knee of the curve' in a graph that represents pollution reduction on one axis and cost of abatement on the other. The 'knee' occurs in the region at which the costs of controlling additional units of pollution begin exponentially to increase. In the NGS case, economists showed that no 'knee' occurred between 70 and 90 percent emission reduction. The operators of the plant, therefore, became more willing to bargain over the 90 percent target.

Another concept, the product-to-emission ratio, became crucial to the Intel agreement. Economists who study the problem of global climate change have shown how this concept may also be relevant to reducing atmospheric loadings of carbon dioxide and other greenhouse gases. They have suggested that treaties adopt a target a ratio between a country's per capita GDP and its emissions – for example, dollar GDP per pound CO_2 – and that wealthier nations help poorer ones obtain the needed cleaner technology.[57]

Third, economists have shown that they can helpfully measure the costs of pollution control and environmental protection and suggest ways to minimise those costs. The negotiations that led to the NGS and Intel agreements succeeded because the stakeholders could agree on the compliance costs associated with different regulatory options. The stakeholders could search for ways to get the most environmental protection at the lowest cost. In other words, all could agree that regulations should be cost-effective even if there is no way nor need to determine whether or in what sense they are cost-beneficial.

The alternative to cost–benefit analysis is economic analyses of other kinds – institutional analysis, transaction cost analysis, cost-effective analysis, and so on. Cost–benefit analysis does not seem to be better than many other ways economists helpfully inform environmental policy. Indeed, in comparison to the many important ways economists contribute to environmental policy, cost–benefit analysis appears the least helpful – and the most likely to lead to regulatory paralysis, political gridlock, litigation, and endless and ineffectual research that benefits only those who collect fees for pursuing it.

NOTES

[1] Arrow et al. 1996, p. 221.
[2] Arrow et. al. 1996, p. 221.
[3] Arrow et al. 1996, p. 222.
[4] Sen 1997.
[5] Milgrom 1993, p. 431
[6] Arrow et al., p. 222. '[E]nvironmental, health, and safety regulations are neither effective or efficient tools for achieving redistributional goals'.
[7] Stokey and Zeckhauser 1978, p. 151.
[8] Leonard and Zeckhauser 1986, p. 34.
[9] Field 1997, p. 19.
[10] Coase 1937; Drucker, 1996.
[11] Dorf and Sabel 1998.
[12] Karkkainen 2001
[13] A vast literature describes and evaluated these methods of changing incentive structures to protect environmental quality. For a good general introduction, see Stewart 2001.
[14] For facts and figures, see Nelson 1997.

[15] These numbers are subject to fluctuation. See Manning 1995, p. 132.
[16] Nelson 1997, esp. footnote 44.
[17] Nelson 1997.
[18] Watkins 2000. See also Abby 1986; Donnahue 1999.
[19] Gardner 1963.
[20] See Holechek 1993; Martin 1994.
[21] Foreman 1995.
[22] Hess and Wald 1995.
[23] Russell n.d.
[24] Russell n.d.
[25] Kerr 1994.
[26] Wilkenson 2002.
[27] Nelson 1997.
[28] Kerr 1998, pp. 66–67.
[29] 43 C.F.R. § 4120.3–2 (2000); upheld in *Public Lands Council v. Babbitt,* 120 S. Ct. 1815 (U.S. 2000).
[30] Livermore 1996; Pooley 1997.
[31] The exemplary negotiation that led to a consensus solution for regulating the Navajo Generating Station deserves more study than it has received. But see, Bergman 1994; Rappoport and Cooney 1992.
[32] Hinchman 1993.
[33] Deck 1997.
[34] National Research Council 1993.
[35] See Rowe and Chestnut, 1982 and 1983; United States Environmental Protection Agency 1979.
[36] Mead 1993.
[37] Deck 1997, 278.
[38] Deck 1997, p. 281.
[39] The author interviewed former EPA officials involved in the regulatory negotiation; this is what one said in a telephone interview.
[40] Decision Focus Incorporated 1990 and 1991.
[41] Deck 1997, p. 290.
[42] Deck 1997, p. 293.
[43] Deck 1997, p.293.
[44] Deck 1997, p.293.
[45] Wald 1991.
[46] *Central Ariz. Water Conservation Dist. v. United States*, 990 F.2d 1531, 1545 (9th Cir. 1993).
[47] Gundling 2000.
[48] Clinton and Gore 1995.
[49] Marcus et al. 2002, p. 105.
[50] Marcus et al. 2002, pp. 85–86.
[51] Intel Corporation 1994.
[52] MCTC 1993.
[53] Marcus et al 2002, pp 119–20.
[54] Freeman 1997, footnote 190.

[55] Marcus et al. 2002, p. 145, footnote 5, write that the 'Production unit factor' was defined using as measures of units 'the area of silicon processed divided by the line width of the smallest transistor on the chip'.
[56] Boyd et al. 1998, p. 5.
[57] Claussen and McNeilly 1998.

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