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MICHAEL H. LEVIN*

Getting There: Implementing the "Bubble" Policy

Two market approaches to air pollution control. Evolutionary change v. revolutionary change. Conflict between proposals and assumptions. Advantages of the bubble concept. Opposition and compromise. The OPM task force. EPA's internal debate. State implementation plans. The controlled trading concept. The 1980 EPA conference. Incentive-based reforms.

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In July 1981 General Electric's (GE's) Louisville appliance plant discovered that it could not install a new plastic-parts line in time to meet Kentucky's October 1981 compliance deadline for emission control. The line's late arrival meant that GE could either risk noncompliance (and substantial penalties) for two years, shut down its old metal-parts coating line with its heavy emissions (and with large production losses), or buy a $1.5-million emissions incinerator that would be worthless when the old line was replaced in 1983. Instead, GE leased several hundred tons per year of emission reductions that had previously been deposited by International Harvester in the Louisville "emissions bank." GE paid $60,000 for its two-year lease, and used the leased emission reduction credits to meet regulatory requirements on the old line. The transaction produced faster compliance, saved GE more than $1.8 million in capital and operating costs, and produced healthier air than conventional controls, since the "banked" reductions contained a toxic component that continued emissions from GE's old line did not.

This emissions trade was made possible by two incentive-based reforms first allowed, then actively encouraged, by the U.S. Environmental Protection Agency (EPA): the Bubble Policy for existing sources of air pollution, and the Emissions Banking Policy, which lets emitters create surplus emission reductions and store or "bank" them for later use or sale. This chapter describes the existing regulatory system, and why previous proposals for incentive-based alternatives failed. It then sets the stage for these reforms, and traces both the strategies of those charged with implementing them and the shifting attitudes, within and outside the agency, that implementation evoked. Finally, it offers some guidelines for successful implementation of major substantive reforms in complex bureaucracies, using the Bubble Policy as a model.

Like other incentives approaches, the bubble inevitably implied structural changes in the way regulations are applied and enforced. These implications evoked massive resistance from the agency's Air Programs and Enforcement offices with large investments in the status quo, direct accountability to suspicious environmentalists, and perspectives formed by past dealings with recalcitrants. When their veto efforts failed, these offices attempted to use potential bubble savings as a lever to force applicants to correct larger program defects. Once the agency was firmly committed to the policy, however, it also had to make the policy work. That commitment eventually compelled agency change on more fundamental issues. Those changes forced EPA to become a manager auditing state programs rather than a direct regulator involved in every case, laying the basis for still broader reforms.

WHY MARKET-BASED PROPOSALS FAILED

The decade-long debate over the relative merits of emission fees and marketable permits has largely ignored the fact that *neither* appears workable, given the real-world constraints under which air pollution programs must operate. Both approaches would replace direct "command-and-control" regulation, with fees setting a market-clearing price per unit of pollution or permits setting a total pollution amount. Both approaches would theoretically produce the desired level of ambient air quality for the least cost. Both promise streamlined enforcement, continuous incentives for better voluntary control by emitting sources, and government ability to respond to new knowledge without cumbersome case-by-case rule making. Each sprang from a conviction that pollution control should focus on results (healthy air) rather than on compliance with detailed requirements.

Each was rooted in the belief that emission standards entail enormous unnecessary control costs, that "technology-forcing" requirements tend to freeze rather than promote innovative control technology, and that an incentives approach could cut these costs by harnessing industry's superior knowledge of local opportunities for equivalent emission control.

Under either approach, the profit motive of regulated firms would be put to work for (rather than against) pollution control. Innumerable variations in control opportunities that centralized agencies cannot take into account would effectively be incorporated. Companies would be able to plan how much to control and how much to allocate for permits or fees, secure in the knowledge that fees could be paid or permits bought if control efforts did not work as planned. Hard-pressed state agencies would only be required to monitor a plant's emissions and determine if it paid enough fees or held enough permits to cover them. Decisions about control methods would ultimately rest with plant managers, who know best how to reach stated goals.

Unfortunately, these scenarios generally overlooked the mechanisms by which their results would also have to be obtained. Under the Clean Air Act's bewildering array of acronyms, *EPA* was charged with setting (a) health-based maximum ambient concentration standards for specified "criteria" pollutants, as well as (b) nationwide technology-based emission limits for certain categories of major new stationary sources or modifications (the New Source Performance Standards [NSPS]), and (c) still more stringent limits for all major new sources in areas that met or did not meet the ambient standards, respectively.[1] But the *states* were responsible for designing EPA-approvable state implementation plans (SIPs) to assure that ambient standards were "attained and maintained" through control of *existing* sources, and were required to do so by compiling a quantified inventory of all emitting sources in their "nonattainment" areas,

by relating those emissions to ambient violations, and by imposing source- or process-specific control requirements sufficient to make those violations disappear.

There were some facially good reasons for this approach, including the states' long (if spotty) history of direct air pollution regulation, a desire to prevent the flight of new plants to "pollution havens," and strong congressional belief that new sources should be stringently controlled at the design stage. But the approach posed critical implementation problems for any incentive-based alternative. The Clean Air Act implied uniform maximum pollutant concentrations, above which adverse health effects would occur, for every cubic meter of air throughout the nation. It assumed specific air quality effects from each required set of controls, based on mathematical dispersion models designed to relate emissions from particular plants to ambient pollutant levels. It relied heavily on government engineering expertise and standardized end-of-pipe control technology, both for economies of scale in setting emission limits and for ease of enforcing them. It contained short deadlines backed by severe penalties for SIP submittal and approval, for industrial compliance with emission limits, and for areawide attainment of ambient limits. It implied further control if the SIP was not enough to attain ambient air standards. It seemed to require every change in emission limits to be processed as an individual SIP revision, entailing notice, comment, hearing, and review at both state and federal levels.

Given these boundaries, how could any incentives approach let plant managers make "economically rational" decisions to pay fees or buy permits instead of install controls, where the change in emissions might cause new ambient violations because the location of those emissions was critical? What plant manager would risk the uncertainties of an untested control strategy, faced with short compliance deadlines and the danger that success might become a regulatory requirement? Absent continuous emissions moni-

tors (which often were technologically infeasible), how could fees or permits be enforced without simultaneous tests of every stack or vent in a plant — a strategy that was itself unenforceable?[2]

If these problems were arguments for changing the legal framework to accommodate new approaches, they were also evidence of how much that framework would have to change. And beyond them lay other implementation issues. How would short-staffed state agencies acquire and use the detailed knowledge of potential industry cost curves needed to set *emission fees* that would not drastically overcontrol or undercontrol? How would they adjust fees that their legislatures would see as taxes and would insist on setting legislatively? How would they administer different fees for each geographic area where the level of pollution (and required cleanup) differed? Most important, how could they credibly enforce fees, which required both accurate measurement across the whole emissions spectrum (rather than a narrow band around a standard) and audits of every source obliged to pay a fee?

Permits offered more environmental certainty because they could set the total pollution amount. But if inventories had to be redone across the board to determine this total, no state would adopt permits. Assuming this hurdle was passed, how would permits be allocated? Grandfathering them to existing firms based on historical emissions would grant an economic windfall and might discourage geographic entry by new competitors. Auctioning them would entail huge payments to continue established production activities. Most important, the efficiency of permits rested on an easily used market in which firms could control up to the permit price, then sell excess permits to those whose control costs were much higher. How would states screen sales for ambient effects, assure that the same permits were not sold twice, and allow smooth permit transfers without prohibitive transaction costs?

Overhanging these issues was the stark fact that no major interest group wanted a wholesale shift to incentives. For industry, permits and fees posed increased uncertainty, plus double payments for control and the reform. For large firms with established environmental staffs—the only industry voice usually heard in Washington on air pollution matters—current problems were minor annoyances compared to the investment needed to learn a wholly new system. They had spent years learning to deal with the old system and could easily meet most technology requirements. Indeed, they had discovered that uniform technology requirements could increase their market shares.[3] They would stick with the devil they knew. For state air agencies, permits and fees represented huge restaffing and reeducation investments for potentially uncertain gains. For national environmental groups—many of whose leaders had been trained in early, bruising compliance battles with Pennsylvania steel mills—market-based incentives evoked both enforcement loopholes and the shibboleth of a "license to pollute" under which firms could simply pay to keep emitting. These groups had helped draft the Clean Air Act not merely to clean the air, but to punish: to force firms that for decades had used the atmosphere as a free dump to pay the maximum amount for past sins.

In short, proposals for permits or fees threatened to expose the gross defects in air quality management that direct regulation had largely swept under the rug—large gaps in inventories of actual emissions; huge inefficiencies of politically expedient engineering requirements that treated similar industrial processes identically; poorly understood relations between emissions and air quality; inadequate SIPs that EPA was compelled to approve in order to avoid writing local plans itself. Moreover, that threat was posed by the very economic benefit these proposals advanced: their ability to make extra pollution reduction financially rewarding. For if "legitimate" reductions in inventoried actual emissions

were valuable, costless "illegitimate" reductions in phantom emissions from plants operating far below their permit amounts, or from facilities due to close anyway, were still more valuable and would leave polluted areas even farther from attainment. If fees or permits could save local firms millions in conventional control costs, it would be difficult for states to deny these savings based on air quality models with a 100 percent error factor.

Ultimately, proposals for permits or fees collided with assumptions on which Congress and EPA had long operated: that mandated technology would solve every problem; that government had a monopoly on pollution control knowledge and could do the job better; that the states required a strong federal presence to avoid succumbing to developmental pressure; that rules must be written to exclude most firms as bad actors, rather than to assume good faith and leave bad actors to enforcement. Through October 1981, not a single jurisdiction had adopted a fee or permit system in lieu of direct regulation, though some brave souls were still attempting designs to overcome these barriers.[4] The economists' vision was no one else's dream.

SETTING THE STAGE

Thus the threshold reform issue—whether movement towards more flexibility, less government intrusion, and reduced costs should come through evolution or revolution—was settled at the start in favor of nonthreatening incrementalism. Any successful reform would have to change fundamental attitudes by fitting *within* the existing system and demonstrating that reliance on market mechanisms rather than marching orders could produce both savings and clean air. It would have to rest on concrete benefits to key participants, not on abstract efficiency claims. It would have to

start small but encourage increased use that would pressure constraints and broaden its appeal. It would have to promise returns large enough to outweigh the disruption costs to EPA regions, states, and industries asked to do business differently. It would have to be easy to understand and use, producing short-run success stories that others would seek to imitate. Above all, it would have to be put on the streets to be used and marketed to insure its use. For though regulated firms remained the prime beneficiaries of market-based approaches, there were ten years of bad blood between industry and environmental agencies. And no matter how large the potential benefits to others, state agencies with shrinking budgets would not adopt any reform unless firms eager to use it forced them to respond.

This incrementalism was directly responsible for the birth of the "bubble" concept. For under the existing system, firms were required to meet uniform statewide or nationwide emission limits for identified industrial processes (e.g., no more than 75 tons per year of particulate matter from blast furnaces or 25 tons per year from cast houses). But the cost of removing 1 ton of particulates from adjacent processes could vary by over 100:1. Why not let plants—or groups of plants—treat all their emission points as though they were enclosed by a giant bubble and rearrange controls to remove more $1 tons and fewer $100 tons, so long as air quality remained the same? This "bubble" approach would *use* (rather than replace) existing regulations and procedures by letting plant managers counterpropose more efficient permit limits tailored to the unique age, size, and configuration of processes in specific plants. It would let firms trade increased control on processes where the cost of control was low for decreased control where the cost of controlling the same pollutant was high. It would give managers a balance sheet incentive — potential savings of millions of dollars per year —to seek new chances for cheaper control, and to justify those expenditures to corporate cost centers. It would reduce

government intrusion, delegate more responsibility for individual control decisions, and make it easier for firms to plan compliance. It would also promote faster compliance and better emission measurement, since only quantified reductions below current requirements could be used to meet or avoid requirements elsewhere. As a voluntary program, it would neither require all firms to participate nor force state agencies to make massive structural adjustments. Indeed, it offered those agencies a painless way to upgrade their inventories and correct other deficiencies on a gradual basis, as individual bubble applications arrived. Most important, it could begin to change the beliefs that standardized engineering was the only way to assure environmental progress and that firms should rely solely on approved technology rather than on reductions produced by others or other means.

GETTING STARTED

Unlike some other successes, the origins of the bubble concept are not clouded with claims by competing proud parents. It began in 1972–1973 with suggestions from major smelters and the Nixon administration that EPA redefine "sources" subject to NSPS to include entire plants. This change would excuse plants undertaking major modifications, reconstructions, or expansions from stringent NSPS controls so long as total emissions from the plant did not increase. The proposal came from a heavily polluting and recalcitrant industry, appeared to contravene the Clean Air Act's directive that better controls be designed into new facilities, and was fiercely opposed by EPA's Air Programs and Enforcement offices on enforceability and equity grounds.[5] Under continuing pressure—and counterarguments that this bubble approach would produce better control on dirty *existing* sources, without overall increases in emissions—EPA ultimately proposed to allow plantwide bubbles for modifications but not for wholly new or reconstructed facilities (40 *Federal Register* 58416 [1975]).[6]

This result was immediately appealed by environmental groups asserting its illegality, as well as by smelters asserting that it should cover all three types of "new" facilities. On 27 January 1978 the District of Columbia Circuit Court struck it down in a notably formalistic decision, holding in the case of *ASARCO Inc.* v. *EPA* (578 F.2d 319 [C.A.D.C.]) that EPA lacked statutory authority generally to define "source" as a plant *by the form of words it had chosen,* though it might reach the same result for individual industries by different means.[7] In the two and one-half years this bubble approach had been on the books, not a single plant had tried to use it.[8] The agency had adopted no strategy for marketing the reform or promoting its use by industries identified as good actors.

However, the bubble concept immediately reappeared in another context, having been embraced as a *cause célèbre* by the agency's Office of Planning and Management (OPM). The 1970 Air Act banned all new construction that might cause or contribute to air quality violations in nonattainment areas after 1977. By 1976 it was clear that many industrialized areas would not meet this deadline. To avoid prohibiting economic growth, EPA issued a 1976 "Offset Ruling" that allowed major modifications, expansions, or wholly new sources to construct in such areas so long as they installed very stringent controls and secured sufficient extra reductions from nearby existing sources to produce a net decrease in emissions.[9] In 1977 Congress confirmed and required revisions in this rule, raising the possibility of a plantwide bubble to avoid these new emission requirements. This issue was a central point of EPA's internal debate during 1978, with the Air Programs and Enforcement staffs insisting *first,* that any such bubble was illegal after *ASARCO,* and *second,* that every available reduction should be seized in

nonattainment areas, regardless of its small size or high cost. EPA's Office of General Counsel (OGC) supported a broad bubble, noting that Congress had arguably ratified EPA's plantwide approach *before ASARCO*, that NSPS would still apply to new facilities within plants, and that bubbles would assure no increases in emissions while providing an incentive for existing sources to do more than the minimum required.[10] Again, no economic data were advanced to support these asserted benefits. Again, policy debate was cloaked in legal terms to give it more force.

The final "compromise," issued in January 1979, explicitly banned bubbles in areas subject to the federal ruling, but permitted *states* to allow them—for modifications only—in their new nonattainment SIPs due to be approved by that July.[11] But this was a compromise in name only, for as Air Programs staff already knew, most SIPs for significant nonattainment areas would not be fully approved for years. Moreover, the new SIPs were statutorily required to be submitted by 1 January 1979—two weeks *before* the date of this ruling. Many had already gone to state-level rule making, and word of the availability of state bubble options did not reach most affected industry in time. Concerned with their SIPs' approvability in light of these negative signals, the states declined this ambiguous invitation.

The 1979 Offset Ruling did, however, establish two principles that would later prove important. It indicated that surplus emission reductions for bubble purposes might legitimately be created in nonattainment areas so long as they did not *interfere* with progress toward attainment. And it explicitly stated that such reductions could be "banked" or stored for future use. This banking provision was particularly crucial. It laid the basis for readily available reductions that could facilitate interplant bubbles and encourage firms to meet emission requirements through trades. It also enlarged opportunities for bubble savings, since cost-effective combinations of emissions increases and decreases seldom occur at the same time.[12]

Meanwhile, OPM was moving to consolidate the bubble concept and co-opt internal opposition on several other fronts. In the spring of 1978 an agencywide task force headed by OPM was formed, with the administrator's blessing, to examine the legality and technical feasibility of new and existing source bubbles for both air and water pollution. The impetus for this task force was again a recalcitrant industry (steel). But the industry was led by Armco, Inc., which had both a reputation as a "good actor" and the willingness to produce detailed studies of the bubble's economic, energy, and environmental benefits at its plants. Moreover, the association with the steel industry was diluted by the task force's decision to focus on benefits for all industries. It was also diluted by a presidential task group (the Solomon committee) that had found steel to be financially troubled and involved three important outside bodies in bubble development—the Treasury Department, the Council of Economic Advisers, and the regulatory reform arm of the White House Domestic Policy Staff. For the first time, the bubble concept had an external constituency that could neither be identified as industry shills nor easily charged with evading legitimate compliance.

The OPM task force progressively focused on a bubble for existing air pollution sources as the most feasible alternative, discarding objections that would have trivialized the concept's economic benefits or destroyed its acceptability to potential users. These objections were: *legal or enforcement arguments* that would, for example, have barred any relaxation of SIP requirements as part of a bubble; *technical arguments*, such as those that would have limited bubbles to precisely the same type of emission point and pollutant (e.g., no bubble between stacks and vents, or between SO_2 and SO_3); and attempts to use the bubble to *correct perceived defects in the current regulatory system*, such as proposals that mandatory state operating permit systems for existing plants be required by EPA before any bubble could be approved. A

fourth line of argument suggested that bubble savings be "plowed back" into better mandatory control by applicants as a prerequisite to approval. The drafting process began to force a gradual split between Air Programs staff—who became increasingly committed to making the bubble work—and the program's senior managers, who were prepared to accept some form of bubble but were more concerned with multiple safeguards to prevent potential abuse.

The task force's September 1978 report recommended that bubbles for existing sources be endorsed by EPA but that a variety of eligibility requirements and safeguards be adopted to assure prompt compliance and environmental equivalence. Bubbles, it said, (1) should incorporate specific emission limits reflecting rearranged controls; (2) could not allow air quality to deteriorate; (3) should not allow trades between toxic and nontoxic pollutants, or between stacks and vents, unless emissions from the latter could acceptably be quantified; and (4) could not be used unless applicants met current emission limits or were on an enforceable compliance schedule to meet them. To conserve state resources, the report envisioned bubbles' being approved through normal state permitting processes. To further conserve resources, it recommended that the burden of proof on air quality and enforceability be placed on applicants, and that applications be limited to single plants. It explicitly noted that bubbles would encourage plants to disclose all their emission points (thus improving inventories) and adopt innovative control strategies that *would provide information leading to more stringent regulation.* Finally, the report identified several "major" unresolved issues, including whether EPA should actively encourage bubble applications, and whether bubbles should be floated on a trial basis before national endorsement. The legal arguments had been removed by perhaps the shortest opinion memorandum in government history, a July note from EPA's General Counsel that stated in full: "Is the bubble legal? Yes."[13]

The report produced a flurry of activity that was remarkable both for how quickly these "major" issues disappeared and for how fast internal attitudes began to converge. To this point, the program offices were principally concerned that bubbles not result in unenforceable emission limits or otherwise undermine past regulatory progress, while OPM and OGC believed new approaches were needed to assure future air quality improvement. Now, under pressure from a variety of external factors, these views began to coalesce. The Air Act would be reauthorized by Congress in 1980; the country was becoming more conservative; public attention had discernibly shifted from support for air quality regulation to more immediate concerns like nuclear safety and hazardous waste (see, e.g., Resources for the Future, Inc., 1980, summarizing trends). How could EPA continue to insist on point-specific regulatory requirements that involved the most rather than the least cost for air quality compliance? How could it demand that state agencies—faced with shrinking budgets, growing developmental resistance, and hostile legislatures—continue to regulate more and more small businesses while cranking down further on previously regulated ones? With some exceptions, direct regulation was starting to look as though it had reached the point of diminishing returns, and as though it were poor environmental management as well.

Beyond these factors lay the stark difference between the "ideal" regulatory world posited by environmental defenders and the real one. In that ideal world, states had comprehensive emission inventories; prompt compliance with state-imposed requirements based on those inventories and backed by EPA would produce clean air by fixed national deadlines; and state plans offered clear guidelines citizen groups could enforce. In the real world, inventories were grossly inadequate; all requirements were subject to negotiation; no one knew how to control many emission points; "compliance" was largely determined through unaudited

self-certifications by regulated firms; states simply imposed requirements on industries that could bear the cost; the air quality effects of genuine compliance were uncertain; and a state plan could be ten file cabinets that no one had fully read. Industry and state agencies were already beginning to argue to Congress that the system was overloaded with expensive, unnecessary requirements that produced little real environmental benefit. These issues would have to be faced soon in any event; the bubble offered a way to begin to address them through gradual nonregulatory means.

In November 1978 Air Programs developed its own draft Bubble Policy for existing sources. While the draft emphasized possible burdens on state agencies and the use of bubbles for more stringent regulation, it generally tracked OPM's version and was quickly applauded by that office. It did contain some new wrinkles that could effectively have prohibited bubbles,[14] but these wrinkles quickly became bargaining points, not absolute demands. Moreover, OPM was under pressure, too, for the lead time required to order, install, and de-bug new control equipment required the policy to be issued as soon as possible to be usable by affected plants.

After a last-minute skirmish over whether the proposed policy should be issued before or after the 1 January due date for the new SIPs—a skirmish that involved the symbolic issue of whether the policy would be perceived as required in those SIPs or as merely a state option—the proposal was published on 18 January 1979 (44 *Federal Register* 3740). It "encouraged" states to allow bubbles for all existing sources, though it asked states to comment on resource drains and retained language about using bubbles for further regulation. Among other things, it would have limited bubbles to single plants; prohibited all bubble trades between toxic and conventional pollutants; prohibited trades between industrial process emissions and difficult-to-quantify emissions from storage piles, haul roads, or other "open-dust" sources; and

barred extensions of existing compliance dates as a result of any bubble application. But it officially and freely permitted bubbles in all areas with approved SIPs, subject to air quality and enforcement tests, and it allowed increased controls on other production processes to meet requirements for process-fugitive emissions that were notoriously difficult and expensive to control.

More important than this content, however, was the fact that the agency had made the proposal public and committed itself to further publicity. For the first time, a rudimentary implementation strategy would accompany a proposed systemwide reform in environmental regulation. Comments were sought and received throughout that spring in a series of nationwide public meetings jointly run by the affected offices, as well as through the *Federal Register* proposal.

The comments were predictable. Environmental groups feared a political signal to relax regulation and continued to urge additional constraints to make sure the policy did not "call forth innovations in evasion [rather] than in technology."[15] State agencies saw resource drains behind every rock and asserted that they already possessed SIP authority to use bubble approaches, ignoring the fact that previous bubbles had been used solely as bargaining chips that rewarded recalcitrant firms engaged in drawn-out compliance negotiations. A score of regulated industries contended the policy was a "good idea" but that proposed constraints must be eased. Armco, in particular, noted that allowing open-dust trades would save it tens of millions of dollars while *improving* air quality. Indeed, it asserted, requiring process-fugitive controls without bubbles would *degrade* the air, since the electricity needed to operate those energy-intensive controls would significantly increase emissions from nearby power plants. It filed detailed studies to support these claims, which were paralleled by leading firms in chemical, petrochemical, refining, automotive, and other industries.

The comment *process*, however, served the more critical purpose of identifying and building a strong constituency of potential bubble proponents for the first time. Environmental groups would remain suspicious until demonstrated economic *and* environmental successes began to appear. State agencies (and most EPA regional offices) would process individual bubbles, but had no independent motive to go out on a limb by stimulating demand. Only if industry began using the bubble successfully would the proposed policy become real. However unsatisfactory and small a step towards use of incentives the proposed policy represented, getting it out was beginning to work. By the summer of 1979, states were already complaining about the volume of industry requests to use the bubble, and an internal Air Programs report had raised "the specters of bureaucratic strangulation" if constraints founded on mere suspicion were not eased (Standley 1979, p. 5).

This new impetus forced the agency to respond and paved the way for final policy resolutions that fall. Bubbles would still have to be individual SIP revisions, but EPA would speed their approval by helping its regions evaluate proposals and by proposing approval simultaneously with the states. The disquieting threat of further regulation and the ban on multiplant bubbles would be dropped. So long as the applicant demonstrated equivalent enforceability and air quality impacts, EPA would approve bubbles that used open-dust controls in lieu of process-fugitive equipment, provided the plant first installed those controls and verified their results; bubbles between toxic and nontoxic pollutant streams, provided the toxic stream decreased; even some bubbles that produced emissions increases—though it bluffed that, because of long-range pollution problems, it would "not approve such SIP revisions consistent with its current legal authority [to deny them]" (none). It would let states guarantee bubble applicants against more stringent future requirements derived from their applications so long as

general SIP requirements were met. Plants that were entitled to statutory compliance extensions for any other reason (such as for installation of innovative control technology) could also get extensions to implement bubbles (see 44 *Federal Register* 71780 [11 December 1979]). EPA would affirmatively encourage states to approve bubble proposals in the interest of economic efficiency, while Air Programs would designate bubble coordinators in each region to respond to inquiries and facilitate requests. And these changes would be supported by recently completed analyses suggesting that bubbles might save very large amounts without adverse environmental effects—35 to 50 percent of conventional control costs for electric utility installations, for example; 60 percent of conventional control costs, or $80 million, for 35 domestic duPont plants; and 90 percent of duPont's costs if multiplant bubbles were allowed (U.S. Environmental Protection Agency 1979; Maloney and Yandle 1979; also Maloney and Yandle 1980, pp. 49–52).

The final Bubble Policy was signed by then EPA Administrator Douglas Costle on 29 November 1979. The event was marked by various forms of hoopla, including statements that the policy would produce "less expensive pollution control, not less pollution control," and a press conference that was treated to competing impromptu addresses on the need for safeguards and flexibility by the agency's assistant administrators for Air Programs and Policy. Key agency participants were also treated by the administrator to an evening bubble reception that appropriately featured a champagne toast. Unfortunately, the champagne was cheap and symbolic; for the agency had formally assigned just three staffers to implement the policy, had made no organizational or funding changes to back its rhetoric, and had only the foggiest notion of the resources that full-scale national implementation might entail. The policy was to become a major reform through $50,000 in emergency funds and the efforts of a competent economic analysis branch that was neither inclined to implementation nor organized for it.

GETTING GOING

One month before the final Bubble Policy, a new Regulatory Reform staff (RRS) within OPM had been created and charged with "coordinating" effective implementation of the bubble, emission banking, and related incentive-based reforms. It soon became apparent that "coordination" would not work where these projects were in separate divisions, were not answerable to the coordinating office, and were composed of close-knit staffs who viewed coordination as interference. The clean answer was a reorganization to bring these projects under common control. But reorganization was complicated by the fact that it would enlarge one OPM division at the expense of two others, as well as by the chicken-and-egg reluctance of OPM management to commit more resources until it was clear the bubble would succeed.

There were two interim answers, however. A common language could be created that emphasized the similarities and interrelations between these historically haphazard reforms. RRS could use that language to assume the marketing aspect of implementation—as a simple conceptual framework to explain to industrial groups, state personnel, and other actors how these reforms could profitably and predictably be used. Once that constituency was built and RRS was identified as the agency's public contact and application facilitator, reorganization would flow logically from the way EPA would have to respond.

The vague concept of "controlled trading" was duly given content to describe how all these reforms made extra control profitable by letting firms trade inexpensive reductions created at one emission point and time for expensive regulatory requirements on other points at different times, under controlled conditions to assure air quality and enforceability. In January 1980 implementing controlled trading was made a

top regional priority in the administrator's budget guidance for fiscal year (FY) 1981. On 18 January the new chief of RRS and the head of the Bubble Project embarked on a cross-country series of double-barreled workshops for regional personnel, state agency staffs, and industrial representatives in which he explained the integrated trading concept while she described the Bubble Policy and where it fit in. Between March and July RRS and the bubble staff made nearly three dozen speeches embellishing these themes before trade associations, development groups, and air pollution professionals. A series of documents, ranging from elementary through technical, was developed to help leverage this effort and conserve manpower while responding to growing requests. RRS began to cultivate key press and trade journal contacts, sending them these materials and giving hundreds of hours of background interviews to explain the approach's importance and help spread the word to likely users.

In June the first bubble applications began to arrive and the bubble project was transferred to RRS, which began to act as a line Air Programs office to track these applications, provide technical assistance, and expedite approvals. This function proved to be particularly critical. It not only made RRS a central part of the agency's decision making, with strong necessary ties to state and regional officials; through individual applications it pinpointed ways the policy should be liberalized and provided vehicles for doing so. Moreover, it did so on potential opponents' own grounds, for applicants documented their arguments to show that liberalization would produce environmental as well as economic improvements.

But if issuance of the policy seemed a major victory to OPM veterans scarred by nearly two years of internal negotiation, it was soon apparent that despite initial interest the subject of this marketing effort would not sell. The final policy was a significant advance over the proposal. But it was not available in heavily industrialized areas without ap-

proved SIPs demonstrating attainment by December 1982—areas that included most major urban zones, that contained the widest mix of industry subject to the most stringent control requirements, in which the policy was most needed and could most cost-effectively be used. Even where the policy could be used, all bubbles had to be SIP revisions, and applying plants had to be on compliance schedules with old emission limits—a combination whose delays and short deadlines virtually forced plant managers to start investing in conventional controls. And as several applications had unfortunately demonstrated, the requirement that air quality equivalence be shown through detailed, site-specific dispersion modeling tended to "incriminate" applicants by predicting ambient violations not disclosed through the less fine-grained modeling appropriate for general areawide SIPs. Such results required not merely denial of the bubble application, but imposition of more stringent controls—though these bubbles actually produced better air quality than the SIP. Moreover, EPA would not have discovered the chance for improvement without them.

By the summer of 1980 over 40 bubbles were being actively developed by American industry, many promising large environmental as well as economic benefits. But influential state officials were already insisting that these applications were the crest of the wave rather than the tip of the iceberg, and that the policy left them far less discretion to implement bubbles than they had had before it was issued. For major industry, it had become conventional wisdom that the bubble was a good idea that had been killed by agency suspicion—that the policy was impractical because it viewed corporate managers as criminals and contained too many needless procedural hoops.

GETTING THERE

In September 1980 RRS convened a national conference of 250 senior EPA, state, and industry officials whose stated theme was "Getting More for Less: Regulatory Reform at EPA." The conference's formal purpose was to give these officials a shirt-sleeves chance to tell EPA what was right or wrong with its trading reforms and which directions the agency should pursue. Its secondary goal was to start a genuinely constructive dialogue between EPA and hostile constituencies. Its ultimate aim was to bring sharply to the attention of top EPA management the need for drastic liberalization if the bubble—and the agency's credibility—were to survive: to accelerate the momentum for constructive change begun by individual applications, confront the most critical constraints created by conservative interpretations of enabling legislation, and bring home the common perception that the policy was a public relations gesture because too few resources had been allocated to make it real.

The conference succeeded beyond its sponsors' dreams. In open sessions and closed workshops, official after official came forward to excoriate the agency for its narrow-minded suspicion and lack of responsiveness, blast EPA's insistence on direct involvement in every air pollution permit, provide detailed examples of how they and the environment could benefit if illogical bubble constraints were removed, and urge that EPA give states more latitude and rethink its whole approach to air quality management. The consistent underlying message was that the bubble was important to responsible industrial managers, but that EPA seemed ready to see it—and the whole incentives approach—fail for fear of phantom abuses that, if they materialized, could be corrected by less prohibitionary means. At the conference's close, David Hawkins, then assistant administrator for Air Programs and a died-in-the-wool environmentalist, publicly

promised to find some legal way to approve most bubbles without case-by-case SIP revisions or federal review.

Within a month the agency's bubble staff doubled and the bubble's technical assistance budget quintupled. In October the banking project was reorganized into RRS. That same month the agency agreed on a three-tiered modeling screen that would prevent bubble applicants from incriminating themselves and would sharply cut the prohibitive expense of full-scale modeling demonstrations. If bubbled emission points were similar and close together, an even emissions trade without modeling would suffice. If those points were distant or dissimilar, a limited model that showed no significant increase in ambient concentrations would be sufficient. Only if the bubble produced a net increase in emissions or a significant increase in ambient concentrations would full-scale modeling still be required.[16]

In November the agency reversed a prior decision and proposed to endorse a "generic" New Jersey SIP rule that would let that state approve hydrocarbon bubbles without EPA review. The block here had been legal: to assure air quality attainment, the Air Act required federal notice, comment, and approval for every local change in emission limits, and the legislative history showed that Congress had inserted this provision to prevent the agency from approving any "secret" relaxations. But the question was what constituted a "change in emission limits." If the state had a SIP rule that assured that every bubble that met its terms also preserved air quality, EPA could approve all those bubbles in advance merely by approving the rule. The emission limits *authorized by the SIP* would not change (45 *Federal Register* 77459 [24 November 1980; proposal]; 46 *Federal Register* 20551 [6 April 1981; final approval]).

This was easy for hydrocarbons, which did not require modeling; within broad geographic limits, a pound of hydrocarbons from one source was equal in ambient effect to a pound from any other source, and bubbles could be approved

under generic rules so long as permit totals were the same. But in December the agency went further and agreed to extend this generic approach to several classes of bubbles that normally required modeling. It also agreed to extend the policy to industrial areas without approved SIPs, so long as attainment would not be jeopardized.[17] Sources would also be given more time to implement bubbles, either through generic rules where the statute allowed it, or through discretionary case-by-case deferral of penalties where it did not. In all these situations, a state that adopted a generic rule as a one-time SIP revision could avoid further federal review.

The significance of these decisions was that, for the first time, they gave *all* relevant actors a substantial stake in the policy's success. For state agencies, generic rules offered escape from the uncertainty, delays, and resource drains of hydra-headed federal review—drains far more massive than resources needed to evaluate bubbles at the state level alone. For EPA regions—especially industrial regions overwhelmed with long backlogs of individual SIP revisions—they offered similar benefits. For industry, they held the clear prospect of a predictable alternative that fit corporate planning cycles, without hidden penalties or the dangerous fiction of having to agree to a compliance schedule with short milestones before more cost-effective emission limits could be proposed.

Because of the pending shift in administration and the six-month paralysis in agency rule making that would inevitably follow, the vehicle for these decisions became a press release. After a last-minute scramble, the release emerged on 16 January 1981, the Friday before the inauguration. It rested on EPA's good experience with actual bubble applications as its primary justification, admitted past excesses of caution, and carefully stated the rationale for its announcements, characterizing them as agency intent but noting that they were not meant to preclude even broader changes.[18] The next week RRS convened a nuts-and-bolts conference for

consulting engineers, development firms, and other potential brokers of surplus emission reductions. The conference made front-page financial headlines and created a new nucleus of credible industrial advisers to press for trades and generic rules. Articles triggered by this conference generated more than a dozen major stories on controlled trading, the new Bubble Policy, and use of incentives between January and July, and made bubble developments regular fodder for the influential business press.[19]

In March EPA reversed another past decision and proposed to let modifying or expanding sources in nonattainment areas use a bubble approach to "net out of" preconstruction permits and other burdensome new pollution source review requirements, so long as plantwide emissions did not significantly increase (see 46 *Federal Register* 50766 [14 October 1981; final rule]). In April the New Jersey generic rule was approved and EPA's Seattle region hosted the first regionally sponsored conference on controlled trading for industrial and state representatives from California and the Northwest, focused on the scope of generic rules and the uses of surplus reductions for bubbles and netting. In May the agency's Steering Committee approved a draft Controlled Trading Policy Statement meant to supersede and liberalize the original Bubble Policy, and set clear guidelines for when surplus emission reduction credits (ERCs) could be created, stored ("banked"), and legally protected for use in any trade. In June/July RRS held the first regional workshops on generic rules for state personnel in the industrial Midwest.

By October 1981 three formal banking systems were operating, with more than a dozen others close behind. Firms had paid others $1,000 per ton for surplus particulate reductions and over $500 per ton for surplus hydrocarbon reductions, even in the absence of formal banks. Over 90 bubbles were being developed for federal approval; these *averaged* $2 million in savings over the cost of conventional controls,

with many producing environmental improvements and energy benefits. EPA had approved 12 of these bubbles and proposed to approve about 6 more, with 30 others pending approval after state endorsement. They (and their state relations) included the following examples:

- Narragansett Electric of Providence, Rhode Island, is burning high-sulfur domestic oil at one generating station and natural gas at another, in lieu of low-sulfur oil at both. The bubble reduces overall sulfur dioxide emissions by 10 percent and ambient concentrations by 30 percent, while saving Narragansett and its customers over $3 million per year in imported oil.
- Can-coating facilities are saving $107 million in capital costs and $28 million in annual operating costs under an approved bubble approach that lets them average plantwide hydrocarbon emissions on a daily basis, instead of having to meet emission limits for each line throughout the day. The approach lets these plants avoid installation and operation of energy-intensive gas incinerators, promotes innovative low-solvent technology, and sets a precedent for other coating operations, such as those for appliances and wire.
- 3M's Bristol, Pennsylvania, tape-coating plant will save $3 million capital and $2 million in annual operating costs under an approved bubble that uses innovative low-solvent and solventless technology on three lines in exchange for not controlling seven others. The bubble will reduce net hydrocarbon emissions by about 10 percent more than the Pennsylvania SIP.
- Armco's Middletown, Ohio, steel plant will save $15 million capital and $3 million in annual operating costs through a bubble that allows it to control particulate emissions from ore piles, haul roads, and other open-dust sources in lieu of expensive conventional controls for cast-

house emissions. Despite its location in a nonattainment area and the limits in the original Bubble Policy, Armco secured approval by installing open-dust controls and demonstrating that they would bring *the area of its emissions' impact* into attainment. The bubble will improve air quality, eliminate six times as many emissions as conventional controls, and provide data that may make constraints on future open-dust trades unnecessary. Armco will save about $42 million in capital and $10 million in annual operating costs—almost 25 percent of the parent corporation's pretax profits—if pending applications are also approved for two other company sites.

- E. I. duPont's Chambers Works in Deepwater, New Jersey, will save about $10 million in capital plus several million dollars in operating costs by controlling hydrocarbon emissions to 99 percent at seven large stacks in lieu of state-required 85 percent control at several hundred vents, pumps, and seals. The bubble will improve air quality more than conventional controls and produce quicker compliance as well as easier enforcement, since only seven sources need be controlled and inspected.
- Another New Jersey bubble would let Johnson & Johnson overcontrol a newer plant in exchange for not retrofiting a marginal older one several miles away, preserving a positive cash flow and 150 jobs.
- The same month as the transaction in the headnote, Borden Chemical used the Louisville bank to buy 25 tons of hydrocarbon reductions from B. F. Goodrich for $1,000 per ton. Borden used the credits in a multiplant bubble that produced the same emission reductions as state-required methanol tank controls costing $5,800 per ton.

However, attention had already shifted to generic rules, which at least 15 areas—including Illinois, Oregon, Wisconsin, Massachusetts, Maryland, Pennsylvania, Maine, Ohio,

Michigan, Florida, Oklahoma, and the Los Angeles Basin—were developing. Many of these rules covered all pollutants and were at or through formal rule making; most included banking as well as bubble provisions. New Jersey had extended its generic rule to allow multiplant trades and was predicting several dozen state approvals by early 1982. Two more regional conferences were scheduled for Dallas and Philadelphia before the end of the year. Major accounting and management consulting firms were beginning to highlight descriptions of controlled trading opportunities in monthly bulletins to their clients. The agency had approved informal circulation of the draft Controlled Trading Policy Statement for comment by states, industry, and environmental groups, and RRS was revising it for final agency review. Guidelines for regional audits of state actions under generic rules were also being developed, with strong emphasis on checks of approval procedures rather than individual results. Air Programs had asked to assume day-to-day implementation of controlled trading and had begun friendly negotiations on that point. Bubble and trading approaches were being actively explored for water pollution and mobile source regulation, and had led to preliminary marketable permits proposals for non-aerosol chlorofluorocarbons and asbestos (see 45 *Federal Register* 66726 [7 October 1980; CFCs]; 44 *Federal Register* 60056 [17 October 1979; asbestos]).

The Bubble Policy had forced the agency to face and resolve larger program issues: to make modeling a decision tool rather than a decision rule; to delegate more responsibility to the states; to conceive SIPs as collections of approved procedures for developing or changing emission limits rather than collections of fixed limits; to start becoming a manager who audited state programs instead of a regulator directly involved in every case. By the fall of 1981, the bubble was almost routinized within the agency, an automatic first response when difficult problems had to be resolved.

CONCLUSIONS

The bubble is not yet institutionalized, though the principal dangers now are conflicting perceptions within the new administration that (a) it is solidly established and needs no more visible support, (b) it is a Democratic smoke screen to divert attention from the "real issues" of federal intrusion and overly stringent regulation, and (c) its effectiveness may undermine the administration's program for revising the Clean Air Act. The ill-defined tension between "regulatory relief" (with overtones of deregulation) and "regulatory reform" has further muddied the outcome. But it seems fair to say that this, too, shall pass. For this trading approach is starting to produce real state delegation and very large savings that the administration can accelerate and take genuine credit for; and after all cost-ineffective regulations are adjusted, there will remain a large body of uniform rules whose inefficiencies can be reduced only through individual trades based on knowledge no centralized agency can afford to acquire. Moreover, industry knows—and is beginning to say—that imperfect but predictable administrative solutions are better than grand designs sought through an uncontrollable legislative process.

It also seems fair to say that controlled trading has made it possible to think about practical implementation of marketable permits for air pollution control. That possibility exists not just because threshold problems have been faced and multiplant bubbles have begun to convince industry that reliance on reductions produced by others may make solid financial sense; it also exists because only a few elements need be added to controlled trading to produce the functional equivalent of marketable permits. Once those elements are added, the only difference would be whether transferable requirements are created by reductions below a regulatory baseline or by allocations that start from some other point.

Here, as elsewhere, it is important to define the experiment to succeed rather than fail. Under either controlled trading or marketable permits, substantial government involvement will still be needed to assure accurate inventories and reduction assessments, define the commodity, prevent the same permits from being sold twice, deal with the nonlinear relation of emissions to environmental effects, and bring buyers together with sellers. Hence the short-term goal cannot be an active free market. Especially where the commodity is intangible, such markets do not spring up overnight; a hundred years ago the New York Stock Exchange consisted of men named Goldman and Loeb walking Wall Street with bid tickets in the bands of their stovepipe hats. But the large savings, flexibility, and increased predictability provided by the bubble, banking, and related steps are nothing to be ashamed of. Indeed, these steps are building blocks that create both a foundation for and a momentum towards marketable permits, while allowing participants to stop and regroup at any point if the system becomes too stressed.

Finally, it seems fair to say that the bubble experience provides a good model for implementing other "substantive," incentive-based reforms that cut across whole programs or groups of regulations and are meant to change how industry complies and how much compliance costs. Whatever the regulatory system, any major substantive reform:

- *must start as a supplement, not a replacement.* "Reform" threatens institutions that have reached an equilibrium and implies that the reformer knows their interests better. Existing attitudes and modes of doing business are supported by strongly felt beliefs that will not easily change, however inefficient they appear. The more ambitious the reform, the more skepticism and resistance it will meet. The point, it would seem, is to start small but structure the reform to create an internal dynamic that will broaden it once it starts being used;

- *must be easy to understand.* Because of the "not invented here" syndrome and the inevitable resistance to new approaches, any reform whose nature, purpose, and benefits cannot be clearly described in ten minutes is likely to be dismissed by key participants. Why change is needed and what it can do for each potential constituency must be plainly defined; sufficient safeguards to keep potential opponents neutral and allow implementation to begin must also be included;
- *must provide potential benefits large enough to outweigh its disruption costs to government entities and users.* "Habitat," the Montreal World's Fair modular housing exhibit, was supposed to revolutionize home building because it cut housing costs 90 percent. Unfortunately, it cut only *structural* costs 90 percent; since structural costs were only 10 percent of total house costs, this was insufficient to overcome local building codes and other inertiae. The Bubble Policy always offered large savings to industry, but it did not really start moving until removal of SIP revision burdens created both a large vocal constituency and large incentives for state agencies and EPA regional offices;
- *must provide regulated entities with more certainty than the current system.* Benefits include certainty; potentially large savings accompanied by sharp decreases in predictability will be shunned. The problem is difficult, since regulatory innovation, like other innovation, tends to increase uncertainty for both the innovator and the innovation's users. It was solved for the bubble because the "moving target" nature of the Clean Air Act created even more uncertainty, and controlled trading offered a way to reduce that uncertainty by using extra emission reductions to meet future compliance requirements;
- *must be gotten out on the street to be used.* As for individual regulations, optimality is a self-defeating goal. However

imperfect, it is much more important to get the reform out so it can start being used and individual applications can provide concrete vehicles for later rationalization;

- *must be structured to produce quick real-world success stories.* Legislatures, regulatory agencies, and industry tend to act more on anecdotes than on analytic data. Nothing succeeds like success; business is imitative and will quickly join a bandwagon if it sees competing firms or industries profiting. On the other hand, no one wants to be the first to volunteer. The first question asked will be: "Who is doing it?" If the reform remains just a nice idea, it will fail;
- *must not be loaded down with constraints aimed at achieving other program goals.* Reforms that offer large benefits to regulated industry create large temptations to channel those benefits into mandatory correction of other program defects. Early proposals to use the bubble to secure mandatory state operating-permit programs or require bubble savings to be used for more stringent control or faster compliance are good examples. Though some compromise is inevitable, these restrictions must be resisted. They run counter to the whole purpose of an incentives approach and make potential users feel they are being asked to correct problems not of their making. If the program has defects, they should be faced directly; the reform must not be so burdensome that it cannot be easily used;
- *will inevitably evolve,* since problems and opportunities for further change cannot be foreseen. This implies that more and more resources will be needed to track individual applications, doument success stories, and make needed secondary changes as the reform moves from design through implementation and redesign towards institutionalization;
- *must be backed by organizational change.* Reorganization for its own sake is an exercise in turf-building. But limited

organizational change can send strong signals to the agency and outside constituencies that the reform effort is serious, and can place reformers in decision-making centers that require other actors to respond;

- *must build a constituency within and outside an agency,* both by involving program staff, regulated firms, and interest groups in the reform's design, and by making sure their concerns are responded to so that they will develop a stake in the outcome once initial design work is done;
- *must be developed with and transferred to the relevant program offices if it is to be institutionalized.* Institutionalization means the reform becomes a normal part of program office thinking. Planning offices seldom have the resources for full-scale implementation of a major national reform, and the reform must become embedded in the reactions of midlevel program managers and GS–9 permit writers to survive. If the reform continues to be seen as a foreign body, a planning staff creature, over the long run it will wither and fail.

Because a meaningful incentives approach means decentralized decision making and more individual responsibility, it inevitably implies structural changes in the way regulations are applied and enforced. Successful reformers must develop an implementation strategy that deals with those threats, contingencies—and opportunities—too. If the bubble experience is any guide, major reforms are a combination of grass-roots organizing and trench warfare; to succeed, they require tenacity, expanding resources, constituency building, intimate knowledge of messy program details, and constant vigilance.

4

THOMAS P. GRUMBLY

Self-Regulation: Private Vice and Public Virtue Revisited

Three aspects of health and safety regulation. Voluntarism and consensus. Federal agencies and regulatory penalties. Willful noncompliance. Problems in deregulation. Carol Foreman and 1979 changes in mandatory quality control. Implementing voluntary and self-regulatory systems.

The search for alternatives to the command-and-control health and safety regulation of the 1970s will depend in part on the extent to which private arrangements can accomplish

firms for information, cooperation, status rewards, and later employment, and hence will become co-opted to the industry's point of view (see Bernstein 1955, Mitnick 1980). Many of the toughness-enhancing regulatory reforms referred to above were designed explicitly to counteract presumed tendencies toward capture and indifferent enforcement. As is sometimes the case in social science, the theory pointed the way to human action that would disconfirm its claim to universal validity. See Quirk 1981, Anderson 1981, Weaver 1978.

4. More precisely, perhaps, regulators are usually criticized more severely for failing to prevent certain kinds of concentrated harms that result directly from lax regulation than for the more diffuse harms to persons unknown that may result from the "unanticipated," second-order effects of "tough" regulation. For example, the Food and Drug Administration (FDA) and the congressional committees that supervised it were especially concerned, throughout the 1960s and much of the 1970s, with preventing horrifying thalidomide-type side effects from new drugs and were especially sensitive to criticisms of laxity in that regard, but were much less responsive to the criticism that a large but more diffuse group of persons was exposed to suffering or death because of the FDA's overcaution and the regulatory delay in bringing beneficial new drugs onto the market. See Seidman 1977.

2. William R. Havender: "Assessing and Controlling Risks"

1. These agents are by no means to be equated with "chemicals" or "pollutants," a common misinterpretation. Instead, the estimate refers to the *total* sources of environmental differences, which are in the main related to cultural and personal practices. Whether or not one smokes, chews betel nut, chooses to reside in sunny climes at high altitudes, eats fibrous or fatty or pickled foods or moldy peanuts or corn, drinks alcoholic beverages such as Calvados, is sexually promiscuous or abstemious, or bears one's first child at an early or late age, are all factors that have been shown to be correlative with—and in some cases, causal to—particular cancers. Only a small fraction of all cancer in the United States is presently thought to be attributable to workplace chemicals or to general environmental pollution with man-made chemicals, namely, 4 percent and 2 percent respectively (Doll and Peto 1981, pp. 1245, 1251, and table 20).

2. There are many theoretical reasons for thinking inflection points or thresholds must frequently exist. For one, the human organism has evolved in a sea of naturally occurring carcinogens, so it is likely to have developed defenses for coping with these in normal circumstances. In fact, we have direct evidence of such a defense in skin pigmentation, the level of which determines sensitivity to ultraviolet (i.e., sunlight) induced skin cancers. Another defense is DNA repair, which can be accomplished by many identified enzyme systems. One genetically caused defect in DNA repair—namely, xeroderma pigmentosum—leads to greatly elevated proneness to sunlight induced skin cancer. Other enzymatic systems are known to be in the liver where they are constantly at work cleansing the blood of toxic materials. Any of these systems can be saturated or overloaded by sufficiently high doses, and there is little reason to expect that cancer effects seen only in animals whose normal defense mechanisms have been overloaded by high doses must necessarily be predictive, either qualitatively or proportionately, of the results to be seen at does that allow these systems to function normally. In addition, some enzyme systems are known that not only metabolically *activate* carcinogenic substances but whose level is inducible by those same substances.

For these, the dose response must be nonlinear, curving upwards at high doses. Finally, many apparent carcinogens may be acting by means of "promotion" rather than by "initiation"—that is, by enhancing the effects of true carcinogens. Practically nothing is known about the dose response of promotion; there is not the slightest theoretical reason to think that its dose response must in general be linear.

3. Only one such "megamouse" test has been carried out. In brief, the chemical used (2-acetyl amino fluorene) induced tumors in only two organs, the liver and the bladder. For liver tumors, the incidence at the lowest dose (which was only five times less than the highest dose) was excellently predictable from the incidence seen at the higher doses by a linear model; but for the bladder tumors there was a clear inflection point, and the low-dose risk would have been overpredicted manyfold by linear extrapolation from the higher doses (Littlefield et al. 1980, pp. 23, 27). Nature is not yielding her secrets easily!

4. For saccharin, see Havender 1979, pp. 17–24, Hoover and Strasser 1980, pp. 837–40, Wynder and Stellman 1980, pp. 1214–16, Morrison and Buring 1980, pp. 537–41; for hair dyes, see Clemmesen 1981, pp. 65–79; for DDT, see Laws et al. 1967, pp. 766–75, World Health Organization 1971, and Council on Occupational Health 1970, pp. 1055–56.

5. For sugar, see Hoffman LaRoche 1978; for pepper, see Concon et al. 1979, pp. 22–26; for eggs, see Nelson et al. 1954, pp. 441–45; for Vitamin D, see Gass and Alaben 1977, p. 477.

6. In fact, in the famous saccharin rat studies, males but not females developed tumors. Thus, even within a single species under uniform test conditions, males failed to predict the outcome for females (Office of Technology Assessment 1977, pp. 50–60). This weakens the basis for predicting a significant cancer risk to humans, particularly women, from these results.

7. Personal communication from John Mendeloff in 1981.

8. For a general discussion of the "knowledge" problem, see Hayek 1945, and Sowell 1980.

9. This is another instance of maximin thinking—taking the worst possible case in the population (fetuses and young children) as the basis for regulating everyone else.

3. Michael H. Levin: "Getting There: Implementing the 'Bubble' Policy"

1. Under the Clean Air Act (CAA) as amended, EPA was eventually directed to set NSPS, reflecting "the degree of emission limitation and the percentage reduction achievable through the application of the best technological system of continuous emission reduction which (taking into consideration . . . cost . . . and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated" for major categories of new or altered industrial facilities that increase emissions of regulated air pollutants above certain cutoff levels (CAA Section 111, 42 U.S.C. 7411 [1979]). EPA was also directed to set still more stringent emission limits, through a preconstruction permit program, for major new "sources" seeking to commence operations in clean- or dirty-air areas. These were to reflect either Best Available Control Technology (BACT, for clean-air areas), defined as "the maximum degree of reduction . . . which the permitting authority, on a case-by-

case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable . . . through application of production processes and available methods, systems, and techniques" with applicable NSPS as minimum requirements; or Lowest Achievable Emission Rate (LAER, for dirty-air areas), defined as either "the most stringent emission limitation . . . contained in the implementation plan of any State for such class or category of source, unless the owner . . . demonstrates that such limitations are not achievable, or the most stringent emission limitation . . . achieved in practice by such class or category of source, whichever is more stringent" (CAA sections 160–69, 171[3], 42 U.S.C. 7470–79, 7501[3] [1979]). The following passages generally refer to the act as it existed after the 1977 amendments, since the changes were progressive and integral.

2. Individual stack tests cost $5,000–$10,000, take 2 to 3 days, and require substantial advance notice to perform. For an expanded version of the points in this and the following paragraphs, see Drayton 1978.

3. Two well-known examples include bicycle-safety regulations, drafted by the American bicycle industry for the Consumer Product Safety Commission (CPSC), which would have excluded foreign-made bicycles from the domestic market; and safety rules for swimming pool slides, which conformed to the industry leader's production molds and allegedly drove domestic competitors from the field. See Cornell et al. 1976, pp. 493–94; "Taking a Dive at the CPSC," *Regulation*, July/August 1981, p. 7. See also JACA 1975.

4. See, e.g., Hahn and Noll 1981 (re marketable permits for SO_2 for the South Coast [Los Angeles] Air Quality Control District); also statement of James Smith et al., Philadelphia Air Management Services Division, to the Senate Committee on Environment and Public Works (2 June 1981; re emission fee/subsidy plan as alternative SIP for Philadelphia).

5. The principal arguments were that this bubble rested on difficult technical determinations that plantwide emissions had not increased, that it would allow plants to leave long-lived new facilities uncontrolled merely by closing old ones that would have shut anyway, and that it would reward polluters who had installed the least amount of control on existing facilities.

6. The rationale for this compromise was that operators altering existing facilities needed more flexibility than those constructing wholly new ones.

7. The court partly relied on the "purpose" of NSPS to *enhance* air quality through the narrowest reasonable definition of "source": the more narrow the definition, the more "sources" would be subject to stringent control. This was dubious reliance in light of the NSPS' primary intent to discourage flight of new industry to less-regulated areas—a purpose that did not apply to modifications. Moreover, since new facilities meeting NSPS would still *add* emissions to the plant, the bubble appeared to accomplish air quality enhancement more effectively than the court's disposition, at least over the short term.

8. This lack of use was one of the major reasons cited by the agency's Office of General Counsel for the Solicitor General's refusal to seek review of *ASARCO* in the Supreme Court. Letter, Joan Z. Bernstein, General Counsel, EPA, to William D. Nordhaus, Member, Council of Economic Advisers (undated; week of 20 June 1978).

9. Emission Offset Interpretative Ruling, 41 *Federal Register* 55524 (21 December 1976). The ruling required such sources to install LAER control technology, to obtain more than enough reductions from existing emitters to offset their remaining emissions, and to meet several other conditions. Though it was justified within the agency as a way to compensate for states' inability or unwillingness to control existing sources more tightly, this ruling was EPA's first full-dress attempt to use market forces to obtain new emission controls. It represented a tacit admission that, at least for existing sources, direct regulation alone was not enough.

10. For similar reasons, the agency had grudgingly adopted a limited eligibility bubble, applicable only to modifications, in regulations specifying control technology requirements for plants in clean-air (PSD) areas. See 43 *Federal Register* 26380, at 26394 (19 June 1978).

11. (Revised) Emission Offset Interpretative Ruling, 44 *Federal Register* 3274, at 3276–77, 3282 (16 January 1979). The critical condition was that approved SIPs had to demonstrate both attainment of ambient standards by December 1982, and reasonable further progress towards attainment (RFP), measured in annual incremental emission reductions, during the interim.

12. The 1976 offset ruling had banned banking on the ground that "extra" reductions should accrue to the states to assure attainment "as expeditiously as practicable." See CAA Section 110(a)(2)(A), 42 U.S.C. 7410(a)(2)(A) (1979). This confiscatory approach was bound to discourage better voluntary control by existing sources. The 1977 Clean Air Act amendments removed the legal basis for this confiscation approach and paved the way for the shift. See 44 *Federal Register* at 3280.

13. Memorandum, Joan Z. Bernstein, General Counsel, EPA, to William Drayton, Jr., Assistant Administrator for Planning and Management (undated).

14. E.g., a new suggested limitation that bubbles not result in increased *concentrations* of the bubbled pollutant, rather than not create or aggravate any ambient violation. Since a bubble shifts emissions to the most cost-effective control locations, it will by definition produce some increase in ambient concentrations somewhere, unless the emission plumes from the bubbled points precisely overlap.

15. Letter, Richard Ayres and Frances Dubrowski, Natural Resources Defense Council (NRDC), to James Kamihachi, Economic Analysis Division, EPA (22 September 1978). See also NRDC, "Comments on Proposed 'Bubble Policy' " (15 March 1979).

16. See "Guidance on Modeling Involving Point or Process Sources." Memorandum from Walter C. Barber, Director, Office of Air Quality Planning and Standards, to David Kee, Director, Air and Hazardous Materials Division, EPA Region V, 19 January 1981.

17. The block here was a policy consideration. If states gave bubble credit for surplus reductions from existing sources that would later have to be controlled to Reasonably Available Control Technology (RACT) levels under approved SIPs, relied-upon reductions from those sources might be undermined, since they would *already* have been controlled to allow emission increases elsewhere. Especially for major sources with local political power, it might be difficult for state agencies to "revisit" these approved trades and require them to be undone. The solution was yet another compromise. Large plants could agree to a RACT baseline, below which further reductions could be credited towards bubbles. Smaller plants could elect either actual emissions or RACT-level emissions as their baselines, and if they chose RACT they would be granted a five-year federal immunity from further SIP requirements.

18. See EPA press releases of 16 January 1981, entitled "EPA Announces Major Changes in Bubble Policy" and "Detailed Statement on Bubble Policy Changes."

19. See, e.g., "How to Limit the Rising Costs of Stricter Regulation," *Chemical Week*, 21 January 1981, pp. 36–40; Shabecoff 1981; Hamilton 1981; Hagerty 1981; Smith 1981, pp. 796–98; Mosher 1981, p. 362; Ryan 1981, pp. 8–9; "Cutting Red Tape in Emission Rules," *Business Week*, 4 May 1981, pp. 62F–62H; Alexander 1981, pp. 234–54; Tucker 1981, pp. 31–38; Pasztor 1981, p. 29 Drayton 1981, pp. 38–52; Raufer et al. 1981, pp. 839–45; "Putting the 'Bubble' Control of Pollution to the Test," *Chemical Week*, 9 September 1981, pp. 22–24.

6. Paul Danaceau: "Developing Successful Enforcement Programs"

1. Danaceau (1981) provides detailed descriptions of the on-site inspection activities of Limpert, Hollenbeck, and Finucane. The experience cited in this chapter comes largely from observations the author made during one week spent in the field with each of the three model inspectors. Each week also included discussion with the inspectors as well as the representatives of the companies being inspected regarding their respective roles in developing more effective and successful enforcement programs.

2. Danaceau (1980) provides a discussion of how people in a city of 50,000 perceive and respond to government regulation.

8. George C. Eads: "White House Oversight of Executive Branch Regulation"

1. Whether the Reagan administration will seek to alter substantive statutes that forbid or discourage cost-benefit analysis remains to be seen. Its Clean Air Act proposals certainly sidestep the issue.

2. Memorandum for Heads of Executive Departments and Agencies from David A. Stockman, Director, Office of Management and Budget: "Certain Communications Pursuant to Executive Order 12291, 'Federal Regulation,' " 11 June 1981, p. 2.

3. Some agencies, to gather information required to frame intelligent regulatory options, make use of a device called the "Advance Notice of Proposed Rule Making" (ANPRM). This should be encouraged. I do not know whether OIRA extends its formal authority to ANPRMs, but it should resist any temptation to do so. It will be hard enough for OIRA to frame intelligent priorities for its activities if it concentrates on genuine NPRMs and ignores the "fishing expeditions."

4. The Supreme Court's recent "Cotton Dust" decision, *American Textile Manufacturers* v. *Donovan*, reemphasizes the need to do this.

9. Lawrence S. Bacow: "Private Bargaining and Public Regulation"

1. For a full review of the health and safety activities of unions, see Bacow 1980, pp. 60–88.

2. *Whirlpool Corporation* v. *Marshall*, 48 LW 4189, 4194 (1980).

3. For a description of case studies of environmental regulation, see Susskind, Richardson, and Hildebrand 1978.

10. Michael O'Hare: "Information Strategies as Regulatory Surrogates"

1. This example is contaminated by arguments from externalities, like damage to the injured person's family, or the risk that he will become a public charge. I will return to these questions.

2. A concept much underappreciated in the social sciences, an operational definition defines a dimension that provides the process by which it is observed. For example, an operational definition of *the height of a building* might be "the tangent of the angle read from a transit focussed on the top of the building and located at the elevation of the building's base, times the horizontal distance from the transit to the building's nearest wall."

3. This article contains an extensive bibliography of books and articles about the economics of information. A shorter version appears as O'Hare 1981*b*.

4. The guarantees in question apply to property-value losses that may result if the plant operates as it should. If an accident were to occur, of course, the operator's liability insurance would cover the much greater damages incurred.

5. National Fire Protection Association, telephone interview, October 1981.

6. American Cancer Society, telephone interview, October 1981.

7. Karig 1981 provided some refinement of this concept in a class paper.

8. W. Kelly, *op. ignot.* It is a continuing embarrassment to the academic information retrieval industry that no concordance to the works of this sage exists.

11. Eugene Bardach and Robert A. Kagan: "Liability Law and Social Regulation"

1. See, for example, *Borel* v. *Fibreboard Paper Products*, 493 F.2d 1076 (5th Cir. 1973), opening the way for lawsuits by thousands of exposed workers who inhaled asbestos fibers over the years and apparently, as a result, contracted asbestosis (an emphysema-like disease) and mesothelioma (a lung cancer). In one such case, a jury awarded $450,000 to an insulation installer who suffered from asbestosis; in another, a widow won $3 million. See Schept 1980, p. 1, and Krieg 1979, pp. 3, 6.

2. In Soble's proposed statute, compensation for "pain and suffering" would be authorized, unlike workers' compensation, but would be limited to one-half the total award.

3. An objection to this system might arise from the fear that chemical firm managers would be tempted to gain sure profits (and credit for them) today by speeding up or cutting down on current testing while discounting the risk of damage claims ten or twenty years hence—when they personally might no longer be with the corporation, or might have moved up to another job. But that objection may underestimate the impact of the enormous liability threat posed by such a mistake, and hence the motivation of corporations to structure incentives and career lines and pension rights to avert that kind of temptation. Moreover, chemical company officials cannot be sure that a hazardous chemical will not generate certain harms and liability suits soon after it hits the market as opposed to twenty years later.

4. See *Eisen* v. *Carlisle and Jacquelin*, 417 U.S. 156 (1974 [notice must be sent by plaintiff to all members of the class]); *Sosna* v. *Iowa*, 419 U.S. 393 (1975); and "Developments in the Law: Class Actions," *Harvard Law Review* 89 (1976: 1319). The Supreme