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Fixing the Hole in the Ozone Layer: A Success in the Making

Drusilla J. Hufford

Paul Horwitz
University of Alabama - School of Law, phorwitz@law.ua.edu

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Barely two decades ago, an image obtained by the British Antarctic Survey of the hole in the earth's protective ozone layer generated enormous public concern and heated discussion of the science surrounding the problem. National news magazines sported cover pictures of the hole in the ozone layer and the issue captured the public's imagination. Indeed polls continue to show high public awareness of, and concern about, ozone layer depletion.

Public and scientific focus on the problem mobilized vital policy creativity behind the idea of global cooperation to reverse the damage to the ozone layer. The resulting international accord, the Montreal Protocol on Substances That Deplete the Ozone Layer, was signed by twenty-seven countries in 1987. Montreal Protocol on Substances That Deplete the Ozone Layer, 1522 U.N.T.S. 293, *reprinted in* 26 I.L.M. 1550 (Sept. 16, 1987) (Montreal Protocol). The treaty to protect stratospheric ozone was a first-ever international collaboration to preemptively avert a growing environmental threat with the potential to harm people and ecological systems worldwide.

At the international level, the accord has been highly successful. It has now been signed by 187 nations, making it the most nearly universal of treaties on the environment. The parties to the Montreal Protocol include both developed and developing countries, all of whom have committed to meet real and measurable reduction targets with quantifiable environmental goals and milestones.

The United States has been a leader in protecting the ozone layer, having taken substantial preventive action even before the Montreal Protocol was negotiated. In 1978, the United States banned the use of chlorofluorocarbons (CFCs) in aerosol products like consumer spray cans. 42 Fed. Reg. 22,018 (Apr. 29, 1977); 43 Fed. Reg. 11,319 (Mar. 17, 1978). Since the passage of the Clean Air Act Amendments of 1990 (CAA), the United States has met and often exceeded targets agreed to under the Montreal Protocol. 42 U.S.C. §§ 7661 *et seq*.

Ms. Hufford is director and Mr. Horwitz is principal negotiator for the Stratospheric Protection Division, U.S. Environmental Protection Agency. They may be reached at hufford.drusilla@epa.gov and horwitz.paul@epa.gov, respectively. The views presented here are the authors' alone and do not necessarily represent the views of EPA.

The CAA calls upon EPA to create comprehensive domestic regulatory controls on production and consumption of ozone-depleting compounds (ODCs). Over the past ten years, these controls have been successfully implemented to address the worst ozone depleters, slashing overall U.S. production and consumption of ODCs by more than 96 percent. A regulatory framework now exists to ensure that ODCs still being produced and used are carefully managed to prevent unnecessary emissions, and to implement remaining production phase outs for the many less potent ODCs that are still being produced. 42 U.S.C. §§ 7661 *et seq*. As a result of all these steps, ozone layer protection is a success in the making.

Some point to this record of success as proof that the problem has been solved. Regrettably, the success so far has not ended ozone damage. The 2003 seasonal ozone hole was, in fact, the second largest ever observed, reaching 11.1 million square miles (slightly larger than the North American continent) on September 24, 2003. This is only slightly smaller than the largest ever recorded on September 10, 2000, when the ozone hole covered 11.5 million square miles. www.gsfc.nasa.gov/topstory/2003/0925ozonehole.html.

One reason this damage continues is the very long life of many ODCs. In addition, even though developed countries have banned production and consumption of the most damaging ODCs, they have not banned use of remaining stocks or required that ODCs contained in existing equipment be destroyed. Thus, emissions to the atmosphere continue from ODCs that are used in—and slowly leaking out of—millions of individual pieces of existing equipment.

Scientists have predicted that it will be at least fifty years before the ozone layer recovers. This estimate assumes complete worldwide compliance with the Montreal Protocol, including required reductions in production for all controlled substances. During the time it takes the ozone layer to recover, we are all living under changed skies. Average ozone loss at midlatitudes, where most of the world's populations reside, are on the order of 3 percent to 6 percent. World Meteorological Organization, Scientific Assessment of Ozone Depletion (2002). Because of this ozone loss, more ultraviolet (UV) radiation will penetrate the thinner ozone layer. This means that for some time, we face higher lifetime risks of skin cancer and cataracts from elevated UV levels.

Given the strength of the scientific case supporting action, the assumption of full compliance has been a safe one until quite recently. However, it has proven challenging, either for economic or technical reasons, for developed countries to completely end reliance on ODCs in some sectors. The sound policy instincts that led treaty negotiators to tackle the big problems first has left some of the most intractable ones for last, proving the economic maxim that the last few percent of any job is the most challenging. Solving these problems cannot rival the environmental contributions of progress already achieved, which has led some to argue that solving these problems does not matter to the overall effort to protect stratospheric ozone. Nothing could be further from the truth.

Incremental unraveling of specific protections in the Montreal Protocol could lead to much larger erosions in the public health gains we have made. This is because the determination of one country that it is not environmentally important to comply with a small obligation that they deem in their national circumstances difficult to complete invites other countries to question their need to comply with provisions that are difficult for them. If the large developing countries were to rethink their currently small ODC reduction obligations because compliance is difficult, their rapidly growing economies would expand ODC use vastly—potentially enough to wipe out all of the global reductions achieved to date. Thus, one possible outcome of a weakening of will to complete the job in developed countries could be not just delay in the recovery of the ozone layer, but a failure to restore the ozone layer at all.

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History of CFC Research

The theories of U.S. scientists Drs. Sherwood Rowland and Mario Molina first focused scientific interest on the problem of ozone depletion in the stratosphere. They posited the possibility that the widely used, human-made industrial family of CFC compounds could reach the earth's stratosphere intact because of their molecular integrity. Mario Molina & Sherwood Rowland, *Stratospheric Sink for Chlorofluorocarbons: Chlorine Atomic Catalyzed Destruction of Ozone*, 249 NATURE 810 (1974). There, they postulated, the sun's energy could release the chlorine atoms in CFCs, freeing them to react with, and destroy, ozone in the earth's stratosphere. Each single release would not merely destroy one or a few ozone molecules, but many, as each chlorine atom combined and recombined in an ongoing chemical reaction.

This hypothesis generated profound concern among public health experts and environmentalists who understood the human health and ecological stakes: the stratospheric ozone layer shields the earth from harmful UV radiation, making life on earth possible. If not checked, thinning ozone could have allowed increasing amounts of UV radiation to reach earth, causing millions of skin cancer deaths, as well as disrupting ecological systems by damaging or killing organisms that are also intolerant of additional UV exposure.

The hypothesis also generated alarm among those who viewed CFCs, which were in widespread use in such critical areas as refrigeration, air conditioning, insulation and industrial cleaning, as vital to national economies. Consequently, the scientific discussion in the peer-reviewed literature that filled in the picture sketched by Rowland and Molina was conducted amid a chorus of voices taking different sides of the issue. Over time, however, scientific evidence firmly established the causal link between CFCs and ozone depletion, leading the world community to take specific action in the form of the Montreal Protocol.

The original Montreal Protocol negotiated in 1987 represented a modest first step, calling for a 50 percent reduction in CFC use over a decade. A second set of chemicals, the fire-suppressant halons, was considered so vital that despite their large contribution to ozone depletion, the original parties agreed only to freeze their production and consumption.

The Montreal Protocol was amended four times in succeeding years. Its subsequent strengthening was based on a growing body of published peer-reviewed science, including observational evidence showing that actual damage to the ozone layer was more severe than the mathematical models predicted. The first change, the 1990 London Amendment, added several chemicals to the Montreal Protocol, and called for a phase out of production and consumption of CFCs and halons by 2000. In addition, the parties at this time created an innovative Multilateral Fund to assist and thereby enable full developing-country participation in the global regime. The second change occurred in 1992, when the parties, meeting in Copenhagen, agreed to accelerate the phase out of CFCs even further—to 1996. Also at that time, the parties agreed to add a newly identified ODC (methyl bromide) and to a 1994 phase out for the highly ozone-depleting halons that just seven years earlier had been judged to be irreplaceable. Subsequent amendments in 1997 in Montreal, and 1999 in Beijing, strengthened the instrument in a manner designed to enhance compliance.

Throughout this process there was strong U.S. leadership in crafting the policy architecture of the Montreal Protocol. The first President Bush strongly pushed the world community to go beyond the treaty's original terms. A front-page story in the *Los Angeles Times* reported, "Heeding disturbing new warnings that the Earth's ozone layer is being destroyed at a startling pace, President Bush called Friday for a ban on use and production of ozone-depleting chemicals by the turn of the century. . . . " Cathleen Decker & Larry B. Stammer, *Bush asks ban on CFCs to save ozone*, L.A. TIMES, Mar. 4, 1989, at A1. Further, President Bush made that statement in an atmosphere of tremendous bipartisan support. Once signed, the Montreal Protocol was ratified in the U.S. Senate without dissent, an occurrence virtually unheard of today. While there was robust debate about many details, the amendments to the Clean Air Act passed in 1990, making the controls under the Montreal Protocol U.S. law.

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It is useful to consider the factors that contributed to this unusual level of consensus around an environmental accord that required major changes in industrial and consumer production. One factor was wide agreement in the scientific community that ODCs were destroying the ozone layer. After spirited initial resistance, extraordinarily broad-based industry support for action also developed. The strong public opinion in favor of saving the ozone layer was a factor that helped to create this shift in perspective. Perhaps more important, some of the chemical producers had been experimenting with alternatives to CFCs for quite awhile. The most innovative among them saw a way to publicly exercise environmental leadership while also developing new product lines and business opportunities.

While these factors may have served as the main impetus to action, other aspects of the policy architecture of the Montreal Protocol also helped broaden support. The Montreal Protocol was science-driven yet flexible enough to incorporate some basic rules of reason, setting against its environmental imperative important constraints reflecting other strong interests of societies. The treaty combined unflinching commitment to environmental result—a 100 percent production phase out—with a pragmatic approach to the implementation process. For example, one rule of reason that was key in its wide early acceptance was tackling the biggest contributors to the problem first (e.g., CFCs and halons), rather than tackling the full panoply of ODCs all at once. Another rule of reason is reflected in the individual chemical phase outs under the treaty, which occur in graduated reduction steps over time, giving national economies time to adjust, implement alternatives, and make measured transitions.

The Montreal Protocol explicitly required a periodic review of the state of the ozone layer to ensure that as science progressed the accord could be revised to recognize new science. This review was to be conducted by an international body of scientists who would report periodically on the state of the science. So that the parties could react rapidly to changing science, the Montreal Protocol incorporated a novel adjustment procedure that enabled agreed-upon accelerations of controls on chemicals to be legally binding in a matter of months based on review of new scientific information. Montreal Protocol, art. 2, ¶ 9. Other multilateral environmental agreements require countries to go back to their legislatures and seek national ratification of such changes before they enter into force—a process that can take years.

Another significant attribute in the Montreal Protocol is its ability to take into account the technical feasibility of replacing ODCs with alternatives. Recognizing the possibility that there might be some very important uses for which alternatives did not exist by the phase out date, the Protocol included important safety valves in the form of exemptions from the production phase outs for uses deemed by parties to be "essential." Montreal Protocol, art. 2. This allowed parties to move forward more confidently with a goal of 100 percent production phase outs, knowing that the Protocol provided for the possibility that some replacement tasks would be harder than others because of the high value to society of the use being replaced, unusual technical demands of certain uses, or important public health issues.

A further rule of reason in the Montreal Protocol is the freedom accorded individual country signatories to meet the targets to which all parties agree. The treaty sets broad goals, like an agreed-upon timetable for cuts in production and consumption by specific dates, but leaves individual countries to decide how best to meet these goals. Experience has proven the wisdom of this approach, as different countries have used different strategies with success.

Finally, staging the developed country phase-outs first allowed for amassing extraordinary technical experience in making the transition in key sectors that could then be shared with the developing world. This tactic of including, but delaying, developing country compliance has been key to the broad-based participation of developing countries in the process. Once the Multilateral Fund was set up to provide financial assistance, nearly all developing countries signed onto strict measurable control provisions that followed the developed country lead by, in most cases, ten years.

Successes So Far

During the run-up to the phase out of CFCs in 1996, the United States consistently outperformed the required levels of reduction for Class I ODCs. Similarly, for other production phase outs, the U.S. has outperformed the production targets of the Montreal Protocol in the majority of control years. Success can also be measured in other ways: Health benefits of protecting the ozone layer are of a magnitude seldom seen in environmental programs. Studies required by the CAA to evaluate the protections and cost-effectiveness of its programs suggest that we are getting more health benefits through the ODC-reduction program than just about any other CAA requirement. Ending damage to the ozone layer is expected to prevent millions of deaths from skin cancer over the next hundred years or so. This is an enormous benefit in combating a disease that kills one American every hour.

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Further, those health benefits came at a lower cost than originally thought possible. EPA expected the original Montreal Protocol to deliver a 50 percent reduction of CFCs at a cost of \$3.55/kg. However, just four years later, EPA anticipated a full phase out of CFCs for an estimated cost of \$2.20/kg. Even when the phase out was accelerated four years to 1996, reductions were delivered for \$2.45/kg. Many factors account for this. An important one is the difficulty of properly capturing the creativity of industries responding to clear targets, which can drive costs much lower than anticipated. Clearly, industry leadership continues its vital contribution to this record of success. WORLD RESOURCES INSTITUTE (WRI), OZONE PROTECTION IN THE UNITED STATES: ELEMENTS OF SUCCESS (Elizabeth Cook, ed., 1996).

The successes achieved so far are all the more striking when one considers how pervasive was the reliance on the use of ODCs a little over a decade ago. Consider the first hour of a typical day: it starts with the clock radio alarm, components of which were cleaned with CFCs. Beds are lofted with CFC foam; rugs cushioned with CFC padding. Bath water is hot because of CFC foam insulating the water heater. Downstairs a refrigerator is cooled by CFCs, and contains CFC-blown insulating foam. Cars on the road are air conditioned with CFCs, and foam in the steering wheel and seats was created with CFCs. The commute to work is made easier by roads where white lines were laid down using methyl chloroform. Workplaces are air conditioned by CFCs and made safe by halon fire extinguishers; and offices are filled with desks laminated together with carbon tetrachloride and with computers whose chips were cleaned with ozone-depleting solvents. It is remarkable that removing ODCs from all of these uses occurred with so little disruption.

Not only have U.S. successes so far been impressive, but progress in other developed countries has also been enormous. Specifically, the world community as of 2002 has totally phased out the annual use of: 29,000 tons of methyl chloroform (a solvent used by thousands of businesses), 140,000 tons of carbon tetrachloride (another solvent with thousands of users), 110,000 tons of halons, and finally, 710,000 tons of CFCs. While there are some outliers, developing countries are also doing very well. Although at present developing countries are only required to have frozen their consumption of ODCs at historic levels, many are exceeding their initial freeze targets by a substantial level. With the assistance of the Multilateral Fund, most have reduced their historic consumption levels by 50 percent.

Critical Success Factors

The policy framework created by the Clean Air Act Amendments of 1990 is among the most vital factors in the success to date of the U.S. effort to protect stratospheric ozone. The policy framework relies on a carrot-and-stick approach combining incentives and disincentives into a robust substitute for prescriptive command-and-control regulation. The first element in this framework was turning off the production tap. This element envisioned the end, in a practical and verifiable way, of the actual cause of damage to the ozone layer. Empirical evidence of the success of this approach was provided by a precipitous decline in atmospheric amounts of methyl chloroform, a short-lived ozone-depleting compound. S. Montzka et al., *Present and Future Trends in the Atmospheric Burden of Ozone Depleting Halogens*, 298 NATURE 690 (Apr. 22, 1999). If the short-lived methyl chloroform is already showing a steep decline, it is likely that longer-lived ODCs will also decline, although over a longer time period.

Controlling production is an "upstream" regulatory approach, allowing EPA to develop regulations to control the activities of a small number of chemical producers and importers. This sharply limited set of control targets for regulation and compliance assurance has made it possible to implement the program to date with a tiny investment of taxpayer resources.

The framework has also been effective in its broader operation in the economy. Reducing supply made prices rise, which provided an incentive for producers to invest in developing alternatives at the same time that buyers experienced a price-based incentive to adopt those alternatives. Congress, recognizing that restricting supply alone might not lead to the most expeditious phase out, created an additional impetus in the form of a tax on most Class I ODCs. The tax was responsible for more than tripling the price of CFCs over what it would have been with supply restrictions alone. WRI, OZONE PROTECTION IN THE UNITED STATES: ELEMENTS OF SUCCESS.

In brief, the CAA transformed the major reduction requirements of the Montreal Protocol into U.S. law, mainly to be implemented by EPA. At the broadest level, the CAA sets out a hybrid system that combines an end of U.S. production for ODCs with interim reduction milestones. It is a hybrid system because it also includes other mechanisms, including requirements for recycling, for managing essential uses, for identifying and listing acceptable alternatives, and for ending nonessential uses. The more than ninety ODCs controlled by the Montreal Protocol are grouped into two classes according to their intrinsic propensity to damage the ozone layer. Class I ODCs include the most potent ozone-depleting compounds, like the CFCs and the halons. Class II includes the hydrochlorfluorocarbons (HCFCs), a group of chemicals created specifically as less-ozone-depleting transitional substitutes for the Class I compounds. The Class II ODCs have their own, later, phase out dates.

The 1990 reauthorization of the CAA served as a forum for discussion and an impetus to action. The rapid growth of scientific knowledge and the gathering sense of crisis that accompanied it led to strong support to plan for chemicals that might yet be discovered, and that might prove to be major sources of ozone layer damage. To address this problem, the CAA requires that EPA list and phase out within seven years any chemical newly identified as a significant ozone depleter, without exception or exemption. 42 U.S.C. § 7671a(d). This provision had significant merits, especially given the ever more alarming evidence of ozone depletion at the time of passage. At the same time, it introduced rigidity into a process characterized in many other ways by reasonableness and balance; the provision includes no mechanism to allow consideration of the feasibility in specific cases of achieving the seven-year schedule, or of any alternative measures that might be applied. This precautionary "kicker" clause required EPA, in the early 1990s, to add the agricultural fumigant methyl bromide to the U.S. schedule for phase out, and to set its initial phase out date for 2001.

CAA requirements also provide incentives to carefully use, recycle, service, and manage existing stocks of materials. These requirements control use of CFCs and halons by requiring recycling and other forms of specialized handling, all aimed at delaying the emission of these compounds to the ozone layer. Congress also directed EPA to identify and ban nonessential uses, so that ODCs used in less crucial applications, for example as propellants in party favors, could be replaced with safe alternatives more quickly. 42 U.S.C. § 7671i.

EPA also provided consumers with better information by requiring the labeling of products made with or containing substances that damage the ozone layer. 42 U.S.C. § 7671j. Given public concern about this issue, this information reduced demand for labeled products, making room for alternatives. While highly controversial at the time, the labeling requirement was responsible for some of the most rapid and sweeping changes in industrial practice that occurred in the implementation of ozone layer protections in the United States.

The CAA also required EPA to undertake an aggressive program of identifying, listing, and evaluating alternatives to ensure the availability of a clearinghouse of viable, safer options. 42 U.S.C. § 7671k. Under the Significant New Alternatives Policy (SNAP) program, manufacturers introducing substitutes for ODCs into interstate commerce must notify EPA of their intent to do so ninety days before introduction. This gives EPA a brief period to evaluate the alternative relative to other options available for the same application and create, if necessary, the information required to support an unacceptability determination to prevent the product's introduction. In fact, very few substitutes have been listed as unacceptable. EPA has identified and listed more than four hundred acceptable substitutes for the ODCs and has, at the same time, prevented the introduction of a few chemicals that would have created unacceptable environmental and safety risks.

Crucial demand-side leadership came from a vibrant interagency partnership between EPA and the Department of Defense (DOD). DOD was among the largest users of ODCs prior to 1992, requiring their use in a variety of highly technical applications. DOD's leadership was vital in ending widespread reliance on ODCs within a large sector of the economy. Given the national security concerns within their purview, DOD's leadership is particularly outstanding in actively stimulating the transition to ozone-safe production by changing military procurement specifications to require purchase of items made without ODCs.

Five Remaining Challenges

EPA is now focused on meeting five substantial remaining challenges in realizing the health and environmental benefits of ozone layer protection. First, EPA is working to consolidate gains in sectors where production of the more highly depleting Class I ODCs has ceased, but because of existing stocks of ODCs, much of sector transition lies ahead. An example is large building air conditioners or chillers, where transition out of CFCs has proceeded more slowly than anticipated.

EPA's second challenge is completing the phase out of Class II hydrofluorocarbons (HCFCs), the transitional compounds that were created as substitutes for major uses of the CFCs. The first of these to complete its phase out, HCFC-141b, was selected first by both industry and EPA for phase out in 2001 because of all the HCFCs, HCFC-141b is the most damaging to the ozone layer. Given the enormous reliance, particularly in the refrigeration sector, on the Class II transitional chemicals, much work remains to meet required reduction steps for phasing out production of the remaining Class II chemicals.

A third challenge arises because "ending production" of CFCs does not imply a 100 percent phase out. Because the Protocol included the essential use exemption, about 1,700 tons of CFCs continue to be produced for use in the United States every year. This goes almost exclusively for hand-held, metered-dose inhalers that 16 million U.S. asthma patients rely on daily. The existence of a safety valve for vital uses was important to sustaining the resolve among governments to agree to the overall controls on the Montreal Protocol, and the amounts that have been allowed through this mechanism are less than 1 percent of the original amounts of CFC use—the 1986 baseline quantities.

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This essential use exemption has proven to be very effective. During the last decade, it has provided pharmaceutical companies with adequate time to solve the complex technical problems associated with finding effective alternatives, while also spurring innovation in delivery techniques and treatment approaches that may yield additional benefits to patients. As a consequence, the use of CFCs in this application has been reduced by more than 80 percent from EPA's initial requests for exemptions. While this residual use may seem small, medical progress tends to set standards that ultimately translate into a one-world standard of care. A failure to phase out this residual use in developed countries could mean that asthmatics in China and India may also require CFC-based inhalers in the future. The aggregate impact of this residual use could significantly delay recovery of the ozone layer. Thus, EPA's third challenge involves a careful and balanced conclusion to the essential use program, one that is respectful both of the claims of patients and of the need to foster worldwide transition to ozone-safe alternatives.

EPA's fourth challenge is managing the phase out of the final Class I chemical, methyl bromide (MeBr). MeBr is among the most widely used agricultural fumigants, with the United States using, as of 1996, nearly 40 percent of all MeBr produced in the world. It is primarily used to prepare soils for planting, and is injected in gaseous form deep into planting areas that are often covered with tarps to enhance its effectiveness by retaining the gas as long as possible in the soil. MeBr is a well-understood chemical in commercial agriculture, and has proven its value over the past forty years as a broad-spectrum pest control tool. Because of its toxicity, it is a highly effective general biocide. Its spectrum of activity is very wide, virtually sterilizing the soil prior to the introduction of the desired crop.

When the CAA provisions on ozone layer protection were negotiated in 1990, MeBr was not known to deplete ozone. Shortly after 1990, MeBr began to attract scientific interest and it rapidly became clear that MeBr was in fact highly ozone-depleting. Thus it became subject to the kicker clause in the 1990 CAA, which required EPA to list it as a Class I ozone-depleting compound and to phase it out of domestic production by 2001. The CAA's kicker clause left no room for exception or exemption from this 2001 phase out, nor did it provide for any interim reductions that, in the case of other ODCs, were so useful in creating the market signals that stimulated movement to alternatives. When EPA listed MeBr in 1992, no other developed country under the Montreal Protocol had any similar domestic requirement, making the United States the only country controlling this compound.

For environmental reasons, and to level the playing field with key agricultural competitors, the United States in 1992 urged the Montreal Protocol parties to add MeBr to the Montreal Protocol, which they reluctantly did. Although the United States worked hard to convince other countries to agree to a phase out for MeBr in 2001, matching U.S. law, the parties in 1992 only agreed to a 1995 freeze in MeBr production, a movement toward the U.S. position that was further strengthened in 1995. In 1997, the United States was able to secure an agreement from developed countries to advance the MeBr phase out to 2005, and from developing countries to a phase out in 2015. Recognizing the difficulty of meeting the 2001 CAA deadline, Congress, with administration support, amended the CAA to harmonize with the Montreal Protocol, adopting the same control schedule for the United States that all other developed countries face under the treaty.

These changes to the CAA shifted the United States MeBr phase out from 2001 to 2005, and allowed for a gradual reduction in production over time. It also incorporated into U.S. law the three exemptions for MeBr that had been created by the Montreal Protocol: (1) an exemption for quarantine uses vital to trade in agriculture, commodities, and durable goods that may harbor pests; (2) an emergency use exemption; and (3) an exemption for critical uses, allowing for continued production and consumption of MeBr after 2005 for critical uses that all parties agree have no economically or technically feasible alternatives.

EPA is now in the process of working to ensure continuing availability of MeBr for those U.S. uses for which growers have no technically and economically feasible alternatives. Despite the tremendous efforts to date, the extension of the original CAA deadlines, and the fact that many other developed countries have virtually phased out of MeBr, the United States continues to face significant challenges in phasing out MeBr. Recognizing this, the United States has sought to use the critical-use exemption to a greater degree than was ever necessary in the case of the essential use exemption for CFCs. This has proven to be both controversial and challenging at the international level. It is difficult for some countries to understand both the size of U.S. requests (over 35 percent of baseline levels in the first two years requested, 2005 and 2006), and the reason why alternatives that may be efficacious in their context may not be feasible in the United States.

Of the challenges that remain, the most important is assuring that developing countries comply with their obligations under the Montreal Protocol.

Of the challenges that remain, however, the fifth and final is the most important, and that is assuring that developing countries comply with their obligations under the Montreal Protocol. EPA's primary efforts have been through the Multilateral Fund, through promoting transfer of reliable technologies to facilitate the transition, and by working through the international process to emphasize the importance of compliance with requirements already agreed to by all parties. Because developing countries have yet to make the transition away from chemicals responsible for ozone layer damage, it is vital to maintain their commitment to the Montreal Protocol. If developing countries fail to follow through, their continuing use of ODCs could end the world's progress toward ozone layer recovery.

MeBr is a clear case where the developing world is watching closely as the developed world concludes its own transition. The developing-country phase out is still at its initial stages; these countries have most of their phase out commitments in front of them. Not surprisingly, they have looked to the experience of the developed world for technical support, for financial assistance, and the practical know-how needed to prepare for their own transitions. As they observe the end of the transition to ozone-safe chemicals in the developed world, they will note any weaknesses in the developed world's resolve. Any lack of effort on our part to fulfill related obligations could lead developing countries to question their need to comply with the components of the Montreal Protocol they perceive as difficult in their own national settings. Our success or failure will influence this process.

Challenges of the Endgame

EPA faces significant difficulties in meeting these five remaining challenges to ozone layer protection. The basic reason is that many of the conditions that favored our success in the program's early days no longer obtain. For example, in the past it was conventional wisdom in the United States that global collaboration would be important in solving global environmental problems; now it is more common to view global efforts with skepticism. For good reasons, concerns about homeland security, national sovereignty, and international competitiveness are far more resonant than fostering international cooperation to solve global environmental problems.

Similarly, the program in early years enjoyed the support of many large vested interests. Many companies either had a neutral financial interest or a positive stake in supporting the phase out, based on the expectation of selling alternatives in a post-ODC world market. By contrast, the economic interests that face remaining phase outs in some cases represent pockets of highly focused resistance, where some key companies and sectors have delayed implementing ozone-safe alternatives. Among producers, the reduced expectation associated with successive transitions has made investment in alternatives much less attractive. Also at the program's inception, it was critical to support the phase outs in countries with highly developed regulatory structures, and highly technical manufacturing and business infrastructures. Remaining challenges lie in countries with emerging regulatory structures, where the assistance of the Multilateral Fund is often the only major incentive favoring change.

To understand how these new conditions influence future progress, it may be useful to consider again the example of methyl bromide, where the U.S. transition is

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