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The Business of Ozone Layer Protection: Corporate Power in Regime Evolution

Robert Falkner

The Montreal Protocol of 1987 is frequently cited as one of the clearest examples of business influence over international environmental negotiations. Leading chemical firms, such as DuPont and ICI, played an important role in shaping governmental negotiation positions. Having initially opposed, and later supported, an internationally binding ozone regime, the chemical industry helped to make the Montreal Protocol a success. Subsequently, the producers of ozone-depleting substances (ODS), such as chlorofluorocarbons (CFCs), introduced substitute chemicals and quickly entered into a global race to capture the emerging market for ODS-free technologies and products. The relative success of the Montreal Protocol in reversing the trend towards ozone layer depletion, and the constructive role played by leading chemical firms, has given rise to the now widespread perception that proregulatory business interests and corporate involvement in international negotiations and implementation are key ingredients in effective international environmental governance. Put in a wider context, the experience of the ozone treaty suggests that global corporations are not simply part of the problem, but also part of the solution in international environmental protection. Understanding the dynamics of global environmental politics therefore requires a closer look at the political economy of state-firm relations in international regime creation. The intriguing question that the Montreal Protocol negotiations pose-and that is at the center of many contributions to this volume-is whether corporations have come to exert a pervasive, even hegemonic, form of influence in this global policy area.

This chapter examines the role of the corporate sector in international ozone politics and' the sources of its political power. The process of corporate lobbying from the outset of the ozone controversy in the 1970s is well documented, and I will not cover it here (see Kauffman 1997; Levy 1997; Litfin 1994; Maxwell and Weiner 1993; Oye and Maxwell 1995). Let me therefore state at the outset in what ways the account presented here differs from previous studies.

First, this chapter shifts the focus from the pre-1987 negotiations to the treaty revision phase from 1988 to 1995, and thus to the evolution and implementation of the ozone regime. Regime evolution is far from being a trivial component of effective international governance. The Montreal agreement of 1987 provided only a partial, and in many ways unsatisfactory solution to the problem of ozone layer depletion. It was developments following its adoption that helped transform the protocol into an effective, and increasingly comprehensive, instrument for eliminating, and not just limiting, ODS emissions. As will be argued below, business played a key role in this process.

Second, the subsequent analysis highlights the role not only of CFC-producing chemical firms but also of CFC-using industries, which assumed greater importance in the implementation phase. It was the CFC conversion strategies of user sectors, combined with the technological solutions provided by the CFC producers, that shaped the pattern and speed of the CFC phase-out schedule adopted by the contracting parties.

Third, this chapter conceptualises corporate power as "technological power," thereby highlighting the critical role that corporate actors play in shaping the knowledge framework of international environmental policymaking. Technological knowledge and innovation were pivotal factors that drove the treaty revision process. Of course, new scientific findings that hardened the link between CFC emissions and ozone layer thinning played their role, too. But, ultimately, substitute technologies had to be found and commercially introduced if the ozone regime was to make a difference, and it was in this area that corporate actors set the parameters for political action. More than many other environmental issues, the problem of ozone layer depletion lent itself to a primarily technological solution, which helped to move the role of corporate actors centre stage.

The focus on technological power serves to challenge conventional perspectives on international environmental politics, which see international regulation as a key driving force in technological innovation. The state-centric tradition in international regime analysis, for example, tends to view regulations as "technology-forcing" and environmental protection as a top-down process of standard-setting and corporate adaptation. There is, of course, an element of truth in this. In many ways, the history of the Montreal Protocol provides a showcase for such state-led efforts to bring about a more environmentally sustainable form of technological progress. What is missing from this account, however, is the way in which technological change itself, and the corporate strategies and decisions behind it, shape international rule-setting and the regulatory process.

In contrast to the state-centric view on international regimes, this chapter argues that we need to take a closer look at the dynamics of state-firm relations in order to understand the sources of effective environmental governance. Firms are not simply rule-takers, but are intimately involved in regime creation and evolution. Their privileged position in directing technological innovation gives them special leverage in international politics. Technological power allows corporations to play a decisive role in shaping regulatory discourses, particularly with regard to the design and phasing of environmental regulations. The subsequent analysis looks at the way in which the strengthening of the Montreal Protocol post-1987 was influenced by technological and commercial decisions taken by the corporate sector. It provides a corrective to the view that treaty revisions follow a primarily state-centric logic that is informed by the accommodation of state interests and the accumulation of scientific knowledge.

The first section of this chapter provides an overview of the diverse corporate responses to the Montreal Protocol, focusing on the technological decisions taken by CFC producers and users. The second section examines the ways in which corporate strategy and technological innovation fed into the international political process that produced a series of treaty revisions between 1988 and *1995*. The concluding section summarises the argument and draws out broader lessons for the study of corporate power in international environmental politics.

Corporate Responses to the Montreal Protocol

Chlorofluorocarbons, which were widely used in refrigeration, air conditioning, foams, aerosol and electronics production, were first linked to ozone layer depletion in 1974. The CFC-ozone depletion link started out as a highly contested scientific hypothesis, but scientific evidence in support of it grew over time. By the time atmospheric scientists publicised the discovery of the so-called "ozone hole" over Antarctica in 1985, environmentalists, policy-makers and even some industrialists had accepted the need to take precautionary action. Initially, though, the CFC producer and user industries opposed the scientific hypothesis and sought to discredit its scientific basis. The chemical industry followed the tried and tested strategy of denial and resistance, fighting the growing demands for regulation at national and international level (Roan 1989).

The first signs of a major strategic shift among industry leaders emerged in the mid-1980s, in response to growing scientific evidence of a link between CFCs and ozone layer depletion. The American chemical giant DuPont took the lead among CFC producers and declared in 1986 that it supported international regulations that would cap the future growth of CFC emissions. In doing so, the company single-handedly destroyed the hitherto united corporate front against international CFC restrictions. Many observers at the time felt that it had gambled on its technological strength in developing substitute chemicals that would gradually replace CFCs. By gaining a first mover advantage and promoting international regulations, DuPont was suspected of flexing its economic muscles in the political realm of negotiations in order to create and capture a new market for substitute chemicals. Indeed, the successful conclusion of the Montreal Protocol negotiations in September 1987 owed a great deal to the shift in corporate attitudes and the emerging consensus between governments, industry and NGOs on the need for international action. But the question that soon came to occupy policy-makers was whether CFC producers and users would cooperate in implementing the international agreement, and whether the CFC restrictions put in place could be strengthened in subsequent negotiations. In this, the corporate strategies of both CFC producers and users came to assume a more overtly political dimension.

The CFC **Producers**

Shortly after the Montreal Protocol had been signed in September 1987, the leading CFC producers declared their support for the groundbreaking international treaty. Some corporate representatives may have privately voiced reservations about the protocol's control measures, but the first official statements left no doubt that the chemical industry was willing to work with the new ozone treaty (*European Chemical News* 1987). This marked a shift in position for those firms, such as France's Atochem, which had opposed the treaty right until the end of the negotiations. *They* more or less grudgingly came around to the stance taken by DuPont, the world's largest CFC producer, in 1986, that an international regulatory framework was desirable.

As it turned out, industry's declarations of support were not a mere public relations exercise. The CFC producers could have tried to sabotage implementation of the Montreal Protocol at the national level, a strategy frequently employed by firms in other regulatory contexts. Instead, the chemical industry and some user industries took practical, and even innovative, steps to implement the ozone treaty. This had two important political consequences: first, corporate decisions on technological innovation played a central role in turning political will into economic reality. Second, the evolution of the ozone regime closely followed a technological, and thus largely corporate, logic. In other words, technological power in the hands of corporations both gave teeth to the international regime and shaped the regulatory discourse that underpinned its evolution.

The first evidence of industry's newfound cooperative spirit came in the form of an unprecedented move to pool the testing of CFC alternatives. In late 1987 and early 1988, two industry programs were created to assess the environmental acceptability (Alternative Fluorocarbons Environmental Acceptability Study-AFEAS) and toxicity (Program for Alternative Fluorocarbon Toxicology Testing-PAFT) of alternative chemical compounds. The industry cooperatives counted among their founding members thirteen CFC producers from around the world and had grown to seventeen by the mid-1990s. While these activities were restricted to the noncompetitive area of chemicals testing, some bilateral programs went as far as combining research and development efforts: Kali Chemie and ISC announced a joint effort to develop substitutes in the area of refrigeration and foam blowing; and Atochem and Allied-Signal set up a joint research programme covering a range of substitutes. As soon as the race to find CFC substitutes had started, it became clear that in order to succeed, chemical firms needed to have sizeable research budgets and global presence in the CFC business *(Chemical Engineering* 1988b; *European Chemical News* 1989).

Beneath the surface of industry cooperation, therefore, a fierce commercial battle for the substitutes market unfolded. In contrast to the smaller CFC producers, large chemical firms such as DuPont, ICI, or Atochem were already in a leading position. Not only did they have the necessary financial and organizational resources to invest in new technologies; they could also build on the experience of the 1970s, when the first ozone controversy prompted them to look into the potential for substituting CFCs. DuPont had spent some $70 million on substitutes research in the second half of the 1970s, and decided in 1986, before the Montreal Protocol was signed, to revive this program. After the signing of the Protocol, DuPont stepped up its expenditures and committed over $30 million in 1988 and over $45 million in 1989 to finding CFC alternatives-the largest of all research efforts undertaken in the late 1980s *(European Chemical News* 1989; *Manufacturing Chemist* 1988).

CFC producers played a key role in translating the political regulations of the Montreal Protocol into market signals, and vice versa. As policymakers looked to the chemical industry for technological solutions to ozone-layer depletion, the investment decisions of the major CFC producers assumed an important political dimension. They became the critical link between international regulation and changes in CFC production and consumption patterns, and thus the effectiveness of the ozone regime. The negotiating parties never seriously considered the possibility that governments themselves might set up research programs to find substitutes. It was therefore inevitable that the chemical industry came to shape political actors' perceptions of the technological feasibility of reducing, and eventually eliminating, CFC emissions.

One of the first technological decisions taken by the leading chemical firms concerned the type of chemical compoufid that would replace

CFCs. From the beginning of the ozone controversy, the chemical industry had placed its hopes on finding chemical substances that would be similar to CFCs but with a reduced impact on the ozone layer, so-called "drop-in" substitutes. Finding functionally identical, or at least similar, CFC replacements was no easy task, however. After all, the commercial success of the family of CFCs rested on their unique combination of nonflammability and low toxicity. Any other chemical substance would almost inevitably require some kind of trade-off: reducing the ozone-depletion potential could often be achieved only in exchange for higher toxicity or reduced flexibility in commercial applications. Because of this restriction, the chemical producers in the United States and Europe initially concentrated their efforts on close relatives to the widely used CFC-11 and CFC-12 *(IER* 1988).

The leading contenders to replace the most common CFCs were hydrogenated CFCs-most notably CFC-22, later renamed HCFC-22-and fluorocarbons without the ozone-depleting substance chlorine, so-called hydrofluorocarbons (HFCs). Due to their lower ozone-depleting potential, HCFCs were not included as regulated substances in the 1987 Montreal Protocol and therefore became a major component of the chemical industry's substitution strategy. HFCs, which were thought to pose no threat to stratospheric ozone, promised a more long-term solution for replacing CFCs, and were being promoted primarily in refrigeration and air-conditioning uses (e.g., HFC-134a). Despite continuing problems with toxicity and concerns about the contribution that HFCs made to global warming, a race soon unfolded to capture the emerging market for HFCs. In 1988, CFC producers were not expected to be able to produce HFC-134a on a commercial scale before 1993 *(Manufacturing Chemist* 1988). But only a year later, DuPont announced it was leading the race to develop a manufacturing process, and said it would begin commercial production by the end of 1990, several months before ICI was expected to bring its first HFC-134a facility on-stream (ENDS 1989). In similar fashion, the chemical firms rushed into expanding production of HCFC-22, despite warnings by scientists as early as 1988 that HCFC-22 may soon be considered an unacceptable substitute *(Manufacturing Chemist* 1988). Industry and government officials in North America and'Europe were keen to see "drop-in" substitutes enter the market quickly, and thus largely ignored warnings that HCFCs and HFCs themselves might become the subject of future regulations.

While most CFC producers kept an open mind about potential substitute compounds, competitive pressures gave rise to at least two principal product strategies. The first group of producers, consisting of DuPont, Elf Atochem, and Montedison, simultaneously expanded production of HCFCs and developed varieties of HFCs. This strategy was endorsed by the Alliance for Responsible CFC Policy, a U.S.-based coalition of international CFC producers and users, which warned policy makers not to pursue hasty reduction schedules for these two types of transitional substances (Alliance for Responsible CFC Policy 1989). In contrast, ICI moved more decisively into HFC production. The company increased existing HCFC production without adding further production capacity to meet short-term increases in demand, but sought to convince its customers and the British government that an early switch to HFCs was feasible and the most desirable conversion strategy (Jordan 1997, 16-17). As a consequence of these two substitution strategies, U.S. and European positions on the future regulation of transitional substances began to diverge, with the latter beginning to argue for more forceful reduction targets for HCFCs later in the treaty revision process. The result of this was a near reversal of negotiation roles: whereas in the early to mid-1980s it was mainly the United States that argued for a comprehensive treaty to reduce CFC emissions, the Europeans, with the exception of France, were leading the campaign for an early phaseout of certain transitional substitute chemicals in the early 1990s.

The CFC Users

Unlike the chemical industry, most of the CFC user industries were not actively involved in the ozone controversy until after the Montreal Protocol was signed. And even then, many companies took their time to react to the CFC reduction program, assuming that either the CFC producers would develop alternative substances or policymakers would leave sufficient time for them to adjust. Only a minority of user firms took up the challenge and initiated ambitious efforts to eliminate CFC use. As will be shown below, the strategic choices made by the CFC user

industries were to have an important impact on the evolution of the CFC phaseout regime.

The divergence in user industry approaches is striking, for there is little in the institutional design of the Montreal Protocol that can account for this.' Instead, we need to look at business strategies, market structures and corporate networks to find explanations for the variation in corporate responses, which, in turn, influenced the evolution of the international ozone regime. We can distinguish between three major factors that shaped the user industry response to the Montreal Protocol:

First, at a fundamental level, the nature of CFC usage influenced corporate strategies. In some cases, particularly in the aerosol industry, low technical barriers to substitution allowed for a relatively rapid conversion process. Second, the heterogeneity of the CFC user industries, ranging from small-scale refrigeration and air conditioning service units to large-scale electronics manufacturers, accounted for a certain degree of variation in corporate responses. Unlike the small group of large CFC producers, the user industries were too diverse to coordinate their activities and approach the conversion problem in a concerted manner. Third, market structures within these industry segments and corporate networks between producers and users also played an important role. For example, where the CFC producers enjoyed a close working relationship with CFC users, as in refrigeration, they maintained a strong influence over the choice of substitute technologies by their corporate customers, which, in turn, gave them greater leverage in the treaty revision process.

As the case of the CFC aerosol, solvent and refrigerant user industries shows, corporate decisions on technological innovation had an, indirect impact on the path and speed of CFC conversion. This provides a corrective to state-centric perspectives on the technology/regulation nexus that tend to view international regimes as "technology-forcing." Once corporate agency is moved centre-stage, the impact of pathways of technological change on regime evolution becomes apparent. It is in this sense that corporate agency in directing technological innovation can be said to have a political dimension. In the context of the Montreal Protocol, technological innovation was essential to the effective implementation of the global CFC reduction plan, but could not be taken for granted. It depended, to a large extent, on the decisions taken by both CFC producers and users. Although an important factor in driving technological change, the Montreal Protocol's regulatory framework alone cannot explain the pattern and speed of CFC conversion.

The extent to which the corporate sector was able to shape regime evolution depended, inter alia, on its ability to unite behind a common strategy. Such corporate unity, however, was an elusive quantity in ozone politics. Differences in commercial interests and political strategies emerged not only between CFC producers and users, but also within the user industries. Where CFC user firms opted for the complete elimination of CFCs and substitute chemicals, as in the electronics sector, the position of the chemical industry, both in economic and political terms, suffered a serious blow. In contrast, where the user industries chose to rely on substitute chemicals provided by the CFC producers, as in the case of refrigeration and air conditioning manufacturers, the position of the chemical industry was strengthened in international ozone politics. The pervasive reality of business conflict thus served to curtail the political clout of the major CFC producers that had actively engaged with the international negotiations. The dynamics of competition and conflict in the business sector, rather than its structural power, became key determinants in the emerging relationship between the corporate sector and states in the post-1987 treaty revision process.

The aerosol industry was one of the first CFC users to react to the Montreal Protocol. In the case of CFC propellants, technical barriers did not stand in the way of conversion. This was evident from the US aerosol sector, which had phased out ozone-depleting propellants by the late 1970s. While most European aerosol firms had successfully resisted CFC restrictions in the 1970s, the Montreal Protocol forced them to reconsider their stance. Initially, the European aerosol industry hoped that the chemical industry would come up with "drop-in" alternatives. European CFC producers initially suggested HCFC-22 as the main substitute (ENDS 1987), which required only minimal process changes. However, within two years of agreement of the Montreal Protocol, a fundamental shift was underway in the aerosol market. Splits within the European aerosol industry had emerged. As soon as individual firms, such as Johnson Wax and Talbec, opted for non-ODS products that they wire

advertising as "ozone friendly," others felt they could no longer support HCFC-based solutions. The European aerosol industry switched en masse to hydrocarbons as the preferred alternative propellant. Although requiring higher initial investment costs to convert existing production plants, hydrocarbons turned out to be cheaper than HCFCs and had no negative impact on the ozone layer.

As a result of this market shift, the pattern of CFC propellant replacement in Europe closely followed the example set by the United States in the 1970s. As a consequence, the CFC and HCFC producers were left with no leverage over the aerosol industry and were forced to write off any chances of preserving the HCFC substitutes business in the aerosol sector. By the end of the 1980s, most European countries were well on course to meet the EC-wide target of 90 percent CFC reduction in the aerosol sector by the end of 1990 (UNEP 1989a, 13). Developments in the aerosol sector thus sent strong signals to policymakers in Europe in the run-up to the first treaty revision in 1990, enabling them to consider tougher CFC restrictions than had previously been envisaged.

The CFC solvent user industries reacted to the 1987 ozone treaty in the same reluctant and defiant manner as most other user industries. The electronics industry, the main user of CFC solvents such as CF-113 and methyl chloroform, had been arguing for some time that CFCs were essential to modern processes of electronics manufacturing and could not easily be replaced (Zurer 1988). Their position was strengthened when chemical firms reported that finding a substitute would prove far more difficult in the case of CFC-113 than CFC-11 and CFC-12 (*Chemical Engineering* 1988a). CFC-113 replacement was further complicated by the fact that the world's largest buyer of electronics goods, the U.S. military, stipulated the use of CFC solvents. Initially, therefore, the user industry expected other actors, especially the chemical industry, to take the lead in the search for alternatives. It also placed its hope on persuading governments to draw out the CFC-113 phaseout schedule, to allow for an economically painless conversion programme in a key industrial sector.

Three factors, however, brought about a change to the electronics industry's position, making it one of the first industries completely to eliminate ODS. First, CFC solvent usage during cleaning processes made up only a small fraction of the value of the final product. CFC usage formed part of the manufacturing process, not the end product. Second, the electronics industry did not consider its links to the chemical industry as essential to its business success. The chemical industry thus had limited influence over the CFC conversion process in this sector. Third, the success of the electronics industry was built on the ability to innovate and rapidly respond to changing market conditions and technological advances. This suggested that the industry was more inclined to consider other solutions for dealing with the CFC problem than those provided by the chemical industry.

The first efforts to find an alternative cleansing technology were made only shortly after the Montreal Protocol was adopted. AT&T and Petroferm announced in 1988 that a naturally derived product could be used to deflux electronic circuit assemblies, thus making CFC-113 potentially replaceable (EPA 1997, 68). Other firms developed similar cleansing methods that eliminated CFCs, or introduced process changes that made the cleansing of electric circuit boards redundant. Several multinational electronics firms, including AT&T and Nortel, investigated this substitution strategy, and within only a few years set up plans for the elimination of CFC-113 from electronics manufacturing.

As a consequence of these initiatives, virtually all major electronics companies committed themselves to eliminating CFC use by 1995, and many reached this goal much earlier. Some individual manufacturing plants had already in 1991 achieved 95 percent reduction of CFC usage below the 1987 level, and the overall pace of CFC-113 reduction was uniformly described as fast (Pollack 1991). At a time when the chemical industry was still searching for a replacement of the "magical" CFC-113, most electronics firms had already embarked on a process of eliminating all CFC solutions. The effect of these initiatives was dramatic. By 1992, worldwide CFC-113 consumption had fallen to 126,500 tonnes, down from 276,700 tonnes in 1988 (Makhijani and Gurney 1995, 172). Within a few years, one of the most intractable cases of CFC usage had nearly disappeared from the international agenda, against all expectations of policymakers and industrialists.

The refrigeration and air conditioning industry was one of the most reluctant user industries to respond to the' Montreal Protocol. While

other sectors managed to reduce their CFC consumption in the second half of the 1980s, the use of ODS in refrigeration and air conditioning went up, both as a proportion of overall global ODS consumption and in absolute terms, from approximately 420,000 tonnes in 1985 to over 480,000 tonnes in 1990. It was only in the 1990s that the sector began slowly to reduce consumption of these substances (Makhijani and Gurney *1995,* 132-133).

The main reason cited by the industry for its belated reaction was technological barriers to replacing existing refrigerants. In the absence of a readily available "drop-in" substitute, CFCs were widely seen as "essential" to the proper functioning of residential and commercial cooling systems. However, on closer inspection, other factors related to market structures and corporate strategies also played an important role in shaping the industry's strategic response. The close relationship between the chemical industry and refrigeration and air conditioning manufacturers prevented a more radical redesign of cooling systems which would dispense with ODS altogether. Instead, the refrigeration and air conditioning industry dragged its feet over CFC replacement and relied on the chemical industry to come up with solutions: initially, ODS with low ozone depletion impact, and later HFCs, particularly HFC-134a.

The CFC producers first offered HCFC-22 as the optimal substitute for CFC-12 refrigerants, leading refrigeration manufacturers down a path that would later complicate the complete phaseout of ODS. Only by the mid-1990s, in response to regulatory restrictions on HCFCs, did the refrigeration industry introduce HFC solutions for both refrigerants and insulation (Somheil 1996, 29). Both these substitute choices were challenged by environmental campaign groups, who argued that an entirely different option-hydrocarbons-could replace existing technologies. Greenpeace, in particular, led an international effort to convince refrigeration manufacturers and consumers of the benefits of hydrocarbons as refrigerants, a technology that had already been developed but was rejected by manufacturers. Eventually, the Greenpeace campaign proved successful in a number of European countries, but failed to have an impact on the North American market.

Greenpeace's effort to introduce a CFC-free refrigerator began in late 1991 in Germany and led to an agreement in June 1992 with DKK Scharfenstein, a near-bankrupt East German manufacturer, to produce ten CFC-free refrigerators in a pilot project (Ayres and French 1996). Greenpeace subsequently used its campaigning clout to help market the new CFC-free refrigeration technology, dubbed "Greenfreeze," in Germany and abroad. Germany's main refrigerant manufacturers initially opposed the campaign, but following a shift in the market and the public relations damage suffered by their anti-Greenfreeze campaign, quickly adopted the new technology. Within three years, hydrocarbon systems were used in 90 percent of the German household refrigeration market by 1996. The decision to replace HFC-134a with hydrocarbons dealt a major blow to the German chemical producer Hoechst and its efforts to expand HFC production as part of its substitution strategy (*IER* 1993e).

Outside Germany, only a small number of countries adopted the hydrocarbon technology, among them Switzerland and Nordic countries. In North America, the new technology failed to make an impact with domestic users. This was to a large extent due to U.S. health and safety regulations, which effectively prevented hydrocarbon refrigerators from entering the market, and the perceived lower energy efficiency of the European competitors' model. Moreover, the U.S. refrigeration industry had come up with what it advertised as being "CFC-free" using HFC-134a as refrigerant and HCFCs for foam insulation (Cook 1996, 6). The U.S. industry had no incentive to reverse its technological choice and blocked Greenfreeze technology from advancing further in the North American market.

In the end, the chemical industry's HFC-based strategy paid off. Hydrocarbon systems succeeded, albeit mainly in European markets, and even there only in small-scale household refrigeration units. Large-scale commercial refrigeration systems, which are by far the largest market segment, continued to rely heavily on the chemical industry's preferred substitutes, HCFCs and HFCs. Although the CFC producers failed to achieve exclusive dominance in the refrigerant substitutes market, they nevertheless secured the larger part of the substitutes market and effected a fundamental challenge to their dominant position in the refrigeration substitute business.

The experience of the refrigeration industry suggests that despite regulatory pressure and available substitutes, corporate actors exercise significant influence over the path of technological *innovation* and the speed of CFC reduction. The industry's reluctance to phase out CFCs and its reliance on HCFC and HFC substitutes played a major part in holding back the phaseout especially of the transitional substances, thus providing a boost to the political position of the CFC producers in the treaty revision process.

Corporate Power and the Treaty Revision Process

From CFC Reduction to Phaseout

As discussed previously, the chemical industry had signalled to negotiators its willingness to work with the Montreal Protocol. The CFC producers were confident that they could find substitutes for the two most important ODS, CFC-11 and CFC-12, but warned that finding substitutes for CFC-113 would prove more difficult (*Chemical Engineering* 1988a). Given that the Protocol mandated only a S0-percent CFC reduction over a ten-year period, governments and industry had reason to believe that implementing the ozone treaty was not an impossible feat. The important question was, however, whether the CFC restrictions could be further tightened in subsequent negotiations.

Corporate support for international regulation was more elusive when it came to environmentalists' demands for a complete phase out of CFC production. The major CFC producers made it clear that support for the Montreal Protocol was contingent on the adoption of a measured regulatory approach that would respect technical realities and commercial interests. In 1987, both CFC producers and user industries did not accept that a strengthening of the protocol, let alone a complete phaseout of CFCs, were economically and technically feasible. Developing CFC substitutes would take a considerable time, and even if some substitutes were to be found, not all CFC uses could be eliminated: so-called "essential uses" of CFCs were widely regarded to stand in the way of more stringent CFC restrictions.

More than ever before, perceptions of technological uncertainty came to dominate international ozone politics. The focus on perceived technical barriers to phasing out CFC emissions enhanced the role of corporations. As it turned out, corporate decisions, more than any political or scientific developments, brought about a radical change in the regulatory discourse. The key event occurred in March 1988, when DuPont broke ranks by announcing that it endorsed the target of a complete phaseout of CFC production. It was the second time that DuPont had taken the lead in ozone politics. The resulting rift in the international business coalition created political space for introducing tougher CFC regulations. DuPont's latest move, based on a unilateral strategic decision by the world's leading CFC producer, was to have a crucial impact not only on Washington's negotiating position. It also, and perhaps more importantly, played an important role in shifting the regulatory discourse towards the complete elimination of ODS.

DuPont took the decision shortly after NASA's Ozone Trends Panel published new findings on March 15, 1988, which raised serious questions about whether the Montreal Protocol's restrictions on CFCs were sufficient to protect the ozone layer. DuPont managers involved in the company's decision later attributed it to growing scientific evidence in support of further CFC restrictions-a view that supports epistemic community approaches that emphasise the role of growing scientific consensus in regime evolution (Glas 1988; Haas 1992).

However, DuPont's policy change was a politically significant step in its own right, not simply a reflection of the emergence of a scientific consensus. The NASA report did not present conclusive evidence in favor of the CFC-ozone loss theory. Nor did it mandate any particular policy response. DuPont and the other CFC producers could have insisted-as most of the user industries continued to do-that the Montreal Protocol's provisions represented a reasonable compromise in the interest of precaution, in light of the remaining uncertainties and economic costs of conversion. But, having taken the lead in ozone politics in 1986, DuPont saw the NASA report as signalling a trend in the scientific discourse that pointed in only one direction, toward a strengthening of the ozone regime. The logical conclusion was for DuPont to move ahead of the game and throw its weight behind a total phaseout goal: This, the company hoped, would make it easier to cooperate with policymakers in designing an "orderly" phaseout of CFCs. As the sequence of events

following the Montreal Protocol demonstrated, this strategy largely paid off.'

Corporate decisions also played an important role in determining Europe's response to the Montreal Protocol. The CFC producing countries which had been most reluctant to agree to the ozone regime-Britain and France-continued to act as a brake on European decision making after 1987. Having agreed to CFC reductions in 1987, the EC took over a year to translate the international treaty into community law (Jachtenfuchs 1990). But within a relatively short period of time, Europe moved from a policy of foot-dragging to political leadership in speeding up the CFC phaseout. To be sure, domestic factors, particularly a strengthening of environmental campaigns across the continent, were an important factor. But given the closeness of industry-government links in Europe's corporatist environment, changes in corporate strategy played an equally important role. This was most prominently the case in Germany, which played a key role in overcoming British and French obstinacy within EC institutions.

In late 1987 and throughout 1988, Greenpeace and other campaign groups targeted Hoechst, Germany's biggest CFC manufacturer, as well as selected user industries in their ozone campaigns. Just as in the United States in the 1970s, the initial focus was on CFC use in aerosol manufacturing. As it turned out, Germany's aerosol industry was an easy target. It quickly broke ranks with other user industries and gave up its initial opposition to a complete CFC phaseout, having already agreed to a CFC reduction schedule in the run-up to the Montreal Protocol agreement. Other user industries, although reacting more slowly, followed suit and set the signals for a relatively early phase out of CFCs in Germany (FAZ 1988).

The CFC producers's response was more cautious, but was soon followed by a major shift in strategy. In the first few months after the signing of the Montreal Protocol, Hoechst demonstrated good will by setting up the first European recycling system for refrigeration liquids containing CFCs, while remaining critical of calls for more stringent CFC regulations (*Der Spiegel* 1988). It was in December 1988, in response to a parliamentary commission's call for a 95 percent CFC reduction, that Hoechst declared its support for an eventual phase out of CFCs. Hoechst was in a strong position to follow through this new strategy. By late 1988, the company's own reduction program was already three years ahead of the Montreal Protocol's second phase, and it was able to commit itself to a complete elimination of CFC production by 1999 (SZ 1988). The company eventually brought forward the phase-out date to 1994, becoming the first chemical company to stop CFC production (*IER* 1994b).

Having followed DuPont's leadership in 1988, Hoechst took the lead among its competitors in April 1989 when it went public with its new phaseout target of 1995, which was also adopted by Solvay, Germany's only other CFC producer.' The two firms urged their government to support the development of substitute chemicals and to work for a European-wide harmonisation of CFC reductions in order to create a level playing field. While Hoechst's move to some extent reflected the growth of the anti-CFC movement in Germany, pressure from environmental groups alone cannot explain Hoechst's strategic shift. After all, the decision to phase out CFC production had been taken well before Greenpeace's campaign reached its climax, and greatest public impact, in the summer of 1989, when activists climbed onto cranes at Hoechst's Frankfurt production facility (*FAZ* 1989). At the time, the company was going through a major strategic change which saw higher-profit specialty chemicals promoted at the cost of low-profit bulk chemicals such as CFCs. Given that only 0.5 percent out of a total annual turnover of around DM 40 billion in the late 1980s resulted from CFC production (*Der Stern* 1989), Hoechst managers were not willing to attract any more negative publicity in connection with the CFC-ozone controversy. To the dismay of Hoechst, however, the company found it difficult to capitalize on its leading position in the phase out of CFCs and continued to be the target of environmental campaigns for years to come.

Encouraged by these developments in Germany's CFC industry, the German government adopted a national CFC phaseout plan that aimed for a reduction of CFC usage of 95 percent by 1995, but stopped short of ruling out CFC production altogether. Germany then took this new policy to the EC-level and advocated a 1995 deadline for the whole community. This was unrealistic, but sent a strong signal to the recalcitrant member states. The European Commission itself had' proposed a 1997 target, while France, Britain and Spain argued for 2000 to be kept as the phase out target. The EC eventually decided to aim for a global phase-out from 1997 onwards, and to ban the five regulated substances of the Montreal Protocol by 2000 (*IER* 1989). Germany had succeeded in nudging the EC position into a more proactive direction. As in the case of DuPont, a strategic shift by a leading European CFC producer had far-reaching political consequences.

Revising the Ozone Treaty: From Helsinki (1989) to London (1990)

The decision by the EC to support a complete phase-out by the end of the century, and to push for an earlier date if possible, had an important signal function for the upcoming First Meeting of the Parties in Helsinki in 1989. Only one day after the EC had decided on its new position, President Bush announced that the United States would also phase out CFCs by 2000, although he qualified the statement with the condition "provided that safe substitutes are available" (*IER* 1989). Although the Helsinki meeting produced only a nonbinding declaration, the EC and the United States were able to lay the ground for a major revision of the Montreal Protocol at the Second Meeting of the Parties in London in June 1990.

In the run up to the Helsinki conference, UNEP's assessment panels produced the first set of reports on the state of knowledge in the areas of atmospheric science, environmental impact of ozone depletion, and technological and economic aspects of CFC conversion. The Synthesis Report strongly suggested that the long stratospheric lifetime of CFCs made a wait-and-see approach undesirable. A complete and timely phase-out of all major ODS was, as the report put it, "of paramount importance in protecting the ozone layer" (UNEP 1989c: 28). Although this statement played an important role in strengthening the resolve of governments to revise the Montreal Protocol, it is important to note that by that time the major CFC producers had already committed themselves to an eventual phaseout of CFCs. This corporate commitment was echoed by the 1989 technological assessment panel, which stated that:

> Based on the current state of ;echnology, it is possible to phase down use of the five controlled CFCs by over 95 percent by the year 2000 ... Given the rate of

technological development, it is likely that additional technical options will be identified to facilitate the complete elimination of the controlled CFCs before the year 2000 (UNEP 1989b, ii).

The UNEP technology review thus confirmed what industry insiders had known for some time: that technological innovation could significantly reduce the time needed to complete the CFC substitution process. This did not mean that an international agreement on a revised CFC phase out schedule was now within easy reach. Far from it, negotiations on the path and timing of the CFC elimination programme proved to be complex. What had changed, however, was that scientists, environmentalists and leading industrialists had forged a consensus on the need to close down the CFC business.

What was still to be resolved was the exact phase-out schedule. In deciding this question, corporate decisions on technological change were of paramount importance. The contracting parties recognised this by inviting industry experts to join UNEP's Technology Assessment Panel, which was in a privileged position to shape the parameters of the regulatory discourse. To be sure, industry representatives could not impose their commercial interests on the international negotiations via authoritative technological assessments. Panel members were expected to act as technical experts and not as industry representatives. Moreover, the panels could only offer advice, whereas it was for the negotiating parties to reach a compromise on specific reduction schedules. Companies therefore continued to rely heavily on lobbying their governments in order to protect their particular commercial interests. And with CFC producers and users often pursuing divergent substitution strategies, the success of such lobbying efforts was far from guaranteed.

From a corporate perspective, the critical issues on the agenda of the Second Meeting of the Parties in London in June 1990 were (1) the inclusion of other ODS, such as HCFCs, in the list of regulated substances; and (2) the tightening of the existing CFC reduction schedule. In principle, all chemical producers were keen to safeguard their investment in HCFCs for as long as possible. They argued that if HCFCs were banned in the near future, investment in their production would be at risk and user industries would be reluctant to cut back on their CFC usage until

a safe and acceptable long-term alternative had been found. Governments on both sides of the Atlantic were largely sympathetic to these arguments. In early 1989, the U.S. industry had been given assurances by EPA that the U.S. government would seek to protect the use of HCFC-22 at the forthcoming Helsinki negotiations (ACHRN 1989). And the EC and Japan were even more determined at that time to guarantee the long-term availability of HCFCs.

Eventually, the position of HCFC producing countries prevailed over the calls by those countries that favored an early phaseout of the transitional substances. The final text of the agreement called only for the use of HCFCs to be limited "to those applications where other more environmentally suitable alternative substances or technologies are not available," and to be ended "no later than 2040 and, if possible, no later than 2020" (quoted in Benedick 1991, 263-64). This voluntary phaseout date was heavily criticised by environmentalists who pledged to push for HCFCs to be formally brought into the regulatory regime at the next Meeting of Parties in 1992. They were concerned about the contribution of HCFCs not only to ozone layer depletion but also to global warming.

On the question of revising the existing CFC reduction schedule, it was the EC that favoured a stricter approach than that proposed by the United States and Japan. The EC had put forward the year 1997 as the final deadline for eliminating CFC use, while the United States American and Japan preferred the year 2000. The difference in negotiating positions reflected, to a large extent, differences in corporate interests. While Germany's Hoechst had declared itself ready for an earlier phase-out date, thereby undermining the more cautious approach adopted by ICI and Elf Atochem, the U.S. producer DuPont remained doubtful about a complete phaseout in 1997 (Benedick 1991, 171-72). In the end, the lowest common denominator position prevailed, and a phased elimination programme for the five main CFCs was agreed with the year 2000 as the final phaseout date.

Among the other outcomes of the conference, the EC achieved a concession that allowed its CFC producers to rationalize production EC-wide. Environmentalists scored a victory by having methyl chloroform included as a regulated substance, against chemical industry lobbying at the conference. Reducing methyl chloroform usage (primarily as a solvent) promised the single most important short-run contribution to lowering stratospheric ozone concentrations (Litfin 1994, 151). Moreover, the progress made by electronics firms in replacing ODS in cleaning processes undermined the lobbying effort by methyl chloroform producers. UNEP's technology panel had concluded that 90 to 95 percent of ODS use as solvents could be eliminated by the year 2000 (Litfin 1994, 151).

Moving toward Phaseout: Copenhagen (1992), **Vienna (1995)**

As Karen Litfin (1994, 156) points out in her book *Ozone Discourses,* "two primary factors ... drove the treaty revisions, the scientific observations of unprecedented ozone losses and the rapid progress in generating alternative technologies." In the aftermath of the 1990 conference, new scientific studies painted an even bleaker picture of the environmental damage that was being done to the stratosphere. At the same time, the second report of UNEP's technology and economic assessment panels in 1991 documented the rapid progress in finding CFC substitutes that had been made since the Montreal Protocol was signed. The report predicted that by 1992, CFC consumption would be reduced to SO percent of 1986 levels, a target that the 1990 revisions had set for the year *1995.* Furthermore, the report suggested that virtually all consumption of CFCs could be eliminated between 1995 and 1997 (Litfin 1994, 164). Given this optimistic outlook on the implementation of the Montreal Protocol, the next revision of the treaty, at the Fourth Meeting of the Parties in Copenhagen in November 1992, was widely expected to produce a further tightening of the CFC restrictions.

Indeed, one of the major outcomes of the Copenhagen conference was a relatively uncontroversial agreement on revised phase-out deadlines for the main ODS. Most CFCs were to be eliminated by 1996, along with carbon tetrachloride and methyl chloroform, while the phaseout of halons was to be achieved by 1994. Among the more contentious issues, the phaseout date for HCFCs was brought forward to 2020, although essential use exemptions were included in the agreement, reflecting

strong lobbying mainly from the U.S. chemical firms and refrigeration and air conditioning sector. The U.S. delegation argued successfully that HCFC use in air conditioners for large buildings be permitted until 2030, a position that received the support of France. To the dismay of environmentalists, the world's leading HCFC producers, DuPont and Elf Atochem, had succeeded in securing a largely industry-friendly outcome on the question of transitional substances.

It became clear after the Copenhagen conference that the major regulated CFCs had reached the end of their lifeline. Industry in the developed countries had made sufficient progress for the CFC phaseout deadline to be brought forward even further. The EC environment ministers decided only weeks after Copenhagen to set the year 1995 as the new CFC phaseout date *(IER* 1993a). This was followed by EPA's announcement of a proposed regulation that would ban most CFC uses by the end of the same year *(IER* 1993b). The CFC producers had long stopped opposing shorter phaseout deadlines and concentrated now on securing a sufficient lifetime for their substitute chemicals. The announcement in June 1993 of an earlier phaseout for HCFCs in Europe, therefore, caused some concern on the part of European producers. But the Commission's proposal to achieve total HCFC elimination in 2014, rather than 2030 as agreed in Copenhagen, applied only to domestic consumption in the EC and did not stop European producers of HCFC to continue exporting the chemicals to other countries that still relied on the transitional substitute *(IER* 1993c).

The firms that were most threatened by this development were not the CFC producers, but the user industries. While the major CFC producers and policymakers in Europe and North America cooperated in seeking to eliminate CFC production at the earliest opportunity, some of the user industries that had delayed conversion efforts now faced a situation of rapidly dwindling CFC supplies. Their new problem was that America's CFC producers were planning to stop producing CFCs much earlier than anticipated-in the case of DuPont in 1994.

It was the refrigeration and air conditioning sector that was hit hardest by the speed of the CFC phaseout. In the United States, car manufacturers reacted to the ensuing crisis by lobbying the government to grant exemptions under the "essential use" rules that would allow continued CFC usage. The American Automobile Manufacturers Association, a powerful grouping of America's car makers, pointed out that 140 million cars were in use that needed future supplies of CFCs to service their existing air conditioning systems. U.S. car makers were only planning to start introducing new systems with HFC-134a as a coolant in 1994, the very year that DuPont planned to stop manufacturing CFCs. As a consequence, the automobile industry faced a serious squeeze on CFC stocks in the near future, which in turn would result in higher servicing costs for millions of car owners (*IER* 1993d).

Given the political sensitivity of the issue, the U.S. government gave in to industry pressure and approached DuPont with a request to extend CFC production by one year. The move proved to be highly embarrassing for the government and the chemical producers, as both had so far cooperated in speeding up the CFC phaseout. In the end, lobbying by the car industry and fears of a voter backlash against higher servicing costs won the day (*IER* 1994a).

By the time the Seventh Meeting of the Parties was convened in Vienna in December 1995, the focus in international negotiations had shifted from the CFC phase-out program to debates on international aid to developing countries (Falkner 1998) and the inclusion of previously unregulated ODS, particularly the thorny issue of methyl bromide. On the question of the HCFC phaseout, industry's position had received a boost in the latest Technical and Economic Assessment Panel report published before the Vienna Conference. The panel concluded that although technically feasible, an earlier phaseout date of 2015 would cause unjustifiably high economic costs, as the HCFC-using refrigeration and air conditioning equipment would have a lifetime far beyond 2015 (*IER* 1995). The revisions of the HCFC regulations agreed in Vienna reflected the prevailing expert opinion. Although the phaseout date was officially moved from 2030 to 2020, a "service tail" of ten years was included that allows industrialized countries to supply existing equipment with HCFCs. The decision was strongly criticised by environmental groups for reflecting industry needs rather than environmental concerns (Greenpeace 1996, 4). Yet again, a coalition of HCFC producer and user interests prevailed in the negotiations.

Conclusion: Corporate Power in Ozone Politics

There can be little doubt that leading chemical firms played a key role in bringing about a rapid elimination of CFC emissions, once an international agreement to protect the ozone layer had been reached. They did this not out of altruism but in response to societal and political pressures. But this does not mean that the business response was merely reactive or epiphenomenal. It assumed a more direct political significance as the parties to the Montreal Protocol sought to strengthen the regulatory regime and make its implementation work. Based on their pivotal role in directing technological change, corporations were able to influence the design and phasing of the protocol's regulatory instruments.

To be sure, corporations were not "in control" of the treaty revision process; an economic reductionist account would not adequately reflect the reality of international environmental politics, in ozone layer protection or elsewhere. The corporate sector did not "dictate" the terms and conditions for regulating ODS. The ozone regime was very much a second best solution, particularly for the CFC producers, who had fought over ten years against regulation and incurred high costs in switching to CFC substitutes. But technological power gave corporations the edge over other actors in shaping the regulatory discourse that unfolded as the implementation of the ozone regime got underway.

The political role of corporations in the Montreal Protocol process has at least two dimensions. At a fundamental level, business support for the ozone regime helped to legitimise the role of the CFC producers in the search for technological alternatives to ozone depleting chemicals. Once an international agreement was reached in 1987-and leading industry players themselves had a role to play in this-the CFC industry came to be seen not simply as part of the problem, but also as part of the solution. Governments listened to business advice and actively sought to engage corporate actors in the international political process. Some industry experts even became part of the influential UNEP technology assessment panels that gave authoritative advice to governments on the technical hurdles to phasing out ODS.

Furthermore, as the parties to the Montreal Protocol moved from norm setting to implementation, the corporate sector's technological power became a critical factor in international ozone politics. It allowed the corporate sector to shape the evolution of the ozone regime and exert influence over governmental actors well beyond their lobbying clout. Technological power, understood as the power to direct technological innovation and its introduction in the market, had a direct impact on the regulatory discourse. It set the parameters for what actors perceived as technologically feasible regulations, and thus framed the knowledge structure within which the ozone regime evolved.

Corporations did not control, in the strict sense of the word, the process of technological change. Technological innovation is not, however, an exogenous phenomenon governed by the random accumulation of scientific knowledge. Decisions on investment in alternative CFC technologies, combined with the market power that CFC producers or users possess, can give rise to a considerable degree of influence over the direction of technological change. This was evident in the case of the chemical industry that had decided to invest in transitional substances, such as HCFCs, which it sought to protect against the demands for an early phase-out under the Montreal Protocol's revised regulations.

It is important to recognize that corporate power in the case of ozone politics often found its match not only in the agency of other actors (states, NGOs) but also through business competition and conflict. The CFC producers faced several challenges in their attempt to secure a viable market for their substitute products, as their control over user industries varied from sector to sector. In some cases, predominantly refrigeration and air conditioning, the chemical industry was able to build on its close relationship with CFC users and secure a sizeable market for its preferred substitutes HCFC and HFC. In contrast, the aerosol manufacturers very quickly abandoned any attempt at introducing transitional substances and switched to hydrocarbon technology, thus making the chemical industry's preferred option redundant. Competition, and lack of coordination among business actors, prevented a uniform political front of CFC producers and users. As so often in the relationship between the private and public sector, business conflict creates space for other political actors (Falkner 2001).

In addressing the problem of ozone layer depletion, the CFC industry therefore never found a win-win solution possible. It could only hope to

delay regulatory action, as it did during the 1970s and early 1980s, or to shape the emerging regulatory regime to make it more business-friendly, as became the predominant business approach from the late 1980s onwards. In any case, the chemical industry lost a profitable niche market and the user industries had to invest in costly product and manufacturing process redesigns. The case of business involvement in ozone politics clearly does not lend itself to political-economic explanations that are rooted in economic determinism. In fact, a variety of factors account for the creation, and success, of the Montreal Protocol: political leadership by states and individual state leaders; scientists' efforts to promote understanding of ozone layer depletion and its link to CFC emissions; environmentalist campaigns that mobilized public opinion; and international organisations that provided a forum for negotiation and implementation. But as this chapter argues, corporate leadership in the negotiations and search for substitute technologies came to play a critical role in shaping the process with which the broad coalition of actors in favour of international regulations began to phase out ozone-depleting substances.

Notes

1. The Montreal Protocol did, of course, create an uneven incentive structure for phasing out ODS in that it did not regulate all ozone-depleting chemicals from the outset. By covering only five CFCs (11, 12, 113, 114, 115) and three Halons (1211, 1301, 2402)-a compromise reflecting the delicate balance between precautionary action and commercial interests-the negotiators of the Montreal Protocol created a regulatory framework that allowed users of unregulated substances (e.g., HCFCs, methyl chloroform, carbon tetrachloride) to delay action for many years. But within the group of regulated substances, the protocol did not differentiate between different usage types.

2. DuPont's CFC business, although providing a reliable source of profit, was not central to the company's overall business strategy. Profit margins in CFC production were below average, particularly since the onset of the ozone controversy and the collapse of the CFC aerosol business in the United States. CFC sales accounted for only 2 percent of DuPont's total revenues in 1987 (Reinhardt 1989, 10).

3. Even DuPont had only declared a goal of complete CFC phase out by 2000 (WSJ 1989).

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6

The Genetic Engineering Revolution in Agriculture and Food: Strategies of the "Biotech Bloc"

Peter Andree

Introduction

> Do international relations precede or follow ... fundamental social relations? There can be no doubt that they follow ... (Gramsci 1971, 176)

In the mid-1990s, when transgenic seeds' were first being planted commercially in North America, the biotechnology industry assumed that these crops would become the food of the future, providing a growing population with improved nutrition and farmers with more sustainable production options (Duvick 1995). Given these ambitions, the agricultural biotechnology revolution appears to be a mixed success to date. On the one hand, between 1995 and 2002 the area planted in transgenic seeds grew from a few test plots to 58.7 million hectares (James 2002), an enormous achievement for the champions of biotech seeds. However, 99 percent of this coverage is in only four countries: the United States (66 percent), Argentina (23 percent), Canada (6 percent), and China (4 percent). Elsewhere, an effective moratorium exists on the planting of new genetically modified organisms (GMOs) in member states of the European Union, and several countries have considered banning GMOs altogether (including Sri Lanka, Croatia, and Bolivia) (Villar 2002). A number of African states even rejected food aid because it contains GM grains (Vint 2002). Furthermore, Japan, Australia, and the members of the EU, among others, have created laws that will require the labelling and/or "traceability" of GMOs through the food system. At the international level, the Cartagena Protocol on Biosafety-a treaty under the auspices of the Convention ,on Biological Diversity designed to protect the environment and human health from risks that may be caused by

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