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ORIGINAL PAPER

A critical review of the successful CFC phase-out versus the delayed methyl bromide phase-out in the Montreal Protocol

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Abstract The Montreal Protocol is often described as an international environmental agreement *par excellence*. After all, it successfully led to the phase-out of almost 95% of all chlorofluorocarbon (CFC) use. A critical review of the Protocol's history, however, suggests that its successes are deeply entrenched in the economic opportunities that were made available to phase out CFCs. The Montreal Protocol, in other words, was a "best-case scenario" for CFC producers. This may be problematic for policymakers, ecological modernization practitioners, and other scholars who look to the Montreal Protocol for guidance in phasing out other global environmentally harmful substances and practices that are not as "economically efficient." The shift to delay the phasing out of methyl bromide (MeBr) in the Protocol, an ozone-depleting substance used to this day primarily in strawberry and tomato production, demonstrates how even this most successful of international environmental agreements can become subject to significant setbacks when economic gains and scientific evidence are not obvious to the global powers. Furthermore, changes in what constitutes a viable exemption to the phase-out of CFCs versus MeBr marks a shift away from concern for the general functioning/welfare of society, and toward concern for the market performance of specific individuals. This shift runs parallel to a lack in economic incentives to phase out MeBr in the United States. The article demonstrates how civil society representation in ozone politics is largely dominated by industry interests, especially when scientific uncertainty is high.

Keywords Montreal Protocol · CFCs · Critical use exemptions · Ecological modernization · Global civil society · Individualism · Methyl bromide · Neoliberalism

Abbreviations

CFCs	Chlorofluorocarbons
CUE	Critical use exemption

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EPA	United States Environmental Protection Agency
HCFCs	Hydrochlorofluorocarbons
MBTOC	Methyl bromide Technical Options Committee
MeBr	Methyl bromide
MOP	Meeting of the parties to the Montreal Protocol
NASA	U.S. National Aeronautics and Space Administration
NGO	Non-governmental organization
ODS	Ozone-depleting substance
ODP	Ozone-depleting potential
TEAP	Technology and Economics Assessment Panel
UNEP	United Nations Environmental Programme

1 Introduction

This article provides a critical review of the Montreal Protocol on Substances that Deplete the Ozone Layer (hereinafter the Montreal Protocol). Partial historic accounts of this international treaty have been recorded many times and are well documented (Cf. Andersen et al. 2002; Benedick 1998; Parson 2003). These accounts often highlight how corporations and nation-states—pressured by civil society—and the scientific community were able to put politics and economics aside vis-à-vis compelling scientific knowledge in order to achieve a global good: ozone layer protection. While there is indeed truth to this illustration (as I will note throughout), this article critically examines the reasons for success in phasing out chlorofluorocarbons (CFCs) and the reasons for failure subsequently in phasing out methyl bromide (MeBr). The article will revisit the years leading up to the adoption of the Montreal Protocol, showing that CFC reductions were only possible with strong civil society pressure, and even then only in cost-effective areas of production. Industry contested scientific findings until such data and the political climate made rather clear the imminence of a global CFC ban. Next, the article shows how the Montreal Protocol was likely the best-case scenario for key actors: CFC producers, the United States (U.S.), and the United Kingdom (U.K.). While CFC alternatives were not readily available, history shows that the largest CFC producers benefitted the most from the "substitutes game" (see Sect. 2.2). The Protocol's scientific community played a significant role in helping make CFC alternatives feasible for the biggest players. Finally, the article shows how these favorable conditions changed dramatically with the methyl bromide (MeBr) case. MeBr producers and U.S. agro-industry strongly opposed a MeBr ban for economic reasons, the scientific community disagreed on the feasibility of MeBr alternatives due to its connection with the MeBr industry, and the U.S. pushed for exemptions to the ban to protect its market share. The article stresses the importance of the language of what constitutes an acceptable exemption to the MeBr phase-out in the Protocol's "critical use exemption" (CUE) clause. Unlike the CFC "essential use exemption" clause, which requires that an exempted use be necessary for the general functioning of society, CUEs emphasize the market conditions for individual MeBr users. The article will suggest that this shift and the concomitant delay in the MeBr phase-out may be a harbinger for global agreements that look to the Montreal Protocol for guidance to eliminate other environmentally harmful substances.

The Montreal Protocol is often described as an international environmental agreement *par excellence*. Former UN Secretary General Kofi Annan went as far as to state that it is "perhaps the single most successful international agreement to date".[1] The Montreal Protocol has provided a great service. Without it, by 2050, even the middle latitudes of the northern hemisphere would have lost half of their ozone layer, and the Southern Hemisphere would have lost 70 percent (Flannery 2005, p. 220). Indeed, 95 percent of chlorofluorocarbons (CFCs) have been taken out of production processes (UNEP 2007a).

A critical review of the history of the Montreal Protocol reveals the strong role that the chemical industry and their atmospheric scientists (working in conjunction with the U.S. National Aeronautics and Space Administration (NASA) atmospheric scientists) played in facilitating the phase-out of CFCs. It also reveals the strong connection between science, industry, and powerful nation-states. Upon revisiting this history, it seems clear that the CFC phase-out would have experienced significant setbacks had alternatives to CFCs been considerably more expensive, or if scientific knowledge regarding alternatives to CFCs had not been close to the implementation stage. True, civil society pressure in the U.S. played a significant role in pushing the U.S. government to phase out CFCs from production, regardless of whether the international community would do so. But civil society's role at that time only influenced the phase-out of CFCs in the most economically efficient production area: aerosols.

According to the London School of Economics' Centre for Civil Society (2004), "civil society" is the arena situated somewhere between the market and the nation-state. It "commonly embraces a diversity of spaces, actors and institutional forms, varying in their degree of formality, autonomy and power" and is comprised of a variety of organizations including charities, environmental non-governmental organizations (NGOs), trade unions, social movements, business coalitions, and advocacy groups (Centre for Civil Society 2004). Importantly, while theoretically civil society is considered distinct from state and market institutions, "in practice, the boundaries between state, civil society… and markets are often complex, blurred and negotiated" (Centre for Civil Society 2004).

In the case of the Montreal Protocol, we must consider the chemical industry's push to ensure that the inevitable regulation of CFCs was in their favor as an effort from an influential facet of civil society. Here, business coalitions played an important role in shaping Protocol rules and procedures more so than did environmental NGOs. While NGOs, specifically from the U.S., encouraged the aerosol ban and would certainly contribute to revisions and enhancements to the Protocol (Wapner 2000, pp. 96–97), it is clear that the quasi-coalitions formed among environmental NGOs, the chemical industry and their atmospheric scientists, and the U.S. government [often through collaboration with NASA and interpretation of scientific findings by members of the U.S. Environmental Protection Agency (EPA)] served to quell NGO demands for "stronger global regulation of ozone-depleting substances (ODSs) under the Montreal Protocol in the second half of the 1980s" (Breitmeier and Rittberger 2000, p. 138).

The dynamic relationship between business/industry coalitions and environmental NGOs in the arena of civil society and governments contributes significantly to the outcomes of environmental treaty negotiations. As groups focused on changing state/civil society relations, environmental NGOs in particular

> put states and international organizations under political pressure to strengthen their efforts for the international management of environmental problems; and … [provide] expertise that states and international organizations can make use of when

[1] http://www.theozonehole.com/montreal.htm.

> managing environmental problems at the international and domestic levels (Rittberger 2000, p. 85).

In the case of the Montreal Protocol, however, expertise is historically found primarily in the realm of the chemical industry, and pressures were applied from it and "knowledge brokers" in policy-making positions as well as from government scientists/experts (Bernstein 2002, p. 148; Litfin 1994).

Debates throughout the history of the Protocol involving scientific expertise, political, economic and civil society pressures, and government deliberations provide opportunities to assess how scientific knowledge and politics are coproduced, sometimes in ways that lead scholars to criticize science for pursuing the state's aims (Yearly 1995, p. 459). Yet disputes between experts over scientific assessments are often said to reveal the limitations of the scientific establishment in the hands of the state (Beck 1992; Yearly 1995, pp. 458–459). The outcome of such disputes, ecological modernization theorists hope, will be the democratization of scientific knowledge and the adoption of ecologically friendly production (Mol 2000; Sonnenfeld and Mol 2002). In the Montreal Protocol, however, what appears to fill the gap in scientific indecision almost exclusively is industry. Industry, after all, provided almost all of the funding for the initiation of the search for alternatives to CFCs, it played a major role in shaping policy for powerful states like the U.S. and the U.K., and it made up the majority of members on the CFC scientific expert panels operating within the Protocol.

Of course, private interest groups can be considered, as noted earlier, a faction of civil society. Here, ecological modernization theorists would contend that green movements (another faction of civil society) push state and economic institutions toward ecological sustainability, prompting market innovations and the implementation of more efficient technologies (Mol 1996; Mol and Spaargaren 2002). Additionally, ecological modernization theorists have traditionally expected the role of the state to remain limited to "steering" economic activity in a sustainable direction, resulting in environmental governance becoming "decentralized" (Mol 1996). The Montreal Protocol shows that the role of the state is far from waning, with environmental governance remaining quite centralized even at the global scale.[2] Additionally, a critical review of the Protocol demonstrates that environmental civil society groups can play a relatively minor role in terms of influence and pressure on the decision-making process in times of scientific and economic uncertainty, as evidenced in the MeBr controversy. Such patterns of influence within the Protocol fit with certain critiques of ecological modernization because, rather than providing an opportunistic moment from whence a deliberative democratic approach could emerge, the gap in scientific evidence appears to be captured by private interest groups and powerful states that benefit from such capture (Bailey and Wilson 2009; Goldman 2005).

The history of the Protocol suggests that some ecological modernization assumptions require reassessment, such as that the role of the state will remain limited to that of providing environmental regulation, and that environmental civil society groups will, in a participative manner, provide pressure to corporations to engage in green production (Cf. Hajer 1995; Mol 1996; Mol and Spaargaren 2000; Murphy and Gouldson 2000). True, the strong urgency for precaution from science and demand for action from U.S.-based environmental NGOs in the CFC phase-out seems to represent a "greening of modernity"

[2] It must be noted that recent works in ecological modernization, such as Mol et al. (2009) indeed illustrate the influence that the nation-state maintains in international environmental agreements.

by achieving a win–win situation in terms of sustaining production and environmental protection (Bailey and Wilson 2009: 4). This article, however, aims to show that the chemical industry did not accept the Protocol until it was relatively clear that it had profitable alternatives in the pipeline, and its own scientists were convinced of the impact of CFCs on the environment. When scientific knowledge and economic growth are uncertain, alternative strategies proposed by environmental civil society groups that place environmental protection above economic costs are not considered viable.

Unlike the CFC case, the phase-out of methyl bromide (MeBr), a chemical used to this day primarily in strawberry and tomato production, has been subject to significant delays and problems, with the U.S. even making threats to withdraw from the treaty entirely in 2003 (Gareau 2008b). The MeBr case provides an excellent opportunity to compare with that of CFCs, because the relative conditions were the same; both CFCs and MeBr are substances regulated through the Montreal Protocol, and both chemicals are intricate parts of production processes important to the U.S. The different outcomes of the CFC and MeBr cases appear to be strongly linked to the economic viability of alternatives to maintain production within the U.S. in both cases and the economic opportunity for chemical producers. With MeBr, we see how the U.S.—under much less pressure from civil society (including the chemical industry) to phase out MeBr than it had pressed with CFCs, and much more pressure from the agricultural community to keep MeBr—had successfully stalled its elimination well beyond the scheduled phase-out date of 2005.

There are other differences as well. Unlike the inclusion of CFC experts into the Montreal Protocol scientific community, the inclusion of MeBr chemical industry interests has led to discord and dispute over the viability of alternatives, and delay in ODS phase-out. Most importantly, the rules regarding the exemption of MeBr are very different from those regarding CFCs, in many ways much more reliant on particular interpretations of scientific knowledge and concern for individuals than for the conditions of the global environment (Gareau and DuPuis 2009). The article will show that for CFCs, essential uses were created to ensure the safety and general welfare of human beings and to ensure global economic stability. For MeBr, the effect of alternatives on individual MeBr users is a primary concern used to award exemptions and to ensure the continuance of the status quo in the production of relatively unimportant commodities in terms of global market stability (i.e., strawberries and tomatoes). The shift to delay in the MeBr phase-out marks a new moment in the Protocol's history, demonstrating how even the most successful agreements can become subject to problems when the economic gains of working with international environmental agreements are not readily understood by global powers and their constituents, in this case the U.S. and its agro-industry.

2 The phase-out of (most) CFCs via the Montreal Protocol

> The ozone regime provides the best existing example, and an impressive model of a regime that can evolve dynamically in response to changing conditions—(Parson 2003, p. 280).

In *Governing Water*, Conca (2006) argues that global regimes are more suited to resolving global concerns than local problems with global effects. Issues such as water abundance and quality are resolved most effectively by bilateral cooperation that involves state, civil society, and scientific collaboration. On the other hand, global issues such as stratospheric ozone layer depletion or global climate change fit more snuggly into the global regulatory approach. But even here "conventional regimes may or may not respond effectively to the problem of pollution beyond borders" (Conca 2006, p. 8).

A primary argument of this article is that even global problems, such as stratospheric ozone layer depletion, are not always handled well by established international environmental agreements if the conditions are not right. Indeed, Conca's thesis regarding the inefficacy of such agreements might apply to the Montreal Protocol in the present moment as well. Here, an international environmental agreement that experienced success for a long period of time has recently experienced significant setbacks due to the fact that an issue of local concern (MeBr use in U.S. strawberry and tomato production) has global implications, the depletion of the ozone layer (Gareau and Crow 2006).

The point here is not to overlook the clear successes of this treaty. The Montreal Protocol is exemplary in many ways, enticing global cooperation on all manner of environmental issues. Its model of state, science, corporate, and civil society involvement provided a model for subsequent global environmental challenges, such as global climate change (Canan and Reichman 2002, p. 45). Although scholars rightfully question the transferability of its framework to other issues (Conca 2006; Lipschutz and Mayer 1996; Young 1994), its notable success in eliminating most ODSs is still predominantly attributed to the soundness of its framework in generating cooperation.

The history of the Montreal Protocol and its almost complete phase-out of CFCs is well documented by scholars both inside (Bankobeza 2005; Benedick 1998; Canan and Reichman 2002; UNEP 2002) and outside (Haas 1992; Litfin 1994; Parson 2003) the Protocol's decision-making process. Many accounts remark that the success achieved by the Protocol in phasing out 95 percent of ODSs can be transferred to other efforts to alleviate global environmental harms. As Parson notes:

> The ozone story offers important new insights into regime formation, negotiation strategy, and how scientific knowledge can help shape policy outcomes. …its specific lessons … may apply to other issues where conditions are sufficiently similar (Parson 2003, p. viii).

The point of this article is rather to illustrate why policymakers and scholars must be cautious when trying to glean insights from the Montreal Protocol's successes. The CFC phase-out included in no small manner political and economic opportunism displayed by the chemical industry and powerful nation-states. The article will also describe the immense problems that still remain in phasing out MeBr, problems caused by disagreements over scientific knowledge, and the economic impact that the MeBr phase-out could potentially have on global powers, especially the U.S. Here, arguments by ecological modernization proponents that prosperity and growth can be made ecologically sustainable via state, science, and corporate cooperation require a nuanced understanding of the negative effect that scientific uncertainty regarding technical and economic feasibility, and treaty discourse, can have on nation-state environmental decision-making (Jänicke and Jörgens 2009). Language on what constitutes a critical use exemption (CUE) to the MeBr phase-out has served to delegitimize certain interpretations of feasibility, which might be interpreted as a weakening of democratization. The MeBr case, the newest phase of the Montreal Protocol, shows that without scientific certainty and a clear account of the economic gains for the U.S. future phase-out successes will be unlikely at the worst, sluggish at best.

2.1 The emergence of regulation of ODS

Stratospheric ozone is, in a word, a global sunscreen that absorbs ultraviolet (UV) radiation, thus allowing life to exist on Earth (Andersen et al. 2002). In 1974, Molina and Rowland published an article predicting that CFCs would deplete the ozone layer. Stratospheric ozone layer concentrations are rather small, making up only 8–10 parts per million (ppm) at around 20–35 km altitude. This small concentration of ozone buffers atmospheric radiation and regulates—in part—Earth's temperature and air circulation. When put into contact with UV radiation in the stratosphere, CFCs break down into chlorine molecules, which destroy ozone by depriving the O_3 molecule of one of its oxygen atoms and giving it to another.[3] Once stratospheric chlorine reaches equilibrium, ozone begins to decline (Rowland and Molina 1994). The long-range implications of these findings are that "[e]ven if CFC emissions were to cease immediately, ozone loss would roughly double over one or two decades before beginning a 50- to 100-year recovery" (Parson 2003: 31). Used in many forms for many applications (e.g., CFC-12 for early home refrigeration and wartime insecticide sprays; CFC-13 for commercial cooling and refrigeration; CFC-11 for domestic toiletries and cleaning products in aerosols), by the early 1970s 200,000 metric tons were used in aerosols each year in the U.S. alone (Parson 2003: 20–21).

Concern with public opinion in the U.S. gave rise to action by corporations and governments prior to any scientific consensus on how to deal with the ozone problem. Likely linked to public awareness of other environmental problems occurring in the U.S., states within the U.S. enacted bans (either upheld by legislation or voluntarily enforced) on CFC aerosols, passed a labeling law for CFC-containing products, and "bills to restrict CFC aerosols had been introduced in twelve other states and the U.S. congress (Parson 2003, p. 36). By 1975, CFC aerosol sales plummeted in the U.S. By 1978, all CFC aerosols were banned in the U.S., with medical essential uses (such as CFCs for metered dose inhalers) remaining exempt.

It should be noted that the 1978 CFC aerosol ban only covered half of the CFC uses in the U.S., and this was in the most cost-effective market. Additionally, without global participation in CFC reductions, overall CFC levels worldwide would surpass their then-current levels by 1985. The CFC ban on aerosols led to increased CFC use in other areas unrestricted by U.S. legislation, and foreign competitors that used a higher quantity of CFC aerosols than the U.S. refused to make any high-cost transition (Parson 2003, pp. 41–42). For this and other reasons, no legally binding international agreement was put into effect until 1987. Yet after the 1977 United Nations Environmental Programme (UNEP) Governing Council meeting, countries in the European Community began placing bans similar to those enacted in the U.S. on CFC aerosols. The U.K. (along with Italy and France) was the exception, being a staunch rejecter of any attempt to regulate the CFC industry, likely due to the neoliberal position of Margaret Thatcher's government and the fact that ICI, the largest CFC producer in the U.K., was also its largest industrial firm. In short, a CFC aerosol ban would negatively affect the European firms more than the U.S. firms, and consumer rejection of CFC products was less extreme in the U.K. than in the U.S. Likewise in the U.S., "with the inauguration of the Reagan administration and the appointment of Anne Gorsuch as EPA administrator, the issue fell into neglect" (Parson 2003, p. 58).

[3] Parson makes the interesting observation that this was the first time that a chemical's inertness, and not its reactivity, was a serious environmental threat. That CFCs could remain non-reactive until they reached the stratosphere was the very attribute that threatened life worldwide (Parson 2003, p. 32).

In short, global ozone politics prior to 1986 was almost a complete failure, largely because enforcement of a CFC production ban would disturb the status quo of economic activity. It was not until the Reagan Administration had formulated an economic argument that the benefits of regulation outweighed the costs for the adoption of the Montreal Protocol that the U.S. took a leadership role (DeCanio 2003).

Even when the U.S. changed its position and called for an international ban on non-essential CFC aerosols in 1983, the global community maintained the position that any convention barring the production of CFCs should be voluntary (the Soviet Union opposed even the voluntary ban). Industry worldwide opposed such regulation, arguing that the science was dubious on what effect CFCs had on the ozone layer. In 1981, two major CFC producers, DuPont and ICI, stopped research on alternatives due to the increased costs associated with them, and some scientific research showed ozone depletion levels to be less than expected.[4] Therefore, the 1985 Vienna Convention, albeit useful in empowering the UNEP as secretariat of ozone negotiations, and in establishing intergovernmental cooperation in monitoring ozone depletion, research, and CFC production, was non-binding and ineffective in slowing CFC growth. It should likewise be noted that not a single environmental NGO attended the Vienna Convention when it was adopted (Andersen et al. 2002, p. 63).

Parson makes the observation that the common explanation for industry support of an international CFC ban likely had little to do with the discovery of CFC alternatives per se. Even by the early 1990s, industry would still complain that some CFC alternatives were not perfect substitutes, which meant higher costs and less satisfaction from users of the industry's products (Anderson et al. 1994; Parson 2003: 126–127). However, the potential benefits of a CFC phase-out to big producers were significant. Big CFC producers (DuPont, Allied, and Pennwalt being the largest in the U.S., ICI in Europe) were at a competitive advantage to increase market share in the chemical industry as a whole as CFCs transitioned to alternatives. The increased cost could be absorbed and reduced more easily by the large producers than by the smaller producers, which would consolidate business in the hands of a few, large, chemical companies (Litfin 1994).

In other words, the chemical industry was well aware that scientific data and public opinion were moving closer toward certainty regarding the environmental consequences of CFCs, and it was in the interests of the large corporations to attain a regulatory mechanism that would be to their benefit in the "substitutes game". As Litfin (1994, p. 95) puts it:

> The issue of substitute availability, which appears to be a straightforward matter of fact, actually hinged on perceptions about market trends, and this in turn hinged on the political question of regulatory policy.

DuPont's policy toward CFCs, for example, changed only when they felt future regulation of CFCs was imminent. Yet, without feasible substitutes, regulation would have been extremely difficult to ratify (Litfin 1994, pp. 94–95). It follows, then, that although the Montreal Protocol was not a consequence of CFC alternatives ready to replace CFCs at no cost, its inception still was largely driven by corporate interests to minimize the impacts of their regulation, and the applicability of alternatives drove Protocol decision-making:

[4] By 1984, the U.S. reversed its position again: "The United States, previously the most forceful advocate of binding and compulsory arbitration, had reversed its position after being sued in the World Court for mining Nicaragua's harbors and losing its procedural bid to avoid the court's jurisdiction" (Parson 2003, p. 121).

> [T]he relative availability of substitutes for various uses of ODSs often helped to explain industry's positions toward the [Protocol] negotiations. As substitutes became available in industrialized countries, for example, their support for stronger controls on the specific ODS would increase (Hunter et al. 2007, pp. 573–574).

For a decade after the Molina and Roland study came out in 1974, industry and the scientific community debated over the legitimacy of their respective claims; the latter improving scientific models to measure ozone depletion, the former working on profitable CFC alternatives. In 1985, under much public pressure and with coordination by the UNEP, several industrialized countries adopted the Vienna Convention for the Protection of the Ozone Layer.

2.2 Ratification of the Montreal Protocol

In Montreal on September 16, 1987, the Montreal Protocol on Substances that Deplete the Ozone Layer was adopted. The adoption led to legally binding agreements to phase out most CFCs from production and consumption. After 22 years, the Montreal Protocol now touts having 196 signatories.[5]

The initial provisions included five CFCs and two halons that would be controlled, with production reduced on an incremental basis. CFC production and consumption would be frozen at 1986 levels, with 20 percent reductions occurring in 1993 and 30 percent reductions in 1998. Halons would undergo a production freeze in 1992. What became one of the most notable and successful provisions of the Protocol was the phase-out schedule for developing countries, which was to be delayed by 10 years "as long as their CFC consumption remained below .3 kg per capita" (Parson 2003, p. 137), a principle commonly known in international environmental law as "common but differentiated responsibility" (Hunter et al. 2002, p. 402). The Protocol was designed to encourage ratification by placing trade restrictions on non-party countries: "Parties were forbidden to import controlled substances from non-parties after 1 year, and products containing controlled substances after about 4 years" (Parson 2003, p. 137).

In order to avoid trade discrimination suits under the General Agreement on Trade and Tariffs, any country that abided by Protocol provisions but had not signed the treaty would be considered a signatory in terms of trade. Such restrictions on trade are thought to be the real teeth of the Montreal Protocol, discouraging free rider behavior. Another innovation of the Protocol was that it would become active with only eleven countries (holding two-thirds of CFC global production) as signatories. This was likewise designed to encourage expedited membership by all countries. At least every 4 years, scientific information on ozone depletion was to be evaluated, and the Protocol's controls could be altered to reflect up-to-date knowledge with a two-thirds majority representing half of global CFC consumption (Hunter et al. 2002, pp. 544–545).

The Montreal Protocol, while not being the consequence of consensual science on ozone layer destruction, nor the discovery of seamless CFC alternatives, was likely the best-case scenario for U.S. industry and for large CFC producers as a whole. It allowed the U.S. to establish international regulation that would meet the growing political demands for a CFC phase-out domestically that simultaneously would push out small domestic competitors, and it appeased domestic civil society groups (Breitmeier and Rittberger 2000). It also allowed for global competitors to avoid a possible unilateral decision made

[5] http://ozone.unep.org/Ratification_status/.

by the U.S. to block trade in CFC products, where the U.S. forced to adopt such legislation (due to no international agreement). And it provided developing countries with a ten-year lag period in order to implement CFC alternatives while still importing them from the industrialized world (Parson 2003, pp. 144–145). In line with an ecological modernization scenario, initiating ozone layer protection involved meeting the needs of the chemical industry as much as it did convincing chemical industry scientists of the need for a precautionary approach (Huber 2009).

While the large CFC producers, such as DuPont, might have had the most to gain from a CFC ban because it was furthest along in the substitutes game, it was a major player in the Alliance for a Responsible CFC Policy (Litfin 1994). Therefore, DuPont and other CFC producers would likely not have come on board the Montreal Protocol so easily were its chief scientists not persuaded by discoveries in ozone science. Clearly, the discovery of the ozone hole over Antarctica (Farman et al. 1985) played a leading role in moving all actors toward precautionary action. The discovery of the ozone hole served to reframe the issue to one of reducing chlorine concentrations in the atmosphere, "even though delegates agreed not to consider the evidence or its cause" (Bernstein 2002, p. 149). Here, it is clear that "it was not science, but bargaining that determined the decisions adopted in Montreal" (Parson 1993, p. 60 in Bernstein 2002, p. 149).

What seemed to be a primary concern with Protocol formation were matters of trade:

> EC producers, who dominated export markets and had more effective excess capacity than North American producers because so much of their output was still going to aerosols, wanted the terms of the Protocol to help them maintain their export markets. North American producers wanted to weaken the EC's dominance of exports, or at least not have the Protocol strengthen their position (Parson 2003, p. 145).

Parson, who argues that DuPont did not necessarily consent to the Protocol because it would improve its profits, nonetheless notes that the CFC phase-out through the adoption of hydrochlorofluorocarbons (HCFCs) provided a commercial and potential patent opportunity for big, monopoly-like CFC producers such as DuPont:

> Consequently, while alternatives markets posed many risks, it was also plausible that barriers to entry could make them more favorable than CFC markets for the largest and most technically sophisticated producers (Parson 2003, p. 158).

It is difficult to see this not as a profit-making maneuver, especially when considering that DuPont proposed publicly in 1988 to phase out the remaining 50% of its CFC production by the year 2000, 13 years after the Protocol's ratification; ample time to develop viable alternatives to CFCs that were already showing promising results in key areas (Chemical Week 1988). The first President Bush would later echo DuPont's proposal in preparation of the London meeting of the Protocol in 1990 (Whitney 1989).

Although as late as 1987 alternatives to CFCs had yet to reach the substitutability stage, the future would reveal the advantages to DuPont in leading the transition to CFC alternatives. For example, as early as 1988 DuPont patented a process to produce HCFC-141b and HCFC-142b as replacements for CFC-11. When this technology proved to deplete ozone at higher levels than anticipated (which still, by law, would give DuPont 30 years to eliminate the process from production), it patented HCFC-123. Soon after, both ICI and DuPont became primary producers of HCFC-134a, a replacement technology for CFC-12. Other renditions of HCFCs soon hit the market, all promoted and produced by ICI, DuPont, Allied and other large CFC-producing firms, generating returns up to *ten times* that of

CFCs. By 1990, only 3 years after industry stated that alternatives were “far from available” in economically competitive forms, the largest CFC producers began closing their CFC production capacity and taking advantage of their near-monopoly over efficient HCFC production (Parson 2003, pp. 177–180). Consequently, “the three smallest U.S. producers—including Pennwalt, which tried to compete in new refrigerant and foam markets—were all sold by 1989” (Parson 2003, p. 181).

The proposed alternatives (mostly HCFCs) themselves depleted ozone, but at lower levels (at 2–10 percent that of CFCs). Therefore, the Protocol can be described as successful in that it balanced industry and social demands for the services provided by ODSs. In other words, the outcome was not an immediate ban on ODSs, but involved rather a protracted transition to ozone-free production and complete ozone layer recovery. The 1990 London Amendment to the Protocol, after all, resulted in a non-binding agreement that HCFCs would not require a phase-out until the year 2040. The 1992 Copenhagen Amendment would see that time span reduced to the year 2030. And, by 1992, it became clear that growth levels of CFCs were beginning to slow down, but not to decrease (Butler et al. 1992).

2.3 The role of the TEAP and its technical options committees

According to Parson (2003, p. 144), the most important achievement of the Montreal Protocol was the establishment of a requirement for parties to “periodically support assessments of relevant developments in science, impacts, technology, and economics, and then review the controls in force to consider whether these developments suggested changing them.” Such a policy was important due to the uncertainty over how strict controls on CFCs needed to be in order to protect the ozone layer. Ostensibly, it also allowed the expert assessment panels to make recommendations relatively delinked from political and industrial interests. For one, no CFC producers were allowed to be on the overseeing Technology and Economic Assessment Panel of the Protocol (TEAP). But they were allowed to be on the various subsidiary “technical options committees” (TOCs), to make presentations to the panels on their findings, and to provide information on CFCs and their alternatives. Initially, the two most influential panels, the atmospheric science and technology panels, reported results on recent findings in ozone layer attributes, especially developments in assessments of the ozone hole found over Antarctica, and the availability and efficacy of alternatives to ODSs. Each panel’s TOC, made up of leading technical and scientific experts, was in charge of assessing the feasibility of phasing out particular chemicals. The technology panels did not consider the costs of alternatives, but only assessed their efficacy in not “substantially affecting properties, performance or reliability of goods and services from a technical and environmental point of view”.[6]

It is not secret that the TOCs are made up of representatives of the affected industries. These, after all, are often the most knowledgeable experts on the substances considered for phase-out. Most Protocol scholars do not find this a problem, perhaps because the results were near-consensus on a complete CFC phase-out in almost all areas. Rather, the TOCs are seen as a primary force behind the CFC phase-out by providing technical solutions to problems with alternatives (Andersen et al. 2002; Bankobeza 2005; Benedick 1998; Haas 1992; Litfin 1994; Parson 2003). Yet the initial discussion among the halons TOC provides a different picture. The halons TOC could not agree on a full phase-out, due to the imperfect substitutability of alternatives, and opted instead for a 60 percent cut in

[6] Synthesis Report, UNEP/OZL.Pro.WG.II(1)/4 (89-1-11) p. 9.

production made by merely promoting the efficient uses of these chemicals, and by freezing, but not reducing, halon production (Benedick 1998, pp. 117–125). The halon case provides evidence that if CFCs had only substitutes that substantially affected goods and services, the Protocol likely would have been delayed and required more substantial government regulation of the chemical industry. At the same time, halons were phased out of production prior to any other CFC (by 1993), due to "reducing unnecessary discharge and better managing of existing stocks" and the fact that "the large existing stock, and the small fraction of consumption actually used when it mattered, allowed production to be eliminated long before chemical alternatives were fully commercialized" (Parson 2003, p. 192). It seems clear here that efficiency in production was the driving force behind the success of the halons phase-out, not science per se, nor concern for the fact that bromine (a component of the compound) destroys ozone at a rate 40 times greater than chlorine (van der Leun 2004).

3 A change in ozone political economy: delays in the methyl bromide phase-out

> The Montreal Protocol doesn't work anymore—Lobbyist attending the 2004 16th MOP of the Montreal Protocol[7]

In April 1991, the U.S. EPA reported new data suggesting that the rate of ozone loss was likely double the estimates made by the Montreal Protocol assessment panels. For the U.S. alone, this meant that skin cancer deaths would increase by 200,000 or more over 50 years (Science 1991). Ozone holes continued to appear each year with increased size and for increased periods of time from 1989 to 1992, with a hole estimated to develop in the Arctic over the next few years. Record-breaking ozone hole extent and severity would extend into 1995, with 1994 ozone percentages up to 25 percent below average and 18 percent losses over the U.S. (Parson 2003, p. 223, fn. 137). In 1992, ozone levels over northern Europe and Canada reached their lowest levels in recorded history. Research summarized by the UNEP showed that the quantity and productivity of phytoplankton were diminished in the vicinity of the Antarctic ozone hole (UNEP 1991). The then senator Al Gore warned of an ozone hole imminent over the New England region, and the Senate call "for phaseout of all ODSs 'as fast as possible' passed by 96 votes to none" (Parson 2003, p. 215). It was in this mood that methyl bromide (MeBr) gained prominence as an ODS.

MeBr is a chief ingredient used in conventional strawberry and tomato production, as well as for quarantine and pre-shipment purposes (QPS).[8] Historically, the U.S. has been the largest producer and consumer of MeBr. In 1991, the U.S. used approximately 25,000 metric tons, almost 40 percent of total MeBr used globally. In 1991, about 50 percent of MeBr used by the U.S. went to two crops in two states: Florida tomatoes and California strawberries, where 90 percent of U.S. strawberries are grown. In 1992, pre-plant soil sterilization represented 75 percent of total MeBr use in the U.S. (UNEP 2009). In 2005, the year parties would allow for initial exemptions to the MeBr phase-out, the ozone hole over Antarctica reached almost 10 million square miles, equivalent to the size of North America, and near the record set in 2003. At the same time, the date of ozone layer recovery was extended almost 20 years to 2070 (Environment News Service 2005, 2006).

[7] Interview with the author at the 16th MOP, Prague, 22 November 2004.

[8] QPS uses are currently exempt from phase-out under the Montreal Protocol.

As the last of the bromine-containing substances included in the provisions of the Montreal Protocol, MeBr had the potential to contribute significantly to the reparation of the ozone layer. Out of all the possible amendments that could have been written into the Protocol, the MeBr phase-out was considered both the most cost-effective and ozone-saving option available. Here was an opportunity to put the "greening of modernization" to the test in global environmental governance (Hajer 1995). The production and distribution of MeBr, however, would involve a more complex arrangement of government, industrial, consumer, and other civil society actors than did the CFC case.

3.1 Initiating the MeBr controversy

MeBr became a primary topic of discussion because its reduction would advance total ozone loss considerably:

> Controlling MeBr was a high-payoff opportunity to reduce ozone loss: under certain conditions, each 10 percent reduction in MeBr emissions would achieve as much as a three-year advance in the CFC phase-out (Parson 2003, p. 211).

However, the inclusion of MeBr into Protocol provisions created a new set of controversies for science, nation-state cooperation, and industrial and other civil society involvement. Most significantly, it meant that a new set of producers would become involved in informing the TOCs of their technical, scientific, and economic situation vis-à-vis MeBr alternatives. Initially, these firms included Great Lakes Chemical and Ethyl Corporation from the U.S.; Rhone Poulenc and Atochem from France; and Dead Sea Bromine from Israel (Parson 2003, p. 336, fn. 105). MeBr's "ozone-depleting potential" (ODP) was estimated at .7 of CFC-11, and up to 7 times that of CFC-11 over a period of 10 years in the stratosphere (Parson 2003, p. 218).

Due to amendments to the Clean Air Act, MeBr unquestionably required an immediate phase-out in the U.S., having an ODP greater than .2, and initially was slated for complete phase-out under legislation by 2000. The international community did not bend to U.S. pressure during Protocol deliberations to phase out MeBr internationally by 2000. France and Israel, both home to large MeBr producers, opposed any international restrictions on its use. Domestically, U.S. agricultural producers and the U.S. Department of Agriculture were strongly opposed to the MeBr phase-out mandated by the Clean Air Act, but were unsuccessful at the time in changing the U.S. government's position (Parson 2003: 218). In 1992 at the Copenhagen meeting, the U.S. recommended a phase-out of MeBr by 2000 for industrialized countries and 2010 for developing countries, while other countries recommended incremental phase-outs over a longer period, or, as in Israel's case, delaying any discussion of phase-out until 1995. The adopted outcome, however, was a freeze in MeBr production and consumption at 1995 levels. Consequently, the Bush Administration put off any control of MeBr under the Clean Air Act, and it was not until December 1993 under the Clinton Administration—under extreme pressure from MeBr producers and users—that a domestic MeBr phase-out was enacted; this time in tune with the Copenhagen agreement. However, the domestic legislation went beyond the Copenhagen agreement in one way: by scheduling the complete phase-out of MeBr in the U.S. by 2001 (Parson 2003, p. 221).

After the 1992 meeting, ozone scientists reported that ozone layer losses were occurring at record levels. If all amendments to the Protocol authorized at the Copenhagen and London meetings were followed, by 2045 there would still be 2 parts per billion of chlorine in the stratosphere, with losses peaking at 12–13 percent in 2000. These losses, it was estimated, would be much larger if there were a volcanic explosion (evidenced from the

Mount Pinatubo explosion) or if the Arctic winter was colder than usual. That was not all. Further findings by Montreal Protocol science and technology panels suggested that ozone layer losses would have immune system effects that would increase infectious diseases like malaria and herpes and would alter the recycling of nutrients in terrestrial ecosystems. Such evidence was considered serious enough by the global community to try to tighten controls of ODSs further.

Of all possibilities, MeBr provided the most "bang for the buck". Eliminating MeBr by 2001 would reduce "integrated excess chlorine" in the atmosphere by 13 percent, producing a far greater effect than the elimination of any other substance, including halon banks, HCFCs, and CFC banks (UNEP 1995, p. xxii in Parson 2003, p. 225).

However, it was during this same period that the ozone regime experienced the beginning of what Parson calls a "revisionist backlash" from the U.S. Here, the U.S. began denouncing scientific findings that, in their view, unduly stressed the risks associated with ozone loss in the northern hemisphere:

> Through 1993 the movement gained support from several conservative political figures and a few scientists with no prior expertise in the issue. … The backlash appealed to some members of the 104th Congress, who sponsored hearings to debunk supposedly alarmist science supporting unsound policy decisions, and introduced bills to weaken or abolish controls on ODSs (Parson 2003, p. 225).

By 1996, most of this backlash declined, but it did not alter some U.S. groups' resolve to avoid the MeBr phase-out. At the international level, debates between the E.U. and the U.S. regarding the tightening of controls of a MeBr phase-out continued. At the 1994 meeting in Nairobi, the parties agreed on "essential use exemptions" for MeBr in quarantine pre-shipment uses. Also in 1994, the 65-member Methyl Bromide Technical Options Committee (MBTOC) released a report on the substitutability of MeBr with other substances.

There were several key differences between the MBTOC and the initial CFC assessment panels. For one, the MBTOC included MeBr producers who, as Parson relates,

> had no plans to market alternatives to their current product. Predictably, this was a highly contentious group: manufacturers and many users fought to have the report conclude that there were no alternatives to MeBr, charges of bad faith were widespread, and manufacturers and many users attacked the report on its release (Parson 2003, pp. 227–228).

Consequently, the final report was relatively vague, mentioning that alternatives existed for a number of uses, but that there were no viable alternatives ready for "less than 10 percent of 1991 MeBr use" (UNEP 1994, p. 3 in Parson 2003, p. 228). A subsequent 1995 report showed that the majority of MBTOC members felt that 50 percent reductions in MeBr production were feasible by 2001, while a minority felt that either all MeBr or only a few percent could be reduced by 2001. Prior to the 1995 Vienna meeting, the MBTOC reported that they decided a 25 percent cut in 2005 and a complete phase-out by 2011 would be possible, but that would cost up to $327 million. This debate occurred while the largest ozone hole in recorded history was discovered in Antarctica, and record ozone losses were found again in the northern hemisphere (Parson 2003, pp. 228–230).

The 1995 Vienna meeting created an incremental phase-out of MeBr, with a 25 percent cut in production and consumption in 2001 from 1991 levels, a 50 percent cut in 2005, and a complete phase-out in 2015 in the industrialized world. Developing countries agreed to a 2002 freeze in production and consumption of MeBr, based on their average levels over the

1995–1998 period.[9] Regarding agriculture, a provisional exemption for "critical agricultural uses" (a response to U.S. domestic opposition to MeBr controls from its agro-industry) also was passed, with extreme reluctance and accusations of bad faith by the European Community. One of the MBTOC's most important roles for the next meeting would be to assess the viability and effect of such exemptions. The TEAP also recommended that MBTOC membership be reduced and that MBTOC experts be evaluated based on whether they represent companies that market MeBr alternatives. The idea here was to reduce the obvious bias that existed within the MBTOC. For years to come, the apparent illegitimacy of the MBTOC would be used as a political tool by both sides of the debate (Gareau and DuPuis 2009).

At the 1997 meeting in Montreal, MBTOC presented new scientific evidence on MeBr's ODP, reducing it from .7 to .4. Despite the reduction in its ODP, MeBr was still given the highest priority; its elimination still had the potential to swiftly reduce ozone layer destruction, and its ODP was still double the Clean Air Act ceiling of .2. This time, the MBTOC reported that 75 percent reductions were possible in both the industrialized and less-developed countries. But "industry countered that the estimate was too optimistic and simply reflected political pressure from the U.S." (Parson 2003, p. 233). Nevertheless, the MBTOC responded in the plenary "that the industry was obstructing progress by working to preserve the status quo rather than attempting to develop and implement alternatives" (Parson 2003, p. 233).

The MeBr phase-out changed in 1997, but not as much as the U.S. would have liked, pushing up the complete phase-out to 2005, with incremental reductions in 1999 (25 percent); 2001 (50 percent); and 2003 (70 percent). Parties agreed on an incremental phase-out for the less-developed countries, with 20 percent reductions in 2005 and a complete phase-out in 2015.[10]

3.2 MeBr critical use exemptions: a shift from precaution and social welfare to individualism and market disruption

Criteria for critical use exemptions (CUEs) for MeBr differ greatly from the criteria for essential use exemptions for CFCs. In many ways, the criteria are much more lenient than the CFC exemption clause, and much more based on the concerns for individuals' economic security than the conditions of the global environment. Problems caused by the move away from precaution to market disruption (described below) suggest that the reliance of some ecological modernization scholars on "neoliberal-style market instruments" need to be cautious (Bailey and Wilson 2009, p. 15). Here, any "significant market disruption" potentially caused by MeBr alternatives is enough for parties to grant an exemption to the MeBr phase-out. As the U.S. EPA puts it:

> Under the Essential Use provisions [for CFCs], in order to even be considered for an exemption, it was necessary for each proposed use to be "critical for health, safety or

[9] Final Report of the 7th Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer. Both environmental groups and—later and anonymously—members of MBTOC criticized the 1995–1998 average given to developing countries, worried that it would increase consumption of MeBr over that period in order to get the base level at a higher level. It is likely true that this happened, and, as Parson relates, it likely benefited the chemical companies greatly, who were responsible for up to 85 percent of ODS usage in places like Thailand (2003, p. 231, fn. 187).

[10] Final Report of the Ninth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer.

> the functioning of society." This high threshold differs significantly from the criteria established for the methyl bromide Critical Use Exemption. Indeed, for methyl bromide, the Parties left it solely to the nominating governments to find that the absence of methyl bromide would create a significant market disruption.[11]

The E.U. struggled for more strict language regarding exemptions, but ultimately failed.

The MBTOC announced at the 1998 10th MOP held in Cairo that it assessed that there were alternatives for 95 percent of MeBr uses, and not a single agricultural crop needed the chemical. In 1999, the E.U. resolved to ban all MeBr consumption in 2005. Parties requested MBTOC to report again on alternatives to MeBr in 2003. After this meeting, the U.S. EPA revised the domestic phase-out of MeBr to match that of the Protocol, 2005. However, the U.S. would continue to seek CUEs for agricultural uses of MeBr, especially in strawberry production (U.S. Committee on Agriculture 2000).

The U.S.'s main argument for CUEs has revolved primarily around the phrase "market disruption." Yet it is unlikely that any disruption in the strawberry market will be linked to MeBr per se, but rather to other factors of production, such as labor and land costs (Borrego 2000; Gareau 2008b). The growing fear among some U.S. agro-industry advocates has been a loss of market share to foreign competitors. While fresh strawberries are notoriously quick to spoil, the frozen strawberry market is indeed "global." For example, the U.S. has lost market share in Japan to China. In 2003, China replaced the U.S. as the largest importer to the lucrative Japanese market (Carter et al. 2005a). U.S. strawberry growers are eager to reverse this new trend. For example, in 2008 California Governor Arnold Schwarzenegger commented on how California strawberries would be shipped to China during the 2008 Olympic games (in August and September, when the Chinese strawberry harvest is minimal), the first time China allowed California strawberries across its border (California Strawberry Commission 2008). Indeed, rapidly increasing exports now make China one of the major frozen strawberry suppliers in the world, which has instigated acts of protectionism by the U.S. and the E.U. (FAO 2005; USDA Foreign Agricultural Service 2005).[12] By 2005, over 25 million pounds of fresh strawberries were produced annually in China, with only very limited usage of MeBr (Carter et al. 2005a, b; FAO 2005). California growers have been fighting a losing battle to enter both Europe and China's growing markets while China has boosted its exports to both the U.S. and Europe (California Strawberry Commission 2006; Carter et al. 2005a, b; USDA Foreign Agricultural Service 2005). China's strawberry acreage is already six times greater than California's, albeit with productivity one-third that of California's. Still, China is now the leading strawberry producer in the world, with more than 1 million metric tons of product in 2003 (Carter et al. 2005a, b).[13]

In 2003, Parties reluctantly agreed to allow for almost 10,000 metric tons of MeBr for U.S. strawberry and tomato production for the year 2005. While the MBTOC reported in 2003 that alternatives to MeBr were both economically and technically viable for all uses in strawberry and tomato production, the changes to the exemption clause allowed the U.S. to draw from particular studies based on research conducted in particular sites to override the MBTOC's decision (for an entire account of this exchange, see Gareau 2008b).

[11] http://www.epa.gov/ozone/MeBr_exec_summary.pdf.

[12] On July 6, 2005, the E.U. published a notice of initiation of a safeguard investigation concerning imports of frozen strawberries from the Chinese mainland. The issue was raised by Poland, which complained that China imports could endanger its domestic production (USDA Foreign Agricultural Service 2005: 4).

[13] For a more complete account of the global competition in strawberries, please see Gareau (2008a).

The decisions for granting the U.S.' MeBr exemptions were based on a ''market disruption'' valuation performed by agricultural economists and scientists at UC-Davis (Cf. Goodhue et al. 2005) with financial support from the California Strawberry Commission. While studies supported by the MBTOC showed that the phase-out of MeBr in strawberry and tomato production was efficient from a general welfare viewpoint (e.g., DeCanio and Norman 2005; see also DuPuis and Gareau 2008), the market disruption approach showed that a reduction in MeBr would have a negative economic impact on some U.S. strawberry growers and would allow competing regions to gain market share over them (see Gareau 2008b). By side-stepping the general welfare viewpoint, the Protocol had circumvented a key concern of ecological modernization; improving overall social and environmental welfare (Fisher et al. 2009).

The key differences between the optimistic and pessimistic views of adaptation to a change in the regulatory environment for strawberry growers were the definition of "market disruption", the price change and demand elasticity estimates used, the estimated change in consumption over time, and the use of data on costs and yields from the nominations themselves versus experimental plots used to justify exemption nominations in the U.S. (Cf. Carter et al. 2005b; Norman 2005). To demonstrate the contrast between the U.S. claims of the impact on strawberry growers and optimistic estimations, witness:

> *Even under conservative assumptions*, final cost burdens incident on growers are *a fraction* of up-front cost estimates provided in the Critical Use Nomination for this sector (Norman 2005, p. 175, my emphasis).

Here, it is clear that market disruption is determined to be minimal, making other factors, such as growing competition from China, likely much more important than this agricultural input. Concurrently, the case demonstrates how certain discourses regarding the MeBr phase-out became delegitimized, a sort of "de-democratization" that ecological modernization proponents would denounce.

The change in evaluation of what constitutes a CFC essential use exemption and what constitutes a MeBr critical use exemption has shifted focus from the general functioning and health of society to the economic interests of individuals in the marketplace. As a result, the U.S. has successfully protected its own economic interests by drawing attention to the unique, local conditions of strawberry and tomato production in the U.S. while delegitimizing the claims made by the global knowledge of the MBTOC (Gareau and DuPuis 2009). By 2007, U.S. MeBr "critical uses" would still remain sizable, totaling over 5,000 metric tons. The second largest exemptions for 2007 went to the E.U., at only 700 metric tons. Presently, California strawberries represent the largest MeBr exemption in the world, and they have always comprised either the largest or second-largest exemption worldwide (UNEP 2009). Whereas in 2005 U.S MeBr exemptions accounted for almost half of all exemptions worldwide, by 2009 its share of exemptions would reach over 90 percent of the total (UNEP 2007b).

As I have reported elsewhere, the E.U. and China contain competitive strawberry production platforms that—were MeBr to be phased out—might gain market share in the global strawberry economy (Gareau 2008a; 2008b). In the 1990s, the U.S. was under a great deal of domestic pressure to abide by the mandates of its Clean Air Act, and thus was pressured to phase out MeBr domestically. An earlier U.S. phase-out would allow the E.U. strawberry industry, for example, to gain an advantage and use MeBr at least until 2005. This is likely the reason why the U.S. revised its 2001 domestic phase-out to match the 2005 phase-out of the Protocol. As it turns out, even the 2005 phase-out was virtually eliminated due to the large number of CUEs to the phase-out discussed earlier. The MBTOC is very much divided in its belief of whether these CUEs are legitimate given the mandates of the Montreal Protocol (Gareau and DuPuis 2009).

From its inception, the MBTOC faced great difficulties in deciding how to assess MeBr. In fact, to this day, it is still divided on how to assess MeBr and its alternatives; some feel alternatives exist in virtually all areas, some say none exist for strawberries. All this while the MBTOC was formed under virtually the same conditions as the CFC and halon TOCs, with one difference: it involved MeBr producers as experts from the beginning with no economic gain in promoting MeBr alternatives (Canan and Reichman 2002; Parson 2003). As Jonathan Banks, the then MBTOC Co-chair, commented, this was

> the first time the agricultural sector [and agribusiness] came under the scrutiny of the Montreal Protocol," and "unlike other industrial sectors affected by the Montreal Protocol, the MeBr industry produces no alternatives and therefore has no business interest in alternatives (Banks 1998, p. 168 in Canan and Reichman 2002, p. 86).

Regarding the indecisive and contested science among the global MeBr experts and its alternatives, the MBTOC, Parson writes:

> Leaders of the process reported that they experienced here the kind of obstruction they had expected from CFC producers in 1989 (and for this reason excluded them), but had never experienced from them once they were included (Parson 2003, p. 228).

This insight makes clear the deeply political and economic reasons for CFC phase-out success.

For CFCs,

> the stakes were high, because many of the goods and services provided using CFCs, most notably refrigeration and electronics, were essential. … As industry argued with some justification, CFCs were intermediate goods that were incorporated into other products of substantially higher value that depended on them (Parson 2003, p. 175).

For MeBr, no such claims could be made, especially for strawberry and tomato production, which presently rely on a chemical virtually eliminated from similar production in other parts of the world (Gareau and DuPuis 2009). The overall welfare of the global economy and products that depend on components that require CFCs changed with MeBr to concerns for a few growers who contribute comparatively little to the global economy. Unlike Montreal Protocol CFC amendments, since 2003 MeBr amendments have at times *increased* MeBr use, not always tightening restrictions on use (DeCanio and Norman 2005).

The potential for the U.S. to lose market share in strawberry and tomato production to competitors is no small point. The shift to the impact of market conditions on individuals was something being promoted large-scale by the U.S. since the 1980s (Gareau and DuPuis 2009). Here, in microcosm, was the convergence of neoliberal economic ideals and environmental protection, something that the U.S. pushed with earnest (Bernstein 2002). In fact, the potential loss of market share was important enough for the U.S. to threaten to withdraw from the Montreal Protocol entirely. Witness the U.S.'s closing statement at the 2003 Meeting of the Parties in Nairobi, after parties refused to grant the U.S. CUEs:

> My fellow delegates, if our exemption request is not approved the Protocol's record of fairness and the very foundation upon which this treaty is based will be undermined. Such an outcome could shatter the fragile coalition within the United States

> that enables us to make progress in international bodies. I urge delegates to avoid such an outcome.[14]

The strength of the U.S. agro-industry, the selectivity of scientific knowledge to justify its claims, the de-legitimization of alternative scientific claims, combined with state support, has led to significant delays in the MeBr phase-out. Here, the rift between scientific claims on the efficacy of MeBr alternatives has been filled by protectionist "civil society" groups concerned about the long-term economic viability of a non-MeBr agricultural production regime, not by environmental advocacy groups (including scientists and other experts). Collaboration at the global scale of MeBr ozone diplomacy, then, has excluded certain scientific knowledge and civil society actors in ways that scholars working to promote reflexive strategies for greening modernization need to consider (Dryzek et al. 2009).

4 Conclusions

The Montreal Protocol is indeed a shining star in a relatively bleak history of international environmental decision-making. Due to the CFC phase-out, its framework, levels of nation-state cooperation, and relative autonomy of scientific experts are portrayed as components possible to emulate in other international environmental agreements. Yet the history of the agreement shows that its success has a lot to do with the interests of industry and powerful nation-states, and their ability to organize an agreement that would maintain economic viability in the midst of change to less harmful production practices.

The success of the Montreal Protocol was as much due to politics as to economics. Parson relates, "in the period considered here, direct scientific claims had highly limited effects on policy debates and none on policy outcomes. *The only use of direct scientific claims was the selective adoption by policy actors of results that favored their position*" (Parson 2003, pp. 106–107, my emphasis). This situation changed in 1985–1987 with the discovery of the Antarctic ozone hole (Wapner 1996). Here, increasingly solidified scientific evidence, coupled with pressure from U.S. environmental civil society groups, persuaded the chemical industry to adopt alternatives prior to any definitive proof that they would work and be profitable.

When recalling the 1992–2002 history of MeBr in the Protocol, it is hard not to envisage the contested timelines between the U.S.'s proposed 2001 phase-out and the E.U.'s proposed 2005 phase-out as an issue of competitive advantage in MeBr-related production. An early U.S. phase-out would allow the E.U. to gain an advantage by using MeBr for an extended period of time, researching alternatives, and possibly increasing market share. When the U.S. aligned its phase-out to match the Protocol's 2005 deadline, the U.S. agro-industry fought hard to maintain MeBr use indefinitely. Debates about the economic impact of MeBr alternatives on individual users led to heated plenary debate among nation-state delegations and between delegations and factions of the MBTOC in small groups sessions (DuPuis and Gareau 2008), and internecine polemic in the MBTOC (Gareau and DuPuis 2009). Indeed, allowance in the CUE process for the consideration of economic impact on individual users of MeBr has instigated discord and dispute among Protocol actors from the beginning. Instead of considering the general functioning of society (the

[14] Claudia McMurray, U.S. Delegation, 15th Meeting of the Parties to the Montreal Protocol, 14 November 2003, Nairobi, tape-recorded notes.

CFC exemption criteria), consideration had shifted to that of individual market conditions, with powerful countries left to determine what those conditions may be.

This change in affairs in the Montreal Protocol demonstrates how changes in treaty language to suit the market conditions of particular actors can forestall the elimination of globally harmful substances. These changes deserve our attention, and our scrutiny, most especially at a time when the Montreal Protocol is increasingly looked to for guidance with regard to other global environmental issues, such as global climate change (Barrett 2003; Norman et al. 2008; Oberthur 2001). Furthermore, the history illustrated here suggests that environmentally conscious facets of global civil society engaging with global environmental governance might require new strategies, likely ones divergent from some of the analytical radars of many ecological modernization theorists and like-minded civil society advocates.

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