United Nations Environment Programme

Distr.
GENERAL

UNEP/WG.151/Background 2
15 October 1986

ENGLISH ONLY

Ad Hoc Working Group of Legal and Technical Experts for the Elaboration of a Protocol on the Control of Chlorofluorocarbons to the Vienna Convention for the Protection of the Ozone Layer (Vienna Group)

REPORT OF THE SECOND PART OF THE WORKSHOP ON THE CONTROL OF CHLOROFLUOROCARBONS

Leesburg, USA, 08-12 September 1986

As part of the background information made available to the meeting, the report of the second part of the Workshop on the Control of Chlorofluorocarbons (UNEP/WG.148/3) is annexed to this document

Na.86-2184

3. Ambassador Richard Benedick, Deputy Assistant Secretary of State welcomed participants to Virginia on behalf of the Government of the United States of America. He recalled the events leading to the convening of the Workshop noting that such an international meeting would have been inconceivable not too many years ago as there was no inkling of the global experiment that was being inadvertently practiced on the atmosphere and how it might affect us. The international agreement adopted in Vienna in March 1985 represented a landmark approach to an environmental issue in that the world's nations agreed to cooperate on an environmental problem before there were widespread harmful effects, rather than simply reacting to damages after they happen. Because of the very nature of the ozone layer, its protection requires global cooperation and globally synchronized measures. It is simply not enough for some countries to take the problem seriously, if others do not. It was now necessary to grapple with some of the most complex issues of all. Even so, the purpose was not to negotiate but to discuss and exchange views in a spirit of free inquiry. He expressed confidence that it would be possible for governments and industry to find ways to devise solutions to the problems and thereby serve humanity.

4. Mr. Fitzhugh Green, Associate Administrator of the U.S.Environmental Protection Agency, asked the Workshop participants to keep in mind the concepts of inevitability and timeliness. Inevitability was shown first, in the occurance of adverse effects if ozone depletion were to occur, and second, the effects of CFCs on the ozone layer long after emissions occur.He noted that a tremendous responsibility had been laid on the world to provide a timely response in order to mitigate the likely damage. However, he cautioned, it was necessary to be prudent in making recommendations to ensure that they be appropriate to the potential risk. He concluded by noting the difficulty in harmonizing international agreement given the diverse national legislation already enacted, but at the same time it is essential to do so as the world moves through the final phases of risk assessment prior to the enactment of a risk management process.

5. Ms. Fiona McConnell, the Chairperson of the Steering Committee for the Workshop on chlorofluorocarbons, informed participants of the decisions of the Steering Committee regarding the organization of the work of the sessions including the designation of the subchairmen for each of the topics to be discussed and the structure and preparation of the report.

B. ATTENDANCE

6. The second part of the Workshop was attended by experts from Australia, Austria, Belgium, Brazil, Canada, Denmark, Egypt, Finland, France, Federal Republic of Germany, Hungary, India, Italy, Japan, Kenya, Kuwait, Malawi, Netherlands, Nigeria, Norway, Peoples Republic of China, Sweden, Union of Soviet Socialist Republics, United Kingdom of Great Britian and Northern Ireland, United States of America, Yugoslavia, and Commission of European Communities (EEC).

United Nations Environment Programme

Distr.
RESTRICTED

UNEP/WG.148/3
13 October 1986

ENGLISH ONLY

Workshop on the Control of
Chlorofluorocarbons

Second part,
Leesburg, USA, 08-12 September 1986

REPORT OF THE SECOND PART OF THE WORKSHOP ON THE CONTROL OF CHLOROFLUOROCARBONS

I. INTRODUCTION

1. In accordance with Governing Council decision 13/18 Part I, and with the decision of the first part of the the Workshop on the Control of Chlorofluorocarbons held in Rome, 26-30 May 1986 (Report of this session: doc. UNEP/WG.148/2 and UNEP/WG.1 48/2 Corr. 4) a second part of the Workshop was held in the Xerox Center, Leesburg, Virginia, at the invitation of the Government of the United States from 8 to 12 September 1986.

II. ORGANIZATIONAL MATTERS

A. OPENING OF THE SECOND PART OF THE WORKSHOP

2. The second part of the Workshop was opened on behalf of the Executive Director of the United Nations Environment Programme (UNEP) by Mr. Noel Brown, Director of the UNEP Regional Office for North America. Mr. Brown welcomed participants and expressed UNEP's thanks to the Government of the United States of America for its financial support and the provision of conference facilities in Leesburg which made the holding of the second part of the Workshop possible. He reminded participants of the outcome of the first part of the Workshop, the successes that were achieved and the difficulties that were encountered. Mr. Brown expressed concern at the limited response of Governments to the requests for information on chlorofluorocarbons and their control within countries and urged the need for active collaboration rather than passive goodwill as a prerequisite to achieving the goals of the Workshop. He noted the divergence of opinions that had arisen during several of the topic discussions at Rome and called for a spirit of compromise, especially at this stage in the seeking of appropriate legislation to ensure the protection of the ozone layer. In concluding, Mr. Brown suggested that participants might look upon the meeting as an important link in a chain of international resolve that was being forged for the purpose of restraining environmental damage to the earth's ozone shield.

3. Ambassador Richard Benedick, Deputy Assistant Secretary of State welcomed participants to Virginia on behalf of the Government of the United States of America. He recalled the events leading to the convening of the Workshop noting that such an international meeting would have been inconceivable not too many years ago as there was no inkling of the global experiment that was being inadvertently practiced on the atmosphere and how it might affect us. The international agreement adopted in Vienna in March 1985 represented a landmark approach to an environmental issue in that the world's nations agreed to cooperate on an environmental problem before there were widespread harmful effects, rather than simply reacting to damages after they happen. Because of the very nature of the ozone layer, its protection requires global cooperation and globally synchronized measures. It is simply not enough for some countries to take the problem seriously, if others do not. It was now necessary to grapple with some of the most complex issues of all. Even so, the purpose was not to negotiate but to discuss and exchange views in a spirit of free inquiry. He expressed confidence that it would be possible for governments and industry to find ways to devise solutions to the problems and thereby serve humanity.

4. Mr. Fitzhugh Green, Associate Administrator of the U.S.Environmental Protection Agency, asked the Workshop participants to keep in mind the concepts of inevitability and timeliness. Inevitability was shown first, in the occurance of adverse effects if ozone depletion were to occur, and second, the effects of CFCs on the ozone layer long after emissions occur.He noted that a tremendous responsibility had been laid on the world to provide a timely response in order to mitigate the likely damage. However, he cautioned, it was necessary to be prudent in making recommendations to ensure that they be appropriate to the potential risk. He concluded by noting the difficulty in harmonizing international agreement given the diverse national legislation already enacted, but at the same time it is essential to do so as the world moves through the final phases of risk assessment prior to the enactment of a risk management process.

5. Ms. Fiona McConnell, the Chairperson of the Steering Committee for the Workshop on chlorofluorocarbons, informed participants of the decisions of the Steering Committee regarding the organization of the work of the sessions including the designation of the subchairmen for each of the topics to be discussed and the structure and preparation of the report.

B. ATTENDANCE

6. The second part of the Workshop was attended by experts from Australia, Austria, Belgium, Brazil, Canada, Denmark, Egypt, Finland, France, Federal Republic of Germany, Hungary, India, Italy, Japan, Kenya, Kuwait, Malawi, Netherlands, Nigeria, Norway, Peoples Republic of China, Sweden, Union of Soviet Socialist Republics, United Kingdom of Great Britian and Northern Ireland, United States of America, Yugoslavia, and Commission of European Communities (EEC).

4134

7. Also participating in the meeting were representatives of the Organization for Economic Co-operation and Development (OECD), the European Council of Chemical Manufacturers Associations (CEFIC), the International Chamber of Commerce (ICC), the International Institute of Refrigeration, International Frozen Food Association, the Federation of European Aerosol Associations (FEA), European Association of Flexible Polyurethane Foam Block Producers (EUROPUR), and the European Association of Rigid PU Foam producers (BING); members of the press were invited for the first three days.

8. A list of participants is attached to this Report as Annex III.

C. ELECTION OF CHAIRMAN

9. Ambassador Richard E. Benedick, Deputy Assistant Secretary, Environment, Health and Natural Resources, U.S. Department of State was unanimously elected overall chairman of the second part of the Workshop.

D. ADOPTION OF THE AGENDA

10. The following agenda for the Workshop was agreed:

1. Opening of the Workshop
2. Organization of Work
3. Election of Chairman
4. Adoption of the Agenda
5. Consideration of Topic VI - Identify and Analyze Various Possible Regulatory Strategies, including such new alternatives as quotas and financial incentives in terms of:

   (a) Effects on the demand, production, and emission of CFCs;
   (b) Effects on the atmosphere and the environment including the use of model calculations of the effects of control measures;
   (c) Cost effectiveness and, where possible, cost benefit analysis
   (d) Equity, trade impacts, and ease of implementation and monitoring

6. Evaluation of control strategies against a comprehensive set of criteria
7. Summing up of discussions and preparation and adoption of a report of the second part of the Workshop
8. Closing of the Workshop

E. CONSIDERATION OF TOPIC VI

11. The Workshop then commenced discussion of Topic VI--Identify and analyze various possible regulatory strategies, including such new alternatives as quotas and financial incentives. Each subsection of Topic VI was addressed by the lead country or organization charged with coordination and collection of information and documents solicited from Governments and organizations on the particular subtopic.

12. Brief summaries of the papers presented at the Workshop are attached to this report as Annex I.

13.

TOPIC 6a

EFFECTS ON THE DEMAND, PRODUCTION, AND EMISSIONS OF CFCs

Chairman Stephen Sidel
Reported by K.D. Sharma and S.O. Anderson

Seven papers were discussed under the topic of the effect of alternative control strategies on demand, production, and emissions of CFCs.

The initial paper by M.J. Gibbs (USA: ICF Incorporated), "Control Strategy Options: Definition and Partial Evaluation," provided a framework for evaluating CFC control strategies. Three other papers focused on timing: J.S. Hoffman (USA: EPA) "The Impact of Control Strategy Alternatives in Meeting Future Demands for Chlorofluorocarbons," J.K. Hammitt (USA: The Rand Corporation) "The Timing of Regulations to Prevent Stratospheric Ozone Depletion," and I. Mintzer (USA: World Resources Institute) "Limiting the Build up: An Investigation of Policies to Control the Increase of Chlorine in the Stratosphere." Two papers dealt with commercial perspectives: R.C. Knollys, (U.K.: Federation of European Aerosol Associations) "Impacts of Possible Strategies Controlling CFCs from a User Industry Standpoint" and D. Wirth and D. Doniger (USA: Natural Resources Defense Council) "Preparing for a CFC Phaseout: Who Will Be Left In The Cold?"

Defining the Framework

Mr. Gibbs' paper suggested six primary factors that define a control strategy: (1) Chemical Coverage, (2) Global Stringency, (3) Timing, (4) Method of Setting Requirements, (5) Allocation, and (6) Trading. Three evaluation assumptions are used: (1) Participation, (2) Effects of Substitutes, and (3) Greenhouse Gas Growth.

Two questions were raised for clarification concerning trade and the treatment of CFC-11 and -12. The author explained that in his model CFC-11 and -12 are treated separately but are reported together for the convenience of presentation in the paper. The model divides the world into 10 regions. Trade of bulk chemicals and CFC products is allowed subject to regional limits but no region is allowed in the model to exceed its quota.

Timing of Control Strategies

Mr. Hoffman's paper stressed that the long atmospheric lifetime of CFCs and made time of emissions an important consideration. As a result, emissions in the next 10 or 15 years will play a significant role in costs should reductions be necessary. The presentation showed how despite reductions inthe CFC production rate during the early 1980's, atmospheric concentration of chlorine continued to grow.

Discussion of this presentation focused on the nature of atmospheric equilibrium including emissions of CFCs and atmospheric losses.

Dr. Hammitt's presentation provides analysis of whether immediate regulation to reduce the risk of ozone depletion is justified by costs of such reductions. He concluded that if the probability of depletion is low delay is cost-effective but if the probability of depletion is high then near-term controls are cost-effective. His analysis found that the results are sensitive to the discount rates and the level of stringency required.

In response to questions, the author explained that the analysis compared the costs of near-term versus later-term reductions that result in the same overall level of emissions.

Dr. Mintzer presented an analysis of production limits (capacity and production caps) and usage limits (aerosol and foams). He showed the years in which chlorine would reach concentrations of 6, 8, 10, and 15 ppbv under each control. The conclusion is that neither control approach as modeled in his analysis is adequate to limit the future buildup of atmospheric chlorine.

In response to questions, the author explained that the model does not consider feedback that reduces atmospheric chlorine as a result of increased UV from ozone depletion.

Commercial Perspective

Mr. Knollys' presentation stressed the need for flexbility in choosing control strategies in light of scientific uncertainty, the unknown availability and safety of chemical substitutes, and the effects on small companies. He also stated that use controls over a single emission source would not be an effective long term strategy compared to overall control strategies. He advocated that a maximum safe limit be set by an expert scientific panel.

Discussion focused on the difficulty of establishing that safe limit. Other discussion focused on the advantage of overall use limits instead of a set of limits on specific uses.

The presentation of the Wirth/Doniger paper by D. Doniger asked what response to the CFC issues might be in industries best interest. He advocated that any control strategy must stimulate near-term reductions through innovation. By investing in substitutes for CFCs now, producers and consumers can avoid potential problems that would result if CFC limits were required. He suggested that CFC users have the most to lose from possible future limits to CFCs. He concluded that all parties would benefit from accelerated research into CFC substitutes.

Discussion focused on the problems that industry faced in introducing new chemicals as a result of health, safety, and environmental regulation. Possible future price increases could facilitate development, testing, and commercialization of alternatives to CFCs.

14.

TOPIC 6b

EFFECTS ON THE ATMOSPHERE AND THE ENVIRONMENT INCLUDING THE USE OF MODEL CALCULATIONS OF THE EFFECTS OF CONTROL MEASURES

Chairman George Strongylis
Reported by Ivar Isaksen and Ichiro Araki

The three papers presented, dealt with ozone perturbation studies with time dependent chlorofluorocarbon releases. Two papers (1-D Calculations) discussed the effects of reducing the release of chlorofluorocarbons, while the third focused onthe strong variations in the latitudinal depletion of ozone (2-D model calculations). A second set of three papers discussed the depletion of ozone that might occur during the next century, and focused on the longtime change in ozone due tochanges in CFC releases.

Comments to the paper, "Ozone Perturbations Studies in a Two-Dimensional Model with Temperature Feedback in the Stratosphere Included" by Ivar S.A. Isaksen

It was pointed out that release rates of chlorofluorocarbons are increasing substantially at present and that this, according to his calculations, should lead to ozone depletions much larger than those calculated for a constant release rate on the 1980 level. The further discussion concluded that this increase had to continue for a substantial time in order to have the suggested effect. This is due to the slow response in stratospheric chlorine levels (and in ozone changes) to changes in CFC release rates. A main point is how much chlorine is accumulated in the atmosphere during the period of increased release rates.

It was further commented that the model calculations showed that regardless of what scenarios were applied, marked reductions in ozone can be expected at high latitudes in the next 10 to 20 years.

Comments to the CMA paper, "Atmospheric Ozone: Response to Combined Emissions of CFCs, N_2O, CH_4, and CO_2" by Orfeo

It was asked if it could be concluded from the results of the calculations that the response to regulations was so slow, and had such minor effects that it is not necessary to take any action at the moment. It was, however, difficult to draw this conclusion, the calculations showed rather that the changes in ozone were reversible. It was further concluded that the assumptions of further methane (CH_4) changes are highly uncertain. In any case, the effect of changes in CH_4 growth had minor effects on the calculations.

Comments to the paper, "The Potential Impact on Atmospheric Ozone and Temperature of Increasing Trace Gas Concentrations" by G. Brasseur

In answering a question related to the relative effect of an aerosol ban on top of a production capacity cap, it was pointed that the aerosol ban would

reduce possible ozone depletion in the year 2100 from 4% to 3% (a reduction of 25%). There was a short discussionon the uncertainties connected to the calculations of the temperature feedback effect. It was pointed out that the effect of temperature changes on the ozone column was the result of a difference between a positive and a negative contribution, and that the combined effect could either lead to larger ozone depletions when temperature feedback was included, orto smaller depletions. The results were sensitive to the radiative scheme used. A question about how the latitudinal effect would be, could not be answered since the calculations were based on 1-D model calculations.

In Paper No. 12, "Analysis of the Importance of Various Design Factors in Determining the Effectiveness of Control Strategy Options", Michael J. Gibbs analyzes the importance of eight design factors, i.e., coverage, stringency, method, timing, participation, trade, substitution and trace gas emission. A number of control options are then evaluated in these terms. Other important evaluation criteria which were not included in the analysis include costs of control, fairness and equity, efficiency, ease of implementation, ability to monitor compliance, and incentives for compliance and innovation.

In response to the questions on the implications of reduced trace gasemissions (higher level of ozone depletion), it was explained that the calculation was based on the assumption that emissions of trace gases would grow until the year 2000 at the base level and after 2000 the growth rate would be reduced to the half as a result of effort to reduce such emissions in order to avoid global warming. A question was raised on how reasonable was it to expect reduction in methane emissions in the future, and it was indicated that given the uncertainty regarding future methane emissions, either decreases or increases in the growth rate are possible.

When asked upon what the exhibit of effects of non-participation was based, Mr.Gibbs said it was based on the assumption that non-participants can sufficiently increase their production capacity to meet the growing demand since no trade was allowed in the model.

When asked about the effects of Halon compound emissions, compared with other species of CFCs, Mr. Gibbs said that he considered the effect was relatively small in his calculations because of the small amount of production, long periods that they are kept in the products, and the practice of recovery.

In Paper No. 13, "Analysis of Stringency of Control Strategies to Achieve Alternative Ozone Depletion Limits", John S. Hoffman analyzes the effects of 1% ozone depletion in terms of UV radiation, damages to DNA and cancer incidence. According to his analysis, if ozone depletion at 50^{o}N were to be limited to one or two percent, then roll-back from the emission level in 1980 would be necessary. As to the uncertainty of model calculations, he noted the similarity between the results of one-dimensional Brasseur model and two-dimensional Isaksen model. Furthermore, he said that results of Monte Carlo analysis showed a greater probability of high ozone depletion. Also, he opposed Mr. Gibbs' view of Halon effects and stressed its importance in the ozone issue.

When asked to compare the results of the two models--Brasseur and Isaksen--Mr. Hoffman answered that the average global depletion, predicted by both was approximately the same.

When asked about the prediction of 20,000 more skin cancer cases per year in the United States with 1% ozone depletion, Mr. Hoffman indicated that the rate of skin cancer would be lower in high latitude area because of less radiation. In response to this indication, a question was raised on the significance of taking latitude into consideration in the evaluation of the effect of ozone depletion. To this question, Mr. Hoffman pointed out the importance of people's pigmentation. Furthermore, he mentioned the difficulty of comparison of cancer rates between different countries for statistical reasons. In connection with this, a participant referred to the report* of UNEP/EPA conference on ozone modification and climate change held in June,1986.

In Stephen Seidel's paper, "Potential Health and Environmental Effects of Ozone Depletion and Climate Change", he introduced some of the results of the UNEP/EPA conference in June 1986 on health and environmental effects of ozone modification and climate change. His report covered the effects of ozone depletion on plants, aquatic organisms, weathering of plastics and polymers, and ground level oxidants. He also referred to climate change caused by "greenhouse gases", (the same gases that modify the ozone layer) in terms of effect on sea level rise, water resources and agriculture.

One participant questioned the significance of CFCs' role in climate change. To this Mr. Seidel answered that they played a significant role among the non-CO_2 greenhouse gases which could affect global temperature.

When asked to what extent these findings were accepted among scientists, the author answered that they were in a very early stage of research and enough analysis had not yet been made. Another participant pointed out that the effects of ozone layer modification on agriculture is reported to be "statistically robust" and that the problem was rural in contrast with the problem of urban smog.

* Page 371, Vol. 1.

15.

TOPIC 6c

COST EFFECTIVENESS AND, WHERE POSSIBLE, COST BENEFIT ANALYSIS

Chairman Christopher Bowden
Reported by Michael J. Gibbs and Wang Zhijia

Six papers were presented in this session: D.M. Ambler, "An Assessment of the Economic Costs of Alternative Regulatory"; Stephen O. Andersen, "Factors that Affect the Costs of Protecting the Stratosphere"; British Rubber Manufacturers' Association, "Chlorofluorocarbons in Flexible Foam Manufacture"; K. Kurosawa, "Economy of the Reduction Measure Which Have Been Proposed As Well As The Newly Proposed Measure"; R. Valiani, "Economic Instruments for the Control of CFCs"; and A.S. Miller, "The Economic Risk Associated with Alternative Strategies to Protect the Ozone Layer." that discussed qualitatively the factors influencing the cost-effectiveness of a variety of alternative control strategies. Additionally, the relative cost-effectiveness of alternative strategies was evaluated qualitatively using various assumptions.

In the event that controls were deemed necessary to limit the production, use or emissions of certain substances, the desirability of undertaking the most cost effective method(s) of control was generally recognized. It was suggested that, in principle, the marginal costs and marginal benefits of control should be equated in order to maximize economic welfare. Several experts suggested, however, that due to uncertainties in both the costs and benefits of control, in particular the difficulties of quantifying the potential benefits of preventing stratospheric ozone depletion, successfully designing a policy to equate the costs and benefits of control seemed unlikely.

A variety of alternative control strategies were discussed, including: production cap; use cap; product ban; best practical control technology; and tax or fee. Several experts suggested that no single strategy would likely be the most cost-effective approach, and that combinations of strategies may be appropriate.

The economic efficiency of the alternative control strategies was discussed, including the potential for the misallocation of resources in terms of both production and consumption. In market economies, the potential use of market prices as a means of achieving efficiency in consumption was identified.

Several experts stated that the use of market prices (as would occur under an overall control, such as a production cap) would likely be more efficient in consumption than would the use of non-price mechanisms (such as product bans or best practical control technologies).

The auctioning of marketable production (or use) permits was discussed as one mechanism for addressing potential inefficiencies in production (that could result under a production cap that is allocated using non-market based procedures). However, the auctioning of such permits in an international setting was viewed by some as unlikely.

The importance for allowing appropriate transition time and preparation for controls was discussed. Several experts suggested that large reductions in production implemented quickly (with little transition time) would likely be more costly than phased-in (or pre-announced) controls that permitted adjustment. The importance of initiating (or announcing) controls early to allow transition time was suggested.

The importance of providing appropriate incentives for research and development (R&D) by producers and users was discussed. It was suggested that a production tax could provide an immediate incentive for R&D, depending on the level at which it was set. In order for the tax to provide effective incentives for investors, it was recognized that they would have to be certain that the tax would remain in effect for a sufficienctly long period to justify investments. It was noted that in addition to providing incentives, the imposition of a tax could yield empirical information on the elasticity of demand for the taxed substances. Several experts suggested that improved estimates of the demand elasticities would be very useful. However, some others considered the imposition of a tax to be an extremely expensive experiment to conduct for purposes of estimating demand elasticities.

Several experts felt that implementing a tax on a global basis was not likely to be feasible. Additionally, it was noted that the use of a tax as a regulatory mechanism was not likely to be feasible in many countries. One expert noted that the tax could provide some incentives for R&D even if only implemented in a small number of countries.

Several experts suggested that a production or production capacity cap would also provide incentives for R&D through increases in price that would be expected (in market economies) when production approached the designated limit. Some suggested that in order to achieve immediate incentives with a production cap, the level of the cap would have to be set at or below current production levels. However, others indicated that R&D is proceeding in Europe even though production has not yet reached the EC production capacity cap. Some experts suggested that a production cap may provide less certainty in expected price than does a tax.

16.

TOPIC 6d

CAPITALS/EQUITY, TRADE IMPACTS, AND EASE OF IMPLEMENTATION AND MONITORING

Chairman Dwain Winters
Reported by Jim Hammitt

"The World Ceiling Production System of Chlorofluorocarbons and its Advantages", P.M. Dupuy

Discussion focused on three issues: setting production ceiling across nations, trade, and an early detection system for ozone depletion. Regarding production ceilings and trade, it was suggested that developing countries must be allowed to build capacity to satisfy their own needs. Some experts noted that markets within individual developing countries are too small to support an efficient scale CFC plant, and that production from plants currently proposed would be intended largely for export. It was also suggested that when a production ceiling began to bind in a developed country, low-valued domestic uses would end while exports for high valued uses would continue. Current discussion of a possible capacity freeze provides an incentive for countries to build plants now, to prevent being unable to build later. Finally, it was noted that US CFC-11 and CFC-12 capacity has been reduced on a voluntary basis by about 30 percent in recent years, while European capacity has not been reduced.

Regarding an early detection system, it was suggested that a system capable of detecting a one percent change in column ozone per decade is technically feasible, although it would require significant commitment of financial resources. Some experts felt that calling such a system "early detection" might be a misnomer.

"The Global Production Capacity Cap: Equity, Trade Impacts, Implementation, and Monitoring", L. Gundling

There was considerable discussion over how to allocate national quotas under a global production cap, and whether such quotas would be necessary. Some experts noted the difficulty of assigning quotas, as experienced in the Law of the Sea negotiations, OPEC, and the tin and coffee cartels, although it was suggested that this situation is different in that the goal of restricting production is environmental protection, not profit maximization. Others wondered whether such quotas should be marketable, a condition that might promote equity and avoid the need for a hardship clause as proposed in the paper. Whether the required knowledge to build capacity is transferred by license, joint venture, or other means, it may be necessary to distinguish between transfers to signatory and non-signatory nations.

"Equity of Ozone Protection Strategies", Stephen Anderson

Several participants cautioned that long-term CFC use projections relied on in this paper were extremely uncertain. Some suggested that price increases associated with a production restriction would benefit developing

countries, in that smaller scale plants might become profitable. It was further suggested that price increases associated with a production restriction would benefit developing countries, in that a smaller than efficient scale plant would be more likely to be profitable. It was further suggested that the incentive to innovate emission-reducing technologies resulting from higher prices is important only in the developed countries, because these countries are more likely than the developing nations to produce such innovation.

"Net Use of CFCs--A Technical Discussion Paper", Ingrid Kokeritz

There appeared to be some confusion among some experts concerning the term "use" employed in the paper to regulate net national use, not national production. Many experts argued that it is much more difficult, less efficient, and inappropriate to regulate specific uses. The author responded that her paper did not discuss regulation of specific uses, but rather total national use. It was suggested that the term "consumption" might be less ambiguous than "use".

Restrictions on national consumption might be preferred to restrictions on national production since they might allow more efficient distribution of world wide production. It was also recommended that regulation focus not only on CFCs, but on other potential ozone depleting substances as well. Finally, the assumed equality between production and emissions was questioned, since CFC destroying facilities are apparently in existence.

"Trade Issues Related to CFC International Control to Protect the Ozone Layer", Stephen Andersen

Discussion focused on the difficulties of identifying products for which CFCs had been used in manufacture, but were no longer contained in the product(such as computer chips). Some experts thought this might not be too difficult since certification systems could be developed and manufacturers that comply with restrictions would have an incentive to report non-complying foreign competitors. Others felt it would be very difficult and suggested charging such CFC uses to the producing, not importing, country. It was noted that these trade issues were only relevant between signatory and non-signatory nations, and that they were relevant to many proposed control strategies, not only production caps.

17.

F. EVALUATION OF CONTROL STRATEGIES AGAINST A COMPREHENSIVE SET OF CRITERIA

Chairman Peter Usher
Reported by Christopher Bowden and Per M. Bakken

Six papers were discussed: D.W. Pearce, "The European Community Approach to the Control of Chlorofluorocarbons"; G.V. Buxton, A. Chisolm, and J. Carbonneau, "A Canadian Contribution to the Consideration of Strategies for Protecting the Ozone Layer"; Stephen Seidel, "Analysis of Global Application of an EEC-Based production Capacity Cap"; Boris Gidaspov, "Approach to the Control of Chlorofluorocarbons"; and Herbert Aichinger, "Elements of a National Approach to Reduce CFC Emission".

Several experts saw merit in the Global Emission Limit (GEL) approach but others were concerned about the implications of a GEL approach for the balance of world trade and there was some discussion of whether it was consistent with the principles of free trade. It was suggested that the GEL approach, as outlined in the Canadian paper, did offer protection for free trade. It was suggested that if the allocation of quotas under such an approach did not reflect the distribution of production, it would create idle capacity in one place and insufficiency elsewhere. It was, however, noted that the formula definition of National Emission Limit (NEL) took imports and exports into account and that by deducting exports from national quotas, capacity would not be affected. Referring to the possible basis of allocation, it was suggested that whether or not there was a good historical correlation between GNP and CFC production, this might not hold good for the future. The point was also made that a more complex formula might be needed to iron out big swings between producers and non-producers. Reference was also made to the administrative problems of controlling imports and exports of finished goods and the problems of small countries with a large volume of exports was mentioned. It was, however, suggested that these problems were capable of resolution.

There was some discussion of a phased approach. It was suggested that concerns about latitudinal and seasonal effects of ozone depletion pointed to freezing current CFC production and the point was made that the economic cost of more radical cuts later might be greater than more stringent measures sooner. It was, however, suggested that it was a question of the balance of probability given the scientific undertainties and that in such circumstances it was difficult to persuade people of the need for measures that were potentially economically damaging.

Several experts questioned the effectiveness of the EC limit on production capacity in reducing CFC emissions and whether more stringent measures sooner rather than later might not be needed. It was also suggested that, given that some one third of EEC production was exported, reducing exports would effectively mean that production was even further from capacity. If exports were reduced as the cap was approached this would raise prices for non-producing countries. It was, however, pointed out that the EEC

kept stringency under review and that the level of the cap could be altered if the results of monitoring ozone depletion to detect trends seemed to justify it.

There was discussion of the extent to which ozone depletion was dependent on the stringency of measures in the short-term. Reference was made to work in the EEC to date on measures to reduce emissions and that research was a continuing process.

The USSR expert said that current annual production capacity of CFCs 11 and 12 in the USSR was about 60,000 tons; annual production in the USSR depends on the amount of trade with Eastern Europe; the Kuwait expert informed that the total annual use of CFCs in Kuwait was some 1,000 tons and reference was made to established cooperation among six Gulf states to limit CFCs to essential uses.

Following a brief analysis of issues arising from the papers and discussion of them, there was a more general discussion of possible approaches.

Several experts commended the idea of taking preliminary action in the near future and re-examining at a later date the measures adopted in light of any new scientific information. It was suggested that postponing action because of scientific uncertainties was not acceptable. Several experts expressed support for a GEL approach (as exemplified in the Canadian paper) as a concept even if not in every detail. The point was made that every country had a responsibility to reduce CFC emission but only a few were producers. Several experts noted that notwithstanding the theoretical attractions of a GEL approach, the EEC, for example, had gone in a different direction and it was difficult to retrace steps already taken. It was, however, suggested that a GEL approach could be formulated to accommodate the measures of both the EC and other countries. The point was made that the more general the approach, the greater the chance of its commanding wide acceptance. Other experts suggested that the EC approach was the best way forward. There was also some discussion of whether any possible global approach should be confined to CFCs 11 and 12 or whether it should also extend to other CFCs as well as other potential ozone depleting substances.

The session concluded with an overview of the state of the science by Dr. Watson who stated that:

- While scientific uncertainty still exists, one must also acknowledge that much is known
- If enough chlorine is put into the atmosphere, ozone will be depleted.
- With respect to Ozone depletion it is irrelevant whether the chlorine originates in the form of CFC 11, CFC 12, CFC 113, CH_3CCl_3, etc.
- It also does not matter whether the fluorocarbon was used as a refrigerant, aerosol propellent, solvent, or as a foam-blowing agent
- Ozone only responds to the total burden of stratospheric chlorine

- o Major progress has been made in 2D modeling. All 2D models indiciate that predicted ozone changes are dependent upon season and latitude, with the gratest depletion occurring in Spring and at high latitudes. 1D and 2D models as qualitatively consistent for calculating changes in global ozone

- o While there is awareness of the Antarctic ozone phenomenon, Dr. Watson advised that participants do not allow their awareness of this phenomenon to influence their approach to a CFC protocol. Scientists should be allowed to intensively investigate this interesting and important phenomenon for a one-to-two year period. After this period, the scientific understanding of this phenomenon will have advanced significantly. At that time, policymakers should re-examine their regulatory policies.

  If an interim protocol is negotiated within the next few months that has a "review clause" based on current scientific understanding, then it is vital that we critique the adequacy of our current research programmes and assess the need for a ground based network of scientific instruments to monitor the composition and structure of the stratosphere. Such a network would be used to determine changes in the stratosphere and be used to determine cause and effect relationships between ozone changes and other chemicals. Such a network is feasible but needs strong commitment from governments and industry for funding.

G. SUMMING UP OF DISCUSSIONS AND PREPARATION AND ADOPTION OF A REPORT OF THE SECOND PART OF THE WORKSHOP

18. The chairman, Ambassador Benedick, summed up the discussions of the previous four days. In accordance with the wishes of the meeting, the full text of the Chairman's statement is attached as Annex II.

19. The Workshop then turned to its report prepared by its rapporteurs and the UNEP secretariat. After suitable ammendment reflecting suggestions and corrections made by participants, the Workshop adopted its report.

The chairman thanked participants for their contributions to the meeting and then declared the meeting closed at 11.15 a. m. on Friday, 12 September 1986.

TOPIC 6a

UNITED STATES

1. Gibbs, M.J., (ICF Incorporated), "Control Strategy Options: Definition and Partial Evaluation" (also listed under Topic 6b)

2. Hoffman, J.S., (U.S. EPA), "The Impact of Control Strategy Alternatives in Meeting Future Demands for Chlorofluorocarbons"

ATOCHEM

3. Dupuy, P.M., (Professor at the University and at Paris Institute of Political Science), "The World Ceiling Production System of Chlorofluorocarbons and its Advantages" (also listed under Topic 6d)

FEAA

4. Knollys, R.C., "Impacts of Possible Strategies Controlling CFCs from a User Industry Standpoint"

UNITED STATES

5. Hammit, J.K., (The RAND Corporation), "The Timing of Regulations to Prevent Stratospheric Ozone Depletion" (not available as of 9/5/86)

6. Wirth, D., and D. Doniger, (NRDC), "Anticipation of a CFC Phaseout: Who Will Be Out in the Cold?

WORLD RESOURCES INSTITUTE

7. Mintzer, I. "Limiting the Buildup: An Investigation of Policies to Control the Increase of Chlorine in the Stratosphere"

TOPIC 6b

COMMISSION OF THE EUROPEAN COMMUNITIES

8. Brasseur, G., and De Rudder, A., "The Potential Impact on Atmospheric Ozone and Temperature of Increasing Trace Gas Concentrations"

9. Based on calculations of Guy Brasseur and Anne De Rudder, "Potential Ozone Column Responses to Alternative Chlorofluorocarbon Control Strategies"

FLUOROCARBON PROGRAMME PANEL

10. "Atmospheric Ozone: Response to Combined Emissions of CFCc, N_2O, CH_4 and CO_2"

NORWAY

11. Isaken, I.S.A., (Institute of Geophysics, University of Oslo), "Ozone Perturbations Studies in a Two-Dimensional Model with Temperature Feedback in the Stratosphere Included"

UNITED STATES

12.a Gibbs, M.J., (ICF Incorporated), "Control Strategy Options: Definition and Partial Evaluation"

b Gibbs, M.J., (ICF Incorporated), "Analysis of the Importance of Various Design Factors in Determining the Effectiveness of Control Strategy Options"

13. Hoffman, J.S., (U.S. EPA), "Analysis of Stringency of Control Strategies to Achieve Alternative Ozone Depletion Limits"

14. Seidel, S., D. Tirpak, and J.S. Hoffman (U.S. EPA), "Potential Health and Environmental Effects of Ozone Depletion and Climate Change"

TOPIC 6c

UNITED KINGDOM

15. Ambler, D.M., (Department of Trade and Industry, London), "An Assessment of the Economic Costs of Alternative Regulatory Strategies"

UNITED STATES

16. Anderson, Stephen O., (U.S. EPA), "Factors that Affect the Costs of Protecting the Stratosphere"

BRITISH RUBBER MANUFACTURERS' ASSOCIATION

17. "Chlorofluorocarbons in Flexible Foam Manufacture"

JAPAN FREON GAS ASSOCIATION and JAPAN AEROSOL ASSOCIATION

18. Kurosawa, K., (Steering Committee Chairman, JFGA), and K. Imazeki (Technical Committee Chairman, JAA), "Economy of the reduction measures which have been proposed as well as the newly proposed measure"

ITALY

19. Valiani, R., (LUISS), "Economic Instruments for the Control of CFCs"

WORLD RESOURCES INSTITUTE

20. Miller, A.S., (Visiting Assistant Professor, Washington College of Law, American University), "The Economic Risk Associated with Alternative Strategies to Protect the Ozone Layer"

TOPIC 6d

ATOCHEM

21. Dupuy, P.M., (Professor at the University and at Paris Institute of Political Science), "The World Ceiling Production System of Chlorofluorocarbons and its Advantages"

FEDERAL REPUBLIC OF GERMANY

22. Gundling, L., (Research Fellow, Max-Planck Institute for Comparative Public and International Law, Heidelberg; and Lecturer at the University of Heidelberg), "The Global Production Capacity Cap: Equity, Trade Impacts, Implementation and Monitoring"

UNITED STATES

23. Anderson, Stephen O., (U.S. EPA), "Equity of Ozone Protection Strategies"

SWEDEN

24. "Net Use of CFCs -- A Technical Discussion Report".

UNITED STATES

25. Anderson, Stephen O., (U.S. EPA), "Trade Issues Related to CFC International Control to Protect the Ozone Layer"

STRATEGY EVALUATION SESSION

COMMISSION OF THE EUROPEAN COMMUNITIES

26. Pearce, D.W., (Department of Economics, University College London), "The European Community Appraoch to the Control of Chlorofluorocarbons"

CANADA

27 Buxton, G.V., A. Chisolm, and J. Carbonneau (Environment Canada), "A Canadian Contribution to the Consideration of Strategies for Protecting the Ozone Layer"

UNITED STATES

28. Seidel, S.R., (U.S. EPA), "Analysis of Global Application of an an EEC-Based Production Capacity Cap"

JAPAN

29. Araki, I., "A Possible Regulatory Strategy for the Control of Chlorofluorocarbons"

USSR

30. Gidaspov, Boris, (Institute of Applied Chemistry), "Approach to the Control of Chlorofluorocarbons"

AUSTRIA

31. Aichinger, H., "Elements of a National Approach to Reduce CFC Emissions"

Notes:

1. **Papers 1 and 12 are identical and are summarized as paper 12a.**

2. **Papers 8 and 9 are summarized together under paper 8.**

3. **Papers 3 and 21 are identical and are summarized as paper 3.**

4. **Summary of paper 20 is not available.**

Paper No. 2: THE IMPACT OF CONTROL STRATEGY ALTERNATIVES IN MEETING FUTURE DEMANDS FOR CHLOROFLUOROCARBONS

John S. Hoffman

A number of studies have shown that the global demand for chlorofluorocarbons is likely to increase. Because CFCs persist in the atmosphere for decades and even centuries, the extent of future demand that can safely be met depends, in part, on emissions reductions made in the next ten to fifteen years. For example, 84% of 100 kilograms of CFC 11 emitted in 1987 will still be in the atmosphere by 2000 and 56% by 2030. If action is necessary in the future, that is if the total loading of cumulative emissions is limited, then emissions that remain from current production will displace future emissions. This is illustrated by the fact that if we wished to stabilize concentrations at current levels, the presence of past emissions in the atmosphere would require an 85% reduction in emissions. Because emissions for some uses add more value to products than to others (e.g., use in making a computer adds more value than use in making an egg carton), any strategy which fails to limit low value added uses in early periods will mean that fewer of the demands for higher value uses can be met later.

Paper No. 3: THE WORLD CEILING PRODUCTION SYSTEM OF CHLOROFLUOROCARBONS AND ITS ADVANTAGES

P.M. Dupuy

Only a CFC-11 and -12 world ceiling production system contributes to an a priori secure environmental protection of both the ozone layer and the ground temperature increase. It in fact prevents runzway consumption and obliges humanity to realize the potential danger they are facing in a practical way.The world production level must be regulated according to results coming from a monitoring system of the upper atmosphere.

The production level fixed by the different States or groups of States is scientifically controlled through the ground level monitoring system of CFC concentrations. It must, moreover, differentiate between advanced and developing countries so that the former only will be affected and will generate the technical research for substitute products or processes achieving in this way successively a shift, a limit on and a lowering of the CFC world consumption. This is created by:

- an efficient system both from the ecological and economic points of view: flexible, liberal, technologically stimulating

- an equitable system that takes into account the different development stages of the countries while supplying a global answer to a global problem

- an acceptable system to the different states or groups of states.

Such a system naturally falls within the frameowrk of the Vienna Convention. It separates the normative functions from the scientific ones. It can later on be adapted to the "settling" of other similar problems.

Paper No. 4: IMPACTS OF POSSIBLE STRATEGIES CONTROLLING CFCs FROM A USER INDUSTRY VIEWPOINT

R.C. Knollys

This paper has attempted to show that what is described as a flexible approach to regulation is more effective and more equitable than imposing usage bans in some industry sectors. Particular points addressed include:

a) The need to choose a control which is appropriate at the time of selection to the current needs and yet capable of adaptation as circumstances change.

b) The need to balance the possible environmental effects of CFCs with the effects of other chemicals - both those used as substitutes and others which are disassociated.

c) The ineffectiveness in the long term of implementing use control over one emission source while allowing total production of CFCs to go unchecked.

d) The ability of industry to adapt to a usage limit whereas a ban will lead to some loss of product quality and also will inevitably drive some, especially small companies, out of business.

Finally, we believe that the economic pressures arising from capacity limitation would force industries to work out acceptable ways of reducing their dependence on CFCs and that such an approach is also equitable.

Paper No. 5: THE TIMING OF REGULATIONS TO PREVENT STRATOSPHERIC OZONE DEPLETION

James K. Hammitt

Decisions concerning whether to impose regulations to restrict emissions of potential ozone depleting substances must be made in a context characterized by three important features: (1) Estimates of the likely extent of future stratospheric ozone depletion and its consequences for life on earth are highly uncertain; (2) Continuing scientific research can be expected to reduce, but not eliminate, these uncertainties; and (3) The relationship between production and initial use of potential ozone depleting substances and ultimate environmental consequences is characterized by lags on the order of decades or more. This paper addresses the key question of whether it is desirable to impose emission-limiting regulations now, or to wait five to ten years to develop improved scientific understanding before deciding whether to impose regulations. It employs a simple decision tree framework to focus on this timing question. The framework is constructed so that the environmental benefits of regulations are independent of whether regulations are implemented immediately or after a several year delay; thus, attention is focused on comparing the expected economic costs (lost economic surplus) of the two policies. The relative expected costs depend on the level of emission reductions that may be necessary and on the probability that emission reductions will be required. However, under a broad range of assumptions immediate regulations are expected to be less costly if the probability that emission reductions will be necessary is greater than about 0.3 to 0.5. This conclusion is remarkably insensitive to alternative assumptions about the date by which substantially improved estimates of future depletion and its consequences will be available, the horizon used to calculate regulatory costs and environmental consequences, the possibility that technological development may reduce the future costs of limiting emissions, and the elasticity of demand for potential ozone depleting substances. The conclusions are somewhat sensitive to assumptions concerning future demand growth, the level of regulations proposed for immediate adoption, and the discount rate used to compare present and future costs.

Paper No. 6: PREPARING FOR A CFC PHASE-OUT: WHO WILL BE LEFT IN THE COLD?

David A. Wirth and David D. Doniger

Recent scientific evidence on the role of CFCs and related chemicals in stratospheric ozone depletion and global warming demonstrate that current release levels are intolerably high. NRDC has proposed a global 80 percent cut in production of stratospheric ozone depleters (CFC-11, -12, -22, and -113; certain other chlorinated compounds; and halons) over five years, with full phase-out over 10 years, a period of time sufficient for the development and deployment of alternatives. The paper examines what strategies may be best for CFC producers and users. The paper suggests that the only prudent course for both producers and users is to plan on the basis of the necessity of a phase-out. This means producers should intensify efforts to develop substitutes for current CFCs and other ozone depleters, and users should intensify the search for alternative inputs or alternative means of producing their goods and services. The greatest risk in not pursuing substitutes at this point is that there would be great disruption attending the need to cut CFC use sharply almost overnight if current depletion projections, or worse, are confirmed. Among producers and users, economic advantage will come to those who are first in the race for such alternatives. The leaders in the search for alternatives may find their interest lies in active support for the phase-out proposal.

Paper No. 7: LIMITING THE BUILDUP: AN INVESTIGATION OF POLICIES TO CONTROLTHE INCREASE OF CHLORING IN THE STRATOSPHERE

Irving M. Mintzer

A simulation model is used in this study to investigate the effects ot two types of control strategies applied to CFC-11 and CFC-12 on the commitment to atmospheric chlorine buildup. The effects of a production cap set at three different levels of stringency (i.e., current capacity in place, constant production at 1984 levels, and a 95% phase down by 2025) and of three types of use limits (i.e., an aerosol ban, a foam ban, and improved process controls) are compared to the chlorine commmitment in two scenarios with no controls on CFC production and use.

In the "base case" (with 1% growth per production year), the commitment to chloring buildup in 2075 is estimated to by 14 PPBV. Assuming that the market is allowed to shift production from prohibited to allowed uses, our model estimates that the three control strategies based on use limits commit the atmosphere to 12-14 PPBV in 2075. A production cap set at the level of current capacity in place commits the atmosphere to approximately 11 PPBV in 2075. A production limit set at the level of 1984 output is estimated to commit the atmosphere to 7 PPBV. The model estimates that a 95% phase down commits the atmosphere to 7 PPBV. In all scenarios, we assume that the background level is included in all our estimates of chlorine commitment in 2075.

Our study suggests three conclusions. These are:

1. Controls on specific uses do not substantially reduce the risk of chlorine buildup if the market can shift demand from prohibited to allowed uses.

2. Limits on production of CFC-11 and CFC-12 can reduce the risk of chlorine buildup if the limit is set substantially below the level of current capacity in place.

3. Neither the proposal of the EEC for a production limit set at the level of current capacity in place, nor the Toronto Group proposal of a global aerosol ban is adequate to reduce the commitment to chlorine buildup substantially below the level of 14 PPBV in 2075.

Paper No. 8: THE POTENTIAL IMPACT ON ATMOSPHERIC OZONE AND TEMPERATURE OF INCREASING TRACE GAS CONCENTRATIONS

G. Brasseur and A. De Rudder

Results obtained with a one-dimensional model were presented. This model includes a coupled chemical and radiative scheme and is integrated from 1910 to 1985 with historical increases in CFC emission and CO_2, CH_4 and N_2O concentration. For the future, 0.5%/yr, 1%/yr and 0.25%/yr increases are assumed for CO_2, CH_4 and N_2O, respectively. Several scenarios are considered for CFC-11, -12, and -13.

The model computations show that

1. In the absence of CFCs, the total ozone appears to increase by 5% from 1940 to 2100. This enhancement is due essentially to the effect of methane in the troposphere.

2. If a complete ban in the CFCs is applied in 1985, ozone will further decrease during the next 8 years and then slowly recover. The recovery time is a function of the growth rate in methane.

3. If the trace gas concentration (CO_2, CH_4 and N_2O) remain unchanged at the present level, the ozone column is depleted by 6-9% in 2100 if the present CFC emission is unchanged and by more than 30% if the CFC emission increases by 3%/yr without limitation.

4. If the trace gas concentration increases as previously indicated and if a 3%/yr increase is adopted for the CFC with a capacity cap of 1.5 times the 1984 level, the maximum ozone depletion is found to be 4% (in year 2070). After this, a slow recovery takes place.

5. Even if changes in the ozone amount remain limited, large relative variations of ozone are predicted in the upper stratosphere--significant increases are calculated in the lower stratosphere and in the troposphere. Significant changes are also found in the vertical distribution of the temperature.

Paper No. 10: ATMOSPHERIC OZONE: RESPONSE TO COMBINED EMISSIONS OF CFCs, CH_4, and CO_2

Fluorocarbon Program Panel

Calculations have been conducted using the AER 1-D Model to test the sensitivity of atmospheric ozone to changes in CFC and methane emissions. In particular, emission scenarios were chose to show the effect of increasing CFC emission over a limited period up to 2008 (equivalent to a doubling of CFC 11 and CFC 12 emissions) followed by either constant emission at the 2008 year level or followed by a return to 1984 emission levels for the next 50 years (up to 2060). The sensitivity to changes in methane was tested in two scenarios by reducing growth for 1% per annum after the year 2020. The conclusions of these calculations can be summarized as follows:

- Even in absence of CFC, we would be likely to see changes in ozone concentrations affecting both total column and distribution.

- Limiting CFC emissions to present day levels would not be expected to lead to significant changes in ozone column.

- Limiting CFC emission to twice 1984 levels would be expected to result in only small (-3.5%) changes in total column ozone although vertical distribution will be modified. A lower rate of methane growth after 2020 would not significantly change this result.

- If CFC emissions were to grow to twice the 1984 levels by 2008 before cutting back to the 1984 level, changes in total column ozone would be expected to be small and similar to those in which emissions never exceeded the 1984 level.

Paper No. 11: OZONE PERTURBATIONS STUDIES IN A TWO-DIMENSIONAL MODEL WITH TEMPERATURE FEEDBACK IN THE STRATOSPHERE INCLUDED

Ivar S.A. Isaksen

Future ozone reductions due to increased releases of chlorofluorocarbons, methane and nitrous oxide is estimated in a two-dimensional time dependent model with temperature effects from CO_2 and O_3 included. Four different scenarios are considered. All scenarios have an increase in CH_4 and N_2O of 1.0% and 0.25% per year. Yearly increases in the chlorocarbon releases are assessed to be 0%, 1.2%, 3.0% and 3.8% in the four cases, respectively. All the time dependent calculations are carried out until the year 2030. In all cases considered, total ozone depletion varies strongly with latitude and season. The most marked depletion occurs at high latitudes during winter and spring. Except for the case with constact future releases of chlorocarbons, all scenarios lead to marked depletion in the ozone column. In fact, the model studies indicate that noticable ozone depletions already are occuring at high latitudes. This study indicates further that, assuming that the present increase in release rates continue for the next 20 to 30 years, the impact on the ozone layer will be pronounced throughout the next century. It should be noticed that future development in the CH_4 levels will have significant impact on the changes in the ozone column.

Paper No. 12a: CONTROL STRATEGY OPTIONS: DEFINITION AND PARTIAL EVALUATION

Michael J. Gibbs

This paper is divided into two parts. Section 1 defines a frame work for defining control strategy options. Six elements of a control strategy are defined, including: the method of control (e.g., production limits, use limits, technology requirements, tax, or fee); the stringency level of the control; the coverage of the control (i.e., which chemicals are included in the limitation); timing (when the control goes into effect); allocation (the manner in which production and/or use limits are divided among nations of the world); and trading (the rules that determine the manner in which chemicals or goods may be traded).

In addition to these six elements of a control strategy, several other analysis assumptions are required for evaluating the effectiveness of the control strategy in protecting stratospheric ozone, including: Participation - not all the nations of the world may decide to participate in an international control strategy; Substitutes -as one set of chemicals is controlled, substitutes may be introduced that have adverse effects on stratospheric ozone or other parts of the environment that affect human health and welfare; and Greenhouse Gas Growth - the rates on increase in CO_2, CH_4, and N_2O are uncertain, and in some cases may be influenced by governments in an effort to address the "greenhouse effect."

In the second part of the paper this framework is used to define a series of control strategies. The control strategies are evaluated in terms of their effects on emissions, potential ozone depletion, and equilibrium global warming. The control strategies reflect a wide rage of possible stringencies, timing, and participation values. The potential influence of substitutes, trade, and alternative greenhouse gas assumptions is examined for a small number of cases.

Paper No. 12b: ANALYSIS OF THE IMPORTANCE OF VARIOUS DESIGN FACTORS IN DETERMINING THE EFFECTIVENESS OF CONTROL STRATEGY OPTIONS

Michael J. Gibbs

This paper discusses the effectiveness of a series of control strategy options in terms of their ability to protect stratospheric ozone. A subset of the control strategies defined in "Control Strategy Options: Definition and Partial Evaluation" is used to describe the relative importance of various strategy design factors, including: Coverage (which chemicals are included), Stringency; Participation; Substitution; and Greenhouse Gas Growth.

The analysis indicates several points including: similar protection of stratospheric ozone can be achieved with less stringent controls if more chemicals are covered; the fact that less than the entire world may participate has a substantial affect on the effectiveness of the control strategy in protecting stratopheric ozone; substitutes with very low ozone depleting potential do not lead to estimates of significant ozone depletion if they are introduced as more potent ozone depleters are controlled; and assumptions about the rate of increase in greenhouse gas concentrations can influence estimates of future ozone depletion.

Paper No. 13: AN ANALYSIS OF STRINGENCY OF CONTROL STRATEGIES TO ACHIEVE ALTERNATIVE OZONE DEPLETION LIMITS

John S. Hoffman

The goal of any control strategy is to prevent harm to public health and welfare that could result from ozone depletion. Models represent an important tool for assessing the required stringency of a control strategy to meet a certain goal. One-dimensional models provide a projection of average global depletion. Two-dimensional models provide estimates of depletion at different latitutdes.

Since the increase in ultraviolet radiation at any location depends on the thickness of the ozone column between that location and the sun, the results of two-dimensional models provide a more meaningful tool for assessing harm to public health and welfare at different latitudes.

This paper analyzes the results from the two dimensional model of Isaksen. Alternative latitudes are evaluated for standard setting. Forty degrees was found wanting because a limit set at that latitude would expose people north of that latitude to depletion above the standard. Due too the large population centers north of 40 degrees, 50 was chosen.

Based on Isaksen's results, in order to prevent a depletion of greater than 2% requires a reduction in global CFC emissions below 1980 levels. 1980 levels would be sufficient to prevent depletion above 5% at 50 degrees, assuming that the governments of the world do not eventually take actions to limit the greenhouse warming. A formal analysis of uncertainties indicates these depletion results are fairly robust, although it appears that the probability of a depletion significantly larger than predicted is larger than one significantly lower.

Paper No. 14: POTENTIAL HEALTH AND ENVIRONMENTAL EFFECTS OF OZONE DEPLETION AND CLIMATE CHANGE

Stephen Seidel, Dennis Tirpak, and John S. Hoffman
U.S. EPA

Ozone depletion and climate change can have significant effects on skin cancers, immune response, plants, aquatics, urban air pollution, materials, and sea level rise. Unlike most pollution problems, increased exposure to damaging ultraviolet radiation and the potential for damages will occur at all locations on the surface of the earth. While uncertainties limit our ability to detail the magnitude of many of these effects, current knowledge is sufficient to indicate that impacts will be significant.

Material is available from the conference document developed from the UNEP/EPA Conference on the Health and Environmental Effects of Ozone Modification and Climate Change, June 16-20, 1986. References to those papers are included at the end of this paper. See Attachment A for a complete list of papers.

Paper No. 15: AN ASSESSMENT OF THE ECONOMIC COSTS OF ALTERNATIVE REGULATORY STRATEGIES

D.M. Ambler

The United Kingdom paper by Mark Ambler provides a systematic review of the economic costs and effects of five alternative and discrete regulatory strategies. These strategies are:

1. production capacity cap,
2. controls on the overall level of CFC consumption,
3. emission fees/taxation,
4. End use controls/bans in particular sectors, and
5. best practicable control technologies.

The paper suggests that the economic cost of the strategies should be considered under four headings, as follows:

1. costs due to the misallocation of resource, as such:
   a) long-term costs-losses in economic surpluses
   b) transitional/adjustment costs

2. administration/enforcement costs,
3. Safety costs and accident losses, and
4. secondary effects.

Although the emphasis is on a qualitative rather than quantitative analysis, the paper draws a number of important conclusions about the relative costs of different strategies. The broad conclusion is that quality controls and economic incentive-based strategies will impose lower economic costs than direct controls. The costs associated with quality control are affected by a number of factors, most important of which is the basis of allocation of rights to consume and produce CFCs. In view of the uncertainty surrounding the ozone/CFC issue, it is suggested that the most appropriate way of regarding regulatory policy is as a precautionary policy against significant adverse environmental effects. In such circumstances, or the basis of economic costs, a production capacity cap or an overall use control may offer a superior long-run framework for the control of CFCs.

Paper No. 16: FACTORS THAT AFFECT THE COSTS OF PROTECTING THE STRATOSPHERE

Stephen O. Andersen

This paper considers the costs of achieving an acceptable level of risk to atmospheric ozone. The paper explains why the timing of controls is important to cost and discusses how control strategies can differentially influence research and development that would lead to cost-reducing innovation. The control strategies of globalized EC Cap, Aerosol Ban, and Assessment and Review are analyzed on a basis of cost effectiveness.

qControl strategies reduce emissions by five technical alternatives: product substitution, chemical substitution, manufacturing/processing recovery, improved operations, and recycle and disposal of end use products. A least cost control strategy must consider (1) the value of CFC now compared to the value in the future, (2) the effect of current research and development, and (3) how to minimize societal disruption and waste of producer capital.

Control costs could be unnecessarily expensive: if expensive reductions are required instead of less expensive reductions, if relatively inexpensive reductions are not taken in earlier years, if financial incentives for development of new control technology or substitutes are not designed into a strategy, and if capital is wasted in making reductions now or wasted in the future when emergency situations force rapid reductions.

The EC Cap would ultimately lead to a rise in prices, at which time the least expensive reductions would occur. However, there is little immediate incentive for reducing emissions or for R & D of chemical and product substitutes.

The Aerosol Ban forces substantial reduction in emissions. However, aerosol bans may be expensive in some situations. Furthermore, an aerosol ban alone does not achieve inexpensive early reductions for other CFC uses and therefore would not lead to least-cost solutions. It fails to spur innovation in non-aerosol uses and it may not offer enough protection for the stratosphere.

Assessment and Review fails to create incentives for low cost reductions, now or in the future. It fails to provide economic incentives for innovation. Consequently to the extent control is ever needed, assessment and review would be the least costly strategy.

A strategy that is cost minimizing must employ lowest cost controls through time even if uncertainty persists about the precise level of needed control. For a strategy to achieve cost minimization over time it must both assure inexpensive early reductions are made and that the costs of future controls are diminished by R & D.

Paper No. 17: CHLOROFLUOROCARBONS (CFC) IN FLEXIBLE FOAM MANUFACTURE

British Rubber Manufacturers Association

The paper deals with economic considerations presented by Flakt. They propose two firms, A and B, each of a different size, exposed AO by the difference in air volume going through the stack. The pay-back period for the investment costs are calculated, based upon the data given by Flakt. It is shown that the smaller plant is likely to be more a mean size factory and the installation of an active carbon scrubber would entail a total investment of 4 mio L for the European industry, in order to prevent only some 4000T of CFC/annum from being emitted.

It is further shown that, if the CFC recovery is only 35%, the payback period becomes 10 years, as long as the estimated plant life. Practice has shown that indeed 35-40% is a more realistic figure for CFC recovery than the assumed 50%.

Making the link between technique and investment costs it is further shown that many unknown technical factors are encountered which have to be answered before the industry can accept the proposed technique.

The European flexible block PU industry will itself look for the answer, through its EUROPUR Technical Committee, by studying the problem more thoroughly and by adapting at least one large-scale plant with an active carbon assembly unit. It is hoped that the work can take place in 1987.

Paper No. 18: ECONOMY OF THE REDUCTION MEASURES WHICH HAVE BEEN AS WELL AS THE NEWLY PROPOSAL MEASURES

K. Kurosawa and K. Imazeki

1. If a stringent cap is put on the production capacity for CFC-11 and 12, it will limit the large opportunity of cost reduction by means of developing and introducing new technology.

2. Also, if a shift to alternative products is forced by some control measures, these shifts will create problems in terms of economy and safety, and, in turn, have a negative impact on the national economy.

3. The reduction of the use of CFCs in aerosol products will cause very large losses for the aerosol industry. It will also make it very difficult for most of the aerosol business in Japan (largely small companies) to survive. On the other hand, the effect of the reduction is expected to be small.

4. If level control which is based on CFCs production or use per capita is to be implemented, the control impact can be distributed very equitably or reasonably. The economic impact will vary in accordance with how the tolerable limit is set. The question of how much CFCs can be used for different uses can be determined on the basis of specific circumstances prevailing in different countries, and it will be possible to minimize the negative economic impact of the reduction of CFCs.

Paper No. 19: ECONOMIC INSTRUMENTS FOR THE CONTROL OF CFCs

R. Valiani

The paper examines the factors affecting the efficiency of economic instruments for controlling production or emissions of CFCs and makes some theoretical observations about the problems. The chlorofluorcarbon issue is particularly complicated because of the scientific uncertainty as regard to both the causes of some phenomena and their evolution in time. It is noted that the ozone layer is a single indivisible property and that there is a connection between the present generation and future generations. The discount rate that transforms present costs into future profits is arbitrary and is dependent upon political decisions that will vary from country to country.

The paper also demonstrates by reference to examples, that it is possible to choose between economic incentives and administrative controls and that the former impose a lower cost on the community than bans that are arbitrary and inefficient. In order to control CFC emission, it is better to act through the market with measures such as taxes, marketable permits, production capacity, caps, etc. Rising CFC prices give producers and users an incentive to search for substitutes and CFCs will be used only in applications where it is necessary to do so. When the market decides, it is really the consumers who are the decisionmakers.

Paper No. 21: LIMITING THE BUILDUP: AN INVESTIGATION OF POLICIES TO CONTROL THE INCREASE OF CHLORING IN THE STRATOSPHERE

Irving M. Mintzer

A simulation model is used in this study to investigate the effects ot two types of control strategies applied to CFC-11 and CFC-12 on the commitment to atmospheric chlorine buildup. The effects of a production cap set at three different levels of stringency (i.e., current capacity in place, constant production at 1984 levels, and a 95% phase down by 2025) and of three types of use limits (i.e., an aerosol ban, a foam ban, and improved process controls) are compared to the chlorine commmitment in two scenarios with no controls on CFC production and use.

In the "base case" (with 1% growth per production year), the commitment to chloring buildup in 2075 is estimated to by 14 PPBV. Assuming that the market is allowed to shift production from prohibited to allowed uses, our model estimates that the three control strategies based on use limits commit the atmosphere to 12-14 PPBV in 2075. A production cap set at the level of current capacity in place commits the atmosphere to approximately 11 PPBV in 2075. A production limit set at the level of 1984 output is estimated to commit the atmosphere to 7 PPBV. The model estimates that a 95% phase down commits the atmosphere to 7 PPBV. In all scenarios, we assume that the background level is included in all our estimates of chlorine commitment in 2075.

Our study suggests three conclusions. These are:

1. Controls on specific uses do not substantially reduce the risk of chlorine buildup if the market can shift demand from prohibited to allowed uses.

2. Limits on production of CFC-11 and CFC-12 can reduce the risk of chlorine buildup if the limit is set substantially below the level of current capacity in place.

3. Neither the proposal of the EEC for a production limit set at the level of current capacity in place, nor the Toronto Group proposal of a global aerosol ban is adequate to reduce the commitment to chlorine buildup substantially below the level of 14 PPBV in 2075.

Paper No. 22: THE GLOBAL PRODUCTION CAPACITY CAP EQUITY, TRADE IMPACTS, IMPLEMENTATION AND MONITORING

Lothar Gundling

The global production capacity cap as a regulatory approach for the Protocol on CFC cannot be objected to from the point of view of international law, taking into account the particular aspects of equity, trade impacts, and implementation and monitoring. Any problems that may arise under these particular aspects can be solved.

The global production capacity cap as a regulatory approach is in accordance with the concept of equity. Whichever legal standard is thought of when the argument of "equity" is raised - equity as a maxim to realize the idea of justice or the legal principle of equality of States - the global production capacity cap is compatible with both. It appears appropriate only to provide, in the CFC Protocol, for a specific clause to meet cases which may arise when Member States are not able to cover their necessary need of CFCs 11 and 12 either by using their existing production capacity, or by imports or by substituting CFCs 11 and 12 by other substances. In these specific cases Member States must be able to increase their production capacities to the necessary extent.

Trade implications, in particular the problems associated with imports of CFCs 11 and 12 from States which do not adopt a production capacity cap, maybe solved by providing for an obligation for Member States to control imports of CFCs 11 and 12. An obligation to control imports of CFCs 11 and 12 from States which do not adopt a production capacity cap, does not violate principles of international trade law which might be invoked by other States.

To implement and monitor the global production capacity cap, a reporting system appears possible and appropriate. Member States should be obliged to notify the Secretariat - which may establish a particular Panel - their respective production capacity and to report, in regular terms, on the enforcement within their territory of the production capacity cap and the related obligations.

Paper No. 23: EQUITY OF OZONE PROTECTION STRATEGIES

Stephen O. Andersen

This paper discusses three elements of equity in need of international attention: access to CFCs for developing nations, access to CFCs for future generations, and CFC price increases. It is shown that developing nations use relatively little CFC today and that use by these countries will still be relatively small compared to developed countries use in the next forty years. The need for CFCs at higher expected standards of living and the relatively small total use by developing countries makes a strong case to allow developing nations to have access to CFCs in the immediate future. The foremost concern for future generations is the protection of the ozone lyaer; access to CFC products is a secondary concern. The interests of future generations are protected by emission reductions and technological innovation that allow each new generation the same prospect of CFC end-use production consumption. Price rises can be an intentional and desirable part of CFC emission control strategy. Price rises allow for gradual adjustments and they foster innovation. However, price increases would be unfair to low income consumers. Considerably more research should be conducted to see whether CFCs are an important component of consumer costs for basic human needs in developing countries. The cost increases may be less imprtant than the stake developing people have in avoiding health and agricultural productivity losses due to ozone depletion.

Paper No. 24: NET USE OF CFCs"--A TECHNICAL DISCUSSION PAPER

Ingrid Kokeritz

In designing strategies for control on CFCs, there are several reasons to focus on the "use of CFCs" in different countries as explained below:

1. What we are concerned about is to limit emissions. On a global scale, "emissions" = "production", though with a considerable time lag. On a country-by-country basis, however

Emissions = domestic consumption
(production of CFCs + import of CFCs)
+ import of CFCs in products
- exports of CFCs
- exports of CFCs in products

= "Net use of CFCs"

(if destruction devices come into operation, they should also be subtracted)

The aim of an international agreement is to establish obligations for countries and not for the globe, as the globe is not a responsible subject, neither for the individual producer or user (how they will be affected requires decisions on a national level). The greater the number of countries that control their prospective use of CFCs, the more efficient the control of the emissions will be.

2. The level of emissions are in reality, dependent on decisions by those who manufacture or use CFC-containing products; the producers are only responding to their demand. The possibilities for users to limit emissions are numerous--to use other chemicals, other products, and/or other technologies; to improve equipment, recover CFCs, and even eventually destroy used CFCs. To make these devices workable will take considerable time. The costs will depend on the lead time allowed. The sooner the users start to work on these alternatives, the better the possibilities to find cost-effective ways to limit emissions.

The solutions may in many cases also have effects in other countries (whether or not they are parties to the production limitation strategies)

3. The use of CFCs in developed countries are much higher than in the developing countries, regardless of whether they are producers of CFCs or not. Those who only import CFCs or CFC-containing products are therefore as responsible for reducing their use of CFCs as the producing countries.

To enable us to use the concept of "use of CFCs" in the protocol, we have found it helpful to discuss some technical items that need to be clarified, such as what should be included in "net use of CFCs" of a given country, especially in connection with imported products, what terminology should be used, what types of CFCs should be covered, how should a reporting system be designed, etc. These questions are further elaborated in the paper.

(During the discussion, it was suggested that the term "use of CFCs" be replaced by "consumption of CFCs.)

Paper No. 25: TRADE ISSUES RELATED TO CFC INTERNATIONAL CONTROL TO PROTECT THE OZONE LAYER

Stephen O. Andersen

This paper describes some of the trade issues that are important to CFC protocol design and implementation. Issues of regulatory avoidance, dumping, economic impact, and CFC conservation are considered. Although trade in CFCs has the potential to undermine stratospheric ozone protection and create unfair national advantage, none of these trade issues are intractable. CFC protocol design and implementation can solve trade issues while protecting stratospheric ozone. Protocol strategies can be designed to encourage other nations to join or to practice equivalent CFC conservation.

The paper discusses four types of trade issues: (1) Can regulations be avoided by trade, (2) Will producing countries dump CFCs in other countries? (3) Will CFC Regulation Harm Economies in Countries signing the protocol?, and (4) Will CFC policy encourage countries to join the protocol or to practice CFC conservation?

The likelihood of evasive imports depends on the potential profit from trade, the abaility of a country to identify and control import activities, and the penalties that each country imposes for import violations. Reasonable national efforts to control CFC product movement can counteract the unwanted effects on domestic industry or CFC emissions.

Products are dumped in foreign markets when excess domestic production capacity exists and the seller can charge the high price at home and a discount price overseas. CFC manufacturers in the market where dumping occurs are placed at an unfair disadvantage and low prices encourage CFC use and thus emissions. Dumping can be prevented by protocol provisions or by member nations trade restrictions.

There are at least four necessary economic conditions for unfair competition in CFC use: (1) significant CFC price differences between countries; (2) high CFC cost per unit of product, no close economic substitute; (3) low additional transportation cost to get inputs to non-quota country production facilities and finished products to markets; and no countervailing trade barriers. All CFC uses except electronics components are either not likely to be economic in trade or are easy to regulate.

Trade affects non-joiners in fours ways: product leadership, market leadership, consumer response, and overall innovation.

CFC protocol design and implementation can anticipate and solve trade issues while simultaneously protecting stratospheric ozone and not penalizing domestic industries and desirable aspects of free trade.

Paper No. 26: THE EUROPEAN COMMUNITY APPROACH TO THE CONTROL OF CHLOROFLUOROCARBONS

David W. Pearce

Alternative CFC control strategies are evaluated concentrating on the European Community approach, which combines a production capacity cap with a limit on usage in aerosols and the encouragement of best practicable technology for reducing emissions in the principal non-aerosol uses.

It is contended that the global application of a production cap at an appropriate level is consistent with a low damage risk strategy and the most economically efficient and flexible option, but special incentives may have to be provided to secure the participation of developing countries.

A production cap will tend to redirect sales to the highest value uses, and the relatively small number of producers simplifies monitoring and control. Use bans are less efficient because they involve higher transition costs, do not stimulate the search for substitutes in the other usage fields, and are more complicated to administer because of the multiplicity of consumers.

Emission fees are economically efficient in theory but the available evidence indicates that price elasticity is so low that fees would have to be punitively high to be effective, and would be difficult to implement on a global basis.

Paper No. 27: HIGHLIGHTS OF THE PAPER "A CANADIAN CONTRIBUTION TO THE CONSIDERATION OF STRATEGIES FOR PROTECTING THE OZONE LAYER"

G.V. Buxton, A. Chisholm, and J.Carbonneau

This paper proposed a strategic methodology for bridging the gap between the historical debate on capacity capping versus aerosol ban by suggesting a quota technique premised on overall release.

The authors suggest the establishment of a Global Emission Limit (G.E.L.) based initially on the year of peak production of CFC. This G.E.L. would be subjected to compulsory review every 3-5 years with a view to updating with respect to both scope (inclusion of reference to other ozone modifying substance) and relevance in the light of current scientific findings.

This G.E.L. would be apportioned between nations based on population and Gross National Product (GNP) thereby establishing a National Emission Limit (N.E.L.).

In conclusion, the authors suggest that their suggested approach wouldoffer the following advantages:

a) Since it is based on "release" it directly responds in a measurable way to scientific requirements for control
b) It addresses the global nature of the problem in an equitable way by protecting the future interests of lesser developed countries (quota share based on population) while recognizing the economic realities of developed nations (quota share based on GNP).
c) It can be adjusted easily to reference other ozone-modifying substances or to accommodate a periodic review of the global emission limit (G.E.L.)
d) It fully respects the sovereignty of individual nations by allowing them to decide on what means to implement in order to limit emissions.
e) It causes no trade interference since import or export is not a concern, only release.
f) It leaves open the option of increasing production if advances in recovery technology preclude release.
g) It indirectly takes into account regulatory initiatives voluntarily undertaken by using the year of peak production as the base year (1974) for the first review period.
h) It provides a global "safety factor" vis-a-fix the G.E.L. (some of the lesser-developed countries provided a quota may never consume it. The safety factor is therefore 0-25% of the G.E.L.)
i) It places the control burden squarely on the shoulders of the polluters.
j) It keeps the atmospheric global heritage of mankind under continual protectionist consideration.

Paper No. 28: ANALYSIS OF GLOBAL APPLICATION OF AN EEC-BASED PRODUCTION CAPACITY CAP

Stephen R. Seidel

This paper attempts to quantitatively evaluate the global application of an EEC-based production capacity cap on ozone depletion and other impacts. It also examines the potential impacts of the EEC-based approach along with a base on use of CFCs in nonessential aerosols.

This analysis produced the following results:

First, to be equitably applied worldwide, all nations must have the same access to CFCs as member nations in the EEC. Thus, all nations or groups of nations would be permitted 1.77 kg/per capita as allowed under the EEC cap. A freeze on current world capacity cannot be justified because of equity considerations (e.g., would be unfair to developing nations and non-CFC producing developed nations).

Second, based on current atmospheric models, and the assumed mid-range case for CFC growth developed for the Rome workshop, globally averaged ozone depletion of 7 per cent in 2050 and 14 per cent in 2075 would be anticipated from the EEC-cap applied globally.

Third, if a two-dimensional atmospheric model were used, ozone depletion could be substantially greater (2-4 times as great) than the 7 per cent in 2050 for countries located at northern latitudes.

Fourth, a non-essential aerosol ban in addition to an EEC-based cap has the advantage of substantially reducing emissions in the near-term (about 20 per cent in 2000).

Paper No. 29: A POSSIBLE REGULATORY STRATEGY FOR THE CONTROL OF CHLOROFLUOROCARBONS

I. Araki

When we have acquired more scientific knowledge on ozone layer modification and have discovered the annual global volume of CFC emission that is acceptable, it will be possible to establish a rational control system by allocating maximum permissible production or consumption quotas ("final regulatory strategy").

However, if each nation continues uncontrolled emission of CFCs until the final regulatory strategy is adopted, there could be a danger of severe damage to the ozone layer in the meantime. It will, therefore be both desirable and realistic to agree on the following (a "provisional regulatory strategy") until we can set annual maximum permissible CFC emission levels internationally, at least among developed countries, that are producing and consuming most of the world's CFCs:

- to "cap" CFC 11 and 12 production capacity at the present levels;

- to strive to limit the use and emissions of CFCs by means of appropriate measures.

The initial period of the provisional regulatory strategy could be five years, for example, and an international conference could be convened towards the end of this period to decide whether we should move on to the final regulatory strategy, and if not, for how long should the provisional period be extended.

The combination of the two strategies could be evaluated as a reasonable system in terms of effectiveness, economic efficiency, equity, monitoring, and flexbility.

Paper No. 30: APPROACH TO THE CONTROL OF CHLOROFLUOROCARBONS

For topic: Evaluation of Control Strategies Against Criteria

Professor Boris Gidaspov

1. We completely share the opinion about the certain dangerous nature of CFC compounds due to their effects on the ozone layer of our planet. This problem, unfortunately, is not simple for investigation, because together with chlorine and chlorine oxide radicals numerous other active compounds are directly responsible for ozone destruction, among which nitrogen oxides have the greatest effect.

2. Moreover, no comprehensive investigation of synergism effects which often occur in chemical processes, including ones of radical nature, have been performed until now. Total ozone content varies within rather wide limits, and it is difficult to qualify anthropogenic effects.

3. Besides ecological considerations this problem has a very important economic factor which implies irretrievable loss of a significant number of fluorine, the production of which is related to the consumption of fluorite, though its stock has been rapidly reducing in the world, and also to great power consumption. That is why the USSR conducts large scale engineering activity in order to replace CFCs in aerosol packings, as an urgent step, by some ecologically safe propellents. Naturally, in solving such a large problem we are to consider our country's traditions, its engineering facilities, so that it will take some time to limit fluorocarbons application, because this problem depends on reequipment of aerosol packings manufacture.

4. In the current situation, the highest priority should be given to rapdily developing chemical alternatives to CFC 11 and CFC 12, which are presently the dominant compounds in the general produce of CFCs.

Paper No. 31: ELEMENTS OF A NATIONAL APPROACH TO REDUCE CFC EMISSION

Herbert Aichinger

Austria is a non-producer of CFCs. However, it is a significant user of CFCs in products for domestic use and trade. Inflammable propellants are dominating in Austria because of the special legal situation limiting use of flammable alternatives. About 70 per cent of propellants are CFCs.

In 1981 (base year 1976), Austria succeeded in introducing a 30 per cent reduction in the use of CFCs on a voluntary basis. Therefore, it would be appropriate to very closely examine all sectors of CFC use, especially the propellant sector, and check for the best practical substitution mode. We should examine the propellant sector with regard to the introduction of non-pressurized cans, particularly the pumping system. In the hairspray and the cosmetic sector, the most efficient decrease of CFC use is achievable. Draft of a "substitution schedule" that foresees a timeframe for the producers. A step-by-step procedure will be successful.

The legal situation indicates that substitution by flammable propellants does not represent a realistic alternative. Simultaneously with these measures it would be very helpful to enhance public discussion concerning the whole complex CFC/Ozone-layer/climate issue showing people that slight quality losses in the spray formation will contribute to environment protection. To ensure that CFC-free products will have no higher price than CFC sprays (probably to compensate the higher price by lower taxes), a framework that will substantially support the strategy mentioned above is presented in the Toxic Substances Control Act that is under presentation now. It is expected that this law will provide a realistic basis for implementation of the discussed reduction strategies.

UNEP Economic Workshop on Protecting the Ozone Layer

Chairman's Concluding Remarks
by
Ambassador Richard Elliot Benedick

Leesburg, Virginia

September 12, 1986

For the Past several days, I have listened with great interest to the presentations and discussions, and I have been highly impressed with the quality of these proceedings. At the same time, I have been obliged, by virtue of the ceremonial position you gave me, to endure an unaccustomed silence, and to restrain myself from joining in the discussion.

I am happy to say, however, that participants from several countries have told me that they felt it would be useful for the Chairman to present a personal perspective on where we have come during these days, and how this fits into the longer run international process of which we are all a part.

In my welcoming remarks on Monday morning, I outlined the genesis of this Workshop, which originated from the deadlock last year in ngeotiations over a protocol to control emissions of chlorofluorocarbons. At that time, two blocs of industralized countries confronted each other, saying, in effect: "I've done this to protect the ozone layer, why don't you do the same?" Simultaneously, a third group of countries stood sceptically on the sidelines, and said practically nothing.

Not surprisingly under those circumstances, no internationally agreed protocol was possible. Since then, the international community, under the leadership of UNEP, has engaged in an impressive process to develop a common body of data and analysis to serve as the foundation for future negotiations ona protocol. This process, which has involved enormous energy and effort and ingenuity, has developed additional information, more refined models, and new approaches. The list of these efforts itself eloquently testifies to the broad scope of this process: the international scientific assessment of stratospheric ozone, co-sponsored by NASA, WMO and others; the Rome workshop; the UNEP/EPA international conference on health and climate effects; the meetings of UNEP's Coordinating Committee on the Ozone Layer (CCOL); and this Lessburg workshop.

Following this many-faceted examination, we still don't have answers to all the questions -- and we probably never will. We have been confronted many times, at this workshop and in other contexts, with the uncertainties -- but we have truly come a long way in our understanding.

Indeed, what impresses me is the extent of agreement we have together achieved. As this workshop is not designed to produce a consensus, I ask your indulgence in formulating my own personal views on what I saw as broad areas of agreement emerging from the entire process since the Vienna Conference:

1. The ozone layer is an exceedingly valuable resource for the entire population of the world.

2. The ozone layer has been, is being, and will continue to be adversely affected by the long-lived chlorine molecules which stem from all CFC products.

3. The depletion of ozone appears more serious the further awa -- north and south -- one moves from the equator.

4. This ozone depletion, by permitting greater quantities of harmful ultra-violet radiation to reach the earth's surface, will pose significant, even if currently difficult to quantify, risks for climate change, for human health, and for ecosystems.

5. These risks are considered by virtually all countries (and I would like here to cite in particular the recent contributions by the Soviet Union and Japan) as sufficiently serious as to warrant control actions.

6. Governments in industry are more seriously than ever before considering further regulatory and technological measures to limit future emissions of CFCs.

7. The very nature of the ozone layer requires global co-operation if protective measures are to be effective.

I hope I haven't committed any gross self-delustion in this personal assessment of what I perceived as broad areas of agreement.

And now the next step, as the countries represented here develop positions for the negotiations beginning 1 December 1986 is how to translate this substantial general agreement into a specific international protocol that (1) is effective in preventing a dangerous degree of ozone depletion; (2) is equitable in its application; (3) does not impose prohibitive economic dislocations; (4) is not too complicated to monitor and adminster; and (5) can adapt to changed circumstances.

Agreement on an international control strategy would be simplified if there were now a consensus on precisely how much ozone depletion is tolerable, and precisely what level of CFC emissions causes such depletion. I do sense a growing consensus among scientists on the likely range of ozone depletion for any given quantity of CFC emissions. However, only policymakers can decide whether a particular level of depletion is tolerable for their populations. This is an issue we must face in December.

Even without precise quantification, there seems to be agreement that the world has entered a danger zone. Indeed, industrialists are now asking governments to provide clearer signals to the marketplace, which could stimulate research into alternative products and more environmentally benign technology.

I should note here that we delude ourselves if, during the negotiating phase that lies ahead, we think that we can arrive at an ideal solution, or if countries hold to positions that are essentially painless with respect to their current situation. All participants will have to make real concessions for the common global interest.

Many experts have raised the possibility of an interim protocol, one that would not represent the last word, with specific provisions for relatively short-term review and revision based upon further scientific findings. Clearly this concept merits serious consideration.

Finally, we must not lose sight of the fact that any protocol must ultimately be judged by the amount of ozone depletion it would allow over various regions of the world.

Before closing, I would like, on behalf of all of us, to express particular recognition and appreciation to the gracious and efficient ladies who have contributed so importantly to the success and smooth functioning of this workshop: Wendy Martin, Sandra Miller and Judy Salmon of TAI, and Maria Tikoff of EPA. I am amazed that there are only four of you, considering the sheer volume of your accomplishments.

And now, dear colleagues, I must tell you, as your Chairman, how much I have been truly heartened by the atmosphere that you have engendered here this week. I think most of you would agree that we leave Leesburg with a greater basis for optimism on the likelihood of an international accord on ozone than we had just a few short days ago.

I am confident that the participants in the next negotiating phase will bring to it the ingenuity, good will, and sense of responsibility that have characterized what I would call "the spirit of Leesburg."

Have a safe journey home, one and all -- and until we meet again in Geneva.

The Ozone Workshop is adjourned. Thank you.

- - - - -

LIST OF PARTICIPANTS

COUNTRY	PARTICIPANT
Australia	Dr. Joe Hlubuchek Australian Embassy 1601 Massachusetts Ave, NW Washington, DC 20036
Austria	Dr. Herbert Aichinger Environmental Protection Agency Waehringerstrasse 25A Vienna 1090
	Mr. Friedrich Radlwimmer Austrian Chemical Association Wiedner Hauptstrasse 63 1045 Wien
Belgium	Dr. Hubert Creyf Chairman Europur Technical Committee c/o GECHEM Division Recticel Damstraat, 2 9200 Wetteren
Brazil	Mr. Harlen Santos W3 Norte, Q510-3^{o} Andar Brasilia-of-Brazil Telephone: 061-2749685
Canada	Mr. G.V. Buxton Commercial Chemicals Branch Environment Canada Ottawa, Canada K1A OE7
	Mr. J.M. Carbonneau Commercial Chemicals Branch Environment Canada Ottawa, Canada K1A OE7
	Dr. A. J. Chisholm Atmospheric Environment Service Environment Canada 4905 Dufferin St. Downsview, Ontario, Canada, M3H 574

China	Mr. Wang Zhijia Deputy Division Chief National Environmental Protection Agency of China Baiwanzhuang, Beijing
Denmark	Mr. Henri Heron Agency of Environmental Protection Strandgade 29 1401 Copenhagen K
Egypt	Dr. Elmohamady Eid Chairman Egypt Environmental Affairs Agency (EEAA) Cabinet of Ministers Cairo, Egypt Telephone: 3403809 Telex 939GOM
Finland	Mr. Markku Hietamaki Ministry of the Environment P.O. Box 306 00531 Helsinki
France	Mr. Pierre Woltner Ministere de l'Environnement 14 Dd dn GENERAL LECLERC 92-Neuilly, France
	Mr. Maurice Verhille Environment & Market Expert for France ATOCHEM La Defense 10 Cedex 42 92091 Paris La Defense
Federal Republic of Germany	Dr. Hans Braeutigam c/o Kali Chemie Ag. Hans Boeckler Allee 20 P.O. Box 220 D3000 Hannover 1
	Dr. Lothar Gundling Max-Planck-Institute for Comparative Public Law and International Law Berlinerstrasse 48 D/6900 Heidelburg

	Dr. Hans Jurgen Nantke Bismarckplatz 1 Unwel Houndesant D1000 Berlin 33
Hungary	Mr. Laszlo Kallay Educational Affairs Embassy of the Hungarian Peoples Republic 3910 Shoemaker Street, N.W Washington, D.C. 20008
India	Mr. K.D. Sharma DGTD Ministry of Industry New Delhi, India
Italy	Prof. Paolo Parrini Montefluos S.p.A. Via Principe Eugenio 5, Milan
Japan	Mr. Ichiro Araki Chemical Products Division Ministry of International Trade and Industry 1-3-1 Kasumigaseki Chiyoda-ku, Tokyo
	Mr. Katsuo Imazeki Aerosol Industry Association of Japan Marubil 319 Marunouchi, Chiyoda-ku Tokyo
	Mr. Hiroki Umeki Japan Flon Gas Association Mitsui Seimei Building No. 2-3, I-Chome, Ohtemachi Chiyoda-Ku, Tokyo
Kenya	Mr. B. N. Munywoki Head, Pollution Control Division National Environment Secretariat

Kuwait	Dr. Rifaat Zaki Hassan AlKholafy Environment Protection Council Ministry of Public Health Dr. A. M. AlNasser Environment Protection Council Kuwait University
Netherlands	Mr. Theo Evers Attache for Health & Environment Protection Netherlands Embassy 4200 Linnean Avenue, NW Washington, DC 20008 Mr. W.J. Kakebeeke Head of Department International Environment Affairs Ministry of Housing Physical Planning & the Environment P.O. Box 450 2260 MB Leidschendam Mr. Kees R. Nederveen AKZO Chemie BV Station Straat 48 P.O. Box 247 3800 AE Amerfoort
Nigeria	Ms. Anne Enelta Federal Ministry of Works & Housing Environmental Planning & Protection Division 4 Shaw Road Ikoyi, Lagos
Norway	Mr. Per M. Bakken Ministry of Environment P.O. Box 8013 Dep. Oslo 1 Mr. Per S. Doevle Head of Section State Pollution Control Authority P.O. Box 8100 DEP. Oslo

Mr. Ivar Isaksen
University of Oslo
P.O. Box 1022 Bindern
Oslo, Norway 3

Sweden

Mr. Rune Lonngren (Head of Delegation)
National Chemicals Inspectorate
P.O. Box 1384
S 17127 Solna

Ms. Ingrid Kokeritz
National Environment Protection Board
Stockholm

Mr. Rutger Oijerholm
Ministry of Agriculture
103 33 Stockholm

United Kingdom

Ms. Fiona McConnell, Head
Environmental Protection International
(EPINT) Division
Department of the Environment
Romney House
43 Marsham Street
London SWI

Mr. Mark Ambler
Economic Adviser
Department of Trade and Industry
Ashdown House, 123 Victoria Street
London SW1

Mr. Christopher Bowden
Principal, EPINT Division
Department of the Environment
Romney House
43 Marsham Street
London SWI

Mr. Brian D. Joyner
Chartered Chemist, F.R.S.C.
I.S.C. Chemicals Ltd.
St. Andrews Road
Avonmouth, Bristol

USA

Mr. Richard Benedick
Deputy Assistant Secretary
Environment Health & Natural Resources
U.S. Department of State
2201 C Street, NW
Washington, DC 20520

Mr. Craig Potter
Assistant Administrator
Office of Air and Radiation
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20406

Mr. Fitzhugh Green
Associate Administrator
Office of International Activity
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20406

Ms. Suzanne Butcher
Deputy Director
Office of Environment and Health
U.S. Department of State
2201 C Street, NW
Washington, DC 20520

Mr. Don Clay
Deputy Assistant Administrator
Office of Air and Radiation
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20406

Mr. Michael Gibbs
Project Manager
ICF Incorporated
1850 K Street, NW, Suite 950
Washington, DC 20006

Mr. John S. Hoffman
Chairman
Stratospheric Protection Task Force
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20406

Dr. Iwona Rummel-Bulska
Ag. Chief, Environmental Law and
Machinery Unit

Mr. Peter Usher
P.O. Box 30552
Nairobi, Kenya

Other Organizations

Europur Technical Committee & BING	Dr. Hubert Creyf Chairman Europur Technical Committee c/o GECHEM Division Tecticel Damstraat, 2 9200 Wetteren
CEFIC	Dr. John F.D. Mills Federation of European Chemical Industry Associations ICI, Mond Devision P.O. Box 13, The Heath Runcorn, Chesire WA74QF United Kingdom
	Mr. Joachim von Schweinichen Montefluos Corporation Milan, Italy
	Mr. Maurice Verhille Environment & Market Expert for France ATOCHEM La Defense 10 Cedex 42 92091 Paris La Defense
Federation of European Aerosol Associations (FEA)	Mr. Richard C. Knollys President Federation of European Aerosol Associations (FEA) Square Marie Louise, 49 1040 Brussels
International Chamber of Commerce (ICC)	Mr. Paul W. Halter Business Director FREON Products Division E.I. Du Pont de Nemours & Co., Inc. Wilmington, Delaware 19806

Mr. Donald G. Roberts
General Manager
Australian Fluorine Chemicals
151 Flinders Street
Melbourne 3000

Mr. Joe Glas
DuPont Corporation
C & P Dept., B-13221
Wilmington, DE 19898

Mr. Joe Steed
DuPont Corporation
C & P Dept., B-13221
Wilmington, DE 19898

Observers

Environmental Protection Agency 401 M St. NW Washington, DC 20460	Mr. Derry Allen Mr. Stephen O. Andersen Ms. Nancy Ketchum-Colwill Mr. Richard Morgenstern Mr. Neil Patel Mr. Bill Rhodes Mr. Dean Smith Ms. Maria Tikoff Mr. Dennis Tirpak
Department of State 2201 C Street, NW Washington, DC 20520	Mr. Robert Coe Ms. Debbie Kennedy Mr. John Rouse
Department of Energy	Mr. Rick Bradley 1000 Independence Ave ESH, Rm 46025 Washington, DC 20585
IER	Ms. Catherine Burks International Environment Reporter 1231 25th St. NW Washington, DC 20037
NRDC 1350 New York Ave, NW Suite 300 Washington, DC 20005	Mr. Dick Ayres Mr. David Doniger

Mr. Bill Long
Deputy Associate Administrator
Office of International Activities
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20406

Mr. James Losey
International Activities Officer
Office of International Activities
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20406

Mr. Stephen Seidel
Senior Analyst
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20406

Mr. Bob Watson
Chief Scientist
Global Habitability Program
National Air and Space Administration
600 Indepndence Agencue, SW
Washington, DC 20546

Mr. Dwain Winters
Director of the Office of Program
Development
Office of Air and Radiation
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20406

Mr. Daniel J. Dudek
Senior Economist
Environmental Defense Fund
444 Park Avenue South
New York, NY 10016

Mr. Raymond Feder
Allied Corporation
2501 M Street, NW
Washington, DC

USSR

Prof. Boris Gidaspov
Institute of Applied Chemistry
Ministry of Chemical Industry of the USSR
Moscow, 20

	Dr. Vyacheslav Khattatov USSR State Committee for Hydrometeorology and Control of Natural Environment 12, Pavlic Mozozov Lane Moscow, 123376 USSR Telex: 411117 RUMS SU Cable: GOSGIMET
Yugoslavia	Dr. Vukasin Radmilovic M.D.D.S. Higher Adviser Federal Committee for Labour, Health and Social Welfare of Yugoslavia Belgrade, 11070 BUL AVNOJA 104YU

Intergovernmental Organizations

EEC Brussels	Mr. Christopher Bevington (Consultant to the EEC) Metra Consulting Group Ltd. 1 Queen Anne's Gate London SW1
	Mr. Guy Brasseur NCAR 1850 Tablemesa Drive Boulder, Colorado 80303
	Mr. George Strongylis DG XI Commission of the European Communities 200, Rue de la Loi 1049 Brussels
OECD	Mr. Robert Visser Organization of Economic Co-operation and Development Enviornment Directorate Chemicals Division 2, rue Andre Pascal, Paris
UNEP	Dr. N.J. Brown Director of the Regional Office of North America New, NY

Boston Globe	Ms. Dianne Dumanoski Boston, Mass 02107
Engineering News	Mr. Lois Ember Chemical & Engineering News 1155 16th St. NW Washington, DC 20036
Consultant	Mr. Hugh Farber Dow Chemical 2807 Highbrook Drive Midland, MI 48640
Alliance	Mr. Kevin Fay Alliance for Responsible CFC Policy 1901 N. Fort Myer Drive Suite 1204 Rosslyn, VA 22209
Allied Corp 2501 M St Washington, DC 07960	Mr. Raymond Feder Dr. Robert Orfeo
Rand	Mr. Frank Camm Senior Economist Rand Corporation 2100 Main Street, NW Washington, DC 20037-1270 Mr. James Hammitt Rand Corporation 1700 Main Street Santa Monica, CA 90406-2138
NOVA	Ms. Linda Harrar WGBH TV 125 Western Avenue Boston, MASS 02134
Air/Water Pollution Report	Ms. Carolyn Long

CRSS	Mr. D. Randall Mayfield CRS Sirrine, Inc. 216 S. Pleasantburg Dr. P.O.. Box 5456 Greenville, SC 29606
Sierra Club	Mr. Michael McCloskey 330 Pennsylvania Ave, SE Washington, DC 20003
AU	Mr. Alan Miller American Univ. Law School Washington College of Law 4400 Massachusetts Ave, NW Washington, DC 20016
World Resources Institute 1735 New York Ave, NW Suite 4000 Washington, DC 20006	Mr. irving Mintzer Mr. Rafe Pomerance
Environmental Defense Fund 444 Park Avenue South New York, NY 10016	Mr. Daniel J. Dudek Mr. James Tripp
Senate	Mr. Steve Shimberg Room 408 Hart Senate Office Building Washington, DC
MVMA	Mr. Gerald F. Stofflet
AFFI	Mr. Hugh Symons American Frozen Food Institute 1764 Old Meadow Lane McLean, VA 22101
The Bruce Company 1508 13th St. NW Washington, DC 20005	Mr. John Wells Ms. Margaret Daniel Ms. Kaarina Merikaarto
ABC News 1717 DeSales Washington, DC 20036	Ms. Lynn Sherr Ms. Sharon Young