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Workshop on the Control of
Chlorofluorocarbons

First part,
Rome, 26-30 May 1986

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

I. INTRODUCTION

1. In accordance with Governing Council decision 13/18, part I, paragraph 6, of 24 May 1985, and following the two sessions of the Steering Committee for the Workshop on the Control of Chlorofluorocarbons, the first part of the Workshop on the Control of Chlorofluorocarbons was held in Rome, Italy, from 26 to 30 May 1986, at the invitation of the Government of Italy.

II. ORGANIZATIONAL MATTERS

A. OPENING OF THE WORKSHOP

2. The first meeting of the Workshop was opened on behalf of the Executive Director of UNEP by Dr. Iwona Rummel-Bulska, the Acting Chief of the Environmental Law and Machinery Unit. After greeting the participants and expressing her gratitude to the Government of Italy for acting as host, she recalled the provisions of decision 13/18 of the Governing Council, pursuant to which the Workshop was being held, and reminded the participants of the important task before them, which was to help prepare the ground for the resumption of discussion on a protocol to the Vienna Convention on the Protection of the Ozone Layer, later in 1986. The groundwork for the Workshop itself had been prepared, as requested by the Governing Council, by the Steering Committee, which had met twice in 1985. It was essential that, through a spirit of compromise and mutual understanding, the participants should accomplish the work of the first part of the Workshop in good time, so that the preparatory work required for the discussion on a protocol could be completed at the second part, to be held in September 1986, in Washington DC, at the invitation of the Government of the United States of America.

3. Mr. Filippo Anfuso, representing the Government of Italy, welcomed the participants on behalf of the Italian Minister for Ecology and underlined that the Workshop was an essential part of a long process, initiated many years before, the first milestone of which had been the adoption of the Vienna Convention in March 1985. Further steps were required to render that Convention operationally meaningful. One of the most important of those steps was to be taken at the Workshop, which would review and evaluate all the data relevant to the various options that might form the basis for a protocol on the control of chlorofluorocarbons. Mr. Anfuso paid tribute to the efforts of UNEP for insisting on the importance of timely action on these matters, and to the European Community for its assistance in making the Workshop possible.

4. Professor Maurizio Cignitti welcomed the participants on behalf of the Director-General of the Italian Institute of Health, and recalled that the Institute had been involved in the work leading to the Vienna Convention since the earliest discussions. He expressed his belief that co-operation and understanding among the participants would make it possible to achieve major progress during the Workshop and thus contribute most significantly to the solution of an important and truly global issue.

B. ATTENDANCE

5. The first part of the Workshop was attended by experts from Austria, Belgium, Canada, China, Denmark, Egypt, Finland, France, Germany, Federal Republic of, Italy, Japan, Kenya, Kuwait, Malawi, Netherlands, Nigeria, Norway, Sweden, Turkey, Union of Soviet Socialist Republics, United Kingdom of Great Britain and Northern Ireland, United States of America, and Yugoslavia. Representatives were also present from the Commission of the European Communities (EEC), the Organization for Economic Co-operation and Development (OECD), the British Aerosol Manufacturers' Association (BAMA), the European Council of Chemical Manufacturers' Associations (CEFIC), EUROPUR, the Federation of European Aerosol Associations (FEA), and the International Chamber of Commerce (ICC). The list of participants is attached as Annex VII to the report.

C. ELECTION OF CHAIRMAN

6. Prof. F. Romani (Italy) was elected overall Chairman of the Workshop by acclamation. Mr. E. Eid (Egypt) and Mr. G. Strongylies (Commission of the European Communities) were elected as the Workshop's overall Rapporteurs.

D. ADOPTION OF THE AGENDA

7. The following agenda was adopted by the Workshop:

1. Opening of the Workshop.
2. Organization of work.
3. Election of Chairman.
4. Adoption of the Agenda.
5. Organization of the working group(s).
6. Consideration of the reports and recommendations of the working group(s).
7. Arrangements for the second part of the Workshop.
8. Adjournment of the meeting.

E. ORGANIZATION OF WORK

8. The attention of the participants was drawn by the Secretariat to the reports of the two meetings of the Steering Committee and to the topics selected by it for consideration by the Workshop. It was suggested and agreed that the Steering Committee, which would be meeting during the course of the Workshop, might serve together with the officers to be elected, as a Bureau.

9. The following officers were selected for each of the first five topics:

Topic I:	Chairman:	Mr. S. Tewungwa	(UNEP)
	Rapporteur:	Mr. M. Gibbs	(United States of America)
Topic II:	Chairman:	Mr. C. Elkins	(United States of America)
	Rapporteur:	Mr. C.F.P. Bevington	(Comission of the European Communities)
Topic III:	Chairman:	Dr. C. Veljanovski	(United Kingdom)
	Rapporteur:	Dr. E. Eid	(Egypt)
Topic IV:	Chairman:	Mr. G. Strongylis	(Commission of the European Communities)
	Rapporteur:	Mr. B. N. Munywoki	(Kenya)
Topic V:	Chairman:	Mr. S. Seidel	(United States of America)
	Rapporteur:	Mr. W. Zhijia	(China)

10. Following the suggestion of the Steering Committee, it was decided that the terms of reference for the rapporteurs for the topics would be prepared to allow all the reports to follow the same pattern. These terms of reference were distributed as document UNEP/WG.148/CRP.1.

II. CONSIDERATION OF THE REPORTS AND RECOMMENDATIONS OF THE WORKING GROUPS

11. Following the suggestion of the Steering Committee, it was decided that the reports on the topics would be attached to this report as annexes I to V.

III. ARRANGEMENTS FOR THE SECOND PART OF THE WORKSHOP

12. Ms. F. McConnell (United Kingdom), Chairman of the Steering Committee, reported on the results of the Steering Committee meetings regarding the planning fcr the second part of the Workshop in Washington D.C. The guidelines for the preparation of the documents for that meeting are contained in annex VI. Ms. McConnell stressed that annex VI was intended solely for guidance, and participants should feel free to develop their own strategies if they so wished. She also reported that the Steering Committee proposed that the early part of the Workshop should be chaired by the co-ordinators for each of the four subtopics of topic 6, while UNEP should chair the subsequent and the final parts.

13. The second part of the Workshop would start at 9 a.m. on 8 September 1986, in Leesburg, Virginia, which has close access to Dulles International Airport, Washington DC. Delegates were invited to arrive on 7 September. Detailed instructions would be sent in the near future.

IV. ADJOURNMENT OF THE MEETING

14. At the end of the meeting, Dr. Genady Golubev, Assistant Executive Director, speaking on behalf of the Executive Director of UNEP, thanked the Government of Italy for hosting the first part of the Workshop on the Control of Chlorofluorocarbons in such excellent conditions.

After the customary exchange of courtesies, the Chairman declared the first part of the Workshop closed.

ANNEX I

Topic 1: Background factual papers on current production capacity, production, use, emissions, trade and current regulation of CFCs separately by country and/or region.

SUMMARY

The excellent submissions by countries were recognized as a step toward identifying recent and current CFC use in various applications. These data, in conjunction with the data already provided to UNEP by the Chemical Manufacturers Association (CMA) from reports by producing companies, provide an estimate of the current global use of CFCs. It was noted, however, that these estimates of global use are uncertain, and that of the more than 170 requests for data, only 18 responses were received. The difficulty, cost, and time required to obtain additional data was noted, and the possibility of using a format for future data requests was mentioned.

The following points were also made:

(a) Individual countries with similar economic wealth may have different patterns and levels of CFC use;

(b) For the United States, the other OECD countries as a whole, and the world as a whole, the correlation between economic wealth and CFC use has been strong in the recent past (20 years);

(c) According to CMA, there have been increases in production of 7 per cent per year in 1983 and 1984;

(d) Two years of production data are not sufficient for drawing conclusions regarding long term trends;

(e) There are errors in the overview paper and the Chairman invited authors to submit corrections as necessary;

(f) There were two schools of thought on the inclusion of the executive summary of the February 1986 CCOL assessment of ozone layer modification as an annex to the overview paper: some felt that it was not appropriate for topic 1, while others expressed the view that it provided an important context for the discussions under topic 1.

Discussions

(a) Current Data

The Chairman recognized the uncertainty in the estimates of current global production, and suggested that the CMA figures represent approximately 80-85 per cent of global production. Mr. Verhille (France) asked how, in view of the lack of data (only 18 responses to the 170 requests for data), the available data could represent 85 per cent of total production. Mr. Kakebeeke (Netherlands) recognized that the CMA data did include some estimates, but that the 80-85 per cent figure was approximately correct.

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The uncertainty in the available data was also recognized by Mr. W. Zhijia (China), who reported that China was collecting data, Dr. Mills (CEFIC), Dr. Strobach (United States) and Ms. McConnell (UK). Dr. Strobach (United States) also asked what steps should be taken to improve the situation and in what time-frame. Dr. Dudek (United States) noted that data collection is time-consuming and costly, that complete certainty is not always required to make decisions, and that the benefit of additional data collection should be evaluated before proceeding. A suggestion was made by the Chairman, and suggested by Dr. Mills (CEFIC), that a format for future data collection would possibly be helpful for ensuring consistency of submissions. Dr. Mills (CEFIC) also noted that there are at least two purposes for collecting data:

(a) Global data for scientific assessments of potential impacts on the ozone layer;

(b) For monitoring and control purposes in different regions.

Dr. Mills further suggested that Governments are the best source of data for meeting the second purpose, and that the collection of these data would have to be co-ordinated carefully.

(b) Corrections to the Overview Paper

Mr. Buxton (Canada) pointed out numerous corrections that had to be made to the overview paper to represent accurately the submission by Canada. The Chairman invited. Mr. Buxton and all the authors to supply corrections for incorporation into the overview paper. A one page summary was provided by Mr. Buxton and circulated.

Other corrections noted include:

In addition, Dr. Strobach (United States) noted an error in the data for Brazil on page 21, showing production of 9,000 tonnes/yr and exports of 57,800 tonnes/yr; Dr. Wilson (BAMA), said that the second and third sentences of conclusion 5 on page 23 were inconsistent and required clarification; Mr. Roberts (ICC) pointed at the production capacity in Australia for CFC-22 given on page 17 should be listed as 2,700 t (not 27,000).

Trends in production

Mr. Kakebeeke (Netherlands) noted the recent 7 per cent annual increases in the production of CFC-11 and 12 reported by the CMA for 1983 and 1984. Mr. Mills (CEFIC) noted that two years were not enough to form a basis for conclusions regarding long term trends, and that longer periods should be examined, including accounting for production and economic cycles. Mr. Hoffman (United States) presented data showing a high correlation between CFC use in non-aerosol applications and GNP - this relationship being stable for the past 20 years in the United States, the other OECD countries as a whole, and for the world as a whole. Dr. Veljanovski (United Kingdom) requested that these data be made available and Mr. Hoffman agreed. Mr. Hoffman also noted the recent large increase in the production of CFC-113 for two years in a row, and suggested that these increases are evidence of the importance of including CFC-113 in the Workshop's deliberations.

CCOL Assessment

The CCOL assessment was included as an annex to the summary paper. Dr. Strobach (United States) stated that reference to the "greenhouse effect" in this annex and in the introduction to the summary paper was not a matter for the Workshop.

Mr. Kakebeeke (Netherlands) and Dr. Dudek (United States) each suggested that the CCOL assessment provided an appropriate context for discussing trends in recent production under topic 1.

Mr. Kakebeeke further suggested that the Workshop should adopt the conclusions of the CCOL assessment as part of topic 1.

Ms. McConnell (United Kingdom) suggested that the Workshop was not an appropriate forum to pass judgement on the results of the separate CCOL meeting.

Conclusions

The data submitted under topic 1 and provided to UNEP by CMA provided a reasonable estimate of a substantial portion of the global production and use of CFCs 11 and 12, but the data for one significant area of the world are not available. It was noted that the data are somewhat uncertain, and that improvements can be made. In addition, the CMA data do not include estimates of the production of CFC 113 and CFC 22.

ANNEX II

Topic 2: Under regulations or guidelines applied to date, projections of demand for CFCs, production capacity, production, use, trade and their concentration in the short term (up to the year 2000) and in the long term, taking into account demand-increasing or demand-reducing technologies. Evaluation of methodologies for projecting demand, including for the short-term market-based studies and for the long-term analyses of GNP and population. Analyses of constraints to supply in evaluating future production.

SUMMARY

Analysis of 11 papers contributed for topic 2 showed that the methodologies employed, though widely varying in detail, fall into two groups: the "bottom up" and "top down" approaches. The former constructs projections from detailed knowledge and assessment of all the factors relating to growth in all the end uses of CFCs, including the impact of substitution, technological change and regulation; the latter is based on aggregate statistical patterns including correlations with historical data, with adjustment for technological change. Despite the limitations of both approaches and the variations in treatment, the annual growth projections for CFC 11 and 12 output for the period from 1985 to 2050 were considered by the overviewer to be close enough to derive consensus projections, and it was proposed that growth rate of 1.2, 2.5 and 3.8 per cent should be selected for evaluation of emission effects and control strategies in phase 2 of the Workshop.

In the discussion of the paper, there was considerable criticism of the validity of the methodologies. Some participants suggested that no credence could be attached to the projections and that no specific growth rates should be selected for evaluation. Others defended the overview proposals as representing converging informed views and study, and thought that the three proposed growth rates should be adopted for evaluation, notwithstanding acknowledged uncertainties.

A thorough discussion failed to resolve the divergent views and no consensus was reached on specific growth rates. It was generally agreed, however, that the CFC 11 and 12 growth rates to be used for atmospheric modelling in phase 2 should be selected from the range 0 to 5 per cent.

DISCUSSION

Introduction

Introducing topic 2, the Chairman remarked that while most types of atmospheric pollution responded rapidly to emission reduction measures, CFCs presented unique problems because of their long atmospheric lifetime. He drew an analogy between the functions of the Workshop and those of baggage masters on a freight train who had to decide at each of 75 or so stops whether to accept the baggage presented, or to reject pieces because of potential hazards. Once on board the baggage could not be discarded, and as the load

increased the train might become unstable. The questions faced were: how would the train behave as more baggage accumulated? How much would be waiting at each stop? What control measures were available? What was the condition of the brakes and what would be the outcome of applying alternative control strategies? In terms of the CFC problem, the first question had been addressed at the recent Nairobi meeting, and the others were being considered at the present Workshop.

(Several speakers referred to this analogy in the subsequent discussion and it was pointed out that there is some opportunity to discard "baggage" en route, e.g. by the incineration of the CFCs in scrap closed cells foam plastics. From the commercial viewpoint, it was also desirable to carry as much "baggage" as was safely practicable.)

Presentation of Overview Paper

Mr. M. Gibbs (United States/ICF) summarized the overview of the papers received for topic 2 in terms of scope, the forecasting methods employed and the resultant projections. Two modes of approach had been followed: the "bottom up" approach in which projections were constructed from details of all the factors involved including the expected growth of all end uses, the impact of substitute products, regulation, economic growth, etc.; and the "top down" approach based on aggregate statistical patterns and correlations with historical data, with adjustments for technological change. Both approaches had limitations: the first needing very extensive data, and the second being heavily reliant on aggregate values and historical trends.

Despite variations in treatment the projections for CFCs 11 and 12 were close enough for a consensus to be derived for the period from 1985 to 2050, and, on the basis of four alternative aggregation methods, Mr. Gibbs proposed three consensus annual growth rates averaged over 65 years for CFC 11 and CFC 12 for evaluation in phase 2: 1.2 per cent, 2.5 per cent and 3.8 per cent. Mr. Gibbs also noted that fewer estimates were submitted for other CFCs, and that the growth rates submitted for CFC 113 and CFC 22 were larger than the growth rates submitted for CFC 11 and CFC 12.

General discussion

The Chairman said that he hoped that the Workshop would be able to arrive at a consensus view on the alternative propositions to be considered, but in the ensuing discussion divergent views emerged.

Mr. Bentley (CEFIC) thought the overview did not adequately represent the paper by G. Yarrow, which stressed the unreliability of demand projections based on data extrapolation and past correlations, which were seldom accurate for more than five years ahead. No model of past CFC output changes passed standards tests of consistency with existing data, and long term forecasts could only be regarded as assumptions. A number of other speakers supported this criticism.

Dr. Veljanovski (United Kingdom) pointed to the influence of price movements and the difficulty of predicting these to year 2000. Forecasts were based mainly on history and informed speculation, and could never be regarded as concrete.

Dr. Mills (CEFIC) said that as long as an environmental threat from CFCs existed, coupled with the prospect of more regulations, industry would be deterred from investing in more CFC production capacity or the development of new applications.

Mr. Joyner (United Kingdom) said it should not be assumed that CFC usage in developing countries would grow with GNP in the same way as in the United States, Europe and Japan. Industry five-year forecasts were normally revised annually.

Mr. Strobach (United States/ICC) said United States industry was not aware of any plans to expand CFC 11/12 capacity in the United States, Europe or Japan and that production caps already existed in the EEC and, in effect, in Japan. He cautioned against adopting specific projections, which would acquire a special status as coming from a UNEP Workshop.

In commenting on criticisms of the USA forecasts Mr. Hoffman (United States Environmental Protection Agency) said the modelling approach was not extrapolative as had been alleged, and the scenarios developed provided for a decrease in the intensity of CFC usage with GNP growth, with a range increasing with time to reflect greater uncertainty.

Mr. Camm (United States, Rand Corporation) also made observations on the CEFIC and United Kingdom criticisms: the projections had not relied on history, although it could provide useful indicators; and factors such as product life cycles, substitution and technological change had been taken into account. Despite the uncertainties, some approach had to be adopted to provide hypotheses for evaluating efforts and strategies. Supporting this point, Mr. Dudek (United States, Environmental Defense Fund) said that despite the complexities the task had to be faced, while Ms. Koreritz (Sweden) said that long-range projections had to be attempted because there were products being put on the market today which would affect the emissions of tomorrow, and it took a long time for international agreements to be reached and implemented.

Mr. Gibbs (Unted States/ICF) reiterated that, despite limitations, all the projections represented much informed option and all pointed in the same direction. Surely, therefore, they were useful in policy testing.

After discussion on the question of agreeing on a set of CFC growth projections, Mr. Bickel (Unted Kingdom) said it was clear that no consensus would be reached and that it was not necessary for demand projections to be adopted. The phase 2 workshop could make evaluations based on arbitrary figures. Mr. Bakken (Norway) objected to plucking figures out of the air and suggested using the range in the overview paper.

Mr. Kakebeeke (Netherlands) suggested using the Gibbs scenarios for evaluation but defining the defects in methodology which had been exposed, and Mr. Camm (United States, Rand Corporation) thought that arrangement of more than 5 per cent would represent an unreasonable degree of uncertainty.

Mr. Strongylis (EEC) put forward a proposal that while the uncertainties should be recognized a range of 0 to 5 per cent should be adopted for scientific modelling purposes and that further research into forecasting should be recommended.

There was general acceptance of the 0 to 5 per cent range but disagreement over the question of including specific numbers, and several speakers including Dr. Bräutigam (Federal Republic of Germany) and Mr. Ambler (United Kingdom) considered that any numbers should be taken as "what if" scenarios, not projections. Ms. McConnell (United Kingdom) thought that in the light of the discussion it would be most unwise to adopt percentage point numbers as representing a consensus.

Mr. Buxton (Canada) suggested that the consensus should be the 0 to 5 per cent range, with countries being free to select specific figures if they chose, and the Chairman agreed with this proposal.

Conclusions

1. Considerable uncertainty attaches to the CFC growth projections put forward in the papers contributed for topic 2, and all the methodologies employed are open to criticism.

2. No consensus view could be reached on specific annual growth rates for CFC 11 and 12 output for the purpose of evaluating emissions effects and control strategies, but there was general agreement that the scenarios selected for atmospheric modelling in phase 2 of the Workshop should be drawn from the range 0 to 5 per cent.

ANNEX III

Topic 3: Under regulations or guidelines applied to date, review of the costs and effects in terms of changes in production, use, emissions, production capacity and trade in CFCs and the demand for other products

SUMMARY

Ten papers were submitted to the Workshop plus two background papers. The session was opened by a brief presentation by the Chairman of the overview papers. It was observed by the United States and Canada that the paper did not appropriately reflect viewpoints expressed in the papers and limited the scope of the topic. The Chairman, who was the author of the overview paper pointed out that some of the studies criticized one another's results owing to different methods and assumptions. There was also a difference in perception on what was covered by the topic. In view of this he thought it useful to
reach some agreement on the assumptions giving rise to these disagreements. In light of the different assumptions, methods of estimation and coverage, it was not possible to provide a definitive statement of the costs of aerosol control.

Several participants claimed that the studies did not take a comprehensive enough approach to the costs and benefits imposed by regulation.

The discussion then turned an assessment of whether controls had had an effect on industry and consumers. The participants presented evidence on the effectiveness of control measures and of the use of other propellants as substitutes for CFCs in aerosols. No agreement was reached on this issue. Some participants noted that although the partial aerosol ban was already in place in some countries, where was no eveidence in these countries of an increased effort to search for alternatives, and that demand in unregulated areas was continuing to grow. Some claimed that consumers could not tell the difference, while others said that there were marked differences between CFCs-based aerosols and other products. Evidence was presented in favour of both propositions.

The discussion then turned to the impact of EEC controls on CFC production in Europe. It was said that although the capacity limit had not yet been reached, industries were taking steps to limit their production and use of CFCs and were searching for alternatives. With respect to situations where capacity limit was reached or other potential controls applied, some participants expressed concern about the effects of a production capacity cap on production and use if trade flows were not also subject to control.

The Workshop concluded that the studies so far undertaken did not provide a comprehensive basis for estimates of the cost and effects of CFC control.

DISCUSSION

The Chairman presented his overview paper stressing that the studies were incomplete and that in the case of the United States, the ICF and JACA studies reached diametrically opposite conclusions using the same data. A major problem was that different methods and assumptions had been used, and the Chairman suggested that the Workshop should reach agreement on the approach to be used to measure the effects and impact of regulation.

Mr. Hoffman (United States) observed that the overview paper presented its own evaluation of the approach used to cost regulation. It should have just reported the findings and disagreements.

Mr. Bentley (CEFIC) observed that there were serious flaws in most of the studies and that they did not address the issue of the cost of regulation comprehensively.

Ms. Kokeritz (Sweden) pointed out that, in view of the time available and the different understanding of the coverage of the topic, it was not the intention of the Swedish paper to cover all the costs and benefits.

The Chairman, responding to comments from some participants, said that he had been asked to evaluate the papers, and that the Workshop was really left with no choice other than to address the method of costing regulations given that the findings contained such disparities.

Mr. Hoffman (United States Environmental Protection Agency) presented the results of the ICF study. The study suggested that because consumers has voluntarily abandoned aerosols there was no loss in consumer surplus. It also claimed a saving of $165 million had been achieved through switching from CFCs to hydrocarbons.

Dr. Strobach (United States) said that the ICF study had weaknesses.

Mr. Ambler (United Kingdom) endorsed comments made by Dr. Strobach on the ICF study. Although net economic benefit from regulation was theoretically possible, there was no evidence that the conditions prevailing in the CFC industry were such that it was at all likely.

Mr. Umeki (Japan) spoke about CFC production and methods of control.

Dr. Veljanovski (United Kingdom) sought to gain some agreement on methods and on the proposition that regulation imposes costs on industry.

Mr. Buxton (Canada) said that account should be taken of the costs and benefits to all related sectors not just CFC producers.

Conclusions

The Workshop concluded that the studies so far undertaken did not provide a comprehensive basis for estimates of the cost and effects of CFC controls.

ANNEX IV

Topic 4: On a sector by sector basis, identification of the range of existing and developing technological options for control, their potential costs and effectiveness in terms of reducing demand, production, use, emissions or capacity for producing CFCs.

Introduction

The Chairman read the agenda for topic 4 and then placed the topic in the context of the other topics of the Workshop

He explained that the goal was to examine the various options available and conclude on the ideas that seem promising for technological innovation in the different sectors of use. He then proposed to examine each sector in turn following the overview paper prepared for the topic. He proposed that, since questions concerning the costs and benefits of replacing CFCs in aerosols, and particularly the United States experience, were discussed at length under topic 3, the discussion on topic 4 should focus on the technical prospects in this sector.

DISCUSSION

General

Introducing the overview, Mr. Bevington (EEC) said that while the papers received made valuable and comprehensive contributions on the areas they covered, they tended to adopt the "bottom up" approach to technical options for emission reduction, and there had been no reviews of long-term possibilities, such as whether there might be a distant perspective alternative to vapour compression refrigeration. An important omission of a matter of more immediate concern was the question of how to reduce emissions from "banked" CFCs in closed cell foam plastics, e.g. by measures for the collection and incineration of these foams when scrapped.

Aerosols

Turning to the first item for discussion, Mr. Bevington mentioned the paper from Netherlands on the extensive Government-sponsored research which indicated that on all counts dimethylether was a safe propellant, and that the publication of those results might encourage industries to make more use of it.

Mr. Knollys (FEA) then reviewed the relative merits of the various alternative propellant systems - CFCs, hydrocarbons, dimethylether, compressed gases, compartmented aerosols, pumps - the principal criteria being technical performance and cost. Marketers selected propellant systems on the basis of the best combination for their products, but fillers could be constrained from using flammable propellants by their factory locations and their ability to handle explosive material. The drying properties and densities of liquefied propellants were also important factors.

Mr. Hoffman (United States) and Mr. Kakebeeke (Netherlands) said that, as a general point, it could have been advantageous to have representatives present from industrial sectors that provided some of the alternatives to CFCs.

Subsequent discussion tended to concentrate on the question of the relative quality and consumer acceptability of CFC and hydrocarbon propellant formulation. It appeared that experience varied from country to country, but it was agreed that compressed gas systems were inferior in most product sectors. On the question of safety, Mr. Strobach (United States) said that while consumer experience with HC aerosols suggested no significant increase in hazard, some serious incidents had occured in filling plants and warehouses, and insurance costs had risen accordingly.

Refrigeration

Mr. Bevington introduced the relevant sections of the overview paper by referring to the two papers that were submitted from Denmark and the United States Environmental Protection Agency. Mr. Heron (Denmark) indicated that a firm in Denmark was proposing for sale equipment intended for reducing emissions from refrigeration and air-conditioning systems. It appeared that this private effort could be connected to the code of practice on refrigeration prepared by the EEC with the same end in mind.

Numerous statements, notably from the United States delegation focused on the possibilities for reducing CFC 12 refrigerant use. These included:

- substitution of CFC 22 for CFC 12 in leak testing of refrigeration equipment;
- replacement by CFC 502 in medium temperature retail food refrigeration units;
- recovery of CFC 12 during the disposal of mobile air-conditioning units;
- reclamation of CFC 12 during system repair and servicing.

Rigid (Closed Cell) Foams

Mr. Bevington pointed out that although much of the information contributed related to polyurethane foams, CFCs were also used as blowing agents for polystyrene and phenolic insulating foams, and there was a lack of statistics indicating the relative amounts used for these purposes. The BRUFMA paper demonstrated that there was no alternative to CFCs for obtaining the uniquely low thermal conductivity of these foams, so the questions to be addressed were how to reduce emissions during their life and on scrapping.

Mr. Zhijia (China) gave an account of the incineration technology used in China for treating wastes containing fluorine, in which the acid gases formed were absorbed in alkali spray towers. Three plants were using those procedures in China, and more detailed information could be provided.

Dr. Brautigam (Federal Republic of Germany) said that industry had studied the lifetime of rigid cell foams and that the results had been published.

Mr. Kindermann (BING) informed the meeting that the half life of CFCs in closed cell foams was estimated from 60 to 80 years.

Flexible (Open Cell) Foams

Introducing this item, Mr. Bevington said that as CFCs played the role of agents for producing foams but not of components of the final products, the questions were: were there alternative blowing agents? Could the CFCs be recovered and recycled? Were there alternative blowing technologies?

Dr. Creyf (EUROPUR) reviewed the possible approaches which had been considered by his industry, and quoted from the Europur paper which had been submitted too late for incorporation in the overview. Methylene chloride was an alternative blowing agent but was not technically satisfactory for all grades of foam. Some plants could not meet the low TVL values now being proposed, and IARC had listed methylene chloride as a possible carcinogen. Formic acid ('B') technology had been tried by industry but there were considerable safety problems and it had limited application. It seemed unlikely to secure any widespread acceptance.

Europur had considered the active carbon recovery process described in the paper prepared by Flakt, but there were a number of unresolved technical questions requiring resolution before the process could be fully evaluated, one being the quality of the recycled CFC. A full scale trial of the process was to be conducted in the Netherlands and that might provide the answers.

In response to a question, Dr. Mills (CEFIC) confirmed that both CFCs and pentane were used for blowing polystyrene foam for packing applications. Environmental, health, safety and other considerations dictated the choice in each set of circumstances.

Solvents

The use of CFC 113 as a solvent, mainly for industrial cleaning and drying applications, has been growing rapidly - especially in the electronics industry. Mr. Bevington wondered if the Rand Corporation estimates of substitutability with other agents was over-optimistic.

The alternative cleaning agents, including methylene chloride, perchloroethylene, methyl chloroform, trichloroethylene, petroleum solvents and deionized water, were reviewed by Ms. Wolf (United States) and others. These other solvents also pose health problems. It was pointed out that CFC 113 was a relatively costly solvent and was chosen only because of its superior combination of properties: users also had a strong incentive to minimize losses.

A code of practice published by the EEC covered the design, construction, installation and operation of industrial solvent cleaning equipment employing CFC 113.

In some countries, notably the Federal Republic of Germany, there was significant use of CFC 113 and also of CFC 11 as dry-cleaning agents for garments and textiles.

Ms. Kokeritz (Sweden) stated that the use of CFC 113 for dry cleaning applications was increasing in her country.

Mr. Strobach (United States) said that, in the United States, if perchloroethylene ceased to be available for health reasons, petroleum products would be the most likely substitute.

Ms. Wolf (United States) disputed this claim by pointing out that flammability restrictions on the petroleum solvents would increase use of CFC 113 in dry cleaning if perchloroethylene were restricted.
Dr. Mills (CEFIC) brought the attention of the meeting to a paper presented by the American Halogenated Solvents Industry Alliance (HSIA) on the health aspects of halogenated solvents.

Alternative CFCs

Mr. Halter (Du Pont) stated that although his company (and presumably other CFC producers) had spent significant amounts in an attempt to develop non-perhalogenated CFCs (other than CFC 22), they had not been successful. The main substantial technical problem was the manufacture of those compounds and, even if a solution could be found, the likely cost would be from three to six times the cost of currently used CFCs. Later, Dr. Mills (CEFIC) stated that he believed the eventual cost for such compounds could be eight to ten times current CFC costs.

Conclusions

The Chairman explained that it would be difficult to draw comprehensive conclusions from the wide-ranging set of subtopics discussed under topic 4. He pointed out, however, that certain ideas appeared very promising. They included the possibilities of developing the use of the non-perhalogenated CFCs 22 and 502 for refrigeration. The recovery of used refrigerants, and carbon adsorption systems in foam production.

He then noted that the degree of technological innovation followed closely the price of CFCs, so that one could expect more innovation and attempts to find alternatives as the price of the chemicals increased. Another conclusion that could be drawn from the discussion was that various attempts at alternative technologies (e.g. carbon adsorption systems in foam production) came up against the stringent environmental requirements imposed for other reasons (e.g., in the example given above, TVL values for worker protection).

ANNEX V

Topic 5: Estimates for the production, use and emission of substances other than CFCs that could modify the ozone layer sufficiently to affect possible control strategies for CFSs

Presentations on topic 5

The Rand Corporation presented the results of its working paper on long-term emissions profiles for five chemicals suspected of contributing to potential ozone depletion. These chemicals include the CFC-113, methyl chloroform, carbon tetrachloride and halons 1211 and 1301. Rand presented projections of the production, emissions and bank of non-CFC substances in the world for the period 1985 to 2075. By 2075, those five chemicals could account for about 40 per cent of total emissions weighted by their relative contribution to potential ozone depletion. In 1985, substances other than CFC 11 and 12 could account for 40 per cent the of total bank; by 2075, that would increase to more than 70 per cent of the total weighted amount. The major uses of the chemicals were for solvents (methyl chloroform, carbon tetrachloride and CFC-113) and for fire extinguisher systems (Halons 1211 and 1301).

The United States Environmental Agency provided the Workshop with information on their study entitled "Trace Gas Scenarios". Mr. Hoffman explained how methane, CO_2 and N_2O acted in the atmosphere and reacted with ozone.

His presentation concentrated mainly on:

(a) Factors influencing future trace gas concentrations;

(b) How trace gases influence the stratosphere and troposphere;

(c) The lifetimes of emissions and the predictability of future concentrations.

He suggested that the greenhouse effect caused by these same chemicals, methane etc., may result in a significant increase in global average temperature.
Recent increases in atmospheric levels of these gases were shown as follows: nitrous oxide, .25 per cent a year; carbon dioxide, .5 per cent a year; and methane 1 per cent a year. These increases resulted both from industrial activity and from natural sources. Considerable uncertainty surrounded future atmospheric concentrations in the gases. Because of the long atmospheric lifetimes of carbon dioxide and nitrous oxides, their concentrations were likely to continue to grow even if emissions did not. Methane had a much shorter lifetime (approximately a decade), and therefore future projections concerning concentrations were more uncertain. Efforts to limit methane and CO2 emissions could worsen the risk of net ozone depletion.

SUMMARY OF CONTRIBUTIONS

Solvent use

Dr. Mills (CEFIC) commented that carbon tetrachloride was no longer used in Europe as a fumigant and that use of methyl chloroform had not grown in Europe for the past six years. However, greatly increased research was needed to reduce uncertainties about the forces that determined increases in the concentrations of these gases and their effects on the atmosphere. That was particularly true for methane.

Mr. Strongylis (EEC) commented that the EEC code of practice applied to solvent use of CFCs and that many manufacturers currently used recovery equipment.

Fire extinguisher use of halons

Ms. Kokeritz (Sweden) asked for what product, growth in halons was likely to occur outside the United States. Ms. Wolf (United States Rand Corperation) responded that large uncertainties existed, but estimates were for the world.

An expert from Federal Republic of Germany commented that CO2 could also be used as a fire extinguisher but that a greater concentration was required and risks to human health due to direct contact during fire extinguishing were greater for CO_2.

Mr. Buxton (Canada) stated that a blend of Halon 1301/1211 was now being used for hand-held extinguishers in his country and because of the small quantities of Halon mix (0.5-1.5 kg), recovery or recycling might not be practical.

Several participants suggested that because some halon uses were in large quantities and because they were expensive chemicals, substantial recycling was likely. Ms. Wolf suggested that 10 per cent might be lost in a fire, with the rest escaping to the atmosphere.

Trace gases and global warming

Mr. Elkins (United States) asked about the possible link between reductions in trace gases imposed because of concern about global warning and how these might affect ozone modification.

Mr. Hoffman responded with evidence from a paper prepared by Mintzer and Miller which suggested that the ozone buffering of methane and carbon dioxide could not be relied upon because of concern related to the greenhouse effect.

Mr. Strobach (United States) suggested that the buffering worked both ways and that all interactions had to be considered.

Prof. Cignitti (Italy) recalled the large uncertainties connected with projections concerning concentrations of trace gases and their dependence on the strategies that nations would use for their energy needs.

Emissions of Carbon Tetrachloride from CFC production

Dr. Mills (CEFIC) and Dr. Strobach (United States) suggested that emission of carbon tetrachloride from CFC production was likely to be less than .1 per cent of output.

Weighting factors for potential ozone depleters

Mr. Verhille (France) asked about how depletion weighting factors were developed.

Ms. Wolf (United States) stated that they were based on anotmospheric model and were approximations.

Per capita increases and methodologies

Dr. Strobach (United States) showed how small increases in per capital use resulted in large increases in production.

Mr. Elkins (United States) asked about the costs of calculating per capita use estimates. Methodologies were discussed; Sweden described the methodology it used and explained that the costs had been reasonable.

Conclusions

This session provided useful information on current uses and emissions of potential ozone modifying substances other than CFC 11 and 12 and how they might evolve over time.

ANNEX VI

SECOND PART OF THE WORKSHOP ON THE CONTROL OF CFCs: GUIDANCE NOTE AND ELABORATION OF TOPICS FOR CONSIDERATION

At its meeting in September 1985, the Steering Committee proposed that the second part of the Workshop, to be held near Washington D.C., should consider the following topic:

"Topic 6

"Identify and analyse various possible regulatory strategies, including such new alternatives as quotas and financial incentives, in terms of their:

(a) Effects on the demand, production, and emissions 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."

Following its meetings in Rome, the Steering Committee proposes that the second part of the workshop should be organized in three sections: the first would last perhaps two days, and would consider alternative control strategies under each of the above four sub-headings in topic 6; the second section would assess and evaluate each individual control strategy against a comprehensive set of criteria, and the final section would be devoted to summing up the discussions.

This note is intended to provide guidance to those countries and organizations preparing papers for the Workshop by:

(a) Suggesting a list of the alternative regulatory strategies which might be assessed;

(b) Developing and elaborating a framework within which the strategies might be assessed.

Alternative regulatory strategies

Countries and organizations are encouraged to prepare papers for either of the first two sections of the workshop. They are also encouraged to evaluate one or more of the control strategies in the context of all or some of the criteria listed below.

There are a number of possible strategies which might be adopted to control the production, use and emissions of CFCs. Some have already been

introduced, for example a production capacity cap and bans/limits on specific CFC uses (aerosols), but there are other possibilities which it is appropriate to consider. Below is a list of possible regulatory strategies. Although it is believed to include all the major types, it is not comprehensive, and does not mean that other strategies cannot be considered.

(a) Assessment and review - where efforts to assess and review the science and economics of the ozone issue are regularly reviewed and the need for controls reassessed;

(b) Increased standardized reporting - Reporting and monitoring of production and use per capita of CFCs nationally or by groups of nations;

(c) Annual production limits - Where each nation or group of nations receives a maximum allowable production level;

(d) Annual use limits - Where use (i.e. production minus exports plus imports) is controlled in a nation (or group of nations);

(e) Cumulative production or use limits - Where each nation of group of nations has limits placed on production/use for a specified time period in excess of one year, allowing a country to vary its control strategy over a period of years;

(f) Bans/limits of specific uses of CFCs - Where CFC use in specific products or processes is discontinued or reduced;

(g) Best practicable control technologies - Where specific technologies for limiting CFC emissions are identified and put into effect;

(h) Emission fees - Where a fee is imposed on the production of CFCs;

(i) Hybrids - Where a combination of different strategies is used.

Framework for evaluating alternative regulatory strategies

In the second part of the Workshop, the Steering Committee proposes that each alternative regulatory strategy should be assessed against a variety of criteria. These criteria are essentially those encompassed in the original specification of the topic but it is useful to identify and elaborate on the various headings, which are as follows:

(a) Effectiveness - The effect of each strategy on the production, use, and emissions of CFCs needs to be assessed The consequential effects on the ozone layer and implications for human welfare of each strategy should also be taken into account;

(b) Economic efficiency - The economic costs of alternative strategies needs to be understood and assessed. Attention needs to be given here to the transitional costs associated with implementation;

(c) Equity or fairness - Consideration needs to be given to how alternative strategies are able to ensure that the need of both producing and using nations are equitably met both now and in the future;

(d) Flexibility - Is the strategy structured in such a way that it can be easily and cheaply altered if subsequent developments indicate that a change is warranted?

(e) Administrative convenience - Is the strategy easy to administer and understand?

It is recognized that alternative regulatory strategies may differ in how well they perform under each criterion, but a major purpose of the Workshop is to assess the relative strengths and weaknesses of alternative strategies. It is not the purpose of the Workshop to arrive at a decision regarding the best strategy, and authors and countries are reminded that they should avoid taking a position in their papers.

INFORMATION FOR CONTRIBUTORS OF PAPERS

Papers for the second part of the Workshop which should all contain a one-page summary should be submitted by 1986 at the latest, to the appropriate co-ordinator, as follows:

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Where papers cover several topics, or do not fit precisely into any of them, contributors are invited to send them to the United States co-ordinator.

ANNEX VII

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