The Ozone History
Body papers

DOC. 3358g, Disk 95g

UNEP WORKSHOP ON CHLOROFLUOROCARBONS

BACKGROUND FACTUAL PAPERS ON CURRENT PRODUCTION CAPACITY, USE, EMISSIONS, TRADE AND CURRENT REGULATION OF CFCs SEPARATELY BY COUNTRY AND/OR REGION

TOPIC 1 - OVERVIEW

Submitted by

United Nations Environment Programme

Summary

The following overview paper provides a summary of the replies to requests sent to all Governments for information on the production capacity, production, emissions, use, trade and current regulations concerning chlorofluorocarbons. As far as possible, each submission has been summarized under the headings : production and production capacity; use; trade; and regulations. The chosen order of presentation is to facilitate comparison of countries of economic or geographical similarity. Where possible, attention is drawn to the similarities observed in CFC production and use or differences that appear.

For ease of reference, an executive summary of an assessment of ozone layer modification, made by the UNEP Co-ordinating Committee on the Ozone Layer at its eighth session in February 1986 presenting the latest understanding of the science relevant to possible ozone layer modification by chlorofluorocarbons and other substances, is also attached as an Annex.

Background information on the role of UNEP regarding the programme to protect the ozone layer and of the programme to understand and respond to the issue precedes the national reports.

Based on the information received, a number of tentative conclusions have been drawn and are included in the document.

LIST OF PAPERS

1. Report of CFC-11 and CFC-12 Production, Sales and Release Data through 1984 - The Fluorocarbon Program Panel of the Chemical Manufacturers Association.

2. Chlorofluorocarbons : Production, use, trade and current regulations in the European Economic Community - Christopher F.P. Bevington.

3. Summary of Historical Chlorofluorocarbon production - Michael J. Gibbs.

4. Summary of Alternative Population and GNP projections - Michael J. Gibbs.

Country Reports

DOC. 3358g, Disk 95g

OVERVIEW - TOPIC 1

INTRODUCTION

Chlorofluorocarbons (CFCs) belong to a class of man-made chemicals of enormous value in a variety of industrial processes and domestic productions. CFCs are also considered to have the potential to deplete stratospheric ozone and directly and indirectly modify the thermal balance of the atmosphere. The global dilemma is how to weigh the practical and economic advantages of continuing to produce and use these chemicals against the possible environmental damage that CFC emissions might provoke. On the one hand, real and demonstrated benefits, on the other, theoretical but serious penalties for mankind.

The task of the Workshop is, by UNEP Governing Council decision[1/], to arrive at a common understanding of possible scenarios for the global production, emissions and use of chlorofluorocarbons and other substances affecting the ozone layer and the costs and effects of various control measures. Its purpose is to better facilitate continued work on a protocol to the Vienna Convention to protect the Ozone Layer[2/] that addresses both short-term and long-term strategies for the equitable control of the global production, emissions and use of fully halogenated CFCs, taking into account the particular situation of developing countries as well as recent scientific and economic research. Fundamental to such processes is the gathering and analysis of data on the existence of substances which are predicted to adversely affect the atmospheric environment and on the production, use, trade, emissions and control of the man-made chemicals numbered among such substances. Special attention is initially, being given to chlorofluorocarbons, especially the CFC-11 and CFC-12 varieties, to which the earth's ozone shield is considered particularly vulnerable.

Topic 1, for discussion by the UNEP Workshop on Chlorofluorocarbons was, therefore, designated by the Steering Committee for the Workshop as:

> Background factual papers on current production capacity, production, use, emissions, trade and current regulation of CFCs separately by country and/or region[3/].

Before indicating the methods adopted for acquiring the information and the summary of the national, regional and economic group responses to the request by the United Nations Environment Programme (UNEP) for data, a brief account of UNEP's programme which has led to the holding of the economic workshop may be useful.

UNEP AND THE RISK TO THE OZONE LAYER

The Ozone Layer is the layer of atmospheric ozone above the planetary boundary layer[4/]. Ozone is present in the atmosphere in small concentrations mainly in the stratosphere 15 km to 40 km above the earth's surface. It is in a continuous process of generation (by photoassociation of atomic and molecular oxygen) and destruction by chemical decomposition. Apart from seasonal and latitudinal variations, the balance between production and destruction of ozone can be upset by changing concentrations of other trace gases in the atmosphere. The risk of catalytic destruction of ozone by chlorine (from CFCs, methyl chloride and other substances) and by the influence of nitrous oxide and other oxides of nitrogen was first suggested in the early 1970s. The importance of ozone lies in its ability to prevent certain wavelengths of solar ultraviolet radiation which have known adverse consequences for human health, plants and animals from reaching the earth's surface.

At the request of its Governing Council[5/], UNEP convened, in 1977, a meeting of experts on the ozone layer[6/] which formulated a draft World Plan of Action on the Ozone Layer. The Plan of Action, adopted by the Governing Council at its eighth session, for research into and assessment of the state of the atmospheric ozone layer and the consequences of its modification was to be implemented by UN bodies, specialized agencies, international, national, intergovernmental and non-governmental organizations and scientific institutions. UNEP's role was a broad coordinating and catalytic one aimed at the integration of research. A Coordinating Committee on the Ozone Layer (CCOL) was created to enable UNEP to fulfill the role assigned to it. The CCOL is convened at regular intervals to make an assessment of ozone layer modification and its impact. It last met in February 1986 to consider the physical and chemical changes which are occurring in the atmosphere and to make predictions of future modification of the ozone layer based on the present and predicted state of the atmopshere. It did not consider the impacts of such changes which will be attempted later in a specially convened session of the CCOL.

An executive summary of the report of the eighth session of the CCOL is attached to this document. It confirms the risk to the ozone layer from continued releases to the atmosphere of substances with the potential to modify ozone. Among such substances are the fully halogenated CFC 11, CFC 12, CFC 113 and CFC 114.

For convenience, CFCs are classified by numbers - the digit furthest on the right represents the number of fluorine molecules in the molecule, the digit to its left is the number of hydrogen atoms plus one. The digit furthest on the left is one less than the number of carbon atoms and is omitted when zero. The number of chlorine atoms is the difference between the number of hydrogen and fluorine atoms present. Thus CFC 11 has the chemical formula $CFCl_3$ and CFC 12, CF_2Cl_2. The chemicals are referred to in various ways in the many reports submitted to the Workshop, for example CFC 11 is referred to as F-11, FC-11 and freon-11. All represent the chemical trichloromonofluoromethane $CFCl_3$. Although assessments of ultimate ozone depletion have varied widely over the years, extensive research has not altered the original supposition that chlorine containing compounds emitted to the atmosphere will eventually cause ozone to be depleted in the stratopshere. Indeed, statistically significant ozone depletion consistent with theory has, in recent years, been observed at 40 km. Variations in predictions result from better understanding of chemical and physical processes in the atmopshere and the inclusion of many additional chemical reactions in the atmospheric models used to estimate ozone layer change. Continued concern bred increasing international acceptance of the need to protect the ozone layer and UNEP established an ad hoc Working Group of Legal and Technical Experts to elaborate a Global Framework Convention for the Protection of the Ozone Layer. In March 1985, the final text of the Convention - known as the Vienna Convention for the Protection of the Ozone Layer was adopted by a Conference of Plenipotentiaries and has been ratified by more than thirty States. Parties to the Convention agree to take measures to protect human health and the environment against adverse effects resulting or likely to modify the ozone layer. Two annexes to the Convention provide for cooperation among States in Research and Systematic observation and in Information Exchange. However, no protocol has been agreed. A process to agree on the need for a protocol on chlorofluorocarbons and elaborate the form of an appropriate instrument is to be undertaken in late 1986 or in 1987. The work of the CCOL and the results of the two part Workshop on Chlorofluorocarbons will be the main technical information that will be made available to the Vienna Group which will be convened for the purpose of elaborating the protocol.

Topic 1 - the gathering of information

Background factual data on the production and emission of CFCs and other substances are necessary to confirm the reliability of the monitoring of atmospheric constituents and for the refining of models of the future atmosphere. A considerable portion (probably in excess of eighty per cent) of the global production and release data concerning CFCs 11 and 12 has been made available to UNEP and to the CCOL by the Chemical Manufacturers Association which arranges for the aggregation of such data reported to it from twenty-one manufacturers based in the United States of America, Europe, Canada, Japan, Mexico, Brazil, Australia and India. Formerly data from the Union of Soviet Socialist Republics was also included in the CMA returns but such data has not been available since 1976. The need for more complete global data has always been recognized and both the Governing Council and the CCOL have regularly requested UNEP to try and obtain such information. In 1981, the Council requested the CCOL to compile all relevant information including statistical and technical data on, inter alia, the reduction in the use of chlorofluorocarbons 11 and 12, as well as to production capacity on the basis of an agreed definiton[7]. A letter from the Executive Director of 21 July 1981 requesting such data on behalf of the CCOL resulted in only thirteen responses, not all of them useful. At its seventh session (Geneva, October 1984), the CCOL called the attention of all countries and economic organizations not yet reporting production figures for CFCs 11 and 12, as well as for other halocarbons, to the need for reporting pertinent chemical production, release and usage data, including the more detailed data on production and uses needed for socio-economic analyses. In the same year, UNEP twice requested data from those countries believed to be significant producers of CFCs but not reporting production and use data to UNEP. No responses were received.

In accordance with the recommendations of the Steering Committee established to help organize the Workshop on Chlorofluorocarbons, UNEP as designated coordinator for topic 1, requested relevant data from all member states of the United Nations and from pertinent economic groupings. Specific data on current production, emission and use data and on legislation to control or limit CFC emissions consistent with the provisions of Annex II to the Vienna Convention concerning Information Exchange, obligatory upon States party to the Convention when it enters into force, were requested as follows:

Socio-economic and commercial information of the substances (CFCs and other substances affecting the ozone layer)

(a) Production and production capacity;

(b) Use and use patterns;

(c) Imports/exports;

(d) The costs, risks and benefits of human activities which may indirectly modify the ozone layer and of the impacts of regulatory actions taken or being considered to control these activities.

Legal information

(a) National laws, administrative measures and legal research relevant to the protection of the ozone layer;

(b) International agreements, including bilateral agreements, relevant to the protection of the ozone layer;

(c) Methods and terms of licensing and availability of patents relevant to the protection of the ozone layer.

In additon, a definition of production capacity was suggested for use by States in their reply.

Production capacity should:

(a) Be expressed in tons per year;

(b) Reflect full capacity in 24 hours continuous service multiplied by the average number of days per year, due allowance being made for running the plants under normal conditions of maintenance and safe operability;

(c) Include all lines capable of producing chlorofluorocarbons 11 and 12 either exclusively or on a campaign basis.

Note was also made of the need to report on CFCs imported and exported in manufactured items such as refrigerants, air conditioning units and aerosols, particularly by countries which do not manufacture, emit or trade in raw CFC compounds.

Although data on CFCs 11 and 12 were particularly required, States were also asked to report on other CFCs or potential ozone modifying substances manufactured, used or traded.

Data already available to UNEP, supplied by the Chemical Manufacturers Association comprises:

A list of the 21 reporting companies supplying data for the report.

Tabulations of the total production of CFC 11 and CFC 12 (reported separately) on an annual basis for the period 1931 through 1984 and of the deviation estimate of total production applying the submitted estimate of probable error from reporting companies.

Tabulation of the total CFC 11 and CFC 12 sales (reported separately) for years 1976 through 1984 by sectors (Refrigeration : open and closed cell foam production : aerosol propellants : other uses).

Tabulation of the total CFC 11 and CFC 12 sales by hemisphere for the period 1931 through 1984.

Tabulation of the total production of CFC 11 and CFC 12 on an annual basis reported from India and Argentina companies for the period 1968 through 1982.

Tabulations of USSR production of CFC 11 and CFC 12 and of its total consumption of CFC 11 and CFC 12 by sector (Refrigeration, Foam for refrigerator aerosol propellants, and other uses) for the period 1968 through 1975.

Production of CFC 11 and CFC 12 by companies reporting to CMA total more than 14 million tons since 1931.

Data from four companies is included in the tabulation of India and Argentina data. However, since 1979, the two Argentina companies ceased production. Production data for one of the Indian companies has not been estimated during 1983 and 1984 due to a change of ownership of the company. Peak production was reported in 1975 at 3357 tonnes. 1982 production was 1814 tonnes.

Data for USSR production and use of chlorofluorocarbons have not been published since 1975. Accordingly, no estimates for later years are included in the CMA tables.

Replies to the UNEP request for information

Only 18 replies were received by UNEP to the more than 170 requests for information sent. Of these, 7 responses were from developed countries and 1 was a consolidated response of 10 economically grouped developed nations. However, three of these countries also responded independently to UNEP and are among the 7 responses noted above. Another reply came on behalf of two developed countries and also included information relevant to two other geographically linked countries one of which Denmark, had reported both independently and as part of the European Economic Community report. Nine replies were received from less developed or developing countries.

The two Group responses represented European developed countries - the European Economic Community of ten members and a response from Sweden and Norway which included data from the other Scandinavian countries Finland and Denmark. Of the individual responses seven were from Europe : Belgium, Cyprus, Denmark, Monaco, Netherlands, Switzerland and Turkey. Two were from North America - the United States and Canada. Two from Central and South America - Brazil and Honduras. One was from the Middle East - Saudi Arabia. Two were received from Africa - Liberia and Egypt, and from Asia and the Pacific region, Australia and Thailand sent reports. Although the number of responses are few, they include the majority of CFC-producing nations and possibly represent 80-85% of production and emission data. However, this is speculative and in the absence of up-to-date reliable data from eastern Europe, China, South Africa and possibly other Asian and South American countries, the reliability of estimates of future CFC concentrations in the atmosphere is limited.

Of the reports received, only those from the EEC, the USA and Sweden and Norway are peer reviewed as stipulated by the Steering Committee for the Workshop. In view of topic 1 being concerned with factual data, it was decided to retain all information submitted, whether or not peer reviewed and as such will be referred to in this document. However document distribution to participants was generally restricted to those peer reviewed. About half of the documents were received after the deadline for submission which also necessitated limited distribution to participants.

Information received varied greatly in form and content. Although the request for data was made as specific as possible, there was considerable incompatibility in the data received, particularly with regard to the reporting of production and emission figures for chemicals which were alternatively reported as individual substances or as aggregates of two or more chlorofluorocarbons. There are also variations in the reporting of usage data with individual sectors being reported by some countries and aggregated data by others. Changes in reporting procedures and the addition in deletion of companies or countries contributing to an aggregated submission make comparisons difficult even within an economic group. Data on export and import of chlorofluorocarbons and products which include chlorofluorocarbons are barely comparable even in the broadest sense.

A lesson learned from the data collection exercise is that a standard form must be devised to ensure the completeness and compatibility of data solicited yet ensuring that the confidentiality of information requirements of countries or economic groupings are not transgressed.

Countries not providing data must be further encouraged to cooperate in the collection process. This will in many cases require more stringent arrangements within countries regarding the reporting of trade in raw chemicals and manufactured products containing chlorofluorocarbons and in use of products or chemicals within countries or groups. The enactment of national legislation or rules to this effect will probably be a necessary prerequisite to the provision of data to UNEP and to the Secretariat to the Vienna Convention when it comes into force. It is obvious that many countries particularly from the developing world do not appreciate the present extent of their involvement with the chlorofluorocarbon issue and are, to a greater or lesser extent, ignorant of their trade in or use of CFCs particularly with regard to their being contained in manufactured items such as refrigerators or air conditioning units. It will be necessary to sensitise nations to their global responsibilities in this respect. This could well be a primary task for UNEP in the future. A comment from the Honduras paper is particularly relevant here 'Due to the critical nature of health, economic, educational and housing concerns, efforts to encourage public comprehension of, and action on, such numerous environmental issues as litter control, species extinction, or the contamination and destruction of natural resources are generally met with indifference'.

Summary of replies

United States of America

Two papers were provided for Topic 1:

(a) Summary of Historical chlorofluorocarbon production; and

(b) Summary of Alternative Population and GNP projections. Both papers were prepared by Michael J. Gibbs of ICF Incorporated, Washington DC on behalf of the United States Environmental Protection Agency. The papers can be considered in the context of the CFC production, use and emission data reported by the Chemical Manufacturers Association and referred to earlier.

Paper (a) summarizes the historical trends in CFC production since their first development in the 1930s. It notes the rapid growth in use in many developing industrial and domestic sectors until the decline in growth following the growing environmental concerns and the restrictions imposed on the domestic care aerosol use. The continuing growth in non-aerosol use is noted which continues at an average rate of 7 per cent per year, as is the trend for a recovery in aerosol use since 1980 particularly in countries without restrictions.

The paper summarizes the major CFCs in use and the particular applications to which they are employed (refrigeration, foam blowing, aerosols, solvents).

Note is made of an increase in total production of CFCs since 1982 which increased at a rate of nearly 8% in 1983 and 1984, with production levels returning to nearly the same level achieved prior to concern about ozone depletion. The relative share of global production of the United States which dropped from over 70 per cent in the early 1960s to 34 per cent in 1984 is attributed to the US aerosol propellant ban which came into force in 1978.

Section 4 suggests several relationships between CFC production of non-aerosol applications and economic activity in the form of industrial output and Gross Domestic Product (GDP) per capita. Comparisons are made between trends in the US (per capita use 3 times faster than per capita GDP) and other

OECD countries (per capita use 3.5 times faster than per capita GDP). Other relationships are said to indicate that the intensity of use in OECD countries other than the US exceed that of the US at comparable levels of GDP per capita by about 40 per cent. The paper suggests that as countries may experience larger use at comparable levels of wealth, it is not necessary to follow the experience of the US in terms of CFC use and economic activity.

A reference is made in the combined Swedish/Norwegian paper to CFC use relative to per capita consumption. Examination of data from Scandinavian countries leads them to conclude that CFC use in a given country cannot be calculated based merely on per capita consumption.

The US paper concludes that in the absence of: (1) further restrictions in the use of CFCs or (2) the development of substitutes for CFCs in some of its key uses, it is likely that the current trend of increased production will continue.

The second paper summarized different projections of global and regional population, Gross National Product (GNP) and GNP per capita.

Although this paper is a logical extension of the previous one in view of the relationships drawn between economic growth, per capita GNP and chlorofluorocarbon production, it mainly concerns future projections of different parameters and not current factual information. It does not properly fall into the scope of topic 1. Nevertheless, the conclusions are pertinent to the tasks of the Workshop relating to estimation of future needs for CFCs. It highlights the uncertainties involved in future assessments and concludes '........despite the similarity of (projections of populations, GNP and GNP per capita) declining growth rates, they diverge substantially in their long term estimates. In any case, evaluation of future economic and population-driven events (such as CFC production) must be considered as uncertain as these forecasts.

The US papers do not provide information on international trade nor the ratio of domestic consumption to exports. This data particularly with regard to trade in aerosols is a significant omission. Neither is information provided as to the exact nature of regulatory measures in force although there are passing references in the US and other submitted papers.

European Economic Community

Chlorofluorocarbons : Production, use, trade and current regulations in the European Economic Community by C.F.P. Bevington, Metra Consulting Group, London.

This report responded closely to the request for data by UNEP and, additionally, contains a valuable analysis of different use patterns both within and outside the Community. In view of the relatively large share of the global production enjoyed by the EEC member states, such conclusions that can be drawn are likely to be valuable.

DOC. 3358g, Disk 95g

Production Capacity

Production capacity set by Council decision 80/372/EEC was set at 480,000 tonnes per year as of 26 March 1980. Since then three more producers have been added in an expanded Community and the figure could be revised. Seven member states are CFC producers.

Production and Use

EEC production in 1984 totalled 322 kilo tonnes representing 67 per cent of declared EEC total capacity in 1980 and 46 per cent of world output in that year by CMA reporting companies.

Limited data is reported for Greece (joined the Community in 1981) and data from Spain and Portugal is not included because of their 1986 accession. Data is available for the fully halogenated compounds CFCs 11, 12, 113 and 114. Production and sales information for CFC 11 and CFC 12 are provided for the individual substances and for four use categories - aerosols, refrigeration, foam plastics and other uses. Sales in home markets and exports are given but in the latter case end use categories are not given.

For CFC 113 and CFC 114, the combined total is only given for 1984 under an agreement to report such data if production exceeded 45,000 tonnes. Production rose from 23.5 kt in 1976 by 128 per cent to 53.6 kt (this also represented a rise of at least 19 per cent over the previous year).

Tables supplied include:

- Production of CFC 11 and CFC 12 by EEC and all CMA reporting companies 1970-1984.
- CFC 11/CFC 12 production and sales by EEC producers 1976-1984 by category both inside the EEC and exported outside the EEC.
- Distribution of CMA reporting company sales of CFC 11/CFC 12 by application and territory 1976 and 1984.

Differences exist between the reporting of EEC and CMA reporting company statistics particularly as regards territory. EEC report sales split between the producers and other EEC markets. CMA reports make no such distinction. Two categories of foam blowing (open and closed cell) are reported by CMA. The EEC does not make this split. Other differences regarding data revision and error estimation also occur in the different reporting methods.

Regulations

Council Decisions to restrict and reduce CFC emissions are given.

Council Decision of 26 March 1980 : 80/372/EEC requires member states to ensure that industry in their territories:

(a) Does not increase CFC 11 and CFC 12 production capacity

(b) By 31 December 1981 achieve a reduction of at least 30 per cent compared with 1976 levels of use in aerosols.

A second regulation consolidated the measures specified under the previous decision by providing a definition of production capacity and that the production capacity restriction be applied on this basis. It also required states to furnish CFC 11 and 12 production and use statistics.

In addition to implementing the above restrictions (mostly by voluntary agreement with industry) several member states apply additional regulatory measures. Three directly affecting CFC production and two having an indirect regulatory impact.

Belgium - A ban on increasing CFC 11 and CFC 12 production capacity and a reduction of annual use of CFCs in aerosols by at least 30 per cent relative to the level in 1976.

Denmark - Has established a 'positive list' of substances which may be used in aerosols and as solvents. This effectively bans or restricts the use of CFCs and other substances used as aerosol propellants and solvents in other EEC countries. However exemptions include aerosols for industrial use and export.

Portugal - Has banned CFC 11 and CFC 12 production and restricts imports to a maximum of 3000 tonnes per year. There are some limited exceptions allowed.

Netherlands - CFC aerosol cans are obliged to carry a warning of environmental and health risks related to CFC use. Derogations include aerosols for export.

In addition, three codes of practice, without regulatory status and not part of the relevant Council decisions and national regulations, have been issued by the Community. The extent to which these codes have been distributed and applied is not known.

Trade

Seven EEC member states, France, Federal Republic of Germany, Greece, Italy, Netherlands, Spain and the United Kingdom produce CFCs. In addition to domestic sales, sales in other EEC markets represented 29.4 per cent of total sales in 1984. Outside the EEC 32.2 per cent of all sales occurred, a significant gain since 1976 (25.5 per cent) and a factor in comensating for the fall in EEC aerosol sales.

As stated earlier, the EEC report draws comparisons between EEC and outside EEC production and use of CFCs. Although important similarities exist, marked contrasts in some use patterns draw attention to the risks in attempting to draw conclusions on the production, needs and trade in CFCs of any nation or group based on the activities of others, even those of comparable wealth.

Production both inside and outside the EEC reflects a decline since 1976 and an upturn since 1983 even though production variations are more pronounced outside the Community.

Total world sales were, in 1984, only 7.5 per cent below the 1976 peak. For the EEC, producer sales differed by only 2 per cent from the 1976 figure. Although regulations to limit aerosol use had been stringently applied, compensation through increased refrigeration use and foam plastic production outside the EEC and increased exports and foam plastic production in the EEC, maintained high production figures. There is little reason to expect this trend to reverse as additional aerosol restrictions are unlikely and a probable increasing demand for CFC related products particularly in the developing world.

The EEC Council decision effectively reduced aerosol use of CFCs in 1984 to more than 35 per cent of its 1976 level. Sales outside the EEC were almost 60 per cent less than the 1976 figure for aerosol use.

There is also marked contrast in CFC sales for refrigerators. In the EEC only 10.6 per cent of total sales are used for refrigeration. Outside, the figure is nearly 40 per cent of the 1984 total with refrigeration sales up 40.6 per cent from 1976 to 1984.

32 per cent of EEC sales are for foam plastics which is similar to the proportion quoted for outside the EEC. World sales for this sector has almost doubled since 1977.

The use of CFCs as solvents commands a relatively small share of the total CFC sales. Even so, EEC use in this sector has increased by more than 150 per cent since 1976 compared with a reduction in use outside the EEC. In this sector, there is a considerable rise in the use of CFCs 113 and 114 with their combined sales rising from 11.9 kt in 1976 to 31.3 kt in 1984. Comparable figures outside the Community are not available.

A limited comparison of 1984 CFC 11 and 12 sales, both inside and outside the Community highlights the significant differences that exist:

	Refrigeration	Foam Plastics	Aerosol
Inside EEC	11%	32%	53%
Outside EEC	40%	32%	22%

Similarly comparing changing levels of end use from 1976-1984:

	Non-aerosol use			Aerosol use
	Refrigeration	Foam Plastics	Others	
Inside EEC	+11%	+65%	+153%	-35%
Outside EEC	40%	+120%	-36%	-59%

Belgium

Production

The Belgium submission confirms that no CFC production occurs in the country.

DOC. 3358g, Disk 95g

Uses

CFCs are used in aerosols, refrigeration and as foaming agents.

Regulations

A Royal decree of 22 March 1982 restricts the use of certain propelling gases in aerosol cans. This regulation is in accordance with EEC decision 80/372 of 26 March 1980.

Trade

A comparison of import and export figures for 1970 and 1984

	Imports	Exports
1970	2000 tonnes	88 tonnes
1984	11000 tonnes	2000 tonnes

Maximum import and export of CFCs occurred in 1983 at 12000 tonnes and 2400 tonnes respectively.

Netherlands

Production

Aggregated in EEC data.

Emissions (1981)

CFC 11 and CFC 12 6530 tonnes/a

CFC 113 and CFC 115 430 tonnes/a

Uses

Aerosols	4650 tonnes/a	67%
Refrigeration	740 tonnes/a	11%
Foams	1300 tonnes/a	19%
Solvents	270 tonnes/a	3%

CFCs 113 and 115 used as refrigerants and solvents total 430 tonnes/a.

Regulations

Voluntary emission reductions by industry has resulted in less than 50 per cent emissions compared with those of 1976. This applies to both domestic use and exports. A general administrative order provides for a warning to be printed on spray cans containing CFCs. Exceptions allowed are spray cans for export and for prescription medicine.

Trade

133 million spray cans are exported per year compared with 48 million filled for domestic use.

DOC. 3358g, Disk 95g

A background document relevant to topic 1 'Non-aerosol applications of fluorocarbons in the Netherlands' published by the Ministry of the Environment, was also made available. The document provides detailed information on use by sector in the Netherlands. It discusses possibilities for reducing CFC emissions from industrial processes and the energy and pollution consequences of not using CFCs in foam plastic insulation materials.

1981 consumption in tonnes/year for non-aerosol application of CFC 11 and CFC 12 is given as 4270 tonnes/a. This figure includes CFC 113 used as a solvent but does not refer to CFC 115 use. Also not included is an estimated 800 tonnes/a of CFC 22 used in refrigeration. The figures thus show some inconsistency with those in the Netherlands paper which makes no reference to CFC 22 and estimates non-aerosol CFC use as 2310 tonnes/a of CFC 11, CFC 12, CFC 113 and CFC 115. The discrepancy needs explaining.

A companion report on dimethylether as a substitute for CFCs in certain applications is relevant to other topics.

Denmark

A cable from the Royal Danish Embassy, Nairobi provided additional information and comments to the aggregated data supplied by the EEC.

Production

Nil.

Use	1976	1980	1981	1982	1983	1984
CFC 11						
Aerosols	800	400	400	400	400	300
Soft Foam	-	-	500	600	600	600
Insultation Foam	1700	2300	2000	2400	2200	2000
CFC 12						
Aerosols	1000	400	400	400	300	300
Refrigeration	700	800	800	700	800	700
Insulation Foam	100	100	100	200	200	300
CFC 13						
Solvent	0	200	200	300	500	500
CFC 22						
Refrigeration	200	400	300	300	300	400
CFC-11/12/113/114/115						
Other use	300	300	200	200	200	300
CFC Total	4800	4900	4900	5500	5500	5700

Regulations

Denmark abides by the EEC regulations on reduction in CFC use in aerosols. In 1984, reduction in aerosol use compared with 1976 was approximately 66 per cent.

In 1984, the Ministry of the Environment issued an 'Order on the use of propellants and solvents in aerosol spray cans'. The provisions which do not cover industrial use, fire extinguishers, food stuffs and medicines are:

(a) Fully halogenated CFCs are not allowed after 1 January 1987;

(b) The not fully halogenated CFCs 142B and CFC 22 are allowed in a combined concentration of 40 per cent.

Trade

CFCs are imported for the manufacture of products containing CFCs or for use in equipment designed for CFCs. Exports approximately cancel out imports. The important export areas are aerosols and refrigerants.

The planned strengthening of regulations in Denmark to the level noted above will bring it more in line with other Scandinavian countries.

Sweden and Norway

The submitted report prepared by a consultant was prepared in cooperation with Norway.

Production and Production Capacity

Nil.

Use

Sweden consumed some 4800 tonnes in 1984. Total consumption in Norway was 954 tonnes. These figures are not wholly compatible as the Swedish figure includes CFCs contained in imported products. The Norwegian figure does not.

Uses

Principal uses and total consumption were as follows:

	Sweden	Norway
Foams	2775 tonnes/a (58%)	470 tonnes (49%)
Cooling/Heating	1125 tonnes/a (24%)	288 tonnes (30%)
Solvents	635 tonnes/a (13%)	192 tonnes (20%)
Aerosols)	150 tonnes/a (3%)	
Others)	80 tonnes/a (2%)	4 tonnes (1%)

The low consumption of rigid foams in Norway (25% cf 41% in Sweden) reflects an absence of large manufacturers of household refrigerators, freezers and district heating systems.

The total Swedish CFCs consumption includes 4240 tonnes in domestic production and only 525 tonnes in products. In Sweden CFCs used are CFC 11, CFC 12, CFC 113, CFC 114 and CFC 115. The partially halogenated CFC 22 use is about 300 tonnes/a.

Regulations

Sweden and Norway operate a complete ban on CFCs for non-essential aerosol use.

Trade

In 1984, only 230 tons of CFCs were contained in exported products. No export figures are available for Norway but since there is no production and imports are limited, the export amount is likely to be negligible.

The paper makes, as far as it is possible to do so, comparisons between consumption of CFCs in Sweden, Norway, Denmark and Finland. Use per capita and domestic consumption per capita were calculated from official statistics (for Sweden the figures were 0.57 kg and 0.51 kg respectively). Per capita consumption varied from 1.0 kg (Denmark) to 0.22 (Norway).

The paper concludes 'Obviously, CFC use for a given country cannot be calculated based merely on per capita consumption'. An attempt was made to explain the differences in per capita consumption by means of industrial structure. Even when this was done, the Danish actual consumption still significantly exceeded the theoretical 'industrial weighted' consumption. It was felt that the difference could possible be explained by the different aerosol regulations although this approach would require Finland to have a higher consumption than Sweden as it has a comparatively large aerosol filling industry.

The Swedish paper concludes that per capita CFC consumption probably is determined by a number of factors such as climate, industrial structure and legislation, all of which have to be investigated more closely before calculating the estimated use in a specific country. Even such factors as the existence of a large company may influence the per capita consumption.

Switzerland

Production

Switzerland, like Sweden and Norway, is a non-producer of CFCs. However it is a significant user of CFCs in products both for domestic use and trade. No regulations for CFC use existed prior to 1985 but voluntary agreements were made with industry. In fact use of CFCs in aerosols have been reduced by more than 50% between 1977 and 1984 (5913 tonnes to 2949 tonnes).

Use

Three-quarters of CFC use is in aerosols, mainly for cosmetic use. No information is given on non-aerosol use in Switzerland which is not subject to regulation.

Regulations

A federal environmental protection law allows the regulation of aerosol propellants. Restrictions exist on several CFC substitutes for safety reasons.

Trade

Since 1977 there has been a slight rise in aerosol sprays filled in Switzerland from 52.6 million to 55.7 million. 45 million cans were consumed in Switzerland and 17 million cans were exported in 1984. Imports were just 6 million cans. Total consumption in 1984 for all purposes can be estimated at about 4000 tons, a figure not too different from that of Sweden. In view of the significant difference in usage (aerosols in Switzerland, foam blowing in Sweden) and regulatory measures a comparison of per capita consumption could be instructive.

Canada

Canadian CFC production and emission data is aggregated with world production data reported by the Chemical Manufacturers Association. Individual data from Canadian plants is not reported under laws on confidentiality of trade information.

Production

Two companies manufacture CFC 11, CFC 12 and CFC 22, one of which also produces CFC 113 and CFC 114.

Production Capacity

Stable since 1976 at 31.4 kilo tonnes. The 1984 production was somewhat less than half the production capacity.

Consistent with most other producing countries, peak production occurred in 1974 at 25.3 kt and thereafter fell until 1982 (15.5 kt) before recovering. 1984 production was 16.4 kt. Imports contribute only marginally to the Canadian use figure being usually less than 1 kilo tonne.

Use

Refrigeration is the greatest consumer of CFCs in Canada which commands almost half (48.1 per cent) of the CFC market. Foam blowing (34.4 per cent) solvent and miscellaneous applications (11.7 per cent) and non-regulated aerosol application (5.8 per cent) consumed the remainder.

1974 aerosol application peaked in 1974 at 15.3 kt. By 1982 CFC use had fallen to 7.2 per cent of this latter but, again in line with other producers, there has been renewed aerosol growth since 1982.

95 per cent of CFCs used in Canada are CFC 11, CFC 12, CFC 22 and CFC 113.

Major CFC use in Canada can be further qualified as follows:

Refrigeration - linear growth 1970-1974 followed by a discontinuity probably associated by recession followed by a return to growth whereby 1984 sales are close to the 1974 peak.

Foam blowing - arithmetic growth until 1979 - stable sales until 1982 where a significant reduction occurred (6.8 kt to 4.4 kt). After 1982, a recovery occurred. The major share of the foam blowing market is currently held by rigid foams.

Solvents - current demand for CFCs in solvent applications (for example electronic component cleaning) does not exceed the aerosol demand for CFCs.

Data supplied in tabular and graphic form includes:

CFC production and imports, 1970 through 1984.

Canadian CFC demand pattern by sector, 1970 through 1984.

Canadian per capita CFC demand pattern, 1970 through 1984 (1984 data in all cases is a forecast estimate).

Regulations

The Canadian target is zero propellant use of CFCs. The Canadian paper notes the negligible societal cost of restriction.

The 1980 Environmental Contaminants Act prohibited manufacture and importation of fully halogenated CFCs for use as propellant constituents in hair sprays, deodorants and anti-perspirants. The Department of the Environment also required production and trade information reported to it annually.

Trade

No export data given.

The paper notes that, although losses at production sites are negligible, it can be assumed that virtually all sales will eventually be translated into losses as, in the absence of CFC recovery and destruction systems, there is no such thing as a closed system. This point is highlighted in other papers submitted.

Australia

Production Capacity

Combined production capacity for CFC 11 and CFC 12 is 25000 tonnes and for CFC 22 it is 27000 tonnes. There are no plans for change.

Production

Two companies produce CFCs in Australia. 1984 production was:

CFC 11	6000 tonnes
CFC 12	6000 tonnes
CFC 22	1000 tonnes

Annual production of total CFC production from 1979 is given in graphical form.

Use

Principle uses of CFCs are:

Aerosol spray propellants	40 per cent
Refrigeration and air conditioning	40 per cent
Foam blowing	20 per cent
Solvent	negligible

It is of note how significantly different the corresponding figures for Canada are.

Australia does not know of CFC recovery processes in operation, thus emissions are equivalent to use figures.

Regulations

Voluntary agreements with industry provide for:

- voluntary programme of conversion from CFC to alternative propellants or substitute products

- annual reporting by industry of CFC production and usage data.

Since 1974, CFC use in aerosols has dropped by 66 per cent. Influences include substitution of a hydrocarbon propellant in insecticide and household products and a signficant cost advantage in using hydrocarbons rather than CFCs (a saving of one third).

Cyprus

Production and Production Capacity

Nil.

Uses

Confined to aerosol production using a volume of 500 tonnes/a. No indication of type of CFC is given. 5 million cans each containing 100 gm CFC are produced. 30 per cent is used locally.

Regulations

No national laws relevant to ozone layer protection are in force. The use of aerosols for agricultural and domestic purposes or for the protection of the environment is regulated by 'Pest Control Products Law of 1967 and amendment (Law 17/183)'.

Trade

70 per cent of aerosol production is exported.

Emissions

In addition to the 150 tons of CFCs emitted locally in aerosol use, Cyprus estimates 15 tons are lost in the filling process.

Turkey

Production and Production Capacity

Nil.

Uses

Main uses in Turkey are for refrigeration, cold storage, air conditioning, solvent use. CFC 12 and CFC 22 are the main chlorofluorocarbons employed. No figures for actual quantities used are given.

Regulations

Use and storage of chemicals governed by 'Regulations on establishments preventing health risks (1963)' and, under the General Hygiene Code, 'Regulations on measures of precaution regarding inflammable, explosive and harmful substances (1983)' apply.

Trade

No information given.

As with the suggested comparison of Canadian and Australian use figures, comparison of CFC use in Turkey and Cyprus show marked differences which effectively prevent the reliable projection of CFC use in one country based on the data of another. This will be confirmed as the data from developing countries are examined.

Monaco

UNEP was informed that information on CFCs in the Principality was not available. On the other hand, concentration of chlorides in gas emissions was in the region of 0.9 gm/m^3 and that strongly acidic gas emissions totalled 2.2 gm/m^3 of gas emitted.

Liberia

Said it was unaware of production, release and use of CFCs in Liberia. However, Liberia promised to furnish data when available in accordance with its obligations under the Vienna Convention.

Egypt

Production and Production Capacity

Nil but one plant bottles imported gas.

DOC. 3358g, Disk 95g

Use

Egypt uses CFCs in pesticide propellant systems but these are now being replaced by liquified petroleum gases (LPG). This has required significant capital investment in equipment. A sharp decline in CFC use has followed this move from 8788 tonnes in 1982
to 3722 tonnes in 1984
and to 2884 tonnes in 1985.

In 1982 97% of CFCs imported were used in aerosols
2% for refrigeration and 1% for other purposes.

Regulations

Eight patents from Europe and the United States concerning the use of LPG, Dimethyl Ether, Fluoroalkanes and Silicon Dioxide in Aluminium Powder generating hydrogen, and oxygen from oxygen-liberating solutions are being analysed for feasibility and economic suitability.

Egypt also informed UNEP that a comprehensive programme for ozone layer protection is under development which includes research, monitoring and information exchange. A draft proposal for action for protection of the ozone layer, prepared by Egyptian experts is presently under Governmental consideration.

Saudi Arabia

Production and Production Capacity

Nil.

Uses

Manufactured items containing CFCs - refrigerators, air conditioners and aerosols are imported. Raw chemicals are also imported but the purpose is not specified.

Regulations

None.

Trade

Total halogenated hydrocarbons (including CFCs) imported in raw chemical form was:

1982 4702 tonnes

1983 4336 tonnes

Thailand

Production and Production Capacity

Nil.

DOC. 3358g, Disk 95g

Uses

Solvents, refrigeration, air conditioning and others (drugs/cosmetics). Cosmetic use is for perfume spray/deodorant, hair spray, shaving creams.

Regulations

Import and use of CFCs for air spray/aerosol use except for certain drug and cosmetic use is prohibited.

Trade

Importation of CFCs from ten countries primarily from the United States ($>$ 600 tonnes in 1984 and Italy $>$ 250 tonnes in 1984).

Total imports from Japan, the United Kingdom and Singapore has risen from 627 tonnes in 1981 to 1366 tonnes in 1984. These are variously referred to as CFCs and Freons. Actual chemicals referred to are not specified.

Brazil

Production

Two companies Du Pont and Hoechst produce 9000 tonnes/a (CFC 11:4700 tonnes, CFC 12:12300 tonnes) representing 1.3 per cent of world production.

Production Capacity

17000 tonnes/a.

Uses

Refrigeration	50 per cent
Aerosols	40 per cent
Others	10 per cent

Aerosol use is increasing at a rate of 11.7 per cent in 1980 mainly for personal uses (hair sprays, deodorants, etc.), domestic products (ambient deodorants, polishes, gums), insecticides, paints and other products. 135,600,000 units were produced in 1980.

Regulations

Production is kept within the limits of production capacity. Brazil plans to improve and reinforce control measures as necessary based on information received by it.

Trade

Imports are small, less than 2 tonnes in 1975 and only 65 tonnes in 1982. In contrast, export of 22500 tonnes in 1975 increased to 57,800 tonnes in 1982. Export trade has been highly variable and in 1978 and 1979 was virtually nil.

DOC. 3358g, Disk 95g

The Brazilian submission was the most difficult to assess. There are few similarities with other reports particularly with respect to the growth in aerosol use compared with major reductions in use elsewhere and that maximum aerosol use was achieved in 1980 and not 1976. In contrast world use showed a continued fall after the upward trend in aerosol use was reversed in 1977.

Honduras

Production and Production Capacity

Nil.

Use

117 industries use CFCs in Honduras mainly for refrigeration, pesticides, cosmetics and pharmaceuticals with the principle use being refrigeration which in 1984 employed 159 kilo tonnes.

Regulations

No national regulations are in force and Honduras is neither a party to international nor bilateral agreements.

Honduras however made suggestions for the type of regulatory measures needed which should:

(a) Facilitate the gathering of data from industry;

(b) Set industry standards for the management of pollutants including CFCs;

(c) Provide guidelines for reducing and eliminating CFCs in industry and commercial products.

Honduras also suggests the establishment of an inter institutional multi-disciplinary team to study the ozone problem as related to Honduras and also urges support to UNEP's efforts to protect the ozone layer.

Conclusions

1. Science confirms the risk of ozone layer modification caused by continued release of chlorine containing chemicals to the atmosphere. In the case of CFCs continued production growth of 3 per cent or more are predicted to cause appreciable reductions of total ozone.

2. There is an urgent need to determine the global production and release of CFCs. Such information is essential to the accurate prediction of ozone layer change.

3. Aggregated production data may well be sufficient for the above purpose. However, additional information is needed on the use of CFCs by sector and also information on the import and export of CFCs and CFC-containing products. In this connection, trade in unregulated aerosol products containing CFCs would be especially useful.

4. Information on emissions additional to production data appears largely unnecessary at present as virtually all CFCs produced are eventually emitted to the atmosphere.

5. Current world production is only marginally less than the maximum production year of 1976. Over the past two years both production and aerosol use has shown a rising trend. Reduction in aerosol use of CFCs has been compensated by an equivalent growth in non-aerosol use. The growth in production and use of fully halogenated hydrocarbons other than CFC 11 and CFC 12, particularly CFC 113 and 115 is growing at a rapid pace. Detailed production use and trade information on such chemicals are urgently required.

6. Production of CFCs in developing countries is limited. However CFC use is increasing, not only in essential sectors such as refrigeration and air conditioning, but also in the personal care product sector such as hairsprays and deodorants. In many cases, exports of such products or of CFCs to be used in the aerosol sector is rising even from countries which strictly regulate their own use of aerosols.

7. There appears little large scale employment of substitutes for CFCs and virtually no useful technology for preventing emissions or collecting of CFCs for recycling or destruction. This needs urgent attention in view of the increasing growth of non-aerosol application of CFCs maintaining present production close to previous production maxima.

8. There appears insufficient national legislation, particularly in developing countries, to compel the reporting of imports, exports and use of CFCs and of products containing CFCs. More, preferably all, countries should adhere to the requirements for information exchange as contained in Annex II to the Vienna Convention for the Protection of the Ozone Layer even though the Convention has yet to come into force or the countries are not yet signatories to the Convention.

9. There has been a limited and disappointing response to requests for data on CFC production, emissions, use, trade and current regulations for CFC control. In part, this may be due to a lack of understanding of the issues involved and a limited realization of the extent CFCs are presently used and likely to be used in the future, particularly in developing countries. Improved information, provided in non technical terms, needs to be made available by UNEP to raise the consciousness of all nations to the nature of the risks to the ozone layer and to other global environmental issues.

DOC. 3358g, Disk 95g

References

1/ Decision 13/18 I of 24 may 1985 (UNEP/GC.13/16).

2/ Vienna Convention for the protection of the Ozone Layer. Final Act UNEP 1985.

3/ Report of the Steering Committee for the Workshop on the control of chlorofluorocarbons. First session, London 17-18 September 1985 (UNEP/WG.137/2).

4/ Vienna Convention for the Protection of the Ozone Layer - Article 1.

5/ Decision 65 (IV) of 13 April 1976. UN General Assembly official Records: Thirty-first Session supplement No. 25 (A/31/25).

6/ UNEP Meeting of Experts designated by Governments, Intergovernmental and Non-governmental Organizations on the Ozone Layer, Washington DC, 1-9 March 1977 (UNEP/WG.7/25/Rev.1).

7/ Decision 9/13B of 26 May 1981. UN General Assembly official Records : Thirty-sixth Session Supplement No. 25 (A/30/25).

ANNEX

EXECUTIVE SUMMARY

The ozone layer protects the biosphere from the harmful effects of solar ultraviolet radiation, controls the structure of the stratosphere and influences the Earth's climate.

There is now compelling observational evidence for increases in the concentrations of most atmospheric trace gases which control ozone. These increases are likely due to man's activities. The gases include methane, nitrous oxide, chlorofluorocarbons (CFCs) 11 and 12, carbon tetrachloride, methyl chloroform and other halocarbons.

These gases are the precursors to the hydrogen, nitrogen and chlorine oxides which catalyse the destruction of ozone in the stratosphere by a series of chemical reactions. The reactions involving these oxides are highly coupled and the species interact with one another. Consequently, the effect of individual trace gases on ozone cannot be considered in isolation. Carbon monoxide and carbon dioxide, which are also increasing, can affect ozone indirectly.

The annual statistics on CFCs 11 and 12, produced for the companies reporting to the Chemical Manufacturers Association (CMA), show that in 1984 the production of CFCs 11 and 12 was 312 and 382 kilo-tonnes respectively. These figures represent increases of 7.1% and 7.5% for CFCs 11 and 12 compared with 1983. The 1984 production is close to that reported in 1977. The production figures for countries not reporting to CMA are unavailable.

Mathematical models of the atmosphere which include projected continuation of the currently observed increases in nitrous oxide, methane and carbon dioxide predict decreases of less than 3% in the global average total ozone in the next 70 years, if the sustained rate of increase of CFCs 11 and 12 release is less than 1.5% per year. Even when predicted changes in total ozone are small, a significant vertical and latitudinal redistribution of ozone is predicted, which alters stratospheric structure. Typical predictions suggest that ozone at 40 km would be depleted by 30-70% and that the total ozone changes would be about 4 times larger at the pole than at the equator. For a sustained chlorofluorocarbon emission growth rate of 3%/year the predicted global average ozone depletion is 10% over 70 years and increases rapidly thereafter. A 3% growth rate implies doubling of chloroflourocarbon production every 25 years. Also, since many of the gases have very long atmospheric residence times, once changes in ozone have occurred it will take tens to hundreds of years for ozone to return to its original level.

Identification of changes in global ozone which may have already taken place is crucial. The search for a global ozone trend involves looking for small secular changes amidst large natural variations that may occur on many time scales. Statistical methods for analysis of data for ozone trends have been developed. These analyses have so far shown no significant trend in total ozone; model predictions for the same period are consistent with this, when changes in all the trace gases are taken into account.

Stratospheric ozone trend estimates have also been made using the altitude profile data for ozone measured at a network of stations. These estimates indicate a significant decrease in the middle and upper stratosphere of 2-3% for the period 1970 to 1980. The results are sensitive to the inclusion of a correction accounting for stratospheric aerosol effects. Calculations using atmospheric models are qualitatively consistent with the corrected trend.

Important new observational evidence for a regional total ozone change has recently been reported. The October values of total ozone in the Antarctic have decreased by approximately 40% since 1957, most of this has occurred since the mid-1970s. At present, the cause of this has not been established and therefore the implications of these observations for possible future global ozone change are not known.

The predictions of atmospheric change rely on mathematical models. A primary test of the models is their ability to simulate the features of the present atmosphere, which are being observed in some detail in the current measurement programmes. Most of the key stratospheric constituents have been observed. Disagreements between observations and simulations of key species do appear which place limits on our confidence in the predictive capability of the models. However, in general, there is agreement between observed concentrations and their simulations. An accurate estimate of future changes in precursor gas concentrations is of vital importance for reliable predictions of ozone change. Ultimately, however, our predictive capability will be tested by measurement of the changes taking place in the atmosphere. This will require careful measurement of critical species to be carried out over long periods.

The observed increases of the chlorofluorocarbons, of methane and of nitrous oxide also have direct implications for the Earth's radiative balance through an enhancement of the greenhouse effect. These gases absorb infrared radiation in a part of the spectrum in which the atmosphere is otherwise transparent. The calculated cumulative effect of the increase in all trace gases for the period 1850-1980 is a warming in the range of 0.3-1K. At present, changes in carbon dioxide and in other trace gases are thought to be contributing about equally to greenhouse warming. Estimates indicate that the greenhouse warming predicted to occur in the next 50 years should be about twice that calculated for the previous 130 years.

In summary, there continues to be concern that both the total amount and the vertical distribution of atmospheric ozone, the temperature structure, and climate, will be modified by changes in the atmospheric concentrations of several trace substances, specifically chlorofluorocarbons, carbon dioxide, methane and nitrous oxide. Thus the two issues of ozone modification and climate change should be considered together.

Footnote:

The Co-ordinating Committee on the Ozone Layer, at its eighth session, did not discuss the relationship between changing concentrations of total column ozone and solar UV-B flux at the earth's surface. The CCOL noted the importance of this relationship in view of the risk to human health and the environment should UV-B incidence increase. The subject will be considered at the UNEP/EPA Conference on Health and Environmental Effects of Ozone Modification and Climate Change in June 1986 and will be included in the CCOL Assessment of Effects of Ozone Layer Modification to be undertaken in August 1986.
