COMMISSION OF THE EUROPEAN COMMUNITIES

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CHLOROFLUORCARBONS IN ~~THE~~ the ENVIRONMENT :
INFORMATION AND BASIS FOR EVALUATION FOR THE PURSUIT OF
Community Policy

(Communication from the Commission to the Council)

COMMUNICATION FROM THE COMMISSION TO THE COUNCIL

Chlorofluorocarbons in the Environment: information and basis for evaluation for the pursuit of

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I. INTRODUCTION

The emission of chlorofluorocarbons into the athmosphere is a potential source of disturbance to the athmosphere's equilibrium. These disturbances and the effects they can engender are given cause for concern at international level, both among public authorities and in the economic circles involved.

Community policy in this area has so far been to seek a balance between the need to undertake preventive action in order to avoid the deleterious effects predicted by mathematical models and the impact on industry and employment of reducing the use of CFCs.

The concern of the Community led first of all to Council Resolution of 30 May 1978 (1) concerning both the limitation of the production capacity of CFCs 11 and 12, the intensification of research into alternative products and alternative methods of application, and the elimination of discharge in all sectors.

Council Decision of 26 March 1980 (2) stipulated that the production capacity of CFCs 11 and 12 should not be increased in any Member State and that by 31 December 1981 there should be a reduction of at least 30% compared with 1976 levels of the use of the CFCs in aerosols.

Article 2 of this Decision provides for a re-examination during the first half of 1980 of the scientific and economic data available. To this end, the Commission forwarded a communication to the Council (3) on 16 June 1980. Further measures governing CFCs as may be necessary in the light of this re-examination have to be adopted by the Council not later than 30 June 1981 on the proposal from the Commission.

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1) OJ C 133, 7.6.1978
2) Decision 80/372/EEC - OJ L 90, 3.4.1980
3) Communication of the Commission to the Council of 16.6.1980 COM(80)339 final.

In addition, a certain number of international organization have also carried out work in this sector. The OECD is preparing a report on the problem of CFCs and is about to discuss scenarios which make it possible to evaluate, on the basis of mathematical models, the impact of different rates of increase or decrease of CFC emission.

The United Nations Environment Programme (UNEP) includes the coordination of scientific research undertake in this sector by a Coordinating Committee on the Ozone Layer (CCOL). On the initiative of the Community, the UNEP also adopted a resolution concerning different control measures of CFCs at the 8th session of the Governing Council in Nairobi in April 1980.

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The present communication - which must be considered as supplementary to the one presented by the Commission on 16 June 1980 - is the second contribution of the Commission to the application of Article 2 of Council Decision of 26 March 1980.

After a review of the latest scientific, economic and technical data that have become available since 16 June 1980, the communication contains a certain number of actions to be undertaken in this sector.

II. SCIENTIFIC DATA

1. Under the United Nations Environment Programme, the Coordinating Committee on the Ozone Layer held its 4th session at Bilthoven (Netherlands) from 11 to 14 November 1980. It examined the contributions made by the various countries and organizations, research work concerning the observation and modelling of the stratosphere and the biological effects of any increase in the amount of ultraviolet radiation reaching the earth.

   The Committee found that a risk of depletion of the ozone layer due to CFCs is still most likely and that if CFC releases continued at the existing rate, present model calculations estimate a steady state ozone depletion of about 10%, as compared with the 15% indicated in the Committee's 1979 report.

2. To complete and update the scientific data available in June 1980 (1) and the UNEP evaluation, the Commission organized a scientific workshop from 13 to 15 January 1981 on "The evaluation of the effects of chlorofluorocarbons on atmospheric ozone: present status of research".

   This workshop brought together some 30 leading scientists from the Community, the United States and Canada. The results are laid out in a report shortly to be published, an executive summary of which is given in Annex I.

   As regards the effects of UV-B radiation on health and the biosphere, no new data have been submitted to the Commission since the last re-examination.

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1) Communication of the Commission to the Council of 16.6.1980 COM(80)339 final.

3. The current scientific data suggest that the steady state ozone depletion due solely to CFC 11 and 12 is still relatively high although lower than indicated by preceding data. In contrast, there is still not enough information available on other disturbances (see Annex I). Finally, the progress made in the photochemical theory of stratospheric ozone and in observations has not so far lessened uncertainties.

To sum up, there is nothing to suggest that measures should be taken which would question the preventive policy pursued so far by the Community in this sector.

III. ECONOMIC AND TECHNICAL DATA

1. In this area, too, the Commission has reviewed and updated the data presented to the Council in its Communication of 16 June 1980 on the basis of a study carried out at its request by the Metra Consulting Group and of the data supplied by the Member States. Once again, nothing fundamentally new has been found, either with regard to the economic situation in the various industrial sectors concerned or the development of alternative products and new technologies. A certain amount of statistical data and a description of the current situation with regard to technical possibilities can be found in Annex II.

   Some figures warrant special mention, however. In 1980, sales of CFCs 11 and 12 for use in aerosols dropped to 126,442 tonnes, i.e. 50,472 tonnes or 28.5% less than in 1976. Sales for the same CFCs for other sectors amounted to 90,386 tonnes, i.e. an increase of 34.7% over 1976. This increase occurred mainly in the foam plastics sector. The total production of CFCs 11 and 12 (including imports) amounted to 295 718 tonnes in 1980, a drop of 9,4% over 1976.

   It might be pointed out that the Commission has not received any information since 1977 on CFCs other than CFC 11 and 12, although there would appear to be a marked increase in the use thereof.

2. A provisional assessment of the application of Council Decision of 26 March 1980 can be considered as positive on the whole. The decision's aim was to reduce the use of CFCs 11 and 12 in aerosols by at least 30% compared with 1976 levels by 31 December 1981 at the latest. For this minimum objective to be achieved an average annual decrease of 6% was needed for the Community as a whole (i.e. 18% three years later in 1979, and 24% in 1980). In fact, 1979 already showed a reduction of 22.8% as compared with the 18% needed to meet this average, and 1980 showed a drop of 28.5%.

Most of the Member States implemented the decision through the means of agreements with the industry and collect production and utilization figures on a voluntary basis.

Generally speaking, the decision's objective will probably be achieved in 1980 despite the different socioeconomic impact from one country to another. Some Member States have already achieved or even exceeded the minimum objective (a reduction of 40% in 1980 in Germany, 48% in 1979 in Danemark, and a projected 50% in 1981 in the Netherlands).

Thus, it can be fairly safely assumed that, for the Community as a whole, the use of CFC 11 and 12 to fill aerosol containers will drop by 35% at least.

The Council decision has probably also been implemented with regard to the stipulation that production capacities should not be increased although it has not been so far possible to put a figure on this capacity at Community level.

3. The latest statistics, however, are disquieting in that they indicate a serious increase in the use of CFCs in sectors other than aerosols, so much that within a few years it could neutralize the reduction obtained in the aerosol sector.

As regards these other sectors, the current technological situation makes it difficult for rapid measures to be taken to reduce the utilization and release of CFCs; some technical possibilities do exist, but they still need intensive research and development.

Consequently, if significant new reductions in the use of CFCs were to prove necessary, the aerosol sector would still be the main area where these reductions could be achieved in the short term. (This sector accounted for 58% of the sales of CFC 11 and 12 in the Community in 1980.

IV. CONCLUSIONS AS REGARDS THE POLICY TO BE PURSUED AT COMMUNITY LEVEL

1. The significant reduction (at least 30%) in CFC emission in the aerosol sector, coupled with the freeze on the production capacity of CFCs 11 and 12, stems from the decision adopted on 26 March 1980 as precautionary measures.

Given the facts and figures collected during a re-examination by the Commission with the help of a group of national experts, there is nothing to suggest that the Commission should change this approach. The Community must continue to pursue a preventive policy, bearing in mind all the aspects of the problem (including aspecs of safety which may develop from the remplacement of CFCs by other gases) and the impact on industry and employment.

To prevent existing risks from increasing and in view of the almost lack of fundamentally new data, the Commission feels that a policy of prevention and precaution should be pursued in this area. In the Commission's opinion the measures to be taken at Community level with regard to CFCs should be as follows:

a) Maintenance and consolidation of precautionary measures adopted on 26 March 1980, namely

- freeze on production capacity of CFC 11 and 12, and

- reduction by 31 December 1981 of the use of CFC 11 and 12 in aerosols by at least 30% compared with 1976 levels;

b) Improvement in the collection of scientific, technical and economic data as a basis for a periodic review of Community policy.

c) Engagement in projects, especially with the industry concerned, designed to decrease CFC emission in the sectors other than the filling of aerosol containers.

d) Proposal of, and support for, suitable measures at international level.

Re a)

The Commission is of the opinion that it is necessary to extend the measures taken, which provide a minimum of precaution and acceptable economic effects.

As regards the production capacity of CFCs 11 and 12, it would be useful to give it a nominal value since this would:

- facilitate the application of the decision of 26 March 1980,

- illustrate the real impact of this limitation measure and establish conditions for extending this measure to international level.

A definition of the production capacity approved by the industry involved in the Community is put forward in Annex III. On this basis an exact value of the production capacity in the Community as a whole will soon be available.

As regards the aerosols sector, in addition to maintaining the measures taken, it would be desciable to ensure that after 31 December 1981 there is no increase in the use of CFC 11 and 12 in the Community on the figures given for 1981.

Re b)

A continuous assessment of the situation is indispensable if the requisite decisions are to be taken with full knowledge of the facts, given:

- the intensive scientific research and observations in progress,

- the precautionary nature of the measures adopted, which must lend themselves to change when this proves necessary,

- the very nature of the measures taken, which so far only involve CFC 11 and 12 and the aerosols sector, and

- the rapid development of the market.

It is therefore essential that the Community should have continually-updated information provided through the channels of suitable procedures and mechanisms.

As regards scientific data and the socioeconomic effects of the measures adopted and projected, the Commission will continue to assess these two categories of information in meetings of experts that it will organize or in studies that it will undertake; the results will be distributed to the Member States.

As for alternative products to CFCs or to products containing CFCs and the best technical means of reducing emission, the Commission will try to coordinate the information received through the Member States during regular meetings of national experts and through experts in the industry.

Annual Community statistics on the production, sales, imports and uses of the various CFCs need a systematic collection mechanism which guarantees their confidential nature. This is outlined in Annexe IV.

Member States will be asked to help the Commission to put these procedures and mechanisms into operation under the most suitable conditions.

Re c)

In the sector of foam plastics, refrigeration and solvents development should be followed and, as a measure of precaution, attemps should be made to limit the emission of these substances.

Action programmes have been set up with the help of national experts and representatives of industry; they are intended to reduce CFC losses in these sectors and develop the best technologies to limit emission, especially in:

1) The refrigeration sector, where an ad hoc group of national experts and experts from industrial circles will be set up to devise a code of practice aimed at avoiding needless losses. Its tasks will be first to indicate the changes to be made to handling procedures and practices with CFCs in the subsector of industrial refrigeration where short-term results can be expected, and then to develop changes in domestic refrigeration practice and in the design of the equipment itself.

2) The foam plastics sector, where an ad hoc group of national experts and experts from industrial circles will begin on flexible polyurethane foam to study current technologies, ways and means of recovering the CFC and costs; this study could result in fresh reduction objectives for emissions.

3) The solvents sector, where initial information research is necessitated by the wide variety of users; this research will be coordinated by the Commission.

Re d)

Finally, the Community should take or support the initiative of an international action. Given the worldwide nature of the problem only international action can guarantee the effectiveness of measures taken at national or regional level. Changes of location in production centres must be avoided since these would ruin the effects achieved in some parts of the world.

CFC sales other than in the United States and in the Community (figures supplied by the Chemical Manufacturers Association -CMA) accounted for 40% of world sales in 1979 and increased by 36.7% over 1976 levels.

This action must be undertaken within a suitable international frame. Initiatives have been taken in particular in the UNEP with a view to establishing an international convention. These initiatives should be examined in a favourable light and, where appropriate, given support.

Measures adopted by the Community should be proposed as a basis for implementation at international level, namely:

- no increase in the production capacity of CFCs 11 and 12,
- significant reduction in the use of CFCs 11 and 12 in aerosols containers.

Furthermore, international action of this kind would encourage the research and development of alternative products, new utilization methods and suitable technologies for preventing emissions.

2. The Council is therefore asked to

a) take note of this communication;

b) note the Commission's intention

- to establish suitable procedures and mechanisms for an exchange of scientific, technical, socioeconomic and statistical information, and

- to undertake action in the sectors of foam plastic, refrigration and solvents designed to reduce the emission of CFCs,

and to recommend close collaboration between the Member States and the Commission on these points;

c) provide, in the light of the information and basis for evaluation contained in this communication, the Commission with instructions to enable it to submit at the earliest a proposal for a Council Decision on preventive and precautionary measures to be applied by the Member States after 31 December 1981.

ANNEX I

SCIENTIFIC WORKSHOP

"EVALUATION OF THE EFFECTS OF CHLOROFLUOROCARBONS ON ATMOSPHERIC OZONE: PRESENT STATE OF RESEARCH"

BRUSSELS, 13-14-15 JANUARY 1981

EXECUTIVE SUMMARY OF THE REPORT

- The earth's surface is shielded from potentially harmful solar ultraviolet radiation by atmospheric ozone, about 90% of which is located in the stratosphere between altitudes of 50 km and 10-17 km (depending on latitude). Ozone is responsible, in part, for the positive vertical temperature gradient in the stratosphere which restricts transfer of material between the stratosphere and underlying troposphere.

- Stratospheric ozone is produced by the photolysis of oxygen and removed by various catalytic destruction cycles. These involve a variety of reactive trace gas species including chlorine atoms and chlorine oxide radicals. The photochemical breakdown of man-made chlorine-containing trace gases such as CFC-11 and CFC-12 may, by eventually causing a several fold increase in the Cl and ClO stratospheric abundances, promote the chlorine catalysed destruction of ozone. Substantial reductions in the stratospheric ozone amount may thereby take place in the future with possible repercussions for the biosphere.

- Because of their absorptive properties in the infrared, continued releases at present rates of CFC-12, and to lesser extents of other man-made halocarbons, may cause an increase in average temperature at the earth's surface. This increase, though smaller than that expected from a doubling of carbon dioxide occurring over the same time frame, is expected still to be significant and may have consequential effects on the general atmospheric circulation and climate.

- Since first identified as an environmental problem in 1974, the effect of CFCs on stratospheric ozone has been the subject of much research and many reports. Estimates of the steady-state ozone depletion due to CFCs have undergone several revisions as more laboratory and atmospheric data became available. In January 1981, the Commisson of the European Communities convened about thirty experts from nine countries who produced this Workshop Report. The present report represents an update of the results of the Reports issued in 1979 by the United States National Academy of Sciences, the National Aeronautics and Space Administration an by the United Kingdom Department of Environment.

- Steady state ozone depletion estimates for the continued release of CFCs-11 and 12 alone at their 1976 rates, have declined from about 18 per cent estimated with the 1979 chemical kinetics data base to about 10 per cent using revised data available in 1980. This downwards revision has predominantly resulted from re-evaluations of certain rate coefficients involving the HO and HO_2 radicals, especially the reactions of HO with HNO_3 and HO_2NO_2. The corresponding values for present day ozone depletion resulting from releases of CFC-11 and 12 starting in 1931 are estimated to be about 1 % for the total ozone column and about 4% for the local ozone change at 40 km altitude.

- If the releases of other man-made chlorine-containing trace gases, (methyl chloroform, carbon tetrachloride, CFC-113, etc.) continue at present levels then they could increase the steady state ozone depletion by about one third.

- Much greater emphasis has been directed towards understanding the coupling between the simultaneous effects of non-chlorine containing pollutants which may perturb the stratospheric ozone amount over a similar time scale as the CFCs 11 and 12 (50-100 years). The simultaneous effect of a hypothetical CO_2 doubling is predicted to decrease the perturbation due to CFCs 11 and 12 alone by about one third.

- Since 1979 the use of 2-D models to examine the perturbation of ozone by CFCs has increased significantly. These models have contributed to our understanding of potential variations in the seasonal and latitudinal depletion of ozone which has implications for the ultraviolet intensity reaching the earth's surface that may have important ecological consequences. However, it is important to note that the 2-D models yield predicted ozone perturbations which are consistent with those predicted by the 1-D models. Comparisons of field measurements with theoretically predicted constituent distributions using 2-D models are neither improved nor worsened compared with 1-D model predictions for the middle and upper stratosphere but 2-D models provide an improved comparison for the lower stratosphere.

- The model studies allow an assessment of the possible penalties for delaying further restrictions on CFC 11 and 12 release beyond those already enacted by EEC, USA and some other countries. These assessments are highly dependent on model chemistry and transport, but nevertheless indicate that a five year delay in a complete ban on CFCs 11 and 12 would incur a penalty of the order of an additional few tenths of a percent depletion in ozone that would take about a century to die away completely.

- Recent statistical treatments of the trend in the total ozone column, measured with the ground based Dobson network, show a small increase (less than 1 %) between 1970 and 1979 compared with the average value between 1960 and 1970. The value is somewhat dependent on the function used to fit the data. This increase is not inconsistent with the model predictions of a 0.6 % decrease due to CFCs over the same period being within the statistical uncertainties of the observations (95% confidence limits of $\pm$ 2.4 %). In the measurement of total ozone it is possible that a small decrease in stratospheric ozone has been masked by the increase in tropospheric (2-8 km) ozone, observed over the same period.

- In the upper stratosphere the models predict a decrease due to CFCs alone of 3-4 % but the data between 1970 and 1979 from the two available techniques are inconsistent and no firm conclusion can be drawn. There are experimental data to suggest that there has been a decrease in stratospheric temperature between 20 and 50 km within the last decade which could have resulted in a corresponding ozone increase. An additional complication in interpreting an ozone trend due to man's activities is the variability in the UV solar flux, which is still not well quantified.

- Although improved estimates of overall ozone trend due to all causes, natural and man-made, result from the new statistical treatments, the experimental observation of any trend specifically due to emissions of CFC-11 and 12 will require continued measurements of ozone over an extended period in conjunction with an overall improvement of the scientific data base.

- Satellite observations of trace gases and the temperature in the stratosphere are now becoming available for detailed analyses (SBUV, LIMS, SAGE, SAMS). These homogeneous global observations will be extremely useful as input parameters in the models, and for testing the theories about the feedbacks between radiation, dynamics and chemistry. There is, however, a real need of simultaneous measurements of statospheric constituents and the relevant meteorological parameters from the satellite systems. Such climatologies are needed for 2-D or 3-D validation. The requirement for routine operational monitoring of total ozone and its vertical distribution with adequate resolution in space and time should continue to be given high priority. Such observations should be made togeher with simultaneous monitoring of solar UV-flux.

- While the kinetic and photochemical data-base is thought to be relatively well understood for most of the key processes in the photochemically controlled region above 30 km, except for the HO + HO_2 reaction, there are still several uncertainties relating to key processes below 30 km involving temorary reservoirs e. g. CLO + NO_2 + M $\rightarrow$ $CLNO_3$ (isomers), HO + HO_2NO_2, HO + HNO_3, etc.

- Since 1979 there has been an increased awareness of the potentially important role of temporary reservoir species in the lower stratosphere such as HO_2NO_2, $ClONO_2$, HOCl, etc. Special attention now needs to be given to measurements of these temporary reservoir compounds which have relatively short life times in the solar radiation field. It is crucial to measure the profile of those species which have at best been tentatively detected ($ClONO_2$, N_2O_5, NO_3), or not detected at all (H_2O_2, HOCl, HO_2NO_2).

- The field measurement programs have been predominantly in a consolidation phase since 1979. This has resulted in a increased data base for some key species including N_2O and ClO. Several balloon-borne field measurement techniques have recently ben successfully demonstrated, i.e. microwave limb sounder for ClO and O_3, in-situ mass spectometry for O_3, H_2O, etc., infrared emission spectrometry for HCl, HF, etc. and ultraviolet-LIDAR for HO and O_3.

- The results of the recent first measurements of total chlorine in the stratosphere are apparently consistent with the sum of the measurements for individual halocarbons, thus indicating that there are no large sources of atmospheric chlorine which are not accounted for. Some non-methane hydrocarbons have been measured for the first time providing an indirect method for determining an upper limit to atomic chlorine concentrations.

- A complete picture of the stratospheric behaviour of ozone also requires better knowledge of the vertical profiles of the long-lived stratospheric reservoir species such as H_2O, HNO_3 and HCl. In particular the variability in concentrations of water vapour, which is a basic species in stratospheric chemistry, should be known with more precision since there is disagreement between observations and disagreement between observations and theory.

- All these aspects of temporary and long-lived reservoir species in the lower stratosphere are related to an exact knowledge of the HO, HO_2 and ClO concentrations and extension of existing measurements into the lower stratosphere is needed in order to validate the models.

- There are therefore many uncertainties remaining in input data and problems of model formulation and validation which require further study so that it may take many years before theory, observational data and model techniques have advanced sufficiently for a reliable quantitative simulation of the CFC-ozone problem. The problem is however amenable to study, but implies a continuing commitment to atmospheric research.

ANNEX - II

STATISTICS AND TECHNICAL DATA

A. CHLOROFLUOROCARBON PRODUCTION AND USE: STATISTICS

1. Data Sources

- For each of the four years 1976 to 1979, aggregate data is available for production and sales of CFC 11 and CFC 12 by the nine chlorofluorocarbon producer-marketers in the EEC.

The data has been provided by the EFCTC - the European Fluorocarbon producers Technical Committee of CEFIC, under an arrangement whereby individual producers submit data in confidence to an independant firm of UK accountants (Peat, Marwick, Mitchell & Co) who collate the figures.

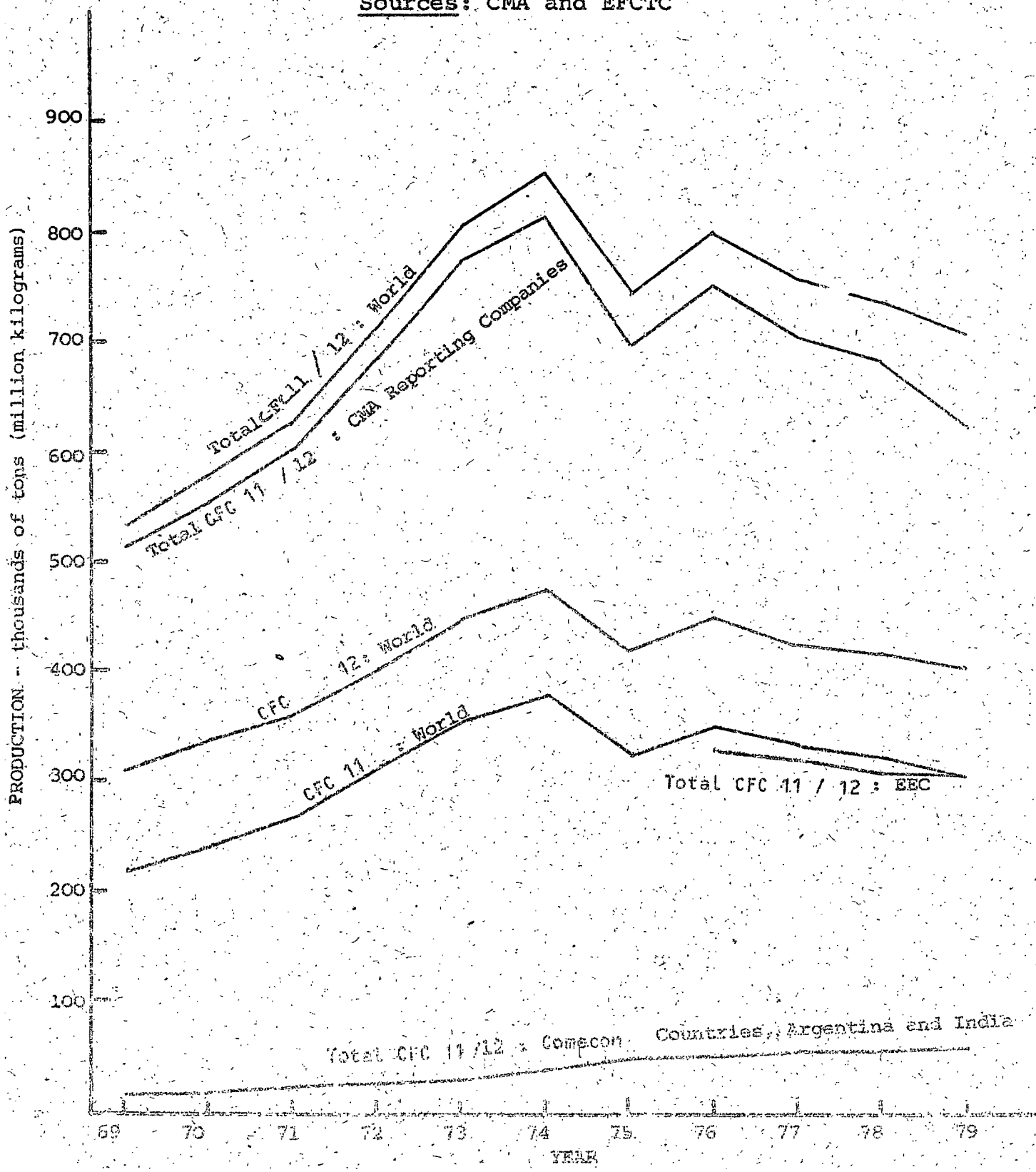
Production totals include any importation by the producers from outside the Community. We have been assured by the EFCTC that with plants running well below capacity such importation is currently negligible, and that they are not aware of any significant importation by non-producers.

Discrepancies between production and sales totals have not exceeded 2 % in any year, and are attributable to stock changes and reporting errors.

- Under a scheme administered by the CMA (the USA Chemical Manufacturers Association) 19 companies, including all the EEC producers, report their annual CFC 11 and CFC 12 production and sales figures to an independant firm of US accountants which prepares aggregate tabulations. They estimate also the annual production and release for COMECON Countries, Argentina and India.

FIGURE 1 : CHLOROFLUOROCARBONS 11 AND 12
WORLD AND EEC PRODUCTION : 1969-79

Sources: CMA and EFCTC



2. CFC 11 / 12 Production Trends

As shown by Fig. 1, world production of both CFCs 11 and 12 has progressively declined from the secondary peaks of 1976. The combined CFC 11 and CFC 12 total of 800 thousand tons in 1976 fell to 702 thousand tons in 1979, a drop of 12.2 %, and over the same period EEC production fell from 326 to 304 thousand tons, a reduction of 6.8 %. The EEC production in 1980 reached 296 thousand tons, a reduction of 9.4 %. Due to the differential rate of decline, EEC output as a proportion of the world total rose from 40.8 % in 1976 to 43.3 % in 1979.

The greater external decline is attributable to the United States ban on CFC propellants in most aerosols, which became fully effective in 1979.

3. CFC 11 / 12 Sales in EEC

The sales by EEC producers are described in tables 1 and 2 and in fig. 2, 3 and 4.

Sales for aerosols fell from 176,914 tons in 1976 to 126,442 tons in 1980, a reduction of 28.5 %. However, this continued to be the largest sales category, accounting for 58.3 % of sales within the EEC, and 42.7 of total (EEC + export) sales in 1980.

Progress towards the minimum 30 % reduction target in sales for aerosols compared with 1976 was ahead of that corresponding to a steady linear rate of decrease, and if the average annual reduction of 7.1 % achieved over the four years continues through 1981, the target will be exceeded (fig. 3).

Sales for Refrigeration have not been changed significantly since 1976, and at 21,174 tons in 1980, accounted for only 9.8 % of EEC sales.

TABLE 1.

CFC 11/12 PRODUCTION AND SALES BY EEC PRODUCERS: 1976 AND 1980

Total CFC 11/12 : tons (thousand kilograms)

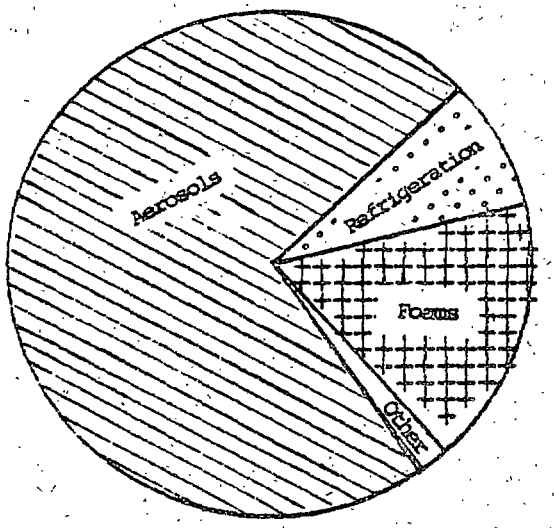
	1976	1980	Change: 1976 to 1980	
			tons	%
PRODUCTION (including imports from outside the EEC)	326,433	295,718	-30,715	-9.4
SALES IN EEC MARKETS (excluding sales to co-producers).				
Aerosols - tons	176,914	126,442	-50,472	-28.5
% All Sales in EEC	72.5	58.3		
% EEC and Export Sales	54.0	42.7		
Refrigeration - tons	20,773	21,174	+ 401	+ 1.9
% All Sales in EEC	8.5	9.8		
% EEC and Export Sales	6.3	7.1		
Foam Plastics - tons	42,154	61,859	+19,705	+46.7
% All Sales in EEC	17.3	28.5		
% EEC and Export Sales	12.9	20.9		
Other Uses - tons	4,178	7,353	+ 3,175	+76.0
% All Sales in EEC	1.7	3.4		
% EEC and Export Sales	1.3	2.5		
Total: Non-aerosol Uses - tons	67,105	90,386	+23,281	+34.7
% All Sales in EEC	27.5	41.7		
% EEC and Export Sales	20.5	30.5		
TOTAL EEC SALES - tons	244,019	216,828	-27,191	-11.1
% EEC and Export Sales	74.5	73.2		
TOTAL EXPORTS OUTSIDE EEC - tons	83,578	79,361	-4,217	-5.0
% EEC and Export Sales	25.5	26.8		
TOTAL EEC AND EXPORT SALES - tons	327,597	296,189	-31,408	-9.6

Source: EECIC

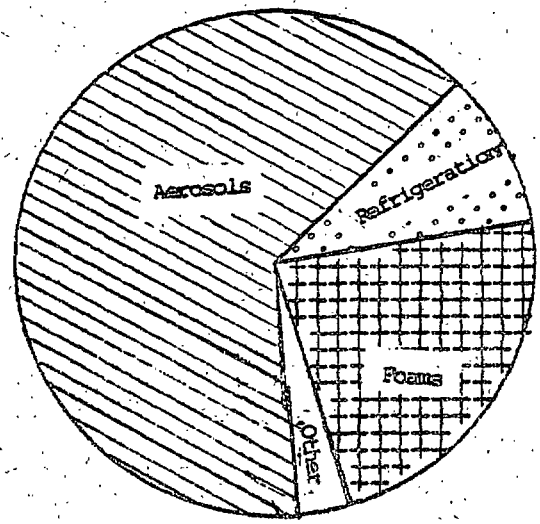
FIGURE 1 DISTRIBUTION OF EEC AND TOTAL SALES OF CFC 11/12 BY EEC PRODUCERS: 1976 AND 1980

EEC SALES

1976

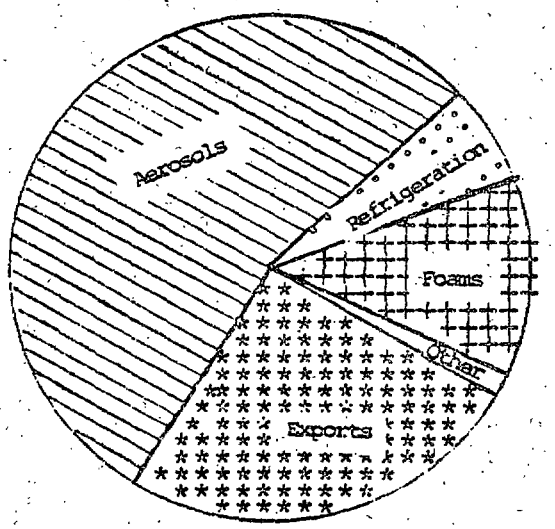


1980



ALL SALES

1976



1980

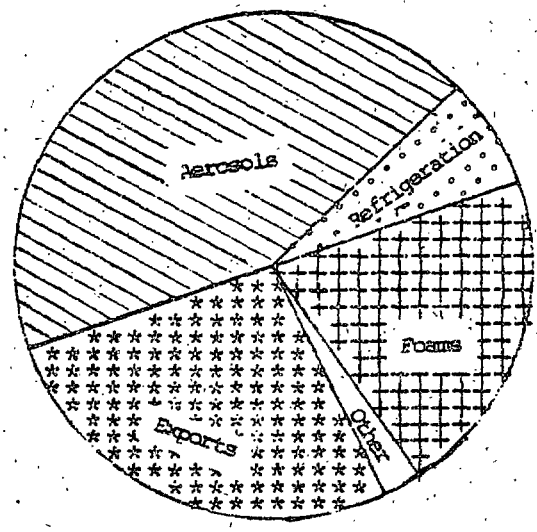
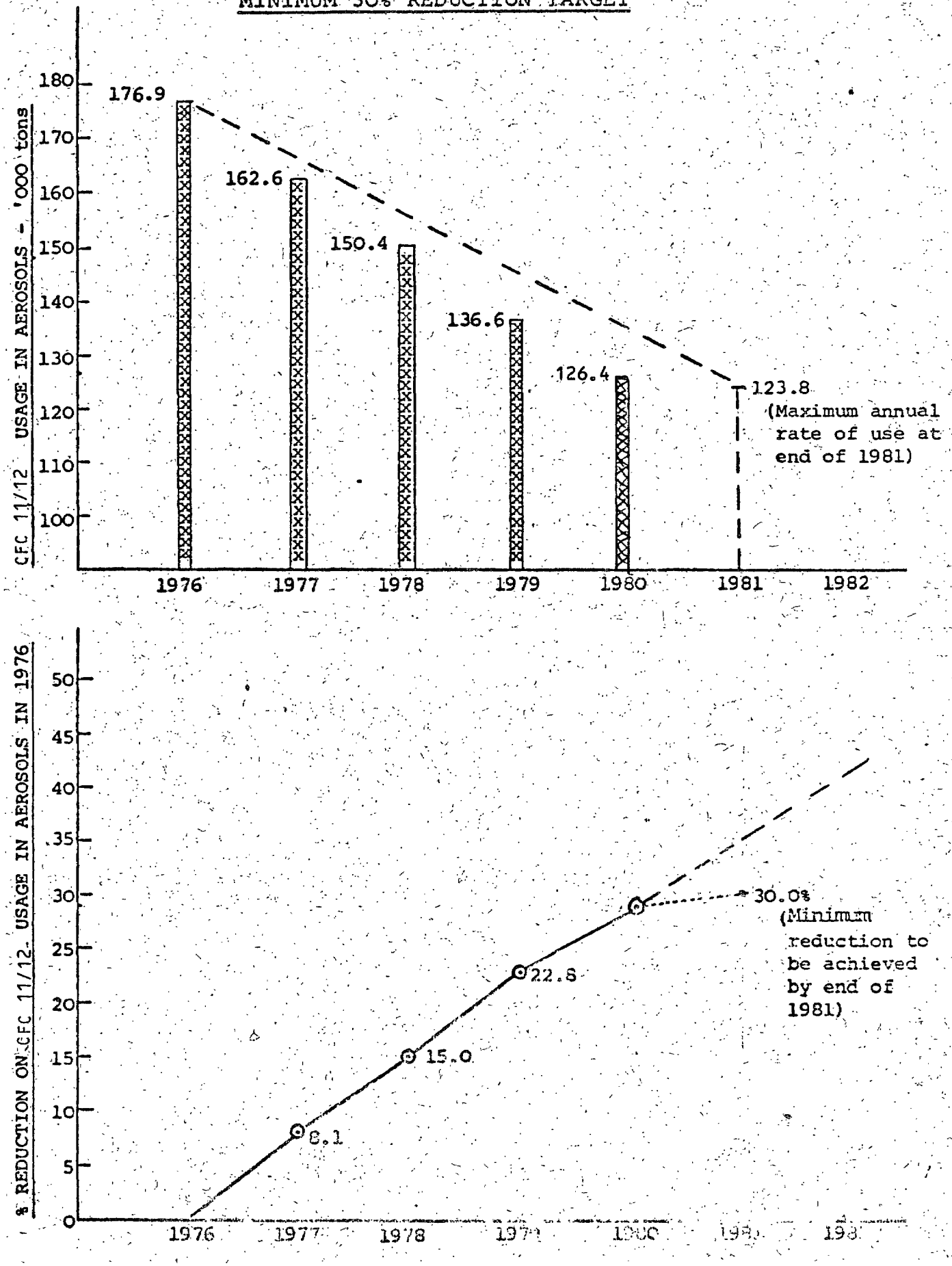


FIGURE 3 CFC 11/12 USAGE IN EEC : PROGRESS TOWARDS MINIMUM 30% REDUCTION TARGET



Sales for Foam Plastics registered substantial growth, and at 61,859 tons in 1980 were 46.7 % above the 1976 level.

Other Uses in 1980 accounted for the relatively small fraction of 3.4 % of EEC sales, although at 7,353 tons the volume was 76 % above that in 1976.

Sales for all non-aerosol uses rose by 34.7 %

Exports Sales declined slightly, from 83,578 tons in 1976 to 79,361 tons in 1980, but in relation to total sales the proportion rose from 25.5 % to 26.8 %.

The net reduction in annual sales over the period was 31,408 tons, or 9.6 % of the 1976 total, the reduction in sales for aerosols having been substantially offset by increased sales for foam plastics and miscellaneous uses.

4. EEC Sales of CFC 11 and 12 in relation to world sales

- The distribution of CFC 11/12 sales between the EEC, the USA and the rest of the world are shown in table 3.

TABLE 3

Territorial Distribution of CFC 11/12 Sales: 1976 and 1979

	1976		1979	
	'000 tons	%	'000 tons	%
EEC	244.0	33.7	219.6	34.0
USA	289.0	39.9	164.9	25.5
Rest of World	191.8	26.5	262.1	40.5
TOTAL	724.8	100.0	646.6	100.0

Table 4 categorises world sales by all CMA reporting companies in 1976 and 1979 and the percentage changes between these years, with corresponding data for the EEC and the USA, and for sales outside the EEC including and excluding sales in the USA.

Figure 5 represents the trends of CFC 11/12 sales in the EEC and the world for the main application categories over the period 1976 to 1979.

Sales for aerosols outside the EEC declined by 53.8 % over the period as compared with 22.8 % within the Community. The disparity is attributable to the fall of 95.2 % in the USA due to ban on CFC usage in 'non-essential' aerosols, since in the rest of the world the decline in the aerosol sector was only 5.1 %.

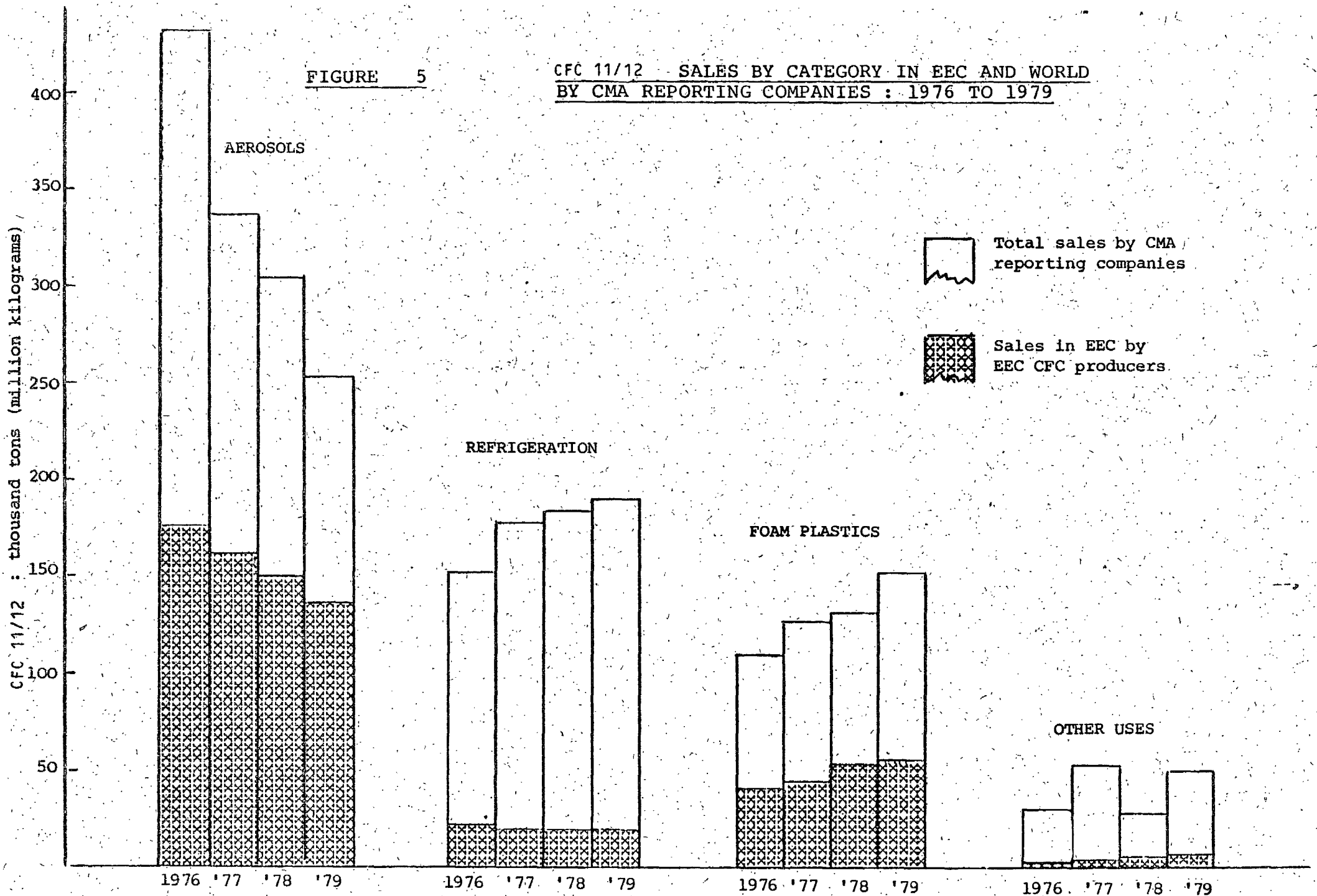
TABLE 4. CFC 11 / 12 SALES BY CATEGORY AND TERRITORY FOR CMA REPORTING COMPANIES : 1976 AND 1979

Sales Category	Year	World	EEC		World Excluding EEC	USA	World Excluding EEC & USA
		'ooo tons	'ooo tons	% world	'ooo tons	'ooo tons	'ooo tons
Aerosols	1976	432.3	176.9	40.9	255.4	138.0	117.4
	1979	254.6	136.6	53.7	118.0	6.6	111.4
	% Change	- 41.1	- 22.8		- 53.8	- 95.2	- 5.1
Refrigeration	1976	152.3	20.8	13.7	131.5	88.0	43.5
	1979	191.1	20.3	10.6	170.8	89.0	81.8
	% Change	+ 25.5	- 2.3		+ 29.9	+ 1.1	+ 88.0
Foam Plastics	1976	110.4	42.1	38.1	68.3	44.4	23.9
	1979	152.4	55.8	36.6	96.6	36.3	60.3
	% Change	+ 38.0	+ 32.2		+ 41.1	- 18.2	+152.3
Other Uses	1976	29.8	4.2	14.1	25.6	18.6	7.0
	1979	48.5	6.9	14.2	41.6	33.0	8.6
	% Change	+ 62.8	+ 65.7		+ 62.5	+ 77.4	+ 22.9
Totals : Non-aerosol categories	1976	292.5	67.1	22.9	225.4	151.0	74.4
	1979	392.5	83.0	21.1	309.0	158.3	150.7
	% Change	+ 34.0	+ 23.7		+ 37.1	+ 4.8	+ 76.3
Totals : All Categories	1976	724.8	244.0	33.7	480.8	289.0	191.8
	1979	646.6	219.6	34.0	427.0	164.9	262.1
	% Change	- 10.8	- 10.0		- 11.2	- 42.9	+ 36.7

Note : 'World' = Total CMA Reporting Company sales for stated category.
(CMA Reporting Companies include all the EEC CFC producers)
EEC and USA figures are for sales within these territories

FIGURE 5

CFC 11/12 SALES BY CATEGORY IN EEC AND WORLD BY CMA REPORTING COMPANIES : 1976 TO 1979



World sales in the non-aerosol sectors rose by 34.0 % overall, with the non-EEC countries registering increased sales in each non-aerosol sector, despite static situations in sales for refrigeration in the EEC and USA, and a reduction in USA sales for foam plastics.

The net outcome of the various sectoral changes was that falls of 10 to 11 % occurred in total EEC, non-EEC and world sales, and a massive reduction of 43 % in sales in the USA. For areas outside the EEC and the USA, however, a rise of 36.7 % occured in total sales, the slight fall in sales for aerosols being outweighed by a doubling of the non-aerosol sector sales.

Table 5 compares the percentage distribution of sales of CFC 11/12 by CMA reporting companies in the EEC, non-EEC countries and the world for 1976 and 1979.

The sales patterns within and outside the EEC are in sharp contrast, the divergence having increased since 1976. In the EEC in 1979, 62.2 % of sales were for aerosols and only 9.2. % for refrigeration whereas outside the EEC the proportions were 27.6 % and 40.0 % respectively.

The proportions for foam plastics were similar (EEC: 25.4 %, non-EEC: 22.6 %) but solvent and other uses accounted for 9.7 % outside the EEC, compared with 3.2 % in the Community.

TABLE 5

PERCENTAGE DISTRIBUTION OF CMA REPORTING COMPANY SALES OF CFC 11/12 BY CATEGORY AND TERRITORY: 1976 and 1979

	% TOTAL CFC 11/12 SALES BY CMA REPORTING COMPANIES					
	1976			1979		
TERRITORY:	EEC	Non-EEC	World	EEC	Non-EEC	World
Aerosols	72.5	53.1	59.6	62.2	27.6	39.4
Refrigeration	8.5	27.4	21.0	9.2	40.0	29.5
Foam Plastics	17.3	14.2	15.2	25.4	22.6	23.6
Other Uses	1.7	5.3	4.1	3.2	9.7	7.5
Non-aerosol uses	27.5	46.9	40.4	37.8	72.4	60.6
	100.0	100.0	100.0	100.0	100.0	100.0

Source: CMA and EFCTC statistics

Note: EEC sales distribution relates to sales within the EEC. Non-EEC distribution relates to differences between world sales by all CMA reporting companies and EEC sales.

5. Other fully halogenated CFC production

World production of the other principal fully halogenated CFCs, CFC 113 and CFC 114, is estimated to have risen from 88,000 tons in 1977 to 109.000 tons in 1979, when it represented 12 % of world production of CFC 11, 12, 113 and 114. Corresponding EEC production figures for 1977, the latest year for which data is available, were 24,000 tons and 7 %.

B. AEROSOLS

1. The EEC aerosol fillings total of 1,868 million units in 1979 was only marginally below the 1976 total of 1,873 milllion (Fig. 6). The fall of 22.8 % in CFC 11/12 usage in aerosols over that period must be attributable to different factors, mainly changes in formulation and sales category patterns, and perhaps also to variations in the average unit fill volumes. These factors cannot easily be quantified, but the reductions of 18 % in hairspray fillings and of 20 % in anti-perspirants and deodorants in the five principal filling countries suggest that sales pattern changes played a significant role, since these two sectors account for the major proportion of CFC usage in aerosols.

In 1979, EEC fillings represented 85 % of the Western Europe total and about 30 % of the world total. In the non-EEC countries of Western Europe, Spain accounted for 46 % of 1979 fillings and Greece for 8.6 %. If the 29 million fillings in Greece are added to the EEC total of 1,868 m. they represent only 1.5 % (Fig. 7).

2. In the USA, fillings climbed to a peak of 2,902 m in 1973, and slumped to 2,150 m in 1977 following adverse public reaction associated with the ozone depletion issue. Fillings are now rising again, despite the ban on CFCs in most aerosol products.

Strong growth is registered in countries outside the USA and Western Europe, where fillings rose from 1,335 m. in 1976 to an estimated 1,837 m in 1979, an increase of 37.6 %.

FIGURE 6 WORLD AEROSOL FILLINGS : 1970-1979

Source: Metal Box

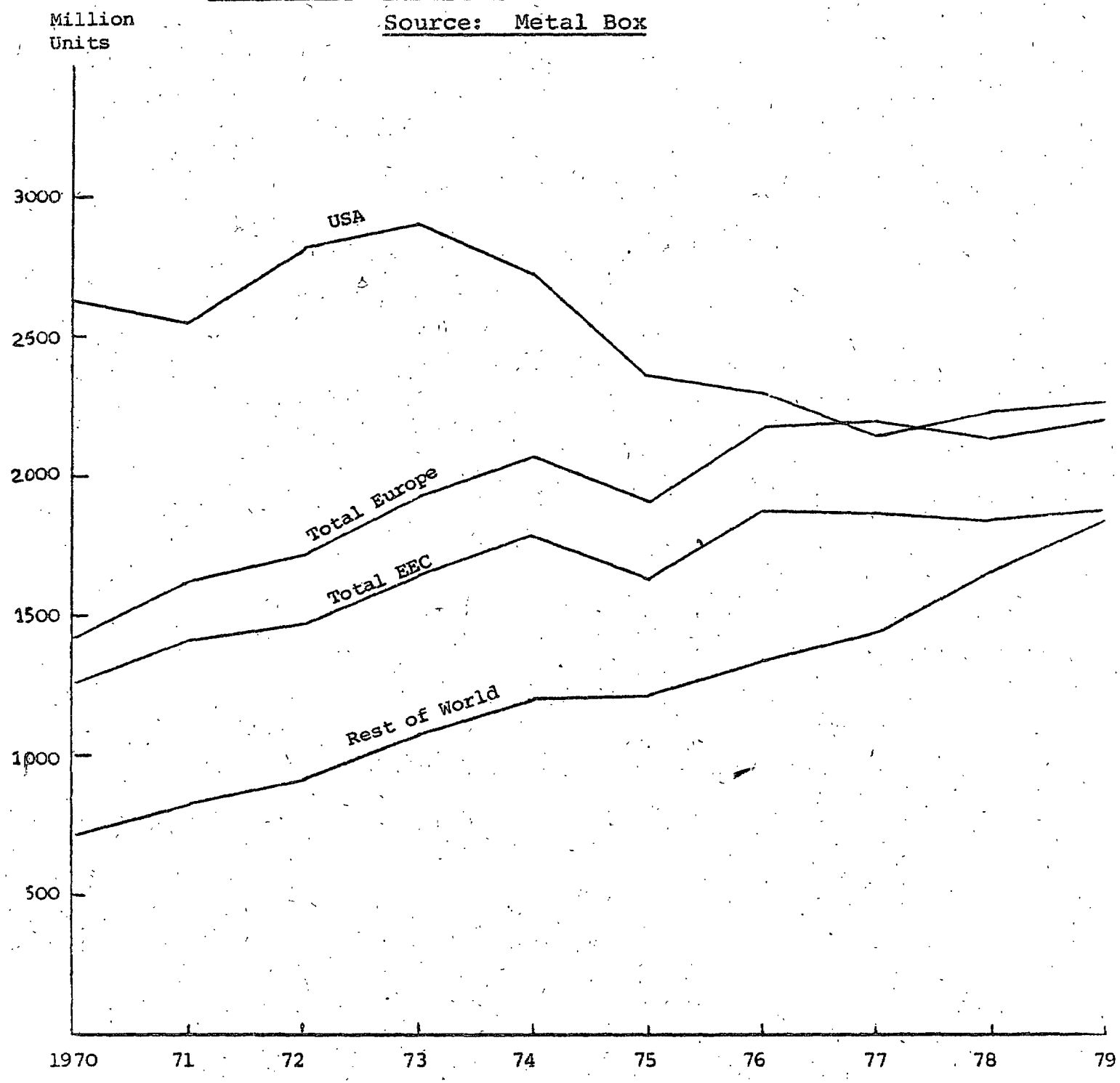
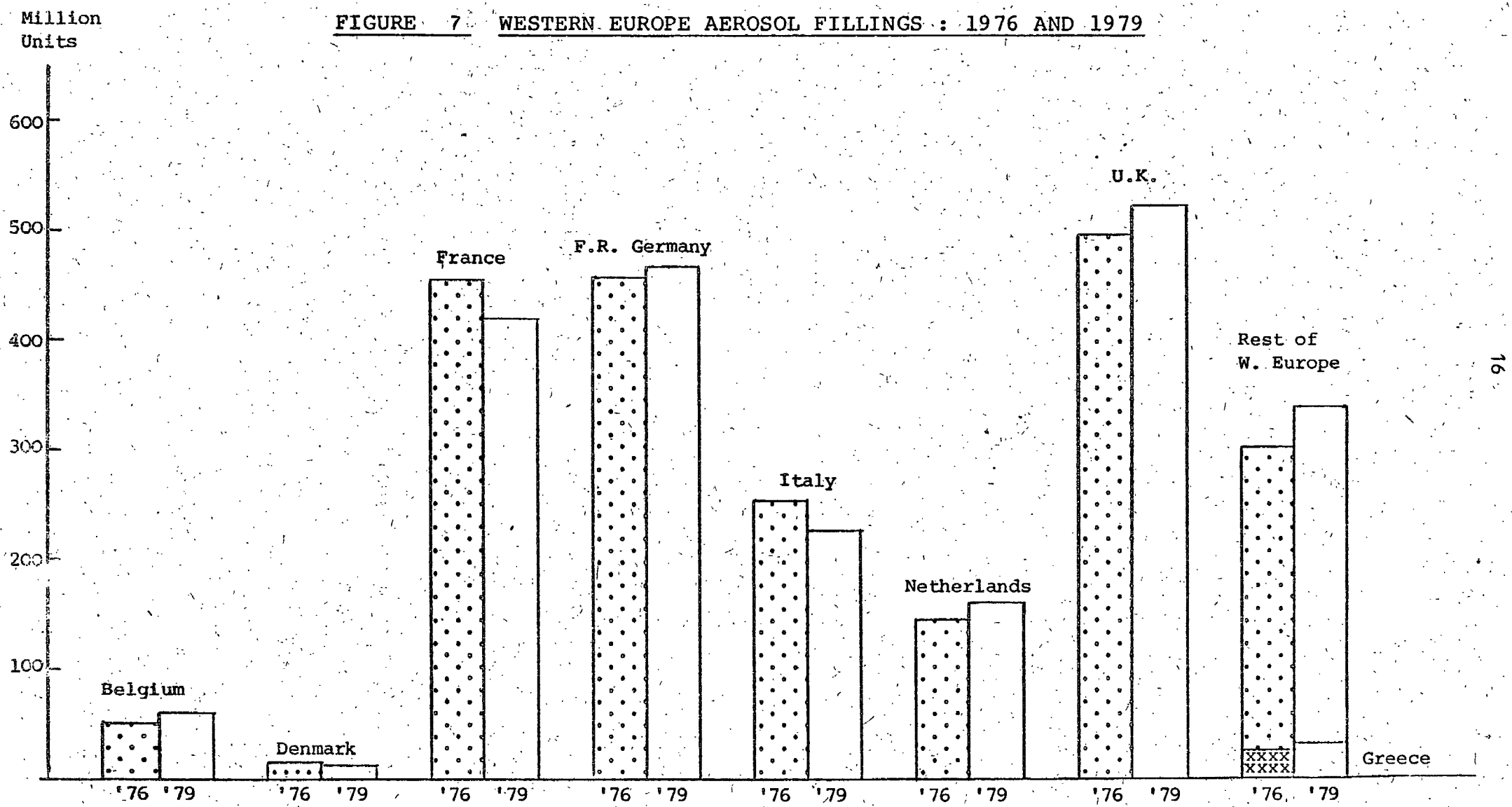


FIGURE 7 WESTERN EUROPE AEROSOL FILLINGS : 1976 AND 1979



3. No alternative fluorocarbon propellants to CFC 11 and CFC 12 have emerged which satisfy the technical, economic, environmental, biological and other criteria for large scale application and none is in prospect. Pump sprays and other devices are not making significant in-roads into the market for self-pressurised packaging based on liquefied gas propellants.

4. Except for fragrances and a few minor product sectors, liquefied hydrocarbon gas propellants are now the established alternatives to CFCs, despite the disadvantages attaching to their high flammability and poor solvent properties, often necessitating the use of auxiliary solvents and diluents such as alcohols and methylene chloride which are also subject to regulatory restrictions.

5. Dimethylether ('DME'), although flammable, could become a valuable alternative to hydrocarbon propellants because of better solvent properties, miscibility with water and compatibility with fragrances. Wider acceptance depends upon the results of a toxicity testing programme, and the availability of more than one primary supplier in the EEC.

6. If further significant reductions in the use of CFC in the aerosol sector are to be achieved what will be the socio-economic impact?

Restrictions leading to elimination of CFC 11/12 usage in aerosols in 1984, could reduce EEC output by about 138,000 tons compared with 1976. The consequent loss of added value at 1980 prices due to lower sales of CFCs and co-products, allowing for reduced raw material imports, is estimated at ECU 228,220,000 with an associated job opportunity loss of 8,620. There would be some off-set - possibly as much as 30 % - due to increased usage in aerosols of hydrocarbon propellants, alcohols, chlorinated hydrocarbons and other materials.

7. At a given sales volume, the socio-economic impact of further CFC restrictions on the aerosol filling sector, aside from development expenditure, is essentially related to the costs and problems of conversion to flammable propellants. The basic capital costs of conversion could typically range from ECU 56,000 for a facility producing up to 1 million units/year on an existing site, to ECU 600,000 for conversion and re-location of a two-line 20 m. unit/year capacity installation.

8. Information on 200 filling locations obtained by postal survey, and on more than 140 others by indirect means indicates that there are up to 400 active fillers in the EEC, with about 70 accounting for 80 % of all fillings. Half the locations surveyed are not equipped for flammable propellants and nearly 80 % of these were reported unsuitable for conversion, but almost all fillers producing over 10 m units/year are able or planning to be able to use flammable propellants.

9. Further CFC restrictions and the need for more conversion would result in consolidation of filling operations of fewer sites. Personnel engaged for more than 50 % of their time on aerosol manufacture in the EEC may total about 10,000; re-structuring of the industry might put up to 2000 job opportunities at risk.

10. The effect of further CFC restrictions on aerosol sales volumes would depend on many factors and is particularly difficult to predict under present economic circumstances; while some depression is likely, this could be minimised if enough time is available for re-formulation to be achieved in a series of graduated steps.

C. NON AEROSOL SECTORS

1. Refrigeration

CFC compression is the predominant system in the manufacture and use of refrigeration and air conditioning equipment in the EEC, and because of its advantages in terms of economics, efficiency, safety and versatility it is most unlikely that the development of absorption and other systems will make a significant impact on this situation in the next decade. It follows that practical measures to reduce CFC emissions in this application field must be concentrated on the reduction of preventable losses at all stages from initial manufacture and installation, to the ultimate disposal of equipment.

The principal CFC refrigerants used in the EEC are CFC 12, CFC 22 and CFC 505. Sales for CFC 12 for refrigeration have remained virtually constant at about 20,000 tons annually, over the period 1976 to 1980; statistics for CFC 22 and CFC 502 are not available.

There is scope for reducing emissions by equipment design improvement, the earlier detection and cure of leaks and by following less wasteful procedures in charging and servicing, but there is little economic incentive for conservation and it is likely to prove difficult to change long established working practices and attitudes.

Potentiality also exists for the recovery or destruction of refrigerant currently vented to atmosphere on account of contamination or other reason preventing re-use. Technology for these measures is not yet established, and they are likely to prove costly and complicated to implement.

2. Foam Plastics

CFC blowing agents are used in the production of a number of foam plastics, but mainly for flexible (open cell) and rigid (closed cell) polyurethane. Reliable statistics on CFC usage for the various foams are not available, but much of the increase in CFC usage for this application, from 42,000 tons in 1976 to 56,000 tons in 1979 (62,000 in 1980), is attributable to rigid polyurethane - the production of which in Western Europe is reported to be growing at a rate of nearly 9% annualy. CFC usage for flexible polyurethane slabstock in the EEC has fallen by about 25 % since 1976 and no growth is anticipated over the next 5 years.

The CFC content of closed cell polyurethane foam is an essential factor in the low thermal conductivity of this material, which has a unique combination of advantages for thermal insulation; no alternative non-CFC blowing agents are available for rigid polyurethane when it is used for this purpose, which is the major application. Reductions in CFC emissions might be made by minimising losses during foam production and conversion, and possibly by measures to prevent release during disposal.

In open cell flexible polyurethane foams, CFCs are used as secondary blowing agents for producing the softer, lower density grades. CFC escapes from the foam during production and the possibility of recovery from the process ventilation air by adsorption on active carbon is being explored in a pilot plant project in England. Methylene chloride is an alternative blowing agent but toxicity problems dictate a cautious approach to substitution. Softer high density grades of foam can now be made using recently introduced polyols, and some reduction in CFC usage is likely to follow from this development. Vacuum blowing is a possibility on which research has been recommended.

2. Solvents

The growing use of fully halogenated CFCs, especially of CFC 113, for solvent cleaning makes this an application area which deserves further attention. More information is needed to quantify the sources of emission.

ANNEX III

DEFINITION OF THE PRODUCTION CAPACITY

EEC effective CFC 11 and 12 Capacity

- expressed in tons per year

- full capacity in 24 hours continuous service, multiplied by the average number of days per year the plants are able to run under normal conditions of maintenance and safe operability.

- included are all lines capable of producing CFC 11 and 12 on the date of 26 March 1980 (Council Decision) either exclusively or on a campaign basis.

CFC DATA COLLECTION MECHANISM

INTRODUCTION

Since 1976, the European Chlorofluorocarbons producers provide the Commission on a voluntary basis with the Community annual figures of production, sales by end-use and exports for CFC 11 and for CFC 12, through an auditing company. The collection of informations is systematized below following a procedure similar to the one utilized previously.

1. Production and sales by CFC producers

1.1. For the chlorofluoromethanes CFC 11 and CFC 12, the individual CFC producers in the EEC submit to an independant auditing concern, to be agreed by the Commission, annual figures such as will enable the auditing concern to prepare for the Community as a whole, and separately for CFC 11 and CFC 12, aggregate statistics in respect of :

- production, including importation from outside the EEC,
- sales in producers' home markets, by end-use,
- sales in other EEC markets, by end-use,
- sales outside the EEC.

1.2. The figures for each calendar year are submitted in the first quarter of the following year.

1.3. The auditing concern maintains strict confidentiality in respect of the individual producers' figures, and provides community totals as listed in 1.1. directly to the Commission.

1.4. The procedure defined in 1.1., 1.2. and 1.3. above is also followed for the chlororluoromethanes CFC 113 and 114 except that :

a) the producers submit figures in respect of the total of CFC 113 and CFC 114,

b) the auditing concern provides Community statistics to the Commission only when total production and imports of CFC 113 and CFC 114, exceed 45.000 tonnes.

2. Purchases by users

2.1. Where, in the opinion of the Commission, a particular end-use accounts for a significant proportion of the total use of any fully halogenated CFC in the Community, the users in that sector supply to an independant auditing concern, approved or nominated by the Commission, figures for the amounts of each CFC purchased for the specified end-uses in the previous year and a forecast for the current year.

2.2. The figures are submitted in the first quarter of each calendar year.

2.3. From the individual users' figures, which are treated as strictly confidential, the auditing concern provides totals in respect of the Community as a whole directly to the Commission.

2.4. Where appropriate, the collection of end-use data is organized through trade associations and confederations, and a two stage system may be employed whereby statistics are first collected on a national basis and then aggregated to provide community totals.

2.5. Where data is collected with the assistance of trade organisations, these organisations, invite any non-members known to them in the sector concerned to participate in the exercise, and provide the Commission with estimates of total pruchases by users who do not participate.

2.6. Where acceptable to the Commission, data may be provided in respect of the combined total of two or more CFCs, e.g. for CFC 11 and CFC 12 together when used in aerosols.