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REPORT OF THE SCIENTIFIC ASSESSMENT PANEL ON THE IMPACT
ON THE OZONE LAYER OF CONTINUED USE OF RECYCLED
CONTROLLED SUBSTANCES

1. As has been described in detail in the recent Scientific Assessment of Ozone Depletion¹, there is strong evidence that all long-lived chlorine and bromine compounds that are released into the atmosphere reach the ozone layer and cause significant ozone depletion there. Observations have demonstrated that these compounds are responsible for the Antarctic ozone hole, and the weight of evidence suggests that they play a substantial role in causing mid-latitude ozone decreases as well. Therefore, all future human release of long-lived chlorine and bromine compounds are expected to cause further ozone depletion.
2. The sources of chlorine in the stratosphere are well understood and described in detail in the Scientific Assessment of Ozone Depletion: 1991. Methyl chloride is the sole significant natural source of chlorine in the stratosphere and represents about 15-20 per cent of the current input. The remainder of the chlorine input into the stratosphere is man-made, and takes the form of a variety of chlorofluorocarbons in current use, predominantly CFC-11, CFC-12 and CFC-113.
3. In order for these chlorofluorocarbons to damage the ozone layer, they must first be released into the atmosphere. Therefore, recycled compounds that are not released into the atmosphere have no impact upon ozone depletion. Conversely, any chlorofluorocarbon that is recycled but accidentally or deliberately released contributes to ozone depletion to the same extent as non-recycled material.
4. For bromine, the relative contributions of human and natural production are less clear at the moment and will be addressed in detail in the forthcoming Scientific Assessment (1994) currently being prepared. It is clear that the man-made halons (mainly halon 1301, 1211 and 2402) represent about 25 per cent of the total input of bromine into the stratosphere while about 75 per cent takes the form of methyl bromide.

¹ Scientific Assessment of Ozone Depletion: 1991 (World Meteorological Organization: Global Ozone Research and Monitoring Project - Report No.25).

Current scientific studies are directed at quantifying the natural and man-made sources and sinks of methyl bromide. The most recent scientific assessment of methyl bromide carried out under the auspices of UNEP in 1992¹ suggested that 25+10 per cent of the source was likely to have been man-made while 75+10 per cent was likely to have been natural; we expect to refine and improve these estimates in our forthcoming report. Based on these figures, about half of the total bromine input into the stratosphere is derived from human releases of halons and methyl bromide.

5. As in the case of the CFCs, the bromine compounds that are released into the atmosphere are believed to cause ozone damage. Recycled compounds that are not released have no impact, while those that are released into the atmosphere during or after the recycling process have the same impact on the ozone layer as any non-recycled material.

6. Compounds such as hydrochlorofluorocarbons represent a possible alternative to CFCs in some applications. Because the lifetimes of these compounds are not so long as those of CFCs, they are less able to reach the stratosphere once released and less able to remain in the atmosphere over long periods. A variety of different compounds are available and their relative impacts upon ozone, compared to releases of an equivalent amount of CFC-11, were assessed 1991¹. The attached table summarizes the steady-state ozone depletion potentials of CFCs, halons and a variety of alternative compounds based upon that report. These figures will be updated in the forthcoming Scientific Assessment (1994).

7. The table illustrates that releases of an alternative compound such as HCFC-123 instead of CFC-11 is of substantial benefit to the ozone layer (i.e., this compound causes only 2 per cent as much ozone damage over its lifetime). As discussed above, any alternative compound used in a closed application that does not involve ultimate release into the atmosphere causes no ozone damage.

Table 6-5 Range of modelled and semi-empirical steady-state
ODPs and recommended best estimates²

Species	Model Range		Semi-Empirical Range		Best Estimate ODP
	ODP	ODP/CLP or ODP/BLP	ODP	ODP/CLP or ODP/BLP	
<u>CFCs</u>					
CFC-11	1.0	1.0	1.0	1.0	1.0
CFC-12	0.88-1.06	0.551-0.665			1.0
CFC-113	0.92-1.01	0.631-0.690	1.07	0.75	1.07
CFC-114	0.57-0.82	0.266-0.382			0.8
CFC-115	0.29-0.48	0.099-0.161			0.5
<u>HCFCs, etc</u>					
HCFC-22	0.032-0.048	0.221-0.314	0.05-0.08	0.33-0.55	0.055
HCFC-123	0.013-0.020	0.709-1.050	0.02	1.112	0.02
HCFC-124	0.016-0.034	0.358-0.793	0.022	0.523	0.022
HCFC-141b	0.10-0.12	0.650-0.767	0.11	0.70-0.72	0.11
HCFC-142b	0.035-0.057	0.186-0.305	0.06-0.07	0.33-0.39	0.065
HCFC-225ca	0.016-0.020	0.714-0.920	0.025	1.093	0.025
HCFC-225cb	0.023-0.031	0.348-0.474	0.033	0.50	0.033
CCl ₄	1.03-1.15	1.014-1.130	1.05-1.11	1.03-1.09	1.08
CH ₃ CCl ₃	0.11-0.13	0.968-1.130	0.122-0.124	1.07-1.09	0.12
<u>Brominated Compounds</u>					
H-1301	10.0-12.7	23.9-32.2	15.2-17.2	40	16
H-1211	1.8-5.0	16.3-49.6	3.9-4.4	40	4
H-1202	1.7	52.9	1.25	40	1.25
H-2402	6.4-10.2	42.1-47.8	5.9-8.5	40	7
H-1201	1.4	35.1	1.4	40	1.4
H-2401	0.4	66.4	0.25	40	0.25
H-2311	0.3	79.9	0.14	40	0.14
CH ₃ Br	0.5-0.7	30.6-67.7	0.44-0.69	40	0.6

² Ibid., p.6.15.