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Interim Hearing on the Earth's Ozone Layer and Chloroflourocarbon (CFC) Emissions: SB 534 (Rosenthal)

Assembly Committee on Environmental Safety and Toxic Materials

ASSEMBLY COMMITTEE ON ENVIRONMENTAL SAFETY AND TOXIC MATERIALS

INTERIM HEARING ON

THE EARTH'S OZONE LAYER AND CHLOROFLUOROCARBON (CFC) EMISSIONS: SB 534 (ROSENTHAL)

October 18, 1988

Room 444, State Capitol
Sacramento, California

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CALIFORNIA STATE ASSEMBLY
Committee on
Environmental Safety and Toxic Materials

Chaired by Assemblywoman Sally Tanner

Interim Hearing
on the Subject of

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Chlorofluorocarbon (CFC) Emissions:
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INTRODUCTION

Chlorofluorocarbons (CFCs) are manufactured chemical compounds which are used in a wide spectrum of human activities. Over the past 60 years, CFCs have been used extensively to insulate walls, propel aerosols, pad furniture, package food items, keep refrigerators and freezers cold, cool the air in our homes, businesses and motor vehicles, clean sensitive metal parts, printed circuit boards and semiconductors, enhance paint, and sterilize medical instruments. CFCs have been preferred for their relative non-toxicity, stability, and non-flammable and, until recent years, were considered no threat to the environment.

Strong scientific evidence indicates, however, that emissions of CFCs and related compounds into the atmosphere are contributing to the depletion of stratospheric ozone, otherwise known as the earth's "ozone layer". Because this layer protects the earth's surface from excessive ultraviolet (UV) radiation from the sun, its depletion means that more UV waves will reach the surface. This, in turn, will lead to larger numbers of skin cancer cases, an increased incidence of cataracts, a negative impact on human immune systems, damaging effects on aquatic, plant and animal life, a reduction in vital crop yields, and accelerated solar weathering of UV-sensitive building materials.

Since 1974, the year this global problem was first identified, a number of national and international regulatory actions have been taken to restrict CFC production and emissions to reduce the rate of ozone layer depletion. Several options are available to reduce CFC emissions, including alternative production and operation processes, substitute chemicals, recovery and recycling of CFCs, and substitute products.

SB 534 (Rosenthal), a measure heard by this committee back in June, would have required the recycling of CFCs contained in refrigeration units at large-sized retail food stores. The bill was held by the committee and referred to this interim hearing.

This background paper places SB 534 in the context both of the ozone layer depletion problem and of other options available to reduce CFC emissions. The first section of this paper describes CFCs and the process by which their emission depletes the ozone layer. The second section describes the various uses to which CFCs are put, with emphasis on CFC use in retail food store refrigeration units. The final section explores options which policy makers could pursue to restrict CFC production and reduce their emissions into the air, again with emphasis on retail food store refrigeration applications.

BACKGROUND

CFCs and Convenience. Trichlorofluoromethane (CFC-11) and dichlorodifluoromethane (CFC-12) were the first CFCs to be synthesized by chemists in the General Motors research labs back in 1928. These scientists were trying to find a safe substitute for the more volatile refrigerants in use at the time: methyl chloride, ammonia, and sulfur dioxide. The new CFC compounds immediately proved very stable, nonflammable, nontoxic, and popular. CFC-12 has been used ever since as a coolant in refrigerators and motor vehicle air conditioners and was eventually mixed with CFC-11 to serve as an aerosol propellant. CFC-11 is used extensively as a blowing agent in the manufacture of polyurethane.

Over a period of 60 years, CFC formulations have pervaded our daily lives and have contributed much to the industrialized world's modern conveniences and necessities. For 46 of those years, CFCs were considered to be the "perfect" chemical providing significant benefits to society with no adverse impacts on the environment or public health. In 1974, all of that changed when Professor F. Sherwood Rowland and Dr. Mario J. Molina, of the Department of Chemistry of the University of California at Irvine announced their theory that CFCs were rising to the stratosphere and depleting the ozone layer.

By September 1988, the United States Environmental Protection Agency (EPA) Administrator Lee Thomas was calling for a complete phaseout of ozone-depleting CFCs. CFC industry groups and a major CFC manufacturer, E. I. du Pont de Nemours and Company (or "Du Pont"), were also calling for an "orderly transition" to chemical substitutes for CFCs. (See the Chronology at the end of this paper.)

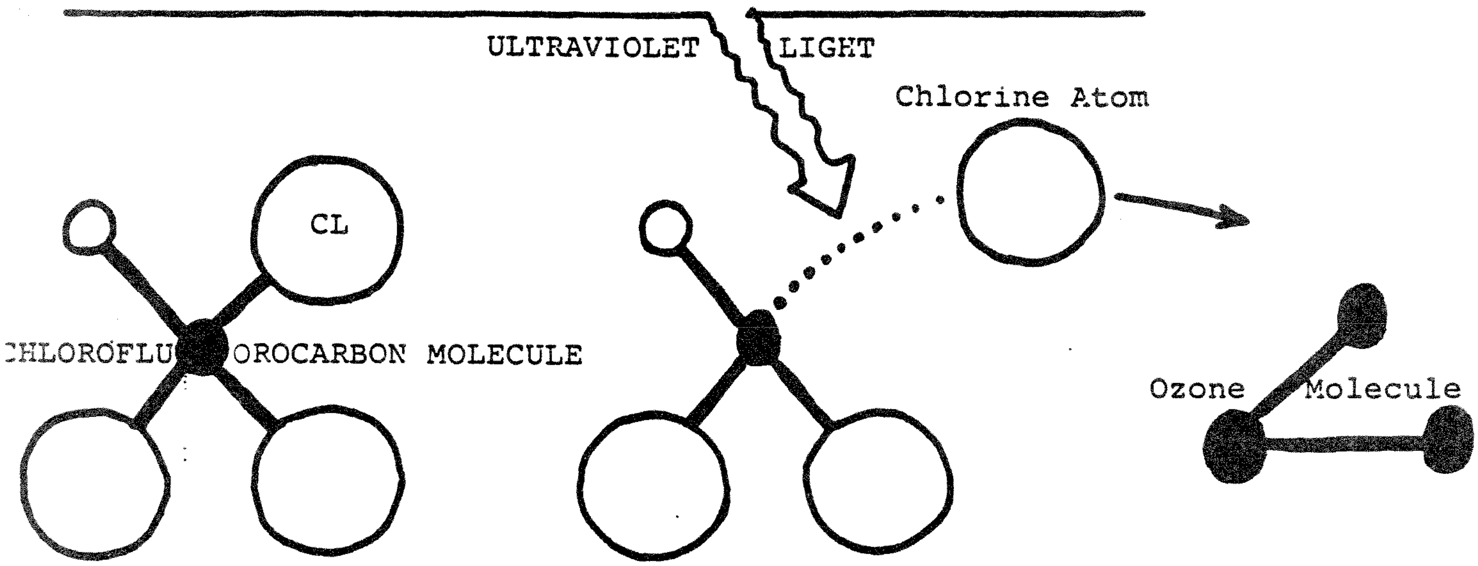
How CFCs Deplete the Ozone Layer. CFC emissions remain in the atmosphere for decades because of their relative stability and their tendency not to react with other chemicals. The emissions are swept around the globe, slowly rising as they spread. (In the troposphere (the lower atmosphere), CFCs and other compounds absorb infrared radiation from the earth's surface, reducing the radiant cooling of the earth, thereby creating a "greenhouse effect" which warms the earth's surface and changes its climate. This effect is projected to cause higher air temperatures, sea level rises, widespread flooding, disruption of agriculture, and shifting rainfall patterns.)

When the CFCs finally reach the stratosphere (the upper atmosphere), the compounds react with UV light and break down into chlorine, fluorine, and carbon atoms. When a free chlorine atom meets an ozone (O_3) molecule, it detaches one oxygen atom from the ozone to form chlorine monoxide and an oxygen molecule (O_2). Later, the chlorine monoxide molecule meets a single oxygen atom, the two oxygen atoms combine to make more O_2, and the chlorine atom is free again to renew the process. (See Figure 1.). Theoretically, one chlorine atom, with a life expectancy ranging up to three hundred eighty years can destroy up to 100,000 ozone molecules. The chlorine eventually becomes inactive or is carried back into the troposphere to be washed out in rainwater or dissolved in the oceans.

CFC formulations vary in their ability to destroy ozone. The "ozone depletion potential", or ODP per kilogram of emissions varies among each formulation. Table 1 lists major CFC formulations, their respective ODPs and their

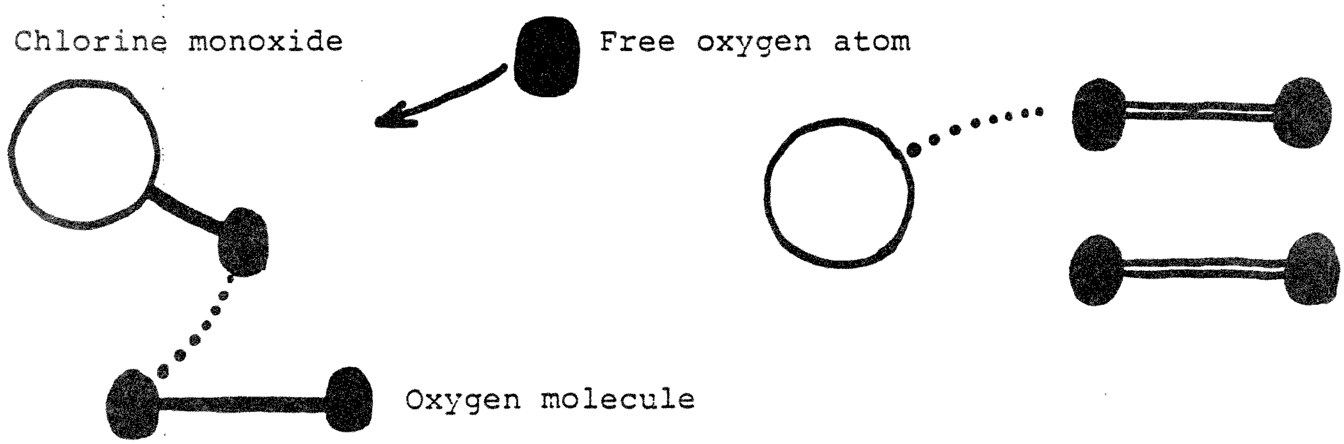
FIGURE 1.

HOW OZONE IS DESTROYED



In the upper atmosphere ultraviolet light breaks off a chlorine atom from a CFC molecule.

The chlorine atom attacks an ozone molecule breaking it apart. An ordinary oxygen molecule and a molecule of chlorine monoxide are formed.



A free oxygen atom breaks up the chlorine monoxide. The chlorine is free to continue on its way to attack other ozone molecules. One chlorine atom is capable of destroying up to 100,000 ozone molecules in its lifetime.

Source: U.S. EPA

Table 1

MAJOR CFC FORMULATIONS

	FORMULA	USES	ODP
CFC-11	CCL_3F	REFRIGERANT BLOWING AGENT	1.00
CFC-12	CCL_2F_2	REFRIGERANT FOOD FREEZANT BLOWING AGENT	1.00
CFC-113	$C_2CL_3F_3$	SOLVENT	0.80
CFC-114	$C_2CL_2F_4$	REFRIGERANT BLOWING AGENT	1.00
CFC-115	C_2CLF_5	REFRIGERANT	0.60
R-500	75% CFC-12 25% HFC-152A	REFRIGERANT	0.75
R-502	50% CFC-115 50% HCFC-22	REFRIGERANT	0.30

R = Refrigerant; ODP = Ozone Depletion Potential. All other CFCs are measured in relation to CFC-11 and CFC-12.

atmospheric lifetime. CFC-11 and CFC-12, widely used formulations, possess great potential to deplete the ozone layer and are used as the benchmarks by which all other ozone depleters are measured. For instance, CFC-115 has 60% as much ozone depletion potential as CFC-11 or CFC-12.

EPA Position. In August 1988, EPA released a report entitled "Future Concentrations of Stratospheric Chlorine and Bromine". The report finds that, even with substantial global participation in the 1987 Montreal Protocol (which limits future CFC production and consumption), chlorine levels in the stratosphere would increase two- to three-fold. Even if emissions were totally eliminated today, stratospheric chlorine levels will continue to grow for about 6-8 years. The report also states that a complete phaseout of CFC production would be needed to stabilize chlorine at current levels during the next hundred years.

As a result of these findings, EPA Administrator Lee Thomas called, in late September 1988, for even greater efforts in halting the depletion of stratospheric ozone by asking all nations to ratify the Montreal Protocol and then move toward a complete phaseout of ozone-depleting CFCs.

CFC USES AND EMISSIONS

How CFCs are Emitted. CFCs are emitted into the air when a product using CFCs is manufactured, operated, serviced or disposed. Some emissions occur early on in the life of the product as is the case for CFC-based solvents and flexible foam. CFCs in motor vehicle air conditioners are usually emitted gradually or not emitted until disposal several years after manufacture. Motor vehicle air conditioners and solvents account for most CFC emissions in the United States, while CFCs in aerosols account for a significant share of emissions in other countries.

CFC Emissions from Retail Food Refrigeration Systems. These systems fall into two temperature ranges: low temperature systems for frozen foods and medium temperature systems for meat and dairy products. Low temperature systems generally use CFC-502, a blend of HCFC-22 and CFC-115, while medium temperature systems use CFC-12, CFC-502, and/or HCFC-22.

CFCs are emitted from retail food store refrigeration systems primarily when the systems:

- Are "leak-tested" by the manufacturer before delivery.
- Are serviced or repaired.
- Leak during operation.
- Totally fail during which all the refrigerant is vented into the air.
- Are disposed.

(These sources of emissions are generally the same for most CFC uses.)

Manufacturers use a mixture of CFC-12 and air or nitrogen for leak testing units. The mixture usually contains about ten percent of refrigerant. Emissions resulting from leak-testing represent a very small fraction of total retail food refrigeration emissions.

Virtually all retail food store refrigeration systems are outfitted with "receiver tanks" so that service people can gain easy access to or isolate the CFC contained in the system. While a typical food store might require 50 service calls a year, malfunctions of the hermetic system (which contains the CFC) occur rarely. According to retail food representatives, complete systems are generally not vented during a service call. According to industry sources, the only time CFC is vented is during a sudden failure (pipe or line failure) or when the service person is careless.

Refrigeration industry sources also indicate that in most systems (five horsepower and larger), it is cost effective to save the CFC; for smaller systems, it will not be cost effective until CFC prices rise substantially. Even if recovery and recycling is cost-effective, retail food store owners don't necessarily demand it.

When these systems are replaced, it is often for cosmetic reasons or for greater energy efficiency, rather than because of a major malfunction. While the CFC contained in the disposed unit is sometimes vented, it is generally saved if the unit is still operational. The CFC and the unit can then be sold on the second-hand market. When a unit is being replaced because of a system failure, the CFC may be emitted immediately, and its capture is probably not feasible.

Current emissions from these refrigeration systems amount to approximately five percent of the total volume of CFCs released into the air.

CFC Emissions from Other Major Sources.

- **Rigid Foams.** These foams are used for insulation or packaging and account for most of the CFC-11 use in this country. The CFCs are blown into polymers to form closed cells which provide extremely effective insulation. Rigid **nonurethane** foams are used for everyday packaging, insulation and food service items and include styrofoam cups, plates and bowls, fast food and egg cartons, grocery store meat trays, ice chests and flotation devices. Rigid **urethane** foams are used as insulation for both construction applications and in refrigeration. Emissions occur primarily when the CFC is blown to form the various products. In addition, CFC may be emitted slowly over time as the product ages.

- **Flexible Foams.** These foams account for about 15% of all CFC-11 used in the United States. The foams are popular "stuffers" for furniture, car seats, bedding, carpet pads and other materials which cushion. Because the cells are "open", CFC-11 is emitted promptly after manufacture.

- **Domestic Refrigerators and Freezers.** CFC-12 is the preferred refrigerant for home systems. Most emissions occur when the refrigerators and freezers are disposed, while the remainder occurs at manufacture, servicing, and through leaking. (CFCs are also present in the insulation material placed in the walls of these appliances.)

- **Motor Vehicle Air Conditioners.** Currently, air conditioners for automobiles, trucks and other motor vehicles, account for 37% of total CFC-12 use in the United States. In automobiles, the air conditioner is charged with about two pounds of CFC-12. Leakage and repair servicing account for two-thirds of all CFC-12 emissions from motor vehicle air conditioners. When an air conditioner needs servicing, the CFC-12 is removed and the unit is recharged. The CFC-12 is usually removed by venting it to the air.

- **Chillers.** These are large coolers for commercial and industrial uses. Depending on the design, chillers use either CFC-11 and CFC-12 or HCFC-22. Leakage and servicing are the major sources of CFC emissions from these systems.

- **Solvents.** Industrial solvents, used primarily by the electronics industry, accounts for all domestic production of CFC-113. Chlorine emissions from these solvents account for approximately 25% of total CFC emissions, although CFC-113 is only 80% as potent as CFC-11 or CFC-12. The electronics industry likes CFC-113 because of its nontoxic nature and compatibility with plastics. Emissions occur when the solvent escapes from cleaning tanks as a vapor or when used solvent is disposed.

- **Hospital Sterilants.** Hospitals and clinics use a mixture of ethylene oxide and CFC-12 to sterilize medical instruments. Emissions occur during sterilization and when the gas mixture is disposed.

OPTIONS TO REDUCE CFC EMISSIONS AND PROTECT THE OZONE LAYER

There are six general options available for reducing or eliminating CFC emissions or the ODP of these emissions. Depending on the particular product or way in which particular CFC formulations are used, the success of each option varies widely. These options are:

- Prohibiting or restricting the production or use of CFC formulations.
- The use of chemical substitutes for harmful CFCs.
- The manufacture of alternative products.
- The recovery and/or recycling of CFCs.
- The development of alternative technologies.
- Better servicing standards to reduce unintended emissions.

Since California probably accounts for less than 20 percent of all CFC use and emissions in the United States and since the U.S. accounts for from a quarter to a third of total world use and emissions of CFCs, it is important to keep in mind that any measures taken in California to reduce or eliminate these emissions are not, by themselves, going to make major inroads in relieving the ozone layer depletion problem. However, to the extent that California both sets an example for other states and countries and represents a major market for refrigerants and coolants, policies we may wish to pursue may lead to action elsewhere.

Prohibiting or Restricting the Production or Use of CFC Formulations. The most direct way of reducing or eliminating the impact of CFCs on the earth's ozone layer would be to prohibit or significantly restrict their production or use. The first major action taken by the EPA back in 1976 was to prohibit CFC use as a propellant in "nonessential" aerosols. The Montreal Protocol of 1987, if ratified, immediately limits CFC consumption and production in industrial countries to 1986 levels and requires both a reduction in production to 90% by

1993 and 60% by 1998 and a reduction in consumption to 80% and 50% by those same years. A follow-up conference is being convened in The Netherlands later this week to examine new data and to consider both the acceleration and strengthening of this schedule.

As noted earlier, EPA has recently called for a complete phaseout of the more harmful CFCs. Several cities in California, including Los Angeles, Berkeley and Palo Alto, have passed ordinances essentially banning the use of fast-food and other packaging made with CFC as a blowing agent. AB 3761 (Connelly), which was vetoed by the Governor three weeks ago, would have substantially restricted the use of CFCs to produce fast-food containers and other packaging materials.

McDonald's, Burger King, Round Table Pizza Parlours, and perhaps other major convenience food chains have already begun to phase out their use of CFC-produced packaging in light of recent ozone data.

Du Pont, the major CFC producer in this country, made a significant policy change this year and now calls for an "orderly transition" away from the more potent CFC formulations. The Alliance for Responsible CFC Policy, an organization representing CFC producers and users, has followed suit in light of recent data and findings of both EPA and NASA's Ozone Trends Panel.

For prohibitions and substantial restrictions of CFC production and use to be most effective, there must be general global agreement on such a policy. If CFC production and use is limited or eliminated in California or the United States without concurrent limits in Europe, Japan, the Soviet Union and developing nations, unilateral prohibitions or restrictions may simply end up shifting a substantial portion of production and consumption to non-abiding areas of the world. Since ozone depletion knows no political or geographical borders, the problem would not be solved with unilateral action. However, if policies pursued in California are adopted elsewhere, as they often are in other issue areas, then prohibitions or restrictions on CFC production and use may be ultimately effective.

The Use of Chemical Substitutes for Harmful CFCs. There are chemical substitutes for many currently used CFC formulations and other related compounds. To the extent that compounds which do not contain chlorine or which reduce CFC stability (and therefore its longevity in the atmosphere) can be substituted for CFC-11, CFC-12 and other high ODP compounds, the future damage to the earth's ozone layer can be substantially reduced. However, substitutes often engender increased product and operation costs, significant investment in research and development, substantial changes in product design, and a possible reduction in customer satisfaction. A worldwide scramble is underway among CFC producers to be the first to develop and market effective chemical substitutes for currently used CFCs, especially for CFC-11, CFC-12, CFC-113.

Substitutes offered by CFC producers primarily take one of two forms: either completely eliminating the need for the chlorine atom in the formulation or adding a hydrogen molecule to the formulation to reduce its ODP.

Du Pont announced three weeks ago that it was going ahead with plans to retool its Corpus Christi, Texas plant to mass produce HFC-134a as a substitute for CFC-12. Since HFC-134a does not contain a chlorine atom, it is harmless to stratospheric ozone. Assuming all runs smoothly and there are no delays, Du

Pont plans to begin commercial production in 1990. As noted earlier, motor vehicle air conditioners use CFC-12 exclusively, and the compound is used also as a food freezant and blowing agent. Normally, development of such a substitute requires several years of toxicity and product testing before the decision is made to mass produce it. Du Pont has decided to take the risk involved in gearing up for commercial production before all toxicity tests have been completed. It should be noted that the bulk price of HFC-134a may be significantly greater than that of CFC-12.

HCFC-22 is a CFC compound already in growing use as a refrigerant and blowing agent. Because of the presence of a hydrogen molecule, the ODP of HCFC-22 is only 0.05, or 1/20th of CFC-11 or CFC-12. However, if HCFC-22 becomes the preferred substitute, its vastly increased use could negate its low ODP in future years.

There are no readily available complete substitutes for CFC-113 for use as an effective and safe solvent. Apparently, there is a new solvent manufactured by Petroferm, Inc. (Florida) and AT&T which is made from terpenes (a natural compound derived from citrus fruit rinds) which has proven effective in some applications. In addition, CFC-123 and CFC-141b have been considered as substitutes for CFC-11 in the production of flexible foams.

<u>The Manufacture of Alternative Products</u>. An option to changing the ingredients of a product is to change over to another product. For instance, instead of relying heavily on rigid foam packaging for eggs, meats and other perishable foods, these containers could once again be made out of paper products and molded pulp. Instead of rigid foam in walls and ceilings, cellulose fiber insulation could be used. Higher density, harder foams which use less CFC-11, could be used instead of current flexible foams. Each of these alternative products involve tradeoffs in cost, effectiveness, and amount needed to do the job.

<u>The Recovery and/or Recycling of CFCs</u>. In general, the best way to reduce the emissions of CFCs already in use is to recover and recycle them. Not only are emissions reduced significantly in the short run, but the need to continue to produce certain CFC formulations to recharge old and existing systems is lessened. Depending on the characteristics of the particular CFC-using product, recovery and recycling can take place at several points in the product's life. CFCs can be recovered when a product such as an air conditioner or refrigerator is leak-tested at the manufacturing plant, when the system is initially installed, when it is serviced or repaired and when the system is disposed. The greatest environmental benefit from recovery and recycling takes place when cooling and refrigeration systems are being serviced and repaired. In addition, depending on the particular system, recovery and recycling are usually cost-effective. As production restrictions on certain CFC formulations take effect and as relatively expensive substitutes are introduced, recovery and recycling will make even more economic sense for the person who has to pay for the refrigerant.

Recovery and recycling of CFCs in retail food store refrigeration systems, mandated by SB 534, is already cost-effective for store's using larger systems. On a purely economic basis, therefore, most large retail food stores should already be saving used CFCs. As noted before, CFCs are rarely vented into the air from these systems unless a catastrophic failure has occurred.

For particular items, such as home refrigerators and freezers and motor vehicle air conditioners, CFC emissions may occur primarily at disposal. Refrigerators' hermetic systems are often removed and vented, while junked cars' air conditioning systems are usually vented during dismantling or scraping. Because these systems generally contain less than three pounds of CFC per unit, dismantlers and disposers do not take the time and trouble to save the systems' remaining charge. Unless, the price of refrigerant goes up substantially, recovery and recycling at this point in the products life would probably have to be mandated by government to protect the environment.

The Development of Alternative Technology. To enable many refrigeration and cooling units to operate using reduced CFC-charges and chemical substitutes, to allow access for recovery and recycling, and to leak less CFC into the air during operation, it may be necessary to either redesign existing systems or approach the need to cool and freeze from new perspectives.

Alternative technologies have been developed and are being marketed for both home and retail food store refrigeration systems. On the home front, separate CFC systems can be used for the refrigerator and freezer. The refrigerator evaporator is designed to keep the department at the required temperature using HCFC-22 (a low ODP formulation), thereby limiting the need for CFC-12 to the freezer unit. In addition, freezer units could be redesigned to use Du Pont's HFC-134a (a non-depleter) instead of potent CFC-12.

United Energy (Maine) has developed a two-stage, two-temperature, single compressor refrigerator cycle with thermal ice storage. This refrigerator uses CFC-22 and is currently undergoing tests. It may cost a bit more, is considered more energy efficient, and will considerably reduce the ODP impact of emissions.

United Energy has also developed and marketed a simplified retail food store refrigerator known as the Modularized Energy Processing System (MEPS). This system has a two-stage compressor cycle, is much more compact, uses only a fraction of the conduit and piping conventional systems require (thereby reducing leakage points), uses about 1/10 the amount of refrigerant as conventional systems, and costs much less to purchase and maintain. MEPS is apparently selling well.

Better Servicing Standards to Reduce Unintended Emissions. In several cases, the venting of CFCs during routine servicing is not cost effective. However, many service people do so because that's the way they've always done it. Recovering CFCs adds another dimension to the job of servicing air conditioners, chillers, and refrigeration systems and individual workloads often pressure service people to move on to the next customer as quickly as possible. It is easier, in many cases, to simply vent old CFC and charge the customer for new CFC, than to pump out the old CFC, save it while servicing, and then pump it back in again.

If replacement prices for CFCs increase substantially in the years to come, customers may insist on reuse of existing refrigerants to save on their servicing bills. Otherwise, better servicing standards may have to be mandated by government in order to protect the environment.

CONCLUSIONS

It is apparent from recent scientific data that use of CFCs is resulting in emissions which have already significantly depleted the earth's ozone layer and unless CFC emissions are reduced completely, chlorine present in the stratosphere will continue to increase over the next century.

Trade associations, manufacturers, and other industry groups are now moving to reform the market for CFCs. Current restrictions on CFC production and consumption are likely to be tightened. The development and marketing of substitute chemicals, such as HFC-134a for CFC-12, is already accelerating. The price of refrigerating and cooling may increase significantly in the years to come as more systems will need to be redesigned to run on reduced charges or on more expensive substitutes. Environmentally safer products may engender economic tradeoffs, as well.

Recovery and recycling of CFCs will reduce emissions in the short run and will help to ease the transition to an economy and society significantly less dependent on CFC usage in the future. Recovery and recycling should already be routine in those cases were it is cost effective. In cases where CFC are routinely vented into the air, recovery and recycling should be encouraged or recycled.

While California accounts for the highest CFC consumption in the United States, and while the U.S. accounts for the highest consumption in the world, the global problem of ozone layer depletion will not be solved unless there is substantial worldwide participation in CFC production and consumption restrictions. It is clear, however, that the alternative of doing nothing while waiting for everyone to agree on the method may lead to catastrophic environmental impacts and significant dangers to life on our planet.

A CFC-OZONE LAYER CHRONOLOGY
(1928-1988)

1928 Chemists in the General Motors research labs synthesize CFC-11 and CFC-12 as nontoxic, nonflammable refrigerants.

1957 The British Antarctic Survey begin estimating ozone above Halley Bay.

1971 The U.S. Department of Transportation sets up the Climatic Impact Assessment Program to investigate the threat posed to the ozone layer by nitrogen oxides and other emissions from the exhausts of SSTs.

1972 CFC-11 and CFC-12 are detected throughout the troposphere.

1974 Professor F. Sherwood Rowland and Dr. Mario J. Molina of UC Irvine theorize that CFCs rise to the stratosphere and destroy ozone. They predict, at existing CFC production rates, 7 to 13 percent of the ozone layer will be destroyed in 100 years, increasing UV light, raising skin cancer rates, damaging crops, and leading to significant global climatic changes. They urge ban on CFCs as aerosol propellants. (Summer)

Du Pont, major CFC manufacturer, announces plans to finance studies of the problem over a three year period. Du Pont's position is that there is no data to back up the Rowland-Molina theory. (Summer)

National Academy of Sciences (NAS) announces it will conduct a full-scale investigation of the ozone layer hazard. (Autumn)

The Subcommittee on Public Health and Environment of the U.S. House Committee on Interstate and Foreign Commerce hold two days of hearings to consider banning or regulating CFC production. (December)

1975 A task force, created by President Ford's Council on Environmental Quality and the Federal Council for Science and Technology, reports that CFC emissions were a legitimate cause for concern and that CFC use should probably be restricted. (June)

The State of New York requires aerosol spray cans to carry a label stating that they contain CFCs which may harm the environment. (Summer)

1976 NAS reports, among other things, support of the Rowland-Molina theory, predicts a seven percent decline in the ozone layer at the 1973 CFC emissions rate, and discusses the "greenhouse effect" caused by CFCs and other gases. However, NAS states that CFC regulation is not needed in the near future. (September)

President Ford's Chairman of the President's Council on Environmental Quality rebukes the Academy's report and calls upon federal regulatory agencies to develop rules to restrict discharge of CFCs into the air. He comments are immediately echoed by the Environmental Protection Agency (EPA) and the Consumer Products Safety Commission. (September)

Balloon measurements in the stratosphere detect the presence of chlorine monoxide - a compound formed by the reaction of chlorine and ozone.

1977 Regulatory agencies call for banning bulk manufacture of CFC propellants by October 1978, for banning manufacture of aerosol products containing CFCs by December 1978, and for prohibiting interstate shipment of existing stocks of these products by April 1979. (Spring)

Oregon bans the sale of spray cans containing CFCs. (March)

The National Oceanic and Atmospheric Administration (NOAA) concludes from their stratospheric measurements that chlorine plays a much greater role in ozone layer depletion than previously believed. The potential for CFCs to deplete the ozone layer goes back up. (Summer)

1978 EPA proposes a timetable for reductions in the non-aerosol uses of CFCs. (The plan was shelved soon after when it appeared that suitable substitutes for CFCs would be expensive and hard to come by. EPA also decided that further regulatory action in the U.S. should be deferred until other nations reduce their use of CFCs). (Summer)

Major CFC-producing nations of Europe, as well as Japan and Soviet Union, refuse to take regulatory action. Only Sweden, Canada, and Norway join the U.S. in enacting measures to reduce CFC emissions.

1979 NAS issues a second report predicting, if CFC emissions continue at 1977 rate, an eventual 16 1/2% depletion of the ozone layer. NAS also warns that increased UV radiation, in addition to causing significantly more skin cancer, could have intolerable consequences for the world's food supply by reducing crop yields, killing the larvae of seafood species (including crab and shrimp) and destroying microorganisms at the base of the marine food chain. The report urges international cooperation to immediately reduce CFC emissions.

On the same day, Du Pont issues a statement declaring that ozone depletion by CFCs is not based on actual scientific measurement but on theoretical calculations.

The Stratospheric Research Advisory Committee conducts a study for the United Kingdom's Department of the Environment which concludes that the validity of the Rowland-Molina theory remains in doubt because of the many uncertainties still prevailing in the knowledge of stratospheric chemistry and in modeling technology.

1980 The Council of the European Economic Community, asked each of its member nations not to increase CFC production capacity and to achieve a 30% reduction in the use of CFCs as aerosol propellants by 1982. (March)

Representatives of Canada, Denmark, West Germany, the Netherlands, Norway, Sweden, and the Commission of the European Communities call upon all major CFC-producing nations to reduce emissions. (April)

EPA proposes to freeze annual U.S. production of CFCs at the 1979 level and the United Nations Environment Programme recommends that its member governments reduce CFC uses and not increase production. (April)

Japan announces that it intends to take similar action (September)

A lobbying group called the Alliance for Responsible CFC Policy, made up of producers and industrial users of CFCs, is formed to fight further attempts to regulate CFCs without sufficient scientific data. (Summer)

EPA announces its proposals to restrict CFC production, require their recovery and recycling, and place a ceiling of total CFC production established through a system of permits. (October)

1981 EPA backs away from announced proposals and embarks on a re-evaluation of its entire CFC position. Draft bills are introduced in Congress to shift EPA's focus away from regulation and toward research. (Summer)

NASA's Nimbus 4 and Nimbus 7 satellites indicate that ozone at the 25 mile altitude of the stratosphere had been depleted by several percent between 1970 and 1979. (Summer)

The Chemical Manufacturers Association releases a report which indicates atmospheric ozone levels had actually increased during the 1970s and that there had been a 20% decline in worldwide CFC production. (October)

1982 The NOAA reports that atmospheric ozone declined by one percent between 1961 and 1980, and Rowland announces findings that CFC concentrations in the atmosphere have almost tripled within the last ten years (April)

NAS issues a third report which upgrades the danger of increased skin cancer incidence, predicts painful irritation of eyes and adverse effects upon the human body's immune system. (April)

1984 A fourth NAS report reduces the eventual ozone depletion caused by CFCs to two-to-four percent and predicts actual ozone concentration in the atmosphere may rise by one percent over the next few decades. (February)

The NOAA reports that during the first half of 1983 a drop of between five and seven percent occurred in ozone concentrations over the Northern Hemisphere. (Autumn)

The British Antarctic Survey describes large losses of ozone above Antarctica since 1977 during October of each year. (December)

1985 NASA's Nimbus 7 satellite confirms the British Antarctica observation. The satellite's data indicate a 40% loss of ozone in October 1983. (Later data indicate a 60% loss in October 1985.) A new analysis of data collected between 1978 and 1984 shows that there has been a decline of ozone over that period in all global latitudes. (April)

Allied Corporation, the second largest U.S. CFC producer, reports that linkage between CFC emissions and the Antarctica problem is speculative.

The Vienna Convention for the Protection of the Ozone Layer meets under the auspices of UNEP and calls for a worldwide conference to agree on methods for reducing the production and consumption of CFCs.

1986 EPA releases its Stratospheric Ozone Protection Plan to determine need for additional CFC regulation and states that it doesn't accept, as a precondition for decision, verification that ozone depletion is occurring. (March)

1987 "The Montreal Protocol on Substances that Deplete the Ozone Layer" is signed by 24 nations to, among other measures, limit CFC production and consumption to 1986 levels and to reduce production and consumption by 35% and 50%, respectively, by 1998. (September) (To date, the Protocol has not been ratified by the required number of nations. If it is ratified, it takes effect January 1, 1989. Du Pont and the Alliance for Responsible CFC Policy support the Protocol.

EPA proposes rules generally following the timetable of the Montreal Protocol, place consumption quotas for producers and importers, place production quotas for producers, and allocate permits to producers. Becomes effective if Protocol is ratified.

1988 NASA's Ozone Trends Panel, made up of more than 100 scientists, reports that ozone depletion over the United States was 1.7% to 3.0% during the Summer between 1969 and 1986 and from 2.3% to 6.2% during the Winter. Ozone depletion was much greater in Arctic and Antarctic zones. (March)

Du Pont revises it position, as a result of Ozone Trends Panel data and advocates additional steps to be taken for protection of the ozone layer. Du Pont sets as its goal an orderly transition to the total phaseout of fully halogenated CFC production. (March)

EPA reports that, even with 100% global participation in the Protocol, chlorine in the stratosphere is projected to triple by 2075 and that an immediate elimination of all CFC compounds would be needed to stabilize chlorine at current levels during the next 100 years. EPA Administrator Lee Thomas calls for ratification of the Montreal Protocol and then a move toward complete phaseout of CFCs. (September)

Du Pont announces its intention to mass produce HFC-134a as a non-ozone depleting substiturte for CFC-12 (September)

UNEP reconvenes member nations to a conference at The Hague, Netherlands to review recent scientific data and to consider acceleration of the Montreal Protocol's CFC production and consumption reductions. (October)

CHAIRWOMAN SALLY TANNER: Good morning. I am Sally Tanner. I chair the Assembly Environmental Safety and Toxic Materials Committee. I would like to welcome you to this interim hearing on the impact of chlorofluorocarbons, or "CFCs" on the Earth's ozone layer.

Depletion of the ozone layer and the potentially catastrophic results of that depletion have become, perhaps, the most pressing environmental problem facing the world community.

The solution is made all the more difficult, because the very compounds that are causing the destruction of our ozone layer are those upon which we, as a society, have become so greatly dependent. Every air conditioner, every refrigerator and freezer, many hot food containers, much of our home insulation and the cleaning agents used by the electronics industry all apparently contribute significantly to this grave global dilemma. National and international actions are now being taken to reduce the production and consumption of CFCs and to limit their emissions into the air.

Californians are, by far, the greatest consumers of CFCs in this country. For instance, there are approximately 18 million motor vehicles in this state equipped with air conditioning units which employ CFC-12. For this reason, California needs to address its responsibility to help preserve our earth's vital ozone layer.

The Committee will be hearing testimony today from the very people who are the most active in pursuing solutions to the problems caused by CFC usage. There is testimony from individuals who are experts on the topic of how use of CFCs result in ozone layer depletion and how to recover and recycle these compounds to keep them from being emitted. The Committee will also hear from individuals who represent industries which manufacture CFCs and heavily depend on these compounds.

This hearing should be educational to the Members of the Committee and will provide us with an opportunity to more closely examine the problems of ozone layer depletion caused by CFCs.

Last year, Senator Rosenthal, introduced a bill that addressed CFCs in refrigeration. The Committee looked at the bill and felt that we needed much more education on the subject, that most of us were fairly ignorant on the subject. Senator Rosenthal was very gracious when we decided to ask him to drop the bill, for the moment, so that we could have an interim hearing.

I would like to introduce Senator Rosenthal. And I ask you to make a statement, if you wish, Senator.

SENATOR HERSCHEL ROSENTHAL: Thank you, Chairwoman Tanner and Committee, for hosting this forum, and thank you all for coming.

I'm looking forward to hearing from the witnesses from the business, the scientific and the environmental communities in where we are now, and where we should be going, on the issue of ozone depletion.

Based upon what we now know, the case against CFCs is strong and the need to mitigate the damage they've caused is almost irrefutable. Because California is one of the world's largest markets for CFCs, the state can, and should, explore strategies that go further than the "Montreal Protocol" to curb

CFC emissions.

In particular, I'd like to hear specific comments today on the feasibility of recycling CFCs used as refrigerants and coolants, which was the emphasis of my legislation last year. And I hope we will hear about the progress in the development of CFC alternatives with less ozone depleting potential.

And with that, thank you very much, and we might just as well go on with the hearing.

CHAIRWOMAN TANNER: Thank you, Senator.

Our first witness is Dr. Kathleen Wolf. She is a CFC emissions expert. She's going to give us an overview of CFC ozone problems and the emissions reduction options. Dr. Wolf.

<u>DR. KATHLEEN WOLF</u>: Thank you. It's a pleasure to be here.

CHAIRWOMAN TANNER: Yes. I would like for you to identify yourself.

DR. WOLF: Can I try it without the microphone?

CHAIRWOMAN TANNER: We have to have the microphone.

CHAIRWOMAN TANNER: All right?

DR. WOLF: All right.

My name is Katie Wolf. I work for several different organizations. I'm the Project Manager of The Source Reduction Research Partnership. I'm a Consultant for the Rand Corporation in Santa Monica. In that capacity, I work with the UCLA Center for Hazardous Substances Control.

The remarks that I make today are my own, and they don't represent the opinions of any of the organizations where I work.

I am going to talk (inaudible) about a thing that I've studied for many years, and that is the use emissions and control measures for ozone depleting substances. I'm sure most of you are familiar with this, but I thought I would give you a review, a little background on ozone depletion, in case that many people in the audience aren't familiar...

CHAIRWOMAN TANNER: ...Actually, I think most of us would like to hear as much as you can tell us, because we are not too familiar with the subject.

DR. WOLF: In 1974, two professors at the University of Irvine, Roland and Molina, hypothesized that the fully-halogenated CFCs -- and at the time, CFC-11 and CFC-12 were the most widely-used CFCs -- were very stable chemicals, that they did not break down in the lower atmosphere for many, many years, perhaps 100 years, and eventually, they reached the stratosphere of the upper atmosphere, which is up about 15 kilometers. When they reached the stratosphere, ultraviolet light impinged upon them and they decomposed, liberating their chlorine. This chlorine was available then to undergo a series of catalytic reactions with ozones, depleting the ozone layer.

Now, I'll show you a little more about what's involved with with this project. (Away from microphone)

CHAIRWOMAN TANNER: ...We're having difficulty, because we can't tape when you're not at the microphone. Mrs. La Follette has a question.

ASSEMBLYWOMAN MARIAN LA FOLLETTE: Could I ask you a question? Is there any other kind of atom that has as close an affinity, or a natural affinity, for your chlorine atom? Would there be any other way, instead of the chlorine joining up with the oxygen, having some other atom up there that might attract it more than the oxygen?

DR. WOLF: Well, indeed, bromine is more effective in depleting the ozone than is chlorine. There are some chemicals that contain bromine that are fully halogenated that do pose a greater threat to ozone depletion.

ASSEMBLYWOMAN LA FOLLETTE: Okay, but what about on the positive side? To neutralize it.

DR. WOLF: To neutralize it. Well, the trick would be to find something with a very long atmospheric lifetime. The longest atmospheric lifetime chemicals are the fully halogenated, either chlorofluorocarbons or other species. So, I can't think of any way that that could be done.

You know, people do hypothesize. Coming from L.A., I'm particularly aware of the fact that we have a great deal of ozone in the troposphere, or lower atmosphere, otherwise known as, "smog". If some way could only be devised to pump that ozone in the lower atmosphere to the upper atmosphere.

DR. WOLF: ...we would have our solution. I'm really joking; that isn't a true technical solution.

Now, I just thought I would outline some of the consequences of ozone depletion, here, although I'm sure others will talk about those in much more detail.

We have a possibility of an increased incidence of skin cancer if the ozone depletion occurs in the frequency range that I indicate there. It's one of the ultraviolet frequency ranges, which is where ozone depletion occurs. Various kinds of skin cancer can result. There are two kinds that are rarely fatal: squamus cell and basal cell carcinomas. Another kind is not as strongly linked with ultraviolet radiation, but there is some sense, now, among epidemiologists that it may be related to exposure to the sun, and that, of course, is melanoma, a very serious kind of skin cancer that is often fatal -- almost always.

There can also be an increased incidence of cataracts. It can affect the eyes. Various immune deficiencies can result from increased ultraviolet radiation reaching the earth: plants, aquatic organisms can be damaged, and plastics become weathered. Also, I mentioned the smog in Los Angeles: depletion of the ozone layer in the upper...

CHAIRWOMAN TANNER: Doctor, when the plastic is affected, does the CFC emit from the plastic at that time?

DR. WOLF: No. I was speaking more about how, if you have less of an ozone layer, more ultraviolet radiation will reach the earth, and the ultraviolet radiation, itself, will damage the plastic.

CHAIRWOMAN TANNER: But, when the plastic is being damaged, there's no emission from that plastic?

DR. WOLF: I suppose if it were blown with CFC -- for instance, the McDonald's cartons, that were somewhat affected recently --it would be possible.

CHAIRWOMAN TANNER: Okay.

DR. WOLF: And then, of course, there's an interaction of the ozone-depleting chemicals in the "greenhouse effect", as well, the warming of the earth. They also contribute to the "greenhouse effect".

There are a variety of substances that can have an impact on the ozone layer. I've listed them in three categories, here: The first set is the set that I'll focus on in the balance of my remarks. That includes the fully-halogenated CFCs -- what are called, halons which are brominated chemicals, and various other chlorinated species.

The other categories of substances that increase ozone are carbon dioxide and methane. Carbon dioxide, of course, is also responsible for the "greenhouse effect".

Nitrous oxide is an interesting chemical because, depending upon the chemical reactions that occur in the upper atmosphere, it can either lead to an increase or a decrease of ozone.

I just wanted to focus on the first category, here. I've listed the fully-halogenated CFCs that are most widely used: CFCs 11, 12, 113, 114 and 115. Then we have the halons, which, once again, as I mentioned before, contain bromine, and thus are thought to pose a greater threat to the ozone than do chlorinated chemicals, halons 1211, 1301 and 2402.

Other substances that, in principle, deplete the ozone, are CFC-22, which is not a fully-halogenated CFC-111 trichloroethylene, which I've called TCA, here -- it's otherwise known as, methalchloroform; it's a solvent, and carbon tetrachloride.

CHAIRWOMAN TANNER: What are halons used in?

DR. WOLF: I was going to get to that. Halons are primarily used as fire extinguishers. Virtually all of the computer rooms in the United States have what are called, "Halon 1301 Total Flooding Systems". The advantage of using this sort of fire extinguisher when you have an electronics fire is that the extinguisher, itself, does not damage the electronic equipment, which many other fire extinguishers do. It's also non-hazardous to people if they're caught in the room. So, it's a very good fire extinguisher.

I've just listed, here, the ozone depletion potential of many of the substances that contribute to ozone depletion. Actually, the ozone depletion factor is a number that was derived to represent the potential for depletion of ozone of each of these substances, relative to that of CFC-11 and CFC-12, which are set at 1. As you see, CFC-113 and CFC-115 are slightly less strong ozone depleters than are CFC-11, CFC-12 and CFC-114. As I mentioned before, the halons that contain this bromine have much higher ozone depletion factors -- 10 and 3 and 6, as you see there.

The reason that CFC-22 has not been much of a focus in the regulation or in the "Montreal Protocol" is because it is not fully halogenated. This is reflected in its ozone depletion factor, there, of .05; it's five percent of the ozone depletion factor of CFC-11, which is very low. The same holds true for 111 trichloroethylene, the solvent; it has a very low ozone depletion factor of .1.

Carbon tetrachloride is fully halogenated; it has a very high ozone depletion factor. The reason it's not focused on in the regulation of the "Montreal Protocol" is that nearly all of it is converted in a chemical process to other chemicals. Ironically, it's used as a precursor chemical in the production of CFC-11 and CFC-12. Virtually none of it is emitted to the atmosphere.

I just wanted to show you the production levels of these chemicals in the United States. I show you CFC-11, CFC-12 and CFC-113. CFC-114 and CFC-115 are manufactured only in small quantities -- roughly 9,000 metric tons for each, in 1985. As you see, also, halons 1211 and 1301 have low production levels. And by the way, those numbers are reversed -- it should be 5.4 thousand metric tons for halon 1301, and 2.7 for 1211. In spite of the fact, however, that there production values are very low, people have focused on them because they contain bromine and their ozone depletion potential is much higher.

What you have to do to decide how damaging a chemical is, is multiply its production level by its ozone depletion factor. That gives you an idea of the relative potential for depletion of these substances.

TCA I've shown there, as well -- 111 trichloroethylene -- because its production level is very, very high.

CHAIRWOMAN TANNER: So, when we talk about phasing out the use of CFCs -- and a great deal of study has been done, and is being done -- are we also talking about the bromines?

DR. WOLF: Yes. The halons are included in the domestic regulation and in the "Montreal Protocol". Yes, they are.

I just wanted to show some of the wide-ranging uses of these CFCs, because no one should make a mistake. They are extremely valuable chemicals to our society and to our industrial base. CFC-12 is, of course, used in automobile air conditioning; that's the highest use of the CFCs. CFC-12 is also used in retail food refrigeration equipment, in grocery stores, to keep food cold. Another chemical, which is an azeotrope, a blend of two of the CFCs, called CFC-502, is also used in retail food stores.

In air conditioning, there is a wide-ranging use of the CFCs. Virtually all of them are used to air condition buildings. CFC-22, which is not the subject of regulation, is used in home air conditioning.

I brought a piece of flexible foam to show you. Flexible foam is manufactured with CFC-11, as an auxiliary blowing agent. Virtually all of it is emitted in the production process, so that there is none left of it when the flexible foam is produced.

CFC-11 is also used in the production of rigid foam insulation, the insulation in buildings. CFC-12, of course, is used as a blowing agent in packaging foam; we heard much about the McDonald's cartons, in the last year.

The halons 1211 and 1301, are used as fire extinguishers. I mentioned how halon 1301 was used in total flooding systems. Halon 1211 is used in the hand-hand fire extinguishers and the small fire extinguishers that you can buy to put next to your computer at home -- those are halon 1211.

CHAIRWOMAN TANNER: I would guess those fire extinguishers...that doesn't happen too often, does it?

DR. WOLF: That's right.

CHAIRWOMAN TANNER: So that the problem with emissions isn't too great, in that case.

DR. WOLF: They need to test the system, and they're looking at alternative substances to use to test them. You see, to test them, they're supposed to fill the room up to five percent of that substance, to make sure that the room is intact, in case of a fire -- that it doesn't leak.

CHAIRWOMAN TANNER: Then what happens is that they can't recover it?

DR. WOLF: That's right. They are looking at using alternatives for that.

CHAIRWOMAN TANNER: I see.

DR. WOLF: At one stage, in the early years, they were using CFC-12 as an alternative for that, primarily because the halons are much more expensive. The workers who were testing the system...The CFC-12 displaced the oxygen and they had acute responses. So, they looked at other things, at this stage. Also, they can be inadvertently discharged, which doesn't happen frequently.

CHAIRWOMAN TANNER. Yes. I wouldn't think so.

DR. WOLF: Or they can be discharged, in the event of a fire, mainly. Then, there is a small amount of leakage, but it's minor.

CHAIRWOMAN TANNER: So, the testing is really where the emissions are greatest, right?

DR. WOLF: Well, the emissions probably would be greater in the case of inadvertent discharges in fires, because there is a larger amount.

CHAIRWOMAN TANNER: But, there has to be testing done?

DR. WOLF: Right.

CHAIRWOMAN TANNER: ...every installation of...

DR. WOLF: Right.

CHAIRWOMAN TANNER: Okay. Then there isn't a fire in every...?

DR. WOLF: No. That's true. In the 1930's, Dupont chemists discovered CFC-11 and CFC-12. After that, in the years that followed, they found many, many uses for them, and I've just represented some of them, here. We had home refrigerators, as Doug Schultz from Dupont pointed out to me, much earlier than the 1940's, but that was the time when everybody started buying refrigerators. Then, we had aerosols introduced just after the mid-1950's -- everybody remembers aerosols. Solvents are our more recent introduction. Halons entered the market in about 1972, when people found that they were excellent fire extinguishers.

To try and understand how use and emissions are interrelated, you must understand the characteristics of the products, because use is not necessarily equal to emissions, in all cases. There are, in fact two types of different uses: Uses where the CFC is emitted promptly, when the product is first manufactured or a short time thereafter. In the case of aerosols, for instance -- aerosol cans -- the CFCs used in them were emitted promptly; they were emitted right away when you used the aerosol. The same hold true of solvents, for the most part; most of the solvent is used and emitted right away.

Then you have other kinds of products where the CFC is not emitted promptly, things like halon fire extinguishers and things like rigid foam insulation in the walls of buildings. All of that, the CFC-11 used in walls, in rigid insulation, is probably not emitted until the building is demolished.

CHAIRWOMAN TANNER: The solvents that are used...There is no way to recover the CFC?

DR. WOLF: Yes, they are routinely recovered today.

CHAIRWOMAN TANNER: I misunderstood then. The emissions are great, but they are recovered?

DR. WOLF: Emissions are a very large fraction of the total amount used, and you sometimes can recover the emissions. That is not done as frequently as the waste liquid solvents; that is usually recycled and fed back into the process.

CHAIRWOMAN TANNER: Okay.

DR. WOLF: There is more potential for doing things, there. But, it can't necessarily all be captured cost-effectively. That's a tricky one.

Just to give a historical perspective, because it wasn't always thought that CFC really did deplete the ozone layer, there were a bunch of changes, as time went on. Originally, when Roland and Molina hypothesized their theory of ozone depletion in 1974, there was quite a lot of panic. The National Academy of Sciences instituted several studies, where they looked at ozone depletion, and looked at whether or not ozone was being depleted. In those early years, from the first studies, they concluded that ozone depletion in the next century would be substantial, like 15% to 17%.

Then, in response to that, the U.S. put in a ban on use of CFC-11, CFC-12 and CFC-114 in aerosol application. We unilaterally banned CFC use for that purpose. We thought we had taken care of the problem and, indeed, later National Academy studies indicated that ozone depletion would be much less than we had thought, probably no more than two percent, if at all, by the next century.

Then, we discovered the Antarctic ozone hole in 1985, and everybody realized that we didn't know what was going on any longer. So, we began looking into it further. Then, there were a series of international meetings -- and I was fortunate to attend one of the first on control technologies, which was held in Rome so I was truly fortunate.

CHAIRWOMAN TANNER: Really fortunate.

DR. WOLF: In September of 1987, an international agreement was reached. That was quite a thing, because it's very difficult with one of these global issues to get all nations -- or at least, the nations that you see substances the most heavily -- to agree on something. So, it was quite a landmark thing. Then, EPA followed the September 1987 agreement with a proposed regulation in December of 1987.

Dupont came out in early 1988, and supported a total phase-out, because more information became available, that simply capping production, like the "Montreal Protocol" and the domestic regulation wanted to do, would not be sufficient. Then, EPA in August of 1988, promulgated its final regulation -- and I'll talk a little bit about that.

Before 1987, as I've already mentioned, the U.S. unilaterally banned the use of CFC-11, CFC-12 and CFC-114 in aerosols.

CHAIRWOMAN TANNER: Mrs. La Follette has a question.

ASSEMBLYWOMAN LA FOLLETTE: Yes. I want to go back to the Antarctic and the Artic.

DR. WOLF: Okay.

ASSEMBLYWOMAN LA FOLLETTE: Were any theories developed, as to why there was more of a concentration of CFCs?

DR. WOLF: The consensus is that it's related to long-term ozone depletion and that the ozone-depleting substances are responsible.

Early on, no one really knew whether it was a transient phenomena, or whether it was linked to long-term ozone depletion. One of the things that it really brought out was that we didn't understand what was actually occurring in the atmosphere, that the atmospheric models did not predict the Antarctic and the Arctic ozone hole. So, people went back and tried to come up with other explanations and to re-vamp the models.

As I said, there is a consensus now, that the Antarctic hole is related to long-term ozone depletion, and that regulating CFCs will have an effect on that.

ASSEMBLYWOMAN LA FOLLETTE: Can CFCs be produced naturally at all?

DR. WOLF: No, I don't believe they are. I could be wrong about that. I mean, there might be minute quantities, but they are synthetically produced chemicals.

ASSEMBLYWOMAN LA FOLLETTE: Dr. Wolf, why the hole in Antarctica?

DR. WOLF: Well, there are several theories.

ASSEMBLYWOMAN LA FOLLETTE: I'm really curious about that.

DR. WOLF: I'm not an expert on the atmospheric, and I wouldn't like to speak out on that.

CHAIRWOMAN TANNER: Oh. I hope there is someone here who maybe can respond to that.

DR. WOLF: Really, they believe...

ASSEMBLYWOMAN LA FOLLETTE: Yes, tell us what they believe.

DR. WOLF: They believe that heterogeneous reactions are occurring, instead of homogeneous, which was always assumed in the atmospheric models. It's because of the cloud particles and the vapor that's present in the Antarctic that they now believe causes the ozone depletion.

ASSEMBLYWOMAN LA FOLLETTE: Does the temperature have something to do with it?

DR. WOLF: Yes, probably, the temperature does, as well. Yes.

ASSEMBLYWOMAN LA FOLLETTE: In other words, it really sounds like we don't have answers yet.

DR. WOLF: Oh, I don't think that we really do have an understanding. But, you know...I'm not certain that it matters. The thing I'm very interested in is that, ultimately, a consensus is reached -- a societal consensus.

ASSEMBLYWOMAN LA FOLLETTE: But, you ask us to make a consensus, or to make some kind of policy decisions, and to me, it seems very pertinent and of value to know why an area that is not populated has a higher concentration of CFCs than an area that is populated. I think we need to have some answers to that.

DR. WOLF: It may not have a higher concentration of CFCs, but it may be conducive to the chemical reactions that occur, causing such a hole.

But, I meant by the consensus, we don't have a full understanding of any of these concepts, but there is a societal consensus that ozone depletion is occurring and that the fully-halogenated CFCs and the halons are, at least in major part, responsible.

The European economic community also acted. They put a capacity cap on their CFC production capability. I evaluated this in a study that I did when I was at the Rand Corporation, and I found that it would not be effective for several years, because the amounts that they were producing would never exceed that capacity cap until the 1990's. So, it was largely ineffectual. They also put some good operating practices into a policy document.

By the way, it's interesting that other countries have different value systems about where their CFCs should be used.

They feel, for instance, that CFCs are extremely valuable in aerosols, whereas we decided that they were not so valuable, and we banned them in those applications.

They don't, of course, in the rest of the world, use automobile air conditioning as much as we do, at all. They also don't have retail food refrigeration equipment in their stores; they go on a daily basis to pick up their fresh food. So, we use CFCs in different ways and have decided that that's our value system. The Europeans still have not banned CFCs in aerosol applications.

The "Montreal Protocol", as I mentioned before, focuses heavily on the fully-halogenated CFCs, the five of them, and the three halons. It caps production of the fully-halogenated CFCs at 1986 levels, beginning January of next year. That will go into effect in July of next year. It then decreases the production of those CFCs to 80% of the 1986 level by 1993, and it decreases production of the halons, beginning in 1992.

CHAIRWOMAN TANNER: It doesn't phase the CFCs out, altogether, then?

DR. WOLF: No, it does not.

SENATOR ROSENTHAL: Dr. Wolf, a question: If all of the "Montreal Protocols" are implemented, do you think there is anything further that we should be doing, that our government should be doing, to reduce emissions?

DR. WOLF: Well, I think...

SENATOR ROSENTHAL: Will that do it?

DR. WOLF: No, it will not. I believe that Dupont has taken a position that that will not do it, and so has Lee Thomas, who is head of the Environmental Protection Agency. Dupont, of course, as you know, the largest CFC manufacturer, has agreed to voluntarily phase out the CFCs, probably within a decade.

SENATOR ROSENTHAL: The EPA has...

DR. WOLF: "Waffled."

SENATOR ROSENTHAL: "Waffled," yes. They have two different kinds of positions. Are they in favor of recycling CFCs?

DR. WOLF: They're not promulgating a regulation. But, I would have to answer that sort of indirectly: What they are doing is capping production. When they cap production, demand will exceed supply, and the price of the CFCs will increase. I think it's their belief that recycling will be instituted, because the chemicals will be more valuable, and they will be less available. So, people will adopt recycling as part of their economic incentives policy. They are economists and they are into that sort of thing.

CHAIRWOMAN TANNER: What impresses me is that Lee Thomas, as well as Dupont, the largest producer of CFCs, feels that something really drastic should be done.

DR. WOLF: That's right.

CHAIRWOMAN TANNER: And there should be something done quickly.

The EPA has "waffled"; they really have -- Well, not necessarily the EPA; maybe the National Academy of Science has had one kind of a report, then backed off of that report, and then another kind of a report, and then, of course, the public gets confused, as well as the scientific community. But, the manufacturer -- the main manufacturer -- of CFCs feels that something should be done. And Lee Thomas, who is the Director of the EPA...

DR. WOLF: One of the problems with the "Montreal Protocol" and the regulation that the EPA finally promulgated was that the most recent information wasn't available when those were written, so they didn't accommodate the new scientific understanding that people thought they had. I think, had they written the regulation and the "Montreal Protocol" after that information had been available, they would have asked for a phase-out. It was simply that the timing was not good on that.

But, I think most people are in agreement that CFCs should be phased out within the next decade, now -- and I think we all need to work towards that.

CHAIRWOMAN TANNER: And how much ozone depletion will occur during that phase-out?

DR. WOLF: Well, there are atmospheric models that indicate a bunch of different things, depending upon whether you use one-dimensional models, two-dimensional models, and so on. It does appear that if we leave CFCs in place, at the levels that are specified in the "Montreal Protocol" and the domestic regulation, there would still occur at least a four percent depletion into the next century. So, indeed, we do probably need to phase them out.

CHAIRWOMAN TANNER: All right. You may continue.

DR. WOLF: I was just going to describe the domestic regulation, which completely mimics the "Montreal Protocol." Its form, of course, is a production cap, as I said, and they hope for an incentive -- to offer an incentive to people -- by raising the price of the CFCs, to conserve on it.

I'm addressing the question of whether or not further action is required. As I mentioned, the Ozone Trends Panel document came out after the "Montreal Protocol" and the domestic regulation was promulgated. The difficulty with going back and changing things on an international level is that it's very difficult to get all of the countries to agree to something; there's a whole bunch of stuff that goes on in the background to try to get that to occur. After all, it is a global issue, and we are responsible only for, roughly, one-third of the world.

CHAIRWOMAN TANNER: I recently read that Russia, for instance, would welcome a warmer climate.

DR. WOLF: I'm sure, yes.

CHAIRWOMAN TANNER: And there are other parts of the world that would welcome the "greenhouse effect." I would guess it's pretty difficult to get total agreement. Canada would get our agriculture.

DR. WOLF: There are a whole range of different control options that can be used to either reduce or eliminate emissions of CFCs and halons. They fall into these generic categories that I've listed here: In terms of chemical substitution, we might substitute methylene chloride -- and I'm going to talk about this a little later -- for CFC-11 in the production of the flexible foam. In terms of process substitution, we might use water as a cleaning agent for deflecting printed circuit boards in place of CFC-113 solvents that are used today. Product substitutions might involve using Fiberglas in place of CFC-11 rigid insulation foam in buildings.

We can recycle the refrigerant in refrigeration devices or solvents, and that is routinely done. We can modify the equipment; that's done commonly in the solvent industry. They have better equipment that keeps the solvent more contained. We could make automobile air conditioners less leaky, so that they didn't emit as much CFC-12. We can do better housekeeping things. We cannot vent refrigeration devices when we're working on them.

Finally, we could destroy the CFC, if necessary; we could take the rigid foam insulation in a building and not crush it at the site, take it to a landfill and put it in an incinerator in some way -- cut it up and put it into an incinerator -- if we find that we need to destroy it. Or, we could destroy, by incineration, probably, the halons that are in fire extinguishers today.

The implications of a total phase-out, which seems to be the thing that everyone agrees must occur, ultimately.

CHAIRWOMAN TANNER: I want to stop you, because what you just said made me think -- If we were to ban the use of halons and CFCs -- and currently, there is a great deal that is being used -- If, say, we were to dispose of those, we would have to consider landfill or burning or incineration or some other method of gathering up.

DR. WOLF: That's right.

CHAIRWOMAN TANNER: That's a very large problem, isn't it?

DR. WOLF: Yes, it is. As you know, -- Actually, there is a regulation that requires the asbestos in buildings to be taken to a landfill and to be watered down when the buildings are being demolished. So, in principle, the mechanism exists. I'm not certain how wise it would be to do that -- only if we really found that things were extremely dangerous.

The other thing that I'll comment on a little later, on whether or not -- I don't believe that we should institute a ban immediately because, as I'll show you, I think that some of the products that might be used in place of the CFCs are, themselves, dangerous -- but in a different way -- and that an orderly phase-out is definitely required.

I wanted to point out here that you can adopt all of these options, in the short-term, when you still use the CFCs in recycling, and so on. But, ultimately, the only real option to phase them out is substitution of either the chemical, the process or the product.

Here are some of the substitutes that have been proposed for the fully-halogenated CFCs: CFC-123 is being looked at as a substitute for CFC-11; its characteristics are similar. It could be used in flexible foam manufacturing. CFC-141-B is also being looked at as a substitute for CFC-11, but it has a disadvantage; it is somewhat flammable, and many people will not be able to use it, as a result, because it will pose a workplace danger.

CFC-134-A is my favorite; it is a substitute for CFC-12, and it has virtually identical properties to CFC-12. The advantage there is that you can put it into existing equipment with virtually no modification. The one thing that needs to be changed is that a different oil needs to be used with it, but that will be a minor problem.

CHAIRWOMAN TANNER: What effect would that CFC-134-A...?

DR. WOLF: CFC-134-A doesn't contain any chlorine, so it would not deplete the ozone layer, at all. And CFC-123 and 141-B do contain chlorine, but they are not fully-halogenated, so they decompose in the lower atmosphere and don't pose a threat to the ozone layer.

CHAIRWOMAN TANNER: Mrs. La Follette?

ASSEMBLYWOMAN LA FOLLETTE: So, why aren't we using 134-A now?

DR. WOLF: It's a very new chemical. They've looked at it for many years. For a long time, there was no known manufacturing process. In the early days -- in the seventies -- when the CFC producers were first looking at CFC-134-A, they manufactured three pounds of it, sent it to General Motors, and required General Motors, after they had tested it in an automobile air conditioner, to return the three pounds, because it cost thousands of dollars a pound for them to manufacture.

They've now done a lot more work on finding a production process for, actually, 123 and 134-A, and it's going to be more successful, now. The remaining problem is that CFC-134-A and 123 will be much more expensive than CFC.

CHAIRWOMAN TANNER: I think one of our witnesses will be discussing that.

DR. WOLF: Right. Then, we have 111 trichloroethylene, which can be a potential substitute for CFC-113. As I mentioned earlier, it also depletes the ozone layer, but to a much smaller extent, and it is not included in the regulation or the "Montreal Protocol." And I'm glad that it is not.

CHAIRWOMAN TANNER: It's a toxic chemical, right?

DR. WOLF: Well, I don't know. I mean...

CHAIRWOMAN TANNER: We've sure heard that for years and years.

DR. WOLF: I think you may be thinking of trichloroethylene, TCE.

CHAIRWOMAN TANNER: Yes. TCE, TCA?

DR. WOLF: TCA is much less toxic than TCE.

CHAIRWOMAN TANNER: But, it is toxic?

DR. WOLF: It's toxic, in an acute sense, in that workplace exposure levels must be held lower than that of chemicals that are assumed to be non-acutely toxic.

CFC-502, as I mentioned earlier, is a mixture of two CFCs. It also depletes the ozone layer; it's got an ozone depletion factor of about .3, compared to that of CFC-11. It's used today in retail food refrigeration and could be used in place of CFC-12, but it would also be subject to regulation, because part of it -- the CFC-115 that's in it -- is regulated.

CFC-22 -- For many years, people have thought that CFC-22 could function as a substitute for CFC-11 and CFC-12. But, the problem with that, technically, is that all of the equipment would have to be re-tooled and all of the devices re-designed, because it has very different properties.

CHAIRWOMAN TANNER: Well, I'm going to ask a question that probably isn't too bright: CFCs are chlorofluorocarbons, right?

DR. WOLF: Right.

CHAIRWOMAN TANNER: So, the dangerous element in CFCs is -- what?

DR. WOLF: The chlorine.

CHAIRWOMAN TANNER: All right.

DR. WOLF: Because it's the one that undergoes the catalytic reaction.

CHAIRWOMAN TANNER: Now, you just described CFCs, which are not dangerous. Why are they called "CFCs"? Don't they have chlorine in them?

DR. WOLF: That's probably my mistake. Some of them do have chlorine in them, but they are not fully-halogenated. You see, the ones that we are focusing on, as strong ozone-depleters, contain chlorine as the dangerous atom that undergoes the catalytic reaction, but they also are fully-halogenated; that is, they contain only bromine, fluorine or chlorine -- no hydrogen. These other things all contain hydrogen.

CHAIRWOMAN TANNER: I see. Okay.

DR. WOLF: So that they break down in the lower atmosphere, and they don't survive to reach the stratosphere.

CHAIRWOMAN TANNER: So, if there were legislation to ban CFCs, we couldn't do that, because CFC-134-A is -- you know, if we were to say banning CFCs, that's not correct. We'd be eliminating CFC-12, 11 -- I think that...

DR. WOLF: That's right.

CHAIRWOMAN TANNER: ...would be a difficult thing for...

DR. WOLF: I have mis-labeled these. I should call 134-A "HFC."

CHAIRWOMAN TANNER: That would be better.

DR. WOLF: Because it contains no chlorine; but, then, CFC-123 does contain chlorine -- it's one of the alternatives. But, it's not fully-halogenated, so that is still called a CFC.

CHAIRWOMAN TANNER: Well, I'm glad I asked.

DR. WOLF: So, it's a nomenclature. Yes, it's a good question.

I believe what needs to happen in this phase-out is that there has to be a systems approach to the controls. I have not found that EPA likes to take a systems approach, unfortunately. I think that it is underway, however. We have the alternative CFCs in testing. A consortium of worldwide CFC manufacturers has agreed to test in long-term animal studies -- the two-year animal studies -- CFC-134-A and 123, and they've also recently added CFC-141-B to the list. That, unfortunately, will take a number of years, because the animals don't die for two years, and then you need a couple of years to analyze the results. Unlike in the past, where we've substituted things without looking at the toxicity characteristics, I think this is a very good thing, that we're testing these up front.

The other problem with not taking a systems approach is that other substances that are available on the market to replace these are themselves dangerous, but simply in a different way. I don't think that we should encourage, however inadvertently, movement towards those substances.

Another problem that arises when you want to substitute other things is that there may be impediments to these -- institutional impediments. Military specifications, for instance; they prevent the use of recycled solvent. So, if you want to use an outside recycler and buy back that solvent with CFC-113, you can't, if you're making equipment for the military.

CHAIRWOMAN TANNER: Is the recycled solvent less effective, or unclean, or what?

DR. WOLF: There are various opinions about that. In the past, there have been some irresponsible recyclers -- not Dennis Omera, who is here, of course, but others -- and they have produced recycled solvent of insufficient quality. People have been burned, so they don't want to use recycled solvent. This is a high-purity application, primarily deflecting printed circuit boards.

I, personally, do not believe that properly recycled material will cause a problem. But, changing the military's specs is a huge undertaking. They are actually looking at that right now, and unfortunately, the scheme they've devised is going to make a mistake, and we'll be back where we started, but with more things that you can use on the list. But, they will not actually have addressed the real problem, in my view.

Another problem that can arise if you don't take a systems approach is that you can simply transfer the problem from one medium to another. If, for instance, you decide you want to recover the CFC-11 blowing agent when you make flexible foam, you will absorb it on a carbon bed later, when you desorb it with water, the water will contain small amounts of CFC-11, which will then go into the sewer, instead. So, we don't want to transfer the problem from one medium to another.

Just to illustrate some of these problems -- Really, I feel very strongly about these things, and I devote my life to the study of these things. I believe that we have really done things in a piecemeal fashion, in the past, without accommodating the life cycle of things, without accommodating a systems approach. I think we've done some things that have had terrible, unexpected consequences.

If we look at the case study of flexible foam, for instance -- this foam right here. Today, two auxiliary blowing agents are widely employed: CFC-11 and methylene chloride. As many of you may know, methylene chloride is a suspect carcinogen, and people are trying to move away from it. But, of course, with the regulation coming and all the scrutiny on CFC-11, they can't really move into CFC-11; and, indeed, no one would want to encourage them to do so. So, we're faced with a real dilemma, in this particular industry. The regulations on CFC-11, in my view, will cause people to switch to methylene chloride, and we will have a toxicity problem in the workplace that is greater than the one we have today.

The other controls, unfortunately, are years away. It will be several years before CFC-123 or 141-B can be used as an alternative blowing agent for the flexible foam. Union Carbide is working on an interesting scheme, where they get rid of all the auxiliary blowing agent and just use water as the sole blowing agent. But, that also is probably years away; it's in the "R&D" phase right now. They're re-formulating what are called the "polyalls," which form the backbone of the foam, ultimately.

Another case study that illustrates what I'm talking about...

ASSEMBLYWOMAN LA FOLLETTE: I need to ask a question.

DR. WOLF: Okay.

ASSEMBLYWOMAN LA FOLLETTE: This is another question that's sort of rudimentary, I suppose. What is this flexible agent? What is the biggest use for it -- the most important use?

DR. WOLF: Let's see. It's used in furniture and bedding and carpet underlay -- like the seats you're sitting on.

ASSEMBLYWOMAN LA FOLLETTE: None are essential?

DR. WOLF: Well, do you recall -- you probably don't recall, because you're much too young, but, years ago, when we had...

ASSEMBLYWOMAN LA FOLLETTE: We had coil all over everything, the day the world was created.

DR. WOLF: Remember the coil springs in couches, where if you sat directly on the spring, you would have good buoyancy, but if you moved over to the side, you would sink four feet into the couch? That, and rubberized horse hair were the things we used in the old days.

Today, there are product substitutes for it, as well, but, they're not as desirable -- things like synthetic fiberfill, and other things like that.

ASSEMBLYWOMAN LA FOLLETTE: I won't have that stuff in my house, so I have found other ways not to use it. That's why I'm wondering how vital it is that we have something like that.

DR. WOLF: That foam, once it's fabricated into furniture, doesn't contain any more blowing agent. It's all gone, by that time. It's all emitted promptly in the manufacturing process.

ASSEMBLYWOMAN LA FOLLETTE: Okay. Thanks.

DR. WOLF: Another industry, where trade-offs arise, is as I mentioned already, the solvent use, which mainly involves CFC-113. It's used widely to deflect printed circuit boards. An alternative, to some extent, to CFC-113 in that application, is 111 trichloroethylene. As we discussed a moment ago, it is toxic in other ways, and it may, ultimately, itself be regulated by EPA as an ozone depleter.

I also mentioned the impediments to adopting some of the conservation methods of CFC-113, like recycling, or adopting water. Military specifications also prevent the use of water-soluble fluxes so people cannot really use water as an alternative for removing the fluxes from printed circuit boards, either.

CHAIRWOMAN TANNER: But, is that a good option -- water?

DR. WOLF: Water? Oh, I believe it is.

CHAIRWOMAN TANNER: For Heaven's sake.

DR. WOLF: There are some technical problems that arise. We're moving further and further towards small electronic devices, and what that involves is to mount the components of the printed circuit boards directly on the surface. They didn't used to do that. Now that they're doing that, there is a very small spacing between the surface-mounted components and the board. Water, because of the contact angle, isn't as good at getting under those small components and carrying away the flux, as is CFC-113. So, there do arise some technical problems at some spacing.

Now, what I believe we have to do, as a society, is go back in the fabrication process of the printed circuit boards themselves, and get the designers involved with the toxic chemical use in later parts of the process, and get them to design around that. Because if they just design surface-mount boards that have...

CHAIRWOMAN TANNER: So that the water could reach...

DR. WOLF: Then, we could use water. Of course, you would still have to get rid of the military specifications, if you did that.

Then, alternatives that you might use will effect the other media. The disadvantage, of course, in using water is that it will carry metal and flux elements into the sewer, where they would not otherwise have gone, and that may impact the drinking water. You will have metal concentrations in the sewer that you would not have had there, had you used the solvent.

CHAIRWOMAN TANNER: Where does the metal go to and the flux? Where do they go to with solvents?

DR. WOLF: If you use the solvent, you will probably send your solvent to a recycler. And even if you can't buy back recycled solvent, the recycler will recycle that solvent and sell it back onto the market. He gets a sludge that contains the metal. He mixes that sludge with other solvents and sends it to the cement kiln at Lebec. So, the metals come out in the baghouse dust and are buried on the property of the Lebec cement kiln. It's not entirely safe, either, but they're not entering the water. I just wanted to illustrate that you get things in other media, if you do things a different way.

I tried to address the question of whether or not refrigerant recycling is promising. I believe that it has been cost-effective to recycle refrigerant in large devices, like in chillers and retail food refrigeration units, for at least the last 10 years; we just haven't done it.

Many people say, "Why should we institute recycling of refrigerant if we're just going to identify alternatives to these CFCs?" And my response to that is that the alternatives will be much more expensive than the current CFCs that are used, so it will pay even more, in the years to come, to recycle, if we institute it now, even when those substances are adopted.

I think that we have a number of tricky issues to work out in this. I wish we would not go ahead with this unless we work these things out, in depth. One of the issues that will arise is whether or not the refrigerant is hazardous, and whether or not the grocery stores have to actually manifest that refrigerant when they send it to an off-site recycler.

I've talked to EPA about it. They made a ruling in response to a letter that you did not have to manifest. The California Department of Health Services has indicated to me that they would prefer, as well, that manifesting not be done. I also feel it shouldn't -- I mean...

CHAIRWOMAN TANNER: It's not a toxic.

DR. WOLF: Well, it actually is listed on the RCRA list of waste.

CHAIRWOMAN TANNER: As toxic?

DR. WOLF: As a "U-listed waste" -- what's called a "U-listed waste" -- and that's like an offset product, or something. I don't really know why they originally listed it; there really was no reason for doing so, but they nevertheless did. But, EPA has ruled that this is not an offset product, so it doesn't fall into that category. I don't know if that's a legally binding ruling or not; I suspect it is not, because it hasn't been tried in court. But, informally, at least, the Office of Solid Waste has indicated that it would rather not consider these things hazardous waste.

You see, in the past, what people have done, sometimes, when they're working on these devices or when they're remodeling, is they just take the cap off, and because it's a gas at room temperature, it goes into the atmosphere. So, this issue of hazardous waste hasn't arisen.

If you talk about recycling, you have to pump that refrigerant down into cylinders -- and Dennis will, of course, talk about that, more than I. The question then arises as to whether or not it is hazardous waste if you remove it from the property. You see, I feel it's cost-effective to do this. But, if we put a whole bunch of other things onto people, it will involve additional costs, and it will make it not cost-effective. I think it's much easier to do these.

CHAIRWOMAN TANNER: What you're saying is, be cautious in the kind of legislation that you put together.

DR. WOLF: That's exactly right. I believe that the emissions reduction could be significant from doing this. I did some very quick calculations, and I estimate that there are 2,000 metric tons of refrigerants that could be recycled this way, annually, in California.

One of the most important things that California could do, I think, is serve as a model for legislation in other states or for a piece of national legislation. I think that California uses, roughly, 10% of the CFCs in the nation -- I'm not sure how accurate that number is; I always make the assumption in all my research that California uses 10% of whatever, so I'm just using that one again.

So, that suggests that, nationwide, we could, in principle, recover 20,000 metric tons of refrigerant, annually. I think that's an underestimate; I've only looked at "chillers" -- centrifugal chillers -- and retail food refrigeration devices. There are other places where the refrigerants are used, like trucking refrigeration, and so on, where recycling might be an option, as well. But, that's the best number that I can come up with.

Thank you very much for allowing me to...

CHAIRWOMAN TANNER: Well, Dr. Wolf, I really do appreciate hearing from you. I feel your testimony was excellent. I'm very impressed, and I understand a lot more than I did.

DR. WOLF: Thank you very much.

CHAIRWOMAN TANNER: Thank you very much, Doctor.

Our next witness is Dennis Omera. Mr. Omera is the President of Omega Recovery Services.

Yes, Mr. Omera. Would you identify yourself?

MR. DENNIS OMERA: My name is Dennis Omera. I'm President of Omega Recovery Services in Whittier, California.

Omega has been recycling refrigerants for about 30 years -- or CFCs, of the different issues, both on the solvent and refrigerant basis.

Currently, we're recycling in excess of a couple million pounds a year, here in the United States -- in Los Angeles. We pick up the material from a wide range of sources; we just recently picked up 8,000 pounds from JFK International Airport, and brought it all the way across the country. As far as I know, we're the only ones in the whole country who recycle all the different types of CFCs -- 11, 12, 114 -- CFC-113 is recycled much more frequently by other people, because of the solvent use, but we recycle all the different refrigerants.

I'll try to explain a little bit about what we go through and some of the processes we do in recycling refrigerants, and that might give you a little better background as to what the process really means when you recycle refrigerants or the different CFCs.

Historically, in the past, the reason people recycle material was not from any legislation; it was strictly an economic need. Pacific Telephone, Sears and some of the other larger companies have large installations where they have a couple thousand pounds at a time. Disneyland, in fact, has a centralized unit. What they do is, when a unit goes bad -- you either get a leak in the water tube, or (inaudible) -- it would pump the refrigerant down and send it to us to be recycled. We would recycle it, and bring it back to original specifications, and send it back to them. That's what we've been doing, primarily, for a long period of time.

In the case of other refrigerant users, sometimes we would get the smaller users, who bring the material to us, and we would recycle it and send it to a third party, who would use the material. So, there are two different methodologies where we recycle back to the original user, or recycle to a third party, on the different materials.

Historically, what happened is, the customer would call us up and ask us to pick up his material. I know that Dr. Wolf and I have a little difference of opinion. I will demand that they have an EPA generator's number, or I won't pick up their material. Because of some prior problems in the hazardous waste issue, it is for the protection of not only the generator, but, primarily, as there is a quandary as to whether it is hazardous waste of not, there are U numbers for 11 and 12. And so, consequently, when there's a discrepancy, I don't want to be the one left holding the bag at the end of the issue, where somebody says, ten years later or four years later, retroactively, "Why didn't you have these different materials done?" I think, unfortunately, lately, that has been a common problem. So, what we do is, we then have the person give us his generator's number, we then go out and pick up his waste, bring it in to our facility, process it, and then return it back to him. We do that on that particular basis. In fact, in New York, I couldn't move the material from New York without having JFK have their EPA generator's number. Unfortunately, the problem is that a lot of people -- this building, itself, probably doesn't have an EPA generator's number; yet, they have a tremendous amount of refrigerant sitting at the top of the building. Technically, if they had a problem, I couldn't pick up the material -- at least, I won't -- unless they have an EPA generator's number. Unfortunately, it takes 10 to 18 weeks to get an EPA generator's number.

CHAIRWOMAN TANNER: What about people who are repairing the refrigeration system in a market? The market would have to have a generator's number or the person who does the work?

MR. OMERA: The EPA generator's number is really a site-specific number; you have to get it from each site, at least, that's what the EPA requires. So, the generator at the site must have an EPA number.

CHAIRWOMAN TANNER: So, then, how in the world could those CFCs be recycled?

MR. OMERA: Well, historically, most of our larger customers have gotten them, as well as the commercial service men have gotten EPA generators' numbers and they then take title to the material themselves and use their generator's number to get it.

CHAIRWOMAN TANNER: So, the service men have the EPA.

MR. OMERA: They use it. They'll take title to it and use their responsibility to take the material. The reason why -- Katie addressed it rather well -- there has been some discrepancy...One department at EPA says one thing and another one does another and then we, potentially, get caught in the middle.

So, what happens is that we recycle that material on a manifest, bring in the manifest, and then return it back to them under normal shift, because you now have to have a manifest go back when the material is finished as a product.

CHAIRWOMAN TANNER: Senator?

SENATOR ROSENTHAL: Do you think that recycling ought to be required?

MR. OMERA: Personally?

SENATOR ROSENTHAL: Yes.

MR. OMERA: Most definitely, both from an economic viewpoint...

SENATOR ROSENTHAL: But, I'm not talking about it because it's going to make your company grow larger.

MR. OMERA: Definitely.

SENATOR ROSENTHAL: Technically and economically.

MR. OMERA: Environmentally. We've all been talking about -- I didn't mean to be self-serving, but, in this case, what is interesting in our business, is that we are really solving the problem of the environmental issue by recycling the different material. We have another "sister" division that recycles 12 million pounds of plastics each year in California. So, I really believe that what we're doing is presenting a product back to the environment -- and Mother Nature does it all the time.

SENATOR ROSENTHAL: In your opinion, how much of that material is being recycled in refrigerants, presently?

MR. OMERA: Unfortunately, I can only speak for ourselves and, in talking around the country to a variety of different people, we're the only ones who bring the material in on a regular basis and recycle it, and we do about a couple million pounds a year of the CFCs.

SENATOR ROSENTHAL: What category of companies are doing most of the recycling?

MR. OMERA: Of the refrigerants?

SENATOR ROSENTHAL: Of the ones that you're working on. Are we talking about markets? Are we talking about commercial buildings?

MR. OMERA: Commercial buildings, primarily, have been the heaviest users of the recycling process. Commercial buildings, department stores, telephone companies. Each of the telephone companies has a switching station. Historically, in the past, they had what they call, "electrical-mechanical" devices that generated a lot of heat, and by defense regulations, required these to be in closed buildings, because they didn't want access to them.

They have now replaced them with electronic instruments, or equipment, that also generate heat, so they all have to have air conditioning systems on them. They have to be maintained on a regular basis, because if they lose their air conditioning there is a failure of the communication system. So, primarily, most of those systems are what we've been using for recycling. The department stores and the various telephone companies' switching stations have historically been our largest recyclers.

I only recently, in the last three weeks, picked up refrigerants from Von's grocery stores. I was fortunate enough to talk to some food marketing executives, and I think they see the handwriting on the wall, and they're making some efforts in that phase. They're starting to do something along that particular line.

CHAIRWOMAN TANNER: What is the quality of recycled product?

MR. OMERA: We go back to the original federal specifications, BBF-1421-A. They're on the back of our brochure. I also sit on the Air Condition-Refrigeration Institute, which has established standards for refrigerant recycling, because they obviously see these things. That's what we propose to do and continue to do. It's basically coming back to the BBF-1421-B, which are the federal standards for refrigerants. You have to; otherwise, the product liability...

CHAIRWOMAN TANNER: What you're saying is, because I don't know what BBF...

MR. OMERA: I'm sorry.

CHAIRWOMAN TANNER: What you're saying is, the quality is close to, or the same as...

MR. OMERA: It's the same as what the federal standards require.

CHAIRWOMAN TANNER: Okay.

MR. OMERA: We go back to those same standards.

CHAIRWOMAN TANNER: Okay.

MR. OMERA: When we (inaudible) those standards, we adhere to -- we have adhered to -- at least since I've been involved, which is now approaching 14 years.

So, what we do is, we check the material before it's shipped out, to make sure it meets the moisture levels (inaudible) residue and the quality of the material, which is usually about 99.8% purity levels. So, it goes back; otherwise, the manufacturer, or the consumer would have a problem on his equipment is he used substandard material on it that was detrimental to his unit. And those units are not cheap; they're very expensive. They sometimes range between $25,000 to $75,000 -- to a couple hundred thousand dollars -- on the different units. So, they do want to make sure they have some product liability, and we do that on that particular basis.

CHAIRWOMAN TANNER: I'd like to welcome Assemblywoman Killea. It's good to see you.

MR. OMERA: Historically, what happens is, in the past, we would get some phone calls from a variety of different people. And the general rule -- Our economic cost for recycling is about half of that of the new material. Recently, the EPA came up with proposals...

SENATOR ROSENTHAL: Wait, wait. It costs half as much to recycle as it does to buy new material?

MR. OMERA: Yes.

SENATOR ROSENTHAL: Why wouldn't everybody do it, then?

MR. OMERA: Well, quite frankly, the people who are making the decisions, sometimes, are not the people who are the responsible parties of the dollar costs. So, what happens is, if you have, let's say, an installation may have a couple hundred pounds of refrigerants. Currently, that costs about $300 to $400 for 300 hundred or four hundred pounds. If you send somebody up there -- a repairman, in the air conditioning industry -- he usually gets between $35 and $40 an hour. He has to pump it down, and, unfortunately, most of the air conditioning units are on the roof of a building, and there is no elevator going to the roof.

When you fill a refrigerant cylinder, it usually weighs between 100 and 200 pounds. I know, because I've done it myself, that you have to take them down the stairs. Nobody likes to do that; so, what they do is, they usually vent the material, and they say, "It's only a couple hundred bucks; let's get rid of it. And then we can charge it up with some new material." That's why, if you ever take a helicopter ride across any major city, and you take a look at the roofs, you see a lot of abandoned cylinders and drums sitting on top of the roof, because nobody wants to take them back down.

It's human nature. You know, it's only a couple hundred dollars, and the people who own the units are just concerned about getting the refrigerant back on line, especially if you're a department store owner and, all of a sudden, you're air conditioning goes down, and you have nobody showing up at your store, you just want to get that thing back on line as fast as you possibly can.

CHAIRWOMAN TANNER: Assemblywoman Killea?

ASSEMBLYWOMAN LUCY KILLEA: Ordinarily, what you recycle is returned to your customer? You don't do recycling and then make it available in any other way?

MR. OMERA: Yes, we do.

ASSEMBLYWOMAN KILLEA: You do?

MR. OMERA: Over a period of time...Historically, it has been almost 80% of the material that people didn't want back. But, now, as the price has been growing in the last, say, eight years, more and more people are realizing that it's more cost-beneficial for them to get the material back, because, on a long-term basis, some of this material will be either allocated or they'll have some difficulty in getting it. So, I think they're trying to establish some procedures to keep the material in their own inventory. I think they're looking at that, seriously, more and more. But, it's still much more in the early stages; I think it's going to take another year, when the product allocations really start to go into effect on July 1st of next year.

ASSEMBLYWOMAN KILLEA: I guess this is just to get it in my mind clearly, what the market is, here, is what I'm trying to do. Then, if someone needs to get new refrigerant, would they think of going to somebody like you? Do you do a marketing job, yourself on this?

MR. OMERA: We go out and talk to people, but what we usually do is go out to the service contractors, because obviously, a person who is putting in new installation wants what they call, "virgin material." What we are usually dealing with is the "after market," or those who have a problem with their unit and need to have that refrigerant recycled.

Our real marketing exposure has been with the service contractors. But, the service contractors also have to deal with the owner, and if the owner -- He knows he's going to have to bill the owner for extra hours to get the material recaptured, rather than just venting the material. So, there sometimes (inaudible), shall we say, "economically easier," in their eyes, to just vent the material and get a new charge going in.

There's one other issue that sometimes happens...If they have a problem, and it goes "down", it takes us about two or three days, because we can't just instantaneously recycle the material. So, sometimes, there is a two or three day lapse. To get around that, what we've done is pre-ship them the refrigerant that they need, so when they take the old refrigerant out, they can put the recycled refrigerant back in again, and then there is no real lapse and waiting for the material to be recycled.

ASSEMBLYWOMAN KILLEA: (inaudible).

MR. OMERA: Right. But, if it comes back to the same standard...

ASSEMBLYWOMAN KILLEA: (Inaudible).

MR. OMERA: That has, primarily, been the concern. And the other thing, too, is that a majority of the refrigerant that we've been recycled has been R-11 and R-113, the 12, the 22s and the R-114s have not been as much, because, quite frankly, those are what they call, "pressurized gasses" in normal atmospheric condition. So, usually, you have to have a pump, or some type of compressor to pump the material and put it in these cylinders. And they are heavy; and they just don't want to do that, because it's a little bit more difficult to do.

Primarily, we're seeing more of the large installation, where a person has, maybe, 2,000 or 3,000 or 4,000 pounds of material. Then they start to be concerned about it, because, again, now the issue is liability. If we went into, say, the "Rosenthal Building" -- I'm just using it as an example -- you, as an owner, are now concerned that if, all of a sudden, there are emissions going on, that potentially, you may have a liability, as EPA becomes more enforcement regulationed oriented in getting these materials handled in the proper manner. Also, there are some fees, both on the state and the federal level. And if an employee turns in a company, then he can also get some type of compensation for that. So, that's an inducement to be able to comply.

Historically, in the past, we've tried to keep everybody -- keep the refrigerants -- separate; and usually, that's not a problem, because when the installation goes down, it's usually the same type of material. So, the material is packaged, we bring it in and we check it again before we start the processing, and then we recycle it and bring it back to specifications, we check it, and then we package the material, so it can go back out again.

ASSEMBLYWOMAN LA FOLLETTE: In other words, I think, Mr. Omera, you do see a growth in the number and the interest of individuals in the recycling process?

MR. OMERA: EPA did a study, and they asked, "What is the price of these CFCs going to be in effect after this 'Montreal Protocol' is put into effect?" By their own estimates, they see the price going on up -- this is using the wholesale value for truckload quantity of material. Using different scenarios, it goes from 45 cents in today's marketplace to $2 a pound next year. That's an increase of 400%. And over a period of time, by the year 1998, it goes up to $10 a pound.

There has been some thought by the EPA that they want to put what they call a "Windfall Tax" on it, because, obviously, any time you have a restricted amount of a product, which is needed -- an essential need all over this country -- there's going to be some type of what they call "conserved price inflation."

My personal thinking is that the manufacturers aren't going to see the price inflation from them; it's obviously going to come from the wholesalers, who, historically, have been using it as a loss leader, will now find it as a scarce product, and will be able to build up the price at a much higher level. If you recycle the product, you only need a very small percentage of material to be added back into it to increase the material, because we can't recover 100% of their needs.

Usually, if a unit is a 2,000 pound charge -- I'm using it as an example -- we'll usually get somewhere between 1,700 to

1,800 pounds of waste material coming to our facility. We, in turn, recycle that, and we'll get somewhere between 1,600 and 1,700 pounds of available material. But, the customer still needs about another 300 to 400 pounds to make up, to get a full charge back into his unit, or else his unit won't operate effectively.

ASSEMBLYWOMAN LA FOLLETTE: And what's the cost of the recycled product?

MR. OMERA: Historically, we've used, as a general rule, you can almost save about half the cost of new material. Obviously, our costs won't go up as much as the new material goes up. Hopefully, we're seeing here what will be a major price difference between us and the new material. So, hopefully, that will be an encouragement to people to use our services.

SENATOR ROSENTHAL: Just give me some sort of an idea of what we're talking about. When you talk about 2,000 pounds, how large a building are we talking about?

MR. OMERA: In this particular building, here, you'd have in the range of between 4,000 and 10,000 pounds. To take care of this entire building, you'd probably have two or three different units in this building.

A normal switching station, a Pacific Telephone switching station, would, on the average, have between 1,500 and 2,000 pounds, and that's about a two or three story building, about 40,000 or 50,000 square feet.

SENATOR ROSENTHAL: It would have 2,000 pounds? So, a large office building, 60 or 70 floors, in Los Angeles...

MR. OMERA: Arco Towers is 20,000 pounds.

SENATOR ROSENTHAL: Okay. That gives me an idea of what we're talking about.

ASSEMBLYWOMAN LA FOLLETTE: And what kind of pounds are we talking about in the homeowner's refrigerator cooling system?

MR. OMERA: That's only about 11 ounces, or a fraction of a pound -- pretty close to a pound. Air conditioning in an automobile runs from two to four pounds -- in a automobile air conditioning system. So, you can see that there's a rather large realm of differences between the two.

Can I address one point? You were asking about the EPA, and I was able to be privy a little bit at a couple of different meetings...What they would really like to do...They're trying to use economic needs -- which, I think, is the same thing that you people are trying to do; to acquaint the users with the possibilities of recycling by pushing the economic models to encourage them to do other alternatives. Because, as the price gets more expensive you'll take a look instead of throwing something away, and start utilizing again for continued usage. I think that's their intent.

They are trying to do something, with a collaborative method, with the automobile manufacturers. They're looking at setting small units to filter the different refrigerants, to see if that will be capable of being used again in a different system.

SENATOR ROSENTHAL: Do you think, at some point, there will be some sort of a penalty for venting?

MR. OMERA: That's what they're trying to do inherently, in the same way, because if you vent the material, and you can't recapture the material, or you can't obtain the material, or you're going to be paying significantly. Right now, for example, you can buy the little eight-ounce cans for your air conditioning in your automobile for about a dollar. Probably, if you take this, at this particular level, you're going to be paying $10 and $15 -- I'm estimating this; this is my own personal estimate -- probably within 18 months to two years for that container.

So, there is an economic incentive for you to recycle that, if you possibly can, because if it's going to cost you $15 to replace your air conditioning unit, you're going to start taking another look at it. Also, the availability of that material because, -- my discussion with different people -- when you go into product allocation, there is going to be a hierarchy of those who need the material. By law, they've made it so that if any of the manufacturers produce more than one pound more than their production level, they're going to be billed at $25,000 a pound for all going and past production capacity. In that case, there's a big, heavy inducement not to go below the production cap.

Still, there are certain industries, or certain agencies, that still need all they can get. I understand the Defense Department was going to ask for 100% of their needs because of the defense requirement and the national interest. Then, you have certain public agencies and public buildings -- the police department, the hospitals -- that will need to get 100% of their material; otherwise, there are going to be certain essential services that are not going to be able to function. If you give

100% to all those people, the remaining people are going to have to take an even deeper cut.

CHAIRWOMAN TANNER: You are based in Whittier?

MR. OMERA: Yes.

CHAIRWOMAN TANNER: And you're the only company, right now, that...?

MR. OMERA: As far as I know.

CHAIRWOMAN TANNER: Let me finish my -- If you were to pick up and recycle CFCs from Los Angeles, or from Southern California, then it would cost the generator X amount of dollars. But, then, if you were to go to Northern California -- to pick up in Northern California -- the price would go up, wouldn't it?

MR. OMERA: Yes.

CHAIRWOMAN TANNER: Because of the transportation? If we were to require recycling, there would absolutely be a need, then, either for you to expand, or for other companies to be formed, to do that recycling. Where it would be cost-effective in one area, how could it possibly be cost-effective in Nevada or Colorado, if you're the only company that recycles?

MR. OMERA: Chairwoman Tanner, the only thing that I can say is that we picked up material in Syracuse, New York, recently -- about 35,000 pounds. We do have plans to expand; we're in the permitting process, right now going through the Department of Health Services and the Office of Permit Assistance on a Northern California site. But, unfortunately, it takes about two or three years to go through the permitting process.

CHAIRWOMAN TANNER: Yes.

MR. OMERA: I'm sure that if anybody else comes along in the program, they're still going to have to go through the same permitting process to do the same thing as we're doing. Sometimes, you get a "Catch-22" situation.

CHAIRWOMAN TANNER: All right. Say you are planning on expanding; but, in the meantime, say we pass legislation and require recycling on certain things, then the volume would be so great. How could you handle it? How could you handle the volume?

MR. OMERA: Unfortunately, we've had this 'Montreal Protocol,' we've had this EPA proposal that's been in place now for over two years. It still takes a long time for people to make the adjustment to that. Our capacity is really under-utilized. Obviously, either that or recycle refrigerants or recycle paints. That's what we are, primarily; we've always focused on those things. We've doubled our capacity this year; we're doubling it again at the end of this year. So, we're quadrupling our capacity from what it was a year ago, anticipating, not just your particular passage, but that the "Montreal Protocol" will be coming into effect, one way or the other, making the requirement for our services that much more beneficial.

CHAIRWOMAN TANNER: So, you feel you could handle it -- the volume of refrigerants, for instance, that would have to be recycled?

MR. OMERA: Definitely, I would like to make a very good try for that, but I think there are other recyclers in this state who could probably put in additional pieces of equipment, and within a reasonable time, be able to not only be competitive with us, but also produce the same type of service.

CHAIRWOMAN TANNER: But, then, what about the permitting process?

MR. OMERA: Some of them are already permitted, as a hazardous waste treatment facility. They would just have to adjunct a new type of circulation of treatment system. If you wanted to put in a new facility all by itself, that's where the long lead times go into effect.

CHAIRWOMAN TANNER: Okay.

Are there any other questions? Do you have more testimony?

MR. OMERA: Just to answer your questions, if I can. Thank you for your time. I appreciate it.

CHAIRWOMAN TANNER: Thank you. It's a good thing you're around.

Our next witness is Richard Charles, of the American Society of Heating, Refrigeration and Air Conditioning Engineers. Mr. Charles.

Would you identify yourself?

<u>MR. RICHARD A. CHARLES</u>: I have a prepared statement which I'd like to present, and then I'll take questions afterwards, if that would be okay.

CHAIRWOMAN TANNER: Fine.

MR. CHARLES: I'm Richard A. Charles, a Consulting Engineer and President of Charles and Braun Consulting Engineers in San Francisco. I'm also serving as the Vice President of the

American Society of Heating, Refrigerating and Air Conditioning Engineers, which is more commonly known as ASHRAE. I'm here in Sacramento today to provide information on behalf of ASHRAE.

I will summarize a portion of my presentation today, and would request that my complete written statement be made part of the hearing record.

CHAIRWOMAN TANNER: It will.

MR. CHARLES: I have extra copies that I can leave, if your want.

CHAIRWOMAN TANNER: Fine.

MR. CHARLES: ASHRAE is a technical society of approximately 50,000 individual members, worldwide. There are no corporate members. Some 3,500 members reside in California, many of whom participate on key technical committees of the society. Our membership is composed of consulting engineers, such as myself, contractors, design professionals and employees of academic and research institutions of manufacturers and of government.

ASHRAE is interested in occupant comfort in buildings and refrigeration, including food preservation. ASHRAE concentrates on the associated technical knowledge; the use of chlorofluorocarbons and other refrigerants is part of our technology.

ASHRAE is the world's leading source of published technology on heating, ventilating, air conditioning and refrigeration. ASHRAE develops standards and guidelines, which are used by industry and government. The Society raises funds from the private sector for a research program which is carried out by research organizations, most of which are universities.

First, let me comment on the questions posed in your letter: Verified information on some of the questions is not available; however, we will provide what pertinent information we have received. More appropriate sources for this particular data would be available from equipment manufacturers, contractors and servicing activities and, perhaps, chemical producers.

Question number one: Is there an estimate of CFCs emitted to the atmosphere from various refrigeration and air conditioning unit leaks? Is there any estimate of the overall contribution that unit leaks make to total CFCs emissions to the atmosphere?

To our knowledge, there are no good estimates. Air conditioning and refrigeration systems are designed as sealed system, and should remain tight throughout their lifetime. It is our understanding that the EPA, in its estimates, assumes that all chemicals, ultimately, appear in the atmosphere. If systems remain tight, the refrigerants should remain in place for many years; and if disposed properly, some refrigerants may never appear in the atmosphere.

There are a number of sources of information from the private sector -- producers and manufacturers -- and from public sector, including the U.S. Department of Energy and the U.S. Environmental Protection Agency. The data are not consistent; however, I will indicate the numbers, which have been used by DOE for the 1985 portion of CFC production directed to refrigeration use. The total amount of ozone-depleting substances: 1.54 billion pounds; the refrigeration portion: 23.8%; global air conditioning portion: 7.4%.

To estimate the portions of CFCs directed to refrigeration, which is used in field installation and the servicing capacity, one of the producers has reported that the U.S. fully-halogenated refrigerant usage in 1986 was provided to stationary installations, which would be the systems in air conditioning in buildings and such. The original market was 7%; the after-market, or the repairs, 48%. In mobile applications, the original market was 9%, the after-market, 2-6%.

ASHRAE is considering sponsoring...

CHAIRWOMAN TANNER: Why don't you explain that?

MR. CHARLES: Yes? What's your question?

CHAIRWOMAN TANNER: What you just said, the 7%.

MR. CHARLES: That's the new system, the original system.

CHAIRWOMAN TANNER: Okay.

MR. CHARLES: Then, the 48% is the repairs and modifications and additions to the system. Say, the building's life is 30 years to 50 years, the air conditioning equipment may last anywhere from 10 to 20 years. So, as the equipment breaks down and has to be repaired, or you add replacement equipment, this is what we're talking about in the after-market. It's the same way with car air conditioning: As it breaks down, and needs to be re-serviced, you're losing refrigerant because of hose leaks or something happens to the compressor, and they have to replace it.

The next question: What engineering efforts, over the past few years, have been made to reduce CFC leakage from these units? Is it feasible, or cost-effective, to design a refrigeration system, or air conditioning unit, which, with proper maintenance, will not leak CFCs?

A properly designed, properly installed, routinely inspected, and periodically serviced system rarely develops a leak. Also, it should be noted that manufacturers currently design equipment, which requires less refrigerant.

Since the Assembly has been focusing on supermarket refrigeration, an article which will appear in the November issue of the ASHRAE Journal, which is our publication on supermarket application.

CHAIRWOMAN TANNER: Actually, I believe that this hearing is more broad than supermarket application.

MR. CHARLES: I would hope so.

Typical systems, which have been serviced for long periods of time, and represent earlier technology, lose their charge about three times in a 10-year period.

Since leaks can result in system malfunction and compressor damage, most systems receive attention promptly. The first time we know we have a leak is when the air conditioning system begins to not produce cold air -- or the cold in the refrigeration process. If the system should develop a leak, and the refrigerant level falls below desired levels, the compressor may suffer damage, and shorten the lifetime of the system.

The third question: Are there any standards for CFC purity, especially in terms of recycled CFCs?

The manufacturers' trade association, the Air Conditioning-Refrigeration Institute, "ARI", is developing a new standard on the purity requirements of refrigerants. ARI is attempting to establish the necessary specifications for building-oriented systems through its "ARI 700-P" standards.

CHAIRWOMAN TANNER: Ms. Killea has a question.

ASSEMBLYWOMAN KILLEA: Could you tie that in with Mr. Omera's testimony about the federal standard that they apply? Are you talking about the function of the machine, or are you talking about the refrigerant? He was speaking about the standard that they have for the recycled refrigerant. Can you compare what you're saying to that?

MR. CHARLES: Let me go on through, because I'm going to cover that later.

ASSEMBLYWOMAN KILLEA: All right. Good. Thank you.

MR. CHARLES: There are other specifications for purity of "virgin refrigerants," which are in use within the military and by the General Services Administration. EPA has proposed some specifications for the recycled refrigerants for use in mobile air conditioning systems. However, the mobile systems may be more tolerant to refrigerant impurities. So, that's the only standard we know of, right now. They have not gone beyond that, to our knowledge.

The fourth question: What is being done, in terms of design and modifications, to address the possibility of using alternatives to currently used CFC formulations.

Manufacturers report that in the design of new equipment, they are aggressively pursuing the use of AHCFC-22, and other CFC blends, which have a smaller ozone depletion factor than pure halogenated CFCs. New alternatives have yet to complete toxicology and other safety tests. It will be the early-1990's before this data is complete.

There are many trade-offs required by safety, energy efficiency etcetera in evaluating the adaptability of new chemicals. For the new chemical alternate, 134-A, producers have not yet identified a suitable lubricating oil, which is mandatory for use of the chemical in refrigeration application. Compressors are lubricated by the oils dissolved in the refrigerant itself.

In preparation for the possible use of 134-A, ASHRAE sponsored the development of its thermophysical properties at the National Bureau of Standards, now known as the National Institute of Standards and Technology.

CHAIRWOMAN TANNER: Is your group attempting to engineer modifications, so that when the CFC-134-A -- when there is a lubricant found, that you're prepared to be able to use that, or not use the 134-A?

MR. CHARLES: We think it's a very important.

CHAIRWOMAN TANNER: But, is there engineering to modify the current refrigerators that we have -- or air conditioners?

MR. CHARLES: Well, there's a problem, and I think the manufacturers need to talk to that more directly than we do. There's a problem in what the physical properties of the refrigerants do and how they react to the actual machines that are being designed. ASHRAE is developing the standards, which the manufacturers will then be able to use when they are designing their new equipment.

CHAIRWOMAN TANNER: And those standards include provisions for CFC-134-A?

MR. CHARLES: Yes.

CHAIRWOMAN TANNER: Okay.

MR. CHARLES: It should be emphasized that any chemical substitute may have similar properties, but will not be identical. If new alternatives are available, system performance can be expected to change, which will have corresponding energy impact.

The next question: Are refrigeration and air conditioning units currently designed to permit reclamation and recycling of CFCs? What engineering efforts are being made to modify unit design to incorporate CFC recycling? How do product warranty requirements come into play?

Manufacturers, again, are the best source for this information. The reclamation of refrigerants is an emerging technology; however, the primary barrier today to reclaiming and re-using refrigerants is the classification of the substance type and the associated potential regulations for handling and transporting.

Interpretations of the classifications vary within the federal government and vary throughout the nation, from jurisdiction to jurisdiction. Probably the most positive step, which could occur, at this point, to encourage recycling of refrigerants, is classification and standardization of the classifications of the substances from the legislative body. That's the biggest problem, because you can understand the problem if one state classifies a particular product in one way, and then not in another way -- or the government, by one standard says, "This is classified this way," and somebody else classifies it a different way. It really confuses

CHAIRWOMAN TANNER: You're talking about hazardous or non-hazardous, toxic or non-toxic?

SENATOR ROSENTHAL: Let me ask a question.

CHAIRWOMAN TANNER: Senator.

SENATOR ROSENTHAL: In terms of the recycling, it's my understanding that the holding tanks for refrigeration systems are too small and, therefore, not helpful when one wants to recycle.

MR. CHARLES: Well, there are two things that you would be talking about: Some refrigeration systems have what we call, "receivers" which means that you can store the refrigerant in a particular tank on the system itself; other systems don't

CHAIRWOMAN TANNER: You mean, during repair? Is that right?

MR. CHARLES: Yes, by repairs, sure. The others systems don't have this. So, the only way that you could then store that refrigerant while you're working on the system is to be able to put it into another container. You've heard, by previous testimony that the containers themselves get quite heavy, and the workmen have to carry these containers onto to the job -- both empty and then full. When you're lugging a 200-pound container around, this makes it very difficult, especially with the time. You know, "time is money." So workmen having to take the responsibility for the extra time to lug a container and to pump it back directly into the tank is where the problem is.

CHAIRWOMAN TANNER: That doesn't sound like an "advanced" technology to me.

MR. CHARLES: No.

ASSEMBLYWOMAN KILLEA: That's sort of my question. If the tanks are the problem practical application are there other materials that they can be made of?

MR. CHARLES: My personal opinion is that once there is a need, or a requirement, to do something, there will be. Everything will take place. There will be people to recycle it, there will be easier means to get the material back into tanks, there will be easier means to get new emissions control guidelines. ASHRAE has under development a new guideline, "GPC-3P" for reducing emissions of the fully-halogenated chlorofluorocarbons refrigerants in refrigeration and air conditioning systems. The drafting committee is using as a point of departure the European Community Code of Good Practice for the Reduction of Emissions of Chlorofluorocarbons, CFCs R-11 and R-12, in refrigeration and air conditioning applications.

The Assembly will be interested in these as individual topics being addressed in this new guideline. Each item focuses on sources of inadvertent losses of refrigerants during the indicated activities: (1) the design of equipment and equipment components; (2) laboratory testing of components and systems; (3)

procedures during the manufacturing processes; (4) installation and service; (5) guidance for the users and routine inspections; (6) recovery, re-use and disposal of refrigerants; (7) alternative refrigerants; (8) training of personnel; and, (9) handling and storage of refrigerants, including refrigerant transfer between containers.

SENATOR ROSENTHAL: Madam Chair, may I ask a question?

CHAIRWOMAN TANNER: Yes.

SENATOR ROSENTHAL: You said that you had something to pass out, that you were going to use a shorter version. Is this the shorter version?

MR. CHARLES: No, this is the actual version.

SENATOR ROSENTHAL: Oh. I misunderstood you, then, when you began.

MR. CHARLES: I had a prepared statement and I had extra copies of that. That's it.

SENATOR ROSENTHAL: Okay. I just wondered how big the full study was, if this is the short one.

CHAIRWOMAN TANNER: Let's move right along.

MR. CHARLES: The Chairman of the ASHRAE Guidelines Committee advises that the draft is approximately one-half complete, and he hopes that the document will be available for public review by mid-1989.

The development of consensus standards and guidelines in the private sector involves a detailed, quasi-legal process. The members of the drafting committee are selected experts, representing a broad spectrum of the affected community, so that no single interest can dominate the deliberations.

Extensive and detailed public review procedures must be followed in the developmental process, if the new standards or guidelines are to be widely accepted by the industry and government, and endorsed by the standard certification boards, such as the American Standard Institute, ANSI.

CFC industry roundtable: to demonstrate ASHRAE's involvement in this issue, I would like to tell you of a particular activity in the Society, which took place this last summer. ASHRAE organized and co-sponsored with ARI, an industry CFC round table, involving the top leaders of the key trade associations in technical society. Several branches of the refrigeration industry were invited to participate -- trade organizations from the producer industry, equipment manufacturers, transportation and food industries and contractors and servicemen industries.

CHAIRWOMAN TANNER: Mr. Charles, you have thirteen points here. Could you sort of highlight those, so that we can move on?

MR. CHARLES: Well, sure.

CHAIRWOMAN TANNER: Those that you feel are most important.

MR. CHARLES: There were 13 items that the 50 individuals discussed. Number one was to re-label R-22 as "HCFC-22"; number two was to make reclaiming of CFCs easier; number three was to develop standards and methods of testing to determine the accessibility of the reclaimed refrigerants; number four was to accelerate development of ASHRAE guideline 3P. Number five was to study the economic impacts that would result from altering the "Montreal Protocol"; number six was to develop a contingency plan to determine what percent reduction of harmful CFCs can be met by using HCFC-22 and R-502; number seven was to establish a task force to compile information on the status of replacement refrigeration development -- the development of technical data by equipment manufacturers, on conversion, reclamation and recovery of CFCs 11 and 12; number eight was to field test substitute refrigerants now under development; number nine was, when possible, for both retrofit and new construction, install systems that do not use fully halogenated CFCs; number ten, license dealers and service stations to recycle CFC-12; number eleven, design for leak prevention in mobile applications -- for example, by improving the replacement hoses and seals; number twelve, use 502 as a preferred refrigerant in new equipment for non-mobile transportation applications; and, number thirteen, installation applications in the transportation industry, to use water blown foams until a suitable replacement HCFC is available. ASHRAE is planning a second CFC industry round table in the spring of 1989, which will address these and other items.

International approach: ASHRAE supports the international agreement, known as the "Montreal Protocol". This week in Europe, meetings are underway to review scientific understanding, to determine the status of substitutes and alternative technologies and to consider the legal measures. It is anticipated that there will be an acceleration of the provision of the "Montreal Protocol". In a few months, the U.S. and other nations will be cutting back production of targeted chemicals to the 1986 levels. In the U.S., this may mean a 15% reduction from current availability. U.S. consumers may feel the impact of this action more quickly, in their daily lives, than other citizens of the world.

Most other nations have yet to adopt the ban on non-essential aerosol usage of fully halogenated CFCs, which the U.S. put in place some 10 years ago. These nations may be able to satisfy their reduced quotas for a period of time by simply doing what the U.S. has already done.

The availability of CFCs may impact the HVAC&R industry first in the United States. The marketplace is already well along in making adjustments. With additional international restrictions looming on the horizon, the marketplace itself will mandate conservation of fully halogenated CFCs.

During discussions of the CFC industry round table in June, was our perception that the most positive step to encourage conservation of fully halogenated CFCs is clarification and standardization of how reclaimed refrigerants must be handled. This is an area clearly in the hands of governments, at several levels. If progress could be made on that single point, substantial movement would occur in the marketplace. ASHRAE would urge the Assembly to concentrate efforts there.

The fully-halogenated chlorofluorocarbon issue is a high priority activity among ASHRAE. The Society will continue to direct funds to sponsor related research to develop new standards and guidelines and to serve as a worldwide vehicle for dissemination of emerging technology related to CFC issues. Education of the public and the technical updating of professionals are the major activities of ASHRAE in 1989.

CHAIRWOMAN TANNER: Good. That's good.

There are questions that I have, but we are going to have to move along. From your testimony, I feel that you would like -- or your group would like -- for the policy makers to set the standards?

MR. CHARLES: I think the key element is the classification of the materials that we're talking about, so we have standards and they're not considered to be hazardous and how they can be transported, and all the rest

CHAIRWOMAN TANNER: Yes.

MR. CHARLES: I think that's the key issue.

CHAIRWOMAN TANNER: All right. Thank you very much, Mr. Charles.

Our last witness before lunch will be Diane Fisher, who is a scientist and is with the Environmental Defense Fund.

Do you have an entire statement, or are you going to?

DR. DIANE C. FISHER: Well, I was planning to go through most of it. It's not as long as it seems; I've attached a fairly long document to the end. My statement is, actually, I think, relatively brief.

CHAIRWOMAN TANNER: All right.

DR. FISHER: Although, you know, if you want me to move faster, I'm willing to try.

CHAIRWOMAN TANNER: No, no. I want to hear from you, and I want to hear all of your testimony.

DR. FISHER: First of all, I'd like to thank Assemblywoman Tanner and the other Members of this Committee for holding this hearing today.

My name is Dr. Diane Fisher. I'm a chemist and a staff scientist with the Environmental Defense Fund, which is a national, non-profit organization. For the past several years, EDF has been actively conducting research into the environmental effects of CFCs, and identifying possible options for dealing with the environmental threat these chemicals pose. I am here today to share with you some of the results of our work.

Before I get too much into my testimony, I want to mention that two people in our New York office, Dr. Dan Dudek, who is an economist, and Sarah Clark, who is a scientist, have been working on model legislation for enactment at the state level to reduce CFC emissions -- in particular, addressing the issue of recycling. They expect that model legislation to be available within about a month. So, I would urge you to consult both of them, since I think that they've both done a lot of work on this issue, and I think they would be a useful resource.

CHAIRWOMAN TANNER: We would like to do that. After the hearing, we can get the addresses and information from you.

DR. FISHER: In fact, the address and phone number of our New York office is on the cover sheet to my testimony

CHAIRWOMAN TANNER: Okay. All right.

DR. FISHER: In fact, most of what I'll be talking about today will be a summary of their work; in particular, the work of Sarah Clark -- and that's the long document I've attached to my testimony. It's something which Ms. Clark recently prepared, called, "Protecting the Ozone Layer: What You Can Do."

CHAIRWOMAN TANNER: Okay.

DR. FISHER: In the first half of my testimony, I'm going to talk in a little bit more detail about some of the effects of CFC emissions. Katie Wolf mentioned those briefly; I'd like to discuss them in more detail.

In the second half of my testimony, I will be discussing what can be done at the state level, why we believe that states actually can have an impact on this admittedly global problem. In particular, we feel that recycling is one area where states can have a big impact, and I'd like to talk about some of the steps that we think could be taken to make that whole recycling process easier.

First of all, the effects of CFCs. CFCs are contributing to two of the most serious environmental problems facing us today. They are completely responsible for the destruction of the protective ozone layer in our upper atmosphere, which we've mostly been talking about, so far. They are also responsible for approximately 25% of the global warming, commonly known as the "greenhouse effect," because they are also greenhouse gases, and that threatens even more severe consequences, environmentally, than ozone depletion.

CFCs are extremely stable compounds persisting in the atmosphere for hundreds of years.

CHAIRWOMAN TANNER: That statement you just made: The "greenhouse effect" is more serious.

DR. FISHER: Well, I think they're both very serious problems.

CHAIRWOMAN TANNER: Yes. I understand that. I read in the Sunday Times, in the editorial section, two columns regarding planting of trees -- a million trees -- to help the "greenhouse effect."

DR. FISHER: Yes. That doesn't, of course, deal with the CFCs; that deals with carbon dioxide. That would help, but what is even more important, is just to stop cutting down the trees we're cutting down right now; in particular, in South America, something like 100 acres per minute. Think about the number of acres of trees that have disappeared, while we've all been sitting here this morning; it's a pretty astounding number.

Since we are talking about CFCs today, I'll mostly talk about the effects of ozone depletion and increased UV radiation, but I do want us all to not forget that they contribute to this other very serious problem, as well.

As I said, CFCs persist for a long time; hundreds of years. They're extremely efficient in destroying ozone. One CFC molecule can be responsible for the destruction of as many as 100,000 molecules of ozone. For these reasons, we need a 95% reduction -- or, almost complete ban -- of CFCs, if we're going to halt and reverse the deterioration of our ozone shield.

Assemblywoman La Follette asked a question earlier: While we're implementing the ban, how much ozone depletion will happen? It's important to realize that because these compounds persist in the atmosphere for hundreds of years, even after the ban is fully implemented, there will be decades, or even a hundred years, whereI don't know the exact time scale, but for a very long time after the ban is fully implemented, the ozone depletion will still be occurring. Eventually, the level of CFCs will go down, and that depletion will halt, but it's going to happen for a long time after we ban them.

This is a reason why it is worthwhile to move as quickly as possible because, since these chemicals do last in the atmosphere for hundreds of years, any reduction of CFC emissions that happens now keeps those chemicals from getting into the atmosphere in the first place where, if they do get into the atmosphere, they will stay around for hundreds of years.

The ozone shield absorbs harmful UV radiation; so, by destroying that shield, we're increasing this harmful UV radiation. Let me briefly go through some of the effects: skin cancer has been mentioned; that's, perhaps, the best-known effect. EPA has done a comparison of skin cancer from unchecked CFC emissions versus skin cancer, assuming implementation of their protocol; that is a 50% reduction. They estimate that by the year 2075, with unchecked CFC emissions, there will be something like 174 million additional cases, between now and then, of skin cancer of which close to 4 million would be fatal. They also estimate an additional 19 million cases of cataracts. There is evidence that this radiation also has a harmful impact on the human immune system.

Although averting a skin cancer epidemic and an epidemic of cataracts is good reason in and of itself to reduce these emissions, there are several other effects that we should be concerned about: UV radiation has been demonstrated to reduce crop yield; EPA, in the same scenario, estimates a seven percent reduction in grain yields by 2075, which is certainly an important concern to an agricultural state, such as California.

The effect of this radiation on natural ecosystems may be even more severe, particularly in aquatic ecosystems. Algae and other phytoplankton are important links in the food chain of oceans. These organisms are extremely sensitive to this UV radiation; even a small increase in UV radiation could lead to a collapse of the phytoplankton community. Other small organisms are sensitive, as are the larvae of larger organisms, such as fish. Increased UV radiation could lead to a really disastrous collapse of the oceanic ecosystem.

Increased UV radiation would also make the already severe smog problem in Los Angeles and other cities even worse, because this radiation stimulates the processes which produce smog. As I mentioned, in addition to the role in ozone depletion, these chemicals contribute to the "greenhouse effect," which is expected to cause a large rise in sea level, increased flooding and more severe storms. Portions of the river delta are already below sea level, and even heroic and very expensive efforts to maintain the levees and build new ones cannot entirely prevent an expansion of San Francisco Bay inland. Even if we make heroic efforts, we can expect some important agricultural, residential and business areas to be inundated.

CHAIRWOMAN TANNER: And this is all largely a result of the ozone depletion or the "greenhouse effect?"

DR. FISHER: Well, the "greenhouse effect", as I said, about 25% is due to CFC. I should mention that it's 25%, without the "Protocol"; if you assume full implementation of the "Protocol," that gets you down to CFCs being 15% of the problem. However, I think part of what we're talking about here is, how California call help implement the "Protocol," in addition to going further; that's why I use the 25% as what will happen in the absence of action.

I also wanted to mention -- someone mentioned earlier that Canadians and Russians might welcome the "greenhouse effect."

CHAIRWOMAN TANNER: I said that.

DR. FISHER: Yes. Well, I've heard Canadians say this, too. You know, "Oh, well, you sent all this acid rain to us; now the next big environmental problem is going to be your problem." I'm afraid our Canadian friends may be mistaken, because, although it will get warmer up there, warm temperatures are not the only thing you need for agriculture; you need good soil, as any farmer will tell you. In Canada, they simply do not have the soils to maintain good agriculture. Now, I don't know what the soils are like in Russia; I know in Scandinavia, they don't have the appropriate soils, either. So, even those areas that think they're going to benefit from "greenhouse" warming, may be sadly mistaken.

CHAIRWOMAN TANNER: Yes.

DR. FISHER: Although there may be some areas that benefit from "greenhouse" warming, I think it's important to realize that we're not talking about a zero-sum gain; we're talking about a very negative-sum gain, where the harmful effects will far outweigh any beneficial effects. Those are the main effects of CFCs that we should be worried about.

Because of the threats posed by these chemicals, an international agreement, known as the "Montreal Protocol On Substances That Deplete the Ozone Layer," was negotiated and signed in September of 1987. This agreement requires a 50% reduction in CFC emissions by mid-1998, if ratified by a certain number of countries by January 1989. The "Protocol" has been ratified by eight nations, thus far, and ratification by enough other nations for the "Protocol" to become effective is expected in the near future.

Although this is a good start, a 50% reduction is simply not enough. The U.S. EPA has already called for a 95% reduction, or a nearly complete ban of CFCs, because this is the only way to halt and reverse the destruction of the ozone layer. International negotiations may be renewed, so as to arrive at an agreement for further reductions; in fact, I think this international meeting in the Netherlands that's happening right now is discussing whether these negotiations should be re-opened to accelerate the time table, and agree to higher reductions.

CHAIRWOMAN TANNER: Ms. Killea has a question.

ASSEMBLYWOMAN KILLEA: I'm a little behind on my "Montreal Protocol," but most of the nations that are producing

CFCs are participating in that?

DR. FISHER: Well, in the meetings where the "Protocol" was developed and written up, I think most of the nations participated. As far as whether the big CFC producers have signed on yet or not, well, certainly, one of them has; namely, the United States. I actually, unfortunately, don't know the exact status of which other nations have signed on, and how big of CFC producers they are. I think it is expected that the other big CFC-producing nations will sign on, if they haven't yet done so.

The agreed-upon production reductions have already spurred research into non-ozone depleting substitutes for CFCs. Some of these may be commercially available, in a decade or so.

Given the global nature of both ozone depletion and the "greenhouse effect," and that alternatives to CFCs are already being developed, it's reasonable to ask if action taken at the state levels can have an impact. There are two reasons that a state program could lead to a significant reduction in CFC emissions worldwide: First, because the United States is responsible for one-third of the annual CFC world production, and California is one of this nation's most populous states and also a center for the chemical industry, it is quite possible that the amount of CFCs produced and used in this state is, in fact, significant even on a global scale. Secondly, and perhaps more importantly, any program to reduce CFC emissions in California may serve as a model for the rest of the nation and, perhaps, the rest of the world.

The major uses of the CFCs in the U.S. have been discussed in much more detail by others previously; they are: refrigerants, as industrial solvents and as blowing agents for making various foam products.

The area in which states may have the biggest impact is in setting up programs to capture and recycle so-called "banked" CFC emissions. In other words, some of these emissions, as mentioned previously, are "prompt" -- the CFCs are emitted right away in the manufacturing process. There are other CFC emissions -- I guess you could think of them as emissions -- which are "banked," particularly in refrigerators, where you have a huge store of CFCs in existing refrigerators, which represent potential CFC emissions, if we do not capture those CFCs; in particular, if we continue to vent those CFCs to the atmosphere every time we service a refrigerator or dispose of a refrigerator. Because these refrigerators can last five to 20 years, we're talking about a huge store of CFCs out there.

In the short term, establishing a network to collect and re-use these CFCs could go far in reducing needless and preventable emissions. In the long run, as alternatives to CFCs become available, the same network could be used to collect and safely dispose of CFCs, rather than allowing this huge bank of CFCs to be emitted.

CHAIRWOMAN TANNER: Doctor, what is the safe way to dispose of the CFCs?

DR. FISHER: Well, the only way I know of would be incineration. Katie Wolf made this point in the research on alternatives, that you have to be careful that your alternatives don't create any other environmental problems. I would say with incineration, we would have to do tests to make sure that we weren't emitting things that were toxic, and develop incineration processes, which didn't create other environmental problems. I do believe that that can be done.

CHAIRWOMAN TANNER: Here we have all of these units all over the world, with CFCs in them. Then, when we find another chemical -- if there is another chemical -- used in place of CFCs, we've got this problem of disposing of all of those units, which have CFCs.

DR. FISHER: Right.

CHAIRWOMAN TANNER: You know, we've had great difficulties finding methods of safely disposing any...

DR. FISHER: Well, one of the good things about CFCs -- in fact, the reason that they have been used so widely -- is that most of them are non-toxic. Now, I don't know whether they're still non-toxic when you burn them, but at least...

CHAIRWOMAN TANNER: Perhaps they will be non-toxic, and then can be burned.

DR. FISHER: It's possible; I don't think we should assume that. I think we should do the testing and make sure that that's true. But, I think that is possible. If that's not true, perhaps we should look into other ways of disposing of them, although I personally have a hard time thinking of too many others, off the top of my head. But, maybe other people can come up with ideas, I don't know.

In the short run, we would hope that accelerating recycling would help to displace some of the uses of virgin CFCs while we are starting to put caps on production and cut down on production. So, in the short-term, we could recycle them, and hopefully, in the long-term, dispose of them.

Some of the previous speakers talked about some of the impediments to recycling. I have several steps, here, which I think will help remove some of those impediments. These are discussed in much more detail in the document, which I attached to my testimony, written by Sarah Clark, of our New York office.

Some of our suggestions would be: First of all, to establish more CFC recycling centers. You've spoken to, I believe, the one CFC recycler in the nation right now. Apparently, according to him, even so, there are cases where the transportation cost, all the way from New York, is still worthwhile. Obviously, if we build more of these centers, that will reduce the transportation costs, thus making CFC recycling economically feasible for more users. So, our first suggestion would be to establish more recycling centers.

Our second suggestion is to establish refrigerant pick-up programs. You could further reduce the transportation costs by establishing a pick-up program for smaller CFC users, such as air conditioning repair services or automobile service stations. Based on a "milk run" model, refrigerant could be picked up, brought to the recycling facility, recycled, and then delivered back to the same business.

CHAIRWOMAN TANNER: It sounds so simple, but that is so difficult. This Committee has been concerned for years about small generators' hazardous waste, and how to handle that hazardous waste for small generators. So, this is just one more situation where we'd have to put together a program of picking up the CFCs and getting them to a disposal site, if there is a disposal site.

DR. FISHER: Or a recycling center, right.

CHAIRWOMAN TANNER: Ms. La Follette.

ASSEMBLYWOMAN LA FOLLETTE: I just have to comment on this. Actually, maybe this isn't such a bad idea, because it would get rid of all those abandoned refrigerators that are in the canyons. Maybe we ought to tie all this together, and we can help clean up California, in several ways.

CHAIRWOMAN TANNER: Really. We've tried so hard, on the hazardous waste. It's difficult.

DR. FISHER: Yes, I'm sure it is. But, I certainly think that trying to address those difficulties is a worthwhile endeavor.

Our third suggestion is to adopt or enact new air conditioning and refrigerator service standards. Currently, as previous witnesses have mentioned, when air conditioners or refrigerators are serviced, the refrigerant is generally released into the air, and new refrigerant added. In fact, manufacturers, typically, do not honor a unit's warranty if anything other than "virgin refrigerant" is used in the unit. The state could adopt servicing standards requiring service stations and air conditioning repair companies to recover refrigerants. Economic incentive programs could be devised to encourage these companies to purchase the necessary equipment to capture CFCs. Manufacturers could be encouraged or required to allow recycled refrigerant -- quality controlled to make sure it's pure enough to allow that recycled refrigerant in their units.

The next suggestion is to require recovery of CFCs when refrigerators and air conditioners are disposed. The state could mandate recovery and recycling of refrigerants in junked cars, and old retail and home refrigerators. An ordinance could require these units to be picked up by a permitted salvager or local sanitation department. Economic incentive programs for salvagers or sanitation departments could encourage purchase of recovery equipment. In addition, home refrigerators need to be equipped with appropriate valves to facilitate CFC recovery, a requirement that the state could make mandatory. For commercial refrigerators, I don't know if they have the appropriate valves or not, but if they don't certainly, you could require the appropriate fittings for whatever appliances that use CFCs, to assure that they could be recovered.

CHAIRWOMAN TANNER: You know, it didn't occur to me, until you just mentioned it. All of these old cars in junk yardsI'm certain that there hasn't been a recovery -- or a recycling -- program. I mean, I feel that there hasn't. Do you imagine that there has been, at all?

DR. FISHER: Well, I don't know if it would be worthwhile to go out to the ones that have already been junked, but, certainly

CHAIRWOMAN TANNER: Think of how many are being junked, daily.

DR. FISHER: Well, in fact, the automobile air conditioners have been estimated to be responsible for about 20% to 30% of the CFC emissions in this country; that's a pretty big chunk.

CHAIRWOMAN TANNER: Yes.

DR. FISHER: The next suggestion would be to require large scale users to recover refrigerants. For example, utility companies often pick up old refrigerators to cut down unnecessary power loads. This would be a very good time to also recover the refrigerants. Some businesses, such as rental car companies, municipal bus fleets and airlines, use large volumes of refrigerants. These companies could be required to use recycled refrigerants, or offered tax breaks for substituting recycled for "virgin refrigerants."

Establish refrigerant removal training workshops for small businesses. In fact, you don't even have to limit it to small businesses; I suppose you could establish these training workshops for anybody who might be doing CFC recovery. Some of the previous witnesses have mentioned that some of the people who are servicing these refrigerator units, basically, have very little idea on how to even recover the refrigerants. In some cases, they lack the necessary equipment, and in some cases, it's just a very difficult, very onerous task. I think you could accomplish a lot just by training people on how to do it and to try to take steps to make it easier to do.

The last suggestion is to require improved automobile air conditioner recharge units. Cans of refrigerant sold in auto parts shops could either be required to have high-quality shut-off valves to prevent leakage, or they could be banned altogether.

In addition to establishing a recycling program, the state should consider measures to reduce other major uses of CFCs, as industrial solvents and as foam blowing agents.

The electronics industry, especially the computer industry, is one of the biggest users of CFCs as solvents. Since there are a large number of these businesses in California, this is another area where the state may have a significant impact. The state could encourage or, perhaps, require solvent users to adopt plans to use these solvents more efficiently. Apparently, some of these users are already recycling CFCs, but I believe that there are still things they could do to make their whole operation more efficient, and use these solvents more efficiently.

Alternatives for reducing CFC emissions from foam products could also be explored. Not all foam products are made with CFCs, and some manufacturers have already switched to CFC alternatives or CFCs which are weaker ozone depleters. One possible action to encourage this would be for the state to buy foam products only from those manufacturers who use non-ozone depleting -- or minimally-ozone depleting -- processes. This is a measure which the State of Maine has already adopted.

It is essential that we reduce and ultimately eliminate CFC emissions if we are to save the Earth's fragile ozone layer and prevent the severe biological damages that will otherwise occur. Any program to reduce CFC emissions will also slow down the "greenhouse effect," protecting vulnerable coastal areas and their human populations. International cooperation is needed to solve these global problems. However, there is much that can be done at the state and local level; in fact, I would argue that some of these things really can only be done at the state and local level. Setting up a collection network for recycling CFCs, and eventually for disposing of them will benefit California, and will serve as a model for the nation and for the world.

CHAIRWOMAN TANNER: Thank you very much. This Committee does intend to work together and put together legislation. I know Senator Rosenthal is going to put together legislation. This Committee intends to work with environmentalists, with science and with industry to try to put some reasonable legislation together, because, clearly, it's a critical problem -- critical.

DR. FISHER: I agree.

CHAIRWOMAN TANNER: I really do appreciate your being here. Thank you, Doctor.

DR. FISHER: Thank you for asking me.

CHAIRWOMAN TANNER: We will break for lunch now.

LUNCH BREAK

CHAIRWOMAN TANNER: I think we'll begin.

Our first witness this afternoon is Robert Srubar, from the Ozone Section, Dupont. I think we'll find that very interesting.

Mr. Srubar, we'll give you additional time, because Kevin Faye is not going to be here. Would you identify yourself?

MR. ROBERT SRUBAR: Yes. I'm Bob Srubar. I work for the Dupont Company in our Freon business. "Freon" is our trade name for our fluorocarbons.

Dupont certainly appreciates the invitation to take part in this hearing. I want to applaud you on how well this morning went. I thought the witnesses were excellent

CHAIRWOMAN TANNER: Good.

MR. SRUBAR: I certainly appreciated the positive interchange between the witnesses and yourselves.

CHAIRWOMAN TANNER: Thank you.

MR. SRUBAR: It was really good to see that.

I want to talk a little bit about who Dupont is and why I'm glad to be here, and really where my remarks come from: Dupont is the world's largest CFC producer. At the time that CFCs were invented, in the late-1920's, Dupont was a large shareholder in General Motors, who owned Frigidaire. As commercial interest would have it, Frigidaire had the desire to have refrigerators in everyone's home that didn't require the iceman to come every day.

CHAIRWOMAN TANNER: "The Iceman Does Not Cometh?"

MR. SRUBAR: "The Iceman Doesn't."

Thomas Mitchely went to the periodic table of elements, realized that he wanted a molecule that was non-toxic, non-flammable. He did a lot of things and he did find that molecule; he found a whole family of them, which Dupont produces today.

We, as I said, are the world's largest producer; we produce the whole line of chlorofluorocarbons, many specialty products that are sold in just a few pounds per year, it seems like, all the way to the very large volume CFCs.

Because of our role in the business, we've also taken a leadership role in exploring the CFC-Ozone issue. One of the things that opened Dupont's eyes, in about 1972, is the invention of the electron capture detector. I know the name; I'm not sure exactly what it all means. But it enabled measurement of CFC levels in the environment and the part-per-trillion levels.

The English scientist, Jim Lovelock, who invented that, shared those measurements with some people in the industry, and a fellow, who was a head of our customer service lab in 1972, on the back of an envelope, figured that if that was the level in the atmosphere, probably everything that had ever been produced was still there. Then, the theory was, "What's going to happen with the rising concentration of these in the atmosphere?"

Industry had a conference in 1972 -- people from academia, people from industry -- to explore just what was the answer to that question. That resulted in the formation of what's now part of the Chemical Manufacturers Association, the Fluorocarbon Program Panel, which funds research into the ozone issue and the fate of chlorofluorocarbons in the air.

Dupont continues to contribute to the development of the science, both on our own, and through groups, like the Fluorocarbon Program Panel. For example, on the NASA Ozone Trends Panel, there was a Dupont scientist -- a fellow I worked with -- who was on that panel and also in the 1987 expedition of the Antarctic. That same Dupont atmospheric scientist took part in that. That has been the thing that has let Dupont understand the science very well. It is that understanding of the science that led us, in March of this year, to reach the conclusion that we favored a global phase-out of CFC production.

While we have been followed by many of our fellow producers and others in favoring that goal, we are, to my knowledge, still the only producer who has set that goal for ourselves internally. It's that goal that right now is driving our business decisions towards moving away from the CFCs and moving to alternative products and to ways for our customers to use less CFCs.

CHAIRWOMAN TANNER: It's wonderful to hear. It's wonderful to know that that's what Dupont is doing -- a little slow in doing it, but, it's very, very good and very wise that you're doing that.

MR. SRUBAR: Thank you. I'm glad we got to this point. It's, of course, a hard road; one that you get doubted on one side or the other, regardless of which way you move. I'm confident that we've made the right decision.

The reason I've asked for the "overhead", is I'd like to go through, a little bit, of the science background on the issue, that I think will help explain some of the policy kind of things, some of the feelings that Dupont has about regulation. I would also reiterate that what I'm giving you is a very condensed version of the brief thing I gave in June to many of your staff members. What I'd like to do, at this point, as well as I can, is use the "overhead" a little bit, and talk if we can divert, just a little bit, to some of the basic science in this issue.

CHAIRWOMAN TANNER: All right. Is there someone here who can help you, so that you can use the mike?

I'd like to build, a little bit, on where Dr. Wolf started, this morning, and some of what some of the other witnesses talked about, that CFCs, as they're emitted at the surface of the Earth, last in the lower part of the atmosphere practically indefinitely. When I use the term, "CFCs" I'll explain that terminology that I'm going to useCFCs being those that contain carbon, fluorine and chlorine only.

CHAIRWOMAN TANNER: Okay.

MR. SRUBAR: Those that contain hydrogen.

CHAIRWOMAN TANNER: Are not really CFCs.

MR. SRUBAR: Yes. I'll use the term, "HCFC," to designate the hydrogen. There is a third group that contains no chlorine, one that was talked about this morning, that I'll call, "HFC"; it contains only hydrogen, chlorine and carbon -- HFC-134-A.

CHAIRWOMAN TANNER: Didn't you just say that it contains no chlorine?

MR. SRUBAR: Yes, it contains no chlorine.

CHAIRWOMAN TANNER: You just said, "hydrogen, chlorine"

MR. SRUBAR: Oh, I'm sorry. Hydrogen, fluorine and...

The fully-halogenated CFCs have no known loss mechanism; there's nothing in, roughly, the first 30,000 or 40,000 feet of the atmosphere that would break them down. Only as they're very slowly mixed into the next higher portion of the atmosphere, the stratosphere, are they broken down by the higher-intensity ultraviolet light. It takes the energy going into it, from the higher-intensity light to actually decompose it. That's a fine distinction, because in the lower part of the atmosphere, they don't decompose, and that's where the, roughly, 100-year lifetime comes from, the mixing into the stratosphere.

The 100-year lifetime is important, from the standpoint that mixing around the globe. Within about 6 months, something emitted -- we'll say in Sacramento -- is mixed evenly around the northern hemisphere within about 6 months, within about two years it's mixed evenly around the globe. So, the dynamics of mixing in the atmosphere, along with the 100-year lifetime of these, make this a truly global issue.

We would like to take action, we would like to solve the problem ourselves, but if we don't get the cooperation of the other countries of the world, we have a problem, because their problem is also our problem.

CHAIRWOMAN TANNER: Yes.

MR. SRUBAR: As they mix slowly into the stratosphere, as was described this morning, they're broken down, releasing their chlorine atom. That chlorine atom will participate in the catalytic cycles, which would destroy ozone.

Let me talk, just a little bit, about the HCFCs. Those compounds, like HCFC-22, that contain hydrogen, have a different decomposition mechanism. They react in the higher part of the troposphere, or the lower part of the stratosphere, with hydroxyl ion -- that's a chemist's word for a combination of oxygen and hydrogen. They're broken down at that level. Fortunately, in the high part of the troposphere, or the low part of the stratosphere, there's very little ozone. The chlorine that is released goes to inactive forms; goes back to earth in the form of compounds and salts, and so forth, somewhat harmlessly. That's the reason for the potential to deplete

CHAIRWOMAN TANNER: Why doesn't that rise into the stratosphere?

MR. SRUBAR: Well, chlorine. Oh, the HCFC-22?

CHAIRWOMAN TANNER: Yes.

MR. SRUBAR: When it gets to this level, where there is concentration of hydronil, if the HCFC 22 in this example gets higher into the stratosphere, the higher energy ultra-violet light won't break it down. Forgive me for the technical explanation, but there are things about what happened in the atmosphere that limits its reactivity to right here which, fortunately I think for mankind, makes it a much more friendly compound.

To summarize some of the things talked about this morning, chlorine and then oxides of nitrogen are the catalysts which would speed up the destruction of ozone, while at the same time the concentrations of CO2 in methane actually catalyze the formation of ozone. And what's actually happening is, if you'll let me think of one molecule in the stratosphere, it has an average lifetime of about eleven days. It's constantly being created and destroyed, and as you can see, there are things that speed up the formation, things that speed up the destruction, and so, what's important is that an equilibrium level be maintained.

Now, if that makes you a little bit nervous, it makes me a little bit nervous, too. The idea that men can somehow control an equilibrium level in nature is, I think, a difficult situation, but it's one that, unfortunately, you have to understand it is something we are living with.

If you take all of that understanding and fit it into computer models of the atmosphere, you can come up with what you would expect to happen to the amount of ozone with time. I'm going to show you this chart to demonstrate some information and then I'm going to tell you why it's wrong.

First, let me demonstrate that basic concept that the time scale on this is roughly the time when CFC's were first starting being produced up to about a hundred years into the future, the why as to why this has actually changed in the amount of stratosphere of the ozone. If there had never been CFC's, if there wasn't this additional pouring destruction mechanism, the effects of CO2 in methane rising in the atmosphere would actually cause the amount of ozone to grow over time. If CFC's remained at roughly the 1986 productional level, the amount of ozone within this span of variability would stay roughly constant, but the problem is, if there were even a three percent per year of compounded growth, the chemistry told us that the amount of ozone would start to decrease very quickly.

That was the point that got Dupont, in 1986, to say it's clear to us that growth would be a problem. We, and this was September, 1986, when we went public saying we would support regulations that would limit growth in the use of these compounds. Let me save that for just a minute.

There is, however, an exception that kind of chemistry, and that is what is happening in the Antarctic. I'd like to describe the process of the Antarctic as we know it and understand it today.

The Antarctic region is very unique as regions of the globe go. Because of the temperature, it is definitely the coldest region of the globe, and because of the wind patterns and, particularly, the wind patterns in the stratosphere -- the wind patterns actually go from the Equator to the Poles, both the North Pole and the South Pole. At the South Pole, when those winds are going to the Pole, they come towards the pole in the form of a vortex, kind of a whirlpool if you will, of wind motion as the earth sinks to ground level and moves back towards the Equator at ground level. What happens each year in the nighttime, or rather in the winter in the Antarctic, there is no sunlight, so it gets even much, much colder. This vortex, if you will, contains the atmosphere, so the same atmospheric components are there for long periods of time, and the region gets so cold that there are clouds in the stratosphere, and they actually have ice particles in them. Those are called "polar stratospheric clouds."

Now, if you think of air travel when you're up above thirty, forty thousand feet, there are definitely no clouds in the normal atmosphere. To think of the Antarctic where it is so cold that not only are there clouds, but they actually have ice crystals, now, that's a unique environment, one that does not exist elsewhere around the globe, per se. In some isolated pockets in the Arctic, perhaps, that sort of thing can happen.

I'll talk a little bit about the Arctic in a minute. that creates what was described this morning as the heterogeneous chemistry. Homogeneous chemistry -- homogeneous means everything is the same -- they are just gases reacting with one another; "homogeneous," meaning just gases. Now, the chemistry "heterogeneous," there's gases and solids, the ice crystals being the solids, and it is theorized that what happens in the Antarctic for that roughly one month of the year is that the heterogeneous chemistry enhances the effect of chlorine. There's no more chlorine there than anywhere else around the globe, as I described the even mixing, so forth there's no more CFCs, but what happens because of that heterogeneous chemistry, the chlorine becomes much more effective in reducing the amount of ozone. As long as those ice clouds are there, the amount of ozone is reduced, and after roughly a month into the springtime, the ice clouds disappear; the amount of ozone returns to near normal.

Now, what I just explained has some speculation in it, some fact in it, but it's an explanation that helps me understand what's happening at the Antarctic. Now, the question is, can that same thing happen elsewhere around the globe?

CHAIRWOMAN TANNER: If the ozone were measured during that creative time when it's heterogeneous, that's when you find the hole?

MR. SRUBAR: Exactly.

CHAIRWOMAN TANNER: But, if it's measured at another time of the year, when the clouds are not there, then it is back to normal?

MR. SRUBAR: It's back to normal levels or near normal levels. That's an important point, that the chemistry only happens as it appears in the time when the clouds are there, and there are effects the rest of time around the year, but that seems to be recovering from the time when a lot of the ozone is destroyed.

So, the question now is, can this happen in the arctic region? Can this sort of phenomena happen, for example, at the Equator or other places? While, practically speaking, temperature seems to be at a real driving force.

The heterogeneous chemistry requires some kind of another phase. There's some speculation that particles, aerosols, droplets of nitric acid, other acids that do appear in the atmosphere could cause this. To date that really doesn't seem to be proving out.

The question is, in the Arctic region, where it is also very cold in the winter months, in smaller regions for perhaps shorter periods of time, could the same chemistry occur? There is an expedition this winter. Starts, in fact, two days after Christmas and goes a couple of months into next year to study that. The same kind of airborne, the same kind of aircraft measurements, balloon-borne measurements and so forth. To try to quantify that, but nonetheless, that is the best explanation I can give you for the Antarctic chemistry and some of the things that could, and perhaps might not, be happening in the Arctic.

CHAIRWOMAN TANNER: Why does this hole mend itself, and, then, what is the concern?

MR. SRUBAR: Back to what causes it to happen. The chemistry, the heterogeneous chemistry, is very effective, and in those elevations where the ice clouds are, the ozone is practically gone, ninety five, ninety eight percent gone. When the ice clouds are gone, the same formation cycles that would normally form ozone, the same destruction cycles that would normally destroy ozone, come into play, and things return to normal.

So, the formation cycle, if you will, will form ozone, the natural mixing from other parts of the atmosphere will replace the ozone, but there is, because that ozone has been destroyed, there is some lasting effect lasting throughout the year to some extent or the other. Back to the idea that an ozone molecule only lasts about eleven days, it does recover, and I'm sure not trying to make any excuse for that; I'm just trying to explain the phenomenon that the amount of ozone seems to recover somewhat.

CHAIRWOMAN TANNER: What is this hundred years?

MR. SRUBAR: Okay, the hundred year lifetime for CFCs is roughly the time that it takes for the CFC molecule to mix up into the stratosphere and get destroyed. That hundred year lifetime is, again, an approximation, but it makes a lot of sense in that if you emit something today it's going to be here an average of a hundred years. It takes about that long for it to get up into the stratosphere, the CFCs, to get into the stratosphere and get destroyed.

CHAIRWOMAN TANNER: The Senator has a question.

SENATOR ROSENTHAL: If that Antarctic situation lasts only one month, what's the problem?

MR. SRUBAR: There seems to be two schools of thought. One is it's the Antarctic, it's not a populated region, so what? Well, I think that's a very callous way to think of it.

The other is, there are life forms there. Of penguins, whales -- a lot of important things in the food chain elsewhere around the globe start at the Antarctic. To the extent that this is a change in the ecosystem, I think it has to be taken seriously.

SENATOR ROSENTHAL: Is there any indication that the hole gets bigger next year than it was this year?

MR. SRUBAR: Yes. The whole, over time, beginning in 1979 to present, has gotten deeper, if you will, and has gone from 10% or 20% to a 30% reduction, and actually, geographically, it has covered more area. Again, this is a delicate balance.

I explained the Antarctic from the standpoint of what's to understand, the scientific phenomena. I think the real indicator is what happens elsewhere around the globe. I think we need to understand the chemistry at the Antarctic, but the reality exists that the hole could go away. If you want to bet on things and for probabilities, I think it is very low. I think, from a policy standpoint, you have to realize that the depletion at Antarctica could be much less this year, therefore, and it could be much less next year, it could be more this year. You know, it's a delicate balance affected by some very severe conditions.

The important conclusion from the Antarctic is that there is heterogeneous chemistry. It's a form of chemistry that wasn't in the atmosphere of the model that I showed you. So, as I showed you that model and talked about how you can feel about emissions of CFCs, that chemistry is not included there. What we've done is we've shown that it can exist, and that is reason for concern.

CHAIRWOMAN TANNER: Assemblywoman LaFollette.

ASSEMBLYWOMAN LA FOLLETTE: Sorry, I just got on the end of this discussion.

Is there any evidence that many countries have substations in the Antarctic? Is there any evidence that they contribute in any way to this hole, wherever the hole is?

MR. SRUBAR: The presence of man in the Antarctic, that could perhaps have done it.

ASSEMBLYWOMAN LA FOLLETTE: I mean, is there any indication that around these substations there are more CFCs?

MR. SRUBAR: I was explaining a little earlier the concentration of CFCs is very uniform around the globe. It is very uniform. what the unusual thing in the Antarctic is, because of the very cold conditions, that the chlorine chemistry, the chlorine as we have talked about this morning being the active species, the chlorine chemistry can be much more effective in those very cold conditions and particularly where there are ice particles in the stratosphere. That seems to be the phenomenon that correlates with the existence of the ozone hole.

ASSEMBLYWOMAN LA FOLLETTE: Thank you.

MR. SRUBAR: At this point, I'd like to continue a little bit of the science discussion and talk about measurements of ozone elsewhere around the globe over a period of time.

This chart is the average of about forty different measurement stations. Measurements taken from forty different locations around the globe over a fairly lengthy period starting in 1957. As you can see, what has been done, or what had been done until very recently, realizing that weather affects the amount of ozone, equilibrium amount, that latitude at different latitudes are differing amounts of ozone, may things affected, so the approach that was taken was to assume that all these things around the globe average one another out. It may be summer in one region while it's winter in another. If you average it all, you're going to pretty well let the pluses and minuses cancel one another out. So, what these are are the global average results for a period of about thirty years.

What you can see in what's just shown is a deviation from the normal level, or from the mean level, is in the early 1960's a dip which has been correlated with the atmosphere testing of nuclear weapons. Getting dust -- and, again, the discussion we just had a second ago about particles, heterogeneous chemistry, -- getting dust high into the atmosphere has an effect. Also, the formation of more oxides of nitrogen that happens in the atmosphere nuclear test. Looking again you can see about an eleven year cycle that corresponds with an eleven year cycle in the intensity of sunlight. Now, that's a natural phenomenon. Also, in there, with a little bit of imagination, you can see about a two-year cycle, ups and down that happen on about a two-year frequency. That corresponds to wind shifts in the stratosphere that change the chemistry a little bit.

The thing that was reason for concern, and the thing that led NASA and the World Meteorological Organization to take a different kind of look at this data, was the dip in the early 1980's, in fact, two dips, one that was thought -- the first one that thought to correspond the the eruption of the El Chichung volcano in Mexico. That's an event that affects the amount of ozone. The second dip was not explained, but, nonetheless, if you look at that, even considering those two dips, the amount of ozone around the globe seemed to be decreasing even though, statistically, the data all the way through 1986 through a statistical analysis show that there was no significant trend that these deviations were in the same magnitude as others we had seen in nature. The question was, those two dips show that trend as not statistically significant, but some of the things we had learned about the Antarctic, that kind of unusual chemistry in the cold climates, is there something more that could be done here? NASA and the World Meteorological Organization formed what was called "the Ozone Trends Panel," and they, indeed, released their findings March 15.

It's important that that's a consensus report of about 110 scientists from around the globe. One hundred and ten atmospheric scientists gets close to all there are. there weren't dissenting opinions. This was the scientific community coming to a conclusion. The things that were done in terms of looking at ozone trends is the accuracy of the measurements. Realize that there are forty different laboratories all doing their own calibrations, hopefully correlating with one another, sometimes not. The accuracy of the measurements statistically was reviewed, changed, hopefully improved, and statisticians have a way of doing that, hopefully, very accurately.

The effects of the natural phenomenon that I described, the eleven year solar cycle, a twenty-seven month wind shift in this stratosphere, were all factored out. the effects of the atmosphere testing and nuclear weapons, the El Chichung volcano, was factored out and then the analysis was done versus different latitude bands to see in different regions of the world was there effect, perhaps, and also for the different months of the year.

Now, this is a very microscopic look at where could the unusual chemistry perhaps be occurring.

Finally, in looking at the Antarctic data, now that there was very reliable measurements of the ozone, there is some other conclusions that could be drawn on, effects beyond the polar region. Now, to display the findings from that group gets to be more complicated than just the one chart I showed you, and I'd like to show you a couple of charts, explain what those findings were that we saw March 15.

CHAIRWOMAN TANNER: Even more complicated.

MR. SRUBAR: Yes, Ma'am, even more complicated.

What they did was compare ozone measurement in 1986 to ozone measurements in 1969. That's a fairly long time period, and what the presentations are for, let's say this one band of latitude form 30 to 40 degrees north, to take measurements in that one band of latitude from around the world and compare January, 1986, to January, 1969, to compare February of 1986 to February of 1969. To look over that long time period, where there really changes, having factored out all the known things that will effect the amount of ozone, trying to take all the noise out of the signal, was there a change?

What they found were reductions in the cold months along the order of two, three percentage points or so, but not as much in the summer months. Then you move a little farther north in latitude, let's say from forty to fifty degrees north, do the same analysis, and you see more of an effect in the winter and spring months but, again, less effect in the summer months. More importantly, now, when you get into the Arctic region and look at the same thing there in the very cold months, you see even more of an effect, less effect than in the summertime.

Now, that's a real eye-opener, when now we have a theory that the Antarctic is caused by the very cold temperatures, the heterogeneous chemistry. Where would you expect to see it but perhaps in the Arctic region? Even though these measurements can't say that it is happening there, they do seem to have a kind of fingerprint, if you will, that perhaps that same kind of chemistry is happening there.

What I'd like to do now is look at that same kind of analysis of the southern hemisphere. The Antarctic ozone phenomenon we've talked about, does it happen the rest of the time of the year? This shows the dip in the September, October time period when the region was because of their springtime. The clouds go away, the amount of ozone starts to return to normal, and you get up here around the rest of the year it's still depressed, thought to be perhaps because of the mixing. The ozone was actually removed from the atmosphere. It doesn't all quite get replaced. The reason for that data gap is there is no sunlight there, and without sunlight there aren't measurements of ozone.

Then you move a little farther north in latitude and you see what's probably dilution from the ozone-poor air in the other months of the year, even the year around.

But, the alarming thing about this data is you get to the southern tip of South America and you see reductions in ozone the year around. Now, that is a much different conclusion than the one I'd used before. Again, this says that there has been reductions in the amount of ozone. This is over just a seven-year time period with the event at Antarctica starting in 1979. Anything before that would just be insignificant. This analysis starts in 1979 and looks from then until now.

I'm finished with charts for now. Those are new conclusions, and that's the information that became available March 15.

CHAIRWOMAN TANNER: So that's a reduction all over the world, actually?

MR. SRUBAR: That's right.

CHAIRWOMAN TANNER: Not only this hole in the Antarctic?

MR. SRUBAR: right. The Antarctic hold and then very small reductions over the rest of the globe which is much different than the conclusion that there had been no global trends in the amount of ozone.

That concludes the science discussion I'd like to have. I'd like to get back now to, I think, some of the remarks I've prepared that I'd like to cover. I appreciate your letting me take the time to go through that. I think it's some interesting information and some that helps, I think, cast the complexion, in some cases, the seriousness of the issue, and in some way some of the understanding of this issue.

SENATOR ROSENTHAL: You indicated at the beginning that Dupont had acknowledged plans to phase out CFCs over a period of time.

MR. SRUBAR: Yes, sir.

SENATOR ROSENTHAL: Over what period of time, and which of the industries that you supply would continue to be supplied because there's nothing to replace it at this point? And which cones do you think would be actually phased out in terms of usage?

MR. SRUBAR: Senator Rosenthal, we in some of the testimony this morning, went through a lot of the -- what I would call the essentiality, the very important usage of CFCs, and the question that Dupont has is why not phase out now? I think the answer comes quickly to mind that there are a lot of important reasons, a lot of important usages, of CFCs that we just don't want to do it now. Doctor Wolf, this morning, used a phrase which I'd like to expand on, one that I call an "orderly transition to alternatives." I'd like to take your question and build on it if I may in some of my continuing remarks.

CHAIRWOMAN TANNER: You will tell us whether -- okay.

MR. SRUBAR: Oh, yes. What I'd like to do is talk about alternatives, the kind of timetable for introducing them, what our thinking is, and really where the industry, we think, might be able to get more in return.

Dupont's goal is really to provide the benefits that CFCs have provided society without the negative effects of CFCs. That's the goal, and the way to get there, I think, is what we just described as an orderly transition. Orderly, not as much from the standpoint of business, -- that's not the issue so much as the effect on you and me and the rest of society. To take the example of the need for electronics, the need for refrigeration in our food chain, and the practicality, if you will, of maintaining buildings like this one, let's say, and all the investments the State of California has in equipment like this in this building for the air conditioning and so forth. The option is either to use today, fight now, is to use CFCs to service it or to get rid of it, replace it. I think that's a pretty stark reality. To face that kind of thing is not what I would call an orderly transition.

So, Dupont's goal is to bring new products to the marketplace, new products that, on the whole, are an improvement over CFCs. I say "on the whole" and "improvement" because there are refrigerants, let's say, that are toxic, flammable, that have their own problems, bring their own dirty laundry with them, that we could use today, but that's why we are using CFCs. What Dupont's goal is is to bring the new products to market. the part of it is the need for global action. I'm very happy that the U.S.

has been a leader in the negotiation of the worldwide Protocol, the Montreal Protocol. The Protocol was finalized in September, 1987, and as was discussed this morning, will call for 50% reductions in the production and use of CFCs over roughly the next decade.

The important, or one of the very important, parts of the Protocol is its ability to be changed. It's an evergreen document that had every four years review of the available science and policy that determined if those control measures were indeed appropriate. What has happened is the Protocol assessment has been actually moved up. The meeting in the Netherlands that started this week is a review of the science and status of alternatives to come to a global consensus on how fast the transition to alternatives, or how complete the transition to alternatives can be and that would be the consensus-building mechanism so the control measures could actually be changed.

Dupont, I think, as I have said, advocates a total phase-out. And we are not in stating our position as certain that that's the right thing for all of the globe, but we would sure like for them to get there.

CHAIRWOMAN TANNER: A total phase-out in what length of time?

MR. SRUBAR: Our goal in the U.S. is by the turn of the century.

CHAIRWOMAN TANNER: In the meantime, what will -- clearly, a phase-out by the turn of the century means that we are emitting a great deal of CFCs into the ozone -- and depleting the ozone. Is that what you meant?

MR. SRUBAR: I guess my answer to that point is that the stringency -- the global agreement -- is more important than the short-term reductions that we could do alone.

I've got one chart that I'd like to use to explain that, a little bit, if you will allow me to do that.

CHAIRWOMAN TANNER: We, the United States, you mean?

MR. SRUBAR: Yes. The United States.

CHAIRWOMAN TANNER: Why would you say that? If the United States...

MR. SRUBAR: Well, the United States is about 30% of the world's CFC usage.

CHAIRWOMAN TANNER: Yes.

MR. SRUBAR: And right now we have a global agreement that the whole world will reduce by 50% by the year 1998. There's the practical question of how fast you can actually ban them. Our guess is that the turn of the century is a good goal. The other question is, how fast can the rest of the world move with you, realizing the importance of getting a worldwide consensus? The...

CHAIRWOMAN TANNER: That is the arms race, isn't it?

MR. SRUBAR: Well, in this case, especially, you need to solve the whole issue.

What this chart is, is chlorine in the atmosphere from CFCs, and is chlorine from global emissions of CFCs, all of the CFCs emitted around the globe. The Y-axis is, perhaps, not as important as the timing element. The different lines on it -- the top one, the solid line, is actually what is included in the

"Protocol" today. This assumes near-total cooperation, near-global cooperation in the "Montreal Protocol."

Our concern with the "Protocol" is that chlorine levels will continue to rise. If the chlorine level in 1979 is any indication of where heterogeneous chemistry becomes important, perhaps that's a goal -- somewhere in there -- where we need to be, in terms of atmospheric chlorine. If you were to take the control measures in the "Protocol" and move them up, and instead of having the freeze in 1989, have an immediate 20% reduction, and four years later, get to the 50% reduction step, you still don't reduce the amount of chlorine in the atmosphere.

What is actually needed is a total phase-out. This line is an 85% reduction, immediately, which would stabilize the amount of chlorine in the atmosphere. But, an 85% reduction doesn't actually reduce the chlorine level very much; you have to go to something like 95%. So, let's just, for the sake of discussion, add a 95% reduction step to the "Montreal Protocol." In the timing, the "Protocol" has things in five-year steps, and that's actually the "D" line. Take the "Protocol" and just add an additional step to it; in the year 2003, and you get the reductions.

So, your question is, maybe the year 2003 is too late; let's see on how we can improve on that. Let's just move those reduction steps up. If you move it up one step, you take some of the "overshoot" out, and you get reductions sooner. What it actually boils down to is, for every year later that you have a 95% reduction, it's five years later that you return to the chlorine level that you would have been at. It's kind of a five-fold multiplier, on a delay factor.

The importance is realizing that the goal has to be a 95% phase-out. I think, in looking at these charts, even 85% just doesn't do it. You have to have a 95% phase-out. If we do it alone, the U.S. being 30% of the world production, that's only a reduction to 70%. We need global cooperation.

There's a trade-off to get to the 95%; it's going to take time to build a global consensus, but that time is also working against you, in terms of allowing this "overshoot" to occur. That is, I think, the important thing to occur in negotiating the "Montreal Protocol."

CHAIRWOMAN TANNER: If the United States phased out more quickly than the turn of the century, don't you believe that other countries would follow?

MR. SRUBAR: The one example I can refer to is the aerosol ban in 1978, where the U.S. unilaterally banned the use of CFCs in aerosol, and almost no one followed. Canada followed with a half-way measure; they banned them is some products. Some of the Scandinavian countries. But, no one followed, practically speaking. In Europe today, about half the CFCs are used in aerosol propellants. So, that is "salt in the wound" when you would like to move ahead very quickly, and others don't follow; they let you solve the problem.

SENATOR ROSENTHAL: Just a follow up: at the time we eliminated aerosols, they weren't using that much aerosol in Europe; so, there wasn't that much to cut back. Ten years ago, they were very little aerosols in Europe; so, what you said doesn't follow. The reason they didn't follow us is because they weren't there.

MR. SRUBAR: Well, they've grown since.

SENATOR ROSENTHAL: I understand that they've grown since. But, you're going to find a growth, for example, in Europe, of refrigeration; the emerging countries of Africa are going to get more involved in refrigeration. So, I don't know what we're talking about.

MR. SRUBAR: Well, my point, if you'll allow me, Senator Rosenthal, is that unilateral action by the U.S. has not brought cooperation. Our willingness to take action ourselves seems to be the biggest "bargaining chip"; that, and of course, the trade sanctions that we have against other countries if they don't follow. That seems to be a "bargaining chip" to get others to move ahead. For example, even in the 50% reduction in the "Protocol," the Japanese, frankly, weren't interested. Only because of a lot of urging from the U.S. and others, did we get them to the 50% level.

The importance of the near-total phase-out, and the idea that even an 85% reduction doesn't do itI think there is a time period we're into now in international negotiations where it's very delicate that we use all of the leverage we have. An important part of that leverage is our willingness to solve the problem ourselves. I realize that there is definitely some "brinksmanship" there, that ultimately, we, as a country, have to do what's right. But, I think in the short-term, we need to use that leverage, just as much as we can.

SENATOR ROSENTHAL: Yes. Let me just ask one further question. Does Dupont have anything to do with other companies producing this materials in other countries -- with other companies producing it?

MR. SRUBAR: We have subsidiaries that are all under the Dupont name in other countries. The Dupont goal is a worldwide one. Every place that Dupont is involved in the CFC business, this goal fits.

SENATOR ROSENTHAL: I understand. When you talk about cutting back in this country, that's not all of your production, because you are producing it in European countries, as well. What would happen if you were to do that same cut-back wherever you had any influence? What other large companies are producing it?

MR. SRUBAR: To think aboutWell, our goal is to cut back in all of our operations. At this point, the idea of, let's say, increasing, is totally out of the question.

SENATOR ROSENTHAL: I understand that.

MR. SRUBAR: But, the cut-back is a global one. Our efforts on alternatives are global efforts. In the other countries of the world, we have a much smaller market share than we have here. In Europe, we are, for example, a fairly small player; our market share is, I know, less than a quarter of the market -- something like that. The impact we would have there, I think, is fairly small. In Japan, that quarter of the market is probably also typical of this; it's something in that range. In the U.S., we're roughly half the market; worldwide, we're about

25%. So, our goal and our willingnessThat orderly transition to alternatives is a global move.

I can tell you that I think the biggest impact that Dupont has had has not been in being willing to phase-out on our own, but rather, the peer pressure we've exerted on other producers. Governments -- people like yourselves -- realize that alternatives can be developed, can be brought to market. Our competitors are very able -- in fact, we're in one heck of a horse race.

The point I wanted to make about the "Montreal Protocol" is that, at this point, there are about 10 countries that have ratified it. Of course, the U.S., Mexico, CanadaJapan has ratified. The countries to date that have ratified represent about 50% of world consumption, with the EEC countries -- the 12 European economic community countries -- ratifying by year's end, which, at this point appears very, very certain. That gets over 80% of the world consumption in the "Montreal Protocol" agreeing to the 50% phase-out. That makes the "Montreal Protocol," I think, by every measure, a landmark environmental accord.

CHAIRWOMAN TANNER: Is there enforcement of the "Protocol?" Would there be enforcement?

MR. SRUBAR: Yes. The real key to the "Protocol" -- the real "club," if you will -- is the trade restrictions. If countries do not live up to the "Protocol" control measures, they can't trade in CFCs, or CFC-related products, with the other parties. For example, Japan's electronic industry would be excluded from the U.S., if they didn't abide by the control measures in the "Protocol." Of course, to Japan, that's very important, but around the world, the idea of being excluded from international trade, makes the "Protocol" a very powerful

CHAIRWOMAN TANNER: So, this really isn't just a "gentlemen's agreement"?

MR. SRUBAR: Oh, no, no. The idea of being out of compliance, and facing trade sanctions, is very important, very significant.

As I said, the answer is safe, alternative products. HCFC-22, with about one-twentieth the ozone depletion potential of 11 and 12, is one that is available today. Dupont, in cooperation with many of our customers -- Olson Industries, a California company, to name one -- went forward and got FDA approval for its use in food packaging foams. By year's end, none of our customers who are using CFC-12 in the McDonald's, clam shells, meat trays and egg cartons, will be using 12; they will all have switched to 22. I think that industry really deserves some applause for that kind of effort; they have moved remarkably fast.

HCFC-22 can also be used more extensively in air conditioning equipment, but not in existing equipment. HCFC-22 has a much higher pressure rating than either 11 or 12; so, where that niche is, is really in new equipment.

CHAIRWOMAN TANNER: No retrofitting then?

MR. SRUBAR: No, not for 22. Thank you; that's a good lead-in to the new alternatives, to products very much like CFC-11 and CFC-12, products that would fit in either the same equipment or equipment of almost identical design.

We've identified those products; both were replaced for 11 and for 12. Toxicity testing, as was described this morning, is underway. With more than 14 of the worldwide producers, we formed a consortium to co-fund the toxicity testing, and we've actually compressed what would have been a very aggressive seven-year time scale down to about five years of testing. That testing is starting now, and will be completed in the early-1990's. It's that chronic toxicity testing -- essentially, screening for carcinogenicity -- that is the last hurdle in the commercialization of these products. It's a very important step.

Dupont is willing to look at interim results. Our competitors are willing to look at interim results, and make business decisions on moving forward, so that they are not waiting until the, roughly, 1992 or 1993 time frame to decide to build plants or not; we're willing to take a certain amount of risk and move forward.

CHAIRWOMAN TANNER: Too often, with chemistry moved a little bit quickly, and ended up with a very toxic or carcinogenic chemical. So, I would hate to jump from an ozone depleter to a carcinogen.

MR. SRUBAR: The term I would use is -- I would not want to trade a long-term, serious threat for an immediate, serious threat. It's somewhere in the chemistry; it just doesn't add up. I agree with you, wholeheartedly.

We now have seven facilities dedicated to alternatives development, be they pilot plants, small plants, to produce test quantities of the alternatives. And actually two commercial scale plants; one being retrofitted to produce HCFCs-141 and 142-B, which will be used in foam-blowing applications, and one which we announced just a few weeks ago, an altogether new plant to produce millions of pounds per year of HFC-134-A. The production from that plant will be used for the larger scale testing by our customers, things like automotive fleet testing, production line size, testing of that alternative. That plant will start up in 1990, and is a very important step towards the commercialization of the alternatives.

After that landmark, our goal is to have new full-scale plants for other alternatives, as soon as late-1992. Late-1992 is a very aggressive time scale, as we just talked about toxicity testing. A five-year program, starting right now, means we will have the final results in the 1993 time frame. So, what Dupont would be doing, and will be doing, as it appears, is that we'll look at interim results, and we'll move forward with the intent that if all the indicators are that we're going to have the kind of toxicity results we believe we're going to have, we'll move forward. That's the kind of prudent risk that we're willing to take to be ahead on this kind of time schedule.

Then comes what I call the "orderly transition" to new alternatives. How do our customers adapt to the new products? The first goal we have, in the customer base that we're working with first, are the producers of the new equipment. As you heard this morning, there is equipment -- the "chiller" for this building, for example -- that is expected to last, probably, 20 to 30 years. The first target that we have is to convert new equipment, so that new equipment going into the marketplace uses the alternatives, so it's not there for 20 or 30 years, using CFCs. Once we've got that in hand, we've have very, very aggressive programs with those manufacturers of refrigerators, insulating foams and the "chillers" for buildings like this.

The next goal is, what to do with the existing equipment. We really have about three alternatives: One, which is not very attractive, is to just throw out the old equipment and buy new equipment. In some cases, that's going to happen, because the it's time, anyway.

The second is to convert that equipment to use the new alternatives. As was described this morning, the new products, while they're very much like the products they replaced, do have differences. In the case of the replacement for CFC-11, it is not compatible with the same materials. It takes some changes in the equipment to use it. We've gone through those changes in the "chiller" that cools the corporate data center for Dupont in Wilmington, Delaware. We've had our "chiller" running on HCFC-123 since about the first of October.

CHAIRWOMAN TANNER: So, you have been able to do this?

MR. SRUBAR: We have done it. And that's a test. We've worked very closely with the supplier of that equipment, and we're very proud of that piece of equipment and of that step forward. That's one. The other would be to do the next thing on a piece of equipment that uses 12 and to do that sort of thing, so there is "retrofit" technology. I didn't understand the reference this morning to the "Rosenthal Building", so that Senator Rosenthal can pick up the phone and say, "I would like the 'chiller' in this building converted to use HFC-134-A." And the serviceman on the other end says, "Well, it's going to cost you 'X-number' of bucks. Of course, Senator Rosenthal would say, "I'm willing to spend it." Maybe it was the "Rosenthal Bill."

CHAIRWOMAN TANNER: Yes, I think so.

MR. SRUBAR: But, anyway, the idea of retrofitting existing equipment to use the alternatives is the next step. That has to happen, so that, let's say, if Senator Rosenthal did own this building, that it was not a surprise to him; an onerous conversion, something that's practical to do, and business does not shy away from doing. That is a goal of ours.

The third alternative is, low CFC-containing blends -- blends of materials, hopefully azeotropes, that would work in the existing equipment, keeping in mind that blends are the second choice in refrigeration, because they do separate. The different components of a blend have different migration rates through elastimers, and eventually -- unless it's a true azeotrope -- the composition of that blend will change. Let's say, for a short-term situation, there's a niche for something like that, and Dupont is developing those kinds of blends.

CHAIRWOMAN TANNER: You were saying that the blend doesn't have the same reaction to the ozone?

MR. SRUBAR: Oh, no. Let's say, there could be a combination of HCFC-22 with some other existing compound, perhaps one of the new alternatives that would work in a machine designed to use CFC-12. Even though it may not work as well, it may be the kind of interim fix for some period of time. That is something that we're working on, to try to make the components of that blend make the CFCs go much farther. Hopefully, we can come up with blends that are purely the alternatives that will work, and make the existing equipment work, and contribute to that orderly transition.

These kind of efforts -- the introduction of new alternatives, equipment using them, the conversion of existing equipment to use them, or to use some other more desirable compound is the kind of orderly phase-out that we are working for, that Dupont would like to see happen. That's the point of the cooperative programs we have with our customers who are the leaders in their industries.

Our goal is to complete this transition, so that after the turn of the century, we're no longer producing CFCs. I hope the rest of the world can do the same. It's certainly our goal that that kind of time schedule, or something close to it, is negotiated into an international agreement.

CHAIRWOMAN TANNER: I certainly admire Dupont for taking this action. I believe your testimony was very, very interesting. Certainly, I've learned a lot. I appreciate your being here.

MR. SRUBAR: Okay. I'd like to go for just one more minute, if I may.

CHAIRWOMAN TANNER: Oh. I thought you had just closed.

MR. SRUBAR: "What can California do?" is, I think, one of the important questions. I would urge California to be a part of that orderly transition. The first step is to be sure that barriers don't exist to the use of the alternatives. Barriers can be things like regulating them as PRC's, PRC's being photochemically reactive compounds that contribute to the formulation of smog. The alternatives that we're developing do not contribute to the formation of smog.

The existing products are largely exempted from PRC regulations, but in some instances, that exemption is being taken away, because of their involvement in stratospheric ozone. That's a hurdle to the introduction of CFCs. The other approval processes, the kinds of things, perhaps, that Dennis Omera talked about this morning. There are institutional hurdles to change, and we would sure like to get over them as quickly as possible.

We certainly encourage the use of re-claimed CFCs. One suggestion I have -- and I offer this suggestion very respectfully -- is that in state-owned operations, reclamation be given a high priority. I'm sure the State of California, as is the Dupont Company, is a big user of CFCs. To take the kinds of things we've talked about today

CHAIRWOMAN TANNER: The state is often slower than the private communities.

MR. SRUBAR: We would like to see good faith on everyone's part.

CHAIRWOMAN TANNER: That's right.

I'm going to have to ask you to close, because we do have other witnesses.

MR. SRUBAR. Thank you.

I certainly appreciate the time you've allowed me, and I appreciate your constructive interaction.

CHAIRWOMAN TANNER: Thank you very much. Thank you.

MR. SRUBAR: One last thing: I do have a number of hand-outs that are really much more comprehensive than what I covered.

CHAIRWOMAN TANNER: We would like to have those.

MR. SRUBAR: I'll leave them for you and your staff.

CHAIRWOMAN TANNER: I think your testimony was very comprehensive. We appreciate it.

MR. SRUBAR: Thank you.

CHAIRWOMAN TANNER: Our next witness is Dr. Marcel Halberstadt. Doctor Halberstadt is with the Motor Vehicle Manufacturers' Association.

DR. MARCEL HALBERSTADT: Good afternoon, Chairwoman Tanner, members of the committee. I am Marcel Halberstadt. I am Director of the Environmental Department at the Motor Vehicle Manufacturers' Association, MVMA.

Just for the record, I would like to read names of the members of the association; there are not many of them these days. They include: Chrysler Corporation, Ford, General Motors, Honda of America, Navistar International, PACCAR Incorporated, Volvo North America, Incorporated -- just seven members.

CHAIRWOMAN TANNER: Sounds like a powerful group.

DR. HALBERSTADT. It is; they are all very large corporations, and manufacture on the order of 97% of all the cars, trucks and buses that are manufactured in the United States.

I will try, in the interest of brevity, to paraphrase the paper which has just been distributed to you.

We're very pleased to have been invited to provide testimony to the Committee, and to present the view of a very large user-industry of CFCs.

As we just heard, from the Dupont Corporation, CFCs, when they first were developed, represented a major breakthrough towards improving the quality of life. These compounds have unique properties: they're non-toxic; they're non-flammable; they're non-corrosive. Their growth has been phenomenal. It's only in recent years, as we also heard earlier today that anyone imagined that they might also have a down side.

Our understanding of how they might take part in some negative effects, such as the destruction of the stratospheric ozone layer and, perhaps, also the "greenhouse effect," has culminated again in the "Montreal Protocol," which is taking this towards the eventual elimination of the manufacture and use of these products.

The MVMA endorses the final rule that was developed by EPA in response to the "Montreal Protocol." The "Protocol" indicates, in our opinion, the worldwide concern with the potential depletion of the stratospheric ozone layer and the possible effect that the CFCs may have on this layer. It also establishes checks and balances to limit the growth of these products, while additional data are collected, and efforts are made towards understanding the problem and resolving the uncertainties concerning the availability of the replacement compound.

Insofar as the industry is concerned, we feel that the "Protocol" provides the industry with minimal lead times, assuming there are no major setbacks, such as, for instance, if there were to be negative results with the toxicity testing that we just heard about.

The "Protocol" also does not appear to place the U.S. at a competitive disadvantage, while alternatives are being developed; that is, it is taking us towards an orderly transition to alternatives, as we just heard from Mr. Srubar.

For the past several years, MVMA companies, along with the chemical producers, have been investigating alternatives for major CFC compounds that are used in the industry. The major use that we've heard discussed is that in auto air conditioners, but the industry also uses CFC-11 in the foam-blowing process to provide interior components for vehicles -- the seats and the seat backs, the padding, which really adds to the interior vehicle safety. And, the industry, of course, is also a very large user of electronics, so that the manufacturer of electronics is definitely affected.

The investigations in which the industry is involved continues to gain importance, particularly in light of the fact that the regulation of CFCs identified in the "Protocol" will be frozen at the 1986 production levels, assuming the "Protocol" becomes effective, as originally scheduled, in 1989. That freeze already provides some hardship to the industry, since it represents a reduction in the availability of regulated CFCs since their usage has already increased since 1986. So, we are already experiencing a reduction, if we're talking about a freeze at 1986 levels.

If I may, now, I would like to go into somewhat greater detail on some of the specific usage areas. The CFC-12 as a refrigerant in mobile air conditioning systems. During 1987, 87% of all domestically manufactured passenger cars and 66% of all trucks sold in the U.S. were equipped with mobile air conditioners using CFC-12 as a refrigerant. The average amount of refrigerant charge for passenger cars and trucks is around two and one half pounds for cars and three and one half pounds for trucks.

In terms of total usage, the best data, we feel, available is that found in the 1986 Rand Corporation report produced for EPA. That report indicates that of the total CFC reporting countries, of that total production, approximately 20% is used for mobile air conditioners. Of that quantity approximately one quarter is used in assembly plants to charge air conditioning for newly manufactured vehicles, whereas only three quarters of the CFC usage for motor vehicle air conditioners is in the service-after market industry, which means that if the industry were to stop using CFC-12 in newly manufactured vehicles there would still be a very large demand for CFC-12 to service vehicles in use.

CHAIRWOMAN TANNER: If there wasn't a need for -- I see, because that's what the vehicles are used for, CFCs they use now.

DR. HALBERSTADT: That's correct, and there is no compound available right now that can be substituted directly in those air conditioners.

It should also be noted that in the period between '77 and '84, domestic manufacturers made significant improvement in engineering their systems such as hose materials through the use of permeability, that is, the rate of leakage of refrigerants. They improved connections and seals and used shorter hoses to minimize the need to return the vehicle to the dealer for service, improving customer satisfaction and, at the same time, decreasing CFC usage. Before that, as much as 3 to 4 pounds might have been a charge for a passenger car. Now we have it down to two and one half pounds.

We have heard a number of witnesses talk about recycling. Let me tell you now what the members of the Motor Vehicle Manufacturers Association are doing about recycling. The industry is committed to reducing and eventually eliminating the CFC-12 usage in their air conditioners, but in the interim the manufacturers are committed to recycling CFC in their air conditioning systems. To accomplish this goal, the manufacturers need data to indicate whether air conditioning refrigerants removed from different agent mileage vehicles can be recycled and used in the compressor without significantly degrading this reliability, and we heard a little about this earlier. EPA, that's the U.S. Environmental Protection Agency, and the AMMA, the After Market Mobile Air Conditioner Industry, are just at this time completing a program in which samples were collected from air conditioners of vehicles of diffferent ages and mileages and tested for moisture, residue refrigerant purity, acidity and other content. The samples are being recycled through several prototype portable recovery units that have been designed to filter and recycle the refrigerant back to the mobile air conditioner system during servicing without releasing any of the refrigerant to the atmosphere, as we heard earlier.

CHAIRWOMAN TANNER: Is there a concern with automobile manufacturers that the recycled CFC is considered a hazardous waste or a toxic material? Is that a concern? Because the recycler mentioned that he is not willing to accept a product recycled unless the generator has an EPA number. Is that a concern among service stations, manufacturers, or people in our community?

DR. HALBERSTADT: The present procedure is to vent the CFC to the atmosphere during the air conditioning cycle. These compounds are not at this time considered to be toxic materials. The collection of the refrigerant during service, if this program goes ahead to its conclusion successfully, would involve the hooking up of an instrument during the service procedure directly to the auto air conditioner, and that material would be collected, cleaned, and stored until whatever is wrong with the air conditioner can be fixed, and then it would be put right back into the same vehicle. So, there would be no venting of that CFC to the atmosphere.

At this stage, we are at the point of the initial samples having been collected and analyzed and the prototype instrumentation -- well, first of all, we have to set specifications for acceptable purity of recycled material, and then the prototype instrumentation will be tested, and it's expected that this program will be completed at the end of January, 1989. In the very near future the successful production of these units by independent manufacturers will begin, and sufficient numbers would have to be produced to provide at least one of these units to each of our member company dealerships and plants as well as to air conditioning repair businesses across the United States. Some rough estimates made to date indicate that the cost of such units would be three to five thousand dollars. So, for some organizations that would be very inexpensive, and for others it would be quite an investment. In terms of checking leaks, certain of our members, the manufaturers, are using helium leak detectors where applicable in plant leak testing of air conditioner system components, but as far as we are aware no helium test unit exists for service application at this time.

In terms of substitution of new materials for mobile air conditioners, I'm going to quickly summarize the discussion that I have in my written paper. The problem is that there is at this time no direct, what we call drop-in, substitutes that can be replaced, that can be put into the air conditioning systems that now exist.

Several substitutes have been suggested. One of them is CFC-22, that we heard discussed earlier. That compound, while in principle could work, is not really a good choice for mobile air conditioners. It suffers from major problems in containment with the currently available elastimer as used for hoses and seals, and I must explain right now that flexible tubing has to be used in mobile applications because of the hostile environment in the vehicle, the vibration and engine movement that must be accommodated. So, whereas in stationary systems you can use rigid tubing, in a motor vehicle you have to use a flexible hose. The development of a suitable lubricant for use with CFC-22 has not progressed very well and that would have to be developed, and, in addition, the higher operating pressures that would be needed for use of the CFC-22 would require a re-engineering of the complete system with heavier and more solid components, and as a result the use of CFC-22 is not really considered to be a viable alternative because the lead time for the development of addressing all the questions that I just summarized for you would possibly surpass that required to implement a totally new refrigerant, such as the 134A which we consider, right now, to be the primary candidate.

We've heard about mixtures and blends as well, and I'm not going to dwell on those, but the industry really does not feel that there is a suitable blend available that could be dropped into the present system, and as a result, again, the efforts in engineering a system suitable for use with blends would be wasted effort we feel, rather than to go ahead and engineer a system for use of 134A. The 134A itself, we feel, has the greatest potential. Since it doesn't contain chlorine, we feel that if it were commercially available it would remove the mobile air conditioning question from the ozone depletion problem. There are a number of unanswered questions regarding development of this compound. The toxicity questions have to be answered, as does the commercial production process, for the 134A, which we just heard from Dupont is well under way.

CHAIRWOMAN TANNER: It always seems to be a trade off, doesn't it?

DR. HALBERSTADT: It certainly is.

The most direct immediate challenge to the industry is the development of the lubricant for use with 134A. The industry is working on the problem, and we believe that the number of possibilities have been narrowed down, but we do not at this time have a suitable lubricant for use with the 134A, so the type of long term engineering tests which need to be done are not yet possible.

Since we don't know exactly what engineering changes need to be made in the air conditioning system, we don't know what a complete, -- well, to what stage a system has to be redesigned in order to accommoodate this, but we're confident that the answers are forthcoming.

In terms of costs, since, as I just noted, we don't know what the requirements of the final system will be, we can't really estimate what the capital costs are. One of our members, however, in 1980, responding to a notice from the Environmental Protecdtion Agency, estimated that it could cost, in 1980 dollars, approximately five hundred to six hundred million dollars to develop a new mobile air conditioning system for production, so this is an order of magnitude for the development costs.

As I mentioned earlier, leaving mobile air conditioning for a moment, another crucial use of CFCs, in this case CFC-113, is in the manufacture of electronics in which, again, in the hostile environment of motor vehicles the product reliability is really of great importance. The vehicles nowadys are all equipped with sophisticated engine control systems and electronic control units whose reliability has to be maintained. CFC-113 is used as a metal degreaser and a solid defluxer to clean electronic components, and the industry feels that at this time there isn't any ready substitute available. The equipment currently used for cleaning is designed to recycle and contain as much of this CFRC as possible, again as we heard earlier. We feel that improvements to presently uncontrolled or fully controlled cleaning equipment may provide additional time during which alternatives to CFC-113 may be evaluated and identified. The use of aqueaous solvents and non-surface melt applications are all being considered by the industry, and at this time, in terms of building reliable circuit boards, are not considered to be adequate, but again, the research is continuiing along those lines.

In conclusion, let me list the following: MVMA endorses the U.S EPA efforts to implement the "Montreal Protocol" on substances that deplete the ozone layer. We also feel the unilateral action by a city, state, or country has a negligible impact on the global CFC problem because the amount of CFCs controlled by such an action will be a neglibile amount of the total global emissions. Such unilateral action does, however, have an immediate impact on the businesses within the jurisdictional area.

CHAIRWOMAN TANNER: The problem is if, say, the State of California decides to wait until there is global action we may wait for another thirty years and there may be no ozone. Isn't that -- isn't that correct? You know, to get a Congress or to get this legislature to agree on anything is very, very difficult. To get all of the nations in the world to agree, I don't know if we can just drag our heels and not take any action.

DR. HALBERSTADT: It poses a serious dilemma.

The MVMA member companies are actively investigating the fluorocarbon 134A as a substitute for CFC-12 in mobile air conditioning, and while there are many unanswered questions relative to this compound, if they are solved without major setback, 134A could be available within the minimal lead times provided by the Protocol, and I repeat that the industry is dedicated to eliminating the use of CFC-12 in mobile air conditioners. The 50% reduction lead time is 1998. The industry has gone on record as wanting to eliminate the use by that time at the latest and if possible earlier, but right now, with the engineering challenges together with the other unanswered questions, that may not be possible. As soon as it can be done the industry is committeed to doing it.

CHAIRWOMAN TANNER: Dr. Halberstadt, are you an engineer?

DR. HALBERSTADT: I'm a chemist.

CHAIRWOMAN TANNER: A chemist. Well, then, you know, if it's ten years before this happens with the motor vehicles before we have this change, couldn't there be serious damage to the ozone in the meantime?

DR. HALBERSTADT: Well, as we saw earlier, the models indicate that there is a potential for significant depletion in the stratospheric ozone projectives into the next centrury. The industry certainly recognizes that and is doing all it can to accelerate the timeframe under which the substitution and elimination of the usage takes place, as well as the containment and recycling. We're working on that.

CHAIRWOMAN TANNER: It's really a frightening thing, isn't it, not knowing what the ultra-violet rays could do to the human, to the body, but all of that chain reaction of the things that were described by some of the witnesses today. It's really very frightening.

DR. HALBERSTADT: It is.

CHAIRWOMAN TANNER: Let me just ask one question. If HFC134A were available today, how long would it take your members to change?

DR. HALBERSTADT: Two years ago we made an engineering projection and said that it would take on the order of five to ten years, which is as close as we could narrow it, to do all the engineering developments if it were available at that time. But presumably, we can scale that back.

SENATOR ROSENTHAL: That's to suggest that you wait until it is available before you do anything. Seems to me that at the same time that Dupont is working on this project now to produce 134A, you ought to also be doing something about it, but that's not what I've just heard you say.

DR. HALBERSTADT: Well, the industry is working in parallel with the chemical manufacturers in looking at the development of lubricants, for instance for 134A. We don't even know whether it's going to get a clean bill in terms of toxicity testing.

SENATOR ROSENTHAL: Yes, but my question is a hypothetical one. I don't like your answer. I'm saying if 134A is available today, how long would it take the auto manufacturers to use it?

DR. HALBERSTADT: Well, first of all, okay, excuse me, if I may try to answer that. I am, unfortunately, constrained by representing the association rather than any of the manufacturers in statements that we have made publicly, and I apologize for the lack of availability of one of our company engineers to really answer that question, but the industry, if pressed, certainly has a lot of resources to apply to the problem, and the industry is being pressed right now so that the development is moving ahead. Where individual companies are, I personally am not knowledgeable.

SENATOR ROSENTAL: You plan to be there when it is available?

DR. HALBERSTADT: That certainly is a possibility, but the U.S. industry is very much aware of that and is working as hard as it can to find substitutes and to reduce the usage of CFC-12. Just before I conclude, I would like to ask that a couple of additional documents be included as part of my testimony. These are letters that we have submitted to the City of Los Angeles, which is also considering action, as you know, on control, and we -- I'm afraid I only have one copy of those with me, but we have appended to one to those letters statements that we've submitted to the U.S. EPA and to the House of

Representatives in answering similar questions, and they expand a little bit further.

CHAIRWOMAN TANNER: We'll get copies available to each of the members of the committee. Do you have anything more you want to add?

DR. HALBERSTADT: This concludes my statement. I can try to answer any further questions.

CHAIRWOMAN TANNER: Any questions? Any further questions? Thank you very much.

DR. HALBERSTADT: Thank you for the opportunity to testify.

CHAIRWOMAN TANNER: Our final witness is Joseph McGuire, who is from the Air Conditioning and Refrigeration Institute. Mr. McGuire.

MR. JOSEPH MCGUIRE: I have the advantage of going last. I'll be the last one you will hear from, and probably a disadvantage. You're all very tired at this point.

CHAIRWOMAN TANNER: Oh, we'll make it fine.

MR. MCGUIRE: I hope you can still concentrate on this very complicated subject.

CHAIRWOMAN TANNER: Complicated subject, but this really is a fairly short hearing. We're accustomed to longer. Would you identify yourself?

MR. MCGUIRE: My name is Joseph McGuire. I'm Vice President of Policy and Government Affairs for the Air Conditioning and Refrigeration Institute, and we appreciate this opportunity to present our views on CFCs, the impact on the environment of public health, and CFC recovery and recycling is a means to reduce emissions into the atmosphere. What I'd like to do is request that my statement be submitted in its entirety for the record, and I promise I will only read a few excerpts from it.

CHAIRWOMAN TANNER: We appreciate it. Thank you.

MR. MCGUIRE: We are a national trade association representing 172 manufacturers of air conditioning, heating, and commercial refrigeration equipment. ARI also writes product performance ratings standards and administers voluntary rating verification programs which rely on third party independent test labs. The products within our scope which rely on the fully halogenated CFCs are primarily commercial air conditioning and refrigeration systems, such as air conditioning chillers, which we prefer to be bought today for large buildings, refrigeration and cold storage retail stores, refrigerated food transport, pharmaceutical refrigeration, drinking water coolers and automatic commercial ice makers. These products rely on CFCs 11, 12, 500, 502, and 114. The vast majority of residential air conditioning relies on HCFC-22, which is not included in the protocol which has a very low overtone solution factor. Room air conditioners, home refrigeration and automotive air conditioning are not included within ARI product scope.

ARI has supported both the "Montreal Protocol" and EPA rules to implement protocol which was finalized this past August. We would also support necessary additional control measures provided that they are pursued through international negotiation and that the implementation of such measures account for the status of CFC substitutes. It's important that there can be an orderly transition away from the fully halogenated CFCs. We understand the concern of this community about CFC emissions, and we commend the chairwoman and the members for their desire to reduce CFC emissions. We hope to be able to demonstrate today that, as users of CFCs who provide vital products, our industry is proceeding as rapidly as possible to move away from fully halogenated CFCs.

At this time, we believe the direct engineering controls or specific bans from CFC use in the air conditioning and refrigeration industry are necessary because manufacturers are rapidly converting to substitute refrigerants as they become available. Clearly, significant steps are already being taken by CFC producers to move away from controlled CFCs as rapidly as possible. However, quantities of such chemicals as HFC-134A and HCFC-123 still are not sufficient for all manufacturers to experiment with them.

It is also important to realize that devlopment of new products designed to operate with new refrigerants is a very time-consuming process. After designs are available, field testing must then occur to verify performance under actual operating conditions. Maufacturers have historically estimated that the total time to bring new products to line market under such conditions is ten years or more. Of those substitute rerigerants promising for many large air conditioning systems, some complications exist, and we've heard about them today from some of the other witnesses. For example, 123 appears to be a good candidate to replace 11 in centrifugal chillers, but according to the chemical producers it may result in efficiency losses for the system. With regard to 134A, which is a promising replacement for CFC-12, acceptable lubricants for large air conditioning systems, refrigeration units, and automobile air conditioners still have not been developed and proven. HFC-134A may also result in the loss of energy efficiency.

In addition to the desire for new products, we must also be very concerned about the large existing stock of air conditioning and refrigeration systems in the field. This equipment is designed to use specific refrigerants, and it must be serviced with the refrigerant for which it is designed. Drop in substitutes will probably not be suitable to service most of this existing equipment. Therefore, even if the industry is able to successfully redesign air conditioning and refrigeration systems to use alternative refrigerants, a large existing stock of systems must continue to be serviced with the controlled CFCs if that stock is to remain operative.

SENATOR ROSENTHAL: A couple of questions. Maybe you are going to get to this, but I just like to make -- has your institute established any public -- (inaudible)...

MR. MCGUIRE: Yes, we have. I was going to get to that in my statement.

SENATOR ROSENTAL: Then, if you will, I would be interested in whether it takes a high degree of expertise by service personnel in order to recycle? If it does, does your institute carry on any technical assistance to those members?

MR. MCGUIRE: Okay. Well, primarily, in the area of recycling and recovery of CFCs, what ARI has done is -- we're in the process of issuing a standard for acceptable levels of contaminants in recycled refrigerants or new refrigerants, for that matter. We believe that that type of standard is necessary for all recyclers to use. It references, in large part, the federal specifications talked abut earlier this morning but does not include additional contaminants.

As far as guidelines for people in the field and instructions for them, manufacturers who have their own service capabilities are instructing service personnel to be sensitive to this issue and to recover where possible.

For example, in some cases where it's not possible to remove a charge and put it into the receiving tank, some manufacturers' service people are actually carrying an extra condensing unit on their service truck, which is really the guts of an air conditioning system on a small scale, pump out the rest of the charge so that an entire charge can be taken out while servicing goes on.

As far as detailed guidelines for people in the field, the representatives from the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) are here this morning as mentioned. They, as a professional society, are working on a document that will be available to all the technicians. I think that would be very important.

SENATOR ROSENTHAL: What about the problem of trying to get it down from the roof?

MR. MCGUIRE: That is a very real problem, a very practical problem. There is another practical problem, and that has to do with these cans or canisters themselves. A lot of them produced today, up through 1988, are non-refillable containers, and they're being refilled anyway.

In some cases, I'm not talking about the big huge loads, but some recovery is being put back into these cans, and that could be very dangerous because they are pressurized containers. But as far as developing a way to get around the fact, that's a very heavy load, so to speak. I don't have an answer for that, but that's more of the infrastructure problem. That is going to have to be responsibly dealt with before we can expect this thing to take off on a large scale.

ASSEMBLYWOMAN LA FOLLETTE: Could we suggest then a relocation of those units? I know they're trying to save room by having it up on the roof rather than adding floor space which could otherwise be used to rent out or whatever. Isn't that going to have to be a major consideration unless they can develop some other way to handle it?

MR. MCGUIRE: It may be for the design of new buildings. As far as existing equipment, a lot of the chillers that are already placed in these budilings, you're talking about huge amounts of money.

ASSEMBLYWOMAN LA FOLLETTE: I understand that. It might be cheaper in the long run for relocation.

MR. MCGUIRE: I think that's something that's going to have to be looked at very closely. As far as steps that manufacturers are taking already to move away from fully-halogenated CFCs where possible, even though the substitutes are not available, and also to reduce emissions, some of the following things are already in place.

Manufacturers are switching from 12, HCFC-22, and medium temperature commercial refrigeration. Switching from CFC-12 to 502 in low temperature commercial refrigeration is becoming more widespread. Screw compressor chillers are being used to displace centrifugal chillers in some commercial air conditioning applications.

Improvements are being conducted to reduce equipment vibration in order to reduce line breakage and leaks. This is especially important in commercial refrigeration systems. We have an awful lot of piping.

Manufacturers are moving away from the use of 12's, a leak test gas. Manufacturers are also adding isolation valves to equipment in order to facilitate improved servicing practices and to reduce emissions. We strongly support recovery of used CFC refrigerants and the recycling of such refrigerants when it is technically feasible, since in some cases destruction may be the most environmentally sound course of action.

We further believe that a CFC recovering, recycling policy can best be formulated and implemented on a national basis. A patchwork of different state and local requirements may actually inhibit or delay crude practices and technologies to limit CFC emissions. ARI, therefore, will be asking the U.S Environmental Protection Agency to issue a national recovery and recycling policy so that a uniform workable program is available across the country.

ARI, however, extends its cooperation to this committee in its investigation of the recovery and recycling issue so that the committee may act based on all existing relevant facts. I've already mentioned our standard that we'll be issuing for recycled refrigerant. While this standard is designed to protect refrigeration equipment, the standard will not be an obstacle to recovery and recycling under normal circumstances.

In the case of CFC recycling, we believe the state or any other policymakers must be careful not to mandate recycling where it is not necessary. Recycling means to recapture used refrigerant and to clean it for reuse, either on-site or at a central location. Recapturing refrigerants is a common practice today for many air conditioning and refrigeration service technicians. Often a refrigerant can be reused in a system without cleaning it.

The recycling of some potential CFC substitutes may not be technically feasible, also. As an example, chemical producers, CFC users, and federal research laboratories are all presently examining various CFC substitutes. Some possible substitutes are referred to as non-azeotropic mixtures which combine more than chemical compounds. These mixtures possess variable temperature and differing liquid and vapor compositions upon condensation of evaporation. This means that such mixtures will not survive the recycling process intact. They would lose the properties of the mixture and would no longer be suitable for reuse. Although the technology to recycle refrigerants exists and is being used in some areas, it is not in widespread use. The state needs to explore whether sufficient recycling capacity exists stateside.

An area that has received much discussion already today and needs to be addressed fully is the discussion of recycling federal hazardous waste requirements. The Resource Conservation Recovery Act requires permits for the transport and handling of hazardous waste as defined under the laws and regulations.

Although used CFC refrigerants are not considered by EPA to be hazardous waste, solvents in discarded virgin CFCs are subject to RCRA's hazardous waste requirements. States are allowed to interpret RCRA on such matters, and some have elected to consider used CFC refrigerants as hazardous waste even though the federal regulations do not require this. This involves more regulatory steps in the recycling process and has proven to be a hindrance for some potential recyclers.

ARI has been working very closely with EPA's air office and with its RCRA office to clear up this discrepancy. We have just submitted to them some documentation at their request which they believe will result in a memorandum from the RCRA office to the states clearing up the fact that used CFC refrigerants should not be considered RCRA hazardous waste.

CHAIRWOMAN TANNER: Did you say new is considered and used is not considered?

MR. MCGUIRE: New refrigerants are considered on the new list because the EPA people were concerned that any chemical refrigerant that was manufactured and was not used, that it not be discarded or thrown away in an unsafe manner, but they clearly have not listed used refrigerants on the list. It's complicated, confusing, and I know of at least...

CHAIRWOMAN TANNER: But it just sounds like government, that's all.

MR. MCGUIRE: I know of at least two states that have gone on to interpret it opposite from that, so I know it's also slowed down some recycling at least once a day. ARI also believes that CFC policies implemented at any level of government should be limited to the compounds covered by the "Montreal Protocol."

Manufacturers and other CFC users are in the process of moving to alternatives to CFCs, and some solutions may include compounds such as HCF-22 and CFC-502. HCF-22 is a much less potent compound than the CFCs with only 1/20th the ozone depletion potential of CFC-11 and 12.

Even Professor Sherry Roland, who first brought this to light, the ozone issue has referred to HCF-22 as part of the solution to this issue. Public policy should not tend to discourage steps such as movement to 22 as an interim solution but allow them to hasten the transition away from fully-halogenated HCFCs.

We appreciate this opportunity to testify today, and I would be happy to answer any other questions you may have.

CHAIRWOMAN TANNER: I have a comment. You know, I find -- thank you very much for your testimony, but I find that those of you who are in industry say, now, give us five years, or give us ten years, and we'll meet these requirements, but this has been going on for a lot of years.

It seems to me that you add up the ten years it will take for the automobile manufactuers, ten years it would take for the refrigeration manufacturers, and add that to the 15 or 20 years that have gone by already, it doesn't make sense to me. Then, I get the -- well, I hear from you that we, as policymakers, should take it easy, take it slow but be careful, maybe let the feds do it, and in some cases, maybe, let the global association, whatever that is, of if there ever will be one, let them make the move. We, as policymakers, can't just wait and hope that everything will be all right. I wish that, if it's clear to the public, many years ago, that the hair sprays and sprays, aerosol sprays, were dangerous -- we were told they were dangerous -- the public stopped using them, I mean, before the ban.

MR. MCGUIRE: The public stopped using them. They were banned, and the scientific reports that came out after that which were referenced earlier today indicated that the ozone depletion issue might have been, at that time was thought to have been, less severe than it was due to be during the aerosol problem. Oviously, since that time, that has proved to be wrong.

CHAIRWOMAN TANNER: But, it certainly wasn't just last year that we found out that that was wrong.

MR. MCGUIRE: Last year was when measurements proved that the models that we've been using to predict ozone depletion cannot be relied upon. I'm sorry if I gave the impression that I'm asking you to relax and take it easy. I think that our industry, as users of these chemicals, are prepared to design new products, new substitutes within the timetable that Dupont and the other producers are talking about before the turn of the century. We're talking about the existing equipment that relies on CFCs doesn't have the advantage, the same keys of going to the substitute.

CHAIRWOMAN TANNER: I understand that. But, it just seems to me that everyone should start it soon.

Now that it's recognized by the industry, that industry is admitting that there really is a problem. Now, give us ten years to correct it is just a very long time. It's critical. It truly is critical and ten years seems like an awful long time.

MR. MCGUIRE: Well, when you talk about ten years, I guess you're referring to the ten years that I had mentioned...

CHAIRWOMAN TANNER: Well, I'm just using ten years as a figure. Dow Chemical needs a certain length of time. Our automobile manufacturers need a certain length of time. The electronics industry needs a certain length of time. It seems to me that a great deal of time has been going on.

The public has been begging for someone to do something about the ozone depletion for years. I don't mean to be -- I'm not being hostile, I'm really not. It's frightening for us, and we have a responsibility do something, as you have responded.

I hope we can all work together and find some solutions. I intend to work with everyone. I'd like for Senator Rosenthal to close.

SENATOR ROSENTHAL: After having listened, and I learned a lot today, I'm pleased that the committee afforded me the opportunity, and all of us the opportunity, to hear it. I'm convinced that we need to do more on this problem. I believe that we have the technology and the wherewithal to eliminate a significant percentage of those emissions.

The legislation I proposed last year focused on recycling, a lot of which I think can be done -- maybe not in each one of those industries but certainly in refrigeration of standing, maybe not mobile, refrigeration.

I intend to continue working on recycling. I invite all of you to take with you as you leave -- I have a preliminary draft of legislation that I'll carry next year which calls for recycling and reclamation of CFCs as used in refrigerants and coolants on a large scale of commercial or industrial facilities. It's an early draft and I hope that all of you who are involved will become involved in the process of helping me shape that legisltion because I'd like to get something that makes sense.

A working group will be meeting during the next month, or the next few weeks at least. If anyone would like to participate, I welcome everybody that would like to be involved in working out something which makes sense to everybody.

CHAIRWOMAN TANNER: Thank you very much.

SENATOR ROSENTHAL: Thank you.

CHAIRWOMAN TANNER: Ms. LaFollette, do you have anything to add?

ASSEMBLYWOMAN LA FOLLETTE: I'd just like to say that on the one hand I do agree that we have been aware of this problem for some years, and it does seem like the industry in general has been slow to pick up on it.

On the other hand, I can certainly understand the argument for, or the request for, an orderly transition because I think sometimes, as all of us who are policymakers get into the act at too many different levels that we, by doing so, we send out so many conflicting messages and so many different rules for you to try to abide with that it really just adds confusion to the problem.

I think the idea of an orderly transition is good, but I do think that doesn't necessarily mean that we have to stall in bringing about the transition. It means that we should move ahead, but each of us really should be doing our part to be a part of the solution and not imposing demands that really are not feasible but cannot be met. So, I would just make that point.

CHAIRWOMAN TANNER: Thank you. Thank you, Mr. McGuire.

Thank you, ladies and gentlemen. The meeting is adjourned. Thank you. I hope that you enjoyed this meeting. I certainly did. It was a very good hearing.