Frequently Asked Questions and Answers

The 20th Anniversary of the Montreal Protocol on Substances that Deplete the Ozone Layer

General Science Questions

1) What is the ozone layer and where is it in the atmosphere?

The ozone layer is a part of the Earth's atmosphere that has relatively high levels of ozone (O_3). Ozone is a gas that is naturally present in our atmosphere, and it is found primarily in the part of the atmosphere called the stratosphere, which is about 50 kilometers above Earth.

The stratospheric ozone layer acts like a shield in the atmosphere to prevent harmful ultraviolet (UV) radiation from reaching the Earth's surface. Overexposure to UV can cause a wide range of health problems for humans, such as skin damage (skin cancers and premature aging), eye damage (including cataracts), and suppression of the immune system. UV radiation can also damage sensitive crops, such as soybeans, and reduce crop yields.

2) When was the problem of ozone layer depletion first recognized?

In 1974, scientists discovered that emissions of chlorofluorocarbons (CFCs) were depleting ozone in the stratosphere. CFCs were a common aerosol propellant in spray cans and were also used as refrigerants, solvents, and foam-blowing agents.

In the early 1980s, scientists observed a thinning of the ozone layer over Antarctica, and people began describing this phenomenon as an "ozone hole." Additional research has shown that ozone depletion has occurred on every continent.

Chemists Sherwood Rowland and Mario Molina were awarded the Nobel Prize in 1995, for their earlier discovery that human-made CFCs were a major factor in ozone layer depletion.

3) What kinds of human activities lead to depletion of the ozone layer?

Certain industrial processes and consumer products result in the emission of ozone-depleting substances (ODS) to the atmosphere. ODS, such as chlorine and bromine from these emissions, cause depletion of the ozone layer. For example, CFCs, once used in almost all refrigeration and air conditioning systems, eventually reach the stratosphere, where they are broken apart to release ozone-depleting chlorine atoms. Other examples of human-produced ODS are halons used in fire extinguishers which contain bromine atoms. Methyl bromide, an agricultural fumigant, is also a significant source of bromine in the atmosphere.

4) How is ozone measured in the atmosphere?

The amount of ozone in the atmosphere is measured by instruments on the ground and carried aloft on balloons, aircraft, and satellites. Some measurements involve drawing air into an instrument that contains a system for detecting ozone, and other measurements are based on ozone's absorption of light in the atmosphere.

5) Why has an "ozone hole" appeared over Antarctica when ODS are present throughout the stratosphere?

Ozone-depleting gasses are present throughout the stratospheric ozone layer because they are transported great distances by atmospheric air motions. The severe depletion known as the "ozone hole" occurs because of the special weather conditions that exist in Antarctica and nowhere else on the globe.

6) Do changes in the sun and volcanic eruptions affect the ozone layer?

Yes. Factors such as changes in solar radiation, as well as the formation of stratospheric particles after volcanic eruptions, do influence the ozone layer. However, neither factor can fully explain the average decreases observed in total ozone over the last two decades. If there are large volcanic eruptions in the coming decades, ozone depletion will increase in years after the eruption. The largest recent volcanic eruption was Mt. Pinatubo (Chile) in 1991.

7) Does depletion of the ozone layer lead to an increase in UV radiation?

Yes. Measurements made using satellite data and other instruments have confirmed that surface UV radiation has increased in regions where ozone depletion is observed.

To protect public health from the effects of UV radiation, EPA's SunWise program promotes sun safety in schools and communities around the country. In addition to applying sunscreen and wearing protective clothing, people can plan their outdoor activities around the UV Index. The UV Index is a tool that provides a daily forecast of the expected risk of overexposure. The Index predicts UV intensity levels on a scale of 1 to 11+, where 1 indicates a low risk of overexposure and 11+ signifies an extreme risk.

SunWise and the National Weather Service developed the UV Alert, a real-time tool the public can use to protect themselves from overexposure to the sun. People who subscribe to the UV Alert receive an email notification when the level of UV radiation is especially high in their area. For more information, visit www.epa.gov/sunwise/uvalert.html

8) What's the difference between ground-level ozone and stratospheric ozone?

Ozone is a gas that occurs both in the Earth's upper atmosphere (the stratosphere) and at ground level. Ozone can be "good" or "bad" for people's health and the environment, depending on its location in the atmosphere.

"Good" ozone is produced naturally in the stratosphere and is "good" because it blocks harmful UV radiation from reaching the Earth's surface where it can harm people and ecosystems.

“Bad” ozone is an air pollutant found at ground level and is “bad” because it is harmful to health and can damage vegetation. Ground-level ozone is a main component of urban smog.

For more information, see: http://www.epa.gov/oar/oaqps/gooduphigh/

Policy/Regulatory Questions

1) What is the Montreal Protocol and why has it been successful?

During the 1980s, as scientific knowledge of ozone depletion grew, so did the international response to the issue. In 1987, leaders from many countries came together to sign the *Montreal Protocol on Substances that Deplete the Ozone Layer*. The Montreal Protocol establishes legally binding controls on the national production and consumption of ODS. Today, 191 countries are signatories to the treaty. These countries are committed to taking action to reduce and eliminate ODS to protect the ozone layer, and the U.S. has always been a leader. Production and consumption of all principal ODS by developed and developing countries will be significantly phased out before the middle of the 21st century. The Montreal Protocol has been successful because of scientific accuracy, effective public policy, and market-based, flexible, innovative approaches to ensuring ozone layer protection and developing alternatives.

The year 2007 marks the 20th Anniversary of the Montreal Protocol, and is an opportunity to celebrate success and emphasize the commitment to completing the worldwide phase-out.

2) Has the Montreal Protocol been successful in reducing ozone-depleting gases in the atmosphere?

Yes. As a result of the Montreal Protocol, the total abundance of ozone-depleting gases in the atmosphere has begun to decrease in recent years. If all countries that have signed the Protocol maintain their commitments, the decrease of ODS in the atmosphere will continue through the 21st century.

3) What has EPA done about ozone layer depletion?

As part of the United States’ commitment to implementing the Montreal Protocol, the U.S. Congress amended the Clean Air Act (CAA) in 1990 and 1998, adding provisions under Title VI for the protection of the ozone layer. Most importantly, the Act required the gradual end to the production of ozone-depleting chemicals. Under the CAA, EPA has created several regulatory programs to address numerous issues, including:

- Ending the production of ODS;
- Ensuring that refrigerants and fire extinguishing agents are recycled properly;
- Identifying safe and effective alternatives through the Significant New Alternatives Policy (SNAP) program;
- Banning the release of ozone-depleting refrigerants during the service, maintenance, and disposal of air conditioners and other refrigeration equipment;
- Requiring that manufacturers label the products either containing or made with the most harmful ODS; and
- Creating exemptions to the phase-out in sectors where the transition to alternatives is ongoing.

With input from industry, environmental groups, other U.S. government agencies, and the public, EPA has published a range of regulations for the protection of the ozone layer. Because of their high ozone-depleting potential, chemicals such as CFCs, methyl chloroform, and halons were targeted for phase-out first, and EPA is preparing to phase out the remaining substances. EPA continues to develop additional regulations under its ozone protection program for the continued protection of the environment and public health.

U.S. Production of First-Generation ODS Phased Out on Schedule

Chemical Group	Production Phaseout Dates	Deadline Met
Halons	January 1, 1994	✓
Chlorofluorocarbons (CFCs)	January 1, 1996	✓
Carbon tetrachloride	January 1, 1996	✓
Hydrobromofluorocarbons (HBFCs)	January 1, 1996	✓
Methyl chloroform	January 1, 1996	✓
Chlorobromomethane	August 18, 2003	✓
Methyl bromide	January 1, 2005	✓

U.S. Production of Second-Generation ODS Being Phased Out on Schedule

Chemical Group	Production Phaseout Dates	Deadline Met
Hydrochlorofluorocarbons (HCFCs)	Cut production 35 percent by January 1, 2004	✓ **(One year ahead of schedule)**
	Cut production 65 percent by January 1, 2010 Cut production 90 percent by January 1, 2015 Cut production 99.5 percent by January 1, 2020 Complete phaseout by January 1, 2030	**On track to meet all future requirements**

4) What substitutes are available for ODS?

Prior to the 1980s, many parts of people's daily lives were touched by ODS. But today, largely due to innovative research, many alternatives are available. For example:

- Refrigerators:
  - Then: CFCs were used in refrigerator coolants and foam insulation.
  - Now: Hydrofluorocarbons (HFCs) have replaced CFCs, and other ozone-safe substitutes are under development.
- Fire Extinguishers:
  - Then: Halons were commonly used.
  - Now: Conventional dry chemicals, water, and HFCs are used.
- Furniture:
  - Then: Foam-blowing agents with CFCs were used in furniture-making.
  - Now: Water-blown foam is used.
- Aerosol Cans:
  - Then: CFCs were the propellant in aerosol spray cans.
  - Now: Pumps and alternative propellants using HFCs have replaced CFCs.
- Automobile Air Conditioners:
  - Then: CFCs were used as coolants in auto air conditioners.
  - Now: HFCs have replaced CFCs.

The foundation for EPA's regulatory efforts to adopt more ozone-friendly alternatives is the Significant New Alternatives Policy (SNAP) program. The SNAP program was launched in 1994 to ensure a smooth transition to practical, safe, and economically feasible alternatives across multiple industrial, consumer, and military sectors. SNAP provides a framework for EPA to evaluate the health and environmental impacts of alternatives to ODS. Based on these evaluations, EPA determines which substitutes are acceptable, which are acceptable with conditions, and which are unacceptable. Through the SNAP program, EPA has approved more than 300 alternatives for more than 60 industrial, commercial, and consumer end uses.

5) In addition to regulating industry, what is EPA doing for consumers and the general public?

In 2000, EPA launched the SunWise program to teach the public about the risks of overexposure to UV radiation. SunWise began as a school-based program for K-8 students but has now grown to include numerous informal education, sports, community, and non-profit organizations. By forming these partnerships, SunWise pursues a more comprehensive approach to teaching children and their caregivers about sun safety. SunWise is now registered in 15,000 schools and also distributes Spanish-language materials. For more information, please visit:
http://www.epa.gov/sunwise/
http://www.epa.gov/sunwise/es/home.html

In addition to the SunWise program, EPA is currently implementing the Responsible Appliance Disposal (RAD) program. RAD is a voluntary initiative that encourages the retirement of old, inefficient refrigerated appliances and provides for the disposal of these units using the best environmental practices available. EPA is currently planning other voluntary initiatives to reduce ODS and greenhouse gas (GHG) emissions. These programs extending beyond regulations add to EPA's environmental contributions.

Questions about the Future of Ozone Protection

1) Does ozone layer depletion cause climate change?

Scientists continue to study the possible relationships between ozone layer depletion and climate change. Since ODS and their substitutes contribute to climate change, phasing out ODS directly benefits the Earth's climate in two ways. Since most ODS are also greenhouse gases, phasing out these substances reduces greenhouse gas emissions. Second, when ODS substitutes are introduced, the equipment in which they are used is upgraded, which means they are more efficient and less leaky.

2) When is the ozone layer going to recover?

The ozone layer has not grown thinner since 1998 over most of the world, and it appears to be recovering because of reduced emissions of ODS. Some breakdown can be expected to continue due to CFCs used by nations which have not banned them, and due to gases which are already in the stratosphere. Certain CFCs have very long atmospheric lifetimes, ranging from 50 to over 100 years, so final recovery of the ozone layer is expected to require several lifetimes. Scientists predict that the ozone layer will return to pre-1980 levels sometime between 2060 and 2075. Sustained recovery of the ozone layer will require a worldwide phase-out of all ODS by both developed and developing countries.

3) What about skin cancer rates increasing?

Over the last 30 years, the skin cancer incidence has gone from 1 in 1500 to 1 in 75. Currently melanoma, the most fatal form of skin cancer, is the number one killer of young women ages 25-29. Researchers believe that overexposure to UV is one factor contributing to an increase in melanoma, in addition to other factors. However, by the year 2165, actions to protect and restore the ozone layer will save an estimated 6.3 million U.S. lives that would have otherwise been lost to skin cancer.

4) What does EPA plan to do next?

Since healing the ozone layer is expected to take many years, EPA plans to continue to expedite the recovery of the ozone layer. Among EPA's near-term plans:

- Complete the ODS phase-out;
- Continue educating the public, especially children, on how to protect themselves from UV exposure through the SunWise program;
- Continue to implement innovative, flexible regulatory approaches;
- Continue to foster domestic and international partnerships to protect the ozone layer; and
- Encourage the development of products, technologies, and initiatives that reap co-benefits in climate change and energy efficiency.

On March 14, 2007, EPA, with the Department of State and the National Oceanic and Atmospheric Administration, put forth a proposal to adjust the Montreal Protocol and accelerate the phase-out of HCFCs. Several other countries also submitted proposals. The U.S. proposal includes four elements that can be considered individually or as a package:

1) Accelerating the phase-out date of HCFCs by 10 years;
2) Adding interim reduction steps;
3) Setting an earlier baseline; and
4) Phasing out the most damaging HCFCs to the ozone layer as a first priority.

These proposals further U.S. efforts to address ozone layer protection, cleaner air, and climate change by calling on the global community to act more quickly in phasing out HCFCs.

5) Many of the alternatives to ODS have high global-warming potential (GWP). Why is the climate system being damaged this way?

The Intergovernmental Panel on Climate Change (IPCC) has noted that the global decline in emissions of ODS has substantial climate benefits. The combined emissions of CFCs, HCFCs, and HFCs have fallen from about 33 percent of the annual carbon dioxide emissions from fossil fuel combustion around 1990 to about 10 percent around 2000.

However, EPA will continue to research and evaluate ozone-friendly alternatives that have low GWP.

6) The U.S. is still requesting exemptions for CFCs in metered-dose inhalers (MDIs) and methyl bromide. Why haven't these been phased out yet?

Exemptions are permitted under both the Montreal Protocol and the CAA for sectors where ODS consumption is necessary for public health or for sectors where there are no technically or economically feasible alternatives.

In the MDI sector, the transition to ozone-friendly alternatives is well underway and the U.S. has only proposed 28 metric tonnes for essential use exemptions in 2008.

U.S. requests for critical use exemptions (CUEs) of methyl bromide have declined steadily since 2005. In fact, the U.S. has reduced critical use methyl bromide consumption by 5,812 metric tonnes since the inception of the CUE program in 2005. EPA also continues to support USDA's Agricultural Research Service as a partner in alternatives research.

With limited quantities of MeBr available in inventories, some important alternatives already available and more under development and regulatory review, and a strong commitment to sensible safety valves for those limited cases where alternatives are not available, we continue to work to protect the ozone layer while meeting the needs of American farmers and maintaining our obligations under the Montreal Protocol.

7) Methyl bromide is a naturally-occurring substance in the oceans, and the U.S. requests always get cut at the international meetings. Why are American farmers being squeezed out of this chemical when the substance already is produced by natural means?

The 2006 Scientific Assessment of Ozone Depletion, produced by the U.N. Environment Programme and the World Meteorological Organization, is the consensus work of hundreds of atmospheric scientists, many of them U.S. experts. The Executive Summary of the 2006 Assessment, released on August 18, 2006, noted that "bromine continues to play a major role in stratospheric ozone depletion" and that "methyl bromide abundance decreased by 14% between 1997 and 2004. This decrease was larger than expected and suggests that when anthropogenic emissions of bromine are reduced, its atmospheric abundance decreases more than previously thought." Methyl bromide is used for biological systems, which can be unpredictable—when there are unexpected pest outbreaks, for example. The transition to other ODS in other sectors was different because those transitions were based on industrial processes.

Every ozone-depleting chemical has various properties and issues associated with it. EPA recognizes that the phase-out of methyl bromide has been challenging. However, some entities, such as Fetzer Vineyards, eliminated methyl bromide during the 1990s. Now, Fetzer Vineyards manages 360 acres of organic production. Other companies, such as Dow AgroSciences, have developed effective alternatives to methyl bromide for both pre-plant and post-harvest sectors.

8) If 2006 was the largest hole on record, how is the ozone layer recovering?

The ozone "hole" varies from year to year and depends on atmospheric concentrations and temperatures. The ozone "layer," however, has not grown thinner since 1998 over most of the world, and appears to be recovering because of reduced emissions of ODS. Antarctic ozone is projected to return to pre-1980 levels between 2060 and 2075.