1997-98 SESSION COMMITTEE HEARING RECORDS

Committee Name:

Senate Committee on Agriculture and Environmental Resources (SC-AER)

Sample:

- Record of Comm. Proceedings
- 97hrAC-EdR_RCP_pt01a
- 97hrAC-EdR_RCP_pt01b
- 97hrAC-EdR_RCP_pt02

- Appointments ... Appt
-
- Clearinghouse Rules ... CRule
-
- Committee Hearings ... CH
-
- Committee Reports ... CR
-
- Executive Sessions ... ES
-
- Hearing Records ... HR
- 97hr_sb0415_pt01
- Miscellaneous ... Misc
-
- Record of Comm. Proceedings ... RCP
-

Danger in the Air

Hope on the Horizon

A Toxic Air Pollution Report by Sierra Club Great Lakes Program

July 1997

...residents of a community even closer to the incinerator had notified Columbus health officials of similar health problems a couple of years earlier, but to no avail. In 1994, a grandmother from that area told the <u>Columbus Guardian:</u>

"The third door, left, there's cancer. The fourth house, she has breast cancer...The house after that, there was a hysterectomy and cancer of the bowel. The next man has heart disease. The one after that had cancer of the bladder and has it removed...Then Mr. K had leukemia. In the next house, a young woman, not even 30, came to me because she had her thyroid removed. Across the street, H has a heart condition. J has emphysema. V has cancer on her face. Mr. F has a lung disease. His neighbor had his bladder and one kidney removed because of a tumor...Sometimes there's such a greasy, oily smell people call the police because they think there's a gas leak."

Danger in the Air

Hope on the Horizon

An Air Pollution Report Prepared by MSB Energy Associates, Inc. for the Sierra Club Great Lakes Program

Written by: **David Oppenheimer, John Shenot, Lynn Danielson and Brett Hulsey**

Cover Design: **Karen Sarafin**

July 1997

ABOUT THE SIERRA CLUB

The Sierra Club, founded in 1892, is a non-profit, member-supported, public interest organization that promotes conservation of the environment by influencing legislative, administrative, and judicial decisions. The Club, with more than 550,000 members and over 65 chapters across the country, works to educate the public about protecting America's environment, for our families, and for our future.

The Sierra Club Great Lakes Program has worked to protect the people, wildlife, and beauty of the Great Lakes for the last 25 years.

Statement of Purpose: to explore, enjoy, and protect the wild places of the earth; to practice and promote the responsible use of the earth's ecosystems and resources; to educate and enlist humanity to protect and restore the quality of the natural and human environment; and to use all lawful means to carry out these objectives.

About the Authors

This report was prepared by MSB Energy Associates, Inc., assisted by John Shenot, on behalf of the Sierra Club Great Lakes Program. MSB is a consulting firm that specializes in energy and environmental issues, providing services primarily to public sector clients, such as governmental agencies and environmental groups. Many individuals contributed to the development of this report. The primary authors include David Oppenheimer, John Shenot, and Lynn Danielson.

David Oppenheimer directed research and writing on all aspects of the report. Oppenheimer has a B.A. from Brown University and six years of experience with toxic air pollution issues, air pollution regulation, and the impacts of air pollution on individuals, communities, and the environment.

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The authors are extremely grateful for the guidance and contributions of many others involved in this project. Special thanks go out to those who generously shared their time and their stories.

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Cover art and editing by Karen Sarafin, Sierra Club Great Lakes Program.

Additional copies of this report are available for $20; please contact the Sierra Club Great Lakes Program at 214 N. Henry St., Suite 203, Madison, Wisconsin 53703, phone 608-257-4994; make checks payable to **Sierra Club Foundation**.

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Chapter I – Executive Summary

Toxic air pollution is the most widespread air and water pollution problem in the Great Lakes region. Over 70% of the pollution industry reports in the Toxics Release Inventory comes from the air. Children, senior citizens, fish-eating families, and people with asthma are especially at risk.

Great Lakes states lead the nation in the dumping of toxic air pollutants that cause cancer and disrupt hormones, and are second in pollutants that cause birth defects. Families face up to a 1-in-200 risk of cancer caused by toxic air pollution. That's 5000 times EPA's definition of "safe." Toxic fallout is also the number one source of water pollution in the Great Lakes region. The five million anglers who fish the Great Lakes and their families are most at risk. They face cancer risks as high as 1-in-22.

EPA, state governments in the Great Lakes region, and businesses are not doing enough to solve toxic air pollution problems. To clean the air and protect our families, the following high priority actions need to be taken:

1. **Implement the new national standards for smog and soot**. Many toxic air pollutants contribute to smog and soot. When we clean up our smog and soot problems, we will simultaneously reduce toxic air pollution, doing a double service.

2. **Clean up the worst industrial sources of toxic air pollution, including power plants, incinerators, and steel mills**.

3. **Clean up the worst non-industrial sources of toxic air pollution, including pesticides and cars**.

Chapter II - The Problem

A. Introduction

Mercury-laden fish, deformed birds, high cancer risks, lost livelihoods. Toxic air pollution in the Great Lakes region exacts a huge toll. Every year, literally *billions* of pounds of hazardous chemicals are dumped into the air in this 8-state area. But as every child knows, what goes up must come down. And when these chemicals come down, they wreak havoc on people's health, fish and wildlife populations, and the economy.

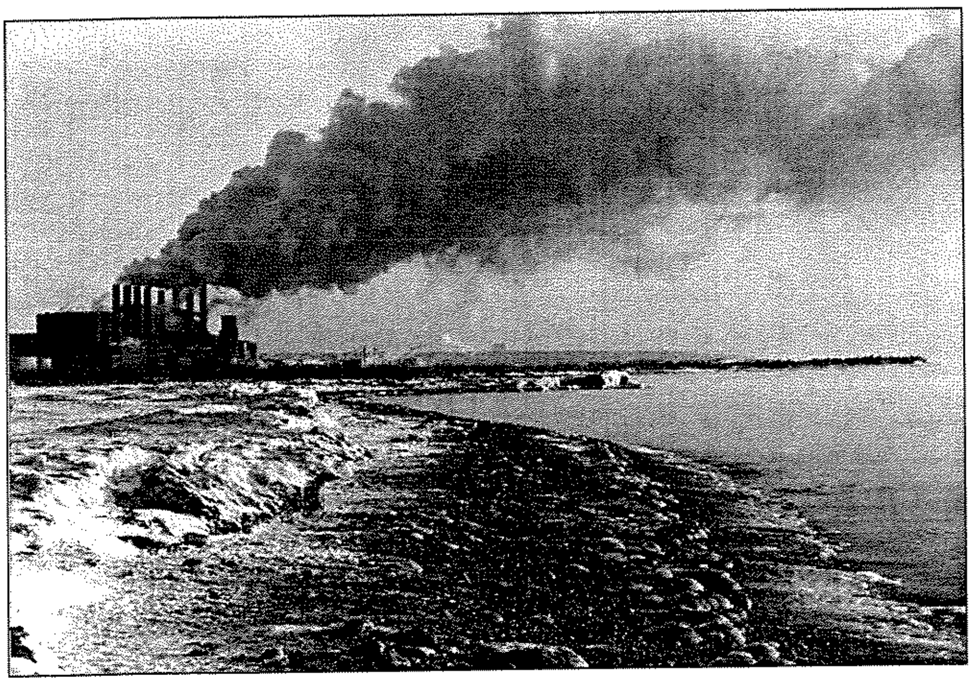

Photo by BS Hemmingway

In September 1990, the United States Environmental Protection Agency (EPA) published a report that identified toxic air pollution as a very serious threat to natural ecology and human welfare.[1] The findings, developed by an independent Science Advisory Board, have been virtually unchallenged by any credible scientist since publication. The only problems that the Science Advisory Board identified as posing a higher risk than toxic air pollution are habitat destruction and species extinction, global warming and climate change, and ozone depletion. Those problems were considered higher risks because they are regional or global in scale, take a very long time to correct, and have irreversible results.

[1] USEPA, "Reducing Risk: Setting Priorities and Strategies for Environmental Protection," SAB-EC-90-021, Science Advisory Board, Washington, DC, September 1990.

In a sense, the Science Advisory Board viewed the risk from toxic air pollution to be lower precisely because we *can* solve the problems locally and regionally in a reasonably short time frame. We don't have to wait or hope for international treaties, or new technologies. It's past time to place a high priority on this problem and to demand solutions.

In this chapter, we'll start by looking at the toxic chemicals themselves. What are they and where do they come from? Next, the chapter discusses how toxic chemicals get into our lungs, water, and food, and into plants and animals. And finally, the chapter concludes with a look at the damage these chemicals can do.

B. The Worst Pollutants

A thousand or more toxic chemicals can be found in various types of air pollution. One organization of science professionals publishes booklets that list more than 500 pollutants and the specific concentrations that are considered maximum limits for healthy air.[2] The United States Congress singled out 189 specific hazardous air pollutants for regulation in the Clean Air Act Amendments of 1990.[3] Some States are more cautious than the federal government. Michigan and Wisconsin, for example, regulate hundreds of toxic air pollutants ignored by the Federal government.

In addition to chemical toxicity and the ability to cause cancer, the key factors in determining the risks from toxic air pollution are: 1) how much of each chemical gets in the air; and, 2) who or what is exposed to the chemical. A very potent pollutant (for example, hexavalent chromium) might cause a problem in a densely populated area even if the amounts dumped into the air are tiny. On the other hand, huge amounts of a less potent pollutant in a sparsely populated area might have serious effects on fish and wildlife, but pose little or no direct human health risk.[4]

The question of which pollutants create the most risk for people and the natural environment is a difficult one to answer. Research over the last few decades has proven to be extremely expensive and time consuming, and rarely results in definitive proof of cause and effect (what some people term a "smoking gun"). Complicating things is the fact that actual risks vary from place to place, and species to species.

We are beginning to understand which toxic air pollutants pose the greatest threats, and why. But even as our understanding grows, the critical question is this: *should we continue to experiment on ourselves and our environment, or should we take precautions to protect our health now?*

But despite some uncertainty and unanswered questions, the evidence against certain chemicals is accumulating. We are beginning to understand which toxic air pollutants pose the greatest

[2] American Conference of Governmental Industrial Hygienists, "1996 Threshold Limit Values and Biological Exposure Indices," Cincinnati, OH, 1996.

[3] The number now stands at 188. One chemical (caprolactam) was removed from the list because EPA judged that air emissions did not and would not cause adverse human health or environmental effects anywhere in the country.

[4] Humans can still be *indirectly* affected if they eat fish or wildlife contaminated by toxic air pollution.

threats, and why. But even as our understanding grows, the critical question is this: *should we continue to experiment on ourselves and our environment, or should we take precautions to protect our health now*? As we discuss the following high risk toxic air pollutants, keep in mind that they are not the only chemicals of concern; rather, these are the ones where evidence of risk is greatest.

Toxic Air Pollution Causing the Greatest Problems in the Great Lakes Region

- ***Metals***: The metals most often associated with health and environmental risks are mercury, lead, chromium, arsenic, and cadmium. In addition to these, EPA also regulates antimony, beryllium, cobalt, manganese, nickel, and selenium as hazardous air pollutants. Some additional research and/or state-level regulation has been done for a few other metals (e.g., copper) but in general the above metals are acknowledged to be the ones most worthy of concern.

- ***Chlorinated organic chemicals (a.k.a. Organochlorines)***: Research consistently has shown that organic chemicals containing chlorine are especially likely to have harmful health effects.[5] There are hundreds of chemicals of varying toxicity that fit in this category. Some of the most hazardous examples of chlorinated organic compounds are dioxin,[6] PCBs,[7] perchloroethylene, hexachlorobenzene, methylene chloride, chloroform, trichloroethylene, and vinyl chloride.

- ***Polynuclear Aromatic Hydrocarbons (PAH)***: This is a large category containing hundreds of similar organic chemicals. Polycyclic Organic Matter (POM) is essentially equivalent to PAH, and the two terms have often been used interchangeably. Within the category, two chemicals that are sometimes evaluated individually are benzo(a)pyrene and naphthalene.

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[5] Organic chemicals are chemical compounds that contain both carbon and hydrogen. Unfortunately, the rise of organic farming has led some people to believe the word "organic" is synonymous with "natural" or "chemical-free." It is not. In fact, some organic chemicals, both synthetic and natural, are extremely hazardous.

[6] In this report, "dioxin" is used to abbreviate "polychlorinated dibenzodioxins and polychlorinated dibenzofurans." This group contains 210 possible varieties of related chemicals (called congeners) and is sometimes expressed by the acronym PCDD/PCDF. Only 17 of the 210 congeners have been proven to exhibit toxic properties. The most toxic of these is 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), which is often used as a surrogate measure for the entire group. The toxicity of a mixture of congeners is often expressed as an equivalent amount of 2,3,7,8-TCDD using a unit of measurement called 2,3,7,8-TCDD toxic equivalents (TEQ).

[7] PCBs is an acronym for polychlorinated biphenyls. This is another group of toxic chemicals containing 209 related congeners.

- ***Coke Ovens***: Emissions from coke oven batteries at iron and steel mills is such a complicated mixture of individual toxic substances that it is usually considered as a single group. This simplification is a convenience; there is actually considerable overlap between the "coke oven emissions" category and other categories already identified in this report (i.e., metals, PAH, and other toxic air pollutants).

- ***Pesticides***: Many pesticides and insecticides are synthetic organic chemicals but are usually studied as an entirely separate category of pollutants. Those most frequently associated with environmental and health risks include DDT, DDE, chlordane, dieldrin, toxaphene, heptachlor, lindane and other hexachlorocyclohexanes, and mirex.

- ***Other toxic air pollutants***: There are many potentially harmful chemicals not included in any of the above categories. Among those which garner the most attention from regulators and researchers are asbestos, carbon tetrachloride, benzene, toluene, xylene, formaldehyde, 1,3-butadiene, acrolein, styrene, and ethylene oxide.

Appendix A provides some information about what these chemicals are used for, and how they are unintentionally created.

C. The Sources of Pollution

Toxic air pollution is created by a wide variety of natural and human activities. EPA estimates that nationwide emissions of the 188 hazardous air pollutants regulated under the Clean Air Act total 8.8 billion pounds per year, or approximately 35 pounds for each person per year.[8] Table 1 displays current annual pollution estimates for the toxic air pollutants listed above. Some of these estimates are probably conservative because surprisingly little is known about some sources of air pollution.

[8] USEPA, "National Air Pollutant Emission Trends, 1990-1995," EPA-454/R-96-007, Research Triangle Park, NC, October 1996b, p.32.

Table 1. Estimated Annual U.S. Air Pollution for Selected Toxics[9]

Pollutant	Emissions
Metals	
Arsenic	27,200,000 pounds
Cadmium	1,580,000 pounds
Chromium	4,508,000 pounds
Lead	9,980,000 pounds
Mercury	452,000 pounds
Chlorinated Organics	
Chloroform	13,860,000 pounds
Dioxin	12.4 pounds TEQ
Hexachlorobenzene	2370 pounds
Methylene Chloride	86,800,000 pounds
PCBs	320 pounds
Perchloroethylene	218,000,000 pounds
Trichloroethylene	106,600,000 pounds
Vinyl Chloride	1,034,000 pounds
PAH[10]	963,366,000 pounds
Coke Oven Emissions	3,660,000 pounds
Other Air Toxics	
Acrolein	98,600,000 pounds
Benzene	964,360,000 pounds
1,3-Butadiene	201,810,000 pounds
Ethylene Oxide	1,304,000 pounds
Formaldehyde	556,256,000 pounds
Styrene	33,400,000 pounds
Toluene	2,110,000,000 pounds
Xylene	374,000,000 pounds

[9] Most estimates in Table 1 are from the 1995 National Air Pollutant Emission Trends Report (USEPA 1996b). Chromium, benzene, 1,3-butadiene, and formaldehyde estimates are from USEPA, "National Inventory of Sources of Emissions for Five Candidate Title III Section 112(k) Hazardous Air Pollutants: Benzene, 1,3-Butadiene, Formaldehyde, Hexavalent Chromium, and Polycyclic Organic Matter - External Review Draft," Research Triangle Park, NC, November 1996c. Estimates for mercury, dioxin, PCBs, hexachlorobenzene, and PAH are from USEPA, "1990 Emissions Inventory Of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)/2,3,7,8-Tetrachlorodibenzofuran (TCDF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury, and Alkylated Lead," Research Triangle Park, NC, June 1997a. Coke oven emissions estimate is from the coke oven batteries NESHAP fact sheet.

[10] This PAH estimate is based on the extractable organic matter (EOM) method, which collectively measures hundreds of individual PAH chemicals. There are three common ways to quantify PAH which provide dramatically different results, so emission estimates normally specify which method was used.

Table 2 below shows the estimated annual national pollution from the 20 source categories (i.e., specific business activities) which create the most toxic air pollution, based on data from the 1995 National Air Pollutant Emission Trends report.

Table 2. Estimated Annual U.S. Toxic Air Pollution by Source

Rank	Source Category	Estimated Emissions (pounds)
1	On-road motor vehicles – Cars, trucks, buses, motorcycles, etc.	3,040,000,000
2	Residential wood combustion – Wood burning fireplaces and stoves	1,050,000,000
3	Glycol dehydrators - Natural gas processing equipment	490,000,000
4	Consumer & commercial product solvent use – e.g., Paint thinner	444,000,000
5	Non-road mobile vehicles – ATVs, boats, construction equip., etc.	418,000,000
6	Forest fires	382,000,000
7	Prescribed burning	262,000,000
8	Industrial wood waste combustion	198,600,000
9	Dry cleaning	179,600,000
10	Halogenated solvent cleaning – Metal cleaning solvents (degreasing)	115,400,000
11	Utility coal combustion – Coal burning power plants	79,200,000
12	Gasoline distribution, Stage II - Vehicle refueling	45,400,000
13	Primary aluminum production	36,000,000
14	Industrial coal combustion	33,800,000
15	Manufacture of motor vehicles and car bodies	30,200,000
16	Gasoline distribution, Stage I - Terminals, tank trucks, tank filling, etc.	27,400,000
17	Plastics foam products – Styrofoam, packaging peanuts, etc.	27,200,000
18	Commercial printing, gravure (a type of printing press)	25,400,000
19	Pulp mills	24,200,000
20	Structure fires	23,600,000

The 1995 National Air Pollutant Emission Trends report presents surprising results about what sorts of activities contribute the most to toxic air pollution. "Major sources," which have received the most regulatory attention, contribute just 30% to total national emissions, while "area sources" contribute 31%! [See box for definitions.] The remaining 39% comes from mobile sources. In fact, the largest single source, as listed by EPA, is on-road vehicles. Only 3 of the top 10 source categories are normally found at big factories. This doesn't mean major sources are being unfairly treated, but it does mean that area sources and mobile sources deserve more attention.

The Clean Air Act Amendments of 1990 divided sources of toxic air pollution into three classifications:

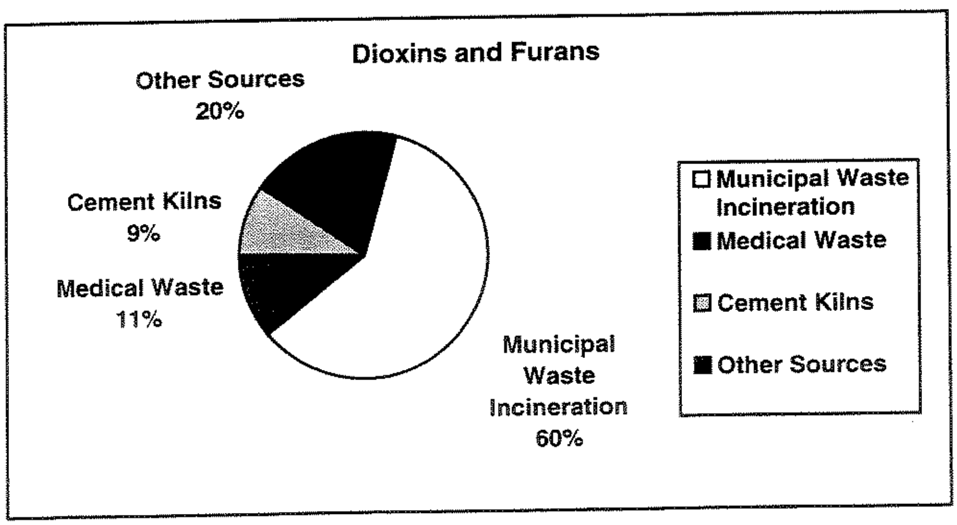
- First, there are **major sources** of hazardous air pollutants (HAPs). Major sources are industrial and commercial facilities that are capable of emitting 20,000 pounds per year of a single regulated HAP, or 50,000 pounds per year of a combination of HAPs. The law requires EPA to develop pollution control requirements for major sources according to a 10 year schedule ending in November 2000.[11]

- The second classification is **area sources.** Area sources are stationary (i.e., in a fixed permanent location) sources of toxic air pollution that are not major sources. They are normally small sources that have little individual impact, but may be quite substantial when all the small sources in an area are aggregated (thus the name).

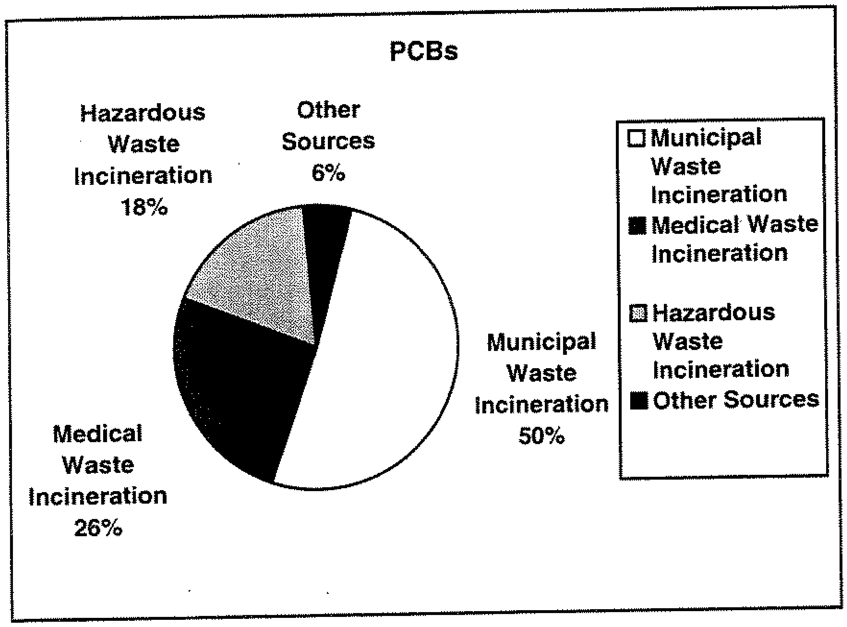
- The third and final classification is **mobile sources,** which includes cars, trucks, airplanes, lawnmowers, boats, trains, farm and construction equipment, etc.

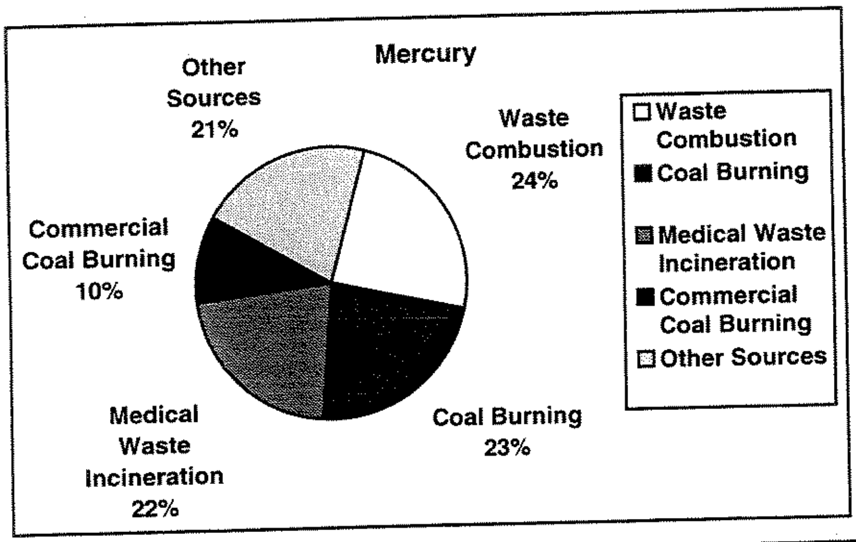
Although Table 2 provides a good overview of where the largest aggregated amounts of toxic air pollution are emitted, the highest emitting source categories for each individual pollutant will vary. To demonstrate this point, let's consider a few examples where the biggest sources of a specific pollutant differ substantially from those sources listed above:

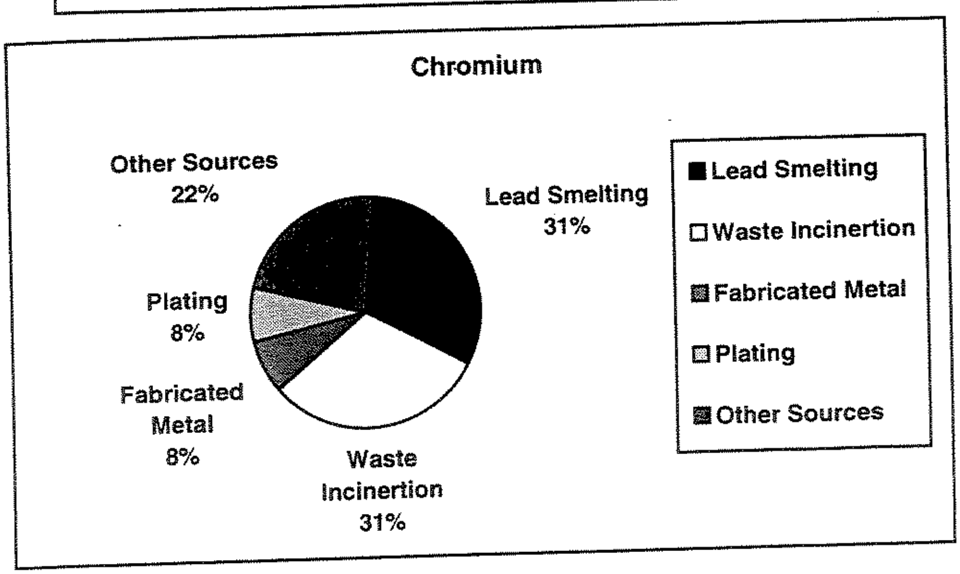
Sources of Pollution:



[11] EPA has been running one and a half to two years behind schedule on most toxic air pollution requirements of the 1990 Clean Air Act Amendments.







Source: USEPA National Inventory for Section 112(k)

For each pollutant, regional results or results within a more specific location may also vary widely. For example, forest fires are one of the leading *national* emission sources for some of the pollutants, but in downtown Cleveland, urban industrial sources of the same pollutants are far more significant, and a greater threat to people. And it is very important to remember that a small source in an urban area might pose a greater human health risk than a big source in the middle of nowhere. Sources that don't show up in Table 2, or in the source breakdowns shown above, may still cause local or regional problems.

The bad news about Table 2 is that most of the largest sources are not currently required by law to control toxic air pollution. In fact, toxic air pollution control regulations are now in effect for just 4 of the top 20 categories listed: dry cleaning, halogenated solvent cleaning, gasoline distribution/stage I, and commercial printing/gravure. Of course, controls are not feasible for some of the categories (e.g., forest fires and structure fires), but in some cases toxic air pollution is currently uncontrolled largely because of relentless lobbying by powerful industrial concerns. Perhaps the best example of the latter would be utility coal burning. Utilities have been especially active and effective in delaying toxic air pollution studies and regulations. The EPA has put off the study of utility pollution indefinitely.

Utilities have been especially active and effective in delaying toxic air pollution studies and regulations. The EPA has put off the study of utility pollution indefinitely.

D. The Pathways of Pollution

Toxic chemicals are dumped into the air many different ways (e.g., evaporation, spraying, factory smokestacks, outdoor fires, engine exhaust, etc.) and are dispersed by wind and/or the force of exhaust (if any). In the atmosphere, some toxic pollutants react with other chemicals or react when exposed to sunlight and change form. These reactions can result in more or less toxic products than the original chemicals. Toxic air pollution eventually returns to earth as a result of atmospheric changes - air currents, temperature inversions, rain, and snow. This toxic fallout is called deposition. In this manner, toxic pollutants dumped into the air eventually end up polluting our land and water.

In fact, the amount of water pollution that originally comes from the air is startling. Overall, 20 to 25% of the toxic pollution entering the Great Lakes comes from the air.[12] But for some of the most troublesome pollutants, atmospheric deposition is much more significant. This is especially true if one considers indirect (i.e., deposition to upstream water that flows into the lake) as well as direct contributions. For instance, more than 95% of the lead and more than 50% of the PCBs entering Lakes Superior, Michigan, and Huron comes directly or indirectly from atmospheric deposition![13] And 90% of the mercury entering Lake Superior is believed to come from the air.[14]

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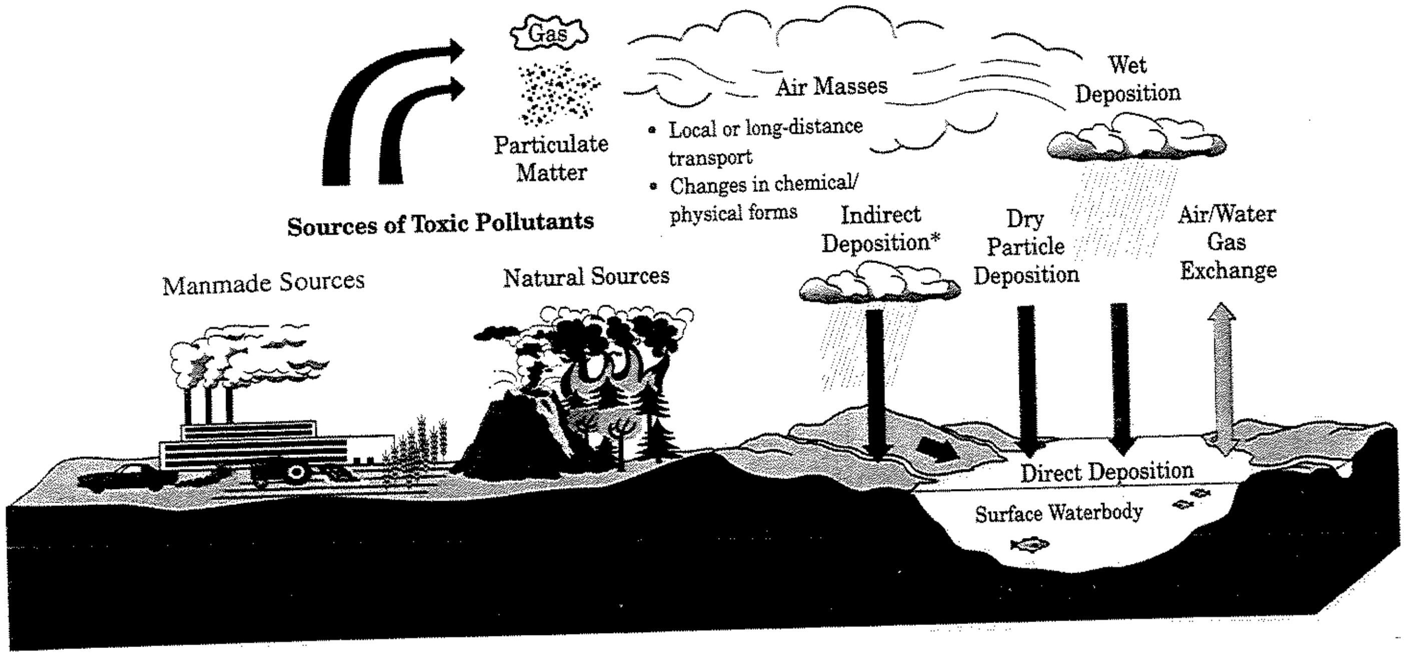
[12] Cooper, K. and K. Millyard, "The Great Lakes Primer", Pollution Probe, Toronto, ON, 1986.

[13] International Joint Commission, "Mass Balancing of Toxic Chemicals in the Great Lakes", 1988.



Source: USEPA Deposition of Air Pollutants to the Great Waters, First Report to Congress, May, 1994

Toxic air pollution can sometimes get into the upper atmosphere and travel very long distances before depositing. This is especially true for stable chemicals. For example, industrial chemicals such as PCBs have been found in the Arctic and Antarctic. The only explanation for their presence is long range transport in the atmosphere. And closer to home, the phenomenon of long range transport is exacerbating problems in the Great Lakes. Scientists from Environment Canada have discovered evidence that some pesticides banned in the U.S. and Canada (e.g., DDT) are transported all the way from Mexico and Latin America before depositing into the Great Lakes. And toxaphene, a pesticide formerly used by U.S. cotton growers, has been found hundreds of miles away on Isle Royale in Lake Superior. Computer models have been used to estimate that about 1/3 of the dioxin depositing in the Great Lakes was not emitted in a bordering state or province, and more than 40% of the hexachlorobenzene potentially depositing in the Lakes originated from outside the region.[15] All of this research serves to make a point: although local and regional efforts can minimize many of our Great Lakes pollution problems, permanent solutions need to consider a far larger area.

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[14] USEPA and Environment Canada, "Lake Superior Binational Program Lakewide Management Plan", March 1995.

[15] Cohen, M., et al., "Quantitative Estimation of the Entry of Dioxins, Furans and Hexachlorobenzene into the Great Lakes from Airborne and Waterborne Sources", Center for the Biology of Natural Systems, Queens College, CUNY, Flushing, NY, May 1995.

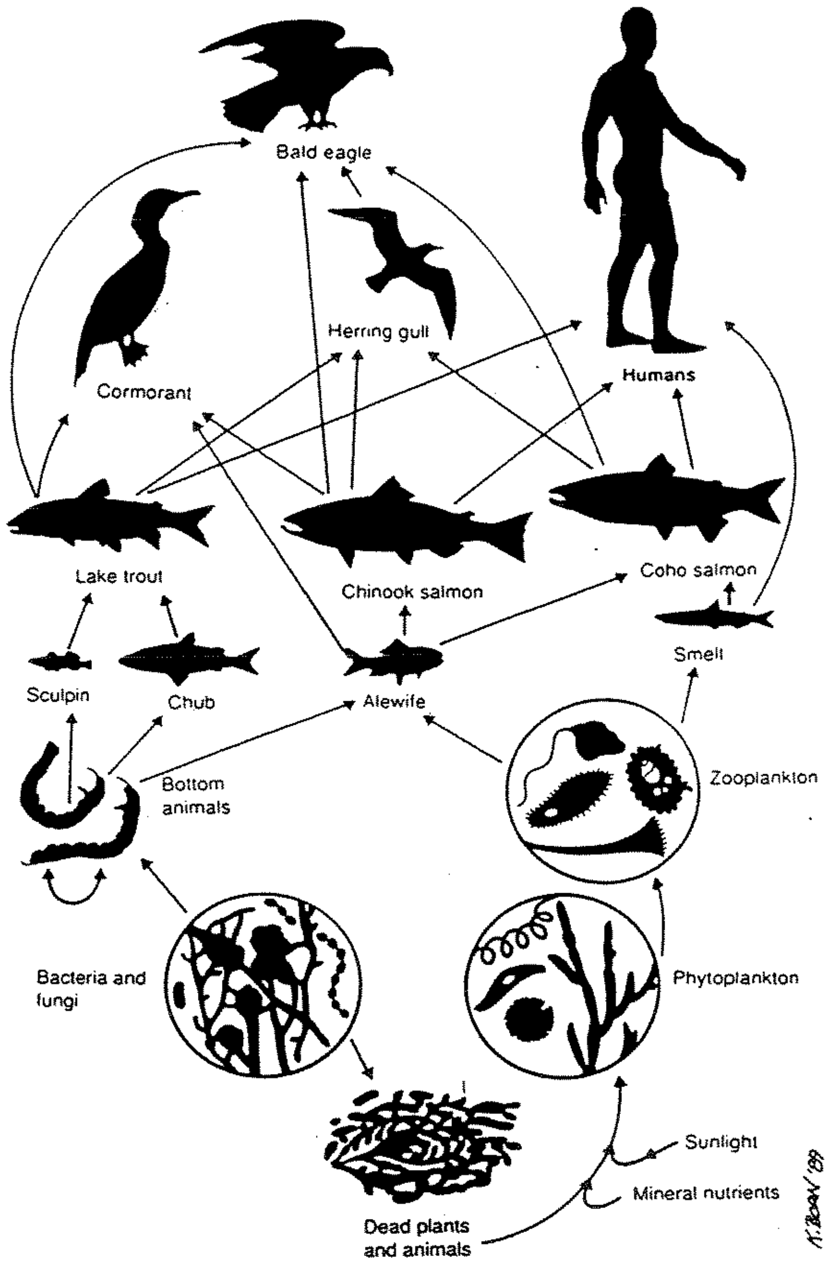
So deposition allows toxics to end up on land or in water. Plants, fish, and animals then drink the polluted water, eat the contaminated food, or, in some cases, absorb poisons directly through their skin on contact. Sometimes this exposure can be immediately hazardous. But there is a more difficult, tenacious problem as well. Some of these poisons persist for years. Persistent toxics are not easily passed out of the tissues of living things. For example, if a small fish eats lots of contaminated plankton, the contamination slowly builds up in the small fish. If a larger fish eats lots of these small fish, it collects all of the contamination from each fish. A bird or fish-eating mammal that eats large fish accumulates even greater concentrations of the persistent toxic chemicals found in each large fish it eats. This process of ever-increasing concentrations is called "bioaccumulation." Amazingly, the concentration of mercury in the eggs of a fish-eating bird can be more than 1000 times higher than the concentration in the water from which the fish came. For PCBs, this "biomagnification" factor can easily exceed one million! And it doesn't stop with birds and mammals. Humans can bioaccumulate, too. This happens when we eat fish, meat, dairy products, or vegetables that have accumulated persistent toxics.

Toxic chemicals that fall on a river or lake usually settle into river or lake sediments. Unfortunately, this is not always the end of the problem. Sediments can become churned up by currents, animals, dredging, or other disturbances, once again raising the possibility of ingestion and bioaccumulation. Another possibility is that some toxics that have deposited on land or water can re-vaporize and once again be inhaled or transported elsewhere. These are the main reasons why we still have a problem with pesticides that were banned or restricted decades ago.

In summary, there are several potential pathways for harmful air pollution. First, you may be directly exposed to toxic air pollutants by breathing them in or by contact with your skin or other tissues. Second, you may be indirectly exposed to toxic air pollution that deposits on land or in water and bioaccumulates in food.

GREAT LAKES FOOD WEB

Simplified Great Lakes Food Web



PRESCRIPTION FOR A HEALTHY GREAT LAKES. Figure 3. 1991. National Wildlife Federation, Ann Arbor, MI.

E. The Victims of Pollution

According to some accounts, the number one source of human exposure to toxic substances is air pollution. In the last 15 years, one study after another has added to the evidence that air pollution is wreaking havoc on fish, frogs, mammals, and birds. These studies have been conducted not just in laboratories, but in the wild under "normal" conditions.

This issue has spawned a great deal of controversy. Many critics (mostly those hired to lobby for industrial groups) have stated that there is little or no evidence of harm to humans from air pollution, except in industrial settings. They often repeat that species are affected differently by toxic exposures, and that we shouldn't assume humans will be harmed just because animals are harmed.

Evidence of human health problems caused by toxic air pollution is difficult to identify, for several reasons:

- First, the effects may not be immediate; they may develop over decades, or even across generations.

- Second, there is rarely a "smoking gun" – clear proof that a certain chemical caused a specific problem for a given individual.

It would be comforting to think that the critics are right – that toxic air pollution is not that harmful to humans. But how can we know? Obviously, we don't want to test their assertion in laboratory experiments on humans. So we are left with two choices: 1) Assume that humans face the same risks seen in animals; or, 2) ignore literally hundreds of published research articles related to fish and wildlife, and wait to see if the critics are right. Clearly, the prudent path is the first. If only one tenth of what is suggested by the research is true, we should be very, very concerned, and we should demand immediate action.

So what are the health effects of toxic air pollution? In the following pages, we'll examine three broad categories of effects: 1) acute (short-term) effects; 2) chronic (long-term) effects; and, 3) transgenerational effects (those that are passed down from parents to their offspring). We'll conclude this discussion by looking at how these effects damage our communities and our economy, too.

ACUTE EFFECTS OF TOXIC AIR POLLUTION

Acute effects are those that are seen as an immediate or short-term result of exposure to toxic air pollution. Obviously, the most serious effect is acute toxicity, or poisoning. In the worst cases, acute exposures to toxic air pollution can cause severe liver, kidney or blood cell damage, loss of consciousness, or even death. All of these results are of course rare, and generally only happen as a result of accidents such as explosions or chemical spills. The most famous recent example was at Bhopal, India in 1984, when a cloud of methyl isocyanate gas leaked from a pesticide factory, killing more than 3000 people and injuring at least 200,000. In another example, 183 cases of a serious skin disease called chloracne were reported in 1976 after an explosion at a chemical factory in Italy dumped high levels of dioxin into the air over a short time period. And closer to home, a fire and explosion occurred at a chemical plant in Helena, Arkansas on May 8, 1997, releasing a large cloud of toxic gas. Three firefighters died, twenty others were treated for smoke inhalation and dehydration, an area within a three mile radius of the facility was evacuated (including 44 patients and 150 employees at a hospital), and a portion of the Mississippi River had to be temporarily closed.

On the other hand, there are less extreme short-term effects that are too often caused by "routine" operation of air pollution sources. One common problem is headaches, such as those experienced by many people when they sniff fumes from paint, glue, or ink. Perhaps more importantly, health researchers have established clear relationships between air pollution levels and respiratory problems such as asthma. They have shown that hospital admissions for respiratory conditions increase on days when air pollution is bad. Other common acute effects from "low" exposures include irritation of the eyes, nose, and throat.

SUMMERTIME BLUES

Like many children, Kyle Damitz, 8, loves to swim and play basketball outdoors in the summertime. But often, he can't. Kyle has severe asthma. On summer days when smog levels are high, Kyle must stay indoors in the central air-conditioning of his Chicago home. "If he plays outside on an ozone-warning day, he can wind up in the hospital," says his mother Maureen. "He doesn't even go to school on ozone-alert days. It's not worth another hospital stay."

Kyle's asthma is aggravated by smog and soot – ozone and small particles created by pollution from power plants, factories, steel mills, cars and gas stations, dry cleaners, bakeries, body shops, farms, and even lawn mowers. Ground-level ozone, the main component in smog, is a harmful form of pure oxygen that causes breathing problems, aggravates asthma, and makes respiratory infections more likely. Breathing in soot – tiny airborne particles called "particulates" – shortens lives and causes cardiopulmonary problems. Some of the same pollutants that contribute to smog and soot are also toxic air pollutants.

Research, including a rigorous sixteen-year study by Harvard University, has found that fine particles contribute to illness and early death from cardiopulmonary problems. The study tracked 8,000 people in six small cities. It concluded that residents of the city with the highest level of fine particle pollution, Steubenville, Ohio, lived one to two years less than residents of Portage, Wisconsin, the least polluted city, after adjusting for other risks such as cigarette smoking. An American Cancer Society study released in March 1995 reported similar conclusions.

"Kyle's asthma isn't caused by air pollution, but it's definitely made worse by it," says his mother. "Air pollution is one of the few factors over which we have no control. We have installed air conditioning and special filters, covered pillows and mattresses, don't keep any pets or smoke, and made many other lifestyle changes. But we can't control ozone-alert days."

The Environmental Protection Agency has recently finalized a rule that will tighten the standards for smog and soot. (Powerful industry lobbyists will probably try to persuade Congress to overturn the new rules.) But having tough standards won't help kids like Kyle unless we also demand tough enforcement of the rules. In 1995, according to the Environmental Protection Agency, about 70 million people across the U.S. lived in places that exceeded the existing, more-lenient smog standards, and 24 million people lived in areas exceeding current soot standards.

On the home front, individuals can do many things to reduce their contribution to smog and soot:

- ***Drive less*** by combining errands, carpooling, taking public transportation or riding a bike. Keep your car well tuned, air up your tires, and avoid idling. And when you fill your gas tank, do so in the evening – when gas fumes interact with sunlight, they turn into ozone.
- ***Conserve energy*** by recycling and purchasing items with little or no packaging.
- ***Avoid using a gasoline-powered lawnmower*** – instead, use a reel mower.
- ***Avoid using oil-based*** paints and solvents and other household products that evaporate easily.

In general, acute effects from toxics exposure are more commonly seen in plants and animals, and they are much more frequently fatal for those organisms. This shouldn't be surprising, given that some chemicals (i.e., pesticides) are specifically designed to kill living things. There are also many reported incidents of air pollution poisoning and killing birds. In 1996, a single incident of irresponsible pesticide use in Argentina killed 20,000 Swainson's hawks.[16] Here in the United States, mercury-poisoned otters have been found dead near heavily contaminated rivers.

Many of our laws and regulations are designed to prevent potential exposure to pollution concentrations that are known to affect healthy adults. Unfortunately, those standards are not always adequate to protect some of our most vulnerable citizens. In particular, laws and regulations may allow exposures that are still strong enough to harm senior citizens, children, ill people and those with immune system deficiencies, and people with respiratory ailments, such as asthma. The health of plants and wildlife, which in some cases may be even more vulnerable, are generally not considered at all when establishing "acceptable" concentrations.

Appendix B identifies acute human and animal health effects known to be caused by the toxic air pollutants previously identified in this report.

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[16] From U.S. Fish and Wildlife Service press release, April 22, 1997.

CHRONIC OR LONG TERM EFFECTS OF TOXIC AIR POLLUTION

Chronic effects are the result of prolonged exposure to toxic chemicals. The most prevalent and most obvious chronic effect of exposure is cancer. The International Agency for Research on Cancer has identified more than one hundred chemicals found in air pollution that are capable of causing cancer in animals, humans, or both. And there are many, many more toxic air pollutants still being evaluated for potential cancer effects. Some of these are rare and obscure chemicals normally found only in laboratories or chemical factories. But some of them are also found in our homes, schools, and neighborhoods. For example, gasoline vapors contain benzene, toluene, and xylene, and formaldehyde is created when almost anything is burned. Appendix B identifies which of the toxic air pollutants identified in this report are known or suspected to cause cancer in humans or animals.

In the United States, the death rate from cancer has begun to decline in recent years. This is good news, but it is also misleading. *Cancer rates in humans have steadily increased since World War II as the nation has industrialized.* The recent decline in cancer deaths is solely due to great advances in medical treatment of cancer victims.[17]

Toxic exposures are associated with skin and lung cancer, leukemia, Hodgkin's disease, and a variety of other cancers in humans. As explained earlier, the evidence of toxic air pollution in non-industrial concentrations actually causing cancer in humans is limited (but growing). However, the evidence is much, much stronger for fish and wildlife.

The Great Lakes empty into the Atlantic Ocean through the St. Lawrence River. Researchers at the St. Lawrence National Institute of Ecotoxicology in Canada, have been studying the river's most famous inhabitant, beluga whales, for years. Autopsies of beluga whales have shown breast and abdominal tumors, bladder cancer, and a host of non-cancer diseases (e.g., ulcers, gum disease, and thyroid cysts). Even though commercial whaling of belugas ended in the 1950s, their numbers are still declining and now stand at just 10% of the estimated population of a century ago. Environmental contaminants, including toxic air pollutants, are among the suspected causes. Cancer in Great Lakes fish appears to be widespread. Visible tumors of the mouth, lips, and skin are a familiar sight to anglers.

Among humans, toxic air pollution is more likely to cause cancer in some groups than in others. Industrial workers and neighbors of major pollution sources are obvious examples of high-risk groups. People living in dense urban areas with combinations of residential, industrial, and commercial developments are another such group. The air in these neighborhoods is like a toxic soup, combining all the problems of major sources, area sources, and mobile sources.

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[17] Environment Canada, Department of Fisheries and Oceans, and Health and Welfare Canada, "Toxic Chemicals in the Great Lakes and Associated Effects - Volume II: Effects", March 1991, pp. 653-656.

A study completed in Southwest Chicago looked at cancer risk from toxic air pollution in a 16 square mile area.[18] The study area was affected by pollution from major sources such as steel mills, area sources such as chrome platers, and mobile sources (e.g., Midway Airport). Researchers found that the risk of getting cancer from toxic air pollution was as high as 1-in-200 in some parts of the study area. On average, the cancer risk was 1-in-5000, implying that one person in this 16 square mile area will get cancer from breathing toxic air pollution every three and a half years. This is in addition to all the other cancer risks these people might face (e.g., smoking cigarettes). Other studies of urban areas have reported similar cancer risks associated with toxic air pollution. This becomes an issue of environmental justice: should people who live in urban areas, including many who cannot afford to live anywhere else, have to face such risks simply because of where they live?

One study found blood PCB levels were 20 times higher in anglers who eat lots of fish than for others. A second study specifically examined the cancer risks of regular anglers in the Great Lakes region. The conclusions are alarming: risks for this group ranged from a 1-in-1000 to a 1-in-22 chance of cancer.

A second, more horrifying example of higher than normal cancer risk is seen in people who regularly eat fish from the Great Lakes. Because toxics can bioaccumulate, as explained earlier, these fish lovers are at great risk of contracting cancer. One study found blood PCB levels were 20 times higher in anglers who eat lots of fish than for others. A second study specifically examined the cancer risks of regular anglers in the Great Lakes region. The conclusions are alarming: risks for this group ranged from a 1-in-1000 to a 1-in-22 chance of cancer.[19] This represents almost 5 million anglers in the Great Lakes region. Once again, this is just the additional risk faced from eating contaminated fish; it does not include any other risks faced by these fish lovers. Anyone in the Great Lakes region who likes to eat fish should demand immediate action to end the toxic fallout of bioaccumulative chemicals.

WHITHER THE "SHORE LUNCH"?

Make reservations at fishing lodge. Sort tackle box and fishing gear. Overhaul car. Check destination for fish advisories.

Planning a fishing trip isn't as simple as it used to be for avid Wisconsin fisherman Geoff Crandall and his 14-year-old son Ross. Before heading to a lake or river that promises a fine catch of trout, walleye, steelhead, or salmon, Crandall spends time at his home computer, calling up the Environmental Protection Agency's National Listing of Fish and Wildlife Consumption Advisories. He wants to find out whether fish that he and Ross may catch are too toxic to eat.

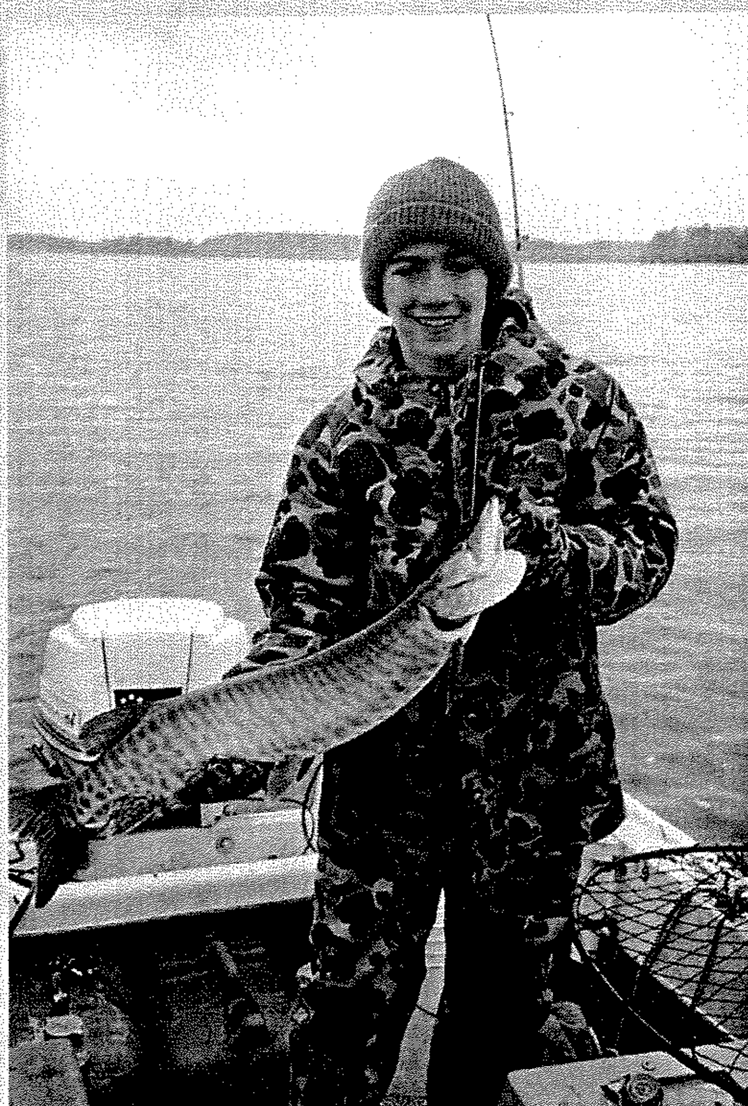
"Mercury, PCBs and other toxics are the contemporary fisherman's nightmare," says Crandall. "You really have to do your homework to know whether fish are safe. It's a shame."

[18] ViGYAN, Inc., "Estimation and Evaluation of Cancer Risks Attributable to Air Pollution in Southwest Chicago: Final Summary Report", for USEPA, Falls Church, VA, April 1993.

[19] USEPA, "Water Quality Guidance for the Great Lakes System", March 1995b.

Mercury, PCBs, dioxin, pesticides and other toxic substances are of concern to people who eat fish because their consumption has been linked to mental retardation, blindness, central nervous system damage, cancer, reproductive damage, delays in walking and talking, and other problems. Often airborne when emitted from power plants, incinerators, chemical factories, and other sources, toxics are deposited in waterways and build up in the bodies of fish and then in the people who consume the fish. Fetuses are highly susceptible to toxics ingested by their mothers.

Crandall worries that the tradition known as "shore lunch" may be a casualty of toxic pollution. The "shore lunch" – a mid-day meal cooked on a fire near the fishing spot – usually features the fresh catch, potatoes, onions, and beverages. "I don't like to think that, holy cow, my child and I could be eating a bunch of mercury, too," says Crandall.



Ross Crandall enjoying a day out on the lake.

Fish sold commercially are tested for contamination, but fish caught recreationally are not – and sports anglers eat three times as much fish as the general public. According to the Environmental Protection Agency, the "excess" cancer risk (the risk over and above the normal cancer risk) for sports anglers in Lake Michigan is one in 22. By comparison, a person who eats only one meal in their lifetime of Lake Michigan trout over 30 inches in length has an "excess" cancer risk from that meal of one in 100,000. Women of childbearing age and children are especially at risk from the toxic pollution in fish.

To help protect those who eat fish, Great Lakes states and the U.S. Environmental Protection Agency develop fish advisories that recommend how much fish can be safely eaten. The recommendations depend on the type of fish and where it is caught. Advisories can differ for children, women of child-bearing age, and other adults.

The database that Crandall uses collects all this information from each of the Great Lakes states. It can be obtained at http://www.epa.gov/OST/fishadvice/index.html.

If Crandall's research – which frequently entails a call to the local Department of Natural Resources after his computer search – indicates that toxics levels are too high, he changes his plans. "We fish somewhere else," he explains. "Or we catch and release – and I pack the peanut butter and jelly."

Canoe outfitter Bill Hansen of Sawbill Canoe Outfitters in Tofte, Minnesota, is concerned about the long-term effects of toxics on his business, which includes many anglers. "Air and water pollution, along with fire, are the major factors that could prevent the wilderness 'industry' from being sustainable," says Hansen. "The wilderness experience should be perceived as high quality. Even having to think about how much fish you should eat in the wilderness detracts from that quality and ultimately could affect our business."

Hansen says that some of his customers are clearly concerned about toxic contamination. "Some say that just the thought that the fish are contaminated spoils fishing for them."

Nevertheless, Hansen approves of the fish advisories he is required to post. "They are an important political action tool that I hope will bring about national policies that protect wilderness," he says.

Some would say that cancer from eating polluted fish is avoidable. This is true, but in reality, difficult to accomplish. Despite widespread government efforts advising anglers to limit or avoid consumption of certain fish from certain waters, behavior is slow to change, and the cancer risk remains. One survey of 8000 anglers showed only a third had changed fish consumption behaviors. Half of the fishing families were not aware of the polluted fish warning. Two thirds of the women eating fish did not know about the polluted fish warning, and four in five minorities were not aware of the fish warnings.[20]

We cannot count on people to decipher the often confusing warnings of government agencies. Nor can we cross our fingers and hope these problems go away. We must take action now to minimize emissions of cancer-causing chemicals.

[20] Connelly and Knuth, "Great Lakes Protection Fund Final Report", 1993.

EFFECTS ON CHILDREN

Sadly, some of the effects of toxic chemical exposure can be passed down from one generation to the next. There are two main ways this happens. One happens before birth, and the other after.

Subtle but serious damage can happen if an expecting mother is exposed during pregnancy to certain toxic chemicals that damage the body's reproductive or endocrine (hormone) systems. Exposures that may have only temporary effects or even no effect at all on the mother can have terrible repercussions for the fetus. The possible extent of these effects is mind-boggling, and truly frightening. Although it sounds like the subject of a nightmare or a horror movie, it is not. It is the real-world legacy of certain toxic chemicals. Consider some specific examples of the effects already observed in humans by scientists:

> ***Miscarriages, premature births, and higher rates of infant mortality*** – Research indicates that women with high levels of PCBs in their bodies are more likely to suffer miscarriages.
>
> ***Birth defects*** – Pesticides may be responsible for increased birth defect levels on Minnesota farms (see story below).

PESTICIDES SUSPECTED IN MINNESOTA BIRTH DEFECTS

Birth defects are more common in Minnesota babies exposed to pesticides than in infants who are not exposed, according to a study published last year by University of Minnesota researchers and the U.S. Environmental Protection Agency. Specifically, researchers found that birth defects were higher in babies born to farmers that use pesticides, in babies born to the general population in areas of the state with high pesticide use, and in babies conceived in the spring.

"All these findings suggest exposure-related effects," the researchers wrote in the April 1996 issue of Environmental Health Perspectives.

The scientists, from the University of Minnesota's Laboratory of Environmental Medicine and Pathology and an Environmental Protection Agency laboratory, examined over 210,000 births in Minnesota between 1989 and 1992 and nearly 5,000 births during those years to farmers licensed by the Minnesota Department of Agriculture to apply restricted-use pesticides.

"Pesticide appliers had significantly more children with an anomaly than did nonappliers," the researchers reported.

Significant increases were found in certain categories of birth defects, including circulatory, respiratory, genital, muscular, and skeletal systems.

Birth defect rates were also higher in regions of Minnesota where pesticides are used more frequently than elsewhere. Defect rates were highest in western Minnesota, a major wheat, sugar beet, and potato-growing area.

"...(F)amilies residing in predominantly agricultural regions of Minnesota are more likely to have children with birth anomalies," the scientists wrote.

Of the 12 herbicides the researchers evaluated, birth defects were most consistently associated with those called "chlorophenoxy herbicides and fungicides," a group that includes pesticides called 2,4-D and MCPA. In "high use" areas for these pesticides, almost 90 percent more birth defects occurred that were related to the central nervous system, circulatory, respiratory, genital, muscular, and skeletal systems.

In the same areas where chlorophenoxy herbicides are used, infants conceived in the spring had about 30 percent more defects than infants conceived in other seasons – an effect not noted in regions not using these herbicides.

Birth defects were more common among male babies born to farmers using pesticides than female babies, according to the study. In Minnesota in 1989-1992, 105 males without birth defects were born for every 100 girls – a typical ratio. For babies with birth defects, however, 138 boys were born for each 100 girls. Something in the pesticides appears to suppress the births of female or favor the birth of male children.

The researchers also reported preliminary findings that indicate that pesticides may be linked to infertility. In 1990, babies were born to pesticide appliers at only half the rate that they were to the general population in the same five-county area. A 1997 study at the University of Iowa also linked infertility to women involved in agriculture, and identified agricultural chemicals as a suspect.

"The present data and those reported by other investigators in the Midwestern agricultural region do signify a clear-cut need for comprehensive examination of the health issues involved," the University of Minnesota and EPA researchers concluded.

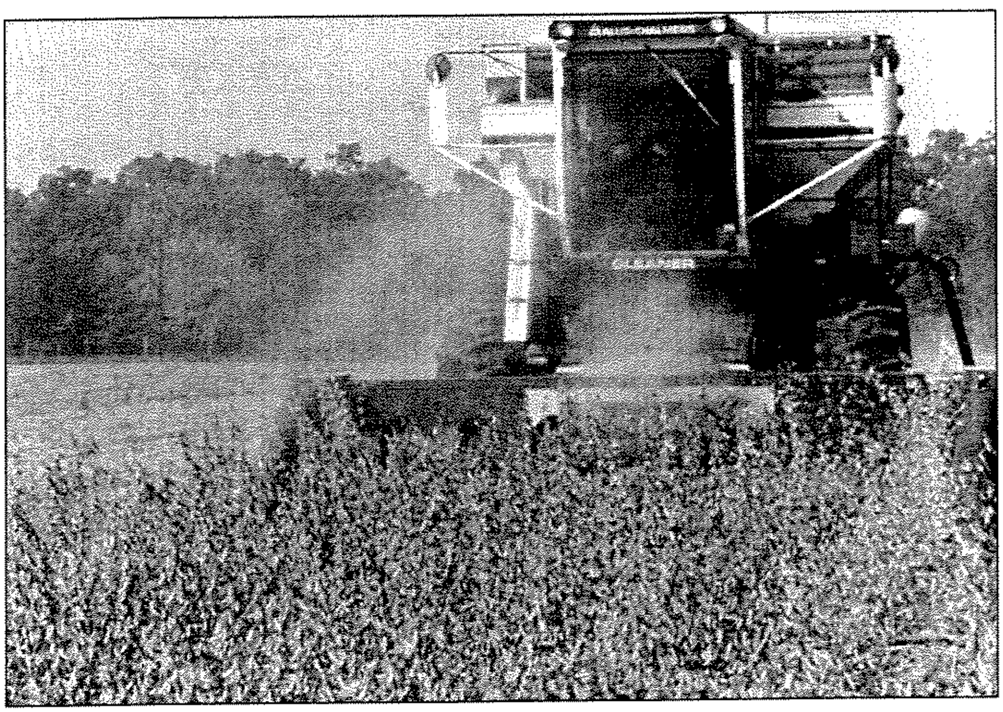


Photo by DNR

Damage to developmental systems and delayed development (inc. walking and verbal skills) – Studies show that increased levels of PCBs in mother's milk lead to decreased reflexes and coordination in children, and increases in hyperactivity.

Brain and nervous system damage (inc. impaired vision, speech, hearing, and coordination) – Several studies have shown that children of women who ate fish polluted with PCBs scored six points lower on IQ tests and two years behind in math and reading, and exhibited subtle changes in memory, thought processing, and activity levels.

Weakened immune systems – Autoimmune diseases and rheumatic fever occur significantly more often in women if their mothers were exposed to a chemical called DES while pregnant.

Cancer in adulthood (even decades later) caused by fetal exposure to toxics – Cancer in teenage girls has been traced to brief toxic chemical exposures while they were still in their mother's womb.

Damage to reproductive systems, reduced sperm counts, and sterility – Average sperm production in men has dropped 50% in just the last 50 years. Endometriosis, a leading cause of sterility, affects 5.5 million women in the U.S. and Canada; prior to 1921, there had been 20 known cases worldwide.[21]

The second way in which toxic chemicals can have transgenerational effects is equally horrifying: babies can actually be harmed by mother's milk. Because mother's milk is high in fat, it tends to bioconcentrate toxic chemicals. Breast-fed babies can develop dangerous concentrations of these chemicals.

Amazingly, this growing body of research suggests that some toxic chemicals can kill or damage someone even if they have never been exposed since birth.

As with cancer, there is even more evidence of transgenerational effects on fish and wildlife. For decades, researchers have studied a wide variety of mammals (e.g., otters, raccoons, bobcats), fish (including walleye, trout, salmon), and birds (e.g., loons, eagles, terns). They have seen mating and parenting behavior changes, embryo toxicity, eggshell thinning, lower hatching success, "wasting" (35% of tern chicks exposed to PCBs and dioxin lost weight and died in less than a month), lower offspring survival, decreased growth rates, abnormalities in offspring (including birth defects), and crossed bills. All of these effects are believed to be associated with toxic chemical exposure, passed down from parents to their offspring.

Entire ecosystems are being chemically altered, and the very survival of some species is in jeopardy. A well-known example serves to illustrate this point. The bald eagle, our national

[21] Reproductive and endocrine disrupting effects of chemicals are catalogued in Colborn, T., D. Dumanoski and J.P. Myers, "Our Stolen Future", Penguin Books, New York, NY, 1996.

symbol, was nearly made extinct because of the pesticide DDT. DDT wasn't killing adult eagles, it was simply ruining their chances of successfully reproducing healthy chicks. It took a government ban on use of DDT in the U.S. to save the bald eagle from extinction.

A lesser known example is the rapidly shrinking population of frogs in the Great Lakes region. Not only are frog numbers dwindling, but recent investigations have found exceptionally high birth defect rates. The reasons are still being debated and researched, but toxic pollution is suspected to be the leading contributor. Frogs may be especially sensitive to toxics, since they absorb water directly through their skin and are predators, increasing the likelihood of bioaccumulation.

MYSTERY OF THE FROGS

What began as a field trip by a group of middle-school students in the south-central Minnesota community of Henderson ended as an environmental mystery – with toxic chemicals a prime suspect.

In August 1995, the Minnesota New Country School nature studies class taught by Cindy Reinitz was on its way to a wildlife refuge. As they hiked along a farm road, students began chasing and catching some of the many frogs hopping about.

Something was wrong. Half the frogs caught – 11 out of 22 – had deformed hind legs. At first, the students thought the frogs had been stepped upon. Soon, however, it became apparent they had a developmental problem.

Since that initial discovery, frogs with deformed limbs, extra or missing legs, missing eyes – and even a one-eyed frog with its second eye growing inside its throat – have been found at over 100 other sites in Minnesota, as well as in Wisconsin, Ohio, Missouri, Vermont, Kansas, California, and Quebec. At one Minnesota site, almost all of the nearly 100 frogs found were deformed. "Once I got a look at these first two sites," says University of Minnesota geneticist and cancer expert Robert McKinnell, "I thought we just might be dealing with an animal Love Canal."

The cause of the deformities is not known yet. Scientists agree that the number of deformed frogs found in the last few years is much higher than normal and that environmental causes are almost certainly to blame. Toxic chemicals – possibly from pesticides or heavy metals – are a major suspect. Scientists have also speculated that parasites or increased levels of UV light – caused by depletion of the ozone layer from air pollution – could be culprits. A combination of factors may also be responsible.

Judy Helgen, a scientist leading the investigation on behalf of the Minnesota Pollution Control Agency, says she thinks that the cause will eventually be determined to be chemicals of some kind, although it could take several years to pin it down.

Frog health is significant both in its own right and because of its implications for human health. According to McKinnell, because of similarities between the metabolisms of humans and frogs, "if it is toxic to a frog, there is a good likelihood that exposure to humans to the same toxic insult will have similar consequences." And because they live on land, in shallow waters, and in deep waters during their life cycle, frogs are considered to be a "biological indicator" of environmental health – if frogs are struggling, then the entire ecosystem may be in trouble.

Betsy Kroon, a ninth-grader at the Minnesota New Country School at the time of the discovery, worries about the implications of the deformed frogs. "I'm concerned that having these frogs in the condition they are may have a great effect on other animals in the ecosystem. What happens to the animals that eat frogs? What about the animals that frogs eat? Is the insect population going to be different because they aren't at such a risk of being eaten? Are the plants around the pond affected in any way? The effects of this problem may be greater than we have realized so far. It really worries me that more may be going on than we've found."

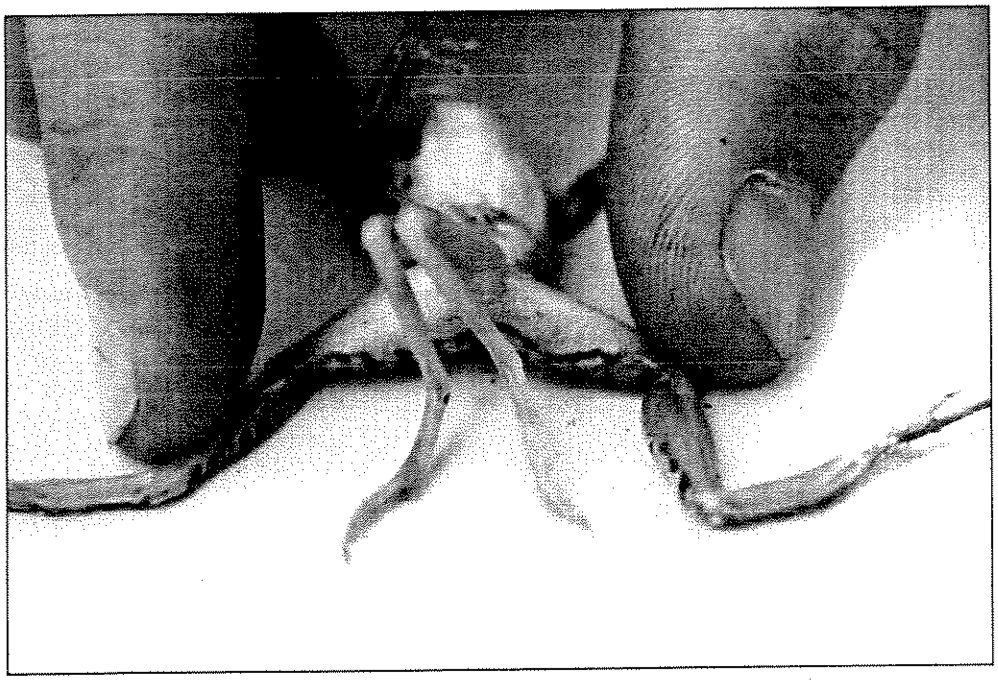


Photo courtesy of Minnesota Pollution Control Agency

At this point, we know that individual species are affected by chemical contamination, but we can only estimate what effects pollution has on ecosystems. Ecologists point out the intricate connections between species, and the likelihood that damage to one species will have ramifications for others. This unraveling of the food web can threaten our natural ecosystems. Toxic chemicals are most likely to harm animals that are predators (because of bioaccumulation), animals that live in "hot spots" with unusually high concentrations of toxics (e.g., bays with contaminated sediments), and animals that are already threatened with extinction.

According to a recent report by the Environmental Information Center, based on information reported to EPA, companies in the Great Lakes region dumped more than 76 million pounds of reproductive toxics and endocrine-disrupting chemicals into the environment in 1995. Toxic air pollution was the source of more than 90% of these chemicals.[22]

[22] Natan, T., "Environmental Information Center Regional Analysis of Major Toxic Chemical Releases: Great Lakes Report on Hormone Disrupting Chemicals", Environmental Information Center, Washington, DC, June 1997.

Appendix B includes some of the most current information on the potential of pollutants to have transgenerational health effects.

IMPACTS ON COMMUNITIES AND THE ECONOMY

Toxic air pollution also puts a heavy burden on our communities and our economy. First, there are the ever-increasing medical costs associated with the health effects described above. There are also indirect health-related costs, such as reduced worker productivity caused by increased sickness and hospitalizations. Another significant cost is the tax dollars spent on research, monitoring, regulating pollution to ensure public health and safety, and educating the public about toxic risks through signs, pamphlets, billboards, advertisements, etc.

But there are some less obvious costs and lost opportunities, as well. In the 1960s, Midwest mink farmers watched helplessly as their lucrative businesses went bankrupt. The reason? Their animals were not breeding. After many businesses were lost, it was discovered that minks fed western fish bred normally, while minks fed Great Lakes fish did not reproduce. And the reason, as we now know too well, was that Great Lakes fish are contaminated with PCBs, which disrupt reproductive processes.

The productivity of Great Lakes fisheries is also declining, and unfortunately we can't ask the fish to eat imported food. One of the causes for this decline is toxic contamination. At least 50% of fish consumption advisories in the Great Lakes region are attributed to deposition of toxic air pollution. Fish which might otherwise provide an inexpensive and extremely nutritious meal cannot be harvested or eaten. And research has proven, for example, that extremely low levels of dioxin in the parts per trillion range can cause newborn lake trout to die off shortly after birth. In fact, this commercially valuable species appears to be more sensitive to dioxin than any other species ever tested. Today, this native species of all the Great Lakes is only able to reproduce naturally in Lake Superior and part of Lake Huron. To ensure the survival of this valuable fishery, the federal government spends $2.5 million each year to stock the Great Lakes with lake trout.

The U.S. Fish and Wildlife Service reported in 1991 that commercial fishing in the Great Lakes provided 9000 jobs and $270 million per year in revenue. But annual losses due to restrictions on commercial fishing and destruction of contaminated catches is approaching $10 million. But some of the most serious concerns about toxic contamination in the Great Lakes region are based on the effects it has on fish and wildlife-related recreation, and tourism. A recent survey conducted by the U.S. Census Bureau for the U.S. Fish and Wildlife Service underscores the importance of

Spending on sport fishing, hunting, and wildlife-related activities has increased an astonishing 59% in just the last 5 years, far outpacing most sectors of the economy. In the Great Lakes region, sports fishing supports 80,000 jobs and contributes more than $3 billion annually to the economy.

these aspects of our regional and national economy. On the national level, one dollar out of every 72 is spent on fishing, hunting, and wildlife-related activities. Amazingly, outdoor enthusiasts spent more than $100 million dollars in 1996 on these activities! Spending on sport fishing, hunting, and wildlife-related activities has increased an astonishing 59% in just the last 5 years, far outpacing most sectors of the economy. In the Great Lakes region, sports fishing supports 80,000 jobs and contributes more than $3 billion annually to the economy. Hunting and fishing provide recreation for almost 40 million Americans, and 63 million Americans enjoy bird watching or wildlife photography. In 1996, 24 million people took trips expressly for the purpose of observing wildlife.[23]

Pollution of our lakes and streams by toxic fallout threatens to undo this economic success story. Obviously, you have to have healthy wildlife populations to support these activities. If animal species are threatened, hunting will be curtailed. If the fish stocks are depleted, limits on sports fishing will be enforced. And if bird populations dwindle, you won't have as many bird watchers. But even if fish and wildlife numbers remain stable, there are potential economic impacts. For example, there is grave concern that people will not want to fish in contaminated lakes because they cannot eat their catch. This jeopardizes the status of Michigan and Wisconsin as the top two destinations in the country for out-of-state fishing vacations. There are over 13,000 lakes in these states and Minnesota with polluted fish advisories for mercury air pollution. The same can be said for swimming – people do not want to swim in polluted lakes and rivers, even if the contamination is invisible.

Farmers are also affected by toxic air pollution. DDT was the first widely available agricultural pesticide used in the United States. This innovation was incredibly successful, initially, and pesticides were hailed as agricultural saviors. New products were introduced annually, until advances in chemistry in the 1960s led to a virtual explosion of new pesticide products.

But something was wrong. None of the pesticides were 100% effective, and farmers found they had to use bigger and bigger doses of pesticides each year to get the same results. Chemical companies sometimes claimed that the new types of pesticides they were developing would solve the problem once and for all, but their promises always fell short.

The truth is, insects have shown an amazing ability to adapt to any chemical killer we throw at them. In fact, the use of pesticides is actually accelerating the evolution of insects into new forms that are super-resistant to chemical attacks. This is not science fiction, it is fact. Prior to the introduction of DDT in 1940, U.S. farmers typically lost about 7% of their crops to insects. By the 1980s, that number had *risen* to 13%.[24]

Unfortunately, insects seem to be the only ones evolving chemical resistance. Pesticides are as dangerous as ever to fish, wildlife, and humans. We really must begin to question the wisdom of widespread pesticide use. With each passing year, we use more dangerous concentrations of

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[23] Data in this and the preceding paragraph are from a U.S. Fish and Wildlife Service press release, "Millions of Americans Enjoy Wildlife-Related Recreation, Pumping Billions into National Economy, Survey Shows", dated July 8, 1997, and from the Sierra Club report, "Clean Lakes, Clean Jobs".
[24] Weiner, J., "The Beak of the Finch", Vintage Books, New York, NY, 1994.

pesticides in greater quantities at exorbitant expense, and yet we're losing more crops than we did in the days when every farmer was an organic farmer.

The irony of increased crop losses due to our reliance on pesticides is not the only problem, either. Data from the U.S. Department of Agriculture indicate that air pollution directly damages crops, at a cost of over $3 billion per year. In the most polluted areas, air pollution can reduce crop yields by as much as 37%.[25]

All of the costs described above would be reduced or eliminated if toxic air pollution problems were solved. Although environmental programs are often thought to be drains on the economy, these examples show how cleaning the air could improve both our quality of life and our economy.

Benefits obviously could be realized if there were smaller amounts of fewer toxics being dumped. This is not to say there might not be associated costs, only that we must look at benefits as well. Industry advocates often ignore benefits of toxic reductions and only tell you what it will cost them. Economists often warn that regulatory costs will not really be paid by polluters, because those costs will be passed on to their customers. But when considering costs and benefits, we must remember that the toxic costs of non-regulation are placed on everyone, including children and future generations, without their consent. The costs of toxic reductions, on the other hand, can and should be paid by the producers and users of products and services that pollute, not by those whose health is damaged. For example, if I take my clothes to the dry cleaner, I and other customers should pay the cost of making sure the dry cleaner does no harm to its community. If we think the costs are too high, we should go to a different dry cleaner or stop using that service. We shouldn't ask people who don't use that service to pay the price of dry cleaning our clothes.

Our refusal to adequately clean up toxic air pollution is threatening our health, but it is even more dangerous to the health of our children and children not yet born. There was a time not so long ago when the danger was not understood. That is no longer the case. Now, the only acceptable course of action is clear. We must do what we can to minimize or eliminate toxic air pollution. Who wants to tell a child with birth defects that society knew the risks, but thought the costs of prevention and clean-up were too expensive?

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[25] Hansen, P., "Air Pollution: The Invisible Thief of American Agriculture", Izaak Walton League of America, Minneapolis, MN, January 1990.

Chapter III – Current Efforts to Control Toxic Air Pollution

A. Introduction

As we have already discussed, there are more than 8,000,000,000 pounds of toxic chemicals emitted into the air each year in the United States – 32 pounds for every American. We've also shown that these chemical emissions can do a lot of damage, and in some cases already have. The obvious question is, *why hasn't somebody done something about this*?

Actually, since passage of the Clean Air Act in 1970, this country has invested tremendous amounts of time, money, and effort to reduce toxic air pollution, with variable success. Many different approaches and experiments have been tried, with mixed results. Before deciding how best to solve the remaining problems, it's important to understand the most common approaches used in these past and current efforts, and learn what lessons we can. What has succeeded, and why? What has failed, and why? In the following discussion, we will attempt to answer these important questions.

B. Outright Bans

The most simple and direct way to regulate toxic air pollution is for the government to forbid the production or use of certain chemicals, or alternatively to forbid certain industrial practices and processes.

Some of the most effective efforts to reduce toxic air pollution have used this approach. When research established that the pesticide DDT was threatening bald eagles with extinction, laws were passed making it illegal to sell or use that product in the United States without special permits. As a result, eagles have made a dramatic comeback in the last 20 years. (A number of other pesticides are also banned or restricted; Appendix A lists examples.)

Another familiar example is the ban on leaded gasoline. The amount of lead dumped into the air has declined by more than 95% nationwide in the last 25 years as a result of this simple ban.[1] An example of a process ban is the prohibition against manufacturing PCBs for use in new electrical equipment. Numerous other examples exist where certain products may not legally contain certain chemicals (e.g., a ban on mercury-based additives in paints).

Bans are *extremely* effective measures for solving toxic air pollution problems, but there is a catch: it is usually very difficult politically to enact a ban. Bans by their very nature put an end to product lines or processes, and often threaten the interests (if not the

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[1] Data from the 1995 National Air Pollutant Emission Trends Report (USEPA 1996b). Unfortunately, aviation gas is exempt from this ban and still has lead in it. This is now the number one source of alkylated lead (a very toxic group of lead compounds) in the country.

viability) of politically powerful businesses. Typically, proposals to ban something are only enacted when all of the following conditions are met:

1) there is a clear threat to public health;
2) public sentiment favors a ban; and,
3) alternatives to the product or process exist.

For example, a virtual ban on DDT use in the United States was possible, despite the objections of its manufacturer, because evidence of animal and human health risk was mounting, a public sensitized by Rachel Carson's best selling *Silent Spring* supported a ban, and other pesticides thought to be less harmful were available on the market. Even with all those conditions in place, the DDT ban included an indefensible political compromise that allowed continued manufacturing and export of DDT for use abroad. It is still the pesticide of choice in many developing nations.

C. Technology-Based Standards

Most air pollution protections do not outlaw chemicals or processes, because most of the time a complete ban is not feasible for political, economic, or scientific reasons. Instead, the regulations usually allow for some amount of legal air pollution, provided that certain standards of performance are met.

There are two fundamentally different approaches to air pollution standard-setting currently employed in the United States. One is the technology-based standard, which focuses only on what is currently feasible. The idea is to determine what *currently available* types of technology are best at controlling air pollution from specific industries. The other approach, the health-based standard, caps the amount of pollution at a level that is not expected to cause adverse effects.

Technology-based standards are not set by evaluating theoretical pollution control options or scientific research papers. They are instead based on the actual, real-life performance *and costs* of existing pollution control equipment and techniques. Companies using pollution control technologies that are among the best currently available are said to meet the technology standard, regardless of their off-site impacts on human health or the environment. Brand new equipment is sometimes required to match or improve upon the performance of the best similar equipment in existence. Thus, over time, the standards may become more and more demanding, because of improvements in the best currently available controls.

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The bottom line for technology standards is that the poorest performing companies are required to do what the best performing companies are already doing. It is, in that sense, an incremental approach that focuses on immediate gains and continual improvement.[2]

Results thus far have been mixed. One significant advantage is that technology-based standards are less controversial, in most cases, than outright bans or standards based on health data (discussed later in this chapter).[3] In fact, dozens of technology-based standards have been promulgated in the 1990s that achieve dramatic reductions in toxic air pollution. For example, EPA estimates that standards passed in the last five years reduce annual toxic air pollution by more 1 billion pounds from chemical manufacturers and 100 million pounds from oil refineries. The annual costs of these huge reductions are estimated at a little over $325 million; in 1996, this represented less than 1% of total after-tax *profits* in these two gigantic industries. The recent standard for metal parts cleaners is even more effective: it reduces annual toxic air pollution by 170 million pounds, and actually saves $19 million per year, by EPA's estimate, because companies use smaller amounts of expensive chemicals![4]

But there are limits to what this approach can accomplish. One significant problem is the consideration of economic feasibility in setting the standards. This sometimes leads to watered down requirements, and is frequently used as a reason to exempt smaller companies ("minor sources") from the standards. For example, the standard for ethylene oxide sterilizers exempts all hospitals and many other sources considered too small to regulate. Quite often, industry groups will agree that a given technology would be particularly effective in reducing toxic air pollution, but they assert it is not economically feasible. Oil companies actually claimed that the cost of control equipment needed to meet the technology-based standard for refineries would be greater than the value of the refineries themselves - a ludicrous distortion of the truth.[5]

Another significant problem is that the technology-based standards apply to all "similar" processes. Sometimes a company will try to argue their way out of regulation by saying their process is unique and shouldn't be compared to another, potentially cleaner similar process. The "aerospace coatings" standard provides an excellent example. Among other things, this standard established limits on the amount of toxics that could be used

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[2] As a bonus, many of the technologies that reduce toxic air pollution also help improve smog and soot problems and save companies money.

[3] Electric utilities are a notable exception. Utilities have tirelessly lobbied EPA and have thus far been successful in delaying toxic air pollution standards for their industry for more than 3 years.

[4] Pollution reduction and cost estimates are from EPA Fact Sheets, which are published in conjunction with each new standard. Chemical and petroleum industry after-tax profits totaled $70 billion in 1996, according to U.S. Bureau of the Census, "Quarterly Financial Reports for Manufacturing, Mining, and Trade Corporations", QFR-96-2 and QFR-96-4, September 1996 and April 1997.

[5] The oil companies based their claim on depreciation, a standard accounting principle that says things lose value as they age. Some refineries are so old that the accountants say the equipment now has zero value - even though it generates huge profits.

when painting commercial airplanes. But one major airline decorates their planes with decals instead of paint, proving that zero toxic pollution is a currently available and feasible "technology." So why wasn't the standard set at zero toxic pollution? Because EPA and the airlines considered painting planes to be a different process than applying decals.[6] A second potential example of the "similar sources" loophole involves pulp mills, one of the largest air and water polluters in the Great Lakes region. Environmentalists want a technology standard based on totally chlorine-free pulping, while industry will argue that pulping with chlorine is a different process and should be subject to more lax standards, which could create more dioxin.

D. Health-Based Standards

It should be evident that technology-based standards focus on economic feasibility and therefore do not guarantee that public health or the environment will be protected. Health-based standards take nearly the opposite approach: the amount of pollution that the government will allow is capped at a level that is not expected to cause adverse effects to human health and the environment.

The health-based standards approach assumes that some amount of pollution may be allowed without jeopardizing human health. The biggest challenge then is to determine exactly what those acceptable levels of air pollution (the health-based standards) are. Once the standards are established, the regulator's job is to prevent "exceedances" (i.e., situations where a polluter's emissions exceed the health-based standard). In theory, air pollution sources anywhere in the country must then meet these national standards, regardless of what it costs.[7]

There are two major advantages of the health-based standards approach. First of all, it is usually the most scientifically sound approach. It recognizes that for some (but not all) pollutants there may be threshold amounts below which the chemical has no harmful effects on the public. As long as pollution stays below those thresholds, it may not be necessary to take any action at all. The second major advantage of the health-based standards approach is that it may allow greater flexibility for companies affected by the standard. In essence, the government tells the company what results it must achieve to protect human health and the environment, but allows the company to decide for itself the best way to achieve those results.[8]

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[6] All things considered, the aerospace coatings standard was a huge success, despite the loophole described above. Annual reductions are estimated at 246 million pounds of toxics.

[7] Some states, including Michigan and Wisconsin in the Great Lakes region, use health-based standards that are more restrictive or affect more sources than the federal standards.

[8] When health-based standards are *exceeded*, the government sometimes revokes this flexibility and prescribes *exactly* what must be done to get results.

Unfortunately, there also some disadvantages to this approach. Regulators often consider only a limited range of health effects - typically only acute toxicity and cancer. Some of the health effects described in the previous chapter are not considered at all. And experience has shown that attempts to establish health-based standards turn into high-stakes political fights, with science used as a blunt instrument. The standards are inevitably challenged by industry as being more restrictive than necessary to protect public health, and too expensive to implement, even though cost is not supposed to factor into the decision making process. Industry lobbyists support their arguments by bombarding the government with industry-funded health studies and industry-funded economic analyses.

The recent national debate over smog and soot standards, although not specifically directed at toxic air pollution, provided many examples of the embarrassing lengths to which these polluter lobbyists will go. For example, a report was published by industry-backed economists that purported to show that smog blocks cancer-causing ultraviolet radiation, and therefore performs a service not considered by EPA. The lobbyists' absurd argument, essentially, is that if pollution is so thick it blocks out the sun, you don't have to worry about skin cancer.[9]

In fact, history has shown that in some cases, such as smog and soot, health-based standards are developed that do not adequately protect human health, and later need revising. And in many cases, perhaps even a majority, the costs of implementation end up being far less than industry projections. But sadly, environmentalists can rarely afford the cost of properly refuting industry's claims.

The end result of all this scientific and political debate is that a lot of time and money are spent, few standards are promulgated, and little progress is made. To illustrate this point, consider that EPA managed to finalize just 7 health-based standards for toxic air pollutants in a 13 year period from 1977 to 1990![10]

But whatever the problems are with health-based standards, they serve an important role and one that will be increasingly important in the near future. The Clean Air Act says that 8 years after EPA enacts a toxic air pollution technology standard for any industry, the agency must review whether the standard did enough to protect human health and the environment. If not, then EPA must promulgate health-based standards to finish the job.[11] This raises the possibility of needing to develop more than 100 health-based

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[9] Wall Street Journal (editorial), "The Human Costs of EPA Standards", June 9, 1997, p. A18.

[10] Health-based standards were established for asbestos, beryllium, mercury, vinyl chloride, arsenic, benzene, and coke oven emissions.

[11] In a blatantly political move, Congress specifically gave the steel industry an additional 20 years, until 2020, to meet any new health-based standards for coke ovens.

standards over the next 12 years. Given EPA's track record in this area, it seems impossible that these deadlines will be met unless major process improvements are made.

E. Permits to Pollute

The most common and important mechanisms for applying all of the standards described thus far are permits to pollute. Permits are documents prepared by government regulators that tell companies how they must act to stay in compliance with air pollution laws and regulations. Permits normally lay out emission limitations and pollution control requirements, including health-based and technology-based standards. Permits also specify operational, monitoring, record keeping, and reporting requirements. There are two types of permits: "pre-construction permits" for new sources of air pollution, and "operation permits" for existing sources of air pollution. Operation permits are renewed every five years.

It is illegal for a company or an individual to build a significant source of air pollution unless they have a pre-construction permit or are exempt from having a permit. When a company wishes to build, it applies in advance for a permit. Government regulators review the application and create a draft permit that states all of the air pollution control requirements for that company (which may be based on health standards or technology standards, as described above). Before the document becomes official, the public must be notified of the government's decision and given a chance to comment on the draft permit.

Because of the complexity of air pollution laws and regulations, the requirements in a permit will vary from industry to industry, company to company, and location to location. Quite often, government regulators are called on to make scientific, engineering, and economic judgment calls about what is and is not feasible. The quality of these decisions depends heavily on the completeness and accuracy of the permit application, the thoroughness and competency of the government reviewer, and the vigilance of the public to make sure the laws are followed.

Air pollution permitting is successful where it applies and is properly implemented. In many cases, the pre-construction permitting process can be used to ensure that proposed factories will be built for good environmental performance. The operation permitting process (for existing sources) often uncovers unknown rule violations and leads to reductions in air pollution.