PSR monitor

PHYSICIANS FOR SOCIAL RESPONSIBILITY

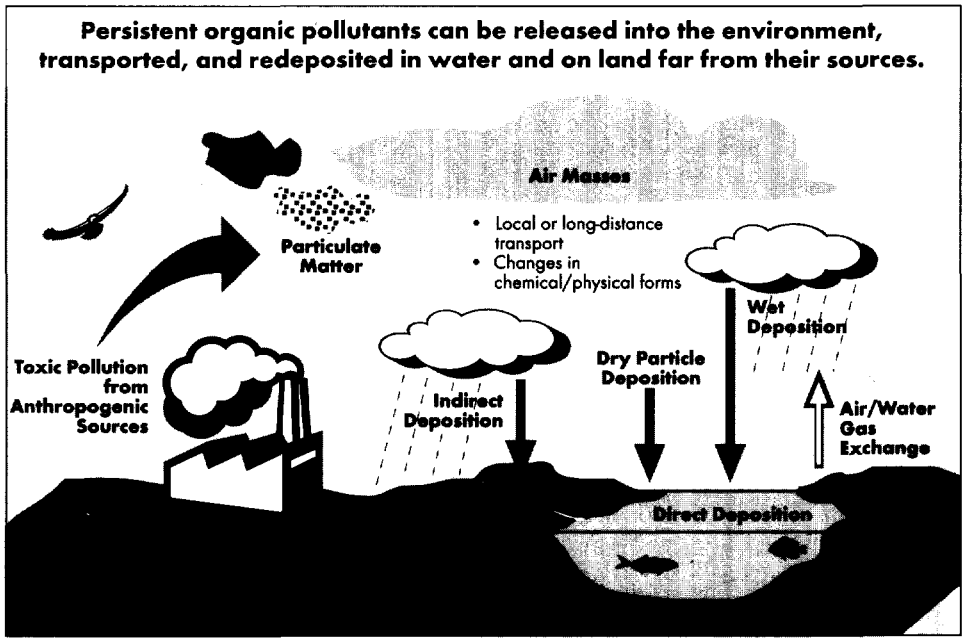
International Effort Would Phase Out 12 Toxins

Persistent Organic Pollutants Affect the Environment, Wildlife, and Human Health

The effects of a human population on an ecosystem extend far beyond that population's immediate surroundings. In a 1988 study, metabolites of the manmade insecticide chlordane were found in penguins in Antarctica, thousands of miles from the chemical's source. Chlordane is a persistent organic pollutant—a class of pollutants which by definition remain in the environment for a long time, resist degradation, are toxic, and can travel long distances. Today it is believed that persistent organic pollutants, or "POPs," have found their way into every living organism on earth.

In 1995, the United Nations Environment Programme (UNEP) adopted a resolution in response to the "major and increasing threats to human health and the environment" posed by POPs. The UNEP resolution, known as Decision 18/32, invited various organizations such as the Intergovernmental Forum on Chemical Safety (IFCS) and the Inter-Organization Programme for the Sound Management of Chemicals (IOMC), to examine the health effects, sources, benefits, and availability of certain persistent organic pollutants. A "short list" of 12 POPs—**DDT, aldrin, dieldrin, endrin, chlordane, heptachlor, hexachlorobenzene, mirex, toxaphene, dioxins, furans, and polychlorinated biphenyls (PCBs)**—were selected for study.

The report the IFCS presented to the United Nations Environment Programme in 1996 included an unequivocal conclusion: *international action is required to reduce the human health risks arising from the release of these 12 POPs.* In February 1997, an Intergovernmental Negotiating Committee (INC) was established, whose mandate is to prepare an international legally binding treaty to reduce and/or eliminate these twelve POPs and to develop science-based criteria and a procedure for identifying additional POPs as candidates for future action. The INC began its work in June 1998 and is expected to complete work on the treaty by the end of the year 2000, with a signing ceremony set for the first half of 2001.



Source: Deposition of air pollutants to the Great Lakes (First Report to Congress). EPA, 1994.

PSR's Position

Recognizing that billions of tons of manmade chemicals—most of them inadequately studied and many of them known to be toxic to laboratory animals, wildlife, and humans—have been manufactured

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TABLE 1. *THE SHORT LIST: 12 CHEMICALS TARGETED FOR IMMEDIATE ACTION*

Chemically similar compounds are grouped together.

Chemical	Sources and Uses	Status in U.S.A.	Fast fact
DDT	Domestic and agricultural insecticide against mosquitos.	Banned in U.S. in 1972.	The subject of a ground-breaking book by Rachel Carson, *Silent Spring* (1962).
Aldrin	Produced as insecticide to control soil pests (namely termites), on corn and potato crops. Fumigant.	Most uses banned in 1974. Termiticide use banned in 1987.	Readily breaks down to dieldrin in living systems.
Dieldrin	Insecticide used on fruit, soil, and seed.	Banned in 1974 and no longer produced.	Has been used to control tse-tse flies and other vectors of tropical diseases.
Endrin	Rodenticide and insecticide used on cotton, rice, and maize.	Banned in 1979.	Metabolites of endrin are more toxic than endrin itself.
Chlordane	Insecticide used in fire ant control and on variety of crops.	Restricted use since 1978 and deregistered (all uses cancelled) in 1988.	Metabolites have been found in Canadian Arctic air, snow, and seawater,and in Antarctic penguins.
Heptachlor	Insecticide in seed grain and crops and termiticide. Used in great quantities for fire ant control.	Limited use since 1978 and deregistered in 1988.	Heptachlor epoxide is highly toxic metabolite.
Hexachloro-benzene	Used as fungicide. Is also a by-product in pesticide manufacture and contaminant in other pesticide products.	Banned as fungicide in 1985.	Found in 100% of human adipose tissues samples in U.S. in 1983; and in 100% of breast milk samples in Canada in 1987.
Mirex	Insecticide and fire retardant.	Banned in U.S. in 1976.	In the presence of sunlight, breaks down to more potent toxin, photomirex.
Toxaphene	Insecticide and acaricide, especially against maggots and on cotton.	Most uses banned in 1982, all uses cancelled in 1987.	Heavily used until 1982 as a safer DDT substitute.
Dioxins	By-product of combustion, especially of plastics; and of chlorine product manufacture and paper production process.	Still being produced as by-product.	Actually a group of 75 similar compounds, of which TCDD is most well known and most toxic.
Furans	By-product, often bonded to dioxin.	Still being produced as by-product.	Actually a group of 115 congeners, with same biological effect as dioxins but less potent.
Polychlorinated biphenyls (PCBs)	Used as weatherproofers, hydraulic fluids in transformers, liquid insulators, dielectrics, and to prolong residual activity of pesticides.	Production banned in 1977, uses of existing stock restricted in 1979, but PCBs remain in some electrical equipment.	Includes 209 congeners differing in placement of chlorine atoms. Some congeners have half-lives of 7 to 30 years.

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and released into the environment, and that POPS in particular pose well documented dangers to human health, PSR advocates prompt international action. PSR urges the U.S. and other nations to negotiate a strong treaty that will protect people against the adverse health effects of POPs by preventing human exposure to those contaminants. In 1998 and beyond, PSR and other environmental and public health groups will work to obtain a binding agreement to phase out the production and use of POPs and to eliminate existing POPs from the environment, starting with the short list of 12.

Why the "Short List?"

The "short list" consists of the 12 persistent organic pollutants listed

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above as targeted by UNEP for immediate action; these 12 are the most studied and widely recognized as highly toxic at low concentrations. Most are already banned or severely restricted in most developed countries, but their continued use in other countries has global effects. All 12 chemicals are *organochlorines*—a class of chlorine-containing organic compounds that includes about 11,000 currently in commerce. UNEP has emphasized that a procedure to identify other persistent organic pollutants is necessary. Based on their bioaccumulation, persistence, toxicity, regional exposure, and dispersion, other POPs will become the focus of international action in future years.

How are Chemicals on the Short List Used?

(See Table 1.) Of the 12, the first nine were produced and used as pesticides in the U.S. until their ban, though many countries continue to use them. Dioxins and furans, on the other hand, are 1) by-products of industrial manufacturing processes involving chlorine and by-products of disinfectant, pesticide, and preservative manufacture; and 2) by-products of municipal, medical, and toxic waste incineration. PCBs continue to have electrical uses.

How Do These Chemicals Differ from Other Common Pollutants?

Persistent organic pollutants bioaccumulate; that is, living things take them up via food, water, direct contact, or inhalation, and then retain them. Moreover, POPs concentrate as they move up the food chain, so that animals at the top, including humans, carry the highest levels. POPs degrade slowly, often remaining in the environment and in human tissue for many years.

Beyond Boundaries: A Persistent, Global Threat

Though most of the toxins on the short list have been banned in the United States, their effect on human health lingers from past usage, and many are still being traded and imported in significant quantities by other countries (see Table 2). Outside the U.S., DDT is still produced for disease vector control (for instance, mosquito control), though it is often misused; chlordane and heptachlor are still produced for termite and ant control, and dioxins and furans are still produced as unwanted by-products. Organochlorine insecticide use continues, particularly in Africa, with DDT and dieldrin used most frequently, but aldrin, dieldrin, endrin, and toxaphene also applied in considerable amounts.

The release of POPs can affect organisms in far-off locations, since POPs travel long distances, even thousands of miles, through a process called *global distillation.* Airborne POPs (particularly those which are more volatile, such as hexachlorobenzene) move through the atmosphere from warm regions to condense in the vegetation, soil, and water in colder regions of higher latitudes. The phenomenon of *atmospheric deposition,* in which pollutants are released to the air from their source, transported to other locations (depending on weather and the properties of the pollutant), and redeposited to the earth, often to bodies of water like the Great Lakes, makes persistent pollutant control an international issue. (See diagram on page 1.)

In spite of regulatory actions in the U.S., POPs on the short list have been widely distributed in the environment and now continue to cycle between living organisms, air, water, and soil. Their continuing presence—due to atmospheric deposition and cycling, release from various industrial processes, and illegal or accidental discharge of stored stocks—necessitates further action. For example, federal and state agencies have long documented significant levels of

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TABLE 2: REGULATORY STATUS OF SHORT LIST IN SIX COUNTRIES

	USA	China	India	Mexico	U.K.	Canada
DDT	●	❖	❖	❖	●	◆
Aldrin	●	○	○	●	●	◆
Dieldrin	●	○	❖	●	●	◆
Endrin	●	○	◆	●	●	◆
Chlordane	❖	❖	○	○	●	◆
Heptachlor	❖	○	○	◆	●	◆
Hexachlorobenzene	●				●	◆
Mirex	●	❖		❖		●
Toxaphene	●	○	●	●	●	◆
Dioxins/Furans	**BP**	**BP**	**BP**	**BP**	**BP**	**BP**
PCBs	●			○	❖	❖

● Banned
❖ Severely restricted
◆ No registered uses but not officially banned
○ Not banned or severely restricted; may be registered or unregistered
BP Still produced as a by-product of various industrial processes

POPs and Human Health

Persistent organic pollutants are ubiquitous in our environment: most Americans today carry detectable background levels of POPs in their bodies. People are exposed to POPs primarily through food consumption; 96 percent of human dioxin exposure, for instance, is through diet. Meat, fish, and dairy products are the most significant sources of these chemicals, and a recent study found detectable levels of DDE (a metabolite of DDT), dioxins, and PCBs in common American fast foods like Big Macs and Haagen-Daz ice cream. With persistent organic pollutants so prevalent in the environment, we must ask what effects they may be having on our health.

There are in essence three distinct "levels" of exposures to POPs chemicals: acute, low-level, and population-wide exposures. Adverse health effects of acute exposures have been well documented in studies of accidentally and occupationally exposed persons, but low-level and population-wide effects are more difficult to ascertain. Although the effects of chronic low-level exposure are not completely understood, compelling evidence exists suggesting neuro-developmental toxicity in persons chronically exposed. Moreover, the population at large is thought to be exposed to certain POPs at levels that may produce deleterious effects.

The presence of persistent pollutants in women's bodies is of particular concern because human breast tissue is an important site of accumulation. Most of the 12 chemicals have very long half lives in the human body (greater than six months) and are not readily degraded or excreted from the body under normal physiological circumstances except during lactation. Lactation exposes nursing infants to high levels of persistent organic pollutants at a time when systems are developing and thus more vulnerable to toxic effects. A 1997 study in the *American Journal of Public Health* found that breast-fed Dutch infants had plasma PCB levels 3.6 times higher than formula-fed infants. Nursing infants thus begin their lives with a hefty dose of toxins—including 50 times the amount of dioxins that an adult takes in daily. Prenatal exposure is also a great concern. The placenta, once thought to be a barrier and source of protection for unborn children, actually *transfers* toxic compounds to the fetus; researchers have found intellectual deficits due to *in utero* exposure to polychlorinated biphenyls.

Discerning the health effects of persistent organic pollutants is a highly complex issue, for how chemicals affect a person depends on a multitude of factors. Furthermore, *synergism* between chemicals may result in a combined effect that is greater than the sum of the effect of each chemical alone. Thus, combinations of toxins can act in ways that we largely do not understand. There is, however, ample evidence documenting the risk persistent pollutants pose to wildlife and humans—and certainly enough evidence to warrant immediate and international environmentally responsible action against the short list (see Table 3).

POPs and Endocrine Disruption

The endocrine system is one of the body's three integrating networks (the nervous and immune systems being the other two) and consists of all the glands that secrete hormones, or chemical messengers. Hormones travel in the bloodstream and affect target cells, fitting precisely into a target receptor, just as a key fits into a lock. By indirectly or directly influencing cell development, carbohydrate and lipid metabolism, protein synthesis, reproductive system growth and function, and even ion and water concentration, hormones are responsible for homeostasis—or the "steady state"—of the internal chemical and physical environment of the human body. Hormones play a central role in virtually every human function, from breast feeding to sleeping, and often work in tiny amounts—for example, the estrogen hormone estradiol operates in concentrations at the parts per *trillion* range.

Upsetting the delicate balance the endocrine system maintains can be disastrous. Yet many synthetic chemicals, including ten of the twelve short list POPs, are known or suspected *endocrine disruptors*, "exogenous agent[s] that interfere with the synthesis, secretion, transport, binding, action, or elimination of natural hormones in the body that are responsible for the maintenance of homeostasis, reproduction, development, and/or behavior." In a 1993 study published in *Environmental Health Perspectives*, dieldrin, DDT, heptachlor, mirex, toxaphene, dioxin, and PCBs were included in a list of chemicals with reported reproductive and endocrine-disrupting effects. The World Wildlife Fund has added furans, hexachlorobenzene, aldrin, endrin and chlordane to its list of known or suspected endocrine disruptors.

TABLE 3. *Health Effects of the Short List: Empirical Findings*

DDT	◆ Long association with reproductive failure in wildlife, especially eggshell thinning in birds. ◆ DDE, a metabolite, possibly linked with human breast cancer,[1] but studies have equivocal results.[2,3] ◆ Nervous system disruption (convulsions, tremors) and muscular weakness following acute doses.[4]
Aldrin **Dieldrin** **Endrin**	◆ All show similar effects, but endrin is the most toxic of the three. Dieldrin is 40 to 50 times as toxic as DDT. ◆ Association with suppression of the immune system.[5] ◆ Nervous system disruptions (convulsions) and long term damage to liver from acute human exposures.[6] ◆ Dieldrin shows reproductive and chronic behavioral effects;[7] suppression of human breast epithelial cell communication.[8]
Chlordane **Heptachlor**	◆ Thought to be cancer and tumor promoters; U.S. EPA has classified as probable human carcinogens.[9] ◆ Heptachlor found to inhibit breast epithelial cell communication; at high concentration is a possible breast tumor promoter.[10] ◆ Significant effects on progesterone and estrogen levels in laboratory rats.[11] ◆ Other animal studies show nervous system disruption and liver damage.[12]
Hexachloro-benzene (HCB)	◆ EPA has classified HCB as a probable human carcinogen;[13] carcinogenic effects seen in rodents.[14] ◆ Affects DNA in human liver cells.[15] ◆ Alteration of white blood cell function following occupational exposure.[16] ◆ Alterations in steroid productions of adrenal cortex cells following low doses in rats.[17] ◆ Acute exposure associated with porphyria cutanea tarda, a metabolic liver disease.[18] ◆ Enlarged thyroid glands, scarring, and arthritis exhibited in offspring of accidentally exposed women.[19]
Mirex	◆ Few studies have been done on human exposures, but known to be carcinogenic in rodents. ◆ Associated with suppression of the immune system.[20] ◆ In rats, exhibits toxic effects on fetuses, including cataract formation.[21] ◆ Liver hypertrophy following long-term low-dose exposure in rats.[22]
Toxaphene	◆ Associated with cancer and reproductive/developmental disturbance in mammals; few studies on human exposures. ◆ Inhibits human breast epithelial cell communication.[23] ◆ Estrogenic activity exhibited.[24]
Dioxins **Furans**	◆ Developmental, endocrine, and immune system toxicants that may have reproductive effects in humans. ◆ The International Agency for Research on Cancer (IARC) has classified 2,3,7,8-tetrachlorodibenzo-para-dioxin (TCDD) as a known human carcinogen.[25] ◆ Developmental and immuno- toxicity in animals, especially rodents.[26] ◆ Alteration of estrogen, progesterone, testosterone, and thyroid hormone levels in several species; decreased serum testosterone in exposed humans.[27] ◆ Inhibits action of estrogens in several species; reductions of fertility, litter size, and uterine weights in mice, rats, primates.[28] ◆ Chloracne a high-dose response following dermal or systemic exposure.[29]
PCBs	◆ Documented history of adverse effects in wildlife and acutely exposed human populations. ◆ Human fetal exposures associated with neural and developmental changes,[30] lowered psychomotor scores,[31] short term memory and spatial learning effects,[32] and long term effects on intellectual function.[33] ◆ Acneform rash produced by dermal contact.[34] ◆ Some demonstrate estrogenic effects in wildlife.[35]

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PCBs, DDT, hexachlorobenzene, and dieldrin in the Great Lakes. Levels have begun to decline due to national regulation, but atmospheric deposition is suspected as a significant source of continued contamination.

Protecting people from POPs cannot be done on a purely domestic scale; their sound management is a global issue that crosses political boundaries. Eradicating POPs is not only a matter of eliminating their production, but also requires the safe destruction of existing stores and the clean-up of presently polluted sediments and waters.

◆

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Landmarks in Persistent Pollutant Policy

Over the last three decades, countries have increasingly recognized that POPs travel the globe with no respect for national borders and that the response to the threat therefore must be international .

In the 1960s, pollution in the Great Lakes of North America became a prominent issue. The Canadian and U.S. governments' combined concerted actions helped reduce conventional pollutants, enabling some wildlife populations to recover and improving the water quality and aesthetics of the region. Still, some species at the top of the food chain, such as fish-eating birds, were slow to recover.

PHOTO INTERNATIONAL JOINT COMMISSION

Adverse effects of POPs in Great Lakes wildlife, such as the deformed bill of this young cormorant, have helped spur international action.

In the 1987 revisions to the Great Lakes Water Quality Agreement of 1978, Canada and the U.S. agreed that ". . .the discharge of any and all persistent toxic substances [should] be virtually eliminated." The drive to control these toxins was further propelled by a 1991 Great Lakes Science Advisory Board Report to the International Joint Commission (IJC)—a U.S. and Canadian organization devoted to protecting the Great Lakes—which found that predator species suffered from population decline, behavioral and hormonal changes, immune suppression, tumors, and metabolic changes because of bioaccumulative, persistent toxins. The IJC agreed that the same persistent toxins affecting wildlife were measurable in humans, and persistent pollutants became a central focus for clean-up. These Great Lakes findings are echoed in a 1997 report released by the Great Waters Program (a U.S. EPA program dedicated to evaluating the atmospheric deposition of air pollutants to the Great Lakes, Lake Champlain, the Chesapeake Bay, and coastal waters), which listed 8 of the 12 POPs among the 15 pollutants of most serious concern.

The Commission for Environmental Cooperation (CEC)—a trinational body created through a NAFTA side agreement to work on transboundary environmental concerns in North America—is also addressing the threat that POPs pose to this continent's future by developing North American Regional Action Plans (or NARAPs) for chlordane, DDT, and PCBS. NARAPs include specific actions for the three countries to take to reduce risks to human health and the environment. NARAPs goals include proposing safe transboundary transport of PCBs for disposal and phase out of DDT use for malaria in Mexico. Hexachlorobenzene and dioxins and furans have also been nominated for evaluation and possible action.

The issue of POPs has also been addressed by the United Nations Economic Commission for Europe (UN/ECE) in its work on Long Range Transboundary Air Pollution (LRTAP). A LRTAP POPs protocol was signed in 1998, and included all 12 POPs in the short list.

During these negotiations, which included Western European countries plus the United States, Canada, and Russia, Russia revealed that it still produces PCBs for use in its electrical grid. As part of the treaty, Russia has agreed to begin phasing out its production of PCBs.

These international actions have set the stage for a global POPs treaty. Delegations from 120 governments have participated in negotiations convened by the United Nations Environment Programme, which began in Montreal, Canada in June 1998. The treaty will be the first global agreement to take action to phase out a class of environmental pollutants for their direct impacts on human health.

There is worldwide public interest in obtaining a strong, legally binding POPs treaty. PSR is part of a network of more than 200 public interest organizations from more than 50 countries, which support the phase out and ultimate elimination of persistent organic pollutants. Known as the International POPs Elimination Network (IPEN), this network has developed a common platform on POPs, and has facilitated the active participation of public interest non-governmental organizations from around the world in these negotiations. ◆

Key Issues in Global POPs Talks

Although phasing out many of the POPs at issue is largely uncontroversial, there are still some issues of contention in these negotiations. Following are key issues and PSR's recommendations:

◆ ***Elimination Objective*** - The only way to effectively protect public health and the environment from POPs is to end their production, use, trade, and release. Thus, the overarching goal should be the elimination of POPs, even though some POPs may require longer phase-out periods than others.

PSR Recommendation: The preamble and objectives sections of the treaty should clearly state that the ultimate, long-term goal is the elimination of persistent organic pollutants.

◆ ***DDT and Malaria*** - In the past, DDT was the primary insecticide sprayed inside houses to control the mosquitos that act as malaria vectors. Today, according to the World Health Organization (WHO), fewer than 25 countries still use DDT in public health house-spraying. WHO's new "Roll Back Malaria" initiative emphasizes the use of low-tech, inexpensive methods like mosquito bednets impregnated with less persistent pesticides.

PSR Recommendation: As physicians, we care deeply about improving the control of malaria. The POPs treaty offers an opportunity to phase out DDT while directing more attention and resources to safe, effective malaria control programs. The treaty should require an ultimate phaseout of DDT, and provide financial and technical assistance to help countries transition from reliance on DDT to an integrated vector management and public health approach.

◆ ***Dioxin and Other POPs By-Products*** - As industrial by-products rather than an intentionally produced substances, dioxins and furans are more difficult to phase out than other POPs. The chemical industries are lobbying to preserve the status quo with regard to dioxin regulation, and the U.S. has been reluctant to go beyond current domestic law, which focuses on dioxin reductions through better emissions control.

PSR Recommendation: The treaty should emphasize pollution *prevention* and dioxin source elimination, with a gradual phaseout of dioxin-producing materials and technologies. Emission reductions should be required as soon as feasible. The focus should be on continuing minimization of man-made emissions, with the ultimate aim of their elimination.

◆ ***Existing PCBs in Use*** - While the production of new PCBs has been banned nearly everywhere in the world, they remain in use in older electrical components and other equipment. The potential for leakage or accidental release makes their continued use unacceptable. The next logical step for a global POPs treaty is to remove existing PCBs from use and dispose of them properly.

PSR Recommendation: The POPs treaty should prohibit the production and new use of PCBs and require efforts over a specified period of time to recover PCBs currently in use in order to prevent pollution from accidental spills. It should ban trade in PCBs, except to export them for disposal using environmentally sound treatment technologies. Incineration, since it contributes to the production of other POPs (dioxins and furans), should be discouraged.

◆ ***Technical and Financial Assistance*** - Perhaps the most important issues in the POPs negotiations revolve around the measures that will make it possible for developing countries to implement a treaty. The countries that are most dependent on POPs, particularly the pesticides, also have struggling economies and little capacity to regulate chemicals. Technical and financial assistance from developed countries will be crucial in the effort to eliminate POPs in Africa, Latin America, Asia, Eastern Europe and the former Soviet Union. Without adequate provisions for assistance written into the treaty, these countries will be unwilling to commit to POPs phaseouts and/or unable to carry them out.

PSR Recommendation: The treaty should include mechanisms for more developed nations to provide adequate technical assistance and funding to less developed nations — directly, through existing multilateral arrangements, or through a new funding mechanism.

◆ ***Other Issues*** - Other aspects of the POPs treaty that may prove problematic before negotiations are concluded include criteria for adding POPs, and the interaction of this treaty with international trade agreements. A scientific experts group has recommended four criteria—persistence, bioaccumulation/bio-concentration, potential for long-range transport, and toxicity—by which additional chemicals beyond the initial 12 could be evaluated and added to a future POPs treaty. These criteria will only be meaningful if thresholds are set low enough to capture a significant number of substances of concern and if economic and political factors are not allowed to interfere with the scientific judgement of what is a POP. With regard to trade, there has been an effort by some countries to subordinate the POPs treaty to the World Trade Organization. An effective POPs treaty, however, must operate independently of the international trading system and the WTO. ◆