

# PVC (Polyvinyl Chloride) – FACT SHEET & Talking Points

<http://archive.greenpeace.org/toxics/html/content/pvc1.html>

<http://www.greenpeace.org/usa/en/campaigns/toxics/go-pvc-free/>

<http://www.who.int/mediacentre/factsheets/fs225/en/>

<http://www.greenpeace.org/usa/en/campaigns/toxics/go-pvc-free/>

<http://www.ens-newswire.com/ens/jan2011/2011-01-21-01.html>

## What is PVC?

- The most environmentally damaging plastic. In fact, this commonplace plastic is one of the most toxic substances saturating our planet and its inhabitants
- From cradle to grave, the PVC Lifecycle (production, use and disposal) results in the release of toxic, chlorine based chemicals.
- One of the world's largest dioxin sources
- These toxins build up in water, air and in the food chain.
- The results: severe health problems, including cancer, immune system damage and hormone disruption.
- No one can escape contamination.
- Everyone everywhere has measureable levels of chlorinated toxins in their bodies.

## How can we get rid of PVC?

- Since safer alternatives are available for virtually all uses of PVC, it is possible to protect human health and the environment by replacing and eventually phasing out this poison plastic.
- Policymakers at the local, state and federal level should enact and implement laws that steadily reduce impacts of PVC disposal and lead to a complete phase-out of PVC use and waste incineration within ten years.
- A new materials policy for PVC that embraces aggressive source reduction of PVC should be adopted to steadily reduce the use of PVC over time

## **Background Information**

“Due to the omnipresence of dioxins, all people have background exposure and a certain level of dioxins in the body, leading to the so-called body burden. Current normal background exposure is not expected to affect human health on average. However, due to the high toxic potential of this class of compounds, efforts need to be undertaken to reduce current background exposure.”

~ World Health Organization (WHO) Fact sheet N°225 - May 2010 ~

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### ➤ **PVC Health Issues**

Dioxin (the most potent carcinogen known), ethylene dichloride and vinyl chloride are unavoidably created in production of PVC and can cause severe health problems, including:

- Cancer
- Endocrine disruption
- Endometriosis
- Neurological damage
- Birth defects & impaired child development
- Reproductive and immune system damage

➤ **PVC Lifecycle** – From cradle to grave, of all the plastics, PVC plastic or vinyl is the most environmentally damaging. Throughout its lifecycle it requires hazardous chemicals in production, releases harmful additives and creates toxic wastes. Dioxins are created during the manufacture of PVC so that production wastes are rich with dioxins and other highly toxic contaminants. Toxic chemical additives are incorporated within PVC products. PVC production is increasing worldwide and is now the world's single largest use of industrial chlorine

➤ **PVC Disposal** - The disposal of PVC creates more environmental problems. Dioxins are created when PVC plastic is burned either in incinerators, household stoves, open trash-burning, and accidental fires in buildings and vehicles. If

burned, either in open fires or incinerators, PVC will release an acidic gas along with dioxins - because of its chlorine content. PVC is a major source of dioxins globally. If landfilled, it eventually releases additives which can then threaten groundwater supplies; landfill fires involving PVC are a further source of dioxin

- **PVC Recycling** is neither technically nor financially feasible. Currently less than 1% of PVC is materially 'recycled'. Post-consumer products or PVC waste products cannot be recycled into the same quality because PVC always needs virgin PVC to make a product of similar quality. The majority of this collected waste is 'down-cycled' or used to manufacture 'inferior' products such as garden benches and sound barriers along highways.
- **It's everywhere** - Polyvinyl chloride (PVC) plastic, commonly known as "vinyl," has become one of the most widely-used types of plastics. It's used in packaging, home furnishings, children's toys, automobile parts, building materials, hospital supplies, and hundreds of other products.

➤ **Why is PVC considered to be so bad?**

'From its manufacture to its disposal, PVC emits toxic compounds. During the manufacture of the building block ingredients of PVC (such as vinyl chloride monomer), dioxin and other persistent pollutants are emitted into the air, water and land, which present both acute and chronic health hazards. During use, PVC products can leach toxic additives, for example flooring can release softeners called phthalates. When PVC reaches the end of its useful life, it can be either landfilled, where it leaches toxic additives or incinerated, again emitting dioxin and heavy metals. When PVC burns in accidental fires, hydrogen chloride gas and dioxin are formed.' ~Greenpeace~

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- All humans and animals now carry body burdens of TCDD and other dioxins.
- PVC and Dioxin - PVC is a major source of dioxins worldwide. Dioxins are created when PVC is produced, recycled and disposed of in incinerators,

- TCDD, the most lethal form of the dioxin family is a known human carcinogen and hormone disrupter and is recognized as the most toxic synthetic compound ever produced.
- **What other governments are doing about dioxin** - Governments and industry are taking action to eliminate PVC. Danish and Swedish governments are restricting PVC use, hundreds of communities worldwide are eliminating PVC in buildings and many companies such as Nike, IKEA and The Body Shop have committed to eliminating PVC from their products.
- Recent testing by several governments has also shown that children can ingest hazardous chemicals from PVC toys during use.
- Recently many governments have banned soft vinyl baby toys and teething rings (i.e., Canada) because of the hazards of softeners leaking into their infants' mouths when sucked or chewed.
- Fires at landfills are frequent occurrences, even in industrialized countries. For example, the U.S. Environmental Protection Agency recently estimated that landfill fires contribute 20 percent of dioxin releases to air in that country.

### How can we get rid of PVC?

- Policymakers at the local, state and federal level should enact and implement laws that steadily reduce impacts of PVC disposal and lead to a complete phase-out of PVC use and waste incineration within ten years.
- A new materials policy for PVC that embraces aggressive source reduction of PVC should be adopted to steadily reduce the use of PVC over time
- PVC Free - The good news is that this industrial transition can be accomplished in a manner that is fair to all involved - the plastic manufacturers, industrial workers, and host communities.
  - PVC can be replaced with safer materials in virtually all cases.
  - Substitutes for PVC include traditional materials such as clay, glass, ceramics and linoleum. In those cases where traditional materials cannot be used as a replacement, even chlorine-free plastics are preferable to PVC.



# World Health Organization

## Dioxins and their effects on human health

Fact sheet N°225  
May 2010

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### Key Facts

- Dioxins are a group of chemically-related compounds that are persistent environmental pollutants.
  - Dioxins are found throughout the world in the environment and they accumulate in the food chain, mainly in the fatty tissue of animals.
  - More than 90% of human exposure is through food, mainly meat and dairy products, fish and shellfish. Many national authorities have programmes in place to monitor the food supply.
  - Dioxins are highly toxic and can cause reproductive and developmental problems, damage the immune system, interfere with hormones and also cause cancer.
  - Due to the omnipresence of dioxins, all people have background exposure, which is not expected to affect human health. However, due to the highly toxic potential of this class of compounds, efforts need to be undertaken to reduce current background exposure.
  - Prevention or reduction of human exposure is best done via source-directed measures, i.e. strict control of industrial processes to reduce formation of dioxins as much as possible.
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### Background

Dioxins are environmental pollutants. They have the dubious distinction of belonging to the “dirty dozen” - a group of dangerous chemicals known as persistent organic pollutants. Dioxins are of concern because of their highly toxic potential. Experiments have shown they affect a number of organs and systems. Once dioxins have entered the body, they endure a long time because of their chemical stability and their ability to be absorbed by fat tissue, where they are then stored in the body. Their half-life in the body is estimated to be seven to eleven years. In the environment, dioxins tend to accumulate in the food chain. The higher in the animal food chain one goes, the higher the concentration of dioxins.

The chemical name for dioxin is: *2,3,7,8-tetrachlorodibenzo para dioxin (TCDD)*. The name "dioxins" is often used for the family of structurally and chemically related *polychlorinated dibenzo para dioxins (PCDDs)* and *polychlorinated dibenzofurans (PCDFs)*. Certain dioxin-like polychlorinated biphenyls (PCBs) with similar toxic properties are also included under the term

“dioxins”. Some 419 types of dioxin-related compounds have been identified but only about 30 of these are considered to have significant toxicity, with TCDD being the most toxic.

### **Sources of dioxin contamination**

Dioxins are mainly by products of industrial processes but can also result from natural processes, such as volcanic eruptions and forest fires. Dioxins are unwanted by products of a wide range of manufacturing processes including smelting, chlorine bleaching of paper pulp and the manufacturing of some herbicides and pesticides. In terms of dioxin release into the environment, uncontrolled waste incinerators (solid waste and hospital waste) are often the worst culprits, due to incomplete burning. Technology is available that allows for controlled waste incineration with low emissions.

Although formation of dioxins is local, environmental distribution is global. Dioxins are found throughout the world in the environment. The highest levels of these compounds are found in some soils, sediments and food, especially dairy products, meat, fish and shellfish. Very low levels are found in plants, water and air.

Extensive stores of PCB-based waste industrial oils, many with high levels of PCDFs, exist throughout the world. Long-term storage and improper disposal of this material may result in dioxin release into the environment and the contamination of human and animal food supplies. PCB-based waste is not easily disposed of without contamination of the environment and human populations. Such material needs to be treated as hazardous waste and is best destroyed by high temperature incineration.

### **Dioxin contamination incidents**

Many countries monitor their food supply for dioxins. This has led to early detection of contamination and has often prevented impact on a larger scale. One example is the detection of increased dioxin levels in milk in 2004 in the Netherlands, traced to a clay used in the production of the animal feed. In another incident, elevated dioxin levels were detected in animal feed in the Netherlands in 2006 and the source was identified as contaminated fat used in the production of the feed.

Some dioxin contamination events have been more significant, with broader implications in many countries.

In late 2008, Ireland recalled many tons of pork meat and pork products when up to 200 times more dioxins than the safe limit were detected in samples of pork. This finding led to one of the largest food recalls related to a chemical contamination. Risk assessments performed by Ireland indicated no public health concern. The contamination was traced back to contaminated feed.

In July 2007, the European Commission issued a health warning to its Member States after high levels of dioxins were detected in a food additive - guar gum - used as thickener in small quantities in meat, dairy, dessert or delicatessen products. The source was traced to guar gum

from India that was contaminated with pentachlorophenol (PCP), a pesticide no longer in use. PCP contains dioxins as contamination.

In 1999, high levels of dioxins were found in poultry and eggs from Belgium. Subsequently, dioxin-contaminated animal-based food (poultry, eggs, pork), were detected in several other countries. The cause was traced to animal feed contaminated with illegally disposed PCB-based waste industrial oil.

In March 1998, high levels of dioxins in milk sold in Germany were traced to citrus pulp pellets used as animal feed exported from Brazil. The investigation resulted in a ban on all citrus pulp imports to the EU from Brazil.

Another case of dioxin contamination of food occurred in the United States of America in 1997. Chickens, eggs, and catfish were contaminated with dioxins when a tainted ingredient (bentonite clay, sometimes called "ball clay") was used in the manufacture of animal feed. The contaminated clay was traced to a bentonite mine. As there was no evidence that hazardous waste was buried at the mine, investigators speculate that the source of dioxins may be natural, perhaps due to a prehistoric forest fire.

Large amounts of dioxins were released in a serious accident at a chemical factory in Seveso, Italy, in 1976. A cloud of toxic chemicals, including 2,3,7,8-Tetrachlorodibenzo-p-dioxin, or TCDD, was released into the air and eventually contaminated an area of 15 square kilometres where 37 000 people lived. Extensive studies in the affected population are continuing to determine the long-term human health effects from this incident. These investigations, however, are hampered by the lack of appropriate exposure assessments. A minor increase in certain cancers and effects on reproduction have been detected and are being further investigated. Possible effects on the children of exposed people are currently being studied.

TCDD has also been extensively studied for health effects linked to its presence as a contaminant in some batches of the herbicide Agent Orange, which was used as a defoliant during the Vietnam War. A link to certain types of cancers and also to diabetes is still being investigated.

Earlier incidents of food contamination have been reported in other parts of the world. Although all countries can be affected, most contamination cases have been reported in industrialized countries where adequate food contamination monitoring, greater awareness of the hazard and better regulatory controls are available for the detection of dioxin problems.

A few cases of intentional human poisoning have also been reported. The most notable incident is the 2004 case of Viktor Yushchenko, President of the Ukraine, whose face was disfigured by chloracne.

### **Effects of dioxins on human health**

Short-term exposure of humans to high levels of dioxins may result in skin lesions, such as chloracne and patchy darkening of the skin, and altered liver function. Long-term exposure is

linked to impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions. Chronic exposure of animals to dioxins has resulted in several types of cancer. TCDD was evaluated by the WHO's International Agency for Research on Cancer (IARC) in 1997. Based on animal data and on human epidemiology data, TCDD was classified by IARC as a "known human carcinogen". However, TCDD does not affect genetic material and there is a level of exposure below which cancer risk would be negligible.

Due to the omnipresence of dioxins, all people have background exposure and a certain level of dioxins in the body, leading to the so-called body burden. Current normal background exposure is not expected to affect human health on average. However, due to the high toxic potential of this class of compounds, efforts need to be undertaken to reduce current background exposure.

### **Sensitive subgroups**

The developing fetus is most sensitive to dioxin exposure. The newborn, with rapidly developing organ systems, may also be more vulnerable to certain effects. Some individuals or groups of individuals may be exposed to higher levels of dioxins because of their diets (e.g., high consumers of fish in certain parts of the world) or their occupations (e.g., workers in the pulp and paper industry, in incineration plants and at hazardous waste sites, to name just a few).

### **Prevention and control of dioxin exposure**

Proper incineration of contaminated material is the best available method of preventing and controlling exposure to dioxins. It can also destroy PCB-based waste oils. The incineration process requires high temperatures, over 850°C. For the destruction of large amounts of contaminated material, even higher temperatures - 1000°C or more - are required.

Prevention or reduction of human exposure is best done via source-directed measures, i.e. strict control of industrial processes to reduce formation of dioxins as much as possible. This is the responsibility of national governments, but in recognition of the importance of this approach, the Codex Alimentarius Commission adopted in 2001 a Code of Practice for Source Directed Measures to Reduce Contamination of Foods with Chemicals (CAC/RCP 49-2001), and in 2006 a Code of Practice for the Prevention and Reduction of Dioxin and Dioxin-like PCB Contamination in Food and Feeds (CAC/RCP 62-2006).

More than 90% of human exposure to dioxins is through the food supply, mainly meat and dairy products, fish and shellfish. Consequently, protecting the food supply is critical. One approach includes, as mentioned above, source-directed measures to reduce dioxin emissions. Secondary contamination of the food supply needs to be avoided throughout the food-chain. Good controls and practices during primary production, processing, distribution and sale are all essential to the production of safe food.

Food contamination monitoring systems must be in place to ensure that tolerance levels are not exceeded. It is the role of national governments to monitor the safety of food supply and to take action to protect public health. When incidents of contamination are suspected, countries should

have contingency plans to identify, detain and dispose of contaminated feed and food. The exposed population should be examined in terms of exposure (e.g. measuring the contaminants in blood or human milk) and effects (e.g. clinical surveillance to detect signs of ill health).

**What should consumers do to reduce their risk of exposure?** Trimming fat from meat and consuming low fat dairy products may decrease the exposure to dioxin compounds. Also, a balanced diet (including adequate amounts of fruits, vegetables and cereals) will help to avoid excessive exposure from a single source. This is a long-term strategy to reduce body burdens and is probably most relevant for girls and young women to reduce exposure of the developing fetus and when breastfeeding infants later on in life. However, the possibility for consumers to reduce their own exposure is somewhat limited.

**What does it take to identify and measure dioxins in the environment and food?** The quantitative chemical analysis of dioxins requires sophisticated methods that are available only in a limited number of laboratories around the world. These are mostly in industrialized countries. The analysis costs are very high and vary according to the type of sample, but range from over US\$ 1700 for the analysis of a single biological sample to several thousand US dollars for the comprehensive assessment of release from a waste incinerator.

Increasingly, biological (cell- or antibody) -based screening methods are being developed. The use of such methods for food samples is not yet sufficiently validated. Nevertheless, such screening methods will allow more analyses at lower cost. In case of a positive screening test, confirmation of results must be carried out via more complex chemical analysis.

#### **WHO activities related to dioxins**

Reducing dioxin exposure is an important public health goal for disease reduction, also with respect to sustainable development. In order to give guidance on acceptable levels of exposure, WHO has held a series of expert meetings to determine a tolerable intake of dioxins to which a human can be exposed throughout life without harm.

In the latest of such expert meetings held in 2001, the Joint FAO/WHO Expert Committee on Food Additives (JECFA) performed an updated comprehensive risk assessment of PCDDs, PCDFs, and “dioxin-like” PCBs. The experts concluded that a tolerable intake could be established for dioxins on the basis of the assumption that there is a threshold for all effects, including cancer. The long half-lives of PCDDs, PCDFs and “dioxin-like” PCBs mean that each daily ingestion has a small or even a negligible effect on overall intake. In order to assess long- or short-term risks to health due to these substances, total or average intake should be assessed over months, and the tolerable intake should be assessed over a period of at least one month. The experts established a provisional tolerable monthly intake (PTMI) of 70 picogram/kg per month. This level is the amount of dioxins that can be ingested over lifetime without detectable health effects.

WHO, in collaboration with the Food and Agriculture Organization (FAO), through the joint FAO/WHO Codex Alimentarius Commission, has established a ‘Code of Practice for the Prevention and Reduction of Dioxin and Dioxin-like PCB Contamination in Foods and Feed’.

This document gives guidance to national and regional authorities on preventive measures. The establishment of Codex guideline levels for dioxins in foods is under consideration.

Since 1976, WHO has been responsible for the Global Environment Monitoring System's Food Contamination Monitoring and Assessment Programme. Commonly known as GEMS/Food, the programme provides information on levels and trends of contaminants in food through its network of participating laboratories in over 70 countries around the world. Dioxins are included in this monitoring programme.

Since 1987, WHO has conducted periodic studies on levels of dioxins in human milk, mainly in European countries. These studies provide an assessment of human exposure to dioxins from all sources. Recent exposure data indicate that measures introduced to control dioxin release in a number of countries have resulted in a substantial reduction in exposure to these compounds over the past two decades.

WHO is now working with the United Nations Environmental Programme (UNEP) on the implementation of the 'Stockholm Convention', an international agreement to reduce emissions of certain persistent organic pollutants (POPs), including dioxins. A number of actions are being considered internationally to reduce the production of dioxins during incineration and manufacturing processes. In responding to the needs of the Stockholm Convention on POPs, the WHO GEMS/Food has developed a new protocol for a Global Survey of Human Milk for POPs in order to meet the health, food safety and environmental objectives of WHO, UNEP and their member countries. This protocol will assist national and regional authorities to collect and analyse representative samples in order to assess the current state of background exposure and in the future to assess the effectiveness of measures taken to reduce exposure.

Dioxins occur as a complex mixture in the environment and in food. In order to assess the potential risk of the whole mixture, the concept of toxic equivalence has been applied to this group of contaminants. TCDD, the most toxic member of the family, is used as reference compound, and all other dioxins are assigned a toxic potency relative to TCDD, based on experimental studies. During the last 15 years, WHO, through the International Programme on Chemical Safety (IPCS), has established and regularly re-evaluated toxic equivalency factors (TEFs) for dioxins and related compounds through expert consultations. WHO-TEF values have been established which apply to humans, mammals, birds and fish. The last such consultation was held in 2005 to update human and mammalian TEFs. These international TEFs have been developed for application in risk assessment and management, and have been adopted formally by a number of countries and regional bodies, including Canada, Japan, the United States and the European Union.

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## Canada Limits Toxic Softeners in Plastic Baby Toys

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OTTAWA, Ontario, Canada, January 21, 2011 (ENS) - Canada will restrict six toxic chemicals used to soften vinyl plastics in order to limit the exposure of infants and children to the chemicals, Health Minister Leona Aglukkaq said Tuesday.

The new regulations, to be implemented in June, will ban toys and child care products that contain greater than allowable concentrations of the six phthalates, a family of chemicals used to soften polyvinyl chloride, or PVC.

"Phthalates may adversely affect reproduction and development," Health Canada said in a fact sheet accompanying the government's decision.

"Today, we are acting to make the toys and products that young Canadians use even safer," said Aglukkaq. "New regulations will ensure products that are imported, sold or advertised in Canada do not present a risk of phthalate exposure to children and infants."

The mere presence of phthalates in soft vinyl toys does not equate to a health risk, Health Canada says, adding that touching or licking soft vinyl does not constitute a health risk.

But young children often put teething rings and soft vinyl toys into their mouths and chew on them, releasing the phthalates in the soft plastic into their saliva.

"It is the amount of phthalates that leach out of the soft vinyl and migrate into the body that can be harmful," Health Canada says. "Phthalates leach out of soft vinyl during periods of sustained mouthing action (sucking and chewing) that occurs on a daily basis, and migrate into the body through the saliva."

"I applaud the government's actions to limit the



**Health Minister Leona Aglukkaq announces phthalate regulations.** (Photo courtesy Health Canada)

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presence of this chemical in children's products," said Rick Smith, executive director of the nonprofit Environmental Defence Canada, which advocates for regulations to limit toxic chemicals.

"Canada's phthalates regulations are now aligned with measures taken in the United States and the European Union and will ensure our children receive the same high level of protection," said Smith.

In the European Union the concentrations of some phthalates has been restricted to 0.1 percent for use in children's toys since 1999. In the United States, a similar restriction was enacted as part of the Consumer Product Safety Improvement Act of 2008.



**Chewing and sucking on soft plastic releases phthalates into saliva. (Photo by [oklagirl](#))**

Canada's new regulations also use the 0.1 percent standard to limit six chemicals - di 2-

ethylhexyl phthalate (DEHP), dibutyl phthalate (DBP), benzyl butyl phthalate (BBP), diisononyl phthalate (DINP), diisodecyl phthalate (DIDP) and di-n-octyl phthalate (DNOP).

Since 1998, phthalates have voluntarily not been used by Canadian industry in soft vinyl pacifiers, teethingers, rattles, baby bottle nipples and other products intended to be mouthed by children and infants.

Even so, Health Canada's own market survey conducted in 2008 found the widespread presence of phthalates in PVC toys and other products for young children.

According to the test results released to Postmedia News under access-to-information legislation, three-quarters (54 of 72) of soft plastic toys and other items for young children contained up to 39.9 percent by weight of PVC.

Health Canada says it conducted the tests to "understand what manufacturers are using instead of phthalates," according to an internal summary of the test results, said Sara Schmidt of Postmedia News.



Many environmentalists want the Canadian government to do a great deal more to control phthalates and other toxic chemicals in everyday consumer products.

A petition filed Thursday by the David Suzuki Foundation and Réseau des femmes en environnement asks why Canada is not enforcing a prohibition on estrogen-mimicking, hormone-disrupting chemicals in personal care products like shampoos, lotions, deodorants and makeup. Estrogens are the primary female sex hormones.

"Canada's Cosmetic Regulations are clear - products that contain estrogenic substances should not be allowed on the shelf," said Lisa Gue, researcher with the David Suzuki Foundation. "So what are these chemicals doing in our body products?"

The petition points out that although Canada's Cosmetics Regulations prohibit the sale of any cosmetic that contains "an estrogenic substance," parabens, siloxanes, phthalates and BHA are common ingredients in cosmetics. All four show evidence of estrogenic activity and have been classified by the European Union as suspected endocrine-disrupting substances.

The petition asks what action Health Canada is taking against manufacturers or importers of cosmetics containing these and other estrogen-mimicking endocrine disrupters.

"There is a growing body of scientific evidence linking exposure to endocrine-disrupting chemicals and adverse effects on wildlife and human health," the petition states. These chemicals have been linked to health effects, ranging from declining sperm counts and increased incidences of male genital malformations, to increased incidences of certain types of cancer.

The petition asks seven questions of Canada's Commissioner of the Environment and Sustainable Development Scott Vaughan. The government will have 120 days to respond.

"Endocrine-disrupting chemicals are ubiquitous and it makes sense to minimize unnecessary exposure," said Gue. "Health Canada has acknowledged this in recent decisions to ban Bisphenol-A in baby bottles and six types of phthalates in soft vinyl toys. We hope that our petition will spur the government to start enforcing the regulatory prohibition on estrogenic substances in cosmetics."

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## Persistent Toxins in the PVC Life Cycle: Potential Exposures from Cradle to Grave

INFORM 2003

Polyvinyl chloride (PVC) plastic, commonly known as vinyl, is used in myriad applications ranging from toys to automobiles. Among many other toxic chemicals, numerous persistent toxins (including PBTs) are used, created, and released throughout the PVC life cycle, from manufacture to use to disposal. PBTs are added as catalysts and stabilizers during the PVC production process. Persistent chlorinated organics such as dioxin and hexachlorobenzene are generated as by-products in the manufacture of chemicals used as PVC feedstocks. And additives such as phthalates, which can persist and bioaccumulate in certain organisms, are added to PVC before it is molded into final products.

### *Persistent Toxic Chemicals Generated During PVC Production*

The PVC life cycle begins with the generation of chlorine gas and ethylene. These are combined to create ethylene dichloride, which is used to make vinyl chloride monomer. The monomer is polymerized into polyvinyl chloride, and the PVC is then mixed with various additives and formed into the products we buy and use every day.

**Chlorine.** Chlorine gas used in PVC production is normally made by splitting salt (sodium chloride) at facilities called chloralkali plants. One method uses mercury to facilitate the chemical reaction. Worldwide, 24 percent of chlorine production in 1997 occurred at plants using mercury, and in 2000 there were about 100 mercury chloralkali plants in operation.<sup>1</sup> In the US, ten facilities use the mercury process, accounting for 10 percent of the nation's chlorine production.<sup>2</sup> In 2000, these plants released over 12,500 pounds of mercury to the environment.<sup>3</sup> Tests of wastewater at mercury chloralkali plants in Europe showed that it contained 1.6 to 7.6 milligrams of mercury per liter.<sup>4</sup>

In addition to mercury, chlorine gas produced at chloralkali plants can contain other persistent toxic chemicals as contaminants, including trace amounts of hexachlorobenzene, hexachloroethane, PCBs, and octachlorostyrene (OCS).<sup>5</sup>

Until recently, graphite electrodes used in the manufacture of chlorine gas at chloralkali plants generated octachlorostyrene as well as polychlorinated dioxins and furans. OCS contamination of Lake Ontario sediment has been traced to the disposal of used graphite electrodes from the chloralkali industry.<sup>6</sup> In addition, high levels of polychlorinated dioxins and furans have been found in the blood of workers who handled sludge from chloralkali plants where graphite electrodes were used.<sup>7</sup> Although graphite electrodes are no longer used in industrialized countries, they may still be used in other parts of the world. Moreover, polychlorinated dioxins and furans can be generated even when graphite electrodes are not used, probably as a result of reactions with carbon present in

other equipment, such as rubber linings.<sup>8</sup> At least one chloralkali plant in the US reported dioxin emissions in 2000.<sup>9</sup>

***Ethylene dichloride to vinyl chloride monomer to PVC.*** The combination of chlorine and ethylene to make ethylene dichloride likewise generates persistent toxic chemicals and PBTs, including polychlorinated dioxins and furans, PCBs, hexachloroethane, and hexachlorobutadiene.<sup>10</sup> In addition, copper used as a catalyst in the production of both ethylene dichloride and vinyl chloride monomer -- the next product of PVC manufacture -- can be released to the environment,<sup>11</sup> and waste from both processes can contain chloroform, hexachlorobenzene, di-(2-ethylhexyl) phthalate (DEHP), zinc, copper, and dioxin.<sup>12</sup>

Small amounts of dioxin can also be emitted when vinyl chloride monomer is polymerized into PVC. One study found that the distribution of different types of dioxin molecules is different in PVC workers than in the general population, indicating dioxin exposure during the PVC production process.<sup>13</sup> In addition, some (but not all) studies show that trace amounts of polychlorinated dioxins and furans can be found in PVC resin and in finished PVC products. However, all these studies concluded that this small amount of dioxin causes no harm to humans, even when the PVC is used as food wrapping.<sup>14</sup>

#### ***Persistent Toxin-Containing Additives***

Apart from its low cost, a major reason for PVC's many applications is that it can be either rigid or flexible. However, without the addition of other chemicals to prevent degradation, PVC would rapidly deteriorate, becoming brittle and discolored and releasing hydrogen chloride gas.<sup>15</sup> In addition, because very high temperatures are needed to make certain PVC products, stabilizers must be used to prevent PVC from degrading during production. Finally, PVC is not inherently flexible and requires additives, called plasticizers, for products such as soft vinyl toys, polymer art clay, and flexible tubing. In order to mold PVC into the required shape, it must be blended with chemicals that provide the desired properties. Many of these additives are persistent toxins or PBTs, which can enter the environment and come into contact with humans and other animals during PVC production, during product use, and during and after product disposal.

***Lead.*** Lead is used as a heat stabilizer and pigment in PVC. According to the Vinyl Institute (a trade association), cable and wire coverings are the only vinyl items manufactured in the US that use lead as a stabilizer.<sup>16</sup> However, imported items may still contain lead used for this purpose. Lead has also been used in vinyl flooring, appliance housings, credit cards, blinds, hoses, automobile upholstery, gutters, pipes, and window profiles and may still be found in these items, especially if they were made abroad.<sup>17</sup> Lead concentrations up to 6,300 parts per million have been found in modular phone cords, children's toys, a sun umbrella pole, and placemats.<sup>18</sup>

***Cadmium.*** Cadmium compounds are used as stabilizers to prevent degradation of PVC from heat and light.<sup>19</sup> They are also found in various pigments used to color PVC products. The use of cadmium for these purposes is declining, particularly in the

European Union, where some countries have banned the chemical from certain applications or struck voluntary agreements with the industry to reduce its use.<sup>20</sup> Zinc-based stabilizers are often used instead of cadmium because zinc is considered less toxic.<sup>21</sup> Cadmium has been found in vinyl items marketed to children, including a play chicken drumstick, placemats, portions of backpacks and tote bags, and a play tent.<sup>22</sup>

**Other metals.** A pair of PVC boots bought in Australia in 1995 containing the preservative mercuric chloride was found to leach small amounts of mercury when exposed to conditions mimicking sweating. These boots had already caused an allergic reaction in the wearer, who was allergic to mercury.<sup>23</sup> Zinc and tin stabilizers and pigments are also used in PVC, with zinc use presumably increasing as cadmium and lead use decline. Antimony-zinc complexes have been used as flame retardants in PVC products.<sup>24</sup>

**Phthalates.** For flexible applications, PVC requires the addition of plasticizers. Some of the most widely used plasticizers in PVC are DEHP and diisononyl phthalate (DINP). In the EU in 1997, 93 percent of the plasticizers used in PVC were phthalates, which can account for 15 to 60 percent of the weight of a product. Since phthalates do not chemically bind to vinyl, they can leach out into the air or into liquids that come into contact with the product.<sup>25</sup>

#### ***Persistent Toxic Chemicals Released During the Use of PVC Products***

Exposure to lead, cadmium, and phthalates has been documented in individuals who have used PVC products containing these additives.

**Lead and cadmium exposure.** The most notable case of lead exposure from vinyl products occurred in the mid-1990s, when it was discovered that childhood lead poisoning could result from exposure to vinyl miniblinds. As the vinyl degraded in the sun, the lead it contained accumulated as dust on the blinds and surrounding surfaces. In 1996, in response to this finding, the trade association representing the importers of such products entered into a voluntary agreement with the US Consumer Product Safety Commission (CPSC) to stop importing vinyl miniblinds containing lead.<sup>26</sup> It is not clear how well this agreement has been enforced and the CPSC did not issue a recall, so lead-containing blinds may still be in service in many homes. In one 1997 study, researchers found children's teeth marks on the blinds themselves.<sup>27</sup> Another case of exposure occurred in 1993, when an adult experiencing neurological symptoms from lead poisoning was discovered to have had a habit of chewing on the PVC coating he stripped off of wires during electrical work. The PVC coating contained up to 3.9 percent lead.<sup>28</sup>

Lead is used as a stabilizer in PVC water pipes in many countries, though not in drinking water pipes in the US.<sup>29</sup> Lead has been documented to leach from drinking water pipes, resulting in high concentrations of lead in the water that passes through.<sup>30</sup>

A Consumer Product Safety Commission study of lead and cadmium in vinyl products marketed to children found that both chemicals could be released during use; however, the CPSC concluded it was extremely unlikely that a child would be exposed to levels

sufficient to have any health effects. A similar study conducted by Greenpeace in 1997 subjected the same items to tests using CPSC protocols and determined that exposure to dangerous levels of lead and cadmium from these products was possible.<sup>31</sup>

**Phthalate exposure.** Much concern has focused recently on phthalates, particularly on medical products containing DEHP, such as tubing, IV blood and feeding bags, masks, and mattress covers.<sup>32</sup> As noted above in the section "DEHP in Medical Devices," the US Food and Drug Association (FDA) issued a Public Health Notification in 2002 encouraging hospitals to use alternatives to DEHP-containing PVC devices in ten different procedures and in particularly vulnerable patients regularly exposed to this phthalate.

Other phthalates are also of concern. In 1998, the CPSC studied the release of these chemicals from teething rings, rattles, and other children's products, and concluded that although children are exposed, few are exposed to amounts that would constitute a health risk. Nevertheless, the CPSC asked manufacturers to remove phthalates from rattles and teething rings.<sup>33</sup>

Finally, phthalates in household products such as flooring have been associated with pediatric respiratory ailments. One study found that a large number of PVC surfaces containing plasticizers in the home increased the risk of bronchial obstruction in children, and another study suggested that exposure to DEHP could play a role in the pathogenesis of asthma.<sup>34</sup>

## Figure 2.1 Life Cycle of PVC

### *Disposal of PVC Products*

Most PVC products are disposed of either through landfilling or incineration. Only a small percentage is recycled (3 percent in Europe and less than 0.6 percent in the US).<sup>35</sup> Because every PVC product contains different additives, only dedicated collection systems that collect a specific brand of a particular product can facilitate the recycling of PVC into products similar to the original. Most recycling programs collect a wide range of PVC items, and it is not cost-effective -- and sometimes not possible -- to determine what additives each item contains. The mixing of PVC products that contain different, unknown additives can cause problems in the recycling process; for example, the additives can form colored compounds not present in any of the original items. Instead, PVC is usually "downcycled" into products such as plastic composite park benches, which may contain lead, cadmium, or other additives present in the original products.<sup>36</sup>

**Lead waste.** Estimates of the contribution of PVC to the lead contained in municipal solid waste range from 1 percent to 28 percent. In 1998, 51,000 tons of lead were used as stabilizers in Europe, and one trade association has estimated that over 6 billion tons of lead were used as stabilizers worldwide in 1997.<sup>37</sup> In 2000, an estimated 10 kilotons of lead entered the waste stream from PVC. Although lead use in PVC products has been declining, the long life of many of these products suggests they will be a source of lead in the waste stream for years to come.<sup>38</sup>

- <sup>19</sup> Agency for Toxic Substances and Disease Registry, "Toxicological Profile for Cadmium," July 1999, <http://www.atsdr.cdc.gov/toxprofiles/tp5.html>.
- <sup>20</sup> Risk & Policy Analysts Limited, *The Risks to Health and Environment by Cadmium used as a Colouring Agent or a Stabiliser in Polymers and for Metal Plating*, European Commission, 2000, <http://europa.eu.int/comm/enterprise/chemicals/markrestr/studies/cadmium.pdf>.
- <sup>21</sup> Jozef Plachy, "Cadmium," in US Geological Survey, *USGS Minerals Yearbook 2001*, <http://minerals.usgs.gov/minerals/pubs/commodity/cadmium/cdmyb2001.pdf>.
- <sup>22</sup> US Consumer Product Safety Commission, "CPSC Staff Report on Lead and Cadmium in Children's Polyvinyl Chloride (PVC) Products"; Hunt *et al.*, "Lead and Other Metals in Play Kit and Craft Items Composed of Vinyl and Leather."
- <sup>23</sup> Patrick Koch and G. Nickolaus, "Allergic contact dermatitis and mercury exanthem due to mercury chloride in plastic boots," *Contact Dermatitis*, vol. 34, 1996, 405-09.
- <sup>24</sup> A. Whelan and J.L. Craft, *Developments in PVC Production and Processing-1* (London: Applied Science Publishers), 1977; Plachy, "Cadmium."
- <sup>25</sup> European Commission, "Environmental issues of PVC," Green Paper, Brussels, July 26, 2000, [http://www.europa.eu.int/comm/environment/waste/pvc/green\\_paper\\_pvc.htm](http://www.europa.eu.int/comm/environment/waste/pvc/green_paper_pvc.htm).
- <sup>26</sup> US Consumer Product Safety Commission, "CPSC Finds Lead Poisoning Hazard for Young Children in Imported Vinyl Miniblinds," press release, June 25, 1996, <http://www.cpsc.gov/CPSCPUB/PREREL/PRHTML96/96150.html>.
- <sup>27</sup> Edward H. Norman *et al.*, "Childhood Lead Poisoning and Vinyl Miniblind Exposure," *Archives of Pediatric and Adolescent Medicine*, vol. 51, October 1997, 1033-37.
- <sup>28</sup> Centers for Disease Control and Prevention, "Lead Intoxication Associated with Chewing Plastic Wire Coating -- Ohio," *Morbidity and Mortality Weekly Report*, vol. 42, June 25, 1993, <http://www.cdc.gov/mmwr/preview/mmwrhtml/00020984.htm>.
- <sup>29</sup> Personal communication, Shah Rahman, Unibel PVC Pipe Association, Dec. 17, 2002.
- <sup>30</sup> Muhammad H. Al-Malack, "Migration of lead from unplasticized polyvinyl chloride pipes," *Journal of Hazardous Materials*, B82, 2001, 263-74.
- <sup>31</sup> Joseph Di Gangi, *Lead and Cadmium in Children's Vinyl Products*, Greenpeace USA, 1996, <http://www.greenpeaceusa.org/media/publications/leadtoc.htm>.
- <sup>32</sup> Rossi, "Neonatal Exposure to DEHP (di-2-ethylhexyl phthalate) and Opportunities for Prevention."
- <sup>33</sup> US Consumer Product Safety Commission, "The Risk of Chronic Toxicity Associated with Exposure to Diisononyl Phthalate (DINP) in Children's Products," Dec. 1998, <http://www.cpsc.gov/phth/risk.pdf>; US Consumer Products Safety Commission, "CPSC Releases Study on Phthalates in Teethers, Rattles and Other Children's Products," press release, Dec. 2, 1998, <http://www.cpsc.gov/cpscpub/prerel/prhtml99/99031.html>.
- <sup>34</sup> J.J. Jaakkola *et al.*, "Interior surface materials in the home and the development of bronchial obstruction in young children in Oslo, Norway," *American Journal of Public Health*, vol. 89, issue 2, 188-92; Hersoug Oie *et al.*, "Residential Exposure to Plasticizers & Its Possible Role in the Pathogenesis of Asthma," *Environmental Health Perspectives*, vol. 105, Sept. 1997, 972-78; <http://ehp.niehs.nih.gov/docs/1997/105-9/oie.html>.
- <sup>35</sup> European figure from European Commission, "Environmental issues of PVC"; US figure calculated using data on PVC in solid waste from US Environmental Protection Agency, *Characterization of Municipal Solid Waste in the United States: 1998 Update*, July 1999, <http://www.epa.gov/epaoswer/non-hw/muncpl/pubs/98charac.pdf> and Principia Partners, "Post-Industrial and Post-Consumer Vinyl Reclaim: Material Flow and Uses in North America," final report to the Chlor-Vinyl Steering Group, July 1999, [http://www.principiaconsulting.com/pdf/reports\\_vinyl.pdf](http://www.principiaconsulting.com/pdf/reports_vinyl.pdf).
- <sup>36</sup> Danish Technological Institute, *Environmental Aspects of PVC*, Environmental Project No. 313, 1995; European Commission, "Environmental issues of PVC"; Tukker *et al.*, *Chemical Recycling of Plastics Waste (PVC and other resins)*; Plinke *et al.*, *Mechanical Recycling of PVC Wastes*.
- <sup>37</sup> European Commission, "Environmental issues of PVC"; Tukker *et al.*, *Risks to Health and the Environment Related to the Use of Lead in Products*.
- <sup>38</sup> *Ibid.* (Tukker).
- <sup>39</sup> European Commission, "Environmental issues of PVC"; Edwin A. Korzun and Howell H. Heck, "Sources and Fates of Lead and Cadmium in Municipal Solid Waste," *Journal of the Air & Waste Management Association*, vol. 40, Sept. 1990, 2110-26.

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<sup>40</sup> *Ibid.* (European Commission).

<sup>41</sup> Bernard Jacquinet *et al.*, "The Influence of PVC on the Quantity and Hazardousness of Flue Gas Residues From Incineration," April 2000,

<http://www.europa.eu.int/comm/environment/waste/studies/pvc/incineration.htm>.

<sup>42</sup> US Environmental Protection Agency, *Municipal Solid Waste in the United States: 2000 Facts and Figures*, 2002, <http://www.epa.gov/epaoswer/non-hw/muncpl/report-00/report-00.pdf>.

<sup>43</sup> Iraj do Nascimento Filho *et al.*, "Identification of some plasticizers compounds in land fill leachate," *Chemosphere*, vol. 50, 2003, 657-63.

<sup>44</sup> European Commission, "The Behaviour of PVC in Landfill," final report, Feb. 2000,

<http://www.europa.eu.int/comm/environment/waste/studies/pvc/landfill.htm>.

<sup>45</sup> Sanna K. Marttinen *et al.*, "Occurrence and removal of organic pollutants in sewages and landfill leachates," *The Science of the Total Environment*, vol. 301, 2003, 1-12.

<sup>46</sup> M.J. Bauer and R. Herrmann, "Estimation of the environmental contamination by phthalic acid esters leaching from household wastes," *The Science of the Total Environment*, vol. 208, 1997, 49-57.

<sup>47</sup> W. Christmann *et al.*, "Combustion of Polyvinyl chloride--An Important Source for the Formation of Polychlorinated Dioxins and Furans," *Chemosphere*, vol. 19, nos. 1-6, 1989, 387-392; F. Theisen *et al.*, "Determination of PCDFs and PCDDs in Fire Accidents and Laboratory Combustion Tests Involving PVC-Containing Materials," *Chemosphere*, vol. 19, nos. 1-6, 1989, 423-28; T. Takasuga, *et al.*, "Formation of dioxins (PCDDs/PCDFs) by dioxin-free fly ash as a catalyst and relation with several chlorine-sources," *Chemosphere*, vol. 40, 2000, 1003-07; T. Katami *et al.*, "Formation of PCDDs, PCDFs, and Coplanar PCBs from Polyvinyl Chloride during Combustion in an Incinerator," *Environmental Science and Technology*, vol. 36, 2002, 1320-24; M. Wirts, "Does Co-Combustion of PVC and Other Plastics Lead to Enhanced Formation of PCDD/F?" *Chemosphere*, vol. 37, no. 8, 1998, 1489-1500.

TL: GREENPEACE'S SECRET SAMPLING AT U.S. VINYL PLANTS: DIOXIN  
FACTORIES EXPOSED

SO: MELANIE DUCHIN, GREENPEACE INTERNATIONAL (GP)

DT: APRIL 1997

#### EXECUTIVE SUMMARY

Greenpeace conducted a two-and-one-half-year investigation into the vinyl industry's production of dioxins to obtain data that the U.S. Environmental Protection Agency (EPA) and the vinyl industry have failed to provide. Greenpeace took 27 samples of vinyl industry wastes from nine facilities and found dioxins or dioxin precursors in 100 percent of the samples tested, with some samples containing levels rivaling those found in wastes from the production of the infamous defoliant, Agent Orange.

This is the first sampling project of its kind in the United States, providing new and alarming information on the dioxins found in vinyl industry wastes. Greenpeace's data stands in stark contrast to the preliminary data provided by the vinyl industry. Industry's data pertain to dioxin contamination of wastewater and vinyl products, the two areas with the lowest and most difficult to detect concentrations of dioxins. There are no data on the dioxins in vinyl industry wastes that account for the vast majority of dioxin emissions when these wastes are burned. These data are important, since they add to the growing body of evidence pointing to the lifecycle of polyvinyl chloride (PVC) plastic as one of the largest single sources of the nation's total dioxin burden.

Dioxins are the most thoroughly studied toxic chemicals in history. In February of 1997, the most potent of dioxins was classified by the International Agency for Research on Cancer as a known human carcinogen. Cancer is just the tip of the iceberg with respect to human health effects linked to dioxins. Other health effects linked to dioxin exposure include diabetes, endometriosis, birth defects, reduced sperm count, decreased fertility, immune system suppression, developmental and reproductive effects and disruption of the hormone system. According to EPA's dioxin reassessment, the general population carries levels of dioxins in their bodies that are at or close to those levels associated with health effects.

The vinyl industry is a glaring example of environmental racism and injustice. Vinyl production is confined primarily to low-income and African American communities in Louisiana and Texas, resulting in a disproportionate amount of the vinyl industry's toxic burden being dumped on these communities. The environmental, human health and social impacts of the PVC industry have no place in a healthy and just society.



As part of an overall dioxin prevention strategy, Greenpeace calls on the EPA to impose a moratorium on permits for new vinyl facilities or expansion of existing facilities, and to modify permits at existing plants to require that dioxin releases to all media, including waste destined for disposal, be brought to zero within five years. This recommendation is part of an overall dioxin prevention strategy that ultimately leads to a phaseout on the production and use of PVC plastic. Any plan to phaseout PVC would prevent or compensate for economic or social dislocation that result from these measures to protect human health and the environment from PVC-related dioxin.

#### GREENPEACE COMPELLED TO ACT

For the past two-and-one-half-years, Greenpeace has been conducting an undercover investigation into the vinyl (a) industry's production of dioxins (b), a family of chemicals that includes the most toxic synthetic chemicals known to humankind. The results of this investigation are startling. Greenpeace found dioxins or dioxin precursors in 100 percent of the vinyl industry wastes tested, with some samples containing levels rivaling those found in wastes from the production of the infamous defoliant, Agent Orange. This is the first sampling project of its kind in the United States, providing new and alarming information on the high levels of dioxins found in vinyl industry wastes.

Greenpeace conducted this investigation to obtain data that the U.S. Environmental Protection Agency (EPA) and the vinyl industry have failed to provide. Greenpeace made several requests directly to vinyl industry companies including Dow Chemical and the EPA asking for data, permission to sample, and an investigation into the dioxins produced by the vinyl industry. After all of these requests were denied or unfulfilled, Greenpeace decided to undertake its own sampling project.

Greenpeace knew it would be impossible to accurately characterize the amount of dioxins produced by the vinyl industry if dioxin levels in particular wastes remained uninvestigated or were being held secret. Greenpeace wanted to know if certain vinyl industry wastes had high levels of dioxins in them because if this was the case -- which it turned out to be -- then sending these wastes to an incinerator would result in the release of dioxins into the environment. (For more information on the dioxins produced when vinyl industry wastes are incinerated, see the Greenpeace reports "The Burning Question: Chlorine and Dioxin" and "The PVC Lifecycle: From Cradle to Grave")

Greenpeace was compelled to take this action as a step towards combating the profound environmental, human health and social impacts of the vinyl industry. The results of this investigation add to a growing body of evidence pointing to the lifecycle of polyvinyl chloride (PVC) plastic as one of the largest single sources of the nation's total dioxin burden. (For more information on the dioxins associated with the lifecycle of vinyl, see the Greenpeace report "The PVC Lifecycle: Dioxin from Cradle to Grave".) The intent is that this evidence will convince the EPA that PVC production is a significant source of dioxins and other toxic chemicals. The hope is that the results of this investigation will assist citizens living near PVC producers in their efforts to halt the expansion of this harmful industry.

Greenpeace's investigation revealed an arsenal of toxic byproducts in vinyl industry wastes including PCBs (polychlorinated biphenyls), hexachlorobenzene and dioxins. Appendix 1 provides an illustrative list of toxic chemicals Greenpeace identified in one sample of vinyl industry waste.

Dioxins are the most thoroughly studied toxic chemicals in history. In February of 1997, the most potent of dioxins was classified by the International Agency for Research on Cancer as a known human carcinogen. Cancer is just the tip of the iceberg with respect to human health effects linked to dioxins. Other health effects linked to dioxin exposure include diabetes, endometriosis, birth defects, reduced sperm count, decreased fertility, immune system suppression, developmental and reproductive effects and disruption of the hormone system.

According to EPA's dioxin reassessment, the general population carries levels of dioxins in their bodies that are at or close to those levels associated with health effects. Studies are also beginning to show that many of dioxin's effects are "transgenerational," meaning they show up in the children of dioxin-exposed parents.<sup>1</sup>

Vinyl production is a case study in environmental racism and injustice. The U.S. is home to 15 plants that make vinyl chloride monomer (VCM) and ethylene dichloride (EDC), the basic building blocks used to make vinyl, and 14 of them are in Louisiana and Texas. (Appendix 2 lists the locations of these plants.) Vinyl production in these states is confined primarily to low-income and African American communities, resulting in a disproportionate amount of the vinyl industry's toxic burden being dumped on these communities. Likewise, a disproportionately high number of the incinerators in which discarded PVC products are burned are located in low-income

communities and communities of color.

The environmental racism perpetrated by the vinyl industry has resulted in entire communities being literally wiped off the map. In 1987, 106 residents of Reveilletown, Louisiana, a small African American community about ten miles south of Baton Rouge, filed a lawsuit against Georgia Pacific and Georgia Gulf arguing that they had suffered health problems and property damage. After settling out-of-court for an undisclosed amount, Georgia Gulf relocated the remaining families and then tore down every structure in town including the church. Management at Dow Chemical's neighboring factory in Plaquemine followed suit soon afterwards, buying out all of the residents of the small town of Morrisonville.<sup>2</sup>

Today, two communities in Louisiana are fighting the expansion of the vinyl industry. The Shintech corporation is proposing to construct the world's largest proposed vinyl plant in a predominantly African American neighborhood in St. James Parish. Likewise, the Westlake company is seeking to expand its vinyl production in a predominantly poor community in the town of Lake Charles. Both the Shintech and Westlake proposals are being met by fierce community opposition, yet the companies continue to railroad these communities into accepting a larger burden of the vinyl industry's dioxin and other toxic wastes.

Greenpeace offers the results of its vinyl industry investigation to the EPA as further evidence that the production of vinyl is a significant source of dioxins. As part of an overall dioxin prevention strategy, Greenpeace recommends the EPA impose a moratorium on permits for new vinyl facilities or expansion of existing facilities, and modify permits at existing plants to require that dioxin releases to all media, including waste destined for disposal, be brought to zero within five years.

This recommendation is part of an overall dioxin prevention strategy that ultimately leads to a sunset on the production and use of PVC plastic.

#### ADDITIONAL STEPS IN THE STRATEGY INCLUDE:

- \* A moratorium on permits for new incinerators and other waste combustion facilities, and modification of existing permits to require that dioxin emissions to all media be brought to zero within five years by eliminating the input of chlorinated wastes and products.
- \* A phase-out of medical and municipal solid waste incineration, having been identified as priority dioxin sources. Ample evidence points to PVC as the primary

source of chlorine for the dioxins that are generated by these incinerators.<sup>3</sup>

\* Rapid phaseouts of:

- \* All short-life PVC uses (packaging, toys, furniture, wall paper, medical devices such as intravenous bags, etc.);
- \* PVC products in areas susceptible to fire (cabling and other construction materials, appliances, and vehicles); and
- \* Metals with PVC residues that are recycled in combustion-based processes (i.e., automobiles).

Any plan to phaseout PVC would prevent or compensate for economic or social dislocation that result from these measures to protect human health and the environment from PVC-related dioxin. Greater detail on Greenpeace's dioxin prevention strategy for PVC can be found in the Greenpeace report "The PVC Lifecycle: Dioxin from Cradle to Grave".

#### THE GREENPEACE INVESTIGATION

Greenpeace undertook this sampling project in two phases, the first in the summer of 1994, the second in the summer of 1996. All told, Greenpeace took 27 waste samples from nine vinyl plants in Louisiana and Texas: 25 in the first phase and two and in the second phase. Greenpeace members obtained these samples by entering vinyl factories under the cover of darkness and in full protective gear, and by following accepted occupational safety and health guidelines and sampling procedures.

The specific compounds being produced by these vinyl facilities are vinyl chloride monomer (VCM) and ethylene dichloride (EDC), the basic building blocks used to manufacture vinyl. Manufacturing VCM and EDC results in the production of highly toxic and dioxin-laden wastes commonly referred to as "heavy ends," "distillation bottoms" or "tars."

The Greenpeace sampling team chose to focus on these wastes for two reasons. First, these wastes are not being addressed in the vinyl industry's voluntary "self-characterization" study of its dioxin emissions. The vinyl industry has submitted data to the EPA on dioxin contamination of wastewater and vinyl products -- the two areas with the lowest and most difficult to detect concentrations of dioxin -- but no data on dioxins in wastes. This overlooks some of the most dioxin-intensive aspects of vinyl production. (For more detail on the vinyl industry's voluntary "self-characterization" study, see "Myth 2" on page 7

of this report.)

Second, these wastes are not subject to the special regulations applied to dioxin-containing wastes and are usually burned in all manner of incinerators, boilers, furnaces and flares. This results in emissions of dioxins into the environment. (For more information on the dioxins associated with the incineration of vinyl industry wastes, see the Greenpeace reports "The Burning Question: Chlorine and Dioxin" and "The PVC Lifecycle: Dioxin from Cradle to Grave.")

#### THE 1994 INVESTIGATION

The first stage of the investigation took place in the summer of 1994. Greenpeace took 25 waste samples from nine VCM and EDC facilities in Louisiana and Texas. (Appendix 2 includes a complete list of facilities sampled.) The waste samples were screened and analyzed for organochlorine and heavy metal content by the Greenpeace International Laboratory at the University of Exeter in Exeter, England. (See Appendix 1 for an illustrative list of toxic chemicals identified in one of these samples). Certain organochlorines can act as "smoking guns" for dioxins, meaning if these chemicals are detected in a waste sample, then dioxins are likely present as well. Although the exact amount of dioxins could not be measured, Greenpeace International's lab detected the presence of these dioxin indicators in all 25 samples, signaling that dioxins were also likely present in all of the waste samples.

Greenpeace chose to have four waste samples analyzed directly for dioxins and two for PCBs due to the high cost of analysis (approximately \$2,000 per sample for dioxins and a comparable amount for PCBs). The analysis was performed by AEA Technology, an independent and accredited lab in Oxfordshire, England. (See Appendix 3 for concentrations of dioxins and PCBs in samples tested by AEA Technology). Greenpeace chose the first three waste samples because they were traceable to a part of the VCM or EDC process that is associated with the production of "heavy end" waste.

Finding high levels of dioxins in these three "heavy end" wastes that would most likely be burned in an incinerator contradicts the vinyl industry's assertion that it releases minute amounts of dioxins. The fourth sample tested for dioxins was a sediment sample taken downstream from a VCM plant, chosen since it could counter industry's claim that dioxins do not escape from VCM plants.

Concentrations of dioxins in the first three samples were extraordinarily high:

1. Vulcan Chemicals, Geismar, Louisiana: 200,750 parts per billion (ppb) dioxins in a sample of "heavy end" waste.
2. Formosa Plastics, Point Comfort, Texas: 761 ppb dioxins in a sample of "heavy end" waste.
3. Georgia Gulf, Plaquemine, Louisiana: 1,248 ppb dioxins in a waste sample from a tank labeled to contain "heavy ends," "tars" and other similar types of highly contaminated wastes.

As a point of comparison, dioxin concentrations found in these "heavy end" vinyl industry wastes rival levels of dioxins found in Agent Orange wastes (c).

The fourth sample tested for dioxins was a sediment sample taken slightly downstream from the discharge point of the Geon Corporation's VCM facility in LaPorte, Texas. Dioxins were measured at 2,911 parts per trillion (ppt), a concentration approximately four times higher than the average concentration reported for North American sediments in the EPA's 1994 draft dioxin reassessment.<sup>4</sup>

Significant amounts of dioxins were found in all four samples tested, and dioxin indicators were found in all 21 remaining samples. Greenpeace presented this information as part of its official comments on the EPA's draft dioxin reassessment. Although the EPA noted these very significant sampling results, the Agency has continued to this day to allow the vinyl industry to voluntarily measure its own dioxin production. The vinyl industry reacted to the data by questioning the methodology and safety of obtaining the samples.

#### THE 1996 INVESTIGATION

In the summer of 1996, Greenpeace went back to Louisiana for another round of sampling at two additional VCM facilities to confirm its previous findings. Greenpeace members were accompanied by a videographer to document the procedure.

Once again, analysis by an independent lab, AEA Technology, revealed significant dioxin contamination in both waste samples:

1. Borden Chemicals, Geismar, Louisiana: 36 ppb dioxins in a sample of "light end" waste.

Compared with dioxin concentrations Greenpeace found in "heavy end" wastes, 36 ppb sounds relatively low. However, given the toxicity of dioxin, this concentration is significant. In addition, the sample was taken from a type of waste commonly

referred to as "light ends" that is produced in vast quantities. Thousands of tons of dioxin contaminated "light ends" are produced each year, and most, if not all, are burned in incinerators.

2. PPG Industries in Lake Charles, Louisiana: 5,448 ppb dioxins in a sample taken from a barrel containing soils contaminated with "heavy end" waste.

The soil in this sample was contaminated with the same kind of "heavy end" waste sampled at Vulcan Chemicals in Geismar, Louisiana with a dioxin concentration of 200,750 ppb. The dioxin concentration in the sample taken from PPG Chemicals is lower because the "heavy end" waste had been mixed and diluted with soil. Again, this waste was destined for an incinerator.

Greenpeace once again submits these data to the EPA and calls on the Agency to begin its own independent investigation of the production and release of dioxins associated with the manufacture of PVC.

#### VINYL INDUSTRY MYTHS AND FACTS

The vinyl industry touts a number of misleading arguments about the toxic pollution it produces. Here are a few of the most common myths industry perpetuates about vinyl production and dioxins:

##### MYTH NUMBER 1:

Dioxins in the wastes sampled by Greenpeace are destroyed in on-site incinerators, thereby eliminating any exposure to the public or the environment.

##### FACT:

Incinerators do not eliminate dioxins, whether on or off the premises of a vinyl factory. Nor do they eliminate the PCBs, hexachlorobenzene and furans Greenpeace found in the sampled wastes.

On the contrary, EPA officials and private research scientists admit that hazardous waste incinerators emit hundreds of times more dioxins and other toxic air pollutants than is allowed by EPA regulations, which require 99.99% destruction and removal efficiency.<sup>5</sup>

Some portion of the original dioxins are emitted undestroyed, and new dioxins are actually created as by-products of the incineration process when chlorinated wastes such as those produced by the vinyl industry are incinerated. Studies also show a correlation between the amount of chlorine going into an

incinerator and the amount of dioxin that is produced. The presence of copper and other metals in vinyl industry wastes can act as a catalyst in further increasing dioxin formation.<sup>6</sup> For more information on the dioxins associated with the incineration of vinyl industry wastes, see the Greenpeace report "The Burning Question: Chlorine and Dioxin."

Overall dioxin emissions are estimated based on one-time stack tests called trial burns. This is tantamount to predicting how little a car will pollute over the course of its lifetime based on emission tests conducted on the factory assembly line. Trial burns are conducted under carefully controlled conditions, using a single chemical or simple mixture of chemicals. There are a number of reasons why this fails to give an accurate measure of what's coming out of the incinerator stack.

First, under normal operating conditions, a cocktail of constantly changing chemicals is burned, resulting in a variety of chemical-thermal reactions and emissions. Second, trial burns do not account for accidents, leaks, spills, explosions, power interruptions and other upset conditions. Third, trial burns fail to account for the majority of dioxins that are merely transferred to fly ash, bottom ash, scrubber water and other toxic leftovers from the incineration process. Finally, analytical methods may measure only a quarter of the dioxins actually emitted.<sup>7</sup>

The vinyl industry has not revealed the quantity of dioxins or any other hazardous chemicals emitted from its incinerators. In fact, there are no dioxin emission data from the vast majority of these incinerators since the companies are not required by the EPA to do regular stack emissions testing or waste analysis to determine how much of the dioxin in the waste is actually destroyed. These companies also regularly burn off wastes in flares, an operation requiring no pollution control, and not accounted for as part of the incinerator tally. The amount of dioxin emitted by these facilities is therefore currently unknown and likely unknowable for the foreseeable future.

#### MYTH NUMBER 2:

The vinyl industry monitors the amount of dioxins it produces and emits to the environment, and is voluntarily providing information to EPA for the Agency's dioxin reassessment. Preliminary results from analysis of wastewater discharges and resins show little to no dioxin is released to the environment or in PVC products themselves.

#### FACT:

EPA has made no attempt to collect or analyze samples of waste, wastewater, or air emissions from the nation's 15 VCM and EDC



facilities or the incinerators that burn wastes from these plants. Instead, the EPA is allowing the industry trade organization, the Vinyl Institute, to voluntarily sample and "self-characterize" the industry's dioxin emissions.

The industry will collect samples from its own plants, analyze their dioxin content, interpret the data, and submit it to EPA. Although there is a "peer review" committee to examine the methodology and results of the vinyl industry's self-characterization, the industry will ultimately choose where, when, and how samples will be taken and analyzed, and which data are suitable for submission. The industry has already submitted data to EPA on dioxin contamination of wastewater and products, the two areas with the lowest and most difficult to detect concentrations of dioxin. No data have been submitted on dioxins in wastes, tars, sludges, or incinerator emissions, ashes, or sludges, which are responsible for the vast majority of dioxin emissions. The vinyl industry does not intend to do so.

A complete and accurate account of the vinyl industry's dioxin production is only a first step towards total elimination of this toxic chemical. Due to dioxin's persistence in the environment and its extreme toxicity, even small amounts pose serious threats to human health and the environment. Low levels of dioxin in wastewater discharges can be magnified many thousands of times as they build up in the food chain. For example, fish swimming downstream from a chlorine-using paper mill have had levels of dioxins in their bodies that are thousands of times higher than the paper mill effluent they swim in. This type of "bioconcentration" continues up the food chain. Species at the top of the food chain -- notably humans -- receive the largest dose.

#### MYTH NUMBER 3:

The Greenpeace investigation does not prove that dioxins are released into the environment around vinyl chloride production facilities. Only one environmental sample analyzed for dioxins showed positive results.

#### FACT:

Numerous studies show dioxins can and do migrate off site from vinyl plants. Although Greenpeace did not undertake a comprehensive survey of dioxin levels around all 15 U.S. VCM and EDC facilities in its investigation, a sediment sample taken slightly downstream from a discharge outside the Geon facility in LaPorte, Texas contained 2,911 parts per trillion dioxins. This is close to four times greater than the average dioxin concentration reported for North American sediments in USEPA's draft dioxin reassessment.<sup>8</sup>

A number of studies conducted by regulatory officials and university researchers in the U.S. and Europe point to VCM plants as a major source of dioxins and other toxic chemicals in the environment:

- \* In 1989, researchers from the University of Amsterdam published a paper tracing high levels of dioxin in Rhine River sediment to a VCM plant upstream.<sup>9</sup>
- \* In a follow-up study in 1996, officials from the University of Amsterdam and the National Institute for Coastal and Marine Management in the Netherlands published studies on levels of dioxins and related chemicals in North Sea coastal sediments. Their findings revealed that vinyl chloride production continues to be a significant source of dioxins and furans in Rhine River and coastal estuary sediments.<sup>10</sup>
- \* In 1996, the National Oceanic and Atmospheric Administration's Contaminants Review Branch released a synthesis of seven studies which show high levels of PCBs, hexachlorobutadiene and hexachlorobenzene (all dioxin indicator chemicals) in the sediment and fish outside the PPG and Vista Chemicals VCM plants in Lake Charles, Louisiana.<sup>11</sup>
- \* Sediment samples taken by the British EPA from the Weston Canal by the ICI vinyl plant in Cheshire, England show significant dioxin contamination. Sediments near two outfalls contained 125 and 2,964 parts per trillion dioxins, and further analysis points to the ICI site as the source. The agency's report says that dioxin levels in sediment "rise significantly downstream of the site, but further downstream fall back to the 'polluted' levels typical of the area."<sup>12</sup>
- \* In 1993, Greenpeace estimated that some 5-10g TEQ 4 of dioxin are released per 100,000 tons of VCM manufactured.<sup>13</sup> The figure was dismissed as an exaggeration by the industry's trade body, the European Council of Vinyl Manufacturers, which produced its own figure of only 0.3g TEQ. In fact, ICI's data showed that the Runcorn process produces 13.5g TEQ for every 100,000 tons of VCM manufactured, a figure higher than Greenpeace's estimate.<sup>14</sup>
- \* Greenpeace investigations have found high levels of dioxins in sediments outside VCM plants in Tarragona, Spain as well as the historic Venice lagoon in Italy.<sup>15</sup>

## MYTH NUMBER 4:

Vinyl manufacturing results in barely detectable levels of dioxin. Far greater amounts are produced from other sources such as municipal waste incinerators and medical waste incinerators. The public interest would be better served if Greenpeace concentrated on the largest sources of dioxin.

## FACT:

By focusing its efforts on the vinyl industry, Greenpeace is concentrating on one of the largest source of dioxin. A full, accurate and independent accounting will reveal that the lifecycle of PVC plastic -- from production of the raw materials to disposal in incinerators or accidental fires -- is one of the largest sources of dioxin. As explained above in myth #2, industry has yet to provide data on the most dioxin intensive aspects of its production process.

Ample evidence points to PVC as the primary source of chlorine for the dioxins that are generated by municipal and medical waste incinerators.<sup>16</sup>

## MYTH NUMBER 5:

PVC production levels have nearly doubled since 1970, while environmental levels of dioxins are declining, providing objective evidence that PVC is not the major source of dioxins, as Greenpeace claims.

## FACT:

If the PVC industry is successful in its plans for expansion, any drop in dioxin levels will most likely be seen as temporary or as a fluctuation in an overall increase of dioxin levels. The current decline may be due in part to prohibitions on open burning of garbage, improved pollution control technologies and the phaseout of chlorinated chemicals in leaded gasoline. Unfortunately, decreases in chlorine consumption in one industrial sector and pollution control only act to reduce the amount of dioxins formed or move it from one environmental medium to another (i.e., from incinerator emissions into the air to ash in a landfill). They fail to eliminate dioxins and human exposure.

A lot of dioxin will be produced if and when the vast amount of PVC manufactured since 1970 winds up in an incinerator or is burned in accidental building fires. Because dioxin is formed when chlorinated products like PVC plastic are burned, logic dictates that dioxin levels will be on the rise in coming years if the massive amounts of PVC manufactured in the last few decades are burned.

PCBs in the environment are a harbinger of what is likely to happen with dioxin since both chemicals are persistent in the environment. PCB production was banned, resulting in declining levels for some time, after which they steadied at levels still considered dangerous. But the production of dioxin has not been eliminated, and in fact, chlorine use continues to rise, mainly to feed an ever expanding vinyl industry.

In terms of the current health threat posed by dioxin, the general population carries levels of dioxins in their bodies that are at or close to those levels associated with health effects.<sup>17</sup> The generation and release of any additional dioxin must be avoided.

□

#### APPENDIX 1

Greenpeace Analysis of Organic Compounds in Waste Feed Tank Adjacent to Hazardous Waste Incinerator at Georgia Gulf Vinyl Facility in Plaquemine, Louisiana.

This list of chlorinated and other toxic chemicals was found in one sample of vinyl industry waste. It is an illustrative example of the vast spectrum of toxic chemicals Greenpeace found in 27 samples of vinyl industry waste. Lists of organic compounds identified in each of the 27 waste samples analyzed are available upon request.

Laboratory sample reference: PU4016  
 Total number of compounds detected in sample: 188  
 Number of compounds listed below: 63  
 Number of compounds listed that are chlorinated: 41

\* Denotes chlorinated compound

Compounds identified with greater than 90% certainty:

tetrachloroethene\*  
 nonane  
 1,1,2,2-tetrachloroethane\*  
 pentachloroethane\*  
 decane  
 undecane  
 1,2,3-trichlorobenzene\*  
 dodecane  
 1,1,2,3,4,4-hexachloro-1,3-butadiene\*  
 tridecane  
 tetradecane  
 pentachlorobenzene\*  
 hexadecane  
 1,3,5-trichloro-2-nitrobenzene\*

hexachlorobenzene\*  
 octadecane  
 tetrachloropyrimidine\*  
 pentachloro(trichloroethenyl)-benzene\*

Compounds tentatively identified with 50% to 90% certainty:

1,1,1,2-tetrachloroethane\*  
 (e)-1,2-dichloroethene\*  
 carbonochloridic acid, 2-chloroethyl ester\*  
 1,4-dichlorobutane\*  
 1,1-dichloropropane\*  
 (1-bromocyclohexane)carboxaldehyde ethyl methyl acetal  
 1,4-dichloro-2-butene\*  
 3,3,3-trichloro-2-methyl-1-propene\*  
 nitrosobenzene  
 hexachloroethane\*  
 nitrobenzene  
 1,1,1,3,3-pentachloro-2-propanone\*  
 1,1'-oxibys(2-chloro)ethane\*  
 1,2,3,4-tetrchlorobutane\*  
 1,2,3-trichloro-1-propene\*  
 1,1-dichloroethane\*  
 1-bromo-2-chloroethane\*  
 1,1,1-trichloroethane\*  
 1-(4-bromophenyl)-ethanone  
 1-chloro-2-nitroethane\*  
 carbonic dichloride\*  
 sec-bromobutane-1,1,1,2,3,3-d6  
 4,5-dihidro-6-methyl-3 (2h)-pyridazinone  
 pentadecane  
 (e)-3-phenyl-2-propenoic acid  
 1,2,3,3-tetrachloro-1-propene\*  
 2,2-dichloropropanoyl chloride\*  
 n-(2,3,5,6-tetrachloro-4-hydroxyphenyl)acetamide\*  
 1,1,3,3,4,4-hexachloro-1-butene\*  
 o,o-bis(chloroethyl)-2-chloroethane phosphonate\*  
 1-[(2-chloroethyl)sulfonyl]-4-nitro-benzene\*  
 trichloroethene\*  
 3-bromo-5-chloro-2-pyridinol\*  
 2,4-dichloro-3,5,6-trifluoropyridine\*  
 1,2-dichloropropane\*  
 bis-1,2-(dichloromethyl)-3-chlorobenzene\*  
 cyclic 1,2:3,5-bis(ethylboronate)-4-(diethylborinate)-xylitol  
 1,2,3,4,7,7-hexachloro-bicyclo[2.2.1]hepta-2,5-diene\*  
 pentachlorophenol\*  
 2-(diethylamino)-benzo[c]cinnoline  
 4-pthalimidoazobenzene  
 1h-dicyclohept[e,g]isoindole-1,3(2h)-dione derivative

2. Company: PPG Industries, Lake Charles, Louisiana.  
 Description: Soil sample contaminated with "heavy end" wastes.  
 Laboratory sample reference: MI6049  
 Laboratory results: 5,448 ppb dioxins.

#### REFERENCES

a Throughout this report, the terms "vinyl" and "PVC" are used interchangeably.

b "Dioxins" is commonly used to represent the 75 different kinds of dioxins and 135 furans that resemble dioxins in terms of their chemical structure, behavior in the environment, and toxic effects.

c Wastes from the manufacture of Agent Orange, the defoliant used on the jungles of Vietnam, is known for its dioxin contamination and for the health effects suffered by soldiers and civilians exposed to it during the Vietnam War.

d TEQ, or Toxic Equivalency, is an internationally recognized calculation that is used to express the toxicity of dioxins and dioxin-like chemicals. In addition to 75 dioxins, there are 135 furans and 209 PCBs that resemble dioxins in terms of their chemical structure, behavior in the environment, and toxic effects. TEQ expresses the toxicity of these chemicals in relationship to a benchmark, 2,3,7,8-TCDD, the most toxic of all dioxins.

1 U.S. EPA, "Health Assessment Document for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds," Volume 1,2 and 3, EPA/600/BP-92/001A,B,C, June 1994.

2 Bowermaster, J., "A Town Called Morrisonville," Audubon, July/August 1993:42-51.

3 Milijoministeriet Milijostyrelsen (Danish EPA), "PVC and Alternative Materials," (English translation) Copenhagen 1993; Green, A., "Medical Waste and Pollution Prevention," Van Nostrand Reinhold 1993; Marrack, D., "Hospital Red Bag Waste: An Assessment and Management Recommendations," JAPCA 38:1309-1311.

4 U.S. EPA, "Estimating Exposure to Dioxin-Like Compounds, Volume II: Properties, Sources, Occurrence and Background Exposures," EPA/600/6-88/005Cb, June 1994:4-13.

5 John C. Kramlich and others, "Experimental Investigation of Critical Fundamental Issues in Hazardous Waste Incineration," EPA/600/2-89/048, September 1989, as reported in Rachel's

Hazardous Waste News, #279.

6 U.S. EPA, "Background Document for the Development of PIC Regulations From Hazardous Waste Incinerators, Draft Final Report," Washington, DC: U.S. EPA Office of Solid Waste, October 1989.

7 Costner, P., "Limitations of Historic and Current Methods for Measuring Polychlorinated Dioxins and Furans in Incinerator Emissions," Greenpeace U.S., May, 1993.

8 U.S. EPA, "Estimating Exposure to Dioxin-Like Compounds, Volume II: Properties, Sources, Occurrence and Background Exposures," EPA/600/6-88/005Cb, June 1994:4-13.

9 E.H.G. Evers, et al., "Catalytic Oxychlorination Processes of Aliphatic Hydrocarbons as New Industrial Sources of PCDDs and PCDFs," University of Amsterdam, the Netherlands, 1989.

10 E.H.G. Evers et al., "Levels, Temporal Trends and Risk of Dioxins and Related Compounds in the Dutch Aquatic Environment," Organohalogen Compounds, Vol. 28, 1996:117-122.

11 Mark S. Curry, et al., "Contamination Extent Report and Preliminary Injury Evaluation for the Calcasieu Estuary," prepared by Industrial Economics, Inc., Cambridge, MA for the Damage Assessment Center, National Oceanic and Atmospheric Administration, Silver Spring, MD, Contract 50-DGNC-1-00007, September 3, 1996, Public Review Draft.

12 U.K. Environment Agency, "Regulation of dioxin releases from the Runcorn operations of ICI and EVC," as reported in ENDS Report 264, January 1997: 24-26.

13 Jane Keys et al., "Dioxin Factories," Greenpeace International, 1993)

14 U.K. Environment Agency.

15 Stringer, Ruth. "Analysis of Sediment from a dry evaporation pond of Aiscondel, Tarragona," transmitted under cover letter to Oliva Nunez, Greenpeace Spain, March 1, 1996.

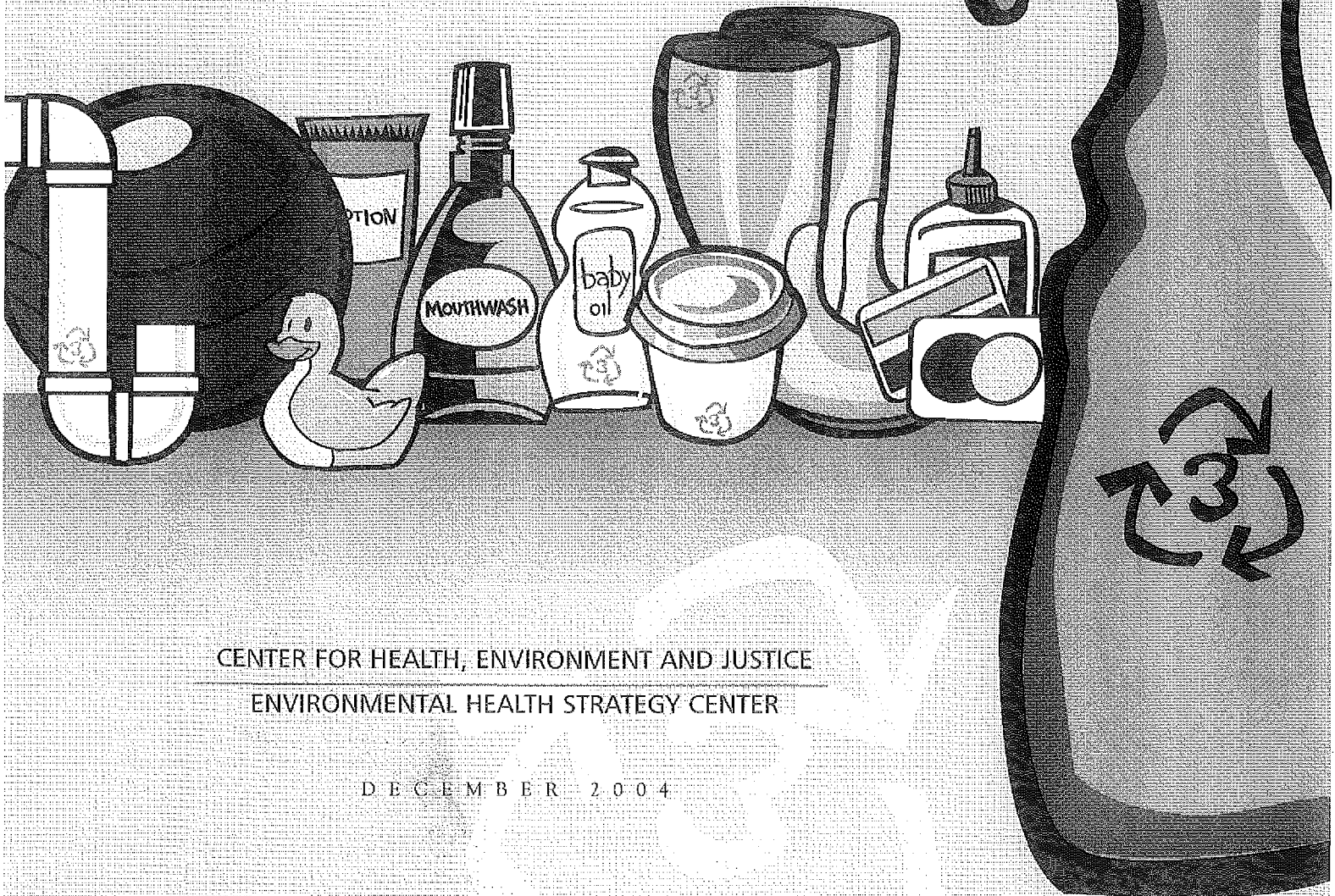
16 Milijoministeriet Milijostyrelsen (Danish EPA); Green, A., Marrack, D.

17 U.S. EPA, "Health Assessment Document for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds," Volume 1,2 and 3, EPA/600/BP-92/001A,B,C, June 1994.

# PVC

Bad News Comes in ♻️<sup>s</sup>

The Poison Plastic, Health Hazards  
and the Looming Waste Crisis



CENTER FOR HEALTH, ENVIRONMENT AND JUSTICE

ENVIRONMENTAL HEALTH STRATEGY CENTER

DECEMBER 2004



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# PVC

Bad News Comes in s

## The Poison Plastic, Health Hazards and the Looming Waste Crisis

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The Center for Health, Environment and Justice was founded in 1981 by Lois Gibbs, the community leader at Love Canal. CHEJ empowers local groups to be active, ongoing, democratic forces working to protect people and the environment from health-threatening contaminants. We provide one-on-one organizing and technical assistance, and coordinate nationwide issue-focused campaigns that strengthen and broaden the movement.

The Environmental Health Strategy Center is a public health organization that exists to protect human health from exposure to toxic chemicals. The Center promotes safe alternatives and clean industry and builds partnerships that focus on environmental solutions as a public health priority. The Center conducts strategic issue campaigns that help set the pace for national chemicals policy reform.

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\*Organizations listed for identification purposes.

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# Keeping the American Promise:

## Achieve Safer and Healthier Future

### By Eliminating PVC, The Poison Plastic

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Dear Friends,

This report provides the facts and a plan of action for one of the most important changes society can make to protect the public's health and the environment.

PVC is a poison plastic. It has earned the title after decades of harming our health and environment. PVC's destructive toxic life begins with manufacturing, continues during product use, and then creates devastating pollution problems when it is disposed. I cannot think of another product that is so destructive throughout its entire life cycle as PVC.

In Louisiana, families gather to talk about how growing health problems in their neighborhood are connected to the local plastic chemical plant's emissions. In Massachusetts, families meet to discuss the rising cancer rates in their valley and the nearby incinerators burning large amounts of PVC and releasing dioxin into the air.

I have traveled across the nation visiting neighborhoods that confront the hazards from manufacturing or disposing of PVC plastics every day. These American families find their homes are suddenly worthless and they are trapped in a nightmare of frustration—trying to prove the pollution from the plant or incinerator has caused the damage to their health. Many of these community stories are briefly described in this report.

Our country's fire fighters and first responders are worried about exposures to PVC's toxic fumes every time they encounter a fire. Consumers are concerned about vinyl plastic tablecloths or shower curtains that release toxic fumes, often referred to as "that new smell." Parents are worried about the leaching of toxic chemicals from PVC toys that their children used in the past.

The sad truth behind the destruction and harm caused by PVC, is that in most cases it is not needed. There are plenty of alternatives that are readily available on the market today. On store shelves, consumers can choose shampoo with a PVC bottle (marked with a #3 or V in the recycle symbol triangle) or a safer PVC-free plastic bottle. A growing number of responsible corporations have decided to stop using PVC. Irresponsible corporations, on the other hand, have refused to move to safer plastics.

An important part of this report is the well-documented fact that there is no "away" for PVC. There is no way to get rid of the product once manufactured. It is with us forever—a legacy left to the next generation. You can't burn it—it just changes to dioxin, another very toxic pollutant. You can't bury it—chemicals leak out into the surrounding soil and groundwater. You can't recycle it—it contaminates the recycling process.

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This report gives us hope by outlining how we as a society can phase out PVC in the future, with clear models to begin that phase out now. You'll learn in this document about the many safer, affordable alternatives to PVC that are available today.

We need to begin a nationwide conversation, community by community, on how to phase out PVC. As consumers we need to send a strong message to corporations who are resisting the effort to eliminate PVC and let them know we will not purchase their products. We need to encourage companies to use their entrepreneurial ingenuity to develop new products without PVC, the poison plastic. And, we need to enlist all levels of government to pass strong policies to phase-out PVC.

We must move quickly. Generating as much as seven billion pounds of PVC waste each year cannot continue. We can't bury it, burn it or recycle it. PVC wastes will live beyond the lifetime of everybody on this planet—a terrible legacy to leave for future generations.

A road map for how society can eliminate PVC is included in this report. If everyone takes a step down this road we can achieve a phase-out and begin to safeguard public health and the environment. I hope you will join us and help to leave our children a healthier, more sustainable world.

Lois Marie Gibbs  
Executive Director  
Center for Health, Environment and Justice

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# EXECUTIVE SUMMARY

**“Billions of pounds of PVC, the ‘poison plastic,’ are being thrown ‘away’ in the U.S.— but there is no away for the health threatening chemicals associated with PVC.”**

*The disposal of polyvinyl chloride (PVC) plastic threatens public health and the environment. Although problematic throughout its lifecycle – from production through final use – the discarding of PVC as waste poses perpetual hazards. PVC is widely used in plastic pipes, building materials (e.g., vinyl siding, windows), consumer products, disposable packaging and many everyday products. We can prevent harm from PVC by replacing it with safer, cost-effective alternatives that are available, and by diverting PVC waste away from incineration and open burning. This report summarizes data on PVC production, use and disposal in the United States, though its conclusions about the environmental health hazards of PVC are applicable to every country.*

## How much PVC do we use?

### Billions of Pounds of PVC are Discarded Each Year

Large and growing amounts of PVC are discarded daily in the U.S. As much as 7 billion pounds of PVC is discarded every year in municipal solid waste, medical waste, and construction and demolition debris. PVC disposal is the largest source of dioxin-forming chlorine and hazardous phthalates in solid waste, as well as a major source of lead, cadmium and organotins. Dioxins are a family of highly toxic chemicals that are known to cause cancer, reproductive, developmental and immune problems. More than 2 billion pounds per year of nondurable (short-lived) PVC products are discarded with U.S. household trash, including blister packs and other packaging, plastic bottles and containers, plastic wrap and bags, and more. In fact, nondurable products account for more than 70% of the PVC disposed of in U.S. municipal solid waste. Worldwide, an estimated 300 billion pounds of PVC, which was installed in the last 30 to 40 years in construction and other long lasting uses, will soon reach the end of its useful life and require disposal.

## What’s so bad about PVC plastic?

### PVC: A Truly “Poison” Plastic

Unlike the many plastics made without chlorine, PVC





other types of non-chlorine plastics make up more than 95% of all plastic bottles, introducing only one PVC bottle into the recycling process can contaminate 100,000 bottles, rendering the entire stock unusable for making new bottles or products of similar quality. PVC also increases the toxic impacts of other discarded products such as computers, automobiles and corrugated cardboard during the recycling process.

## Safer alternatives are available to replace PVC

Safer alternatives to PVC are widely available and effective for almost all major uses in building materials, medical products, packaging, office supplies, toys and consumer goods. PVC is the most environmentally harmful plastic. Many other plastic resins can substitute more safely for PVC when natural materials are not available.

PVC alternatives are affordable and already competitive in the market place. In many cases, the alternatives are only slightly more costly than PVC, and in some cases the costs of the alternative materials are comparable to PVC when measured over the useful life of the product. Phasing out PVC in favor of safer alternatives is economically achievable. A PVC phase-out will likely require the same total employment as PVC production. The current jobs associated with U.S. PVC production (an estimated 9,000 in VCM and PVC resin production, and 126,000 in PVC fabrication) would simply be translated into production of the same products from safer plastic resins.

## How can we get rid of PVC?

To end the myriad of problems created by PVC disposal, we recommend the following policies and activities.

- Policymakers at the local, state and federal level should enact and implement laws that steadily reduce the impacts of PVC disposal and lead to a complete phase-out of PVC use and waste incineration within ten years (see box below).
- A new materials policy for PVC that embraces aggressive source reduction of PVC should be adopted to steadily reduce the use of PVC over time.
- Federal and state waste management priorities should be changed to make incineration of PVC waste the least preferable option.

- In the interim, any PVC waste generated should be diverted away from incineration to hazardous waste landfills.
- Consumers should take personal action to buy PVC-free alternatives and to remove PVC from their trash for management as household hazardous waste.
- Communities should continue to organize against PVC-related dioxin sources such as waste incinerators while working to promote safer alternatives.

### A PVC-Free Policy Action Agenda

#### ▶ Accomplish Within Three Years ◀

1. Ban all open waste burning.
2. Educate the public about PVC hazards.
3. Ban the incineration of PVC waste.
4. Collect PVC products separately from other waste.
5. In the interim, divert PVC away from incineration to hazardous waste landfills.

#### ▶ Accomplish Within Five Years ◀

6. Establish our Right-to-Know about PVC.
7. Label all PVC products with warnings.
8. Give preference to PVC-free purchasing.
9. Ban PVC use in bottles and disposable packaging.
10. Ban sale of PVC with lead or cadmium.

#### ▶ Accomplish Within Seven Years ◀

11. Phase out other disposable PVC uses.
12. Phase out other high hazard PVC uses.
13. If safer alternatives are not yet available, extend the PVC phase-out deadlines for specific purposes.
14. Fund efforts to reduce the amount of PVC generated through fees on the PVC content of products.

#### ▶ Accomplish Within Ten Years ◀

15. Phase out remaining durable PVC uses.
16. Decommission municipal waste incinerators in favor of zero waste.

# INTRODUCTION

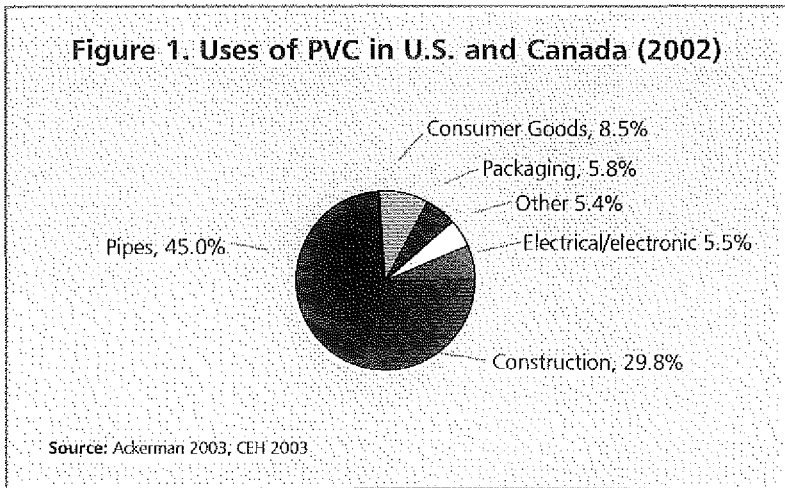
## PVC—The Poison Plastic

*Polyvinyl chloride, commonly referred to as "PVC" or "vinyl," is the second largest commodity plastic in production in the world today. An estimated 59 billion pounds were produced worldwide in 2002 (CEH 2003). Over 14 billion pounds are produced annually in the U.S. (VI 2004). PVC is used in a wide range of products including pipes and tubing, construction materials, packaging, electrical wiring and thousands of consumer goods (Ackerman 2003). The diverse and widespread use of PVC plastic in disposable and durable goods leads to the many immediate and long-term disposal challenges reviewed in this report.*

partial listing of common household products made of PVC can be found in Appendix A.

Plastic pipes and construction uses account for 75% of all PVC consumption in North America. Construction is also the fastest growing PVC sector, with a projected annual average growth rate of 3.5% between 2002 and 2007. Within the construction sector, the fastest growing PVC products are special applications, such as gutters, fencing and decking (growing at 8.1% per year), windows and doors (6.1%), vinyl siding (4.5%) and pipes and tubing (2.5%). PVC use in electrical equipment and electronics is increasing at 2.5% per year. Disposable PVC packaging and transportation-related

Figure 1 provides a general breakdown of the many uses of PVC. Because of its low cost and aggressive marketing, PVC is found in hundreds of consumer products that are used everyday, including children's toys, credit cards, clothing, carpeting, furniture, flooring, automotive seats, garden hoses, cellular phones, computer parts, office supplies, siding on our homes, roofing and other building materials. A



PVC uses will grow by 2.0% every year over the same five-year period (CEH 2003).

This report reviews the many hazards associated with the disposal of PVC in the United States. Although the report relies primarily on U.S. data on PVC production, use and disposal, the information on the environmental health impacts of PVC are applicable to every country. This report is not intended to be a comprehensive review of all the health and environmental risks posed during the lifecycle of PVC throughout its production, use, and disposal. The key impacts of PVC production and use are summarized in order to provide context for assessing the impacts of the disposal of PVC waste.

Throughout the text we have included a number of case studies that illustrate the impact that PVC has on people. In addition, there are a number of sidebars that highlight actions that some organizations have taken to address the public health or environmental impacts of PVC. The following is a brief summary of the report's findings listed by chapter.

### **Chapter 2, The PVC Generation: Large and Growing Amounts of PVC Waste,**

provides an overview of the amount of PVC waste generated in the U.S. each year and estimates how much ends up in different waste streams. This chapter also addresses how PVC increases the toxicity of these waste streams.

### **Chapter 3, Trouble From The Start: The Production and Use of PVC,**

reviews the production and processing of PVC, which involves chlorine and an array of additives that have serious consequences for public health and the environment during PVC use and disposal. The toxic hazards of PVC additives, including phthalates, heavy metals and flame retardants, are described in this chapter.

### **Chapter 4, The Deadly Connection: PVC, Chlorine and Dioxin,**

reviews the relationship between PVC, chlorine and dioxin, which is especially troubling. Dioxin, one of the most toxic chemicals ever tested, is generated when any form of burning is used as a disposal option for PVC.

### **Chapter 5, Don't Burn It: The Hazards of Burning PVC Waste,**

provides a detailed description of the specific hazards of PVC incineration. Open burning of PVC waste in backyard burn barrels or waste piles is especially troubling because of the large amount of dioxins generated.

### **Chapter 6, No Place Left: Problems with PVC in Landfills,**

reviews the specific toxic hazards associated with the land disposal of PVC. Many PVC additives, including phthalates, heavy metals such as lead and cadmium and organotins, slowly leach out of PVC over time when placed in a landfill, eventually contaminating groundwater and surface water. PVC also worsens the impacts of landfill fires and landfill gases that are generated as materials in the landfill decay.

### **Chapter 7, Recycling Menace: PVC Undermines Recycling Efforts,**

reviews efforts to recycle PVC and details its impacts on plastic recycling programs due to its incompatibility with other commonly recyclable plastics. PVC is extremely hard to recycle because of the numerous additives that are used to make a wide range of PVC products. The toxic by-products of PVC also significantly undermine the recycling of other products.

### **Chapter 8, Don't Buy It: Safer Alternatives to PVC are Available, Effective and Affordable,**

looks at the widespread availability of safer alternatives to PVC and provides a summary of an economic analysis conducted by the Global Development and Environment Institute at Tufts University in Medford, MA. This analysis found that cost-competitive alternatives do exist for most uses of PVC. This chapter includes information on resources that can be used to identify alternatives to PVC.

### **Chapter 9, Take Action: Preventing Harm from PVC Use and Disposal,**

describes actions that can be taken by individuals, local grassroots community-based organizations, statewide organizations, and as part of national efforts to prevent harm from the use and disposal of PVC.

In researching this report, we identified a number of important references that we used, and in some cases relied on heavily in writing this report. We appreciate the pioneering work on PVC's hazards and alternatives achieved by the researchers, analysts and authors responsible for these publications. We are especially in debt to these colleagues. We encourage you to consult these resources for more detailed documentation and useful information on the hazards and alternatives to PVC. These and other references are listed at the end of this document.

- Ackerman (2003) F. and R. Massey. "The Economics of Phasing Out PVC," Global Development and Environment Institute, Tufts University, Medford, MA, December. Available at [http://www.ase.tufts.edu/gdae/Pubs/tp/Economics\\_of\\_PVC.pdf](http://www.ase.tufts.edu/gdae/Pubs/tp/Economics_of_PVC.pdf).
- Anderson (2004) P. *Message in a Bottle: The Impacts of PVC on Plastics Recycling*. A Report to the GrassRoots Recycling Network from Recycle Worlds Consulting, June. Available at <http://www.grn.org/assets/pdfs/pvc/PVCBottleRecyclingReport06162004.pdf>.
- Chem-Info Services (1997) "A Technical and Socio-Economic Comparison of Options to Products Derived from the Chlor-alkali Industry," Environment Canada, Burlington, Ontario.
- Commission of the European Communities (CEC 2000) Green Paper: Environmental Issues of PVC. COM (2000) 469 final, Brussels, July 26. Available at [http://www.europa.eu.int/comm/environment/waste/pvc/en.pdf/green\\_paper\\_pvc.htm](http://www.europa.eu.int/comm/environment/waste/pvc/en.pdf/green_paper_pvc.htm).
- Costner (2001) P. "Chlorine, Combustion and Dioxins: Does Reducing Chlorine in Wastes Decrease Dioxin Formation in Waste Incinerators?" Greenpeace International, September 10.
- Greenpeace (2004) "PVC Alternatives Database Building the Future." Greenpeace. Available at <http://archive.greenpeace.org/toxics/pvcdatabase>.
- Greenpeace (2001) "PVC-Free Future: A Review of Restrictions and PVC Free Policies Worldwide." Greenpeace International, Inc. The Netherlands, August. Available at <http://archive.greenpeace.org/toxics/reports/restrictions.pdf>.
- Healthy Building Network (HBN 2004) "PVC Alternatives." A fact sheet available at <http://www.healthybuilding.net/pvc/alternatives.html>.
- Hickling Corporation (HC 1994) "Economic Instruments for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes Basin." Report to the International Joint Commission, Windsor, Ontario.
- Steingraber (2004) S. "Update on the Environmental Health Impacts of Polyvinyl Chloride (PVC) as a Building Material: Evidence from 2000-2004." A commentary for the U.S. Green Building Council, on behalf of Healthy Building Network, April 2. Available at <http://www.healthybuilding.net/pvc/steingraber.pdf>.
- Sustainable Hospital Project (SHP 2000) "Here are four ways to find alternative products." Lowell Center for Sustainable Production, Lowell, MA. Available at [http://www.sustainablehospitals.org/cgi-bin/DB\\_Index.cgi](http://www.sustainablehospitals.org/cgi-bin/DB_Index.cgi).
- Thornton (2002) J. "Environmental Impacts of Polyvinyl Chloride Building Materials – A Healthy Building Network Report." Healthy Building Network, Washington, DC, 2002. Available at [http://www.healthybuilding.net/pvc/Thornton\\_Enviro\\_Impacts\\_of\\_PVC.pdf](http://www.healthybuilding.net/pvc/Thornton_Enviro_Impacts_of_PVC.pdf).
- Thornton (2000) J. *Pandora's Poison: Chlorine, Health, and a New Environmental Strategy*. Cambridge, Massachusetts: MIT Press.



# THE PVC GENERATION

## Large and Growing Amounts of PVC Waste

### MAJOR FINDINGS

- As much as 7 billion pounds of PVC are discarded every year in the U.S. in municipal solid waste, medical waste and construction and demolition debris.
- PVC disposal is the largest source of dioxin-forming chlorine and phthalates in solid waste, as well as a major source of lead, cadmium and organotins.
- More than 2 billion pounds per year of non-durable (short-lived) PVC products are discarded in U.S. household trash, including blister packs and other packaging, plastic bottles and containers and plastic wrap and bags.
- Non-durable (short-lived) products account for more than 70% of PVC disposed in municipal solid waste in the U.S.
- Worldwide, an estimated 300 billion pounds of longer-lasting PVC products, such as construction materials that last 30 to 40 years, will soon reach the end of their useful life and require replacement and disposal.

Every day, PVC plastic becomes the problem waste that nobody wants to talk about. Why? Because it enters the waste stream in large amounts as the least recyclable and most environmentally harmful plastic. If there were an honest national dialogue about PVC and dioxin pollution prevention, support for waste incineration would crumble and the government would phase out PVC production and use. Landfills can't contain the toxic components of PVC. PVC contaminates the recycling of so many products that could otherwise be safely reprocessed into useful materials. PVC waste adds daily to a looming waste crisis as more and more long-lasting products made of PVC, such as building materials, are removed from use. And perhaps most of all, because powerful elements of the chemical industry are wedded to promoting PVC use and the chlorine industry involved in its production.

We should care about PVC disposal because that's when the toxic components and by-products of this seemingly benign and ubiquitous plastic are discarded and dispersed throughout the environment. Not everyone lives next to the chemical plant that emits the dangerous raw materials of PVC production. Not everyone experiences the vinyl building fire, the dioxin-spewing burn barrel, or the medical procedure that leaches dangerous chemicals from the intravenous (IV) tubing made of PVC.

Yet all of us generate PVC waste even if we try to avoid doing so. By learning about the harm posed by PVC disposal, we can spur political, business, and consumer

action to break the cycle of dependence on this incredibly toxic and problematic material. If we don't burn it, we can reduce the worst impacts of PVC. And if we don't buy it, we can avoid all of the problems associated with PVC production, use, and disposal.

aging, or a few decades later when PVC building materials must be replaced. Given the widespread use of PVC and its highly variable lifespan across many types of products, it is no wonder that huge amounts of PVC waste are generated on a daily basis in every community.

## The Quantity of PVC in the Waste Stream

The useful life of a PVC product may come to an end minutes after a purchase in the case of disposable pack-

Table 1 summarizes available information on the PVC content of solid waste in the U.S. The five major waste streams shown in Table 1 account for almost all post-industrial PVC waste: (1) municipal solid waste (MSW); (2) medical waste; (3) construction and demolition (C&D) debris; (4) discarded products collected for recycling; and (5) industrial solid waste generated during manufacturing.

••••• Table 1 •••••  
Annual PVC Waste Production in the U.S.

Waste Stream Total Quantity Generated	Description of PVC Portion of Waste Stream	PVC Content of Waste Stream	
		Percent	Amount (tons)
Municipal Solid Waste (MSW) 229 million <sup>1</sup> - 369 million <sup>2</sup> tons	Packaging and other disposable vinyl products	0.62% <sup>1</sup>	1,420,000 <sup>1</sup> to 2,290,000 <sup>2*</sup>
Medical Waste (Biomedical/Infectious) 3.4 million tons <sup>3</sup>	Mostly medical tubing and bags with some vinyl gloves and supplies	5% to 15% <sup>4</sup>	170,000 to 510,000
Construction & Demolition (C&D) Debris 136 million tons <sup>5</sup>	Vinyl pipes only <sup>5</sup> and vinyl pipes and siding <sup>6</sup> (Does not account for other types of PVC C&D debris)	0.18% <sup>5</sup> to 0.63% <sup>6</sup>	245,000 to 856,000
Discarded Products Collected for Recycling Unknown amount	PVC-contaminated plastics from bottles, electronics, automobiles, scrap wood, cardboard, etc.	Varies	Unknown
Manufacturing Waste Unknown amount	Complete range of PVC products including manufactured homes and plastics fabrication	Varies	Unknown

TOTAL Amount of PVC Discarded Annually in MSW, Medical Waste and C&D Debris

1.8 to 3.6 million tons  
(3.7 to 7.2 billion pounds)  
Average = 2.75 million tons  
(Average = 5.5 billion pounds)

**Sources and Notes:** 1 - USEPA 2003; 2 - Kaufman 2004; 3 - USEPA 1994; 4 - Marrack 1988, Hasselriis 1993, DTI 1995, USOTA 1988; 5 - Cascadia 2003; and 6 - FA 1998. \*These two estimates of total PVC content in MSW are derived using USEPA (2003) and Kaufman (2004) data to generate the low and high estimates, respectively. **Note:** There are many inherent uncertainties in any estimate of the amount of MSW generated. This is reflected in the 140 million ton difference between the USEPA estimate of 229 million tons and the Kaufman estimate of 369 million tons of MSW generated. Part of the reason for this difference is due to the methods used to derive the estimates. The USEPA relied on economic and population data to estimate MSW generated on a per capita basis. Kaufman used a survey sent to state management agencies to collect data on solid waste. The EPA estimate only included household garbage, while Kaufman collected data on a number of solid waste categories and then calculated the MSW portion, which included residential and commercial waste, organics, tires, and "other." In both cases, the MSW estimates included primarily household garbage. A third estimate, not used in this report, was made by the Environmental Research and Education Foundation (EREF 2001) which estimated that 545 million tons of MSW were generated in the U.S. in 1999. This estimate was generated from a survey distributed to both public and private waste disposal companies and included all non-hazardous waste sent off-site for final disposal including household waste, commercial and institutional waste, special waste, C&D waste, regulated medical waste, yard waste, sludge and scrap tires. This estimate clearly includes a much broader universal of waste targeted for recycling or disposal.

## Waste versus Discards

This report often refers to PVC in the waste stream. In fact, what we often call 'waste' is actually discarded products that we end up wasting. When products reach the end of their useful life, they should be collected to be taken apart and recycled back into their original materials. This is the concept of 'Zero Waste', which maximizes recycling, minimizes waste, reduces consumption and ensures that products are made to be reused, repaired or recycled back into nature or the marketplace (GRRN 2004). Unfortunately, PVC is very difficult to recycle and when present in discarded products tends to contaminate the recycling process. Therefore, almost all PVC products are wasted sooner or later.

Table 1 shows that three of the five major waste streams—municipal solid waste, biomedical/infectious medical waste and construction and demolition debris—account for on average about 5.5 billion pounds of PVC discarded every year in the U.S. An estimated 7.2 billion pounds are generated annually in the European Union (EU) (AEA 2000). In the U.S., 63% to 77% of the total amount of PVC waste known to be discarded each year ends up in the municipal solid waste stream. Medical waste has the highest PVC content due to the high reliance of hospitals on vinyl medical bags and tubing. PVC also makes up as much as 18% of non-infectious hospital waste (Hasselriis 1993), which is typically disposed of as municipal solid waste. The PVC content of C&D waste is similar to that of MSW but is expected to grow significantly—mirroring the growth in PVC building materials used in the last thirty years as they are replaced because of aging (CEC 2000). Each of these five major waste streams are described in the subsections that follow.

Although PVC generally contributes only a modest amount to the total volume of a waste stream, as shown in Table 1, there are exceptions such as hospital waste (Marrack 1988, Hasselriis 1993, DTI 1995, USOTA 1988) and consumer electronics waste (MCTC 1996) that have particularly high PVC content. Furthermore, the amount of PVC waste generated which requires disposal appears to be growing due to the expiration of products placed in use 20 to 30 years ago when PVC materials were introduced (CEC 2000). This adds to concerns about the toxic impacts of PVC disposal due to dioxin formation when burned (see Chapter 5) and the leaching of lead, cadmium, tin, and other toxic additives from the plastic when landfilled (see Chapter 6).

## PVC in Municipal Solid Waste

In the U.S., about 79% of PVC in the municipal solid waste (MSW), or about 2.2 billion pounds of PVC, ends up in landfills every year (USEPA 2003). About 21% or about 600 million pounds of PVC in MSW is incinerated every year, leading to the formation of dioxins in air emissions and ash. EPA estimated that a "negligible" amount of PVC is collected for municipal solid waste recycling. MSW includes solid

waste generated by households as well as commercial

and institutional sources. These figures are based on 2001 data (USEPA 2003).

Non-durable goods (materials with a relatively short useful life) make up 71% of the PVC found in municipal solid waste as shown in Table 2. Over one million tons (2 billion pounds) of these materials were discarded in the U.S. in 2001 (USEPA 2003). The largest portion of these materials was PVC Blister packs (hard plastic packaging often used for toys or computer supplies) and other vinyl packaging that accounted for more than 250,000 tons (500 million pounds). About 500,000 tons (one billion pounds) of these short-lived PVC products are tossed in household trash every year from disposable plastic blister packs, other packaging, film wrap, bags, bottles and other containers. Even more PVC is discarded annually as other non-durable goods, such as shower curtains, beach balls, credit cards and checkbook covers.

The third major category of PVC waste in household trash is durable goods, accounting for 411,000 tons (822 million pounds) per year. "Durable" trash containing PVC could include building materials such as piping, siding, windows and flooring, and consumer electronics and appliances.

## PVC in Medical Waste

Until recently, the majority of medical waste was incinerated and much of that was burned on-site at hospitals. By 1990, about 60% to 70% of all medical waste was incinerated (USEPA 1994, USOTA 1990). This included biomedical waste produced by hospitals, labs,



Table 2

**PVC Products Disposed in U.S. Municipal Solid Waste (MSW) in 2001**

Type of PVC Product		Amount of PVC (tons)	(%)
Non-durable Goods (Short useful life)	Blister packs and other packaging	255,000	18%
	Plastic bottles and containers	147,000	10%
	Plastic wrap and bags	68,000	5%
	Other nondurable goods	539,000	38%
	<b>SUBTOTAL - Nondurables</b>	<b>1,009,000</b>	<b>71%</b>
Durable Goods	<b>SUBTOTAL - Durables</b>	<b>411,000</b>	<b>29%</b>
<b>TOTAL Amount of PVC in MSW (tons)</b>		<b>1,420,000</b>	<b>100%</b>

Source: USEPA 2003

clinics, physician offices and other sources. Since then, the amount of medical waste burned and the number of operating incinerators have dramatically declined due to overwhelming evidence of enormous dioxin emissions, leading to government regulation and powerful community opposition.

As the health care industry continues its transition to non-incineration methods for disinfecting medical waste, the problems caused by vinyl medical products in the waste stream may not be solved. For example, until recently almost all of the medical waste generated in the state of Maine was sent to an out-of-state commercial incinerator. After local community opposition, this regional incinerator was closed and Maine's medical waste was shipped to a microwave disinfection treatment facility. However, the disinfected residue after treatment is now sent to a municipal solid waste incinerator in Massachusetts. The Maine Hospital Association (MHA) is in the process of siting an autoclave facility in the state to disinfect medical waste (see Chapter 5). Due to concerns raised about dioxin emissions, the MHA has pledged to dispose of disinfected PVC-rich residue in a landfill rather than a municipal waste incinerator (Belliveau 2002, Huang 2004).

In states like Maine that are highly dependent on incineration to handle municipal waste, the closure of medical waste facilities may not prevent PVC medical waste from being burned elsewhere, releasing toxic additives

and by-products to the environment. Efforts to phase out PVC by the health care industry will prevent such a dilemma.

## PVC in Construction and Demolition Debris

More PVC ends up in construction and demolition (C&D) waste each year than in medical waste (See Table 1). About 850,000 tons (1.7 billion pounds) of PVC is disposed of every year in nearly 2,000 C&D landfills across the U.S. (Kaufman 2004). Very little C&D waste is incinerated, except for a portion that enters municipal solid waste

when generated by households or small businesses. However, many if not most C&D landfills are unlined or poorly lined compared to municipal solid waste landfills. Thus, there are even fewer barriers to keep chemicals from leaking out than those provided by MSW landfills. This is a serious problem that will likely result in more contaminants from PVC entering the environment.

The amount of PVC in C&D waste may be seriously underestimated. The available waste characterization data included in Table 1 only accounts for PVC pipes (Cascadia 2003) or pipes and vinyl siding (FA 1998). There are many other applications of PVC in building materials and furnishings that may become C&D waste, including vinyl window frames, flooring, roofing foils and carpet backing (Thornton 2002).

Also, the growth in the installation of durable PVC building products over the last twenty to thirty years has built up a stockpile of PVC still in use. As these materials reach the end of their useful life, the amount of PVC in the construction and demolition debris will inevitably and rapidly increase in content and amount. An estimated 300 million pounds of PVC materials will require disposal worldwide in the coming years (van der Naald 1998).

## PVC as a Contaminant in the Recycling of Other Products

Another poorly quantified PVC waste stream is the discarded products and materials that are collected for recycling. PVC is very difficult to recycle because of the many different formulations used to make PVC products. Its composition varies widely due to the many additives used to make PVC products. When these different formulations are mixed together, they cannot readily be separated which is necessary to recycle the PVC into its original formulation. It is also virtually impossible to create a formulation that can be used for any application. At best, only about 3% of PVC products and materials are recycled in the U.S.

Two additional problems are created by the presence of PVC in the waste stream targeted for recycling. The first is the difficulty in separating PVC from other plastics, such as PET bottles or nylon carpet facing. This makes it extremely difficult, if not impossible, to recycle these otherwise recyclable materials. Second, the presence of PVC impedes the successful recycling of other valuable commodities such as copper from wiring and cable used in electronics such as computers, steel from scrapped automobiles and corrugated cardboard containers sealed with PVC tape. PVC increases the toxic impacts of recycling these materials. Each of these problems is discussed in more detail in Chapter 7.

## PVC as a Manufacturing Waste

In addition to the health care industry, other industrial, commercial and institutional facilities generate PVC waste. Two manufacturing industries are known users of large volumes of PVC—plastics fabricators where PVC consumer products are manufactured from PVC resin (see Chapter 3) and makers of pre-manufactured homes. Fabricators blend PVC resin with additives to form a variety of rigid and flexible PVC products. Manufacturers of modular and pre-made homes use a large proportion of PVC building materials and furnishings. Some amount of pre-consumer PVC waste should be recycled by these industries. Recycling rates for PVC waste from these types of industries are not readily available.

## PVC Increases the Toxicity of Solid Waste

PVC contributes a disproportionate share of toxic con-

taminants to solid waste relative to its modest weight and volume in the waste stream. The different components of PVC add significantly to the hazardous constituents of solid waste as shown in Table 3. The Table shows that PVC contributes from 38 to 67% of the total chlorine found in solid waste, from 90 to 98% of phthalates, from 1 to 28% of the lead and about 10% of the cadmium. Phthalates, lead and cadmium are all added to the PVC resin to achieve different product features. The toxicity of these and other additives is discussed in Chapter 3.

Chlorine is the primary component of PVC making up 57% by weight of the raw material used to make the pure PVC resin (VI 2004). There have been several efforts to estimate the contribution of PVC to total chlorine found in municipal solid waste (MSW). In MSW, at least 80% of the organically bound chlorine, which is thought to be more conducive to dioxin formation than inorganic chlorine, is from PVC (Thornton 2000). In medical waste, PVC's contribution of chlorine is even higher, accounting for more than 90% of organic chlorine and more than 80% of total chlorine (Thornton 2000, Green 1993). Based on these estimates, PVC could reasonably account for as much as 50% of all chlorine found in MSW.

About 90% of all phthalates consumed in the U.S. are used in PVC products (Thornton 2000). In England, an estimated 98% of phthalates are used in PVC products (OECD 2004). Thus, the disposal of PVC in landfills can be expected to account for a substantial portion of the phthalates found in landfills. Phthalates are a group of chemicals used as plasticizers to make the otherwise brittle PVC resin soft and flexible. The proportion of phthalates leaching from PVC in medical waste could be even higher given the prevalence of pliable vinyl medical products, such as tubing and bags, that are disposed of as infectious medical waste (see Chapter 5).

PVC disposal contributes several toxic metals to the solid waste stream, including compounds of lead, cadmium and tin. These metals are added to PVC as stabilizers to help inhibit the plastic's tendency to degrade in the presence of sunlight or heat. Lead is still commonly used in the plastic vinyl sheathing of wires and cables. Older vinyl mini-blinds also contain lead. Estimates of the amount of lead in solid waste attributable to PVC ranges widely from a low of 1% to a high of 28% (CEC 2000). One study found that 10% of the lead stabilizer from one type of flexible PVC cable containing a mixture of additives was released from the PVC (Mersowski 1999). Lead in rigid PVC is expected to

● ● ● ● ● Table 3 ● ● ● ● ●  
**PVC Increases the Toxicity of Municipal Solid Waste (MSW)**

Toxic Substance Present in PVC	Use in PVC	PVC's Contribution of Toxic Chemicals in MSW
Chlorine	Part of polymer; pure PVC is 57% chlorine	38% - 67% of total chlorine <sup>1,2</sup> and at least 80% of organic chlorine <sup>2</sup>
Phthalates	Added as plasticizer to make PVC soft and flexible	From 90 to 98% <sup>3</sup>
Lead	Added as a heat stabilizer to slow degradation	1% - 28% <sup>1</sup>
Cadmium	Added as a heat stabilizer to slow degradation	About 10% <sup>4</sup>
Tin (organotin) <sup>5</sup>	Added as a heat stabilizer to slow degradation	Unknown
Antimony <sup>6</sup>	Added to enhance flame retardant effect of chlorine in PVC	Unknown
Organochlorines <sup>6</sup>	Added as a flame retardant to reduce risk of ignition and retard combustion	Unknown

**Sources and Notes:** 1 - CEC 2000; 2 - Thornton 2000 reports PVC makes up 50% to 67% of total chlorine and at least 80% of organically bound chlorine; 3 - Thornton 2002, OECD 2004; since from 90 to 98% of phthalates consumed are used in PVC products, we assume an equal amount will end up in the waste stream; 4 - Bertin 2000; 5 - Organotin compounds represent about 9.3% of European consumption of stabilizers (CEC 2000); and 6 - UBA 2001.

stay encapsulated in the PVC waste (CEC 2000). Various organotin additives have replaced some use of lead and cadmium as a stabilizer in PVC. Organotin stabilizers are added to rigid packaging film, bottles, roofing and clear rigid construction sheeting and account for 9.3% of the stabilizers on the market (CEC 2000). These estimates are based on European formulations of PVC that may differ slightly from those used in the U.S.

Certain flexible PVC products are a source of the toxic metal antimony in solid waste. Antimony trioxide (ATO) is added to PVC used in flexible electrical cables and roofing foils (an alternative to roofing felt on flat roofs) to inhibit the formation and spread of flames during a fire (UBA 2001, DEPA 1999). Antimony from PVC would show up in electronic waste (cables) and construction and demolition debris (foils).

Other toxic and persistent organochlorine flame retardants are present in solid waste as a result of their use in PVC. These include chlorinated flame retardants such as chloroparaffins and phosphate esters, which are organic phosphorus compounds that may also contain chlorine in their chemical structure (UBA 2001). Chlorinated paraffins and antimony are added as a flame retardant formulation for some PVC textile fibers that are resistant to soaking and weather (UBA 2001).

# TROUBLE FROM THE START

## The Production and Use of PVC

### MAJOR FINDINGS

- The production of PVC poses serious environmental health threats due to the manufacture of raw chemicals, including chlorine, cancer-causing vinyl chloride monomer (VCM) and ethylene dichloride (EDC).
- U.S. communities surrounding vinyl chloride chemical facilities, half of which are in Louisiana, suffer from serious toxic chemical pollution of their groundwater supplies, surface waters and air. Residents of the town of Mossville, LA had dioxin levels in their blood that were three times higher than normal.
- PVC includes high amounts of toxic additives, which are released during the use (and disposal) of the product, resulting in elevated human exposures to phthalates, lead, cadmium, tin and other chemicals.
- The use of PVC results in dioxin emissions from PVC combustion which occurs regularly in the U.S due to 1 million annual fires that burn buildings and vehicles—two sectors that consume large amounts of PVC in construction materials.

### The Life Cycle of PVC

The 'life cycle' of a product describes the stages that a material goes through from production to disposal. The general life cycle for PVC is shown in Figure 2.

PVC poses environmental and health threats throughout its life cycle, from the production of feedstock chemicals to the final disposal of PVC products. Though some PVC products can pose direct health risks to consumers, most of the hazards associated with PVC occur during production and disposal. An overview of the hazards associated with PVC production, use, and disposal is shown in Table 4.

The major reason why PVC poses so many environmental and health threats throughout its life cycle is because it contains large amounts of chlorine (Thornton 2000). Chlorine is a highly reactive substance that readily combines with carbon molecules, the building block of life in people and animals. Carbon is the most important element in living things because it combines with oxygen, nitrogen and hydrogen to produce stable molecules such as DNA, proteins, hormones, sugars, starches and fats that are essential for life. Chlorine reacts readily with carbon, altering the original molecules and their functions (Thornton 2000).

The chlorine in PVC and its feedstocks (ethylene dichloride and vinyl chloride monomer) results in the generation of very large amounts of chlorine-containing

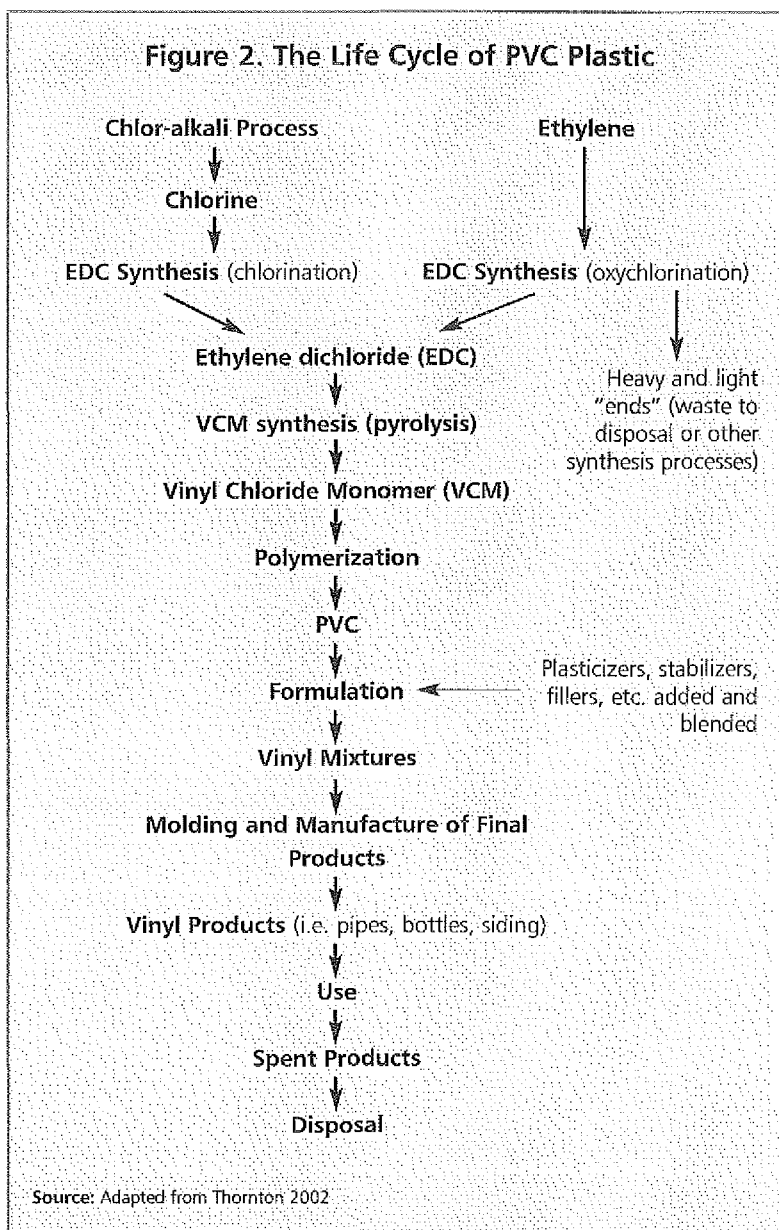
by-products during the manufacture of PVC and the burning of vinyl-containing products and waste. These chemicals include the extraordinarily hazardous chlorinated dioxins and furans, PCBs, hexachlorobenzene, hexachloroethane and hexachlorobutadiene (Papp 1996). Because of the chemical properties of chlorine, these by-products tend to be far more toxic, more persistent in the environment, and more likely to build up in the food supply and the bodies of people than otherwise similar chemicals that do not contain chlorine (Thornton 2000). PVC is the only major plastic that contains chlorine, so it is unique in the hazards it creates.

The chemicals used in the production of PVC (ethylene dichloride and vinyl chloride monomer) are also extremely hazardous. Vinyl chloride is a known human carcinogen that affects the central nervous system and damages the liver (Kielhorn 2000). Ethylene dichloride is a suspected human carcinogen that also affects the central nervous system and damages the liver (USEPA 2003a). Chlorine is a highly irritating gas that damages the upper respiratory system (USEPA 2003b). Hydrogen chloride is a corrosive gas that also affects the upper respiratory system (NAS 2004). These substances pose considerable threats to human health and the environment as a result of PVC production and processing.

## PVC Production

PVC production begins with the conversion of salt to chlorine using huge amounts of electricity and the purification of ethylene from natural gas (See Figure 2). Chlorine and ethylene are then combined in a chemical reaction to form ethylene dichloride (EDC) in a process generally described as “feedstock production.” EDC (considered a “feedstock” chemical) is converted in another chemical reaction to vinyl chloride monomer (VCM), the basic building block of PVC. Vinyl prod-

Figure 2. The Life Cycle of PVC Plastic



ucts are then produced in three additional steps. First, polymerization converts the single vinyl chloride monomer into a long chain of vinyl chloride molecules, the PVC polymer or resin. Second, through compounding (or formulation), additives are mixed in with the PVC resin to produce a vinyl formula with desired characteristics such as plasticity, color or resistance to degradation. The ability to change the properties of PVC (making it hard or making it soft or flexible) is what makes it possible to produce a wide range of PVC products. Third, during fabrication (or molding) the product is melted and then molded into its final shape such as a pipe, floor tile or window casing. A more

Table 4

## Overview of Hazards Associated with PVC Production, Use and Disposal

### Production

- Dioxin and mercury emissions and asbestos waste from chlorine production.
- Air emissions and wastewater releases from Ethylene Dichloride/Vinyl Chloride Monomer (VCM) production facilities.
- Dioxins and other organochlorines released as by-products of Ethylene Dichloride/Vinyl Chloride Monomer (VCM) production.
- Worker exposures to VCM.
- Incineration of production wastes.

### Use

- Additives leach and otherwise migrate from PVC products (plasticizers/metal stabilizers).
- Accidental structure and vehicle fires release dioxins.

### Disposal

#### Landfill

- Accidental landfill fires release dioxins.
- Additives, heavy metals and dioxins leach into groundwater.
- Gaseous emissions from additives.

#### Incineration

- Dioxins form when PVC is burned.
- Hydrochloric acid, toxic metals and dioxins are emitted to air.
- Ash, later stored in landfills, contains high levels of heavy metals and dioxins.

#### Recycling

- Diversity of additives prevents effective recycling of mixed PVC products and materials resulting in poor quality products (downcycling).
- Low recycling rates (currently <1%).
- Contaminates other plastics during recycling as well as other valuable commodities that are targeted for recycling.
- Does not reduce the overall demand for raw materials to make plastics (virgin resin) and has no effect on the amount of vinyl produced each year.

detailed description of the production and manufacturing process for PVC can be found in numerous references (Thornton 2002, Thornton 2000).

In 2000, there were 12 facilities in the U.S. that produced VCM (CEH 2000). Seven of these plants also produced PVC. As of 2003, there were 24 facilities operated by 12 companies that produced PVC resin in the U.S. (CEH 2003) and an estimated 2,332 PVC fabricating facilities (ARCC 2003). These PVC production facilities released 811,000 pounds of VCM and

670,000 pounds of EDC into the environment in 2002 (USEPA 2004). In addition, 6.5 million pounds of VCM and 2.5 million pounds of EDC were sent off-site to sewage treatment plants or waste treatment facilities (USEPA 2004). It should be noted that these are self-reported numbers that represent an absolute minimum. The actual releases are likely to be greater.

During production, most vinyl chloride releases are to the air since it is a volatile gas. A smaller amount of vinyl chloride monomer is released into groundwater or

into wastewater discharged to nearby rivers and streams. The wastes and emissions from production facilities are not limited to vinyl chloride. Dioxins are formed during the oxychlorination process, where chlorine is combined with ethylene gas (or ethylene, oxygen and hydrochloric acid) to form ethylene dichloride (EDC), the primary building block of the vinyl chloride monomer (Evers 1989). Dioxins are also formed when production wastes are incinerated. Incinerators, boilers and acid furnaces burn waste from the oxychlorination process (especially relevant are wastes such as “heavy ends” and distillation tars) and are responsible for the greatest proportion of dioxin releases during PVC production (Thornton 2002). Using data provided by the Vinyl Institute, the USEPA estimates that PVC-only production facilities were a documented source of dioxin air emissions (see Table 6) (USEPA 2001).

Mercury is used in the oldest and most energy intensive process for producing chlorine (Thornton 2002). There are nine chlor-alkali facilities in the U.S. that still use mercury in their process, a 50-year-old technology (Steingraber 2004). Most of this mercury is reused at the plant, but there are still significant air emissions, waste water releases and waste sludge generated (Thornton 2000). Only about 10% of chlorine production in the U.S. still uses mercury, though very little of the mercury-produced chlorine goes to the production of ethylene dichloride or vinyl chloride monomer. The chlorine industry is the largest consumer of mercury in the country (Thornton 2000).

Mercury emissions at these plants are another environmental and public health concern (Steingraber 2004, USEPA 2003c) as mercury causes reproductive and neurological damage (NAS 2000). Mercury is a potent neurotoxin that accumulates primarily as methyl mercury, in aquatic food chains. The highest levels are found in large predatory fish, such as tuna and swordfish. Air emissions of mercury are transported through the atmosphere and eventually settle on land or surface water where natural bacterial processes transform some of the mercury into methyl mercury. Ingestion of mercury-contaminated fish is the primary route of exposure to methyl mercury. Neurodevelopmental toxicity can result from the exposure of pregnant women and young children to mercury, leading to learning disabilities in children (USEPA 2003c, NAS 2000).

Plants that manufacture ethylene dichloride and vinyl chloride monomer are a risk to workers and residents of surrounding areas. In the early 1970’s, plants that manufactured vinyl chloride were found to be exposing workers to levels of the chemical high enough to put

them at risk of developing a rare form of liver cancer—angiosarcoma. In 1974, the industry finally admitted that workers exposed to vinyl chloride did develop this rare form of liver cancer (Creech 1974). Residents of communities near vinyl chloride production plants are also affected by plant emissions. These plants discharge pollutants into nearby communities, contaminating drinking water and releasing dioxins into the air from on-site incinerators. Besides cancer, workers and residents alike are vulnerable to a range of ailments associated with vinyl chloride exposure, including damage to the liver, lungs, blood, nervous system, immune system, cardiovascular system, skin, bones and reproductive system (Kielhorn 2000, ATSDR 1997). More detailed analyses of the human health and environmental impact of PVC production processes can be found in numerous references (Steingraber 2004, USEPA 2002, Kielhorn 2000, ATSDR 1997).

Although the levels of vinyl chloride and ethylene dichloride released from these facilities are lower today than in the past, exposure to these substances is still a concern. There appears to be no safe level of exposure for these substances, especially vinyl chloride. Both of these substances are considered to be “genotoxic” meaning that they cause irreversible damage to DNA (Kielhorn 2000). A generally accepted scientific theory is that mutation in a single cell can result in cancer (Pitot 1991). Similarly, exposure to a genotoxic substance can lead to DNA damage. This means there is no safe level of exposure to these substances and any exposure increases the risk of developing cancer, a birth defect or a genetic disorder. Thus, lower emissions from vinyl chloride and ethylene dichloride facilities reduce, but do not eliminate, health and environmental risks.

The production and disposal of PVC poses dangers relevant to everyone, but often, particular groups of people are especially at risk. Plants that manufacture the ethylene dichloride and vinyl chloride monomer are often located in low-income areas or communities of color, as are incinerators that burn PVC waste and landfills that store PVC waste (Thornton 1997). These types of sites pose a threat. Community-based groups understand the threat these facilities pose to their communities. The urgency of their opposition to these facilities speaks to the intensity of the danger that they feel these facilities pose.

## CASE STUDY

### Mossville, Louisiana: PVC Production in the New "Cancer Alley"

In Calcasieu Parish, Louisiana, residents of Mossville, a small unincorporated community of about 1,500 African Americans, are confronting numerous toxic industries including four vinyl production facilities that include two major vinyl chloride manufacturers. Louisiana is home to more than half of the 12 vinyl chloride plants in the U.S., and Calcasieu Parish produces more vinyl than any other county in the country making it the unofficial PVC capitol of America. At the urging of Mossville residents, air monitoring conducted by the U.S. Environmental Protection Agency (USEPA) in June 1999 showed vinyl manufacturing facilities emitted concentrations of vinyl chloride, a potent human carcinogen, that were more than 120 times higher than the ambient air standard—making the air in Mossville unhealthy to breathe. PPG Industries and Condea Vista in Mossville leaked hundreds of thousands of pounds of ethylene dichloride, a feedstock for PVC, and contaminated the groundwater. As a result of this contamination and a lawsuit settlement with two companies, a significant portion of Mossville families have relocated. This has transformed a once highly populated neighborhood into a virtual ghost town. The Condea Vista facility has changed ownership, but has not improved. The portion of the facility now owned by Sasol Ltd. continues to be ranked in the top 10% of industrial companies that create the highest cancer risk from air and water pollution according to the USEPA 2002 Toxic Release Inventory. This data shows that in 2002 vinyl production facilities in Mossville generated 238,458,615 pounds of toxic waste that were dumped on the community or transferred to disposal facilities. Over 30 million pounds of this waste wound up in landfills and incinerators located in other communities.

In 1998, Mossville Environmental Action Now, Inc. (MEAN) appealed to the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) to test residents for exposure to dioxin, a highly toxic compound that is a by-product of vinyl manufacturing and other industrial processes. In 1999, ATSDR reported dioxin test results showed the average Mossville resident has three times more dioxin in their blood than the average U.S. citizen. Furthermore, testing of breast milk from local mothers found elevated levels of dioxins as high as 30% above the national average. Cancer mortality rates for Calcasieu Parish are 1.6 times the national average and many women suffer from endometriosis, a condition linked to dioxin exposure.

The citizens of Mossville are determined in their search for justice. As descendants of African Americans who proudly settled the community in the late 1800's, they have inherited not only the land, but also the fighting spirit to survive and demand what is rightfully theirs. Working through MEAN, they have lobbied successfully for government action. Through use of a Bucket Brigade program, which allows residents to test their own air, they have caused industry to be fined as much as \$300,000 when testing showed benzene levels 231 times greater than the state standard. In 2001, Sasol Ltd., a South African company with chemical and fuel operations in 20 countries, acquired Condea Vista. Working in solidarity with communities in South Africa, SasolWatch.com was created to expose the company's record of violations and toxic dumping on poor communities. MEAN is working with a local health care provider to develop necessary environmental health services for Mossville residents. The organization is educating the public about the dangers of PVC production, use and disposal. MEAN is also demanding significant pollution reduction, the clean-up of industrial contamination in the local estuary, and the just and fair relocation of consenting residents to a healthier environment. (Sources: MEAN 2000, Ermler 2001, LBB 2004, SasolWatch 2004, Greenpeace 2004a, Greenpeace 2004b).

## PVC Use

PVC plastic used in consumer products is not a pure material. By the time a product containing PVC reaches your home, a wide range of chemicals have been added in order to change its properties to meet a wide range of product needs. These additives include stabiliz-

ers, plasticizers and fillers that are mixed in with, but are not chemically bound to the PVC. A list of common additives found in PVC products is shown in Table 5.

The most important of these chemical additives are the plasticizers known as phthalates (pronounced 'thal - eights') and the metal stabilizers. Plasticizers are added





2002) and potent teratogens (Noda 1993, Pless 2002). Tributyltin affects the nervous system, and has caused reproductive and developmental problems in animal studies (Boyer 1989, ATSDR 1992).

Antimony trioxide (ATO) is added to PVC used in flexible electrical cables and roofing foils (an alternative to roofing felt on flat roofs) to inhibit the formation and spread of flames during a fire (UBA 2001, DEPA 1999). For flame retardant applications, PVC accounted for 32% of the European market for antimony trioxide in 1998 (UBA 2001). The antimony, which is a synergist rather than a flame retardant, acts to enhance the flame retarding properties of chlorine in PVC. Antimony trioxide is a suspect human carcinogen when inhaled and is toxic to the lungs, heart, eyes and skin (UBA 2001, NAS 2000a). During fires and waste incineration, antimony dust and toxic antimony halides are released. Antimony also catalyzes the formation of dioxins and furans (UBA 2001).

Other flame retardants added to PVC include chlorinated paraffins, phosphate esters (organic phosphorus compounds some of which also contain chlorine or bromine) and aluminum trihydroxide (UBA 2001). These additives are used in high volumes but are also used in many other polymer applications in addition to PVC. Chlorinated paraffins and antimony are added as a flame retardant formulation for some PVC textile fibers that are resistant to soaking and weather (UBA 2001). Chlorinated paraffins are complex mixtures of short-chain and long-chain hydrocarbons containing up to 70% chlorine. Chlorinated paraffins cause liver and kidney toxicity in animals while the short-chain mixture is an animal carcinogen and possible human carcinogen (NAS 2000a). Chlorinated paraffins and phosphate esters in PVC also function as secondary plasticizers (UBA 2001).

The phosphate ester flame retardants used in PVC include tris (2-chloroethyl) phosphate, tris (chloropropyl) phosphate [TCCP], and tris (dichloropropyl) phosphate [TDCPP]. These compounds are added to PVC floor covering and are released as off-gassing occurs from the vinyl (Marklund 2003). TDCPP was widely used as a flame retardant in children's sleepwear until May 1977, when it was withdrawn from the market after published reports that it was mutagenic in bacteria (Sanders 1978). The use of TDCPP as a flame retardant may pose significant cancer risks and reproductive harm (testicular atrophy and decreased seminal vesicle secretions), according to a committee of top U.S. scientists (NAS 2000a). The German Federal Environmental Agency has recommended a reduction

in the use of TCCP in favor of safer substitutes, since it has high environmental persistence with some evidence of carcinogenicity. (UBA 2001).

## Structural and Vehicle Fires

Another hazard associated with the use of PVC products arises when PVC is burned in an accidental fire. Not only are many building materials made from PVC but it was once standard practice to use PVC to insulate wiring in buildings. In 1995, there were an estimated 574,000 structural fires and another 406,000 vehicle fires in the U.S. (USEPA 2001). When the PVC in buildings and vehicles burns, a variety of toxic substances are formed that pose major public health risks. The primary combustion products are hydrogen chloride gas, carbon dioxide and carbon monoxide (OFM 1997). Hydrogen chloride gas is a corrosive and highly toxic gas that can burn the skin and cause severe damage to the eyes and lungs. When hydrogen chloride comes in contact with the mucous lining of the lungs, it is converted into hydrochloric acid that can cause severe and permanent respiratory damage (IAFF 1995).

Accidental fires that burn PVC also generate phosgene gas, benzene, toluene, xylenes, dioxins, furans and other products of incomplete combustion (IAFF 1995). The poor combustion conditions that are typical of these fires are ideal for the formation of dioxins and furans (TNO 1996). Dioxins were found in the air, water, surface soil and nearby vegetation following the burning of a plastics recycling plant in Hamilton, Ontario (OMEE 1997). In the World Trade Center fires, dioxins and furans were identified as significant components of the smoke given off by the smoldering buildings (Landrigan 2004). In Germany, dioxin levels in indoor soot remaining after a house fire were found to be as high as 45,000 parts per trillion (ppt) TEQ—more than 300 times the German government's health standard (Fiedler 1993). After a fire at a plastics warehouse in Binghamton, NY, dioxin levels in soils were found to be more than 100 times higher than other areas of the community not impacted by the fire (Schechter 1996).

Firefighters and emergency responders are especially at risk from smoke and gases generated by fires burning PVC. Exposure to combustion gases from building fires has been linked to a high incidence of leukemia and laryngeal and colon cancers in firefighters at young ages (Wallace 1990) and to other adverse health problems including pulmonary hemorrhage and edema due to chemical pneumonitis (Schreiber 2003, Dyer 1976). This is one of the reasons why the International

Association of Fire Fighters supports the use of alternative building materials that do not pose as high a risk as PVC (Duffy 1998).

The toxic gases generated when PVC is burned in accidental fires have resulted in deaths and injuries, including workers exposed to toxic gases from burning electrical wires coated with PVC (Colardyn 1978); residents exposed to airborne toxics from a Hamilton, Ontario plastics recycling plant fire (Upshur 2001); and guests who died in the MGM Grand Hotel fire in Las Vegas (Buerk 1982). A summary of the public health hazards associated with accidental fires that burn PVC has been published elsewhere (Schreiber 2003).

PVC's use to insulate wiring has raised concerns not only for its use in buildings, but also in airplanes. The use of PVC insulation around wiring was once standard practice in airplanes. A typical airplane, for example, could contain more than 100 miles of PVC coated wiring (Ackerman 2003). Insulation of the wires is critical to air safety, but defects in the insulation can lead to short circuits and sparks that could potentially start a fire or spark an explosion. If PVC wiring overheats and starts to smolder, large amounts of smoke are generated and, if moisture is present, hydrochloric acid can be produced. Although there is no proof that PVC insulation has ever caused an airplane crash, concerns have been raised about older airplanes that still contain PVC-insulated wires. Use of PVC wiring is now prohibited on new planes since PVC insulation failed Federal Aviation Administration flammability tests (Ackerman 2003).

Accidental fires are unexpected, and thus difficult to regulate, but phasing out PVC could reduce the harm they cause. If PVC was not so widely used as a building material, accidental fires would not produce the toxic combustion products that are specifically caused by the

burning of PVC. Both immediate and long-term impacts would be lessened: firefighters and victims alike would avoid exposure to the toxic gases and smoke caused by the fire, and the leftover ash would be largely free of these toxins as well.

## CASE STUDY

### Illioopolis, Illinois: PVC Plant Explodes

On April 23, 2004, a PVC plant operated by Formosa Plastics in Illioopolis, Illinois exploded. A towering plume of smoke containing dioxins, hydrochloric acid, vinyl chloride and vinyl acetate could be seen for miles around. The explosion caused both power and water to be cut off and over 900 people were evacuated from the community. People were stationed in makeshift shelters including the local shopping mall. The U.S. Chemical Safety and Hazard Investigation Board called the explosion the most serious the agency has investigated since it was founded in 1998. Four workers were killed instantly and one died shortly after being hospitalized.

Nearly three months after the disaster, the Illinois Environmental Protection Agency (IEPA) reported elevated levels of dioxin were found in the soil at 12 of 13 sites sampled. Some samples reached levels of 50 ppt—10 times higher than normal. Some areas tested were as far as 3 miles from the explosion. Residents are concerned about the constant health risks posed by these hazardous sites. More testing is planned. (Sources: Antonacci 2004, IEPA 2004, Steingraber 2004a).

## CASE STUDY

### Montreal, Canada: PVC Fire and Firefighter Exposure

A 1993 fire in St. Terese, Canada at a plastics plant called Plastibec, Ltd consumed more than 15 tons of PVC. The plant manufactured vinyl blinds and vinyl window frames. After burning for 18 hours and forcing 250 people from their homes, the smoldering structure continued to emit thick black smoke. In the end, the fire produced between 40-85 grams of dioxins and furans, equal to the amount released by the pulp and paper industry in an entire year. Of the 50 firefighters called out to the blaze, 6 were treated for smoke inhalation and more than 30 required medical treatment after being exposed to the fumes (Source: Greenpeace 1994).

# THE DEADLY CONNECTION

## PVC, Chlorine and Dioxin

### MAJOR FINDINGS

- When burned, PVC plastic, which contains 57% chlorine when pure, forms dioxins, a highly toxic group of chemicals that build up in the food chain.
- The PVC content in the waste stream fed to incinerators has been linked to elevated levels of dioxins in stack air emissions and incinerator ash.
- PVC is the major contributor of chlorine to four combustion sources—municipal solid waste incinerators, backyard burn barrels, medical waste incinerators and secondary copper smelters—that account for a significant portion of dioxin air emissions. In the most recent USEPA Inventory of Sources of Dioxin in the United States, these four sources accounted for more than 80% of dioxin emissions to air (based on 1995 data).

### The Formation of Dioxin

A major concern about PVC is the formation of dioxin during production and during disposal through incineration. The term 'dioxin' refers to a family of chemical compounds that are not intentionally made. They are generated as by-products during production and disposal of chlorinated compounds including PVC. There are many forms ("congeners") of dioxin, each with a different toxicity. The most toxic form is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), and is the standard against which the toxicity of all other forms of dioxin is measured. TCDD is a known human carcinogen according to the U.S. National Toxicology Program (USHHS 2002), World Health Organization (WHO 1997) and U.S. Environmental Protection Agency (USEPA) (USEPA 2000). Dioxin is fat-soluble, which means it will bioaccumulate in increasing concentrations as it moves up the food chain. Exposure to dioxins is associated with reproductive and developmental health problems, and has been shown to impair immune system response and interfere with normal hormone function (Birnbaum 2003).

### The PVC-Dioxin Connection

The relationship between PVC and the formation of dioxins in incinerators is clear: PVC is a significant chlorine donor in the incineration process, spurring the formation of dioxins. The strongest evidence of this

comes from laboratory studies. The German EPA found that burning waste that includes PVC or other organochlorines produced dioxins, while burning waste without PVC did not (Theisen 1991). Two Danish studies found similar results (Vikeisoe 2000, Christmann 1989). In Japan, researchers found that adding 4% PVC to a mixture of PVC-free material increased dioxin emissions ten fold (Ishibashi 2000). When PVC was added to a mixture of newspapers or to chlorine-free paper and burned, dioxin emissions increased significantly with chlorine and PVC content (Yasuhara 2001). In a similar study, dioxin levels in fly ash were 200 to 1,200 times higher when PVC was added to a mixture of newspaper or chlorine-free plastics (Takasuga 2000). Several other studies found increased dioxin levels in fly ash or unburned residue were correlated with increased PVC levels in the waste stream burned (Kopponen 1992, Kolenda 1994, Wunderli 2000).

When elemental chlorine was added to a mixture of coal and salt, dioxin levels were 130 times higher than when the same mixture was burned without the chlorine (Mahle 1980). Adding PVC or chlorine gas to chloride-containing vegetable matter resulted in increased dioxin formation (Liberti 1983). In another study, as the level of organochlorines in a waste stream increased, so too did the amount of dioxins formed (Altwickler 1993). A study in Finland found that burning perchloroethylene in a laboratory produced more dioxins, chlorobenzenes and chlorophenols than burning sodium chloride (Halonen 1995).

There is also evidence from small-scale incinerators that support a relationship between burning organochlorine compounds like PVC and dioxin formation. The Danish EPA found that doubling the PVC content of an incinerator's waste feed increases dioxin emissions by 32% (DEPA 1995). Conversely, reducing the PVC feed results in a reduction in dioxin emissions. Researchers in Japan found that burning a mixture of PVC and polyethylene produced large amounts of dioxins (Tamade 2000, Yoneda 2000). A study conducted for the Dutch Environment Ministry found that PVC levels in the waste stream increased dioxin levels in the air emissions (Kanters 1996). Other studies in both the U.S. (Wagner 1993) and Europe (Christmann 1989, Vesterinen 1996, Halonen 1993, Hutari 1996, Manninen 1996, Hatanaka 2000) have found a positive correlation between PVC content in a waste stream and dioxin emissions.

An excellent review of the evidence linking chlorine content in the waste stream and dioxin emissions has

been published (Costner 2001). This paper identified 47 studies involving laboratory and pilot scale combustion system/processes; 12 studies involving small-scale and other combustion systems/processes; and 31 studies involving full-scale combustors that are relevant to the relationship of chlorine content and dioxin emissions. The author found that reduced chlorine content was correlated with reduced dioxin formation in all three study groups and concluded that there is "a compelling body of evidence that dioxin formation in waste incinerators decreases when chlorine input is reduced."

The USEPA confirmed that PVC is a dioxin precursor in 1997 (USEPA 1997). They also acknowledged that, "several studies have identified strong correlations between chlorine content and CDD/CDF [dioxin/furan] emissions during combustion tests." As part of the Inventory of Sources of Dioxin developed by the USEPA, the agency acknowledged that a "review of experimental data clearly indicates an association between chlorine content of feed/fuels and ... synthesis of CDDs and CDFs" (USEPA 2001). However, the agency concluded that the results on whether a relationship between chlorine input and dioxin emissions exists were not "unequivocal" and left it at that.

Additional insight into the relationship between PVC and dioxin emissions can be found by examining the USEPA Inventory of Sources of Dioxin. Table 6 summarizes dioxin emissions from sources that include PVC. The table shows facilities that burn PVC are responsible for most of the dioxin sources identified. Eight quantified air sources and eight non-quantified air sources are identified that include PVC as a chlorine contributor in the waste stream. There are also quantified releases to water and land from sources that clearly contain PVC as a chlorine donor. In addition, quantified sources such as tire burning and asphalt mixing plants may contain PVC when household garbage is burned with tires, or when PVC is added as "filler" in producing asphalt. In fact, any process that burns household garbage—including gasification or pyrolysis (systems that burn waste in the absence of oxygen) — can be expected to generate dioxin emissions in large part due to the presence of PVC in the waste (BREDL 2002). The table also shows a number of other unquantified sources that may include PVC as a contributor to dioxin emissions. The data used to generate these estimates were collected in 1995 and represent the most recent data available on dioxin emissions in the U.S. (USEPA 2001).

The top four quantified sources alone—municipal solid waste incinerators, backyard barrel burning, medical

• • • • • Table 6 • • • • •  
**Dioxin Emissions in the U.S.  
 from Sources that Include PVC**

Sources with Chlorine from PVC	Dioxin Releases (grams/year TEQ*)
<b>Quantified Air Sources</b>	
Municipal solid waste incinerators	1,250 [see note below]
Backyard barrel burning	628
Medical waste incinerators	488
Secondary copper smelters	271
Cement kilns burning hazardous waste	156
Cement kilns not burning hazardous waste	17.8
EDC/VCM production	11.2
Hazardous waste incineration	5.8
<b>Non-Quantified Air Sources</b>	
Landfill fires	
Landfill gas	
Accidental fires	
Scrap electrical wire recovery	
Secondary ferrous metal smelting	
Ferrous foundries	
Manufacturing chlorine and chlorine derivatives	
PVC manufacturing	
<b>Other Possible Air Sources</b>	
Sewage sludge	14.8
Asphalt mixing plants	7
Secondary lead smelters	1.72
Tire burning	0.11
<b>Total Dioxin Releases to Air</b>	<b>3,125</b>
<b>Quantified Releases to Water</b>	
Ethylene dichloride/vinyl chloride	0.43
<b>Quantified Releases to Land</b>	
Ethylene dichloride/vinyl chloride	0.73
Municipal waste water sludge	76.6

**Sources and Notes:** All data are from the USEPA Inventory of Sources of Dioxin (USEPA 2001) which reflects data generated in 1995, the most recent year for which data are available. Since the 2001 inventory was published, dioxin air emissions from municipal waste incinerators have declined for two reasons related to a December 2000 compliance deadline for new federal regulations on toxic air emissions: (1) the closure of 25 waste combustion plants, nearly 20% of the total number, between 2000 and 2002 (Kaufman 2004); and (2) added air pollution controls that shifted much of the total amount of dioxin formed to incinerator ash, which requires land disposal. The USEPA now estimates that dioxin air emissions from large municipal waste incinerators are 12.0 grams of dioxin per year (TEQ) from 66 large incineration facilities in 24 states (USEPA 2002a). Dioxin air emissions from 39 small incinerators were estimated at 50 grams per year TEQ in 2000 and are projected to decline to 1.8 grams per year in response to a December 2005 compliance deadline for new federal toxic air emission regulations (ERG 2002). These more recent estimates have not yet been peer reviewed or published according to USEPA.

\* TEQ = toxic equivalents; a measure of the total amount of all forms of dioxins, furans, and dioxin-like PCBs found in a sample.

waste incinerators and secondary copper smelters—account for 2,637 grams TEQ, which is equivalent to 84% of the annual total estimated dioxin emissions to air. Clearly, not all of these emissions are attributable to PVC. Dioxin can be generated when other chlorine donors are present. The fraction attributable to PVC is not known.

It is clear from this evidence that without PVC, there would be considerably less chlorine in the incinerator feed and hence less dioxins formed. This is not to say that chlorine content is the only factor determining dioxin production. It is not. Facility design, operating conditions and the presence of catalysts also matter, but numerous studies support the conclusion that without chlorine, dioxin cannot be formed and that PVC is the predominant source of chlorine in the waste stream (Costner 2001).

It is misleading to focus only on stack air emissions when assessing chlorine's contribution to dioxin formation. Fly ash, bottom ash and other residues contain dioxin as well. Two studies on municipal waste incinerators provide evidence that only from 0.0004 to 1% of total dioxins formed remain in the stack gases (Fabrellas 1999, Sakai 1997). Other research has shown that there is a positive correlation between dioxin concentrations in ash and the amount of PVC in the waste feed. In one study, when PVC was burned with wood, dioxin levels increased in the ash (Wilken 1994). In another study, higher dioxin concentrations were observed in ash residue from chlorinated plastics than in ash from chlorine-free paper, wood, cotton or wool (Theisen 1991). In general, as more PVC is added, dioxin levels rise.

Nonetheless, most studies focus on dioxin concentrations in stack gas as a means of assessing the relationship between chlorine and dioxin. The fact that many studies examining miniscule dioxin concentrations in this hard-to-measure source still find a positive correlation between chlorine and dioxin testifies to the strength of the relationship.

Despite this compelling body of evidence, the Chlorine Chemistry Council (CCC) has aggressively argued that there is no relationship between PVC content and dioxin emissions from incinerators. The industry's prime support for this claim is a study funded by the Vinyl Institute, a member of the CCC, conducted by an industry consultant and published by the American Society of Mechanical Engineers (ASME). This study examined data from 169 facilities and concluded that there was "little or no correlation between chlorine input and dioxin emissions from incinerators" (Rigo 1995). This study has been critiqued and its methodology shown to be invalid (Thornton 2002, Costner 2000, Costner 1997, Chien 2003). In addition, the conclusions of the ASME study were refuted at a workshop held by the USEPA in 1996 on Dioxin Formation Processes and Sources (Costner 2000).

Furthermore, a memo prepared prior to the release of the ASME study by the public relations firm Nichols-Desenhall Communications (under contract to the

Vinyl Institute) calls into question the derivation and perhaps the integrity of the ASME study. This memo laid out a strategy to diffuse any connection between chlorine content/PVC and dioxin emissions made by the USEPA as part of their Dioxin Reassessment effort. The memo recommends the Vinyl Institute fund an "independent" scientific study to "debunk" the USEPA's claim about the positive relationship between PVC and dioxin emissions (Burnett 1994). This study turned out to be the one conducted under contract with the consulting firm of Rigo & Rigo Associates under the auspices of ASME. An internal Vinyl Institute memo described the role of the ASME, "The purpose of the ASME as the contractor is to provide unassailable objectivity to the study ..." (Goodman 1994). In this same memo, Rigo was described as "... willing to set his priorities to our needs, and he appears sympathetic to Plastics, Vinyl, PVC and Cl2 ..." Additional details on these memos have been described elsewhere (Thornton 2002).

PVC is the primary source of chlorine in the waste stream. Eliminating PVC would dramatically reduce the amount of chlorine being burned, and thereby limit dioxin formation. Given the abundant evidence implicating chlorine as an essential precursor to dioxin formation, it is important to reduce if not eliminate the levels of PVC in the waste stream. Banning PVC would be the most effective means of achieving this goal.

# DON'T BURN IT

## The Hazards of Burning PVC Waste

### MAJOR FINDINGS

- More than 100 municipal waste incinerators in the U.S. burn 500 to 600 million pounds of PVC each year, forming highly toxic dioxins and releasing toxic additives to the air and in ash disposed of on land.
- The largest PVC-burning states include Massachusetts, Connecticut, Maine—which all burn more than half of their waste—Florida, New York, Virginia, Pennsylvania, Maryland, Minnesota, Michigan, New Jersey, Indiana and Washington.
- The incineration of medical waste, which has the highest PVC content of any waste stream, is being steadily replaced by cleaner non-burn technologies.
- Open burning of solid waste, which contains PVC, is a major source of dioxin air emissions and dioxin-laden ash, as well as other dangerous pollutants.
- Backyard burning of PVC-containing household trash is not regulated at the federal level and is poorly regulated by the states—it is completely unrestricted in Michigan and Pennsylvania, partially restricted in 30 states and banned in 18.

When PVC is burned in municipal and medical waste incinerators, dioxins and other toxic gases are formed and heavy metals present in the waste are released into the air and residual ash. Dioxins are also released when residents in rural areas dispose of their trash by burning it in small furnaces or barrels behind their homes, and when PVC products or waste are burned in building, vehicle and landfill fires.

### Municipal Waste Incinerators

Incineration, or high-temperature burning, is frequently used to dispose of municipal, hazardous and medical wastes. Because PVC is a widely used plastic (especially in medical applications), the waste burned in these incinerators inevitably contains PVC. As discussed earlier, the chlorine in PVC facilitates the formation of dioxins and other chlorinated organic compounds that are subsequently released to the environment (Costner 2001). Thus, incinerators are a major source of dioxins released to the air and land, and PVC is largely responsible for this situation.

Municipal waste or household trash incinerators are considered the largest source of dioxin emissions in air (USEPA 2001). The most recent inventory of dioxin sources in the U.S. estimated municipal and medical waste incinerators together account for 55% of all dioxin releases to air (40% and 15%, respectively) (USEPA 2001). Dioxin air emissions have since declined as



Table 7  
States with the Heaviest Reliance on  
Municipal Waste Incineration

State	Percent Incinerated (After Recycling)	Number of Incinerators	Amount of PVC Incinerated (tons)
Maine	66.2%	4	5,448
Connecticut	55.4%	6	16,257
Massachusetts	54.6%	7	28,145
Minnesota	46.1%	15	14,432
Florida	37.1%	13	45,364
Hawaii	32.7%	1	3,454
Virginia	27.9%	5	18,806
New York	24.4%	10	37,517
Maryland	22.6%	3	12,486
Pennsylvania	22.6%	6	17,746
New Hampshire	22.2%	2	1,675
Remaining States*	Varies	32	49,075
<b>Total</b>	<b>10.5%</b>	<b>104</b>	<b>250,405</b>

**Sources and Notes:** Estimates derived from Kaufman (2004) for 2002. The amount of PVC incinerated by each state was calculated by: (1) assuming that the percent PVC content of municipal solid waste (0.62%) estimated by the USEPA (2003) is representative of the typical percentage of PVC in the waste stream; (2) assuming that post-consumer recycling of PVC in MSW is zero; (3) multiplying the average percent PVC in the waste (0.62%) by the total waste generated in that state according to Table 4 in Kaufman (2004); and (4) multiplying this value (the total PVC disposed in the state) by the percent of waste incinerated after recycling as shown in column 2 above. The percent of PVC incinerated after recycling was determined by dividing the total amount of waste incinerated in a state (provided in Table 4 of Kaufman 2004) by the total waste disposed of (after recycling).

\* 19 states did not burn any MSW according to Kaufman 2004 and AL, AK, and MT did not report any data (see Appendix B).

incinerators have closed or added pollution controls to meet new standards (USEPA 2002a, ERG 2002). Now much of the dioxins formed from incinerators are released to the land through landfilling of incinerator ash.

Table 7 lists those states that rely heavily on incineration as a disposal option for municipal solid waste. Maine, Connecticut, and Massachusetts incinerate more than 50% of their municipal solid waste destined for disposal (not counting the amount of waste recycled). Minnesota has the largest number of municipal waste incinerators (15) followed by Florida (13) and New York (10). These states have been dependent on waste incineration since the late 1980's and early 1990's. This trend may have been motivated by zealous protection of abundant groundwater and surface water supplies; limited potential for new landfill capacity; subsidies for generating electricity from waste burning; and state policies which favor incineration over land disposal. A complete listing of the amount of

PVC burned in each state is shown in Appendix B.

As shown in Table 7, an estimated 250,000 tons (500 million pounds) of PVC is burned in trash incinerators in the U.S. each year (Kaufman 2004). This estimate is even higher if you use the municipal solid waste data generated by the USEPA. Using the USEPA data for the year 2001, the amount of PVC burned is estimated to be about 600 million pounds (USEPA 2003). These values are consistent with other estimates (Thornton 2002). As discussed earlier, PVC waste contributes substantially to the chlorine content of the waste and to the formation of dioxins in trash incinerator emissions. Estimates of how much PVC waste contributes to the chlorine content in waste streams vary from 35 to 66% (CEC 2000, ECC 1994). Other minor chlorine sources include food waste and paper. Another source estimates that, on average, about 50 to 67% of the chlorine input in an incinerator can be attributed to PVC (Thornton 2002). However, as much as 80% of the organically bound chlorine, which is thought

to be more conducive to dioxin formation than inorganic chlorine, is from PVC (Thornton 2000).

In addition to dioxins, PVC waste contributes to the formation of hydrochloric acid (HCl) in the flue gases of incinerators. This gas must be neutralized (primarily by lime) and removed by scrubbers. HCl damages the air pollution control equipment because it is so corrosive and requires additional maintenance. In addition, the metal stabilizers in PVC (lead and cadmium) do not break down during incineration but are released either as hazardous air emissions or remain in the ash and cinders (ECC 1994). Older PVC products that used cadmium as a metal stabilizer will contribute cadmium when burned (ECC 1994). Consequently, the more PVC in the waste stream the greater the operating cost of the incinerator due to: (1) the use of more agents to neutralize the acids and flue gases; (2) additional operating and repair costs; and (3) additional waste management costs to dispose of the residual ash (CEC 2000).

Waste incineration has been linked to a number of serious health problems in plant workers, as well as in surrounding communities. Many of these troubles implicate PVC as the root source of contamination. For instance, workers in incinerator plants have increased levels of chlorinated phenols and lead in their body tissues, which may result from PVC, as well as mercury and arsenic (Allsopp 2001). The USEPA has reported that metals emissions in incinerators rise when the chlorine content of the waste rises. In one study, metals were up to seven times higher when the chlorine content of the waste was increased from 0 to 8.3% (Carroll 1989). Elevated chlorine content levels also impair the efficiency of the scrubber (an air pollution control device) to remove metals from stack gases (Carroll 1989). Incinerator operators are not the only exposed group. Populations living near incinerators are particularly vulnerable to elevated levels of dioxins and heavy metals in tissue and blood, as well as to respiratory ailments and cancers (Allsopp 2001). Elevated levels of congenital abnormalities have also been observed in newborns in areas in the immediate vicinity of incineration plants (ten Tusscher 2000).

Even distant populations are at risk, as toxic air releases settle on crops and these crops are transported to other areas and/or eaten by livestock which, in turn, are consumed by people (Cohen 1998, Cohen 1995). A study by Barry Commoner and researchers at Queens College in New York found Inuit Native peoples living in the northern reaches of Canada, miles from any sources of dioxin, had high levels of dioxin in their bodies (Commoner 2000). These researchers also found dioxins released from incinerators and other dioxin sources hundreds of miles away in the U.S. and lower Canada were transported by wind currents to the far reaches of the globe.

A common argument in favor of incinerators is that they significantly reduce the weight and volume of waste going to landfills. While waste volume is reduced by about 45 to 50%, this statement only tells part of the story. The fly ash captured by the air pollution control equipment and the residual ash left in the burner must be disposed of in landfills and is often more toxic than the original raw waste. This is the result of burning metal-containing materials (including PVC), chlorine-containing PVC waste that generates dioxins, and other difficult to burn waste. This ash is stored in landfills, and often leaches into surrounding soil and water. Incineration may indeed reduce the volume of waste going to landfills, but in doing so, this practice shifts the waste burden to air releases and increases the toxicity of the waste that will eventually be landfilled in the

form of ash. Incineration is not a solution to waste disposal, especially not for PVC-containing waste.

## Medical Waste Incinerators

Incineration of medical waste involves the burning of solid waste generated primarily by hospitals and research facilities. PVC accounts for 5 to 15% of medical waste (DTI 1995, Hasselriis 1993, Marrack 1988, USOTA 1988). Medical products made of, or containing, PVC include surgical gloves, dialysis tubing, blister packs, inhalation masks, IV bags/tubing, mattress covers and blood bags. Even non-medical products containing PVC (e.g., office supplies) are often burned along with medical trash.

As the overall volume of waste generated by hospitals has increased over the past 50 years, so has the proportion of that waste containing PVC. In 1996, PVC accounted for 27% of all plastic used in durable and disposable medical products (Rossi 2000). This growth in the use and disposal of vinyl medical products has led to increased chlorine input to medical waste incinerators and thus greater dioxin formation. In 2001, the USEPA cited medical waste incinerators as the 3rd largest source of dioxin releases to the environment in the U.S. (USEPA 2001).

In 1990, roughly 70% of U.S. hospitals used on-site incinerators (USOTA 1990). According to the USEPA, the number of medical waste incinerators operating in the U.S. dropped roughly in half from 1987 to 1995 (USEPA 2001). Similarly, the amount of medical waste burned in these incinerators dropped from an estimated 1.43 billion kilograms (kg) in 1987 to 0.77 billion kg in 1995. Today there are substantially fewer medical waste incinerators operating (USEPA 2004b). Some of this drop is due to new regulations that have gone into effect, which increased operating costs (USEPA 2000a). But the work of activist grassroots citizen organizations and national groups like Health Care Without Harm have played a major role in shutting down medical waste incinerators and encouraging the use of non-incineration treatment technologies (HCWH 2001, Lester 2003).

Hospital waste primarily consists of general solid waste (70%), medical waste (17%), patient waste (9%) and a small amount of hazardous waste (2%). Approximately 15% of this waste is considered to be infectious waste (HCWH 2001), which requires treatment to disinfect the waste but not necessarily incineration. Viable alternatives to incineration exist for the disposal of the

remaining 98% of medical waste that is non-pathological. Much of this waste is paper, cardboard, plastic, metals and general solid waste that does not need to be burned.

The most prominent alternative for treating hospital waste is autoclaving—a process that disinfects the biological waste component. Other treatment methods include microwaving, electro-thermal deactivation, gasification, chemical disinfection and thermal treatment (HCWH 2001). Yet even these alternatives do not address the underlying problem, the initial use and generation of PVC wastes. A better solution is to replace PVC products with non-chlorinated plastics.

Given the finding in recent studies that flexible PVC products used in hospitals (like dialysis tubing) leach toxic additives into patients' bodies (USFDA 2001, NTP 2000), the imperative to employ alternatives is stronger than ever. Additives mixed in with PVC to make it flexible or rigid are not chemically bound to the plastic and are thus prone to leach from the material. One such additive, a phthalate called 2-diethylhexyl phthalate (DEHP), has been found to leach from soft plastic, and has been documented to have a significant impact on the development of the male reproductive system and the production of normal sperm in young animals (Moore 2001). Also linked with DEHP exposure is respiratory distress, changes in kidney and liver function, ovarian dysfunction and decreased hormone production in females (Rossi 2001).

## Open Burning

Perhaps the most under appreciated source of dioxin emissions is the open burning of household trash.

## CASE STUDY

### Detroit, Michigan:

### Henry Ford Hospital Medical Waste Incinerator

In February 2000, residents of a predominately African-American community in Detroit, Michigan succeeded in their efforts to shut down Henry Ford Hospital's medical waste incinerator. Since it began operating in 1980, the facility had been burning approximately 6 million pounds of waste annually. As of 1998, Henry Ford was the only hospital (of 25 surveyed) still burning medical waste in an on-site incinerator. Environmental justice was a primary concern: the Henry Ford Hospital System owns two other hospitals located in predominately white suburbs that send their waste to a commercial autoclave facility in Toledo, Ohio rather than burn it. This inconsistency fueled local activists.

The Henry Ford Hospital incinerator was a major, chronic polluter. For instance, the only emission controls in place were opacity limits, which do not involve emissions testing, but use a visual estimate of how 'opaque' a cloud of smoke emitted from the stack is. And even those limits had been violated on a number of occasions. Federal pollution controls on emissions of mercury, dioxins and heavy metals had not yet been implemented in Michigan, so the facility burned medical and other waste largely without regulation. The impact on public health was consequently severe. A five year long Michigan Department of Community Health study found the rate of children hospitalized for asthma in the zip codes immediately surrounding the incinerator to be three times that of neighboring Wayne County. Moreover, a report commissioned by the New York University Research Program focusing on Ambulatory Care Sensitive Conditions in Michigan from 1983 through 1994 found that in the four zip codes surrounding the incinerator, the average hospital admissions of children aged zero to four were four times the state average.

A coalition of more than a dozen organizations including Detroiters Working for Environmental Justice, Virginia Park Citizen's District Council, a local Sierra Club chapter, and the Sugar Law Center for Economic and Social Justice worked together for four years before successfully closing the incinerator in the spring of 2000. Strategies included civil disobedience, media attention and coalition building. Yard signs helped draw attention to the fight, and a constant barrage of phone calls and postcards to hospital officials ensured residents' concerns would not be ignored. Steady, targeted pressure on executives within Henry Ford Hospital System was a major factor in the eventual shutdown of the incinerator (Sources: Lott 2004, Holden 1999, Bates-Rudd 2000).

## CASE STUDY

### Oakland, California: IES Medical Waste Incinerator

On December 10, 2001, after a 4-year struggle, Integrated Environmental Systems (IES) was forced to shut down its commercial medical waste incinerator in Oakland, California. Even under "perfect" operating conditions, the incinerator was known to emit dioxins, mercury and other toxic pollutants. The facility was also notorious for all kinds of permit violations including excess emissions, broken monitors, odors, uncontrolled bypasses of the pollution control devices and worker safety violations.

The Coalition for Healthy Communities and Environmental Justice, consisting of Oakland residents and community, health, and environmental justice organizations, formed to bring an end to the IES incinerator. After having ignored emissions and permit violations for years, the Bay Area Air Quality Management District finally took action by declining to renew the facility's operating permit in 2001. When IES insisted on its intentions to keep burning millions of pounds of medical and non-medical waste every year, a powerful direct action was planned and executed by the Coalition. Community protesters blocked the entrance to the IES incinerator for eight hours nonviolently putting their bodies in front of trucks carrying waste.

Owing largely to the community's powerful voices and actions, IES sold its company to competitor Stericycle in December 2001 who is reportedly planning to tear down the incinerators and close the facility (Sources: Greenaction 2001, Greenaction 2001a).

## CASE STUDY

### Gila River Indian Reservation, Arizona: Stericycle Medical Waste Incinerator

Members of the Gila River Indian community near Chandler, Arizona organized as the Gila River Alliance for a Clean Environment and succeeded in forcing Stericycle to shut down a medical waste incinerator operating on tribal land in 2002. The incinerator had been burning medical and non-medical waste from several states for about 10 years, and was among the largest in the U.S. Waste from hospitals, medical and dental offices, mortuaries and research institutes was among the waste being burned. When Stericycle's lease for the facility came up for renegotiation, activists seized the opportunity to push for cleaner technologies like autoclaving. The renegotiated lease will allow only an autoclave on the site. With the closure of this facility, there are now no commercial medical waste incinerators in Arizona, Nevada, or California (Source: Greenaction 2002).

Open burning, also called uncontrolled burning or backyard burning, involves the burning of household trash by residents on their property. Burning typically occurs in a burn barrel, open fireplace or furnace, homemade burn box, wood stove, outdoor boiler or open pit (USEPA 2003e). Most backyard burning occurs in rural areas where there is no curbside trash pickup. According to government surveys, an estimated 20 million people in rural areas burn trash in their backyards (MDEQ 2003).

The smoke and vapors from the open burning of household trash contain many toxic chemicals that can affect people's health and the environment, including dioxins and furans; carbon monoxide; heavy metals such as mercury, lead, arsenic, and cyanide; volatile organic compounds (VOCs) such as benzene, styrene, and formaldehyde; particulates; polycyclic aromatic hydrocarbons (PAHs); and hexachlorobenzene (USEPA 2003f, MDEQ 2003). Exposure to these chemicals have been linked to adverse health problems including, but not limited to asthma, lung cancer, and other respiratory ailments, kidney and liver damage, and nervous system, reproductive and developmental disorders (USEPA 2003g). One study found emissions were highest for VOCs such as benzene and styrene, formaldehyde, hydrogen cyanide and hydrochloric acid, followed by polychlorinated biphenyls (PCBs) and arsenic (MDEQ 2003).

Among the toxic byproducts of backyard waste burning, dioxins and furans may pose the greatest public health threat. Dioxins are highly toxic even at low levels and have been linked to serious health problems in people that include cancer and adverse developmental and reproductive effects (USEPA

2003g, Birnbaum 2003). Dioxins are formed primarily because of low combustion temperatures, poor air distribution, and the presence of chlorine (USEPA 2003h). The majority of chlorine in household trash comes from PVC plastic. Because the emissions from open burning are released close to the ground, they are particularly dangerous to people and animals located nearby. There are also no pollution control devices on these burners.

The backyard burning of household trash also produces residual ash that contains toxic metals such as lead, chromium, mercury and arsenic, as well as PCBs and dioxins (USEPA 2003f, Lemieux 1998). The ash left over from the burning is often used by homeowners in gardens or placed in areas where children may play and come in contact with these toxic substances. In gardens, vegetables can absorb and accumulate the metals (USEPA 2003f).

Open burning was not initially identified by the USEPA as a source of dioxin (USEPA 1998). Now the agency has identified open burning as a major source of dioxins. The USEPA's most recent Inventory of Sources of Dioxin estimated open burning may account for as much as 628 grams TEQ dioxin, making it the second largest source of dioxin emissions in the U.S. (USEPA 2001). The USEPA found a single household burn barrel may release more toxic chemicals into the air than a municipal waste incinerator burning 200 tons of household trash a day that is equipped with state-of-the-art air pollution control devices (Lemieux 1998).

A key study used by the USEPA to estimate the amount of dioxins generated by open burning of household trash was published in 1998 by a New York researcher (Lemieux 1998). The author burned two sets of simulated household garbage in separate metal burn barrels in a controlled laboratory setting and measured emissions from each barrel. One barrel con-

tained simulated waste from a household that did not recycle and the other contained waste remaining after "avid recycling." This study reported high emissions of volatile organic compounds (VOCs) including benzene, polynuclear aromatic hydrocarbons (PAHs), chlorinated benzenes and dioxins and furans. Surprisingly, higher levels of dioxins and furans were found in the emissions from the avid recycling household sample compared to the non-recycler.

## CASE STUDY

### Maine Bans Backyard Burning; Warns Public About PVC Hazards

Reducing dioxin emissions and protecting the health of Maine residents was a high priority when the Maine legislature voted to prohibit backyard trash burning in 2001. This new law and PVC educational outreach followed a citizen advocacy campaign led by the Natural Resources Council of Maine which focused on reducing the use and disposal of PVC because of its role as a dioxin-forming consumer product. A 1997 study found 10,000 backyard burn barrels across rural Maine and documented the high levels of dioxin emissions and exposures that resulted. The law also required the Maine Department of Environmental Protection (DEP) to educate people about dioxin-forming PVC products and their alternatives.

An educational bulletin, poster and flyer prepared and distributed by the Maine DEP contain clear and compelling messages about PVC.

"We can make a difference by RETHINKING our purchasing habits to avoid putting PVC products in the waste stream."

"You can help to reduce dioxin pollution from municipal trash incineration by: REPLACING #3 PVC Products with 'less polluting' natural materials OR safer plastic alternatives #1 PETE, #2 HDPE, #4 LDPE, #5 PP."

"PVC plastics waste is a major source of our dioxin pollution in Maine. It is the only plastic that forms significant amounts of dioxin when burned and has very low recycling rates. It is even preferable to avoid burning PVC in municipal incinerators to reduce air pollutant levels and toxic ash disposal. Safe alternatives exist for virtually every use of PVC plastic."

Maine's educational materials also give clear consumer guidance on safer alternatives to typical uses of PVC plastic. The Maine DEP established the link between open burning and PVC as follows: "In addition to eliminating backyard trash burning, we need to reduce the toxic nature of our waste stream that goes to incineration because of the potential for serious health effects and contamination of our food supply" (Sources: MDEP 2001, MDEP 2001a, MDEP 1997).

A likely explanation for this difference may be the higher proportion of PVC plastic which is not recycled that ends up in the trash of the avid recycling household (4.5% versus 0.2%). According to the author of the study, “the higher proportion of PVC plastic in the avid recycler’s waste stream could potentially increase the formation of chlorinated organic compounds.” Other factors such as time, temperature history, mixing patterns, oxygen availability, as well as the mixture of carbon with chlorine in the presence of metal catalysts are also important factors in the formation of PCDDs (dioxins) and PCDFs (furans) (Lemieux, 2000).

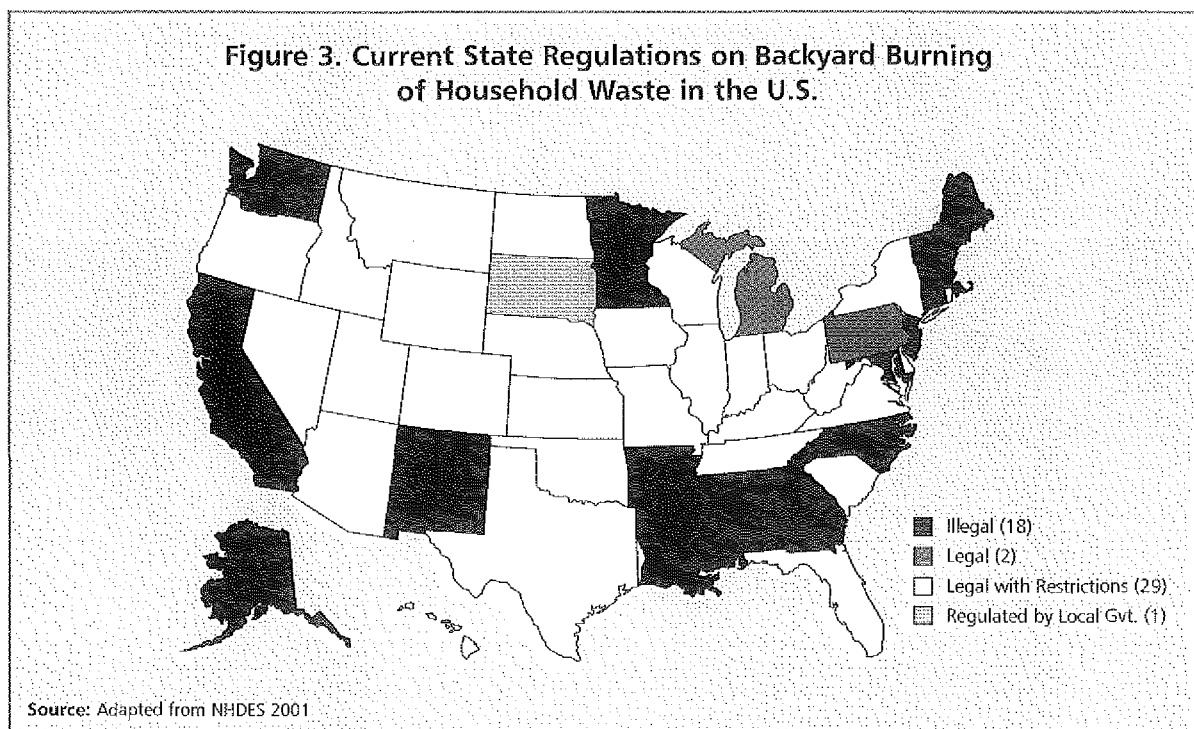
Initially, USEPA considered that PVC content in the waste might be a key determinant of dioxin emissions during open burning (Lemieux 1997, Gullett 1999). They conducted several experiments to evaluate the effect of PVC and chlorine input on dioxin emissions (Gullett 1999, Gullett 2000, Gullett 2001). The latest study concluded that the chlorine in the waste does appear to influence dioxin emissions, but only at high levels not typically found in household trash, and dioxin emissions were independent of the source of chlorine (Lemieux 2003).

A recent reanalysis of this same data found a very strong correlation between PVC and dioxin emissions in the USEPA burn barrel experiments (Neurath 2004). This study found that the percent chlorine, especially

the percent PVC, were “the most important predictors of dioxin emissions”—not combustion variables such as carbon monoxide, temperature, or air input levels as claimed by the USEPA (Neurath 2004). Backyard burning is not like an incinerator where you can control these variables. By definition, uncontrolled burning is uncontrolled. What can be controlled is the type of waste, such as PVC, that is burned.

Open burning of household trash is thought to account for a considerable share of dioxin air emissions in many states including Maine (26%) (MDEP 2004) and New Hampshire (17%) (NHDES 2001). Some states including Massachusetts, Maine, Vermont, Connecticut, North Carolina, New Mexico, and Washington (USEPA 2003i), recognize the threat to public health and have adopted regulations completely banning open burning of household trash. Others, such as Alaska (AKDEC 2004) and California (CARB 2003), while allowing the burning of paper, cardboard and yard waste, have specifically banned the burning of plastic, rubber and other hazardous materials.

Figure 3 includes data originally developed by the New Hampshire Department of Environmental Services and updated in 2004. The figure shows open or backyard burning is illegal in 18 states, restricted in 29 states, completely unrestricted in two states (Michigan and Pennsylvania) and left to local government in one state



(South Dakota) (NHDES 2001, NHDES, 2003, NMED 2004, CARB, 2003a, MRSA 2004). Several states that have yet to enact proper legislation (e.g., Rhode Island, New York, Pennsylvania) have issued public health statements and developed pamphlets warning of the dangers associated with burning plastic, specifically the release of dioxins. The USEPA currently has no regulations that apply to open burning even though they estimate that it is one of the largest sources of dioxin in air (USEPA 2001). To assist in finding current regulations for each state, the USEPA has constructed a virtual map on their Website with links to each state's rules and regulations (USEPA 2003i).

Regulations on open burning typically vary between rural and urban/suburban areas. While generally prohibited in highly populated areas and municipalities, open burning is seldom stringently regulated in rural areas. One reason given for this has been that decisions on whether to restrict or ban open burning of household trash has been driven by citizen complaints (Lighthall 1998). Thus, those communities with enough people to generate a substantial number of complaints are the ones that enact or adopt policies to restrict or ban the open burning of household trash.

Every state has distinct laws though, and even within states, rules are far from uniform. Even in those states and areas where rules and regulations exist, enforcement is extremely difficult. This lack of coherence tends to stifle efforts to curb open burning in general and PVC burning in particular. Unless open burning

can be curtailed or even adequately controlled, it is unrealistic to expect PVC will not be burned. PVC will continue to harm human and environmental health as long as open burning continues to be used to dispose of trash.

In addition to open burning of household trash, vehicle fires, structure fires, construction site burning and landfill fires all represent significant types of uncontrolled PVC combustion. Because PVC is so ubiquitous, the chance that it will be burned in intentional or accidental fires is high.

The cost of waste disposal has risen in recent years, and many rural residents are unable or unwilling to pay these increased costs. Otherwise laudable "pay-as-you-throw" (variable rate pricing) programs in communities across the nation aim to reduce waste, but in rural areas accustomed to paying a fixed rate regardless of the amount of waste they generate, such programs actually tend to trigger an increase in burning and illegal dumping. Rather than reduce the amount of waste generated, the more appealing option for some is illegal dumping and/or open burning. Moreover, proper disposal is often less convenient in rural areas. Burning trash may be a more appealing option than driving long distances to pay for and legally dispose of trash. State and local governments must address matters of affordability and convenience in these areas in order to help bring an end to open burning (MEDEP 1997). In the long term though, replacing PVC with safer alternatives is the only way to eliminate PVC from the waste stream.

# NO PLACE LEFT Problems with PVC in Landfills

## MAJOR FINDINGS

- Dumping of PVC in landfills poses significant long-term environmental threats due to leaching of toxic additives into groundwater, dioxin-forming landfill fires and toxic emissions in landfill gases.
- Land disposal is the final fate of between 2 billion and 4 billion pounds of PVC that is discarded every year in some 1,800 municipal waste landfills.
- Many of the more than 1,900 landfills used for disposal of construction and demolition (C&D) debris are unlined and can not capture any contaminants that leak out of PVC building material waste.
- An average of 8,400 landfill fires are reported every year in the U.S., contributing further to PVC waste combustion and dioxin pollution.

Landfilling is the most common disposal option for PVC and thus is a significant part of the disposal stage of the PVC life cycle. The majority of PVC that is discarded as waste ends up in a landfill. However, landfills do not solve the PVC disposal dilemma. They eventually leak, routinely emit toxic gases and occasionally catch on fire. Landfills merely represent a temporary, polluting alternative to burning PVC and creating dioxins. As an interim strategy, land disposal of PVC is preferable to incineration, but it does not provide a long-term secure solution to PVC waste management.

## Municipal Waste Landfills

In 2001, about 79% of U.S. municipal solid waste destined for disposal was landfilled (USEPA 2003). According to data made available by the USEPA, about 1.42 million tons of PVC was in U.S. municipal solid waste in 2001 (USEPA 2003). This represents less than one percent of the 163 million tons of municipal solid waste disposed of in landfills and incinerators. (This total does not include an additional 49 million tons of municipal discards that were recycled or composted and contained negligible amounts of PVC).

The USEPA data establishes a low-end estimate of about 1.12 million tons of PVC (more than 2.2 billion pounds) that was dumped in landfills in 2001 (USEPA 2003). Using another source of data on municipal waste generation for 2002, the amount of PVC dumped



in landfills was estimated at 2.04 million tons, or more than 4 billion pounds (Kaufman 2004), nearly twice the USEPA amount. This latter estimate assumes the same percent PVC content in the municipal solid waste stream as reported by the USEPA.

The estimated number of active landfills in the U.S. that accept PVC for disposal in municipal solid waste varies. Citing 2002 data reported by 47 states, Kaufman lists a total of 1,767 municipal solid waste landfills (Kaufman 2004). USEPA concluded that 1,858 landfills received municipal solid waste in 2001 (USEPA 2004c). Yet another source estimates that there are 3,200 municipal solid waste landfills (EREF 2004).

Table 8 lists those states that rely heavily on landfilling as a disposal option for municipal solid waste in the U.S. California, Texas and Michigan landfill the most waste. Texas has the largest number of landfills (175), followed by California (161) and Florida (100). A total of 19 states including Texas, Ohio, and Illinois landfill 100% of their waste. A complete listing of the amount of PVC landfilled in each state is show in Appendix B.

The amount of PVC waste going to landfills is expected to increase substantially over the next 20 years. A study in Europe found the amount of PVC waste generated in the 15 European Union countries will increase from 3.6 million tons per year in 2000 to 4.7 million tons in 2010 and to 6.4 million tons per year by 2020 (AEA 2000, ARGUS 2000). This is an increase of more than 75% over 20 years. This is because most PVC products were put into commercial use during the 1970's and their useful service life is ending. Components in cars, construction materials, and electrical, household and industrial goods typically last from 5 to 15 years (AEA 2000). Building materials such as pipes, flooring, and siding may last for decades before being replaced (AEA 2000). As production of these

• • • • • Table 8 • • • • •  
**Estimated Amounts of PVC Discarded in Landfills  
 According to States that Landfill the Most  
 Municipal Solid Waste (MSW)**

State	Number of Landfills	Amount of PVC Landfilled (tons)
California	161	328,260
Texas	175	176,896
New York	26	116,088
Ohio	44	100,509
Illinois	51	98,896
Michigan	52	96,241
Florida	100	76,817
Georgia	60	69,177
Pennsylvania	49	60,844
New Jersey	60	56,166
North Carolina	41	54,842
Indiana	35	52,986
Washington	21	49,128
Virginia	67	48,636
Maryland	20	42,722
Remaining States*	805	610,553
<b>Total</b>	<b>1,767</b>	<b>2,038,761</b>

**Sources and Notes:** Estimates derived from Kaufman (2004) for 2002. The amount of PVC landfilled by each state was calculated by (1) assuming that the percent PVC content of municipal solid waste (0.62%) estimated by the USEPA (2003) is representative of the typical percentage of PVC in the waste stream; (2) assuming that post-consumer recycling of PVC in MSW is zero; (3) multiplying the average percent PVC in the waste (0.62%) by the total waste generated in that state according to Table 4 in Kaufman (2004); and (4) multiplying this value (the total PVC disposed in the state) by the percent of waste landfilled after recycling as shown in column 2 above. The percent of PVC landfilled after recycling was determined by dividing the total amount of waste landfilled in a state (provided in Table 4 of Kaufman 2004) by the total waste disposed of (after recycling).

\* AL, AK, and MT did not report any data (see Appendix B).

PVC materials has been on going for more than 30 years, the PVC waste that is entering the waste stream today is a reflection of the products put in use years ago. An estimated 300 billion pounds of this PVC will require disposal worldwide in the coming years (van der Naald 1998).

## Construction and Demolition Waste Landfills

PVC is also found in construction and demolition (C&D) waste. C&D waste is generated from the construction, renovation, repair and demolition of structures such as residential and commercial buildings, roads, and bridges (ICF 1995). Franklin Associates

(under contract to the USEPA) estimated that 136 million tons of building-related C&D debris was generated in 1996 (FA 1998). This figure did not include road, bridge and land clearing debris. C&D waste consists mainly of wood products, asphalt, drywall and masonry waste with lesser quantities of metals, plastics including PVC, dirt, shingles, insulation, paper and cardboard (ICF 1995). The percentage of PVC in C&D waste is hard to estimate. One report specifically identified and estimated the percent of vinyl siding and PVC pipes in C&D waste to be 0.63% for the two materials combined (FA 1998). Other types of PVC plastic waste were not considered.

In 2002, forty-two states reported that 1,931 landfills were dedicated for disposal of C&D waste (Kaufman 2004). Many if not most of these landfills are unlined, offering groundwater supplies even less protection from contaminants that may leach from PVC and other C&D waste components.

## The Hazards of Landfill Disposal of PVC

There are significant dangers associated with the dumping of PVC in landfills. Although there appears to be little degradation of the PVC polymer (ARGUS 2000, Mersiowski 1999), the additives present in PVC products are not chemically bound to the PVC and they will seep out into the environment over time (CEC 2000). These additives include plasticizers, stabilizers, pigments, fillers and other chemicals that are added to PVC depending on the final product's intended purpose (see Chapter 3). Many of these additives leach out in the disposal phase (Mersiowski 1999). This is especially true of flexible PVC products. In the case of the rigid PVC products, stabilizers are generally thought to be encapsulated in the matrix of the PVC polymer and thus migration is expected to be less than what occurs with the plasticizers (ARGUS 2000, AEA 2000, Mersiowski 1999).

In landfills, PVC (as well as all waste) is subject to different reactive conditions such as moisture, changing temperatures, the presence (or absence) of oxygen, and the activity of microorganisms (CEC 2000). These factors will interact with the waste at different stages of the aging process. Recent studies evaluating the behavior of PVC in landfills found that microorganisms and/or corrosive liquids common to landfill environments act to accelerate the release of additives in PVC products (Mersiowski 1999, Hjertberg 1995).

Cadmium, lead, organotins and phthalates (which account for over 90% of plasticizers) are commonly released from PVC waste in landfills (Mersiowski 1999, Hjertberg 1995). In studies evaluating the leaching of bisphenol A (BPA), an additive used in many plastics, PVC was found to release the highest concentrations of BPA (Yamamoto 1999). These additives will mix with water and other substances in the waste and generate "leachate" which will contaminate local groundwater in the vicinity of the landfill.

Leachate generated by waste in landfills has been detected in groundwater monitoring wells at numerous garbage landfills (Lee 1996). One study in California reported that 72% of 528 landfills had polluted the nearby groundwater (Lee 1996). The USEPA passed regulations in 1991 to control landfill leachate (USEPA 1991). These regulations have been criticized for relying on a "fundamentally flawed technological approach for MSW management that at best only postpones when significant environmental problems will occur as a result of the landfilled waste" (Lee 2003).

Estimates have been made of the amount of lead present in landfills that are attributable to lead additives in discarded PVC products. These estimates range from 1 to 28% (CEC 2000). In 1998, an estimated 51,000 tons of lead were used as stabilizers in plastic in Europe (CEC 2000) and an estimated 6 billion tons were used worldwide in 2000 (Tukker 2001). Much of this lead will end up in landfills and can be expected to be a significant source of lead being released into the environment (NCM 2003). The key question is how much of the lead will be mobilized and released into the environment and when. Although the mobility of lead is generally thought to be low, small amounts will slowly leak out. Over time, this could lead to substantial amounts of lead being released into the environment. One study in Europe reported that an estimated 8 kilotons of lead from PVC entered the waste stream and that 0.5 kilotons was released into the environment in 2000 (Tukker 2001). Given the longevity of PVC products, it can be expected that lead leaching from discarded PVC products in landfills will continue to be a health and environmental threat for many years to come.

The lack of adequate liners and/or leachate treatment in many old landfills (and even some new ones) ensures that these releases have an easy route into surrounding groundwater and soil. Many construction and demolition debris landfills are completely unlined. Most old landfills contain no liner or collection system to prevent leachate generated in the landfill from mixing with and

contaminating local groundwater. This leachate will seep down through the waste and eventually contaminate groundwater with hazardous and toxic chemicals (Lee 1994).

Even landfills equipped with the best liners and most up-to-date treatment methods cannot ensure long-term safety. In instances where liners or collection systems have been installed, leachate is still generated. When it reaches the bottom of the landfill, it is collected by a system of pipes and treated. The treated leachate is often sprayed back onto the waste and eventually collected again. If these pipes clog up, the leachate will accumulate in the landfill and create pressure on the liner. Eventually, this pressure will force the leachate out at the point of least resistance, usually the bottom of the landfill when the bottom liner fails.

These collection systems can be clogged by silt or mud, the growth of microorganisms in the pipes, or chemical reactions leading to the precipitation of minerals in the pipes. The pipes may also become weakened by chemical attack (acids, solvents, oxidizing agents or corrosion) and may be crushed by the tons of garbage piled on them (ERF 1989)

The liners used in landfills are generally made from high-density polyethylene (HDPE). These liners can be degraded by a number of household chemicals that can cause them to either lose strength, soften or become brittle and crack. Liners will also tear during installation or as a result of pressure from the weight of the waste. There may also be defects in the liners such as cracks, holes and faulty seams that allow leachate to pass through the liner (ERF 1992). One study found certain organic chemicals, such as chlorinated solvents, benzene, trichloroethylene (TCE) and vinyl chloride, can readily pass through an intact liner (i.e., a liner with no holes) in a short period of time (Haxo 1988). This finding has been confirmed in separate studies (Sakti 1991, Buss 1995, Lee 1996). Eventually, all landfills will leak whether they have a liner or not (ERF 1992, Bonaparte 1990, Lee 1992) and threaten the health of residents living nearby (ERF 1998). Landfills cannot guarantee safe, long-term disposal of PVC wastes and their by-products.

Landfill fires present another cause for concern. These fires generate a range of hazardous gases including carbon dioxide, carbon monoxide and hydrogen chloride. Dioxins and furan are also formed (USEPA 2001). Such fires are not uncommon. An average of 8,400 landfill fires are reported each year in the U.S. (FEMA 2002) and their ignition can be traced to a number of

causes. Though over half of reported fires have no information available as to the initial cause, 40% of reported fires are classified as deliberate or suspicious; 20% are attributable to smoldering waste, and 5% ignite spontaneously. Highly flammable methane gas, released by landfilled waste as it decays is a primary factor in many cases.

PVC products disposed of in landfills contribute to the formation of dioxins and furans in the event of a fire. Four PVC products—pipes, rigid foils, floorings and cable wires—contribute about 40% of the chlorine content in landfills (Mersiowsky 1999). As previously discussed, the chlorine in PVC contributes to the formation of dioxins. Other factors that influence the amount of chlorinated dioxins and furans formed include fire temperature, and the availability of oxygen and catalysts (e.g., copper). Lower oxygen concentrations and lower temperatures (500-700° C) correspond with elevated dioxin formation (Moeller 1996). Both these conditions occur frequently at landfill fires.

Measured concentrations of dioxins and furans in the air of landfill fires are generally high and consistent with evidence gathered from test fires (Ruokojärvi 1995). As is the case with open burning, these air emissions are unfiltered and largely uncontrolled (see Chapter 3).

Another concern with landfills is the generation of landfill gases. All municipal waste landfills generate gases that result from the degradation of materials in the waste (USEPA 1995). The most common landfill gas is methane that results from the degradation of biological matter in the waste stream. Other common landfill gases include vinyl chloride, benzene, toluene and dichloroethane (ATSDR 2001). These volatile gases result from the breakdown of waste components present in the landfill. When PVC degrades, plasticizers and other additives leach out, and some of these evaporate and contribute to the landfill gases (ARGUS 2000).

Older landfills made no attempt to vent or control these gases. As a result, there were many explosions in homes and buildings located near solid waste landfills caused by the migration of methane gas, a highly explosive substance (USEPA 1990, Lee 1994). More modern landfills attempt to capture these gases using a gas collection system. These systems consist of a series of wells installed throughout the landfill that are used to pull out the gas. A series of pipes connect the wells and carry the gas to either a flare where it is burned or to an energy recovery system where the gases are con-

verted into electricity (USEPA 1990). The flares can be a source of dioxins if chlorinated chemicals such as vinyl chloride are present in the landfill gases (USEPA 2001, Eden 1993).

Since 1996, large landfills have been required to have gas collection systems, which, the USEPA maintains, capture 75% of the gases (USEPA 2002b). However, there is no factual basis for this number. There are no studies that define the collection efficiency of these systems. Instead, this estimate is intended to reflect the best achievable efficiency while the systems are operating. The flaws in EPA's estimate are two fold. First, more of the gases are emitted both before the systems are installed and after they are removed from service, than during the time they are functional. Second, most landfills do not achieve best practices, especially because there is no way to measure emissions that might disclose poor efficiency, other than by detecting odor problems, which is just the manifestation of the worst fugitive emissions. A study that includes these factors found that there is no factual basis to conclude

that, in practice and on a lifetime basis, more than 20% of the landfill gases generated are actually captured and either flared or used to recover energy (Anderson 2004a).

Landfills are also used to discard the residual ash generated when PVC products are incinerated. This ash contains dioxins and many heavy metals that will eventually cause many of the same leaching problems and threats to groundwater discussed earlier (USEPA 1994a, ERF 1990, Denison 1988). Clearly, landfills do not solve the disposal dilemma. They merely present a temporary, polluting alternative to burning PVC and creating dioxins. As an interim strategy, land disposal of PVC in a hazardous waste landfill may be preferable to incineration, but it poses its own environmental and public health threats and does not provide a long term secure solution to PVC waste management. Avoiding the generation of PVC-containing waste is the only sure way to prevent the problems associated with either landfill disposal or incineration of PVC waste.





◆ ◆ ◆ ◆ ◆ Table 9 ◆ ◆ ◆ ◆ ◆  
**Typical Composition of PVC Products and Materials**

Application	Share of the Components (weight - %)				
	PVC Polymer	Plasticizer	Stabilizer	Filler	Others
<b>Rigid PVC Applications</b>					
Pipes	98	—	1-2	—	—
Window Profiles (lead stabilized)	85	—	3	4	8
Other profiles	90	—	3	6	1
Rigid film	95	—	—	—	5
<b>Flexible (soft) PVC Applications</b>					
Cable installation	42	23	2	33	—
Flooring (calander)	42	15	2	41	0
Flooring (paste, upper layer)	65	32	1	—	2
Flooring (paste, inside material)	35	25	1	40	—
Synthetic leather	53	40	1	5	1
Furniture films	75	10	2	5	8
Leisure articles	60	30	2	5	3

Source: Prognos 1994, Prognos 1999, Totsch 1990 as cited in Plinke, 2000.

is necessary to reprocess the PVC back into its original formulation and to retain the unique properties of the original formulation (Plinke 2000, Thornton 2000). This problem is further complicated because PVC formulations for the same materials have changed over time.

There are other problems with mixing PVC with other plastics. One difficulty is color. Recycled products must be separated by color, which in most cases is not practical (Plinke 2000). Another difficulty is that soft PVC cannot be used in rigid PVC applications, and rigid PVC cannot be used in soft PVC applications since the material has to be reformulated (i.e., new additives need to be added). Thus, when different formulations of PVC are mixed together, it becomes virtually impossible to create a formulation that can be used for any application that requires specific properties.

As a result, a lower quality PVC plastic is produced which cannot be used for the same purpose as the original product (Plinke 2000). Thus, PVC can never be truly recycled into the same quality material. It usually ends up being made into lower quality products with less stringent requirements such as speed bumps, parking bumpers, or park benches. The loss of quality in a material during recycling is called "downcycling." The downcycling of plastics is common because of the difficulties in separating out the components with different additives (Plinke 2000). PVC that is downcycled does not reduce

the overall demand for the raw materials (virgin resin) used in making plastic, and has no effect on the amount of vinyl produced each year (Denison 1997).

In Europe, where PVC recycling has received greater attention, the vinyl industry has claimed greater progress in PVC recycling than is actually the case. Instead of measuring recycling progress against the total amount of PVC waste generated, the industry instead limited its recycling goals to the much smaller fraction of PVC waste that they deem to be economically "collectable" and "available." With this distortion the European industry claimed that they achieved their goal of recycling 25% of PVC waste window frames, pipes and fittings, and roofing membranes by 2003. In fact, actual PVC recycling rates were less than 5% for pipes and fittings, 6% for roofing waste and 16% for window frames (ENDS 2004).

The PVC industry's distortion of its recycling progress can't hide the facts. Throughout Europe, the total amount of PVC recycled in 2003 was 2% to 3%, matching only one-fifth of the industry's modest goal of recycling 10% to 15% of all PVC (not just what's collectable and available) by 2010 (ENDS 2003). These modest gains are being rapidly overshadowed by the projected 50% to 80% increase in PVC waste generation over the next twenty years (ENDS 2003, ENDS 2004).

Compare the 2% to 3% PVC recycling rate in Europe (which far outpaces the 0.1% to 3% U.S. PVC recycling rate) with the recycling rates for other commonly discarded products in the United States in 2001: auto batteries (94%), yard trimmings (57%), steel cans (50%), aluminum beer and soft drink cans (49%), paper and paperboard (45%), PET #1 plastic soft drink bottles (36%), tires (31%) and glass containers (21%) (USEPA 2004c).

To further cover its poor recycling record, the vinyl industry has taken to re-labeling PVC waste incineration as recycling. For example, the European Council of Vinyl Manufacturers describes trials of several new PVC "recycling" technologies. These include PVC waste incineration at a Dow Chemical plant in Leipzig, Germany to recover hydrochloric acid, and the chemical processing of waste PVC and mixed plastics to help fuel a steel plant in the Netherlands (ENDS 2003). They also included a proposed PVC waste gasification plant to make hydrochloric acid and a fuel gas, which was later abandoned by Solvay in France due to costs and technical problems (ENDS 2003). High temperature processing of PVC waste will form chlorinated

dioxins and furans and other toxic byproducts and can only be properly classified as incineration or waste treatment, not recycling.

## Impacts on the Recycling of Other Materials

The difficulty in separating PVC from other plastics, such as polyethylene terephthalate (PET) bottles or nylon carpet facing, makes it extremely difficult, if not impossible, to recycle those otherwise recyclable materials. PVC also increases the toxic impacts of recycling of other valuable commodities such as copper from wiring and cable used in electronics like computers, steel from the scrapped automobiles and corrugated cardboard containers sealed with PVC tape. These examples are summarized in Table 10 and discussed below.

### Plastic Bottles

PVC severely impacts the recyclability of other plastics such as polyethylene terephthalate (PET or sometimes PETE). Bottles made of PET and high density polyeth-

◆ ◆ ◆ ◆ ◆ Table 10 ◆ ◆ ◆ ◆ ◆  
**PVC Contaminates the Recycling of Many Materials and Products**

Material and Product	PVC Use	PVC as Contaminant
Polyester from PET plastic (#1) bottles <sup>1</sup>	PVC and PET bottles are commingled in all bottle recycling efforts	Due to similar densities, it is difficult and expensive to separate PVC from PET; the presence of even a little PVC ruins PET recycling during processing.
Nylon facing from carpets <sup>1</sup>	Backing of carpet	PVC can't be readily separated from nylon; it contaminates it and results in "down-cycling."
Copper from wires and cables of electronics <sup>2</sup>	Plastic sheathing of wires and cables	The PVC on wires and cables with low copper content are burned at secondary copper smelters releasing dioxins and toxic additives and by-products.
Steel from automobiles <sup>3</sup>	Undercoating, wiring, interior and exterior trim, other plastics in autos	After shredding, most non-metal "fluff" is landfilled, but some PVC mixed with the steel is burned in electric arc furnaces.
Cardboard from boxes <sup>4</sup>	Tape and other binders used to seal boxes	After separation from corrugated cardboard, PVC plastic is burned at the paper mill.
Scrap wood from C&D <sup>5</sup>	Siding, pipes, window frames, flooring and other building materials	PVC scraps contaminate the waste wood extracted from C&D waste which is chipped to burn as a cheap fuel in "biomass" boilers.

Sources: 1 - Anderson 2004; 2 - SVTC 2004; 3 - CCC 2004; 4 - SCC 1988; and 5 - MDEP 2004a.



ylene (HDPE) make up 95% of all plastic bottles compared to only about 2.3% for PVC bottles (Anderson 2004). PET bottles (recycling code #1) are commonly used to contain water, soda, vegetable oil and many other products (Anderson 2004) and are highly recyclable. Lower quality recycled PET (which has greater tolerance for contaminants such as PVC) is often used to make a polyester fabric known as “fiberfill” that is used in coats, sleeping bags, pillows and carpeting. However, higher quality recycled PET (containing very little PVC) is increasingly being recycled directly back into bottles. It also has an economic benefit as it is sold for fiber at seven times the price of PET contaminated with PVC (Anderson 2004).

When PVC is mixed together with PET or other highly recyclable plastic, such as in the “all-bottle” recycling programs favored by the plastics industry, the few PVC bottles likely to be collected will be virtually indistinguishable from PET containers due to their similar appearance and density. Sophisticated separation technology that uses optical systems is available to identify and remove unwanted plastic bottles, such as PVC (USEPA 1993). However, the effectiveness of these systems is greatly reduced when the bottles are damaged or dirty. This makes accurate readings difficult to achieve and as a practical matter separation of PVC almost impossible (USEPA 1993, Anderson 2004).

If the PVC cannot be separated from the PET, it will severely effect the processing of the PET bottles into reusable plastic resin. This is because PET and PVC behave very differently when they are processed for recycling. PVC burns at a lower temperature than PET. It burns at the temperature that simply melts PET (Anderson 2004, EAF 1993). When this occurs, “black spots” get into the PET resin contaminating the batch and ruining or seriously downgrading the quality of recycled PET residue (Anderson 2004). According to one plastics recycler, “introducing one PVC bottle into the recycling process can contaminate 100,000 PET bottles” (Anderson 2004, EAF 1993). In addition, when PVC is melted, it generates hydrochloric acid, which will damage the processing equipment (OSWM 1993).

Despite these difficulties, the vinyl industry partially subsidized PVC bottle recycling in the mid-1990s (Anderson 2004). This effort failed miserably. At best, barely 2% of the bottles were recovered (Anderson 2004). Instead, truckloads of PVC plastic waste were landfilled (Denison 1997) leading the Association of Post-Consumer Plastic Recyclers (APR), a recycling industry trade group, to declare that vinyl products are “unrecyclable contaminants” in the recycling of PET

and HDPE bottles (PMF 2003). APR later abandoned its efforts to establish viable markets to recycle PVC (RT 2001). A report on the recycling of PVC waste prepared for the European Union similarly concluded “mechanical recycling is not qualified to contribute significantly to the management of PVC post-consumer wastes in the next decades...” (Plinke 2000).

More recently, a report released by the GrassRoots Recycling Network (a group of community activists and recycling professionals advocating for zero waste and sustainable communities) concluded that PVC bottle recycling is negligible today and that at most 0.3% of PVC bottles were recycled in 2001 (Anderson 2004). The report provides details of how PVC recycling of bottles does not exist, cannot exist, and is not wanted even by the plastics recycling industry. The only solution is a total phase-out of PVC and a rejection of programs encouraging curbside pickup of PVC that ultimately cause more harm than good.

## Electronics

An estimated 26% of the plastic used in electrical and electronic equipment is made of PVC (MCTC 1996). The cabling of computers and other electronics is currently a major application of PVC in electronics, although it can be found in the housings of older computers that may still enter the waste stream (SVTC 2004).

When these consumer products reach the end of their useful life, components can be recovered and reused. Recyclers strive to recover valuable metals, such as copper from the wiring of these electronics. This is done by mechanical removal of the plastic sheathing, but it is only economical when the copper content is high. Most PVC cables from consumer electronics do not contain enough copper and so are bundled and shipped to a secondary copper smelter. Once there, the PVC plastic is burned off from the copper, a known catalyst of dioxin formation. Thus, recovery of copper wire results in toxic emissions including dioxins and furans to air and ash (SVTC 2004, USEPA 2001).

Smelting can present dangers similar to incineration. A report on the recycling of computer parts raised concerns that the Noranda Smelter in Quebec, Canada, where much of the North American “electroscrap” is sent, is “producing dioxins due to the residual presence of PVC or other plastics in the scrap” (SVTC 2004). Noranda has denied that this facility presents a “pollution hazard.” Secondary copper smelters, such as the one operated by Noranda, have been identified as one of the highest sources of dioxin emissions in the U.S. (USEPA 2001).

## Automobiles

Cars currently produced in North America average about twenty-four pounds of PVC per vehicle, according to plastics manufacturers (APC 2004). When the hulks of old cars are shredded, some of the PVC plastic mixes with the scrap metal which is melted down to make recycled steel. The high temperature and possible metal catalysts trigger formation of dioxins and furans. The vinyl industry advocates burning the plastics-rich automotive shredder residue (ASR or "fluff") either with municipal solid waste or in a cement kiln (VI 2004b). This will further contribute to dioxin formation from the chlorine present in automotive vinyl materials and formation of toxic PVC by-products (Singhofen 1997, CCC 2004).

The main uses of PVC in automobiles include underbody coatings and sealants, wire harnesses, dash boards, door panels, arm and head rests, upholstery, heating and cooling ducts, floor mats, spray-on sound deadener, seat belt latches, seat covers, mud flaps, and exterior trim such as body side protection strips, weather strips and window sealing profiles (APC 2004, VI 2004c, CCC 2004). PVC is the second largest volume plastic for automotive use in North America (APC 2004).

## Carpets

The disposal of carpets in municipal and construction and demolition waste adds PVC from carpet backing to the solid waste stream. Two progressive companies controlling just ten percent of the market have achieved a modest 22% recycling rate for PVC carpet backing. But mechanical separation used by companies such as Interface Fabrics leaves too much PVC contaminant in with the nylon. PVC burns at the same temperature that nylon begins to soften and destroys the separated nylon fibers (Anderson 2004). Another company that uses recycling (Collins & Aikman) must downcycle the entire carpet to a lower value carpet backing, losing the nylon fibers for reuse and requiring virgin materials for new carpet facing (Anderson 2004).

Truly closed loop recycling for carpets, in which the facing and the backing fibers are recycled back into their original uses, remains elusive (Anderson 2004). And the modest success earned by recycling of PVC carpet backing can't be readily translated to other uses of PVC. The carpet makers enjoy a large volume, steady supply of discards with a relatively standard formula of PVC, unlike the variable PVC mixtures used in so many other far-flung products that are difficult to collect and recycle for a high end use (Anderson 2004).

## Old Corrugated Cardboard (OCC)

Another use of PVC is to make packing tape that binds corrugated cardboard boxes. After this cardboard is used, it is broken down and returned to a paper mill for recycling. Any tape or plastic binding used to seal the cardboard is removed and separated from the cardboard, and then burned in the mill's industrial boilers. When this tape or binding is made of PVC and burned, another source of dioxin is created (SCC 1988). The Smurfit-Stone Container cardboard recycling facility in Missoula, MT processes up to 525 tons of old corrugated cardboard (OCC) per day. This mill generates about 15 to 25 tons per day of "OCC rejects" that consist of plastic packing tape, plastic twine and other non-cardboard contaminants, some of which is made of PVC (WVE 2002). Dioxins and furans have been identified in the air emissions of pulp and paper mills (USEPA 2004d).

## Scrap Wood

Pressures are increasing to burn more scrap wood for fuel and power in so-called "biomass" boilers that are a proven source of dioxin emissions (MDEP 2004). Yet it is increasingly likely that PVC siding, window frames, roofing foils and other vinyl building materials will become mixed with scrap wood recovered from construction and demolition debris. When chipped and burned, this PVC-contaminated wood scrap is likely to add to the amount of dioxins formed.



# DON'T BUY IT

## Safer Alternatives to PVC are Available, Effective and Affordable

### MAJOR FINDINGS

- PVC is the most environmentally harmful plastic; many other plastic resins can substitute more safely for PVC when natural materials are not available.
- Safer alternatives to PVC are widely available and effective for almost all major uses in building materials, medical products, packaging, office supplies, toys and consumer goods.
- PVC alternatives are affordable and already competitive in the market place.
- In many cases, the alternatives are only marginally more costly than PVC, and in some cases the costs of the alternative materials are comparable to PVC when measured over the useful life of the product.
- Phasing out PVC in favor of safer alternatives is economically achievable.
- A PVC phase-out will likely require the same total employment as PVC production (an estimated 9,000 jobs in VCM/PVC resin production, and 126,000 jobs in PVC fabrication) by making the same types of products from safer plastic resins.

Safer alternatives to the use of PVC plastic are widely available, effective and affordable. These alternatives pose fewer toxic chemical hazards than those associated with the manufacturing, use and disposal of PVC. In many cases, they completely avoid the formation of chlorinated by-products of combustion, e.g., dioxins, because they are chlorine-free; they also prevent the release of other harmful chemicals because they do not contain additives such as phthalates, lead, cadmium or tin, which are commonly found in PVC formulations.

Safer alternatives to PVC come in several forms including natural materials, as well as other synthetic plastics that are cleaner than PVC. For instance, instead of a vinyl shower curtain, a cloth shower curtain, wood clapboard siding or glass door easily does the job. For some people, the perceived aesthetic value of these natural materials further outweighs the comparative appearance of the PVC products. For others, the perceived convenience of lower maintenance tips the balance in favor of synthetic materials.

Even so, other cleaner plastics will do the same job as PVC without the high degree of toxic impacts throughout their life cycle. For example, a polyurethane-coated nylon shower curtain will repel water as well as one made of vinyl. The newly marketed polyethylene-based plastic siding avoids the toxic impacts associated with vinyl siding.

## Many Other Plastic Resins are Safer Than PVC

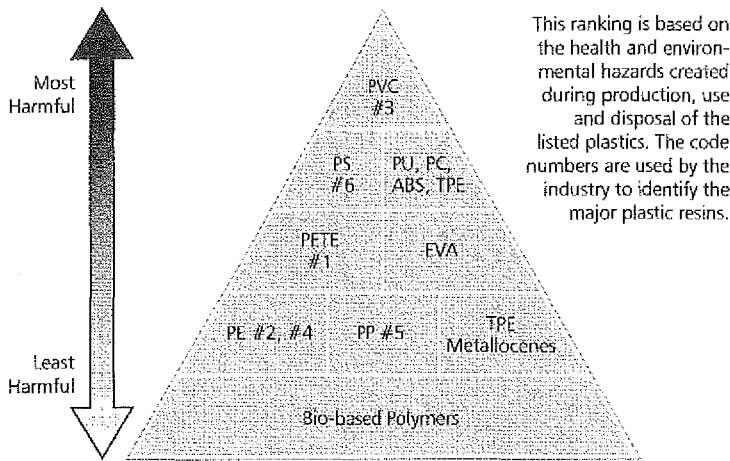
Not all plastics or synthetic polymers are created equal. In a study of all major packaging materials conducted for the Council of State Governments in the U.S., PVC was found to be the most damaging of all plastics (Tellus 1992). A life cycle analysis conducted by the Danish EPA found that common plastics, such as polyethylene, polypropylene, polystyrene, PET and ethylene-propylene synthetic rubber, were all clearly preferable to PVC in terms of resource and energy consumption, accident risk and occupational and environmental hazards (Christiansen 1990).

This ranking of the major plastic resins from most harmful to least harmful is reflected in a revision of the Plastics Pyramid, originally developed by Greenpeace, shown in Figure 4 (DEPA 1995, van der Naald 1998, Tickner 1999a). The ranking qualitatively accounts for the toxic chemical hazards associated with the manufacture, use and disposal of plastics. Similar in concept to the federal government's Food Pyramid, the most harmful items at the narrow top of the pyramid should be avoided or used sparingly, while liberal advantage should be taken of the least harmful items listed at the broad base of the pyramid.

PVC clearly ranks as the most harmful plastic due to its high chlorine content, the toxic intermediate compounds used to produce PVC, the many toxic additives routinely added and its toxic by-products of combustion. PVC products, especially bottles and packaging, are sometimes labeled with the code number "3" (or the letter "V") based on a system used by the plastics industry to distinguish among the major plastic resins.



Figure 4. A Plastics Pyramid



This ranking is based on the health and environmental hazards created during production, use and disposal of the listed plastics. The code numbers are used by the industry to identify the major plastic resins.

**A key to the plastics and some hazards associated with production, use and disposal**

Level 1	PVC = Polyvinyl chloride	Chlorine, intermediates, many additives, byproducts
Level 2	PS = Polystyrene	Intermediates, fewer additives, some byproducts
	PU = Polyurethane	Some chlorine used, intermediates, waste byproducts
	ABS = AcrylonitrileButadieneStyrene	Hazardous intermediates, difficult to recycle
	PC = Polycarbonate	Some chlorine used, intermediates, toxic solvents, BPA
	TPE = Thermoplastic Elastomer	A copolymer or alloy of conventional plastic
Level 3	PETE = Polyethylene terephthalate	Some hazardous chemicals, high recycling rate
	EVA = Ethyl vinyl acetate	Chloride catalyst, some byproducts
Level 4	PE = Polyethylene	Fewer additives, some byproducts, high recycling rate
	PP = Polypropylene	Fewer additives, some byproducts
Level 5	Bio-based Polymers	Naturally based, e.g. starch, cellulose; compostable

Sources: DEPA 1993, van der Naald 1998, Tickner 1999a.

The next level of the pyramid lists plastics that are still harmful but less so than PVC. These include polystyrene (PS), used for plastic cups and utensils and to make Styrofoam, and polycarbonate (PC), used to make compact discs and most reusable water bottles. PC releases a chemical known as bisphenol A (BPA) which is known to interfere with the functioning of the hormone system in lab animals and, as an endocrine disruptor, may pose a hazard to human health (Colborn, 1996). Acrylonitrile Butadiene Styrene (ABS) and polyurethane (PU) are also hazardous, but they are less toxic, persistent, and bioaccumulative than PVC.

The plastics in the middle of the ranking are even less hazardous than PVC and the other plastics higher on the pyramid. These include the polymer most often found in plastic beverage bottles, including bottled drinking water, known as polyethylene terephthalate (PET or PETE) (code # 1). Although hazardous chemicals are involved in the production of PET, it is recycled at a relatively high rate for plastics (19%) (USEPA 2003), especially in the eleven states that have

a returnable deposit on the sale of bottles of beer, wine, soda and other beverages.

Two high volume synthetic plastics are found near the base of the pyramid because they are far cleaner than PVC. These are polyethylene and polypropylene. Although these are both synthetic resins derived from nonrenewable fossil fuels, they are produced without toxic intermediates and far fewer additives or toxic by-products. Polyethylene, which ranks first in production among all resins, comes in two major versions: high density (HDPE or # 2), which is widely used in many applications, and low density (LDPE or # 4), which is commonly used in plastic bags. Both types are highly recyclable. Polypropylene (PP or # 5), often used for containers for products such as yogurt and prescription drugs, can readily be recycled but few recycling markets have been developed.

Even more environmentally preferable are the bio-based polymers, which are derived from natural renewable materials such as cornstarch or cellulose and which can be composted into beneficial organic matter to enrich soils rather than landfilled or incinerated. The Interface Fabrics company, among others, is pilot testing textile fibers made from bio-based polymers. An even higher standard would give preference to bio-based plastics developed from sustainable agricultural practices (e.g., without the use of pesticides and minimal fossil fuel inputs) that do not rely on genetically modified organisms or displace food products from serving the marketplace. Genetically engineered products should not be used in making bio-plastics.

Minimizing the disposal impacts of PVC favors the use of natural organic-based materials whenever practical because they biodegrade and represent a renewable resource. In many cases, however, a durable man-made plastic offers unique advantages to alternatives made of organic matter, minerals or metals.

Fortunately, as Figure 4 shows, many other synthetic plastic resins are widely available for product manufacturers to choose from to avoid the harmful impacts of PVC. And the emergence of bio-based plastics in the commercial marketplace gives an even greater boost to the success of sustainable production and environmentally preferable purchasing.

## Safer Alternatives to PVC are Widely Available and Effective

PVC-free alternatives are already widely available for many applications. Several extensive reports have identified available and affordable alternatives to PVC (Ackerman 2003, Thornton 2002, Greenpeace 2001). Table 11 provides a few examples of available PVC-Free alternatives for several common PVC products. The sources reviewed below provide specific guidance on which vendors currently provide alternatives to specific products representing some of the most common uses of PVC. Several of these resources are searchable online databases of PVC-free products. The alternatives described can be currently found in the marketplace and are functionally equivalent, i.e., are as effective as a PVC product for the specified end use.

### Building Materials

Effective alternatives are available now for most construction-related uses of PVC. Several databases, such as those offered by the Healthy Building Network (HBN 2004: <http://www.healthybuilding.net/pvc/alternatives.html>) and Greenpeace (Greenpeace 2004: <http://archive.greenpeace.org/toxics/pvcdatabase>), list these alternatives. A large number of construction projects, including the Sydney 2000 Olympic Stadium and the new EPA headquarters in Washington, DC have been constructed with little or no PVC (Greenpeace 2001, Greenpeace 2004b).

### Medical Products

The Sustainable Hospitals Project is an excellent resource for healthy medical products, including PVC-free alternatives for gloves, bags and tubing. They operate a Website that includes extensive listings of products by category, by "hazard" or by manufacturer (SHP 2000: [http://www.sustainablehospitals.org/cgi-bin/DB\\_Index.cgi](http://www.sustainablehospitals.org/cgi-bin/DB_Index.cgi)).

### Office Supplies

The Lowell Center for Sustainable Production has identified alternatives to the use of PVC in office supplies (SHP 2000: [http://www.sustainablehospitals.org/cgi-bin/DB\\_Index.cgi](http://www.sustainablehospitals.org/cgi-bin/DB_Index.cgi)). For example, instead of the common vinyl-coated three-ring binder, you can purchase an equivalent binder made of polypropylene with recycled content.

### Packaging

The Grassroots Recycling Network has identified specific brand products that are currently packaged in PVC

● ● ● ● ● Table 11 ● ● ● ● ●  
**PVC-Free Alternatives to Common Materials**

PVC Product	Available Alternatives	Affordability
Automobile Components	Polyolefins <sup>1</sup>	Competitive for most uses <sup>1,2</sup>
Blinds	Wood <sup>3</sup> , Aluminum <sup>3</sup>	Varies
Bottles	High Density Polyethylene (HDPE) <sup>4</sup> polypropylene (PP) Polyethylene Terephthalate (PET) <sup>4</sup>	Slightly more expensive. Costs expected to go down with increased market share.
Flooring (Hard)	Bamboo <sup>5</sup> , Ceramic Tile <sup>5</sup> Recycled Glass Tile <sup>5</sup>	Bamboo is comparable to vinyl. <sup>5</sup> Ceramic and recycled glass are more expensive. <sup>5</sup>
Flooring (Resilient)	Cork <sup>6</sup> , Stratica <sup>6</sup> , Linoleum <sup>6</sup>	Alternatives cost more up front but last nearly twice as long. Savings of 30-50% over 20 years. <sup>6</sup>
Gloves	Nitrile <sup>7</sup>	Cost competitive when purchased in large quantities <sup>7</sup>
Medical Bags, Tubing, Etc.	Polyurethane <sup>7,8</sup> , Silicon <sup>7,8</sup> Polypropylene <sup>7,8</sup> , Polyethylene <sup>7,8</sup>	Prices vary but most hospitals are able to negotiate comparable rates through high volume purchasing. <sup>8</sup> Prices will fall as market increases. <sup>8</sup>
Pipes	High Density Polyethylene <sup>5,6,9</sup> Copper <sup>6,9</sup> , Cast Iron <sup>5,9</sup> Vitrified Clay <sup>5</sup> , Concrete <sup>9</sup>	Decreased labor cost for installation reduces importance of price. <sup>6,9</sup> Pipe selection rarely determined by material cost differences in this industry. <sup>6,9</sup>
Roofing (For Flat Roofs)	TPO- Thermoplastic Polyolefin <sup>5</sup> EPDM- Ethylene Propylene Diene Monomer <sup>5</sup>	Comparable to similar vinyl roofing <sup>5</sup>
Siding	Wood <sup>6</sup> , Fiber Cement <sup>6</sup> , Aluminum <sup>5</sup>	Varies - High quality, longer lasting materials can cost less than PVC if you shop wisely. <sup>6</sup> Aluminum is more expensive but very durable and maintenance free. <sup>5</sup>
Wallpaper	Natural Fiber <sup>6</sup>	More expensive <sup>5</sup>
Windows	Wood <sup>6</sup> , Aluminum <sup>6</sup>	Varies widely <sup>6</sup>

**Sources and Notes:** 1 - Greenpeace 2001; 2 - Singhofen 1997; 3 - Dickey 2002; 4 - GRRN -2004; 5 - CEC 2004; 6 - Ackerman 2003; 7 - Ruzickova 2004; 8- SHP 2000; 9 - Harvie 2002. **Note:** This table is not meant to be exhaustive, as there are endless uses of PVC. Rather, it is provided to offer a few concrete examples of available and affordable alternatives to PVC. In choosing alternative materials for this table, an effort was made to exclude those having significant environmental and/or health concerns of their own. This does not imply an endorsement by CHEJ or EHSC of any materials listed. We do believe, however, that the materials listed offer an improvement over PVC. For any material, there are advantages and disadvantages and we would encourage you to thoroughly research all purchasing decisions.

bottles (GRRN 2004a: To view their list online, go to <http://www.grrn.org/pvc>). The market share of PVC for containers has steadily declined to about 2% of all bottles sold (Anderson 2004). The mostly widely used PVC-free alternatives for plastic bottles are high density polyethylene (used for milk products and almost all per-

sonal and household care products) and PET (used for most beverages and vegetables oils, for example).

### Toys and Other Consumer Products

Greenpeace has established a Website that provides information on PVC alternatives for more general con-

sumer items, including toys. This site includes a toy-company report card that rates companies on a scale of 1 to 5, from being completely PVC-free to refusing to change policies or provide information (Greenpeace 2003, Greenpeace 1997: <http://archive.greenpeace.org/comms/pvctoys>; a more recent 2003 version can be found at [http://www.greenpeaceusa.org/features/details?item\\_id=526899](http://www.greenpeaceusa.org/features/details?item_id=526899)). It is worth visiting each site as they both contain unique information. Greenpeace also has issued a report on worldwide PVC restrictions that includes a list of companies, by country, that have made a decision to phase out the use of PVC in their products (Greenpeace 2001: <http://archive.greenpeace.org/toxics/reports/restrictions.pdf>).

### Automobiles

Many automobile makers are beginning to find and implement alternatives to PVC. General Motors, the world's largest auto manufacturer, was the first to make a public statement of its intention to stop using vinyl. GM planned to end the use of PVC in car interiors by 2004, cutting total PVC use by 30% (CCC 2004: [http://www.cleancarcampaign.org/pvc\\_elvbackground.shtml](http://www.cleancarcampaign.org/pvc_elvbackground.shtml)). Also, other automakers, while remaining less public, have taken similar steps. Daimler Benz has not used PVC for interiors or undercoating in Mercedes autos since 1995 and Honda said they would gradually replace PVC in interiors by 2003 (Greenpeace 2001). Pontiac has found a unique way of applying polyolefin skin for full instrument panel design, instead of PVC. Likewise, Mitsubishi has substituted polyolefins in its instrument panels and door trimmings (Greenpeace 2001). According to the Clean Car Campaign—a national campaign coordinated by state, regional and national environmental organizations promoting a clean revolution in the motor vehicle industry—Volvo, Nissan, Toyota, and BMW are all using alternative materials to PVC in various applications and to varying degrees (Singhofen 1997). And according to the Greenpeace Review of Restrictions and PVC-Free Policies Worldwide, “Ford world-wide has set itself and its suppliers the ambitious target to eliminate applications of PVC by the 2006 model year” (Greenpeace 2001).

Appendix A to this report lists some common products available on the market that may contain PVC, including which products are bottled or packaged in PVC containers. Used with the resources reviewed above, consumers can easily leverage this knowledge to identify and replaced their purchases of PVC with safer alternatives. Also available is a list of specific products packaged with PVC (GRRN 2004a: <http://www.grrn.org/pvc>).

## PVC Alternatives are Affordable

*The following section on the affordability of replacing PVC with safer alternatives was derived primarily from the report “The Economics of Phasing Out PVC,” written by Frank Ackerman and Rachel Massey of the Global Development and Environment Institute, Tufts University, December 2003 (Ackerman 2003). This section was adapted from the above report with permission of the authors. The references used by the authors are cited in the original report which can be found in its entirety at [www.ase.tufts.edu/gdae/Pubs/tp/Economics\\_of\\_PVC.pdf](http://www.ase.tufts.edu/gdae/Pubs/tp/Economics_of_PVC.pdf).*

The serious health and environmental impacts caused by the production, use and disposal of PVC raise two important economic policy questions.

- 1) Are there affordable alternatives to replace most uses of PVC?
- 2) What would be the economic impact on society if PVC were phased out?

The Tufts University Global Development and Environment Institute addressed both of these questions in their recent report *The Economics of Phasing Out PVC* (Ackerman 2003). This report found that alternatives to PVC do exist and that PVC does not offer enormous economic advantages over other materials.

PVC-free alternatives are already competitive in the market place. The Tufts researchers found affordable alternatives available in every commercial and institutional PVC market they evaluated, including pipes, roofing materials, flooring, medical gloves, siding and windows (Ackerman 2003). Because PVC is found in so many products, the alternatives also widely differ depending on the product. The estimated costs of phasing out specific PVC products will likewise differ from one product market to the next. Many manufacturers and suppliers have been identified who currently sell cost-comparable alternatives to PVC used in medical bags and tubing, office supplies and building and construction materials.

The Tufts report concluded that a PVC phase-out is achievable and affordable and that it would not place a large burden on the economy. The study finds that the advantages of PVC are often overstated, that PVC is not substantially cheaper than many alternatives, and that alternatives providing equal or better performance are available for almost every use of PVC. In some cases, the costs of the alternative materials are already comparable to PVC when costs are measured over the



useful life of the product. In other cases, the alternatives are slightly more costly in today's market, though they are likely to come down in cost as their market share expands. There are "good reasons to expect the costs of alternatives to decline over time." The report also found that the continued use of PVC offers small short-term gains in some areas, and none at all in others.

## The Costs of Replacing PVC: Three Studies

The Tufts report identified three detailed studies, all published in the mid-1990's, which estimated the costs of phasing out PVC. All three studies found PVC to be only modestly cheaper than the alternatives. The first study, conducted by the U.S.-Canada International Joint Commission (IJC) for the Great Lakes, examined the cost of phasing out PVC as part of its 1993 "Strategy for Virtual Elimination of Persistent Toxic Substances." This report was written for the IJC by a Canadian consulting firm, the Hickling Corporation, and updated in 1994. Charles River Associates (CRA), a U.S. consulting firm under contract to the Chlorine Institute, conducted the second study. This report, which was prepared in response to the IJC report, provided an economic analysis of the benefits of chlorine and related chemicals and included an analysis of PVC. The third study, conducted by Environment Canada in 1997, evaluated the options for replacing chlorine-based products and included a detailed look at the alternatives to PVC (Ackerman 2003a).

Each of these studies evaluated many specific uses of PVC and compared the prices of PVC products to their PVC-free alternatives. Environment Canada created two sets of price comparisons: a low cost case based on the least expensive available alternative and a high cost case based on higher-priced alternatives. Table 12 provides a summary of the estimated costs of replacing PVC made in each of these three studies. The table shows the cost increase that would result from switching to PVC-free alternatives, expressed in dollars per pound of PVC produced (updated to 2002 prices) for each study. Cost estimates are shown separately for pipes and for all other products since pipes represent about half of all PVC use. The

pipe and non-pipe figures in Table 12 were averaged to obtain a rough estimate of the total cost of replacing PVC.

According to the Tufts report, this table shows that there was a remarkable degree of agreement between the Hickling and CRA studies. These studies found nearly identical average costs for replacing PVC—\$1.07 to \$1.15 per pound. The Environment Canada low estimate had an average cost of about half this much, due to its lower estimate for pipe costs. For the non-pipe uses of PVC, there also was fairly good agreement between CRA, Hickling and the Environment Canada low estimate (\$0.87 to \$1.10 per pound). The data shows that PVC is only modestly cheaper than the alternatives. The Environment Canada study, which included the full cost of installation, found alternative materials would cost just 6% more than vinyl, and building a PVC-free home would increase the cost of a home by just 0.4 percent—increasing the cost of a \$150,000 home to \$150,600 (CIS 1997, Thornton 2000).

## Factors Favoring Phase-Out of PVC

According to the Tufts report, cost estimates such as those made by Environment Canada, based on current market prices, tend to overstate the economic benefits of PVC. Four reasons were given for this conclusion.

### 1) Life Cycle Costs Often Favor Alternatives.

Some of the alternatives have higher initial purchase prices than PVC products, but are actually less expensive over the useful life of the product. The total cost

◆◆◆◆◆ Table 12 ◆◆◆◆◆  
**The Cost of Replacing PVC**  
US dollars per pound of PVC (2002 prices)

	CRA (industry)	Hickling (for IJC)	Environment Canada	
			Low	High
Pipes	\$1.43	\$1.03	\$0.15	\$0.33
All other uses	\$0.87	\$1.10	\$0.94	\$3.84
Average	\$1.15	\$1.07	\$0.55	\$2.08

Average is the unweighted average of pipes and "all other uses."  
Hickling data excludes windows.

Source: Ackerman 2003

over a product's life cycle is the cost that ultimately matters to the user. For example, the maintenance and repair costs for some building materials, such as flooring, can be the largest cost of a product's life cycle. In such cases, the lowest maintenance product is often the cheapest on a life cycle basis, regardless if it has the lowest purchase price. In this example, PVC or vinyl flooring is the cheapest option for commercial and institutional flooring on an initial cost basis, but among the most expensive options on a life cycle basis. When full life cycle costs are taken into account, PVC flooring loses out to alternatives that may have a higher initial price but last longer and are more easily maintained (Ackerman 2003).

## 2) Mass Production Reduces Costs.

Most products are cheaper when they are produced in large quantities. Costs typically drop as production volume increases. Currently, the advantages to mass production favor PVC, as many PVC products are produced in huge volumes. However, the production of the alternatives could likewise grow in volume in the future, making them less expensive and more competitive than they are at present. There are also learning curves that affect costs over time. As an industry gains experience with a production line, "bugs" are worked out, process improvements develop, and maintenance procedures and schedules are improved. All of these factors help to reduce costs.

## 3) PVC Products Endanger Their Users.

As previously discussed, the harmful effects of PVC are sometimes felt by the users of the products. For example, plasticizers in flexible PVC products such as children's toys can leach out of the product during use posing health hazards to users (see Chapter 3).

## The Impact of a PVC Phase-Out on Jobs

The Tufts report examined the impact that phasing out PVC would have on jobs. Using data provided by the Alliance for Responsible Use of Chlorine Chemistry (ARCC), they estimated that there are approximately 126,000 workers in PVC fabrication plants and approximately 170,000 workers at chlorine-producing and chlorine-using chemical plants in the U.S. However, most of the chlorine workers are in non-PVC related chlorine sectors such as paper mills, pesticides, and solvents. The Tufts researchers estimated that only about 9,000 of the 170,000 workers were employed in the production of vinyl chloride monomer (VCM) and PVC resin.

The Tufts report identified 12 operating VCM plants in the U.S. as of 2000, with a capacity to produce 17.4 billion pounds of VCM. According to the report, seven of the facilities that account for more than half the capacity were jointly located with PVC plants owned by the same company. The report also showed that as of mid-2003, ten companies produced 15.8 billion pounds of PVC resin at twenty locations in the U.S. Three other plants were idled by the recession with an additional capacity of 1.2 billion pounds.

The Tufts report suggested that replacing PVC with safer alternatives will change some of these jobs: from fabricating PVC products to fabricating the same products from other materials, most often other plastics; or from making vinyl chloride and PVC resin to making safer substitutes. However, the alternatives are likely to require about the same total employment as production of PVC. In some cases, the same workers who currently make PVC products will be employed making products from PVC alternatives (Sources: Ackerman 2003 and Ackerman 2003c).

## 4) Environmental Protection Costs Are Routinely Less than Anticipated.

History has shown that the actual costs of compliance with environmental standards are often lower than the originally predicted costs. One of the best examples of this occurred in the PVC industry in 1974 when the Occupational Safety and Health Administration (OSHA) established a strict standard for workplace exposure to vinyl chloride, the raw material used to produce PVC. When this standard was proposed, the vinyl industry claimed that the costs of compliance would be in the "billions" and that the industry might shut down. Instead, actual costs were only a fraction of the original estimates primarily because the industry developed new

cost effective technologies to comply with the regulation. Other studies have confirmed this pattern of over-estimating compliance costs (Ackerman 2003b).

In summary, the Tufts report concluded that a "PVC phase-out is achievable and affordable. The alternatives are increasingly well known and well developed,

and in many cases are already cost-competitive with PVC. It is realistic and practical to build health and environmental considerations into materials choices for municipal infrastructure, commercial and residential buildings, medical supplies and consumer products. The cost impacts of substitution will be modest and will grow smaller over time" (Ackerman 2003).

# TAKE ACTION

## Preventing Harm from PVC Use and Disposal

### RECOMMENDATIONS

- Policy makers at the local, state and federal level should enact and implement laws that steadily reduce the impacts of PVC disposal and lead to a complete phase-out of PVC use and waste incineration within ten years.
- A new materials policy that embraces aggressive source reduction of PVC should be adopted to steadily reduce the use of PVC over time.
- Federal and state waste management priorities should be changed to make incineration of PVC waste the least preferable disposal option.
- In the interim, any PVC waste generated should be diverted away from incineration to hazardous waste landfills.
- Consumers should take personal action to buy PVC-free alternatives and to remove PVC from their trash for management as household hazardous waste.
- Communities should continue to organize against PVC-related dioxin sources such as waste incinerators while working to promote safer alternatives.

Personal and political actions must be taken to prevent harm to human health and the environment from the use and disposal of PVC. If we don't burn PVC, the formation of dioxins and other toxic by-products of combustion will be prevented. If we can reduce the flow of PVC to landfills, leaching of toxic additives will be avoided. If we promote and purchase safer alternatives to PVC whenever they are available, then toxic pollution will be prevented throughout the PVC life cycle.

### Making Choices: A New Materials Policy for PVC

When solid waste experts in the U.S. first established meaningful management goals about fifteen years ago, there was universal support for source reduction as the top priority (USEPA 1989). Table 13 shows the priorities established by the USEPA for the most environmentally sound strategies for managing solid waste. Source reduction is the top choice. It means taking action to avoid or prevent waste from being generated in the first place. In keeping with this philosophy, the first priority in managing PVC waste should be to avoid making it or using it in the first place.

We should adopt a universal policy and practice across the country to avoid the purchase or use of PVC whenever possible in order to prevent waste management problems before they start. We need to dramatically

••••• Table 13 •••••

**National Priorities for Solid Waste Management**

Highest Priority	SOURCE REDUCTION	Includes Reuse
Middle Priority	RECYCLING	Includes Composting
Lowest Priority	DISPOSAL	Includes both Combustion and Land Disposal

Source: USEPA 2004d, USEPA 1989

and steadily reduce the amount of PVC waste produced through a source reduction strategy that targets PVC-containing products.

The second best option, if generating waste can't be avoided in the first place, is to reuse, recycle and compost the wastes. With PVC waste, this is not an option. Most PVC products cannot be reused or recycled, and definitely will not compost. What is the best option for PVC waste after source reduction and recycling? The answer lies in defining what ultimate disposal strategy is preferred once PVC waste has unavoidably been generated.

Federal solid waste policy fails to express a preference between waste disposal in incinerators or in landfills, treating each as equally usable options (See Table 13). Consistent with this lack of judgment, the USEPA has failed for over 12 years to finalize its reassessment of the health risks from exposure to dioxins. In addition, the USEPA has failed to take aggressive action to prevent dioxins and other toxic pollutant releases at their source, such as working to reduce PVC use and disposal.

Some states have chosen incineration as their top waste management option, favoring even dirty mass burn facilities over landfill disposal. For example, as shown in Table 14, under Maine state law, waste incineration is preferred over landfill disposal (MRSA 2004a). The State of Maine, in turn, burns the highest proportion of its waste (after recycling) of any state in the country (see Table 7 in Chapter 5).

By favoring waste incineration, such policies encourage the continuous formation of dioxins and other toxic air emissions, and the generation of toxic ash requiring land disposal. The burning of PVC in municipal solid waste releases dioxins and toxic additives. Land disposal, on the other hand, minimizes dioxin formation by avoiding intentional combustion, although some highly polluting landfill fires are unavoidable. Land disposal additives in PVC will leach and eventually contaminate groundwater. However, this is also true for incineration, since a large amount of dioxin and metal-laden incinerator ash also requires land disposal.

We believe that a new health-based materials policy is needed to reorder current federal and state priorities for waste management. Such a health-based policy should be designed so that the greatest effort is invested in the highest priority options as shown in Table 15. We propose a new set of priorities for PVC waste management that are based first and foremost on targeted source reduction steps that will prevent the creation of PVC waste in the first place. This strategy aims to aggressively and continuously replace the most hazardous uses of PVC with safer alternatives whenever available.

These source reduction steps include immediate action

••••• Table 14 •••••

**The State of Maine's Waste Management Policy Favors Incineration Over Landfill Disposal**

Highest Priority	SOURCE REDUCTION	Includes reducing both the amount and toxicity of the waste
2nd Priority	REUSE	
3rd Priority	RECYCLING	
4th Priority	COMPOSTING	Of biodegradable waste
5th Priority	INCINERATION	And other waste processing which reduces waste volume
Lowest Priority	LAND DISPOSAL	

Source: MRSA 2004a

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**Proposed Priorities for PVC Waste Management**

Highest Priorities	Step # 1 - SOURCE REDUCTION	Ban disposable PVC bottles, containers and packaging.
	Step # 2 - SOURCE REDUCTION	End the use of lead and cadmium in all PVC products.
	Step # 3 - SOURCE REDUCTION	Phase out all disposable, non-durable uses of PVC.
	Step # 4 - SOURCE REDUCTION	End the use of PVC products containing phthalates.
	Step # 5 - SOURCE REDUCTION	Phase out PVC uses that are vulnerable to fire hazards, e.g., in building materials and cars.
2nd Highest Priority	EXTENDED PRODUCER RESPONSIBILITY	Require manufacturers to finance the "take-back" and safe management of PVC products at the end of their useful life.
3rd Priority	REUSE AND RECYCLING	Achieve the low potential to recycle bulk PVC waste into the same type products.
4th Priority	LAND DISPOSAL	In the interim, divert any unavoidable PVC waste away from incineration for disposal in hazardous waste landfills.
Last Option	INCINERATION	Ban open burning and incineration of any waste containing PVC

to end the use of PVC bottles and packaging. Other source reduction targets would include short-lived disposable PVC products and those that contain lead, cadmium and phthalates. Fire-vulnerable uses of PVC in buildings and vehicles should be replaced with safer alternatives. To avoid toxic by-products generated during structural fires, vinyl siding, roofing and window frames among other uses, should be replaced with safer alternatives.

This health-based materials policy would favor land disposal over incineration only temporarily and only for legacy waste from the stock of current PVC in use and any other unavoidable PVC waste. This waste would be managed by land disposal in a hazardous waste landfill.

A new materials policy for PVC defines incineration as the least favorable waste disposal option. We need to create effective systems to collect and divert PVC in

the waste stream away from incineration. PVC should be actively managed as a serious problem waste akin to handling household hazardous waste (or other non-hazardous problem wastes like propane tanks or latex paint). This would mean educating consumers to identify PVC waste and separate it from the waste stream. As an interim practice, PVC should be diverted away from incineration for collection and transfer to a triple-lined "secure" hazardous waste landfill. With time, after PVC has been replaced with safer materials, the need to divert PVC to landfills would diminish.

Our vision for managing PVC waste is positive. We promote safer alternatives to PVC that are effective, affordable and available now. Alternatives that exist for most uses of PVC are able to do the job well at a cost that is comparable to PVC. Substituting safer materials for PVC is consistent with principles of clean, sustainable production (see Chapter 8).

To realize steady progress on the path to a PVC-Free Future, many personal and political actions by many people will be necessary.

## Personal Steps

Taking personal responsibility for preventing harm from PVC is an important place to begin. Here are some key actions you can take as a consumer and contributor to generating household PVC waste.

### 1. Identify PVC Products.

Look for the “# 3” or the letter “V” inside the plastic recycling symbol (or sometimes beneath the recycling symbol) on the bottom of bottles and on clear plastic packaging such as blister packs. The # 3 and the letter V indicate that the plastic is made from PVC. Also, look for the words “PVC” or “vinyl” on the product (e.g., plastic pipe) or on its packaging. You will need to use other strategies to identify PVC products that are not labeled. Does the unlabeled soft plastic, such as the skin on a 3-ring office binder or a shower curtain, have that “new car smell” of chemicals? If so, it's probably vinyl and you're breathing phthalates, a PVC additive. Check the PVC product listing in Appendix A for likely suspects. You can also call the company and ask them whether they use PVC. If they do, ask them to switch. If they don't, thank them for being environmentally conscientious.



### 2. Buy and Promote Safer Alternatives.

Search for and purchase non-PVC alternatives (see Chapter 8). Always avoid PVC bottles and plastic wrap (e.g., Saran Wrap). Consult Internet resources on PVC-free alternatives for office supplies, medical supplies, toys and building materials (see Chapter 8). Educate others about PVC hazards. Promote safer alternatives in your homes and business, with your friends and neighbors. If the best alternative is a plastic, look for the cleaner plastics, such as polyethylene (# 4 or # 2) or polypropylene (# 5) (See Figure 4).

### 3. Start Collecting PVC.

Don't toss PVC in the household trash, especially if your garbage is incinerated (see Table 7 to see if your state relies heavily on burning its waste). Put the PVC aside in an enclosed cardboard box and/or garbage bag away from the sun and possible ignition sources. See how much PVC you can salvage and segregate from the waste stream. Every bit of PVC diverted away from incineration will prevent some dioxin formation.

### 4. Ask the Manufacturer to Take it Back.

If you can identify who made the product containing PVC, bundle it up in a secure cardboard box and mail it back to the Chief Executive Officer of the product manufacturer (search the Internet for the address of the corporate headquarters and the CEO's name). Enclose a polite note asking that they take personal and corporate responsibility for safely managing this problem material at the end of its life. Tell them you won't buy any more of their products until they make the switch to PVC-free manufacturing. Warn them not to burn it. Ask them to dispose of it at a hazardous waste landfill or to securely store the PVC unless they can recycle it for high value uses. Ask for a written response.

### 5. Dispose of Your Collected PVC as You Would Household Hazardous Waste.

If you have too much PVC waste to mail back, ask that your community household hazardous waste collection program accept PVC plastic for secure hazardous waste land disposal, not for incineration. Explain the reasons why PVC is a serious problem waste. Encourage others to separate and divert PVC away from incineration.

## Community Action: People, Voices and Communities

Being a PVC-free consumer is not enough. The real power needed to adopt a new health-based materials policy for PVC lies in the number of people involved. When friends and neighbors work together to organize their community to take action, major changes can occur. Grassroots action by community groups around the country has already stemmed the damage from PVC use and disposal. Medical waste incinerators are rapidly being replaced due to community-based campaigns that promote non-incineration alternatives (see case studies in Chapter 5). Few new municipal waste incinerators have been sited in the last ten years due to environmental health concerns and community opposition.

## CASE STUDY

### Intimate Brands Responds to 6,000 Consumers and Stops Using PVC

Greenpeace and the Center for Health, Environment and Justice (CHEJ) teamed up in 2001 to launch a consumer campaign against a major beauty supply company who distributed products packaged in PVC containers. The Victoria's Dirty Little Secret campaign successfully targeted Intimate Brands, the parent company of Victoria's Secret and Bath & Body Works, who agreed to phase-out PVC containers from their product line by the end of 2003 after receiving 6,000 faxes, phone calls, and postcards in one month.

Organizers launched the campaign at an Eco-Conference held annually on college campuses, distributed flyers and postcards, and posted an action alert allowing Website visitors to fax a letter or send a postcard directly to Intimate Brands. The company initially responded by sending defensive letters to the individuals that wrote to them. However, as more letters continued to come in, they took the demand more seriously. In February 2002, they met with representatives from CHEJ and Greenpeace and presented a plan to phase out the use of PVC bottles in both their Victoria's Secret and Bath & Body Work's line. PVC bottle production would stop by 2003 and by 2005 all PVC bottles would be out of circulation. The effectiveness of this campaign is a testimony to the positive changes that can be made when people come together and pressure companies to put safety first (Source: Lester 2003).

Community action has also repeatedly changed national waste policy from the grassroots up. Join with your friends and neighbors to make a difference. Join a local group or start a new one to take action against dioxin sources such as incinerators, backyard burning, landfills, biomass plants or building fires where PVC use and disposal release toxic chemicals into the environment. For referrals and how-to tips, contact the Center for Health, Environment and Justice ([www.chej.org](http://www.chej.org)).

### Organizing To Win Around Issues on PVC

Every day, people facing threats to their health and environment speak out about PVC problems. They look for proof that a landfill leaks, or seek to undertake a health study to link emissions from an incinerator to cancer, or find evidence that a polluting company has a bad environmental record. However, simply speaking the truth

about landfills, incinerators, toxic products or previous violations won't stop the poisoning of our bodies and the environment.

The truth is only a start. In order for things to change, the truth has to be understood by a large group of people who then use this knowledge to fuel their efforts to win justice. The truth won't stop the poisoning, but mobilizing and organizing will.

According to Webster's dictionary, organizing is "uniting in a body or becoming systematically arranged." Organizing to protect our communities from environmental harm means pulling together a large enough, diverse enough, active enough group of people to convince corporations and the government that they have to stop making people sick with toxic chemicals.

Organizing is how we restore the balance between the rights of people to safe products and healthy communities, and the rights of corporations to profit. We will never have as much money as the corporate polluters. We will never be able to

afford their Madison Avenue media campaigns or their twenty-four hour access to elected officials. But we can build our own power to overcome their influence. We can do this by organizing to demonstrate the strength of our numbers and the righteousness of our demands.

Successful organizing happens when a group of people find visible ways to use the truth to wake up the conscience of a larger group. In an era when politics is defined by scandals and sound bytes, organizing can remind the American people that political life is supposed to be about self-government, justice and the common good.

After years of doing it, we've come to the conclusion that organizing is more of an art than a science. At the same time, there are some basic rules for organizing that usually hold true. These rules aren't always applicable, but they are right often enough that you should consider them if you start to get organized around an environmental issue in your community.





## Ten Simple Steps To Organizing

### 1. Talk and Listen

If you are one, two or three individuals without an organization, you'll need to talk with other people in your community to build a group. If you are already part of an organization, then your next step is to talk to the people in your organization about initiating a campaign around a PVC issue in your community.

Brainstorm a list of groups and individuals whose interests are most directly affected by PVC, then determine who you need to talk with first. Who are the people that are most directly affected? Who are the leaders in that neighborhood? What other organizations are involved in protecting the community's health? You can work out the answers to these questions in a brainstorming exercise at an early meeting of your group. Brainstorm a list of the groups of people whose self-interests are most directly affected, then figure out who has contacts with these groups or individuals.

### 2. Create and Distribute Fact Sheets

Create an attractive, easy-to-read and accurate fact sheet to educate the community about the problems and how these problems relate directly to their lives. A simple one-page fact sheet will serve the purpose.

### 3. Recruit Hundreds, One At A Time

Recruiting will help you build the relationships, resources and critical mass to act effectively for change. Reach out to a wide range of local groups to build the broadest possible coalition. It will be much more difficult for decision-makers to ignore your concerns if your campaign represents a wide cross-section of your community. All recruiting is a form of door knocking. If you are trying to organize a neighborhood, the doors line the streets. If you are trying to build a different kind of group or coalition, the doors may spread all over town and you may need appointments to open them. There are several ways to make knocking on doors easier. First come up with a 'rap'— "I am..." "We are..." "This is..." "We want..." "You can..." Also, consider circulating a petition. Not only will the petition help you get the names and addresses of community supporters and show community support to those in power, it also begins the process of getting the people you're talking with involved in the issue. Make sure to listen closely to the concerns of the people you are talking with and link the PVC problem to their interests and concerns.

### 4. Hold Meetings That Make People Want to Come Back and Bring Their Friends

People will come to a meeting if:

- They have made a commitment to come
- They have a role or responsibility in the meeting
- They have an immediate and specific self-interest in the work of the organization
- They have past, positive experiences with similar meetings

To have a successful meeting, your recruitment efforts must satisfy the first and third of these conditions. The second and fourth conditions will depend on how you run the meeting. There are several different kinds of meetings to suit different purposes.

**House Meetings** - This is the kind of meeting many groups hold when they are first forming. The meeting is held at a member's house and the style is informal. One of the biggest benefits of this kind of meeting is the greater comfort level among members.

**Planning Meetings** - Leaders or other key decision makers within the group get together to set their agenda, review the work that's been done and plan activities. Planning meetings should not be decision-making meetings, but rather they should establish the agenda and process by which decisions will be made at a general membership meeting or define a plan to carry out an activity that has already been decided upon by the membership.

**General Membership Meetings** - These meetings are important to ensure that all members of the organization share the responsibility for decision making and carrying out the activities of the organization. The time and location should always be chosen to accommodate the maximum number of people. The meeting should always start with an agenda and when possible, get the agenda out to people prior to the meeting in the form of a flier (this will also serve as a reminder for the meeting). Make sure you pass around a sign up sheet to collect names and addresses to contact people who attended in the future.

People will come to the next meeting if they enjoyed the first one, if it started and ended on time and wasn't a bore, if it produced concrete results, if it was lively and exciting, and if it delivered what was promised.

## 5. Set Goals

It is critically important to have long-term, intermediate and short-term goals to help members understand where they are going and the steps they have mastered along the way. Ask yourselves: What do we want? What is your bottom line? Do you want to pass a local or state law that bans PVC products where alternatives are available? This could be your long-term goal.

Next identify different strategies and tactics that will lead you to your goal such as getting your city or county council to pass a resolution to phase out all PVC products where alternatives are readily available. This could be your intermediate or short-term goal.

## 6. Identify Your Targets

Once you've identified what it is that you want, the next step is to identify who can give it to you. Pinpoint the actions and the people that have the power to help you reach your goal. The people who impede the achievement of your goal are often referred to as the targets of the campaign. This does not mean that they are evil or bad. It simply means that because they have the power to give you what you want, it makes sense to focus your attention and actions on them. The target of your campaign must always be a person or persons. You can't fight City Hall because City Hall is a building, but you can target the person with the power at City Hall to get them to act.

To help your group identify your targets, answer these three questions.

- Who is responsible for the situation you want to change?
- Who can make the changes you want to happen?
- How can you convince them to act on your issue?

## 7. Research Is An Essential Tool

Research is a tool, not an end product. You need to do research to gather enough information to achieve your goals, not to know absolutely everything there is to know. Research should tell you who has the power to give you what you want and should help you figure out what arguments your targets will probably use against you. Once you know this, you can create counter arguments. This report will give you some of the information you need, but you need to undertake the local research related to the problem that you want to address.

## 8. Take Direct Action

An action is any step you take to advance your group's goals. Petitions, letter-writing campaigns and educa-

tional meetings are all actions that advance your group's goals. A direct action is the most dramatic type of action, involving confrontation and demands. Direct action begins after your efforts at education, information sharing and persuasion are ignored. Use direct action when your group is ready to confront a decision-maker with its frustrations and to make specific demands. Direct actions move your organization outside the established rules for meetings and discussion. It takes your group into a forum in which you make the rules and where elected representatives and corporate executives are less sure of themselves and how to handle the situation. A direct action often provides the necessary pressure to force your target to act on your group's issue.

## 9. Target The Media

Who are the media decision-makers who need to be convinced that your story should be covered? What will it take to convince them? In most media outlets, the decision-makers are the editors, and the way you get to them is to spoon-feed them a story they can use without much work. It is important to develop a media strategy for your campaign that you can constantly refine and develop. But don't be fooled into believing that the media is the only way to get your story out. Keep creating your own media through fact sheets, cable access television programs, newsletters, call-ins to radio talk shows, letters to the editor, statements at public hearings, barbecues, rallies, auctions, concerts and videotapes.

## 10. Celebrate The Victories And Keep Applying Pressure

Savor the victories no matter how large or small. A meeting with the City Council is a small victory and a resolution to stop purchasing PVC is a larger victory. Celebrate all victories because it helps members to see that you are moving forward and are winning. No one wants to join a loser organization.

## Policy Action

While personal steps are critically important, community action is a must. But neither are enough. The personal should also be political. Unless the system that unduly relies on hazardous materials like PVC is changed, then green consumerism and green behavior will remain a minor movement of the privileged few. Unless many community-based organizations join forces, large-scale systemic change will be slow in coming.

◆◆◆◆◆ Table 16 ◆◆◆◆◆  
**A PVC-Free Policy Action Agenda**

**Accomplish Within Three Years**

1. Ban all open waste burning.
2. Educate the public about PVC hazards.
3. Ban the incineration of PVC waste.
4. Collect PVC products separately from other waste.
5. In the interim, divert PVC away from incineration to hazardous waste landfills.

**Accomplish Within Five Years**

6. Establish our Right-to-Know about PVC.
7. Label all PVC products with warnings.
8. Give preference to PVC-free purchasing.
9. Ban use of PVC in bottles and disposable packaging.
10. Ban sale of PVC with lead or cadmium.

**Accomplish Within Seven Years**

11. Phase out other disposable PVC uses.
12. Phase out other high hazard PVC uses.
13. If safer alternatives are not yet available, extend the PVC phase-out deadlines for specific uses.
14. Fund Efforts to reduce the amount of PVC generated through fees on the PVC content of products.

**Accomplish Within Ten Years**

15. Phase out remaining durable PVC uses.
16. Decommission municipal waste incinerators in favor of zero waste plans.

Here are a number of action steps that government at the state, local and national levels must take to phase-out PVC in a timely and orderly manner. Actions that may be successful early on and that establish a foundation for future PVC reductions are listed first in order on the timeline below. These policy actions also give guidance to other decision makers in industry, commerce and institutions about policies that they should embrace to help prevent harm from PVC use. This PVC-free action agenda is summarized in Table 16.

**Accomplish Within Three Years**

**1. Ban All Open Waste Burning.** Backyard burning of household trash and other open burning should be

strictly prohibited everywhere as the country's major uncontrolled source of dioxin pollution. However, a statutory ban will not be effective without educating people about the hazards of PVC and simultaneously working aggressively to reduce the toxicity of the waste stream. People burn their waste to avoid real costs and inconvenience, and out of cultural habit and practice. People need to know the truth about PVC and waste burning in order to overcome their resistance to change.

**2. Educate the Public About PVC Hazards.** Conduct a well-funded public education campaign that targets PVC as a serious problem waste that especially threatens public health when burned, but also creates health and environmental risks when disposed of in a landfill. Use a hard-hitting approach that holds the chemical industry responsible for the impacts of open burning and for selling a material that releases toxic additives and by-products. Model the campaign along the same lines as the anti-tobacco industry ads that work to reduce teenage and adult smoking. The educational campaign should sell PVC-free solutions as it persuades people to halt the backyard burning of trash.

**3. Ban the Incineration of PVC Waste.** All forms of incineration of PVC waste should be phased out by a certain date. Designate PVC waste as hazardous waste. Develop educational programs and incentives to remove PVC from waste streams destined for incineration. Replace all medical waste incinerators with non-burn technologies for waste that needs to be disinfected and send the disinfected residue to a "secure" landfill. Develop a workable timeline to ban the incineration of PVC in municipal solid waste.

**4. Collect PVC Products Separately from Other Wastes.** Award grants and publicize new programs to support PVC waste separation and collection. Identify

## CASE STUDY

### PVC Identified as Household Hazardous Waste

In its Plan for the Statewide Collection of Household Hazardous Waste, the State of Maine identified PVC as a problem waste that should be separately collected and, if not recycled, then diverted away from incineration to landfill disposal. Although household hazardous waste remains exempt from regulation, collection programs are being expanded in Maine and elsewhere to encourage residents to turn in old hazardous products for safe management rather than tossing them in the trash. In addition to spent paint thinner, old pesticides, mercury products and other toxic household waste, the Plan targets PVC, latex paint and old propane tanks as problem wastes requiring special collection and management. Efforts are underway to establish a reliable means of funding the operational costs of household hazardous waste collection so that this plan can be fully implemented in Maine (Source: MDEP 2001b).

## CASE STUDY

### San Francisco Bay Area Adopts Dioxin-Free Purchasing Policies

The San Francisco Bay Area is leading the nation in preventing dioxin pollution by passing Dioxin Resolutions in Oakland and San Francisco and establishing dioxin-free purchasing requirements for local governments. The resolutions grew out of a grassroots campaign to shut down the last commercial medical waste incinerator in Oakland, one of the largest sources of dioxin in the Bay Area. A diverse coalition of environmental, environmental justice, health-impacted groups, labor representatives, and local government officials worked together to shut down the incinerator in 2001. In the process, they convinced local governments to pass dioxin resolutions and establish a Bay Area Government Task Force to implement resolutions that will:

- Promote dioxin pollution prevention practices;
- Use less toxic, non-chlorinated products and processes, such as chlorine-free paper and PVC-free plastics;
- Urge health care institutions to phase out PVC products;
- Work with other local governments to convene a Regional Task Force to identify sources of regional dioxin pollution and develop prevention strategies; and
- Pursue dioxin reduction practices that do not cause workers to become unemployed (Sources: Greenaction 2001a, CO 1999, CSF 1999).

PVC as a hazardous waste and add PVC waste products to existing programs that collect household hazardous waste, mercury products and other problem wastes for safer management.

#### 5. In the Interim, Divert PVC Away from Incineration to Hazardous Waste Landfills.

Clarify waste management priorities for PVC to establish preference for land disposal over incineration due to the formation of dioxin and other toxic by-products. Make the institutional arrangements needed to ensure that PVC waste is disposed of in "secure" triple-lined hazardous waste landfills and diverted away from incineration. Identify opportunities for operators of waste incinerators to remove more PVC waste from the floor of the incinerator prior to waste combustion.

#### Accomplish Within Five Years

6. **Establish Our Right-To-Know About PVC.** Require product manufacturers that sell products containing PVC to notify the state of the amount of PVC and the specific chemical name of additives used in individual products, identified by brand name, model and type of PVC use. This information should be made available on-line in a searchable database on PVC products that allows consumers and business people to identify PVC and its ingredients in consumer products and materials. This provides people with the knowledge they need to ask questions and make decisions about safer PVC-free alternatives.

7. **Label All PVC Products with Warnings.** A meaningful education and PVC diversion program will run head long into the current limits on identifying PVC in the

waste stream. By requiring all PVC products to be labeled, PVC can be more readily separated from other waste and diverted away from incineration. Warnings should encourage consumers to avoid burning PVC products. Labeling will also encourage product manufacturers to switch to safer non-PVC materials to avoid labeling requirements.

**8. Give Preference to PVC-free Purchasing.** A government procurement policy that establishes as a priority the purchasing of safer alternatives to PVC will harness institutional buying power. Changing the buying habits of various levels of government will help drive the market for PVC alternatives and begin to affect the practices of other institutions in the supply chain that supports government operations.

**9. Ban the Use of PVC in Bottles and Disposable Packaging.** These two uses of PVC are the easiest and most compelling to ban outright in the near term. Both represent short-lived uses that become PVC waste soon after purchase. The PVC in bottles contaminates the recycling of the more plentiful and safer PET bottles (# 1 plastic) (see Chapter 7). The market in PVC bottles has already been declining steadily. The growing use of PVC for packaging, such as in clear plastic blister packs, adds disproportionately to the problem of PVC in municipal solid waste. Safer alternatives for both uses are readily available and already in the market place.

**10. Ban the Sale of Any PVC Containing Lead and Cadmium.** The continued use of these two highly toxic PVC additives presents a serious hazard that has long been recognized by progressive governments. Even the PVC industry has moved to replace some uses of lead and cadmium as stabilizers in their products. For example, the European vinyl industry has set a voluntary goal to phase out the sale of lead stabilizers by 2015 with a 15% reduction by 2005 and 50% by 2010 (ENDS 2004). However, by 2003 only a 5.3 % reduction in lead had been achieved (ENDS 2004). We think the global PVC industry needs to move away from lead much faster. By banning the sale of any new PVC product containing lead or cadmium, policy makers will be acting on strong public health science. Such a ban will further clean up PVC and raise questions about the other additives used in PVC and the hazards of the material itself.

## U.S. Companies Stop Using PVC in Products

Dozens of U.S. companies have stopped using PVC in their products. Some examples are as follows.

- General Motors announced it would phase out the use of PVC for auto interior panels by 2004, informing its suppliers to use alternatives for all new products (CCC 2004).
- Nine toy manufacturers, including International Playthings, Gerber and Brio are phasing out all the PVC in their products (Greenpeace 2003).
- Mattel, Inc., the world's largest toy manufacturer, is planning to phase in plant-based plastics to replace PVC in company products (Greenpeace 2001).
- NIKE, the shoe and sports equipment manufacturer, is phasing out PVC in its products (Greenpeace 2001).
- Helene Curtis eliminated PVC bottles for packaging Suave, and Intimate Brands, a major beauty supply company, is phasing out PVC containers by 2005 (Lester 2003).

### Accomplish Within Seven Years

#### Priorities for Replacing Specific PVC Uses

1. PVC bottles and disposable packaging
2. PVC containing lead or cadmium
3. Other non-durable disposable PVC uses
4. Other higher hazard PVC uses
5. Other PVC used in durable goods

**11. Phase Out Other Disposable Uses of PVC.** Non-durable products made with PVC become waste in short order, steadily adding PVC to the municipal waste stream. Separating PVC from the waste stream after it is generated will never be 100% effective. Nor can these collected non-durable PVC products be readily recycled. Therefore, the next phase in directing reductions in PVC usage should focus on replacing the remaining non-durable disposable uses of PVC with safer alternatives whenever they are available, effective and affordable.

**12. Phase Out Other High Hazard Uses of PVC.** A further priority should target replacement of PVC uses that expose sensitive groups of people to toxic additives and other uses that are vulnerable to dioxin-forming fires. The continued use of vinyl in medical products

## Health Care Institutions Move to Phase Out PVC

- **Health Care Purchasing:** Four top group purchasing organizations that buy supplies for more than 70% of U.S. health care facilities, such as Premier, Inc., established initiatives to reduce the purchasing of medical products containing PVC, mercury and the chemical plasticizer diethylhexyl phthalate (DEHP) (HCWH 2002a).
- **Baxter International, Inc.,** one of the world's largest medical supply manufacturers, is phasing out PVC in its intravenous (IV) solutions containers (Baxter 1999).
- **Abbott Laboratories** has committed to move toward PVC- and DEHP-free alternatives (Abbott 2003).
- **The thirty-seven members of the Maine Hospital Association** agreed to continuously reduce the use and disposal of PVC plastic in hospitals as part of a statewide pollution prevention agreement (MHA 2001)

## CASE STUDY

### Model Policy Action Taken to Phase Out PBTs and PVC

In 2000, the Washington State Department of Ecology (Ecology) developed a groundbreaking strategy to phase out some of the deadliest toxic chemicals in Washington—persistent, bioaccumulative and toxic chemicals (PBTs). Ecology's program has a goal of reducing PBTs such as mercury, dioxin, PBDEs (toxic flame retardants) and PCBs by the year 2020.

Under Washington's PBT strategy, chemical action plans are developed for high priority chemicals. In 2003, Ecology developed a plan to reduce and phase out mercury and the legislature passed a bill to ban certain mercury consumer products. Right now, Ecology is working on a chemical action plan to reduce and eliminate toxic flame retardants (PBDEs), chemical cousins of PCBs that are rapidly rising in the environment, breast milk, orcas and other wildlife.

The Toxic Free Legacy Coalition, led by Washington Toxics Coalition, Washington Physicians for Social Responsibility, Healthy Building Network, WashPIRG, Breast Cancer Fund and People for Puget Sound, is working to ensure the meaningful implementation of legislation and Ecology's PBT strategy.

On a local level, the Toxic Free Legacy Coalition was successful in getting the City of Seattle to adopt a first in the nation purchasing policy to reduce and eliminate the purchasing of products that contain or generate PBTs, including PVC. The hazards of PVC continue to be central to the debate surrounding successful implementation of the Resolution (Source: WTC 2004).

represents a prime example of unnecessary exposure to the additives in PVC products. DEHP, a type of phthalate additive, leaches out of vinyl medical bags and tubing. An infant boy in neonatal intensive care may be exposed to enough phthalates from PVC to pose harm to his developing reproductive organs (Rossi 2001). Examples of PVC uses particularly vulnerable to dioxin-forming fires include automotive applications and building materials such as vinyl siding. High fire hazard uses of PVC should be replaced with safer alternatives.

**13. If Safer Alternatives are Not Yet Available, Extend the Phase-Out Deadlines for Specific PVC Uses.** A reasonable PVC phase-out policy would make allowance for those few cases where acceptable alternatives are not readily available. In such a case, a temporary exemption could be granted for a scheduled PVC phase-out deadline upon a satisfactory demonstration by a product manufacturer. Further criteria for granting interim relief should consider whether the specific use of PVC is essential to public health and safety or if the available alternative does not work effectively or is much more expensive.

**14. Fund Efforts to Reduce the Amount of PVC Waste Generated Through Fees on the PVC Content of Products.** Funding will be needed for public education, developing diversion and labeling programs, and to administer an orderly phase-out of PVC products. PVC products should be assessed fees to pay for these PVC reduction programs. That's the fairest approach. Fees should be collected at the product distribution level to avoid the administrative burden of retail fee collection.

### Accomplish Within Ten Years

**15. Phase Out Remaining Uses of Durable PVC Products.** The remaining uses of PVC should be relatively lower hazard uses in longer-lived products that have less chance of accidental combustion or public exposure to toxic additives. These uses should be replaced with safer alternatives as the final priority for the orderly phase-out of PVC. By ending all uses of PVC, the toxic impacts across the life cycle from production to disposal will be prevented.

**16. Decommission Municipal Waste Incinerators in Favor of 'Zero Waste' Plans.** Within ten years, we should replace the inherently dirty and obsolete strategy of needlessly burning valuable resources disguised as discarded materials and products. Zero waste strategies involving much more aggressive source reduction (including product redesign), reuse, recycling and com-

posting can reduce waste volumes even more than incineration, and without generating toxic by-products. As the contracts expire on the current inventory of more than 100 municipal solid waste incinerators, these plants should be safely decommissioned. Waste incineration should be relegated to the dustbin of history.

### Conclusion

Within ten years, we can bring a virtual halt to the toxic life cycle of PVC. Through persistent organized action at all levels, discarding harm from PVC disposal will become a practice of the past. Safer alternatives will serve the same purposes filled by PVC now through the use of clean materials and the sustainable production of clean products. The health and environmental problems created by PVC can be solved through two profoundly simple actions—don't buy it, don't burn it!



# APPENDIX A

## Common Household Products and Packaging That May Contain PVC

Thousands of consumer products and packaging are made from PVC. The following is a general list of some common products that are typically made of PVC. This list is meant to be a starting point for identifying what common products are packaged in or made from PVC. In creating this list, we recognize that companies are always changing their products, including the materials they use to package them. In some cases, you may find that a product listed is no longer made from PVC. If this happens, you may want to contact the company and congratulate them for being environmentally conscientious.

While this list may help get you started, not all containers and products are labeled. If you suspect that a product or its packaging is made of PVC, we suggest you contact the product manufacturer and ask them directly about the materials used in the product or its packaging. One way to be sure if the packaging of a product is made from PVC is to look for the number "3" or for the letter "V" inside the universal recycling symbol. This means that the product is made of PVC. Soft flexible plastic products that are made with PVC often have a distinct odor. What you smell is the plasticizer that was added to the PVC material to make it soft and flexible.



PVC



V



vinyl

In addition, a list of specific products identified by brand name that are packaged in PVC bottles, was generated by the Grassroots Recycling Network (GRRN 2004a). This list can be accessed on the GRRN web site at <http://www.grrn.org/pvc>.

### Apparel:

- Boots
- Aprons
- T-shirts with PVC prints (shiny)
- Raincoats
- Rain pants
- Skirts
- Lingerie
- Shoes
- Bags
- Luggage
- Bibs
- Backpacks (PVC coating for waterproofing)
- Watchbands
- Diaper covers

### Personal Care Items (packaging):

- Shampoo
- Hair gel
- Lotion
- Suntan lotion
- Baby oil
- Mouthwash
- Face Wash
- Aloe Vera Gel
- Massage oil
- Liquid soap

**Household Items:**

- Cleaning product containers
- Waterbeds
- Shelving
- Checkbook covers
- Photo album sheets
- Self-adhesive labels and stickers
- Shower curtains
- Imitation leather furniture
- Mattress covers
- Textiles
- Toys
- Clothes racks (covers metal to prevent rusting)
- Pet care product containers
- Strollers

**Kitchen Items:**

- Drinking straws
- Tablecloths
- Beverage containers
- Plastic utensils
- Dishwasher, refrigerator and freezer racks
- Dish drying racks (covers metal to prevent rusting)
- Appliance casings
- Food wrap
- Food containers

**Outdoor Items:**

- Pond liners
- Tarps
- Greenhouses
- Children's swimming pools
- Inflatable furniture
- Outdoor furniture
- Garden hoses
- Balls

**Automotive:**

- Upholstery
- Dashboards
- Door panels
- Underbody coating
- Car seats for children
- Traffic cones
- Wire coating
- Auto-related product containers

**Building Materials:**

- Pipes
- Siding
- Tiles
- Wall coverings
- Window frames
- Door frames
- Door gaskets
- Gutters
- Fencing
- Plastic lumber

- Shutters
- Flooring
- Wire/cable insulation
- Molding
- Cavity closure insulation

**Medical Supplies:**

- Colostomy bags
- Catheters
- Blood bags
- Bed liners
- Tubing
- Gloves
- Mattress covers

**Office Supplies:**

- Computer keyboards
- Computer monitor housing
- Cellular phones
- Floppy disks
- Binders
- Clipboards
- Paper clips
- Tape
- Mouse pads

**Miscellaneous:**

- Credit cards
- Slide holders
- Landfill liners and leachate pipes

**References to Appendix A**

Abacas Studies (2004) "Self Adhesive Polyester (PVC) Labels and Stickers." Christchurch Business Centre United Kingdom. Available at [http://www.abalabels.co.uk/polyester\\_labels\\_stickers.htm](http://www.abalabels.co.uk/polyester_labels_stickers.htm).

Bivings Woodell (1999) Vinyl: Everyday Uses at [www.vinylfacts.com/everyday/](http://www.vinylfacts.com/everyday/).

eBay (2004) "Search for PVC" at [www.ebay.com](http://www.ebay.com).

Harmon (2001) M. *This Vinyl House*. Greenpeace USA, Washington, DC, May.

Helix (2004) "Science with a twist" Website. Available at [www.publish.csiro.au/helix/cf/issues/th62b2.cfm](http://www.publish.csiro.au/helix/cf/issues/th62b2.cfm).

MassPIRG (1998) *It's Perfectly Clear: The Case Against PVC Packaging*. MassPIRG, Boston, MA. Available at

[www.pirg.org/masspirg/enviro/sw/pvc/index.htm](http://www.pirg.org/masspirg/enviro/sw/pvc/index.htm).

North Carolina Department of Environmental and Natural Resources (1998) "Plastic: PVC (#3) Commodity Profile." NC DENR Division of Pollution Prevention and Environmental Assistance.

Thornton (2000) J. *Pandora's Poison: Chlorine, Health, and a New Environmental Strategy*. Cambridge, Massachusetts: MIT Press.

Turner Toys (2002) "An Evaluation of the Hazards of Toys and Other Products made from Polyvinyl Chloride (PVC)." Website at [www.turnertoys.com/pvc9printable.htm](http://www.turnertoys.com/pvc9printable.htm).

Washington Toxics Coalition (WTC 2004) at [www.watoxics.org/content/pdf/Vinyl.pdf](http://www.watoxics.org/content/pdf/Vinyl.pdf).



# APPENDIX B

## Amount of PVC Generated, Incinerated and Landfilled in Each State

State	Total MSW Generated (tons)	Total Amount of PVC Disposed (tons) <sup>1</sup>	Amount of PVC Incinerated (tons) <sup>2</sup>	Amount of PVC Landfilled (tons) <sup>2</sup>
Alabama	*	*	*	*
Alaska	*	*	*	*
Arizona	6,012,359	37,277	0	37,277
Arkansas	3,838,217	23,797	545	23,252
California	54,429,851	337,465	9,205	328,260
Colorado	5,051,132	31,317	0	31,317
Connecticut	4,734,132	29,352	16,257	13,095
Delaware	1,069,042	6,628	0	6,628
Florida	19,706,584	122,181	45,364	76,817
Georgia	11,214,006	69,527	350	69,177
Hawaii	1,706,018	10,577	3,454	7,123
Idaho	1,090,000	6,758	0	6,758
Illinois	15,951,037	98,896	0	98,896
Indiana	9,542,378	59,163	6,177	52,986
Iowa	3,416,268	21,181	366	20,815
Kansas	4,698,338	29,130	0	29,130
Kentucky	5,465,608	33,887	16	33,871
Louisiana	4,952,900	30,708	0	30,708
Maine	1,327,164	8,228	5,448	2,780
Maryland	8,904,464	55,208	12,486	42,722
Massachusetts	8,307,387	51,506	28,145	23,361
Michigan	16,916,076	104,880	8,639	96,241
Minnesota	5,043,752	31,271	14,432	16,839
Mississippi	2,918,407	18,094	0	18,094
Missouri	7,256,744	44,992	207	44,785
Montana	*	*	*	*
Nebraska	2,395,100	14,849	0	14,849

State	Total MSW Generated (tons)	Total Amount of PVC Disposed (tons) <sup>1</sup>	Amount of PVC Incinerated (tons) <sup>2</sup>	Amount of PVC Landfilled (tons) <sup>2</sup>
Nevada	3,365,570	20,867	0	20,867
New Hampshire	1,214,777	7,532	1,675	5,857
New Jersey	10,606,326	65,759	9,593	56,166
New Mexico	2,095,052	12,989	0	12,989
New York	24,775,000	153,605	37,517	116,088
North Carolina	8,981,349	55,684	842	54,842
North Dakota	638,804	3,961	0	3,961
Ohio	16,211,198	100,509	0	100,509
Oklahoma	4,489,028	27,823	0	27,832
Oregon	4,074,945	25,265	2,434	22,831
Pennsylvania	12,675,854	78,590	17,746	60,844
Rhode Island	1,248,745	7,742	0	7,742
South Carolina	5,973,059	37,033	2,004	35,029
South Dakota	518,493	3,215	0	3,215
Tennessee	7,365,920	45,669	1,266	44,403
Texas	28,531,660	176,896	0	176,896
Utah	2,471,404	15,323	782	14,541
Vermont	611,617	3,792	498	3,294
Virginia	10,877,723	67,442	18,806	48,636
Washington	8,666,755	53,734	4,606	49,128
West Virginia	1,754,523	10,878	0	10,878
Wisconsin	5,592,862	34,676	1,545	33,131
Wyoming	693,783	3,301	0	3,301
<b>Totals</b>	<b>369,381,411</b>	<b>2,289,166</b>	<b>250,405</b>	<b>2,038,761</b>

**Sources and Notes:** Estimates derived from Kaufman (2004) for 2002. (1) The amount of PVC generated in each state is derived by multiplying the total Municipal Solid Waste (MSW) generated in that state by the percent of PVC (0.62%) estimated from USEPA (2003). We assumed the percent of PVC estimated from the USEPA data was representative of the PVC content in a typical municipal solid waste stream and that none of the PVC was recycled. (2) The amount of PVC incinerated (or landfilled) in each state was calculated by multiplying the total PVC disposed of in the state by the percent of waste incinerated (or landfilled) after recycling. The percent of PVC incinerated (or landfilled) after recycling was determined by dividing the total amount of waste incinerated (or landfilled) in a state (provided in Table 4 of Kaufman 2004) by the total waste disposed of (after recycling).

\* These states did not participate in the survey conducted by Biocycle magazine (Kaufman 2004).

# REFERENCES

Abacas Studies (2004) "Self Adhesive Polyester (PVC) Labels and Stickers." Christchurch Business Centre United Kingdom. Available at [http://www.abalabels.co.uk/polyester\\_labels\\_stickers.htm](http://www.abalabels.co.uk/polyester_labels_stickers.htm).

Abbott Laboratories (2003) *Making a Difference Around the World*. Global Citizenship Report 2000-2001. Available at: [http://www.abbott.com/citizenship/pdf/2000-01\\_gc\\_report.pdf](http://www.abbott.com/citizenship/pdf/2000-01_gc_report.pdf).

Ackerman (2003) F. and R. Massey. "The Economics of Phasing Out PVC," Global Development and Environment Institute, Tufts University, Somerville, MA, December. Available at [www.ase.tufts.edu/gdae/Pubs/tp/Economics\\_of\\_PVC.pdf](http://www.ase.tufts.edu/gdae/Pubs/tp/Economics_of_PVC.pdf).

Ackerman (2003a) F. and R. Massey. "The Economics of Phasing Out PVC." The studies discussed by Ackerman: "A Strategy for Virtual Elimination of Persistent Toxic Substances," International Joint Commission (IJC), Windsor, Ontario, 1993; *Economic Instruments for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes Basin*, Report to IJC, Hickling Corporation, 1994; *Assessment of the Economic Benefits of Chlor-Alkali Chemicals to the United States and Canadian Economy*, Charles River Associates, Boston, MA 1993; and *A Technical and Economic Comparison of Options to Products Derived from the Chlor-Alkali Industry*, Environment Canada, 1997; are all cited in Ackerman 2003.

Ackerman (2003b) F. and R. Massey. "The Economics of Phasing Out PVC." The references used by Ackerman to support the discussion that environmental costs are less than anticipated: *Gauging Control Technology and Regulatory Impacts in Occupational and Safety and Health*, US Congress Office of Technology Assessment, OTA-ENV-635, Washington, DC, September, 1995 and *A Retrospective Evaluation of Control Measures for Chlorinated Substances (Case Studies of Ex-Ante/Ex-Post Socioeconomic Effects)*, Report to Environment Canada and Ontario Ministry of Energy, Science and Technology, Cheminfo Services, 2000.

Ackerman (2003c) F. and R. Massey. "The Economics of Phasing Out PVC." The references used by Ackerman to provide statistics on VCM and PVC facilities in US: *Chemical Economics Handbook: Polyvinyl Chloride (PVC) Resins*," CEH Marketing Research Report, SRI International, Menlo Park, CA, September, 2003 and *Chemical Economics Handbook "Vinyl Chloride Monomer"*, SRI Consulting, Menlo Park, CA, December, 2000.

AEA Technology (AEA 2000) *Economic Evaluation of PVC Waste Management*. Prepared for the European Commission Environment Directorate, by AEA Technology, Oxfordshire, England, June.

Agency for Toxic Substances and Disease Registry (ATSDR 2001) *Landfill Gas Primer An Overview for Environmental Health Professionals*. Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA. Available at <http://www.atsdr.cdc.gov/hac/landfill/html/intro.html>.

- Agency for Toxic Substances and Disease Registry (ATSDR 1997) *Toxicity Profile for Vinyl Chloride (Update)*. Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA, September. Available at <http://www.atsdr.cdc.gov/toxprofiles/tp20.html>.
- Agency for Toxic Substances and Disease Registry (ATSDR 1992) *Toxicity Profile for Tin*. Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA, September. Available at <http://www.atsdr.cdc.gov/toxprofiles/tp55.html>.
- Al-Malack (2000) M.H., A.Y. Sheikheidin, N.M. Fayad, and N. Khaja. "Effect of Water Quality Parameters on the Migration of Vinyl Chloride Monomer from Unplasticized PVC Pipes." *Water, Air and Soil Pollution* 120 (1-2): 195-208, May.
- Alaska Department of Environmental Conservation (AKDEC 2004) "Open Burning and Policy Guidelines." Alaska DEC Division of Air Quality Air Permits Program. May. Available at <http://www.state.ak.us/dec/air/ap/docs/obrguide.pdf>.
- Alliance for the Responsible Use of Chlorine Chemistry (ARCC 2003) "Chlorine Chemistry Key to U.S. Economy and Life." Available at <http://www.chlorallies.org/employ.html>.
- Allsopp (2001) M., P. Costner, and P. Johnston. *Incineration and Human Health – State of Knowledge of the Impacts of Waste Incinerators on Human Health*. Greenpeace Research Laboratories, University of Exeter, United Kingdom, March. Available at <http://archive.greenpeace.org/~toxics/reports/euincin.pdf>.
- Altwickler (1993) E.R., R.K.N.V. Konduri, C. Lin, and M.S. Milligan. "Formation of precursors to chlorinated dioxin/furans under heterogeneous conditions." *Combustion Science and Technology* 88: 349-368.
- American Plastics Council (APC 2004) *Frequently asked questions*. APC Automotive Learning Center. Available at [http://www.plastics-car.org/s\\_plasticscar/doc.asp?cid=407&did=1604](http://www.plastics-car.org/s_plasticscar/doc.asp?cid=407&did=1604)
- Anderson (2004) P. *Message in a Bottle: The Impacts of PVC on Plastics Recycling*. A Report to the GrassRoots Recycling Network from Recycle Worlds Consulting, June. Available at <http://www.grn.org/assets/pdfs/pvc/PVCBottleRecyclingReport06162004.pdf>
- Anderson (2004a) P. Personal Communication with Peter Anderson, Recycle Worlds Consulting, Madison, WI, October 13.
- Antonacci (2004) S. "Formosa Tests Find Higher Dioxins." *The State Journal-Register*, Undated. Available at <http://www.sj-r.com/sections/news/stories/30228.asp>
- ARGUS (2000) *The Behaviour of PVC in Landfill. Final Report*. ARGUS in association with University of Rostock-Prof Spillmann, Carl Bro a/s and Sigma Plan S.A. European Commission DGXIE.3, February.
- Bates-Rudd (2000) R. "Henry Ford to Shut Down Incinerator." *The Detroit News*, February 23. Available at: <http://www.detnews.com/2000/detroit/0002/25/02230049.htm>.
- Baxter International (1999) Memorandum of Understanding dated March 5. Available at: <http://www.noharm.org/details.cfm?type=document&id=304>.
- Beck (1996) R.W. *1995 National Post-Consumer Plastics Recycling Rate Study*. R.W. Beck and Associates for the Vinyl Institute, September.
- Belliveau (2002) M. "Reducing PVC Through a Statewide Pollution Prevention Agreement." Presented at CleanMed 2002 in Chicago, Illinois, October.
- Bertin Technologies (Bertin 2000) *The influence of PVC on quantity and hazardousness of flue gas residues from incineration*, Study for DG XI, April.
- Birnbaum (2003) L. and W. Farland. "Health Risk Characterization of Dioxins and Related Compounds," in *Dioxins and Health*, Second Edition, Edited by Arnold Schecter and Thomas Gasiewicz, John Wiley and Sons, Hoboken, NJ.

- Bivings Woodell (1999) Vinyl: Everyday Uses at [www.vinylfacts.com/everyday/](http://www.vinylfacts.com/everyday/).
- Blue Ridge Environmental Defense League (BREDL 2002) "Waste Gasification Impacts on the Environment and Public Health." BREDL Glendale Springs, NC, April.
- Bonaparte (1990) R. and B.A. Gross. "Field behavior of double-liner systems." In *Waste Containment Systems: Construction, Regulation, and Performance*. Rudolf Bonaparte (editor). Geotechnical Special Publications No. 26. New York: American Society of Civil Engineers, pp. 52-83.
- Boyer (1989) I. "Toxicity of dibutyltin, tributyltin and other organotin compounds to humans and to experimental animals." *Toxicology* 55: 253-298.
- Buerk (1982) C., J. Batdorf, K. Carmack and O. Ravenholt. "The MGM Grand Hotel Fire. Lessons Learned from a Major Disaster." *Archives of Surgery* 117: 641-644.
- Burnett (1994) R. "Crisis Management Plan for the Dioxin Reassessment." Memorandum and enclosures from the Vinyl Institute Executive Director to the Vinyl Institute Executive Board Members and Issues Management Committee Members. Vinyl Institute, Morristown, NJ, September 6.
- Buss (1995) S.E., A.P. Butler, P.M. Johnson, C.J. Sollars, and R. Perry. "Mechanisms of leakage through synthetic landfill liners materials." *Journal of The Chartered Institution of Water and Environmental Management* 9: 353-359.
- California Air Resources Board (CARB 2003) "Backyard Household Waste Burning Fact Sheet: What you don't know can hurt you." CARB, Sacramento, CA, revised April 15. Available at <http://www.arb.ca.gov/smp/resburn/factsheets/resburn-eng.pdf>.
- California Air Resources Board (CARB 2003a) *Airborne Toxic Control Measure to Reduce Emissions of Toxic Air Contaminants from Outdoor Residential Waste Burning*. California Code of Regulations, Section 93113, Title 17, Final Regulation Order, Effective February 3.
- California Air Resources Board (CARB 1999) *Common Indoor Sources of Volatile Organic Compounds: Emission Rates and Techniques for Reducing Consumer Exposures*. Final Report. Contract No. 95-302, January.
- Carroll (1989) G.J., R.C. Thurnau, R.E. Mournighan, L.R. Waterland, J.W. Lee, and D.J. Fournier, Jr. "Partitioning of Metals in Rotary Kiln Incineration." US Environmental Protection Agency, PB90-132812, Cincinnati, OH, September.
- Cascadia Consulting Group (Cascadia 2003) *Wisconsin Statewide Waste Characterization Study*. Final Report, prepared for the Wisconsin Department of Natural Resources with the assistance of R.W. Beck GRG Analysis, May. Available at [www.dnr.state.wi.us/org/aw/wm/publications/recycle/wrws-finalrpt.pdf](http://www.dnr.state.wi.us/org/aw/wm/publications/recycle/wrws-finalrpt.pdf).
- Chemical Economics Handbook (CEH 2003) "Polyvinyl Chloride (PVC) Resins." CEH Marketing Research Report, SRI International, Menlo Park, CA, September, as cited in Ackerman 2003.
- Chemical Economics Handbook (CEH 2000) "Vinyl Chloride Monomer." CEH, SRI Consulting, Menlo Park, CA, December, as cited in Ackerman 2003.
- Chem-Info Services (CIS 1997) *A Technical and Socio-Economic Comparison of Options to Products Derived from the Chlor-alkali Industry*, Environment Canada, Burlington, Ontario.
- Chicago Tribune (CT 1996) "Hazardous Lead Levels Exist in Plastic Vinyl Mini-Blinds." *Chicago Tribune* July 8, page A7.
- Chien (2003) T. Affidavit before the Supreme Court of the State of New York in the matter of the Resilient Floor Covering Institute and Tarkett, Inc. versus the New York State Department of Environmental Conservation.
- Christiansen (1990) K., A. Grove, L.E. Hansen, L. Hoffmann, A.A. Jensen, K. Pommer, and A. Schmidt. *Environmental Assessment of PVC and Selected Alternative Materials*. Prepared for the Danish National Agency of Environmental Protection, Danish Ministry of the Environment.

- Christmann (1989) W. "Combustion of polyvinyl chloride – an important source for the formation of PCDD/PCDF." *Chemosphere* 19: 387-392.
- Citizens' Environmental Coalition (CEC 2004) *Building Green Without Going in the Red - A Household Guide to Healthy, Affordable Building Materials*. Albany, New York.
- City of Oakland (CO 1999) "Resolution for the City of Oakland Establishing a Regional Task Force and Policy on Dioxin, Public Health and the Environment." Passed by the Oakland City Council on February 2. Available at: <http://www.noharm.org/details.cfm?type=document&id=735>.
- City of San Francisco (CSF 1999) "Establishing Dioxin Pollution as a High Priority for Immediate Action for the City and County of San Francisco in Order to Restore Water, Air and Total Environment Quality" City and County of San Francisco Resolution passed on March 22. Available at: <http://www.noharm.org/details.cfm?type=document&id=739>.
- Clean Car Campaign (CCC 2004) "PVC in Vehicles." A Fact Sheet prepared by the Clean Car Campaign. Available at <http://www.cleancarcampaign.org/pvc.shtml>.
- Cohen (1998) M., B. Commoner, J. Richardson, S. Flack, P.W. Bartlett, P. Cooney, K. Couchot, H. Eisl, and C. Hill. *Dioxin Sources, Air Transport and Contamination in Dairy Feed Crops and Milk*. Center for Biology of Natural Systems, Queens College, Flushing NY.
- Cohen (1995) M., B. Commoner, H. Eisl, P. Bartlett, A. Dickar, C. Hill, J. Quigley, and J. Rosenthal. *Quantitative Estimation of the Entry of Dioxins, Furans and Hexachlorobenzene into the Great Lakes from Airborne and Waterborne Sources*. Center for Biology of Natural Systems, Queens College, Flushing, NY.
- Colardyn (1978) F., M. Van der Straiten, H. Lamont, and T. Van Peteghem. "Acute Inhalation-Intoxication by Combustion of Polyvinylchloride." *International Archives of Occupational and Environmental Health* 38: 121-127.
- Colborn (1996) T., D. Dumanoski, and J.P. Myers. *Our Stolen Future*. Penguin Books, New York.
- Commission of the European Communities (CEC 2000) *Green Paper: Environmental Issues of PVC*. COM (2000) 469 final, Brussels, July 26. Available at [http://www.europa.eu.int/comm/environment/waste/pvc/en.pdf/green\\_paper\\_pvc.thtm](http://www.europa.eu.int/comm/environment/waste/pvc/en.pdf/green_paper_pvc.thtm).
- Commoner (2000) B., P. Woods Bartlett, H. Eisl, and K. Couchot. *Long-Range Air Transport of Dioxin from North American Sources to Ecologically Vulnerable Receptors in Nunavut, Arctic Canada*. Center for the Biology of Natural Systems, Queens College, City University of New York, Flushing, New York.
- Consumer Reports (CR 1998) "Hormone mimics, they're in our food: Should we worry?" *Consumer Reports* 63: 52-55, June.
- Costner (2001) P. "Chlorine, Combustion and Dioxins: Does Reducing Chlorine in Wastes Decrease Dioxin Formation in Waste Incinerators?" Greenpeace International, September 10.
- Costner (2000) P. "Chlorine Input and Dioxin Output from Incinerators and Other Combustion Systems." Part 2 of Greenpeace Comments to the US Environmental Protection Agency Science Advisory Board on the Y2000 Dioxin Reassessment Draft Final Report, November 12.
- Costner (1997) P. "Correlation of Chlorine Input and Dioxin Output from Combustors: A Review and Reanalysis." *Organohalogen Compounds* 32: 436-438.
- Creech (1974) J. and M. Johnson. "Angiosarcoma of liver in the manufacture of polyvinyl chloride." *Journal of Occupational Medicine* 16: 150-151.
- Danish Environmental Protection Agency (DEPA 2001) *Environmental and Health Assessment of Alternatives to Phthalates and to Flexible PVC*. Environmental Report No. 590. Danish Environmental Protection Agency, Copenhagen, Denmark, as cited in (HCWH 2002).



- Danish Environmental Protection Agency (DEPA 1999) *Brominated Flame Retardants; Substance Flow Analysis and Assessment of Alternatives*. June.
- Danish Environmental Protection Agency (DEPA 1995) *PVC and Alternative Materials (English translation)*. Danish Environmental Protection Agency, Copenhagen, Denmark.
- Danish Technical Institute (DTI 1995) *Environmental Aspects of PVC*. Copenhagen, November.
- Denison (1997) R. "Something to Hide: The Sorry State of Plastics Recycling," Environmental Defense Fund, Washington, DC, October.
- Denison (1988) R.A. and E.K. Silbergeld. "Risks of municipal solid waste incineration: an environmental perspective." *Risk Analysis* 8(3): 343-355, September.
- Dickey (2002) P. "Vinyl Exam: Eliminating PVC in your Home" A Washington Toxics Coalition Fact Sheet, September. Available at: <http://www.watoxics.org/content/pdf/vinyl.pdf>.
- Di Gangi (1997) J. *Lead and Cadmium in Vinyl Children's Products*. Greenpeace USA, Washington, DC, October.
- Duffy (1998) R.M. Letter to Concord School Board Members. International Association of Fire Fighters. Washington DC, April 14, as cited in Thornton 2002.
- Dyer (1976) R.E. and V.H. Esch. "Polyvinyl Chloride Toxicity in Fires." *Journal of the American Medical Association* 235 (4): 393-397.
- Eastern Research Group, Inc. (ERG 2002) "National Emission Trends for Small Municipal Waste Combustion Units [Years 1990 to 2005]." Memorandum from Jason M. Huckaby, Eastern Research Group to Walt Stevenson, USEPA/Combustion Group, June 12.
- eBay (2004) "Search for PVC" at [www.ebay.com](http://www.ebay.com).
- Ecocycle Commission of the Government of Sweden (ECC 1994) *PVC: A Plan to Prevent Environmental Impact*. Ecocycle Commission, SOU, Stockholm, Sweden: 104.
- Eden (1993) R. "Toxic emissions from different types of LFG burners." In Proceedings of Sardinia '93 IV International Landfill Symposium, Sardinia, Italy, pp. 635-636, October.
- Erna (1995) M. A.M. Kurosaka and Y. Ogawa. "Comparative developmental toxicity of butyltin trichloride, dibutyltin dichloride and tributyl chloride in rats." *Journal of Applied Toxicology* 15: 297-302.
- Ermler (2001) S. "Toxic Silence in Louisiana." *New York Catholic Worker*, June-July. Available at <http://www.dallaspeace-center.org/toxicla.htm>.
- Environmental Action Foundation (EAF 1993) "The Real Wrap on Polyvinyl Chloride Packaging." Solid Waste Action Paper #8, The Solid Waste Alternatives Project, EAF, Takoma Park, MD.
- Environmental Data Services Ltd. (ENDS 2004) "Slow progress on voluntary PVC recycling targets." ENDS Report 352, May, pp. 32-33.
- Environmental Data Services Ltd. (ENDS 2003) "PVC industry raises the bar on recycling." ENDS Report 340, May, pp. 20-21.
- Environmental Research and Education Foundation (EREF 2001) "Size of the United States Solid Waste Industry." Prepared by R.W. Beck and Chartwell Information Publishers, Alexandria, VA, April.
- Environmental Research Foundation (ERF 1998) "Landfills are Dangerous." *Rachel's Environment & Health Weekly* # 617, Environmental Research Foundation, September 24.

- Environmental Research Foundation (ERF 1992) "New Evidence That All Landfills Leak." *Rachel's Hazardous Waste News # 316*, ERF, Annapolis, MD, December 16.
- Environmental Research Foundation (ERF 1990) "Incineration Worsens Landfill Hazards." *Rachel's Hazardous Waste News # 162*, ERF, Annapolis, MD, January 3.
- Environmental Research Foundation (ERF 1989) "Leachate Collection Systems: The Achilles Heel of Landfills." *Rachel's Hazardous Waste News # 119*, ERF, Annapolis, MD, March 7.
- Evers (1989) E. *The Formation of Polychlorinated Dibenzofurans and Polychlorinated dibenzo-p-dioxins and Related Compounds During Oxyhydrochlorination of Ethylene*. University of Amsterdam, Department of Environmental and Toxicological Chemistry, Amsterdam.
- Fabrellas (1999) B., P. Sanz, E. Abad, and J. Rivera. "The Spanish dioxin inventory: Proposal and preliminary results from municipal waste incinerator emissions." *Organohalogen Compounds* 41: 491-494.
- Federal Emergency Management Agency (FEMA 2002) *Landfill Fires: Their Magnitude, Characteristics, and Mitigation*. United States Fire Administration, May. Available at <http://fema.gov/downloads/pdf/publications/fa-225.pdf>.
- Fiedler (1993) H., O. Hutzinger and J. Hosseinpour. "Analysis and remedial actions following an accidental fire in a kindergarten." *Organohalogen Compounds* 14: 19-23.
- Forsyth (1997) D.S. and B. Jay. "Organotin leachates in drinking water from chlorinated poly (vinyl chloride) (CPVC) pipe." *Applied Organometallic Chemistry* 11: 551-558.
- Franklin Associates (FA 1998) *Characterization of Building-Related Construction and Demolition Debris in the United States*. Prepared for the U.S. Environmental Protection Agency Municipal and Industrial Solid Waste Division Office of Solid Waste by Franklin Associates, Report No. EPA530-R-98-010, Prairie Village, KS, June. Available at <http://www.epa.gov/epaoswer/hazwaste/sqg/c&d-rpt.pdf>
- Goodman (1994) D. Memorandum: Incineration Task Force, Vinyl Institute, Morristown, NJ, August 22.
- GrassRoots Recycling Network (GRRN 2004) "What is Zero Waste?" GRRN, Madison WI. Available at [http://www.grrn.org/zerowaste/zerowaste\\_faq.html](http://www.grrn.org/zerowaste/zerowaste_faq.html)
- Grassroots Recycling Network (GRRN 2004a) "So what is packaged in PVC, anyway?" GRRN, Madison, WI. Available at <http://www.grrn.org/pvc>.
- Green (1993) AES, "The future of medical waste incineration." In Green, AES, ed. *Medical Waste Incineration and Pollution Prevention*, New York: Van Nostrand Reinhold, pp. 170-207.
- Greenaction (2002) "Stericycle Closes Controversial Waste Incinerator at Gila River Indian Community Reservation in Arizona." News Update, November 26. Available at <http://www.greenaction.org/ies/pr112602.shtml>.
- Greenaction (2001) "Trucks Carrying Medical Waste Blocked at IES Incinerators, 499 High Street, East Oakland!" News Update, August 7. Available at <http://www.greenaction.org/ies/pr080701.shtml>.
- Greenaction (2001a) "IES Medical Waste Incinerators in Oakland to Close Immediately!" News Update, December 7. Available at <http://www.greenaction.org/ies/pr120701.shtml>.
- Greenpeace (2004) "PVC Alternatives Database Building the Future." Greenpeace. Available at <http://archive.greenpeace.org/toxics/pvcdatabase>.
- Greenpeace (2004a) "Mossville, Louisiana." Fact Sheet. Available at <http://www.greenpeaceusa.org/media/factsheets/mossvilletext.htm>.

Greenpeace (2004b) "Lake Charles, Louisiana: a Global Dioxin Hot Spot." Fact Sheet. Available at <http://www.greenpeaceusa.org/media/factsheets/hotspottext.htm>.

Greenpeace (2003) "2003 Toy Report Card" Greenpeace. Available at: [http://www.greenpeaceusa.org/features/details?item\\_id=526899&campaign\\_id=512832](http://www.greenpeaceusa.org/features/details?item_id=526899&campaign_id=512832).

Greenpeace (2001) *PVC-Free Future: A Review of Restrictions and PVC free Policies Worldwide.* Greenpeace International, Inc. The Netherlands, August. Available at <http://archive.greenpeace.org/toxics/reports/restrictions.pdf>.

Greenpeace (1997) "Play Safe Buy PVC Free." Greenpeace. Available at <http://archive.greenpeace.org/comms/pvctoys>.

Greenpeace (1994) "PVC Fires List: Accidental Fires that have Involved the Synthetic Material Polyvinyl Chloride." Washington, DC, June. Available at <http://archive.greenpeace.org/toxics/reports/gopher-reports/pvcfires.txt>.

Gullett (2001) B., P. Lemieux, C. Lutes, C. Winterrowd, and D. Winters. "Emissions of PCDD/F from uncontrolled, domestic waste burning." *Chemosphere* 43: 721-725.

Gullett (2000) B., P. Lemieux, C. Winterrowd, and D. Winters. "PCDD/F Emissions from Uncontrolled, Domestic Waste Burning." *Organohalogen Compounds* 46: 193-196.

Gullett (1999) B., P. Lemieux, C. Lutes, C. Winterrowd, and D. Winters. "PCDD/F emissions from uncontrolled, domestic waste burning." *Organohalogen Compounds* 41: 27-30.

Halonen (1995) I., J. Tarhanen, T. Ruokojarvi, K. Tuppurainen, and J. Ruuskanen. "Effect of catalysts and chlorine source on the formation of organic chlorinated compounds." *Chemosphere* 30: 1261-1273.

Halonen (1993) I., J. Tarhanen, T. Kopsa, J. Palonen, H. Vilokki and J. Ruuskanen. "Formation of polychlorinated dioxins and dibenzofurans in incineration of refuse derived fuel and biosludge." *Chemosphere* 26: 1869-1880.

Harmon (2001) M. *This Vinyl House*. Greenpeace USA, Washington, DC, May.

Harvie (2002) J. and T. Lent. *PVC-Free Pipe Purchasers' Report*. Draft, Healthy Building Network, Washington, DC, November. Available at <http://www.healthybuilding.net/pvc/alternatives.html>.

Hasselriis (1993) F. and L. Constantine. "Characterization of Today's Medical Waste." In Green AES, ed. *Medical Incineration and Pollution Prevention*, New York: Van Nostrand Reinhold pp. 37-52.

Hatanaka (2000) T., T. Imagawa, and M. Takeuchi. "Formation of PCDD/Fs in artificial solid waste incineration in a laboratory-scale fluidized bed reactor: influence of contents and forms of chlorine sources in high-temperature combustion." *Environmental Science and Technology* 34: 3920-3924.

Haxo (1988) H.E. and T.P. Lahey. "Transport of Dissolved Organics from Dilute Aqueous Solutions through Flexible Membrane Liners." *Hazardous Waste & Hazardous Materials* 5(4): 275-294.

Health Care Without Harm (HCWH 2002) *Aggregate Exposures to Phthalates in Humans*. HCWH, Washington DC, July.

Health Care Without Harm (HCWH 2002a) "Top GPOs Embrace Effort to Reduce Environmental Impact of Health Care." News Release, October, 31. Available at: <http://www.noharm.org/details.cfm?type=document&id=692>.

Health Care Without Harm (HCWH 2001) *Non-Incineration Medical Waste Treatment Technologies*. A resource for Hospital Administrators, Facility Managers, Health Care Professionals, Environmental Advocates, and Community Members. HCWH, Washington DC, August.

Healthy Building Network (HBN 2004) "PVC Alternatives." A fact sheet available at <http://www.healthybuilding.net/pvc/alternatives.html>.

- Helix (2004) "Science with a twist" website. Available at [www.publish.csiro.au/helix/cf/issues/th62b2.cfm](http://www.publish.csiro.au/helix/cf/issues/th62b2.cfm).
- Hickling Corporation (HC 1994) *Economic Instruments for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes Basin*. Report to the International Joint Commission, Windsor, Ontario.
- Hjertberg (1995) T. and T. Gevert. *Evaluation of possible degradation of pipes and cable insulation of PVC-Results obtained with samples collected after about 25 years use*. Department of Polymer Technology, Chalmers Technical University of Gothenburg, Sweden.
- Holden (1999) A. "Environmental Justice: A Burning Issue in Detroit." *EJ Times*. Sierra Club, October-December. Available at [http://www.sierraclub.org/environmental\\_justice/newsletter/1.pdf](http://www.sierraclub.org/environmental_justice/newsletter/1.pdf).
- Huang (2004) J. "Medical waste site sought." *Maine Sunday Telegram*, April 4.
- Hutari (1996) J. and R. Vesterinen. "PCDD/F emissions from co-combustion of RDF with peat, wood waste, and coal in FBC boilers." *Hazardous Waste and Hazardous Materials* 13: 1-10.
- ICF (1995) *Construction and Demolition Waste Landfills*. ICF Incorporated, prepared for the USEPA Office of Solid Waste, Contract No. 68-W3-0008, February.
- Illinois Environmental Protection Agency (IEPA) (2004) "Formosa Plant Information." *Formosa Plastics Corporation Site*, June 22. Available at [http://illioopolis.tripod.com/pages/formosa\\_plant\\_information.htm](http://illioopolis.tripod.com/pages/formosa_plant_information.htm).
- International Association of Fire Fighters (IAFF 1995) *Hazardous Materials: Polyvinyl Chloride*. Department of Occupational Health and Safety. Revised May 16.
- Ishibashi (2000) N., Y. Yoshihara, K. Nishiwaki, S. Okajima, M. Hiraoka, and J. Shudo. "The effects of organic- and inorganic-chloride in municipal solid wastes on dioxins formation and emission." *Organohalogen Compounds* 546: 122-125.
- Jaakkola (1999) J., L. Oie, P. Nafstad, G. Botten, S. Samuelson, and P. Magnus. "Interior surface materials in the home and the development of bronchial obstruction in young children in Oslo Norway." *American Journal of Public Health* 89 (2): 188-191.
- Kanters (1996) M. J., R. Van Nispen, R. Louw, and P. Mulder. "Chlorine input and chlorophenol emission in the lab-scale combustion of municipal solid waste." *Environmental Science and Technology* 30: 2121-2126.
- Kaufman (2004) S.M., N. Goldstein, K. Millrath and N.J. Themelis. "The State of Garbage in America: 14<sup>th</sup> Annual Nationwide Survey of Solid Waste Management in the United States." A Joint Study with the Earth Engineering Center of Columbia University, *BioCycle*: 31-41, January.
- Kielhorn (2000) J., C. Melber, U. Wahnschaffe, A. Aitio, and I. Mangelsdorf. "Vinyl Chloride: Still a Cause for Concern." *Environmental Health Perspectives* 108 (7): 579-588, July.
- Kolenda (1994) J., H. Grass, M. Wilken, J. Jager, and B. Zeschmer-Lahl. "Determination and reduction of PCDD/F emissions from wood burning facilities." *Chemosphere* 29: 1927-1938.
- Kopponen (1992) P., R. Torronen, J. Ruuskanen, J. Tarhanen, T. Vartiainen, and S. Karenlampi. "Comparison of cytochrome P450IA1 induction with the chemical composition of fly ash from combustion of chlorine containing material." *Chemosphere* 24: 391-401.
- Landrigan (2004) P.J., P.J. Liroy, G. Thurston, G. Berkowitz, L.C. Chen, S.N. Chillrud, S.H. Gavett, P.G. Georgopoulos, A.S. Geyh, S. Levin, F. Perera, S.M. Rappaport, C. Small, and the NIEHS World Trade Center Working Group. "Health and Environmental Consequences of the World Trade Center Disaster." *Environmental Health Perspectives* 112 (6) 731-739.
- Lee (2003) G. F. "Deficiencies in the US EPA's Characterization of the Protection Provided by Subtitle D Landfilling of MSW." *El Macero*, CA, March 12.

Lee (1996) G. F. and A. Jones-Lee. "Landfill Leachate Management." *MSW Management* 6: 18-23.

Lee (1994) G. F. and A. Jones-Lee. "Impact of Municipal and Industrial Non-Hazardous Waste Landfills on Public Health and the Environment: An Overview." Prepared for CA EPA Comparative Risk Project, May 1994.

Lee (1992) G.F. and A. Jones. "Municipal Solid Waste Management in Lined, "Dry Tomb" Landfills: A Technologically Flawed Approach for Protection of Groundwater Quality." G. Fred :Lee Associates, El Macero, CA, March.

Lemieux (2003) P.B. Gullett, C. Lutes, C. Winterrowd, and D. Winters. "Variables Affecting Emissions of PCDD/Fs from Uncontrolled Combustion of Household Waste in Barrels." *Journal of Air & Waste Management Association* 53: 523-531, May.

Lemieux (2000) P., C. Lutes., J. Abbott, and K. Aldous. "Emissions of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans from the Open Burning of Household Waste in Barrels," *Environmental Science & Technology*, Web release date January 4, 2000 10.1021/es990465t S0013-936X(99)00465-4 Available at [http://www.ecy.wa.gov/programs/air/outdoor\\_woodsmoke/AmerChemReport.pdf](http://www.ecy.wa.gov/programs/air/outdoor_woodsmoke/AmerChemReport.pdf).

Lemieux (1998) P. Evaluation of Emissions from the Open Burning of Household Waste in Barrels. USEPA National Risk Management Research Laboratory Project Summary EPA/600/SR-97-134, Cincinnati, OH March.

Lester (2003) S. "When people lead, policies follow." *Organohalogen Compounds* 65: 398-401.

Liberti (1983) A., G.Goretti, and M.V. Russo. "PCDD and PCDF formation in the combustion of vegetable wastes." *Chemosphere* 12: 661-663.

Lighthall (1998) D. and S. Kopecky. "Confronting the Problem of Backyard Burning: The Case for New York." Colgate University, Department of Geography, Hamilton, New York.

Lott (2004) L. "Health Care With Harm: A Study of the Initiative To Shut Down Henry Ford Hospital's Medical Waste Incinerator in Detroit, Michigan." Undated. Available at <http://www.umich.edu/~sure492/jones/henryford.htm>.

Louisiana Bucket Brigade (LBB) "Birds of Prey: Feeding off of Mossville and Calcasieu Parish." LBB undated.

Mahle (1980) N. and L. Whiting. "The formation of chlorodibenzo-p-dioxins by air oxidation and chlorination of bituminous coal." *Chemosphere* 9: 693-699.

Maine Department of Environmental Protection (MDEP 2004) Tabular Presentation of Sources of Dioxin in Maine. August. Available at <http://www.state.me.us/dep/dioxin/inventory.htm>.

Maine Department of Environmental Protection (MDEP 2001) *Toxic Dioxin Emissions Cause Maine Legislature to Ban Back Yard Trash Burning*, Environmental Bulletin, A Maine DEP Information Bulletin for Maine Citizens & Municipal Officials, Winter 2001/02. Available at <http://www.state.me.us/dep/air/compliance/byb/bybban.pdf>.

Maine Department of Environmental Protection (MDEP 2001a) *Dioxin pollution causes ban on open burning of wastes!* A poster prepared by the Maine Department of Environmental Protection. Available at <http://www.state.me.us/dep/air/compliance/byb/posterbyb.pdf>.

Maine Department of Environmental Protection (MDEP 2001b) *Plan for the Statewide Collection of Household Hazardous Waste*, March.

Maine Department of Environmental Protection (MDEP 1997) *State of Maine 1997 Backyard Trash Burning (BYB) Study*, Bureau of Air Quality, Augusta: Maine.

Maine Hospital Association (MHA 2001) *Blueprint for Action*, Maine Hospitals for a Healthy Environment – Working Together to Build a Healthier Maine Environment, Winter. Available at <http://www.themha.org/hhe/blueprint.htm>.

Maine Revised Statutes Annotated (MRSA 2004) Title 22, Section 9324, Out-of-door Fires: Prohibited Acts; added by Chapter 277, An Act to Reduce the Release of Dioxin from Consumer Products into the Environment, Public Laws of Maine, First Regular Session of the 120<sup>th</sup> Legislature, 2001.

Maine Revised Statutes Annotated (MRSA 2004a) Title 38, Chapter 24 - Solid Waste Management and Recycling, Section 2101 - Solid Waste Management Hierarchy, Paragraph 1, Added by Public Laws of 1989 as Chapter 585. Available at <http://janus.state.me.us/legis/statutes/38/title38sec2101.html>.

Manninen (1996) H., A. Perkio, T. Vartiainen, and J. Ruuskanen. "Formation of PCDD/PCDF: effect of fuel and fly ash composition on the formation of PCDD/PCDF in the co-combustion of refuse-derived and packaging-derived fuels." *Environmental Science and Pollution Research* 3: 129-134.

Marklund (2003) A., B. Andersson, and P. Haglund. "Screening of organophosphorus compounds and their distribution in various indoor environments." *Chemosphere* 53: 1137-1146.

Marrack (1988) D. "Hospital red bag waste: An assessment and management recommendations." *Journal of the Air Pollution Control Association* 38: 1309-1311.

MassPIRG (1998) *It's Perfectly Clear The Case Against PVC Packaging*. MassPIRG, Boston, MA. Available at [www.pirg.org/masspirg/enviro/sw/pvc/index.htm](http://www.pirg.org/masspirg/enviro/sw/pvc/index.htm).

Mersiowski (1999) I. and J. Ejlertsson. "Long-term Behaviour of PVC Products Under Landfill Conditions." Technical University of Hamburg-Harburg, Germany; Linköping University, Sweden, July.

Michigan Department of Environmental Quality (MDEQ 2003) "Burning Household Waste." Brochure. MI DEQ Air Quality Division, Lansing, MI. June 2003. Available at <http://www.deq.state.mi.us/documents/deq-aqd-bhw.pdf>.

Microelectronics and Computer Technology Corporation (MCTC 1996) *Electronics Industry Environmental Roadmap*. MCTC, Austin, TX.

Moeller (1995) S., J. Larsen, J. Jernes, H. Faergemann, L. Ottosen, and F. Knudsen. *Environmental Aspects of PVC*. Environmental Project No. 313, Danish Environmental Protection Agency.

Moore (2001) R., T. Rudy, T.M. Lin, K. Ko, and R. Peterson. "Abnormalities of Sexual Development in Male Rats with *in Utero* and Lactational Exposure to the Antiandrogenic Plasticizer Di(2-ethylhexyl) Phthalate." School of Pharmacy, Environmental Toxicology Center, and Endocrinology-Reproductive Physiology Program, University of Wisconsin, Madison, Wisconsin, USA. Available at <http://ehpnet1.niehs.nih.gov/docs/2001/109p229-237moore/abstract.html>.

Mossville Environmental Action Now, Inc. (MEAN 2000) "Breathing Poison: The Toxic Costs of Industries in Calcasieu Parish, Louisiana." A report by MEAN, Lake Charles Area Concerned Citizens, Communities for a Better Environment - NORAN Project, Earthjustice Legal Defense Fund (Louisiana Office).

National Academy of Sciences (NAS 2004) *Acute Exposure Guideline Levels for Selected Airborne Chemicals, Volume 4*. Subcommittee on the Acute Exposure Guidelines Committee on Toxicology Board on Environmental Studies and Toxicology Division on Earth and Life Sciences National Research Council, Washington, DC.

National Academy of Sciences (NAS 2000) *Toxicological Effects of Methylmercury*. Committee on the Toxicological Effects of Methylmercury, Board on Environmental Studies and Toxicology, Commission on Life Sciences National Research Council, Washington, DC.

National Academy of Sciences (NAS 2000a) *Toxicological Risks of Selected Flame-Retardant Chemicals*. Subcommittee on Flame-Retardant Chemicals, Board on Environmental Studies and Toxicology, Commission on Life Sciences National Research Council, Washington, DC.

National Environmental Trust (NET 1999) *Phthalates Found in Common Children's Toys*. NET Washington, DC, December.

- National Toxicology Program (NTP 2000) Center for the Evaluation of Risks to Human Reproduction *Expert Panel Reports: Di(2-ethyl hexyl) phthalate, Butyl benzyl phthalate, Di-isononyl phthalate, and Di-n-octyl phthalate*, Research Triangle Park, NC. Available at <http://cerhr.niehs.nih.gov/news/phthalates>.
- Neurath (2004) C. "PVC's Role in Dioxin Emissions From Open Burning: New Analysis of US EPA Data." *Organohalogen Compounds* 66: 1146-1152.
- New Hampshire Department of Environmental Services (NHDES 2003) "Prevention, Abatement, and Control of Open Source Air Pollution" New Hampshire Code of Administrative Rules, Chapter Env-A 1000.
- New Hampshire Department of Environmental Services (NHDES 2001) *New Hampshire Dioxin Reduction Strategy*. NHDES, Concord, NH, February.
- New Mexico Environment Department (NMED 2004) "Environment Department Announces Major Changes to Open Burning Regulation, Trash Burning Ban" Press Release, January 9.
- Noda (1993) T. et al. "Teratogenic effects of various di-n-butyltins with different anions and butyl(e-hydroxybutyl)tin dilaurate in rats." *Toxicology* 85: 149-160.
- Nordic Council of Ministers (NCM 2003) *Lead Review*. Prepared by COWI Consulting Engineers and Planners, January.
- North Carolina Department of Environment and Natural Resources (NCDENR 1998) "Plastic: PVC (#3) Commodity Profile." NC DENR Division of Pollution Prevention and Environmental Assistance.
- Office of the Fire Marshall (OFM 1997) *Protecting the Public and the Environment by Improving Fire Safety at Ontario's Recycling and Waste Handling Facilities*. Ministry of the Solicitor General and Correctional Services Office of the Fire Marshal, August.
- Office of Solid Waste Management (OSWM 1993) "The Technology of Plastics Recycling." *Solid Waste Management* Vol. 7, No. 7, July, University of Illinois at Chicago (M/C 922), Chicago, IL.
- Oie (1997) L., LG Hersough and JO Madsen. "Residential exposure to plasticizers and its possible role in the pathogenesis of asthma." *Environmental Health Perspectives* 105: 972-978.
- Ontario Ministry of the Environment and Energy (OMEE 1997) *Plastimet Inc. Fire Hamilton Ontario July 9-12, 1997*. OMEE Environmental Sciences and Standards Division and Operations Division, October.
- Organization for Economic Co-operation and Development (OECD 2004) OECD Environment Health and Safety Publications, Series on Emission Scenario Documents Number 3, Emission Scenario Document on Plastics Additives, Environment Directorate, Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, Pesticides and Biotechnology, June 24.
- Papp (1996) R. "Organochlorine waste management." *Pure and Applied Chemistry* 68:1801-1808.
- Pearson (1993) S. and L. Trissei. "Leaching of diethylhexyl phthalate from polyvinyl chloride containers by selected drugs and formulation components." *American Journal of Hospital Pharmacy* 50 (7): 1405-09, July.
- Pitot (1991) H.C. and Y.P. Dragan. "Facts and theories concerning the mechanisms of carcinogenesis." *The FASEB Journal* 5: 2280-2286.
- Pless (2002) P. and J.P. Fox. *Environmental Assessment of Shoreguard and Alternative Bulkhead Materials*. Report presented to California Coastal Commission, November 18.
- Principia Partners (PP 1999) *Post-Industrial and Post-Consumer Vinyl Reclaim, Material Flow and Uses in North America, A Final Report to the Chlor-Vinyl Steering Group*, July. Available at [www.principiaconsulting.com/pdf/rereports\\_vinyl.pdf](http://www.principiaconsulting.com/pdf/rereports_vinyl.pdf).

Plastics Machining and Fabricating (PMF 2003) "APR Calls PVC Post-Consumer Bottles a 'Contaminant' to Recycling of PET and HDPE Bottles." *Plastics Machining and Fabricating: Industry News Archive*, July 30. Available at <http://www.plasticmachining.com/magazine/news/news4.html>

Plinke (2000) E., N. Wenk, G. Wolff, D. Castiglione, and M. Palmark. *Mechanical Recycling of PVC Waste*, Final Report, A Study for DG XI of the European Commission in co-operation with Plastic Consult (Italy) and COWI (Denmark), Basal/Milan/Lyngby, January.

Recycling Today (RT 2001) "APR pulls back from PVC." *Recycling Today On-Line* August 5. Available at <http://www.recyclingtoday.com/articles/articles.asp?Id=3270&SubCatID=12&CatID=3>.

Rigo (1995) G., A. Chandler, and S. Lanier. *The Relationship Between Chlorine in Waste Streams and Dioxin Emissions from Waste Combustors*. The American Society of Mechanical Engineers, New York.

Rossi (2001) M. *Neonatal Exposure to DEHP (di-2-ethylhexyl phthalate) and Opportunities for Prevention*. Health Care Without Harm, Falls Church, VA.

Rossi (2000) M. and T. Schettler. "Setting Healthcare's Environmental Agenda: White Paper on PVC." October 16. Available at <http://www.noharm.org/details.cfm?type=document&ID=489>.

Rudell (2000) R.A. "Polycyclic Aromatic Hydrocarbons, Phthalates and Phenols. In *Indoor Air Quality Handbook*, Edited by JD Spangler, JF McCarthy and JM Samet, New York: McGraw Hill 34: 1-34.

Ruokojärvi (1995) P., M. Ettala, P. Rahkonen, J. Tarhanen, and J. Ruuskanen. "Polychlorinated Dibenzo-P-Dioxins and -Furans (PCDDs and PCDFs) in Municipal Waste Landfill Fires." *Chemosphere* 30 (9): 1697-1708.

Ruzickova (2004) K., M. Cobbing, M. Rossi, and T. Belazzi. *Preventing Harm from Phthalates, Avoiding PVC in Hospitals*. A Health Care Without Harm Report. Available at: <http://www.noharm.org/details.cfm?type=document&id=918>.

Sadiki (1999) A. and D. Williams. "A study on organotin levels in Canadian drinking water distributed through PVC pipe." *Chemosphere* 38 (7): 1541-1548.

Sadiki (1996) A., D. Williams, R. Carrier, and B. Thomas. "Pilot Study on the contamination of drinking water by organotin compounds from PVC materials." *Chemosphere* 32 (12): 2389-2398.

Sakai (1997) S. and M. Hiraoka. "A study of total PCDDs/Fs release to environment from MSWI." *Organohalogen Compounds* 31: 376-381.

Sanders (1978) H.J. "Flame retardants: Government regulations and public emphasis on safety provide the impetus for an expanding industry." *Chemical & Engineering News*, pp. 22-36, April 24.

Sasolwatch (2004) Available at <http://www.sasolwatch.com>.

Sakti (1991) J.P., J.K. Park, and J.A. Hoopes. "Permeation of organic chemicals through HDPE geomembranes." In *Proceedings of ASCE National Environmental Engineering Conference*, ASCE, New York, July.

Schecter (1996) A. and H. Kessler. "Dioxin and dibenzofuran formation following a fire at a plastic storage warehouse in Binghamton, New York in 1995." *Organohalogen Compounds* 27: 187-190.

Schreiber (2003) J. Affidavit before the Supreme Court of the State of New York in the matter of the Resilient Floor Covering Institute and Tarkett, Inc. versus the New York State Department of Environmental Conservation.

Seth (1982) P.K. "Hepatic effects of phthalate esters." *Environmental Health Perspectives* 45: 27-34.

Silicon Valley Toxics Coalition (SVTC 2004) "Just Say No to E-Waste: Background Document on Hazards and Waste from Computers." SVTC, San Jose, CA. Available at <http://www.svtc.org/cleancc/pubs/sayno.htm>



- Singhofen (1997) A. "End-of-Life Vehicles: A Threat to the Environment, The Need to Ban the Use of PVC (Vinyl) Plastic in Cars." Clean Car Campaign, December. Available at [http://www.cleancarcampaign.org/pvc\\_elybackground.shtml](http://www.cleancarcampaign.org/pvc_elybackground.shtml).
- Steingraber (2004) S. *Update on the Environmental Health Impacts of Polyvinyl Chloride (PVC) as a Building Material: Evidence from 2000-2004*, a commentary for the U.S. Green Building Council, on behalf of Healthy Building Network, April 2. Available at [www.healthybuilding.net/pvc/steingraber.pdf](http://www.healthybuilding.net/pvc/steingraber.pdf).
- Steingraber (2004a) S. "Fireballs in the Night Sky, Death by a Thousand Cuts; Lessons from the Formosa PVC Plant, Illiopolis, Illinois." Healthy Building News, May 3.
- Stone Container Corporation (SCC 1988) Correspondence with Attachment from Jenny Brown, Process Engineer – Paper to Larry Lloyd, Administrator, Montana Department of Health and Environmental Sciences, Helena, Montana. Attachment was a revision to the proposed OCC plant report previously submitted to the MDHES, October 19.
- Stringer (1997) R., I. Labounskaia, D. Santillo, P. Jonston, J. Siddorn and A. Stephensen. *Determination of the Composition and Quality of Phthalate Ester Additives in PVC Children's Toys*. Greenpeace Research Laboratories Technical Note 06/97 University of Exeter Department of Biological Sciences, Prince of Wales Road, Exeter, England, September.
- Sustainable Hospital Project (SHP 2000) "Here are four ways to find alternative products." Lowell Center for Sustainable Production, Lowell, MA. Available at [http://www.sustainablehospitals.org/cgi-bin/DB\\_Index.cgi](http://www.sustainablehospitals.org/cgi-bin/DB_Index.cgi).
- Takasuga (2000) T., T. Makino, K. Tsubota, and N. Takeda. "Formation of dioxins (PCDDs/PCDFs) by dioxin-free fly ash as a catalyst and relation with several chlorine sources." *Chemosphere* 40: 1003-1007.
- Tamade (2000) Y., T. Ikeguchi, Y. Yagi, K. Yoneda, and K. Omori. "Generation of dioxins from waste plastics combustion in a fluidized bed incinerator." *Organohalogen Compounds* 46: 166-169.
- Tellus (1992) Institute. *Council of State Governments/Tellus Packaging Study*. Prepared for the Council of State Governments, US Environmental Protection Agency, and New Jersey Department of Environmental Protection and Energy, Boston MA.
- ten Tusscher (2000) G.W., G.A. Stam, and J.G. Koppe. "Open chemical combustions resulting in a local increased incidence of orofacial clefts." *Chemosphere* 40:1263-1270.
- Theisen (1991) J. *Untersuchung der Moglichen Umweltgefahrndung Beim Brand Von Kunststoffen (Investigation of Possible Environmental Dangers Caused by Burning Plastics)* German Umweltbundesamt Report 104-09-222, Bismarkplatz 1, 1000 Berlin 33, Germany.
- Thornton (2002) J. *Environmental Impacts of Polyvinyl Chloride Building Materials – A Healthy Building Network Report*. Healthy Building Network, Washington, DC, 2002. Available at [http://www.healthybuilding.net/pvc/Thornton\\_Enviro\\_Impacts\\_of\\_PVC.pdf](http://www.healthybuilding.net/pvc/Thornton_Enviro_Impacts_of_PVC.pdf)
- Thornton (2000) J. *Pandora's Poison: Chlorine, Health, and a New Environmental Strategy*. Cambridge, Massachusetts: MIT Press.
- Thornton (1997) J. *The PVC Lifecycle: Dioxin from Cradle to Grave*. Greenpeace, April 1997. Available at <http://archive.greenpeace.org/~usa/reports/toxics/PVC/cradle/dcgtoc.html>.
- Tickner (1999) J. *The Use of Di-2-Ethylhexyl Phthalate in PVC Medical Devices: Exposure, Toxicity, and Alternatives*. University of Massachusetts at Lowell: Lowell Center for Sustainable Production, Lowell, MA.
- Tickner (1999a) J. *A Review of the Availability of Plastic Substitutes for Soft PVC in Toys*, University of Massachusetts at Lowell: Lowell Center for Sustainable Production, Lowell, MA, February.
- TNO (1996) Center for Technology and Policy Studies. *A PVC Substance flow Analysis for Sweden: Report for Norsk-Hydro*, Apeldoorn, Netherlands as cited in Thornton 2002.

Tukker (2001) A., H. Buijst, L. van Oers, and E. van der Voet. *Risks to Health and the Environment Related to the Use of Lead in Products*. TNO Strategy, Technology and Policy. TNO Report STB-01-39 (Final), September, 2001. Available at <http://europa.eu.int/comm/enterprise/chemicals/legislation/markrestr/studies/lead.pdf>

Tuomainen (2003) A., M. Seuri, and A. Sieppi. "Indoor air quality and health problems associated with damp floor coverings." *International Archives of Occupational and Environmental Health* 77(3): 222-6, April.

Turner Toys (2002) "An Evaluation of the Hazards of Toys and Other Products made from Polyvinyl Chloride (PVC)." Website at [http://www.turnertoys.com/PVC\\_framepage1.htm](http://www.turnertoys.com/PVC_framepage1.htm).

UBA (2001) Umweltbundesamt (German Federal Environmental Agency) A. Lesisewitz, H. Kruse, and E. Schramm. *Substituting Environmentally Relevant Flame Retardants: Assessment Fundamentals: Results and summary overview*, Environmental Research of the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety, Research Report 204 08 542 (old) 297 44 542 (new), UBA-FR 000171/1o.

Uhde (2001) E., M. Bednarek, F. Fuhrmann, and T. Salthammer. "Phthalate esters in the indoor environment – test chamber studies on PVC-coated wall coverings." *Indoor Air* 11(3): 150-155.

Upshur (2001) R., M. James, E. Richardson, G. Brunton, W. Hunter, and L. Chambers. "Short-term Adverse Health Effects in a Community Exposed to a Large Polyvinyl Chloride Plastics Fire." *Archives of Environmental Health* 56(3): 264-270.

U.S. Congress Office of Technology Assessment (USOTA 1990) *Finding the Rx for Managing Medical Wastes*. OTA-O-459, Washington, DC, September.

U.S. Congress Office of Technology Assessment (USOTA 1988) *Issues in Medical Waste Management Background Paper*. OTA-BP-O-49, Washington, DC, October.

U.S. Department of Health and Human Services (USHHS 2002) Public Health Services, National Toxicology Program, *Report on Carcinogens*, Tenth Edition, December 2002. Available at <http://ehp.niehs.nih.gov/roc/toc10.html>.

U.S. Environmental Protection Agency (USEPA 2004) "Toxic Release Inventory, Release Year 2002." Chemical Report Vinyl Chloride and Dichloroethane U.S. 2002. Data set frozen April 1, 2004 and released to the public June 23, 2004. Available at [www.epa.gov/triexplorer](http://www.epa.gov/triexplorer).

U.S. Environmental Protection Agency (USEPA 2004a) "Lead Compounds Fact Sheet." USEPA Technology Transfer Network Air Toxics Website, last updated June 14. Available at <http://www.epa.gov/ttn/atw/hlthef/vinylchl.html>.

U.S. Environmental Protection Agency (USEPA 2004b) "HMIWI Facility and Emissions Inventory–English Units." June 8. Available at [http://www.epa.gov/ttn/atw/129/hmiwi/2004hmiwi\\_inventory.xls](http://www.epa.gov/ttn/atw/129/hmiwi/2004hmiwi_inventory.xls).

U.S. Environmental Protection Agency (USEPA 2004c) "Basic Facts: Municipal Solid Waste (MSW)," A fact sheet prepared by the U.S. Environmental Protection Agency. Available at <http://www.epa.gov/epaoswer/non-hw/muncpl/facts.htm>.

U.S. Environmental Protection Agency (USEPA 2004d) "Toxic Release Inventory, Release Year 2002." Chemical Report Dioxin and Dioxin-like Compounds U.S. 2002. Data set frozen April 1, 2004 and released to the public June 23, 2004. Available at [www.epa.gov/triexplorer](http://www.epa.gov/triexplorer).

U.S. Environmental Protection Agency (USEPA 2003) *Municipal Solid Waste in the United States: 2001 Facts and Figures*. USEPA Office of Solid Waste and Emergency Response (5305W), EPA530-R-03-011, October.

U.S. Environmental Protection Agency (USEPA 2003a) "Ethylene Dichloride (1,2-Dichloroethane) Fact Sheet." USEPA Technology Transfer Network Air Toxics Website, last updated February 12. Available at <http://www.epa.gov/ttnatw01/hlthef/di-ethan.html>

U.S. Environmental Protection Agency (USEPA 2003b) "Chlorine Fact Sheet." USEPA Technology Transfer Network Air Toxics Website, last updated February 12. Available at <http://www.epa.gov/ttn/atw/hlthef/chlorine.html>

- U.S. Environmental Protection Agency (USEPA 2003c) "National Emission Standards for Hazardous Air Pollutants: Mercury Emissions from Mercury Cell Chlor-Alkali Plants. Final Rule." 40 CFR Part 63 *Federal Register* Vol. 68 (244) 70904, December 19.
- U.S. Environmental Protection Agency (USEPA 2003d) "Cadmium Compounds Fact Sheet." USEPA Technology Transfer Network Air Toxics Website, last updated February 12. Available at <http://www.epa.gov/ttn/atw/hlthef/cadmium.html>.
- U.S. Environmental Protection Agency (USEPA 2003e) "Backyard Burning: Basic Information." USEPA Office of Solid Waste and Emergency Response, September 17. Available at <http://www.epa.gov/epaoswer/non-hw/muncpl/backyard>.
- U.S. Environmental Protection Agency (USEPA 2003f) "Backyard Burning: Health Effects." USEPA Office of Solid Waste and Emergency Response, September 17. Available at <http://www.epa.gov/epaoswer/non-hw/muncpl/backyard>.
- U.S. Environmental Protection Agency (USEPA 2003g) "The Hidden Hazards of Backyard Burning." Brochure. USEPA Office of Solid Waste and Emergency Response, EPA530-F-03-112, August. Available at <http://www.epa.gov/epaoswer/non-hw/muncpl/backyard/pubs/residents.pdf>.
- U.S. Environmental Protection Agency (USEPA 2003h) "State and Local Governments Are Key to Reducing Backyard Burning." Brochure. USEPA Office of Solid Waste and Emergency Response, EPA530-F-03-003, August, 2003. Available at [http://www.epa.gov/epaoswer/non-hw/muncpl/backyard/pubs/st\\_local1.pdf](http://www.epa.gov/epaoswer/non-hw/muncpl/backyard/pubs/st_local1.pdf).
- U.S. Environmental Protection Agency (USEPA 2003i) "Where You Live: Information on what your state and community are doing about backyard burning." USEPA Office of Solid Waste and Emergency Response, last updated September 17. Available at <http://www.epa.gov/epaoswer/non-hw/muncpl/backyard/live.htm>.
- U.S. Environmental Protection Agency (USEPA 2002) "Vinyl Chloride Fact Sheet." USEPA Technology Transfer Network Air Toxics Website. Available at <http://www.epa.gov/ttn/atw/hlthef/vinylchl.html>.
- U.S. Environmental Protection Agency (USEPA 2002a) "Emission from Large MWC Units at MACT Compliance." Memorandum from Walt Stevenson, Combustion Group, ESD, OAQPS, USEPA to Docket A-90-45 (Large MWCs), Research Triangle Park, North Carolina, June 20.
- U.S. Environmental Protection Agency (USEPA 2002b) *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks*. EPA530-R-02-006, May. Available at <http://www.epa.gov/epaoswer/non-hw/muncpl/ghg/ghg.htm>
- U.S. Environmental Protection Agency (USEPA 2001) *Exposure and Human Health Reassessment of 2,3,7,8 Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds, Part I: Estimating Exposures to Dioxin-Like Compounds, Volume 2: Sources of Dioxin-Like Compounds in the United States*. September 2000. Available at <http://www.epa.gov/ncea/pdfs/dioxin/part1/volume2>.
- U.S. Environmental Protection Agency (USEPA 2000) *Exposure and Human Health Reassessment of 2,3,7,8 Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds*. September 2000. Available at <http://www.epa.gov/ncea/pdfs/dioxin/part3/chapter1-6.pdf>.
- U.S. Environmental Protection Agency (USEPA 2000a) "Federal Plan Requirements for Hospitals/Medical/Infectious Waste Incinerators Constructed On or Before June 20, 1996, Final Rule." *Federal Register* 65 (158): 49868-49894.
- U.S. Environmental Protection Agency (USEPA 1998) *Inventory of Sources of Dioxins in the United States*. Review Draft. EPA/600P-98/002Aa. April 1998. Available at <http://cfpub1.epa.gov/ncea/cfm/recorddisplay.cfm?deid=20797>
- U.S. Environmental Protection Agency (USEPA 1997) *Locating and Estimating Air Emissions From Sources of Dioxins and Furans*. USEPA Office of Air Quality Planning and Standards, Office of Air and Radiation, EPA-454/R-97-003, Research Triangle Park, North Carolina, May 1997.

- U.S. Environmental Protection Agency (USEPA 1995) *Air Emissions from Municipal Solid Waste Landfills – Background Information for Final Standards and Guidelines, Final EIS*. Office of Air Quality Planning and Standards, EPA-453/R-94-021, Research Triangle Park, NC, December.
- U.S. Environmental Protection Agency (USEPA 1994) *Medical Waste Incinerators – Background Information for Proposed Standards and Guidelines: Industry Profile Report for New and Existing Facilities*. USEPA Office of Air Quality Planning and Standards, Research Triangle Park, NC., July. Available at <http://www.epa.gov/ttnatw01/129/hmiwi/rihmiwi.html>.
- U.S. Environmental Protection Agency (USEPA 1994a) "Supreme Court Rules; Treat Incinerator Ash as Hazardous Waste." National Center for Environmental Economics, newsletter Volume #1, Summer.
- U.S. Environmental Protection Agency (USEPA 1993) *Evaluation of an Automated Sorting Process for Post-Consumer Mixed Plastic Containers*. USEPA Office of Research and Development, EPA/600/R-93/165, Washington DC, September.
- U.S. Environmental Protection Agency (USEPA 1991) "Solid Waste Disposal Facility Criteria; Final Rule." 40 CFR Parts 257 and 258. *Federal Register* 56 (196): 50,978-51,119, October 9.
- U.S. Environmental Protection Agency (USEPA 1990) *Air Emissions from Municipal Solid Waste Landfills – Background Information for Proposed Standards and Guidelines*, Draft EIS, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 12.
- U.S. Environmental Protection Agency (USEPA 1989) *The Solid Waste Dilemma: An Agenda for Action*. Final Report of the Municipal Waste Task Force, EPA530-SW-89-019, February.
- U.S. Food and Drug Administration (USFDA 2001) *Safety Assessment of Di(2-ethylhexyl)phthalate (DEHP) Released from PVC Medical Devices*. FDA Center for Devices and Radiological Health, Rockville, MD, September.
- van der Naald (1998) G.N. and B.G. Thorpe. *PVC Plastic, A Looming Waste*. Greenpeace International, The Netherlands, April.
- Vesterinen (1996) R. and M. Flyktmann. "Organic emissions from co-combustion of RDF with wood chips and milled peat in a bubbling fluidized bed boiler." *Chemosphere* 32: 681-689.
- Vikelseo (2000) J. and E. Johansen. "Estimation of dioxin emissions from fires in chemicals." *Chemosphere* 40: 165-175.
- Vinyl Institute (VI 2004) "Vinyl – the Material." Fact sheet prepared by the Vinyl Institute. Available at <http://www.vinylinfo.org/materialvinyl/material.html>.
- Vinyl Institute (VI 2004a) "Recycling Vinyl." Fact sheet prepared by the Vinyl Institute. Available at <http://www.vinylinfo.org/recycling/index.html>.
- Vinyl Institute (VI 2004b) "Vinyl Automotive." Vinyl Facts. Fact sheet prepared by the Vinyl Institute. Available at [http://www.vinylfacts.com/auto/auto\\_briefing.html](http://www.vinylfacts.com/auto/auto_briefing.html).
- Vinyl Institute (VI 2004c) "Infinite Uses." Vinyl in Automobiles (Europe). Fact sheet prepared by the Vinyl Institute. Available at <http://www.vinylinfo.org/infiniteuses/automotive/autobriefing.html#5>.
- Wagner (1993) J. and A. Green. "Correlation of chlorinated organic compound emissions from incineration with chlorinated organic input." *Chemosphere* 26: 2039-2054.
- Wallace (1990) D. *In the Mouth of the Dragon: Toxic Fires in the Age of Plastics*. Avery Publishing Group: Garden City, New York. 1990.
- Washington Toxics Coalition (WTC 2004) Available at [www.watoxics.org/content/pdf/Vinyl.pdf](http://www.watoxics.org/content/pdf/Vinyl.pdf).

Wilken (1994) M. "Dioxin emissions from furnaces, particularly from wood furnaces." Berlin: Engineering Group for Technological Environmental Protection for the German Environmental Protection Agency, February 1994. German Environmental Protection Agency (UBA) "Dioxin emissions from wood furnaces" (Press release). Berlin, February.

Women's Voices for the Earth (WVE 2002) "PVC- What is it? Why do we care?" Fact sheet on PVC and Smurfit-Stone Container prepared by WVE, Missoula, MT.

Woodward (1990) K.N. "Phthalate esters cystic kidney disease in animals and possible effects on human health: a review." *Human Experimental Toxicology* 9: 397-401.

World Health Organization (WHO 1997) International Agency for Research on Cancer Monographs on the *Evaluation of Carcinogenic Risks to Humans, Volume 69 Polychlorinated Dibenzo-para-Dioxins and Polychlorinated Dibenzofurans*, Lyon, France, February.

World Health Organization (WHO 1980) *Environmental Health Criteria 15. Tin and Organotin Compounds: A Preliminary Review*. International Programme on Chemical Safety, Geneva, Switzerland.

Wu (1989) W., R.S. Roberts, Y-C. Chung, W. Ernst, and S.C. Havlicek. "The extraction of organotin compounds from polyvinyl chloride pipe." *Archives of Environmental Contamination and Toxicology* 18: 839-843.

Wunderli (2000) S., M. Zennegg, et al. "Determination of polychlorinated dibenzo-p-dioxins and dibenzofurans in solid residues from wood combustion by HRGC-HRMS." *Chemosphere* 40: 641-649.

Yaw (1999) E.M. and J. Morris. "Old PVC Pipe a Potential Problem." *Opflow*, pp. 6-7, January.

Yamamoto (1999) T. and Yasuhara, A. "Quantities of bisphenol A leached from plastic waste samples." *Chemosphere* 38: 2569-2576.

Yasuhara (2001) A., T. Katami, T. Okuda, N. Ohno, and T. Shibamoto "Formation of dioxins during the combustion of newspapers in the presence of sodium chloride and poly (vinyl chloride)." *Environment Science & Technology* 35 (7): 1373-78, April 1.

Yoneda (2000) K., Y. Yagi, T. Ikeguchi, Y. Tamade, and K. Omori. "Behavior of dioxins and precursors in industrial waste incineration." *Organohalogen Compounds* 46: 170-173.



November 20, 2012

Council Member, Ed Reyes  
Chair  
Planning Land Use and Management Committee,  
and,

Council Member Jose Huizar  
Council Member Mitchell Englander

Dear Committee Members:

I want to make a few key points, since I have participated in numerous community meetings, and all formal public hearings on this matter other than the Cultural Affairs Commission meeting. In addition, I'm submitting into the official record my written correspondence, and five documents related to the serious, long term negative public health and environmental impact of vinyl. In relation to the last issue, I applaud the City Council's position to "Ban all Vinyl Bags" in the City of Los Angeles.

In addition, the City Planning Department realized the numerous irrationalities, problems and its failure to review the public record in relation to Draft Mural Ordinance text submitted at the August Central City Planning Commission public hearing. The citywide public artist coalition, rightfully vigorously opposed that draft text. The substantial revisions and structural changes contained in the Mural Ordinance text presented at the October public hearing served to validate the citywide artist alliances, UPPA and other interested citizens in how they envision a Mural Ordinance for the City. Thus, I concur with a significant level of the changes contained in the text being discussed today.

However, there are a few problematic issues that I want to specifically address.

**1. A ban on any public art on single family properties.**

The proposal to mandate that only property owners with only one building on a lot is among the worst public policy proposals emanating from the Department of Planning in a number of years. Essentially, the department implies is that owners with only one unit, are deemed as being of a lower class status.

Class segregation

In clearly delineating the requirement for a minimum buildings per property, the department is overtly creating class based segregation in public art. In

my view this is blatantly illegal. I will oppose the City in federal court if this discriminatory provision is retained in the final Mural Ordinance text.

### Eliminate Public Art and Urban Revitalization Projects and Programs

This provision will essentially decimate the linkage between public art and urban revitalization projects. A vast majority of working class homeowners have only one building on their respective property. Thus, it would be illegal for them to participate in urban revitalization and beautification projects based on this draft ordinance. For instance, the "Green Alleys Project" at Jefferson High School, of which I have provided pro bono city planning expertise would be eliminated, and most likely the entire local alley restoration strategy abandoned since the students, teachers and community propose to utilize public art on single home properties as the central component of this project.

### Deny single family owners the ability to beautify their property

This is among the most inane, absurd policy proposals I have ever experienced from the City Planning Department. They should be ashamed of themselves for even supporting this measure.

## **2. Vinyl Inclusion in this ordinance and long term City legal liability**

I have submitted five policy reports and/or research on the dangers of vinyl pollution. The City, in an enlightened public policy vote, has banned this substance from the city in the form of bags. What is clear from each public hearing is that the Central City Planning Commission, the City Attorney's Office, the City Planning Staff, the Cultural Affairs staff, and a broad section of the public who have commented on this matter recognize one key factor, this is a highly toxic material that "requires additional measures" in how it is controlled in relation to public exposure.

Section B.9 basically validates opposition to vinyl being included in the Mural Ordinance., by mandating that the Fire Department and Building and Safety have direct jurisdiction on this toxic substance.

The Mural Ordinance was never developed to have the Fire Dept. reviewing public art. This issue, vinyl art belongs where it currently resides, "Under the jurisdiction of the Building and Safety, and Fire Departments.

All too often in this society, new technologies, materials and/or innovations are rapidly adopted. Then, the long term regressive environmental impacts force government and the public to change course.



I fear that the inclusion of vinyl in this ordinance will create legal liability problems for the city in the future. Because, essentially by not separating vinyl into where it current resides, Building and Safety, vinyl reproductions, replicas and other similar installations will be allowed in public places, libraries, public buildings, clinics, hospitals, and/or schools. Some individuals or parents, recognizing the long term negative public health impacts of this material will consider or engage legal support to take action due to public health problems. A substance that may nessecitate the 'Fire Department's approval' does not belong in a Mural Ordinance. (I'm not interested in addressing artistic merit on this matter).

### **3. Vinyl IS NOT PRESERVATION NOR CONSERVATION**

One of the most egregious statements at the Central City Planning Commission's October hearing was when the General Manager of Cultural Affairs used the terms vinyl and preservation in the same sentence. Vinyl is not recognized in any major national or international organization empowered to govern art preservation and/or conservation as being a conventional component of this type of effort.

Neither the European Confederation of Conservator-Restorers' Organization (ECCO), nor the American Institute for Conservation of Historic and Artistic Works (AIC) consider vinyl an valid strategy. It is these standards that the Mural Ordinance should aspire toward, in the long term defense of the world class public art that exists in this city.

Vinyl is the 'Walmart' of public art.

It is solely a "replacement alternative," which is normally associated with the destruction of the original art work. Thus, instead of defending the long term legacy and copyright interests of Vintage and/or Internationally recognized art, vinyl replacement actions only diminish the urban form and the art history of this city, with basically an elongated photograph.

### **4. Fee Structure**

The PLUM committee should incorporate a fee waiver for any mural and/or public art project that is on a educational site, utilizes apprenticeships for the local community or is implemented on a pro-bono basis (with the exception of supply costs). In addition, these fees should be utilized to enhance the legacy of public art, not for other administrative purposes.

Respectfully,

Dr. David R. Diaz  
Director  
Urban Studies Program  
CSU Los Angeles

M.C.R.P.      Masters in City and Regional Planning, UC Berkeley, 1976  
Ph.D.         Urban Planning, UCLA, 1994

July 12, 2012

Central Planning Commission  
City of Los Angeles

Subject: Public Hearing in relation to the "Second Final Draft Mural Ordinance"

Dear Planning Commissioners,

I want to express my strong opposition to this draft proposal due to a significant range of substantive changes from the "Final Draft Mural Ordinance" that the City Planning Dept. presented to the Cultural Affairs Commission over two months ago.

This new text contains numerous, regressive changes that virtually renders an entire six months civic participation process mute. The 'New Text' even changes the definition of what constitutes public art. This issue was among the very first settled during the lengthy series of meetings and discussions. In fact, any language related to "installation," rightly belongs in the sign ordinance, which has current jurisdiction on this type of structural permitting issue.

I categorically oppose this "Second Final Draft Mural Ordinance."

Conversely, I was among the first speakers at the initially city hall public hearing on this matter in strong support of the "Final Draft Mural Ordinance" that the Cultural Affairs Commission reviewed with the city planning department and the general public over two months ago.

The major, significant changes, many of which were thoroughly discussed and rejected during the public hearing process leading to the "Final Draft Mural Ordinance" have been reinserted without any public explanation.

I plan to develop an extensive critique of the City Planning Department's unfair manipulation of this matter. The following comments address key problems with the "Second Final Draft Mural Ordinance" that the planning department is submitting to the commission.

I'm, in similar fashion to a substantial percentage of those who have participated in this process, perplexed and disappointed in how the planning department has handled this issue. One Final Draft for one commission, a different, Second Final Draft for another commission. If this continues, I will assume a third version will be presented to the PLUM committee, as if both the Central Planning Commission and the Cultural Affairs Commission reviewed the same text. Not true.

1. The 'Process of Significantly Changing' what had been considered a citywide consensus on the specific criteria and language of the original 'Final Draft Mural Ordinance' that a overwhelming percentage of those that participated in public hearings supported, is a disturbing and recent development. .

The public hearing before the Cultural Affairs Commission was the cumulation, now proven erroneous, of a broad based citywide consensus on the text presented by the City Planning Department. With this, essentially re-structured text, that has not been vetted publicly, that consensus has been shattered. In addition, no one in the City Planning Dept. has offered a clear rational for the numerous substantial changes that are in this text.

It is essential that each member of the Central Planning Commission read the Final Draft Mural Ordinance text that the City Planning Dept. presented to the Cultural Affairs Commission to comprehend what had been developed and why this "Second Final Draft Mural Ordinance" is highly contentious and controversial.

I, as others, demand that the planning department comprehensively, and honestly submit a written explanation to the public and commissioners as to why they dramatically changed the text between the two commission meetings.

This has resulted in an acute lack of trust between the public and city staff.

The process itself, and intensive six months of meetings throughout the city, appears to be a wasted effort and the voices of the hundreds of participants effectively blunted and ignored.

This is NOT how to build trust and consensus through the planning process. Most of the public who actively engaged in the process are now incredulous in relation to the duplicity, unfairness, behind the scenes changes, and acute lack of public transparency related to the "Second Final Draft Mural Ordinance" that is being address today.

This is city planning at its 'worst'. The department needs to fully and publicly explain why it structurally re-wrote the text of this proposed ordinance, between the timeframe of presenting the same issue to two different commissions.

The public deserves nothing less than full and open disclosure about this inequitable manipulation of the public participation process.

To date, neither Mr. Rothmann nor any other member of the planning department has offered a compelling rational explaining this unsettling, to state the obvious, situation.

2. Class segregation in relation to which type of property owners will be allowed to benefit and appreciate public art, and those who are unfairly and blatantly excluded by the language contained in this NEW version of the ordinance.

This is a sad commentary of the status of the City Planning Dept, that in the 21st century they are advocating class segregation in terms of which property owners will be specifically excluded from enjoying public art.

Specifically, one regressive impact of this proposal will result in the termination of the Green Alleys Project at Jefferson High School, of which I'm a sponsor. It will end a community revitalization project focused on alley restoration that involves students, teachers, administrators, parents, community members, and the pro-bono efforts landscape architects, city planners, architects and others who have supported this innovative urban renovation strategy.

The City Planning Dept. should be embarrassed that they have incorporated a class segregationist language in the text that will specifically eliminate any homeowner in this section of South Central Los Angeles, who have only one home on their lot, from any further participation in the Green Alley's Project, or face penalties imposed by the city in relation to the specific language contained in this text.

Mr. Rothmann has yet to either provide extensive written and/or verbal justification as to why the City Planning Dept, by mandating that only those properties with five or more units can have public art, is advocating class segregation in public art for the long term future of this city.

Others view this as overt Environmental Racism. I will withhold judgement on this claim, at this time. Conversely, there is no question that is highly regressive, class based segregation. In the 21st century, in this city, it is stunning that the quality of vision in this administration's Planning Dept, has sunk to this depth.

### 3. Deletion of Vintage Murals from this latest version of the ordinance.

Planning department has not provided any legitimate rationale for this change.

If this text is adopted, any type of public art, even art being created during this meeting, in the perspective of the City Planning Dept. has the same status of Vintage Murals, that are a cultural and historic legacy of this city.

This will have a direct, regressive impact on the status of Los Angeles in the public art universe.

It will result in direct harm to tourism and the economy of art patrons regionally and nationally.

During the public hearing process leading to the "Final Draft Mural Ordinance." There exists citywide consensus for incorporating specific language recognizing Vintage

Murals as a distinct and important category. They are different. These murals have assisted in defining Los Angeles as a public art center.

Vintage Murals also have historic and cultural value, to the immediate and surrounding community, distinct from other public art, from any era, 1960s to the current period. They definite art styles, artistic movements, reflect important historical events, and they recognize the essential culture of communities.

Vintage Murals also deserve specific attention since they have received national and/or international acclaim.

Categorizing Vintage Murals will others, is a confusing aspect of this "Second Final Draft Mural Ordinance," because in essence the Planning Department is hindering the public art legacy of this city without any compelling rational to date.

4. Vinyl installation required by digitally created images is not public art. In essence, it is computer oriented design, that is then superimposed on walls through various types of vinyl. This is problematic issue on three levels.

Irrespective of this ordinance, Building and Safety, and potentially Zoning will become involved. Vinyl produced design has to be installed, often affixed, not directly attached to a wall. Thus, this type of structural engineering will essentially require a Building Permit, and an inspection for public safety and engineering integrity.

Vinyl is toxic, as are the compounds contained in the inks required to transition from a computer design to a digital vinyl surface. This places the immediate and surround public at risk This a fundamental reason why almost 95% plus of digital art is on billboards, a critical distance from the pedestrian public.

Vinyl begins to erode from the date of installation. Most vinyl advertising is designed to last a relatively short period of time. It appears that a significant majority of vinyl art will not maintain its integrity for the minimum two years of attention as required in this text. Once it has to be replaced it loses VERA status, because it is no longer an 'original art', in relation to this law. Also, if the artist is required to maintain the art, they will have to return to the city for re-permitting.

I highly recommend, as have others throughout this process, that vinyl art be placed in a section of the sign ordinance which is designed for installation products, that specifically resemble what will occur with vinyl art. The Central Planning Commission may chose to direct the Planning Dept. to develop a separate category for this type of art that encompasses a definitively different set of installation requirements versus a painted mural.

5. There are a substantial range of additional problems with, what is essentially a New Final Draft Mural Ordinance. I, and others will be submitting extensive additional

comments in relation to the numerous problematic, unfair, irrational, and highly controversial changes that the City Planning Department has chosen to develop in this latest proposal.

For instance, the inclusion of the Visual Arts Rights Act (VARA) and the California Art Preservation Act (CAPA) are redundant and unnecessary. Both federal and state law supersede any city ordinance. Far too much attention has been focused on this matter by the planning department, in which a modest inquiry to any expert attorney on these laws would have informed staff that the city has no jurisdiction on either law. Artists are protected, irrespective of this draft ordinance.

I staunchly oppose this "Second Final Draft Mural Ordinance" and urge the Central City Planning Commission to reject this version.

I remain in support of the "Final Draft Mural Ordinance," that this same department presented to the Cultural Affairs Commission a couple of months ago.

I demand that the city planning department draft and distribute, for citywide review, a report that legitimates each and every structural change in text, scope, intent, and/or new additions in this "Second Final Draft Mural Ordinance." To date, I seriously question that the City Planning Department has offered any member of the public, including each member of the Central City Planning Commission, why such draconian, last minute changes to the original "Final Draft Mural Ordinance" were developed.

This is among the most perplexing aspects of this entire process.

In addition, rest assured that if the City of Los Angeles adopts a Mural Ordinance that endorses class based segregation in relation to which classes of property owners benefit directly from public art, I commit that I will be in federal court in opposition to the City's action.

Respectfully,

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## **Planning Process and Ignoring the overwhelming orientation of Public Perspectives**

The mural artists, art supporters and arts organizations of this city *Publicly Demand* that the City Planning Department respond, in written analysis, with their rational on the following four questions based on fair and ethically planning principles.

1 Why did the Planning Department fundamentally restructure the “Final Draft Ordinance,” between the hearings before the Cultural Affairs Commission and the Central City Planning Commission?

2 Why have the overwhelming majority of public artists and supporters perspectives been ignored by the Planning Department?

3 What value, if any, was the five month public meeting and opinion process to this Second Final Draft Mural Ordinance?

4 Why did the Planning Dept. not distribute the Second Draft Final Mural Ordinance for public review, since it contained numerous, structural changes not offered for public comment, in an adequate time frame prior to the meeting before the Planning Commission?



## **Vinyl Installation and the Building and Safety Department**

David Diaz

### **Technical Review**

Vinyl installations will REQUIRE the strong oversight of the Building and Safety Department due to inherent toxic and hazardous substances required in this installation process.

The City will be required to review all vinyl installations to insure that all potential regressive environmental and public health issues are comprehensively addressed, especially in sites where their is substantial pedestrian access, and/or school locations with children and young adults.

Irrespective of whether vinyl is incorporated in the Mural Ordinance, which we staunchly oppose or it remains in the Sign Ordinance, which to protect the public health, it should be situated, the city will necessarily be required to maintain a strong oversight role for the long term future.

The significant negative environmental hazards associated with vinyl products will have long term, and unintended public health impacts, that the Building and Safety Department will be required to monitor long after the Mural Ordinance is adopted.

Vinyl installations belong in the Sign Ordinance, in which the city has developed criteria, environmental review, maintenance policies and hazardous materials regulations, that are not a component of an ordinance designed for hand painted, mural art.

### **Hazardous Substances**

Vinyl is an oil derivative that inherently contains toxic materials, which are substantially different from traditional, artist painted murals. There is no 'Green Vinyl'. It is a material that has numerous, acknowledged negative impacts on the environment. In addition, the installation process demands a range of highly toxic adhesives, dependent on the scale and composition of the specific vinyl product, which must be monitored and regulated on a permit by permit basis.

The Building and Safety Dept. is the conventional entity responsible with oversight in the handling of a range of hazardous materials involved in vinyl installation. These materials will also have residual negative environmental impacts over time, as it decomposes when directly exposed to the natural environment (a factor that occurs, almost immediately).

### **Structural Alterations**

Vinyl installation is a complex process that involves assessing the specific composition of the wall materials and surfaces, and the type(s) of adhesives that will insure that the vinyl product will actually attach to a specific surface composition. The types of walls and differing types of adhesives constitute a complex challenge to the city.

In many instances, attaching a vinyl product requires construction of an exterior wall that mandates bolting and/or other technical requirements to insure that vinyl covers actually remain attached to a wall surface for an extended period of time. Neither the First Final Draft Mural

Ordinance text, nor the subsequent revisions by the City Planning Dept. are designed to address this complicated and changing process.

Thus, the scale of project, interior or exterior spaces, will often require structural modifications that are already contained in the Sign Ordinance. Within this ordinance, city officials have addressed the complexities of vinyl installation for an extended period of time. The Mural Ordinance, is not designed for this level of either structural nor environmentally hazardous issues.

### **Zoning Administration and Land Use Issues**

The range of hazardous substances inherent in vinyl installation and vinyl products will have an impact on land use policy that may require that Zoning Administration render a decision in relation to allowable uses in many zoning districts in the city. This is a fundamentally different type of issue versus the painting of a conventional public art mural.

The scale of a vinyl installation project, along with required toxic adhesives may not be allowable within existing a wide range of zoning restrictions. Thus, those projects that are solely based on vinyl should be required to have a hearing before Zoning Administration to insure cohesion within existing zoning codes.

The issues of public controversy over hazardous substances and vinyl, especially in residential zones, and institutions with high percentages of children and young adults will most likely impact this process. Since the City has recently banned "all vinyl bags," public awareness on this important environmental issue will have a long term impact on public policy in relation to vinyl installation in the future.

### **Public Health Hazards and Vinyl Installations**

The Building and Safety Dept's role in addressing public health issues is an essential component of enlightened public policy. Cultural Affairs does not have this capacity nor should the City have separate bureau's evaluate the same issue. The City should not establish redundancies in public art policy, when one system of review already exists, in the Sign Ordinance.

We acknowledge that the City has a fundamental responsibility to review and rule upon the types and/or range of chemical components of adhesives and other products required in vinyl installations. This is essential public policy. Conversely, the Mural Ordinance is an inadequate mechanism for this level of environmental review, especially when there is already an existing department with this level of expertise.

Vinyl, as the City has already acknowledged, has long term regressive air and ground contamination that has cumulative, negative environmental impacts. Thus, the Sign Ordinance is the proper legislative structure from which the City can monitor and manage a range of cumulative impacts of large and/or multi vinyl installations in relatively small spatial relationships on a continual basis.

## **Only Owners with Five or more Buildings on a Lot?**

The proposal to mandate that only property owners with five or more buildings on a lot is among the worst public policy proposals emanating from the Department of Planning in a number of years. Essentially, the department implies is that owners with only one unit, much less those not meeting this proposed threshold, are deemed as being of a lower class status. The department, to date, has failed to offer a public rational for this discriminatory and regressive proposal. For instance, what role does the number of buildings have on the quality of public art? Will public artists be forced to reject any and all contracts to perform public art on properties with less than five buildings? What values is the department imply with this class segregation policy?

### **1 Class segregation**

In clearly delineating the requirement for a minimum of five buildings per property, the department is overtly creating class based segregation in public art. In my view this is blatantly illegal. Conversely, artists at this point in the debate over the mural ordinance cannot mandate that the City Planning Dept. delete this devious provision.

It was initially a part of the ordinance. During the extensive public hearing process, when representatives of the department could not offer a legitimate rational for this regressive public policy it was deleted. The 'Final Draft Mural Ordinance' did not contain any text and/or language on this issue.

The 'Second Final Draft Mural Ordinance' clearly advocates a class bias be a provision in the Draft Mural Ordinance. We demand a full and extensive written analysis legitimating this provision and an explanation for it purpose in this draft ordinance.

### **2 Eliminate Public Art and Urban Revitalization Projects and Programs**

This provision will essentially decimate the linkage between public art and urban revitalization projects. A vast majority of working class homeowners have only one building on their respective property. Thus, it would be illegal for them to participate in urban revitalization and beautification projects based on this draft ordinance. If the community and city focused on alley,

sidewalk, street frontage restoration linking public art and urban renovation, well over 90% of home owners in working class zones would be prohibited from participation.

In fact, a vast majority of property owners in the city, irrespective of class (a fair estimate would be well over 90%) would be excluded from participation in any type of urban revitalization program that incorporates public art. The department has failed to provide the public with a rationale in relation to how this provision will impact urban revitalization in the future and why it is essential to structurally limit participation by this section of the draft ordinance.

### 3 Deny single family owners the ability to beautify their property

Why does this draft ordinance directly discriminate against single family home owners? The rationale, yet to be articulated by the city, appears pointless. Why are those property owners with only one house being unfairly targeted by this draft proposal? What public purpose is being exposed and endorsed by the city planning department on this matter?

Is this the future of fundamental planning principles and ethics in the future, a class based litmus test?

### 4 Discrimination against small rental owners with less than five buildings

This provision will also clearly have a discriminatory impact on small rental owners with less than five buildings. In fact, a vast majority of rental owners in this city have only one of two multi-family structures on their respective properties. Thus, they will be eliminated from any benefit of public art and neighborhood revitalization.

### 5 The example of "Green Alleys Project," in South Central, Jefferson HS, CSULA, UCLA and the surrounding community

The City Planning Dept's proposal will essentially kill the "Green Alleys Project," in South Central LA. This project, initiated by students and teachers at Jefferson HS, with strong community support was developed to restore alleys as a transit option for students who ride bikes to school and as

an alternative to gangs. The students wanted to a space for themselves. They often use alleys to traverse to and from school. Needless to state, the alley's are in horrible conditions, with all, and any types of urban blight.

Faculty at CSU Los Angeles were initial supporters, and now UCLA and USC urban policy and landscape architects have collectively provided pro-bono support for this project. The goal is to clear, restore and finally beautify a network of alleys through public art. Virtually 99% of the properties are single family homes. Thus, this draft proposal would deny them the ability, along with students, teachers, community and public artists, the ability to paint fences and garages, poles and other objects in a manner that the students envision.

This is a pathetic commentary of the state of the city planning department, to propose language that will destroy the dreams of youth and almost five years of intense planning to initiate the restoration of alleys for youth in South Central Los Angeles.

## **Elimination of Vintage Mural Designation**

The designation of Vintage Murals was a key demand, citywide, as a result of six months of public meetings on this issue. The key consideration of identification and protection of the cultural and historic legacy of public art in Los Angeles. This city, at one time, was considered the Mural Capital of the World. This was based on both the high quality of Vintage Murals, those public art productions that are nationally and internationally acknowledged and documented, and the significant level of public art that was developed between the late 1960s and into the early 21st century.

The 'Final Draft Mural Ordinance', contained specific language defining and designation Vintage Murals as a critically important category. The major reasons were protection of cultural heritage, art tourism, the economy of public art, and long term copyright protection for public artists.

The 'Second Final Draft Mural Ordinance' eliminated this designation. The City Planning Dept has failed to address this issue with a written analysis why this provision was deleted. In the current text, any type of public art, even graffiti art and/or murals being currently produced have the same status of the legacy public art that made this city internationally prominent.

An irrationality in terms of this issue was an initial burst of discussion related to VERA and CAPA, federal and state laws relating to copyright protections and protection of public art. This was basically a waste of time. Those participants who constantly mentioned these interrelated laws should have known from the outset, that city ordinances cannot overrule either state nor federal law. This is simple logic related to our federal system of laws and governance.

Thus those individuals constantly raising these laws, of no value to a city ordinance, are suspect in relation what purpose they were really engaged in during the public hearing process.

The two most significant policies, that directly address the criteria, quality, specifications and professionalism necessary to protect public art, especially Vintage Murals, are the European Confederation of Conservator-Restorers Organizations (ECCO), and the American Institute for Conservation of Historic and Artistic Works (AIC). It is within the specific criteria established by ECCO and AIC, that credible debate over protection of

artist's copyrights, professional mural restoration and preservation techniques, and specific measures to insure qualitative protection of the legacy Vintage Murals throughout Los Angeles should have been focused upon to insure that the Draft Final Mural Ordinance presented before the Cultural Heritage Commission (the text supported by over 95% plus of public artists throughout the city) adheres to nationally and internationally recognized standards.

1 Diminishes the Historic significance of an internationally recognized legacy of this city

The lack of specific language specifying Vintage Murals in the current proposed texts significantly and permanently diminishes the historic significance of public art in this city. Without any acknowledgment of key pioneering, prominent, and/or internationally celebrated public art, which is readily accessible in innumerable books on this subject, these treasures to the city's cultural legacy will be lost. Without this type of designation, future grants from state, federal and/or foundation sources to preserve Vintage Murals will be negatively impacted.

The proposed Mural Ordinance, is the only logical avenue in which the City has the opportunity to clearly identify, and essentially protect, prominent public art for the long term future.

2 Inhibits internationally recognized methods for conventional public art restoration techniques, which will result in the loss of designation of 'original art'.

The two most significant policies, that directly address the criteria, quality, specifications and professionalism necessary to protect public art, especially Vintage Murals, are the European Confederation of Conservator-Restorers Organizations (ECCO), and the American Institute for Conservation of Historic and Artistic Works (AIC). Both of these highly reputable entities have established specific criteria designed to insure, 1) protection of artist's copyrights, 2) professional standards for mural restoration and preservation techniques, and 3) specific measures to insure qualitative protection of historically significant public art.

The legacy of Vintage Murals throughout Los Angeles should be focused upon these two entities to insure that the Mural Ordinance adheres to nationally and internationally recognized standards.

ECCO and AIC have developed internationally recognized mandates for the professional and technical standards to conduct art preservation and conservation. They contain strict guidelines to insure the integrity of artistic copyright and mural preservation adhere to recognized practices that do not impinge upon legacy art. These standards have been widely distributed throughout the world in relation to the ECCO and nationally by the AIC. One aspect of the debate over the Mural Ordinance is crystal clear, vinyl reproduction and/or computer generated vinyl art are not considered worthy of these standards. First, any type of reproduction eliminates any copyright protection. In addition, vinyl does not meet international standards for art conservation. Secondly, computer generated art is not considered equal to the artistic creativity involved in the production of a work of public art.

Thus, any discourse on this specific matter should be oriented to specific consideration where the city will necessarily have to establish guidelines, the Dept. of Building and Safety, and the existing Sign Ordinance. In addition, we challenge any claim that there exists an 'Eco-friendly' gas and/or oil derived product. The City Council and Central City Planning Commission are surely knowledgeable that the city recently banned all plastic bags for environmental reasons.

Returning to ECCO and AIC, the City Planning Dept, should at minimum be familiar with both highly influential public art preservation and conservation conventional requirements. The text in the future ordinance should reflect a serious orientation to adhering to national and international standards of mural protections, for both the artist(s) and the art work.

It is within this framework that it is essential that the category of "Vintage Murals" be restored to the text of the Draft Ordinance language. Los Angeles should celebrate its public art legacy, as exemplified by Vintage Murals that have received national and/or international recognition. Thus, a Vintage Mural category will insure that ECCO and AIC technical standards remain a key goal in the preservation and conservation of public art for the long term future in this city.



### 3 Economic damage in relation to art tourism

The lack of language specifying Vintage Murals will have a long term, detrimental impact on art tourism in the city. Vintage Murals are a reason why art aficionados plan trips to this region. They are the basis for tours, mainly by non-profit organizations, to attract members and new art supporters.

For instance, when art tourists do on-line for public art in this city, and view the text of this proposed ordinance, no concept of Vintage Murals will appear. This would imply that at worst there is no significant public art worthy of a Vintage Mural designation or at best, the City does not really care about its public art cultural legacy.

Collectively, the failure to recognize the significance of this designation, which was an ESSENTIAL COMPONENT of the initial 'Final Draft Mural Ordinance', is among the most glaring irrationalities of this proposed text.

### 4 Elevates virtually any type of public art as being 'equal to some of the most significant art' in the city's history

The failure to maintain a Vintage Mural section in the Second Draft, essentially and incredibly, elevates any public art, irrespective of quality, to the same status of Vintage Murals. Thus, even a high school student or a group of artists developing a public art project for the first time, have the same level of importance in terms of city public policy in relation to public art.

This is irrational public policy. Clearly, the City Planning Dept has the basic resources to read a few nationally and internationally recognized books on this subject to recognize the importance of Vintage Murals to this city and the public art movement in the US.

### 5 Limits artist's ability to defend copyright protections and future restoration activities

An important issue related to inclusion of Vintage Murals as a category in the ordinance is insuring that artists have the ability to defend copyright protections, and professionally manage future restoration and conservation activities of their prominent art work through ECCO and AIC. Vintage

Mural status is a modest method in which the city should be fully supportive of its most prominent artists and historically significant works of public art. The final ordinance is the essential avenue for this level of appreciation, respect and acknowledgment of those artists who's creative vision is nationally and internationally recognized.

## Public Art Fee System

The city's artistic community is experiencing a challenging period of survival. The imposition of fees constitutes a burdensome regulation that will have a negative impact on the future production of public art. In addition, it will have a regressive influence on younger public artists who want to develop a career in this field. The overwhelming public comments on this issue were negative. The City Planning Dept has failed to acknowledge the public comment record on this issue.

The department, at minimum, has to offer a public rationale in relation to the potential impacts on the future production of public art inherent in this section of the text in the proposed Second Draft.

### 1 No fees

The City should not impose any fees on public art projects. The economy of public art is not substantial, thus any fee structure imposes an unfair and regressive burden on public artists. In fact, after almost an entire decade of banning public art (an incredibly incompetent level of public policy, especially in this city), any legislation should be designed to encourage, support and celebrate the renewal of public art throughout the city. Any type of fee structure contradicts the goals and objectives of the future adoption of a Mural Ordinance.

### 2 The motion picture and television industry have significant fees and taxes waived in relation to cultural production.

Currently, the city has aggressive offer fee waivers and/or tax holidays for other related areas of creative production to encourage the economy of art and culture in this city. For instance, the motion picture and television industry have significant fees and taxes waived in relation to cultural production in this city. The city is willing to forego substantial levels of tax revenues to support the cultural production economy. Public art should be in the same category. Public artists deserve the same consideration as other sectors of the cultural economy in Los Angeles.

The city should be completely supportive of the public art tourist economy in Los Angeles, especially the renewal of public art production in this area.

3 Disincentive for young, emerging artists to engage in public art. Forces public artists to eliminate inclusion of community youth in job training activities and/or apprenticeships due to fee considerations. An important legacy of the public art movement has been the inclusion of young, emerging artists within this arena of cultural productivity. In addition, public art is a pro-active socialization avenue that nurtures pro-active socialization. This is an alternative to regressive, destructive behavioral patterns, and thus city policy should be totally supportive of young emerging artists. A fee structure is a disincentive and a barrier to inclusion of the youth generation in positive arenas of career orientation and community revitalization.

The ordinance should waive all fees for young emerging public artists. A mandated fee structure hinders the inclusion of youth in the future public art movement of the city.

No city policy should regressively impact nor eliminate the ability of professionals toward the inclusion of community youth in job training activities and/or apprenticeships.

4 Public art being developed on a 'pro-bono basis', should not be required to pay a fee.

The draft ordinance needs to incorporate specific language that eliminates any fees on Public art being developed on a 'pro-bono basis'. The draft text should not penalize those public artists who are not being paid to produce public art.

In addition, any public art project that includes job training, youth employment or is linked to an urban revitalization project should not be required to pay a fee. Imposing a fee should not be a detrimental barrier to enhancing the public art experience in this city. Nor should those artists, working in communities be forced to 'pay a fee' when offering their services on a, mainly, pro-bono service.