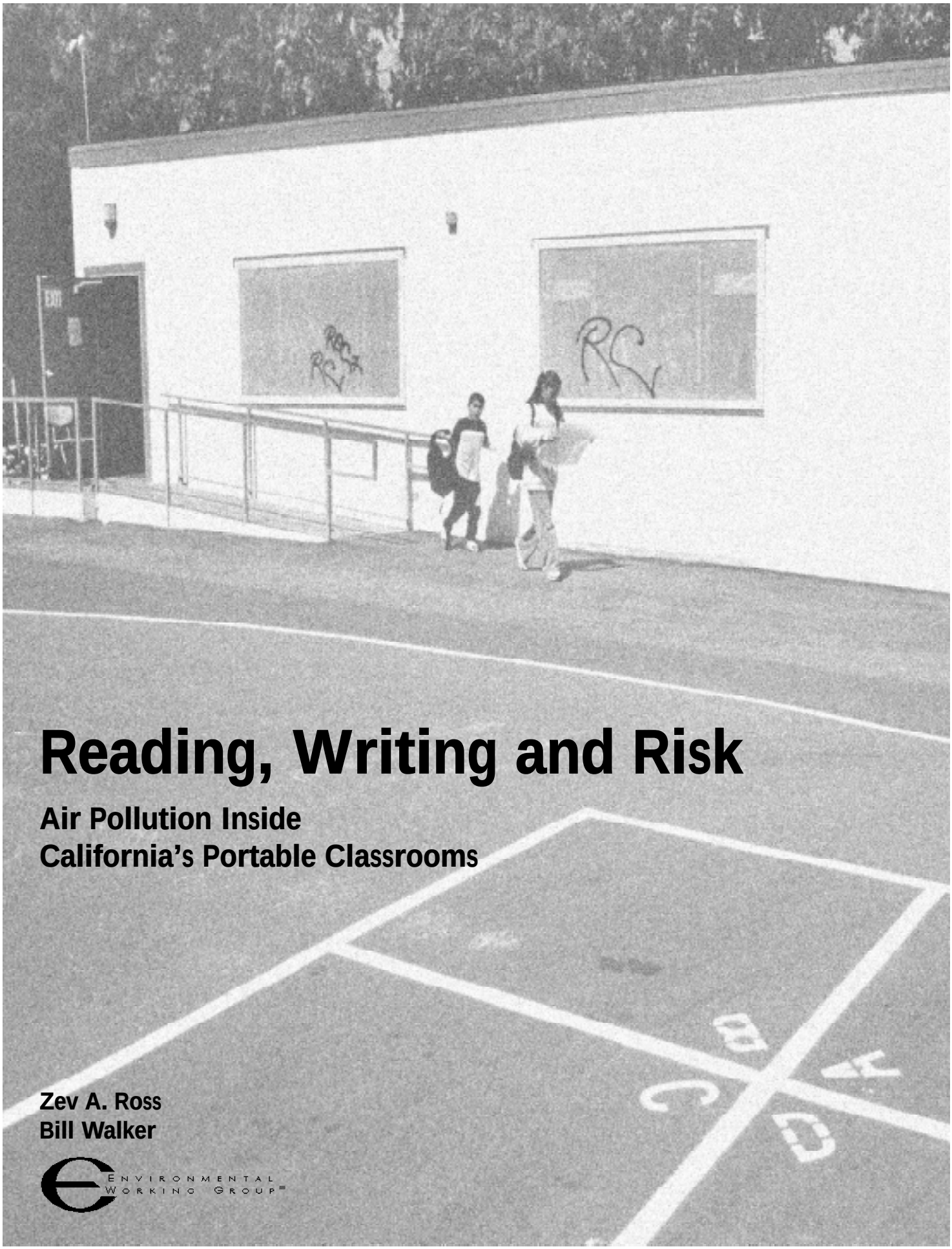

Reading, Writing and Risk

Air Pollution Inside California's Portable Classrooms

Zev A. Ross
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Environmental Working Group

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Much of this report's information on formaldehyde and non-toxic alternatives was derived from *Toxic Deception: How the Chemical Industry Manipulates Science, Bends the Law and Endangers Your Health*, by Dan Fagin and Marianne Lavelle. (Common Courage Press, 1998.)

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"Many California schools now look more like migrant camps — row after row of drab wooden boxes of uncertain safety."

—Peter Schrag, former editorial page editor, *The Sacramento Bee*

"[Portables send] the wrong message [to students]….It reminds children that their society doesn't think of them very highly."

—Jonathan Kozol, author of *Illiterate America*

"My first official act [as governor], will be to issue an executive order to get rid of portable classrooms, absolutely. When I took my son to [elementary school], it looked like a colony of trailers. We've got to get the kids out of those."

—Alabama Gov. Don Siegelman

"A portable is not as good as a regular classroom. If you think it is, visit some of them and talk to the teachers. Listen to the noise. . . . Some of them have been around a long time. You smell the mold. You smell the mildew."

—Florida Gov. Lawton Chiles

"Portable classrooms… are not realistic answers to a long-term, persistent growth in the number of students."

—U.S. Secretary of Education Richard W. Riley

"What are we going to do about it, all these portables? . . . All around the country, this is a great problem."

—Vice President Al Gore

Executive Summary

More than two million California children attend school in portable classrooms that can be a significant source of exposure to airborne toxic chemicals and molds, according to state and federal data analyzed by Environmental Working Group (EWG).

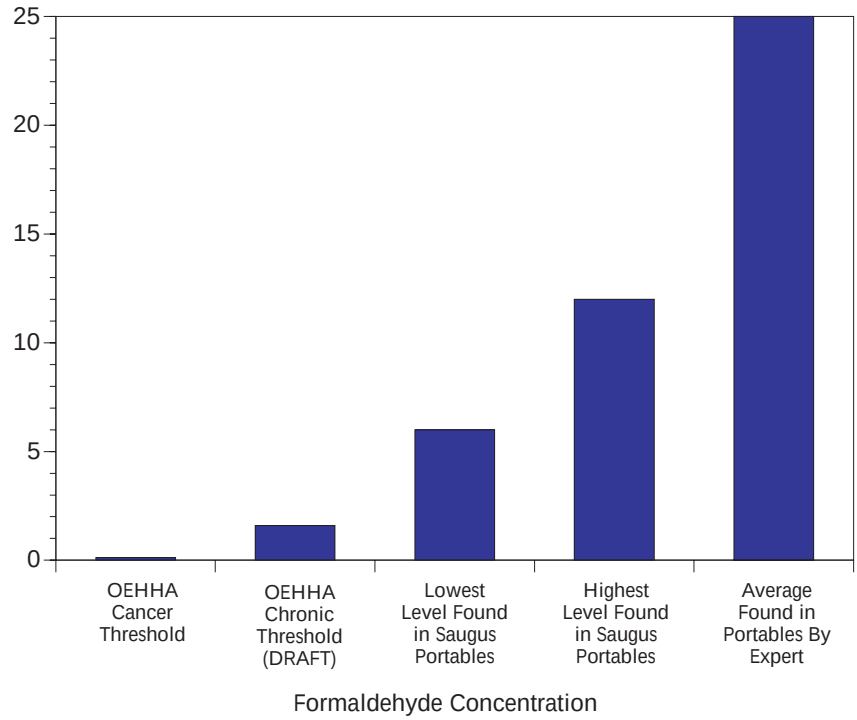
Tests by school districts and indoor air quality specialists, plus extensive documentation of air toxins in mobile homes and similar structures, indicate that manufactured buildings emit hundreds of chemicals, including a number known to cause cancer, birth defects, brain and nerve damage, asthma and other illnesses. Of greatest concern are volatile organic compounds (VOCs) such as formaldehyde, benzene and toluene, which are emitted from the particle board, plywood, fiberglass, carpets, glues and other materials used in portables. Manufactured buildings, which are often prone to leaks, are also favored habitat for toxic molds that can cause nausea, nosebleeds, respiratory illness, and in extreme cases, even death.

How serious the health risks are in portable classrooms is hard to say. In many reported cases, students or teachers who suffered health problems in portables experienced short-term effects such as headaches or nausea that abated when they switched classrooms or ventilation deficiencies were corrected. But an exhaustive review of the scientific literature finds clear evidence that some portables can expose children to toxic chemicals at levels that pose an unacceptable risk of increasing their chances of developing cancer or other serious illness.

The chemicals found in portable classrooms are very similar to those found in conventional buildings. But the combination of tighter construction, fewer windows and inadequate ventilation in portables can lead to a greater buildup of toxic compounds. Data on the actual or average levels of VOCs and other air contaminants measured in portables are limited. Just as scarce are health-based government standards for exposure to contaminants in indoor air. But comparisons with standards for chronic exposure in outdoor air show that the outdoor exposure thresholds for formaldehyde are many times lower than levels that

An exhaustive review of the scientific literature finds clear evidence that some portables can expose children to toxic chemicals at levels that pose an unacceptable risk of cancer or other serious illness.

Figure 1. Formaldehyde safety threshholds and levels measured in portable classrooms.



Source: Environmental Working Group, from OEHHA, Machado Environmental Corp., Offerman 1999.

For some children, exposure to formaldehyde at levels that have been measured in portables carries two to three times the increased risk of cancer permitted under the Clean Air Act.

have been measured in portables (Figure 1).

In 1998 a Lawrence Berkeley National Laboratory scientist, considered one of the top experts on the issue, measured average levels of total VOCs in new mobile homes that were more than three times the indoor air quality standards set by the State of Washington and eight times the "comfort range" recommended by European experts (Hodgson 1998). (Table 1) Newer portable classrooms are required to provide better ventilation than mobile homes, but there is abundant anecdotal evidence that many portables are not properly ventilated — in some well-documented cases, the vents were found to never have been opened. In 1996 another Lawrence Berkeley Lab expert surveyed county health officers and air quality districts in California and found that the highest total VOC levels measured in a portable classroom were more than five times the Washington standard and more than 14 times the European comfort range (Daisey 1998).

The Washington standard and the European recommendation for indoor air allow continuous exposure to levels of toxins greater than acceptable outdoor concentrations when cancer or other chronic illnesses are considered. Based on risk assessment guidelines developed by the U.S. Environmental Protection Agency and the State of California, standards for chemicals in outdoor air, EWG calculated that for some children, exposure to formaldehyde at levels that have been measured in portables carries two to three times the increased risk of cancer permitted under the Clean Air Act (one additional case per million people). Similarly, exposure to benzene at levels measured in mobile homes (no measurements from portables are available) also carries the same level of increased risk of cancer (OEHHA 1999). These estimates assume that children are exposed to these carcinogens only during the time that they spend in portable classrooms.

Table 1. Total Volatile Organic Compounds (VOCs): Measured levels (micrograms per cubic meter) vs. standards.

Standard or Measurement	Level	Notes
Highest portable classroom measurement in California	2900 µ/m3	From survey of county health and air pollution officials.
Median level found in new mobile homes	1600 µ/m3	Portable classrooms are required to provide better ventilation than mobile homes, however, differences between the two types of structures mean that even properly ventilated portables may emit higher levels of toxic chemicals.
State of Washington	<500 µ/m3	This is a target level for all new state construction in Washington. It considers only short-term effects.
European experts' "comfort zone"	<200 µ/m3	Below this level, no short-term health effects are expected. This level only considers short-term effects.

Source: Environmental Working Group, from Int. Conf. on IAQ, State of Washington, Lawrence Berkeley Laboratory.

No Standards, No Monitoring, No Action

According to estimates by independent school analysts, over 86,500 portable (or "relocatable") classrooms are in use in California (EdSource 1999). The number is growing each year, as districts are caught between their severely limited post-Proposition 13 ability to raise funds for new construction and state mandates to reduce class sizes. Although portables have been in use in California since before World War II, they have multiplied rapidly since 1996, when the state offered school districts cash bonuses for reducing class sizes — payments sufficient to buy or lease portables, but often not enough to build permanent facilities. Between 1991 and 1999, state officials estimate that the number of portables in use in California doubled (Peoples 1997). "As a consequence," writes one education analyst, "many California schools now look more like migrant camps — row after row of drab wooden boxes of uncertain safety." (Schrag 1998)

California has no indoor air health standards for most toxins found in portables. Those that do exist are based on the risk of short-term health effects, ignoring the long-term potential for these chemicals to cause cancer or other serious illnesses. California's standards for airborne chemicals are based on supposedly safe levels of exposure for the average adult male, not children and other sensitive populations. Nor do the standards for individual chemicals take into account the cumulative effect of exposure to a combination of pollutants.

California has no indoor air health standards for most toxins found in portables.

Worst of all, in the face of mounting evidence that childhood exposure to toxic chemicals can retard mental and physical

The state has failed to exercise effective oversight over air quality in portable classrooms.

About 162,000 children in Los Angeles, and more than 2 million statewide, spend the school day in buildings that may be harmful to their health.

development, the state has failed to exercise effective oversight over air quality in portable classrooms. There are no enforceable regulations, no monitoring programs, not even restrictions preventing manufacturers from continuing to sell portables to schools after the company's buildings have been repeatedly implicated in health complaints. Despite these data gaps and regulatory neglect, a state report warning of potential indoor air quality problems in portables and other classrooms has languished in bureaucratic limbo since last year and has not been made public, much less acted on.

In the fall of 1998, a state interagency task force completed a report that said portables "have endemic indoor environmental quality problems, and there has not been adequate monitoring of these problems or their impacts on educational programs." Because the document was completed during the final months of Gov. Pete Wilson's term, the state held the report while waiting for the new administration of Gov. Gray Davis to take over (Hardy 1999).

The state was still sitting on the report when the issue erupted into newspaper headlines. In May 1999, a toxicologist and a pediatrician reported that they had treated at least six children from the Saugus school district in Los Angeles' San Fernando Valley who suffered health problems after attending class in portables. The students' blood and urine contained elevated levels of formaldehyde, benzene, arsenic and other chemicals commonly used in portables construction. The toxicologist said the toxins "were oozing out of the walls and just recirculating and going into their bodies." (Aidem 1999)

One-Third of California's Kids in Portables

An EWG survey of California's 20 largest districts found more than 19,127 portables in use — almost 6,500 just in the Los Angeles district, the nation's second-largest with an enrollment of more than 680,000 students. (Table 2.) At an average of 25 students per classroom (EdSource 1999), that means about 162,000 children in the Los Angeles district, and 478,000 in the state's largest districts, attend class in portables. Applying the average number of kids per classroom to the 86,500 portables in use yields an estimate that 2.16 million California children – more than 35 percent of total enrollment – are spending at least part of each school day in an indoor environment that may be harmful to their health.

In the uproar that followed the Saugus incident, parents, teachers and editorialists called on the state to act immediately to protect children's health. They urged the passage of AB 1207, a bill by Assemblyman Kevin Shelley of San Francisco, which would assess indoor air standards for portables and provide

Table 2. California's 20 largest school districts use more than 19,000 portable classrooms.

Rank	District	County	Enrollment	Number of Portables	Students in Portables (Est.)*
1	Los Angeles	Los Angeles	680,430	6,470	161,750
2	San Diego	San Diego	136,283	1,864	46,600
3	Long Beach	Los Angeles	85,908	1,275	31,875
4	Fresno	Fresno	78,156	1,251	31,275
5	San Francisco	San Francisco	61,007	NA**	NA**
6	Santa Ana	Orange	53,805	690	17,250
7	Oakland	Alameda	53,564	800	20,000
8	Sacramento	Sacramento	51,042	847	21,175
9	San Juan	Sacramento	47,837	530	13,250
10	San Bernardino	San Bernardino	47,385	353	8,825
11	Garden Grove	Orange	45,776	315	7,875
12	Elk Grove	Sacramento	40,197	840	21,000
13	Capistrano	Orange	40,174	750	18,750
14	Riverside	Riverside	38,878	511	12,775
15	Mt. Diablo	Contra Costa	35,841	319	7,975
16	Stockton	San Joaquin	35,645	531	13,275
17	Montebello	Los Angeles	33,771	520	13,000
18	Fontana	San Bernardino	33,332	530	13,250
19	Saddleback Valley	Orange	33,172	338	8,450
20	West Contra Costa	Contra Costa	33,110	393	9,825
			TOTAL	19,127	478,175

**Based on 25 students per unit.*
***San Francisco Unified failed, despite repeated requests, to supply the number of portables in use.*

Source: Environmental Working Group survey, 1999.

schools the knowledge and incentives to improve indoor air quality. "Is it too much to ask that classrooms be safe and healthy environments for learning?" asked a spokesman for the California Teachers Association (Hardy 1999).

But the warning signs of problems with portables are nothing new. According to a state school facilities official, there are reports every year of "sick building syndrome" associated with portables (Lovekin 1997). A search of California newspaper databases turned up dozens of such incidents in the last decade, increasing noticeably after 1996. Nor is the problem unique to California. Although no national estimates are available for the number of portables in use, they are found in every state, and use is heaviest in booming Sunbelt states. Where portables proliferate, complaints about air quality follow. (See "Problems With Portables Common," page 8.)

California's class-size reduction program has produced windfall profits from public funds for some makers of portable classrooms.

Manufacturers of portable classrooms maintain that their units are safe when correctly installed and ventilated, and point out that over the last 15 years significant reductions have been achieved in the levels of toxins emitted from processed wood construction products. Indeed, levels of VOCs and other airborne toxins in properly ventilated newer-model portables may be no higher than in conventional buildings, especially new construction or buildings that are freshly painted or carpeted.

There is growing evidence that indoor air pollution, whether in portables or conventional buildings, may be significantly more hazardous to health than outdoor contamination, because toxins have been shown to build up indoors and most Americans spend 90 percent of their time indoors (EPA 1995). Although indoor air pollution is a problem everywhere, schools are unique environments because their management involves special responsibilities to protect children and use public funds wisely. They typically house four times as many occupants per square foot as comparable office buildings. They are also home to a wider variety of potential sources of pollution, including art and science supplies, industrial and vocational shops, and specialty maintenance chemicals (Minn. DEHS 1997).

Windfall Profits for Manufacturers of Portables

California's class-size reduction program has produced windfall profits from public funds for some makers of portable classrooms. Between 1996 and 1998, quarterly revenue for Modtech Inc. of Perris, the state's largest producer of portables, increased by nearly 1,000 percent (Benson 1998). With future profits underwritten by continued school growth, manufacturers must take responsibility for reducing the health risks from their products — by using less-toxic materials in construction, disclosing the chemicals that are used and their potential health effects, and taking the lead in training school districts in proper ventilation. (See "The Portables Industry," page 24.)

In November 1998 California voters approved a record $9.2 billion bond measure for school construction, of which some portion will inevitably go for more portables. The bond money is in addition to a $4 billion state budget surplus, of which the Davis Administration has pledged $144 million for long-deferred school maintenance needs. This massive public investment should not be squandered on facilities in which suspect air quality undermines the urgent necessity to provide children with a safe and healthy environment at school.

Recommendations

To protect children's and teachers' health and ensure the safety of California classrooms, EWG recommends:

- The California Department of Health Services (DHS) and the Office of Environmental Health Hazard Assessment (OEHHA) should conduct a study of air quality in portable classrooms, which must include an assessment of VOCs, toxic molds and other indoor air contaminants as well as ventilation issues.

- OEHHA should promptly develop health-based standards for indoor exposure to toxic chemicals and other contaminants, and these standards must account for children's heightened susceptibility to pollution.

- The state's unreleased report on indoor air quality in California schools must be made public immediately, and its findings must be taken into account by legislators and Gov. Gray Davis in upcoming budget deliberations, especially in connection with the governor's education package. Unhealthy classrooms will undercut efforts to raise the quality of instruction and level of academic achievement in California.

- The state should require that portables manufacturers allowed to sell to schools meet standards for less-toxic, lower-emission construction materials; that all toxic chemicals used in construction, and their health effects, are disclosed to school districts before purchase; and that manufacturers are required to assist or train school officials in proper installation and operation of the units. (See "Safer Alternatives," page 19.)

- The state should provide schools with adequate resources for facilities that will not compromise children's health. Although portables are likely to remain part of school districts' tools to meet the challenges of increasing enrollment and reduced class sizes, schools should not be forced to choose less healthy learning environments due to lack of adequate funds.

- The state should also drop the requirement that school districts must have at least 20 percent of their classroom space in portables as a condition for raising district-assessed developer fees. This law may be intended to ensure that districts remain flexible in their facilities planning to deal more efficiently with fluctuating enrollment, but its effect – promoting the continuing and long-term use of portables — is another example of the rule of unintended consequences.

Schools should not be forced to choose less healthy learning environments due to lack of adequate funds.

Problems With Portables Common in California and Elsewhere

• **Orange County:** In 1991, elevated levels of a breakdown product of benzene and trichloroethane were found in the blood of a teacher and a student using a new portable classroom at an elementary school in San Clemente, Orange County. Both chemicals are known human carcinogens. The teacher requested the tests after 80 percent of her students complained of nausea, chest pains, headaches, dizziness and breathing difficulties (Hernandez 1991). A few months later, two students at an elementary school in nearby Mission Viejo suffered seizure-like attacks after attending class for just a few weeks in a brand-new portable (Froomkin & Tugend 1992).

• **Santa Clara County:** In 1996, school officials in Cupertino spent more than $50,000 to test air quality and replace toxic materials in portable classrooms after some second-grade students, teachers and parents experienced nausea, fainting, headaches and eye irritation. One parent with a history of chemical sensitivity said she remained ill for months after spending just 10 minutes in her child's portable classroom (Peterson 1997).

• **Riverside County:** In 1997, a teacher and a dozen students reported dizziness, burning eyes, headaches and watering eyes after attending class in a portable classroom at an elementary school in Riverside. That same year, parents of children with asthma and other health problems were angered to learn that the Corona school district, also in Riverside County, had known for two years about problems with mold and ventilation in its portables, but never advised parents (Lovekin 1997).

• **Sacramento County:** In 1998, a portable classroom was removed from an elementary school in Elk Grove after tests found a toxic mold connected with a rash of infant deaths in Cleveland, Ohio. Tests confirmed the presence of *Stachybotrys chartarum*, a rare mold whose spores can cause respiratory problems, nosebleed and diarrhea, leading to death in severe cases. At least six children, plus their teacher, had suffered severe allergic reactions while attending class in the portable (K. Garrett 1998).

• **Du Page, Ill.:** In 1993, mothers of two boys in a suburban Chicago elementary school said their sons suffered chemical reactions that led to learning problems after attending class in a portable for more than a year. Tests by state health officials found levels of formaldehyde 25 percent above the Recommended Exposure Limit of the National Institute of Occupational Safety and Health (Mehler 1993, NIOSH 1994).

• **Winslow, Maine:** In 1994, in a hearing before the Maine Legislature, a mother testified that her fourth-grader was hospitalized seven times during the school year while attending class in a portable. At home, and during the following summer, he was healthy. Five days after starting fifth grade – again in a portable classroom – he was back in intensive care (Business News 1994).

• **Ontario, Canada:** In 1998, hundreds of portable classrooms in Toronto and Ottawa were discovered to harbor *Stachybotrys* mold after a survey found that more 1 in 12 of the students in one school district suffered unexplained chronic health problems. Tests also measured levels of carbon dioxide in some portables four times higher than Canadian exposure standards (Rogers 1998).

Portable Classrooms: The Health Risks

Indoor air pollution has taken a back seat to other environmental issues, despite the fact that the average American spends 90 percent of his or her day indoors. Research in the past decade has shown that concentrations of pollutants are frequently two to five times greater, and sometimes hundreds of times greater, in indoor air than outdoors. Reflecting this evidence, the U.S. EPA now ranks indoor air pollutants as one of the top five health threats among common environmental problems (US EPA 1995).

The sources of indoor air pollution are varied. Outdoor pollutants can infiltrate buildings through the ventilation systems and in some cases undergo chemical reactions to generate secondary pollutants. Most indoor air pollution, however, originates from indoor sources such as particleboard, plywood, carpet, construction glues and furnishings. Many of these materials can be sources of dozens, even hundreds, of potentially harmful chemicals.

Children are at greater risk from exposure to air pollutants because they are generally more vulnerable to toxic substances, and because they have a higher respiratory rate than adults — they take more breaths per minute and they have a greater lung surface area relative to their size than adults. Indoor environments with potentially high concentrations of airborne toxic chemicals can be particularly hazardous for children. Not only is the dose of a chemical important, but so is the timing of the exposure. Even exposure to extremely small concentrations at a critical period of development can have lifelong effects (Porter 1999).

One childhood disease clearly related to indoor and outdoor air pollution is asthma. Asthma rates are skyrocketing throughout the country, but children are the hardest hit. Among children four and under, the prevalence of asthma increased 160 percent between 1980 and 1994 while the increase for the population as a whole increased 75 percent (CDC 1998). There is little doubt that asthma can be caused or exacerbated by air pollution, outdoors or indoors. One indoor air quality expert says: "Schools are facing two epidemics: an epidemic of deteriorating facilities and an

Schools are facing two epidemics: an epidemic of deteriorating facilities and an epidemic of asthma among children.

At low levels VOCs can cause eye and respiratory tract irritation, headaches, dizziness, visual disorders, and memory impairment.

epidemic of asthma among children." (Bayer et. al 1999)

Volatile Organic Compounds (VOCs)

Thousands of common household materials contain and emit volatile toxic gases. Volatile organic compounds (VOCs) commonly detected in portable classrooms include such highly toxic compounds as formaldehyde, benzene, toluene and styrene. These chemicals have been shown to cause cancer and reproductive harm and are of particular concern when children are exposed. At levels that have been measured in manufactured buildings, VOCs can cause eye and respiratory tract irritation, headaches, dizziness, visual disorders, and memory impairment. Longer term exposure can contribute to increased rates of chronic diseases like cancer. Recent research has also shown that "certain reactive chemicals [including formaldehyde and toluene] are . . . able to initiate asthma in extremely low concentrations" — concentrations far lower than current regulatory thresholds (Bakke 1993).

Despite the high potential for toxic emissions in portable classrooms, California has failed to set standards for VOCs in indoor air, or even to conduct air monitoring in any of the tens of thousands of portables in the state. However, air monitoring for VOCs in mobile homes and other buildings with similar construction materials strongly suggests that portable classrooms may expose their occupants to potentially harmful levels of a number of air contaminants.

How harmful is difficult to say, because there are few health standards or guidelines for VOCs in indoor air, and what few do exist fail to consider long-term health effects such as cancer, reproductive harm and asthma. No guidelines address the effects of breathing combinations of dozens or even hundreds of VOCs. Nor are existing guidelines based on levels of exposure that are safe for children and other sensitive populations. Says one expert: "A variety of new or reformulated products and materials are used in the construction of new houses including manufactured houses, with generally unknown impacts on VOC concentrations and occupant exposures." (Hodgson 1998)

Total Volatile Organic Compounds

In the absence of real health-based standards, scientists frequently use the sum of air concentrations of individual VOCs or "total volatile organic compounds" (TVOC) to identify problem buildings where TVOC levels are not within "typical ranges." The TVOC "comfort range" developed by European experts is designed to assess exposures to VOCs and associated short-term health effects and discomfort. At levels below the comfort level the likelihood

of short-term health effects appears low. Levels above the comfort range can contribute to symptoms of irritation and discomfort including respiratory irritation or headaches. This standard is based only on readily observable symptoms and provides no protection from more subtle or long-term effects (Mølhave 1996). Similarly, Washington State has developed a standard to address the short-term health effects of TVOCs in indoor air. The standard was first recommended as part of the indoor air quality specifications for state office buildings, and continues to be used as the standard in state construction.

Researchers frequently find that TVOC levels in manufactured construction exceed normal ranges. In 1998, a Lawrence Berkeley National Laboratory scientist considered one of the top experts on the issue measured average levels of TVOCs in new mobile homes that were more than three times the indoor air quality standards set by the State of Washington and eight times the comfort range recommended by European experts (Hodgson 1998).

In 1996, another Lawrence Berkeley Lab scientist surveyed county health officers and air quality districts in California and found that few measurements had been made, but the highest total VOC levels measured in a portable classroom were more than five times the Washington standard and more than 14 times the European comfort range (Daisey 1998). And a private consultant and recognized national expert with experience monitoring air in portables told EWG that in portable classrooms with properly working ventilation systems, his company finds average total VOC levels that are equal to or slightly higher than the Washington standard and about three times the European comfort level (Offerman 1999).

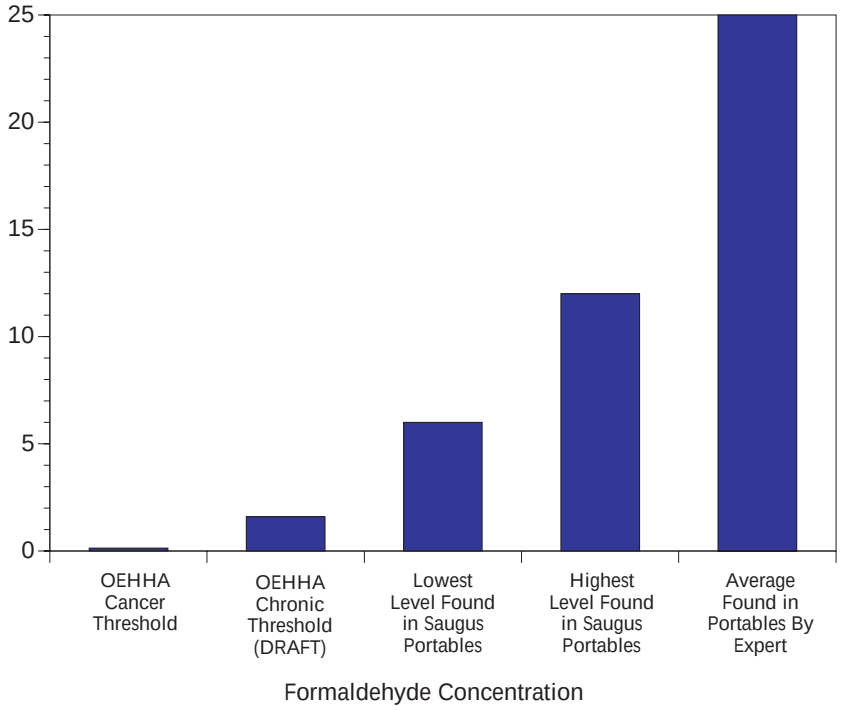
Formaldehyde

Formaldehyde (a VOC) is so widely used in industrial processes that it would be difficult to list all the household products containing it. But its primary use, combining it with other toxic chemicals to make construction glues, "has put it in the cabinets, flooring, walls or furniture of virtually every American home built or renovated since the post-World War II housing boom." (Fagin & Lavelle 1999)

There is widespread evidence that mobile homes and similar portable construction have higher concentrations of formaldehyde than conventional construction. According to the California Air Resources Board, research finds mean concentrations of 24 parts per billion (ppb) in office and public buildings, 50 ppb for conventional homes and 72 ppb for mobile homes (ARB 1997). DHS recommends that short-term indoor air concentrations not exceed 50 ppb, but for chronic health effects, standards for outdoor exposure to formalde-

Formaldehyde is so widely used in construction materials that it is found in virtually every building in America.

Figure 1. Formaldehyde safety threshholds and levels measured in portable classrooms.



Source: Environmental Working Group, from OEHHA, Machado Environmental Corp., Offerman 1999.

hyde are far lower. While the average formaldehyde concentrations in these studies were at or below state standards for offices and conventional homes, the mean concentration in mobile homes was 44 percent above the recommended 50 ppb standard. All of these levels are far higher than chronic and cancer standards (Figure 1).

Since 1986, when formaldehyde manufacturers and users voluntarily accepted emissions guidelines proposed by the U.S. Department of Housing and Urban Development, considerable progress has been made to reduce formaldehyde in indoor air. It is likely that cash-strapped districts continue to use tens of thousands of portable classrooms built before the stricter emission standards were implemented. While conventional wisdom suggests that the risk evaporated with the formaldehyde years ago, research demonstrates that even old mobile homes can have potentially dangerous levels of formaldehyde. According to Austrian researchers, "[A]fter some years . . . the emission of formaldehyde [in processed wood products] only decreases to some extent, but still remains on a rather high level." (Tappler 1996)

Brand-new buildings often have considerably higher VOC levels than older ones, but these high levels may decline as the building "airs out." One large California study, however, which measured 500 mobile homes, found that although new homes had higher formaldehyde concentrations, the formaldehyde concentrations in older homes were only 20 to 30 percent lower, depending on the season. These homes, a large percentage of which were 10 years or older, still contained average formaldehyde concentrations above the current state standard (Sexton et. al 1986). This suggests that even older portables classrooms may continue to emit dangerous levels of formaldehyde despite more than a decade of off-gassing.

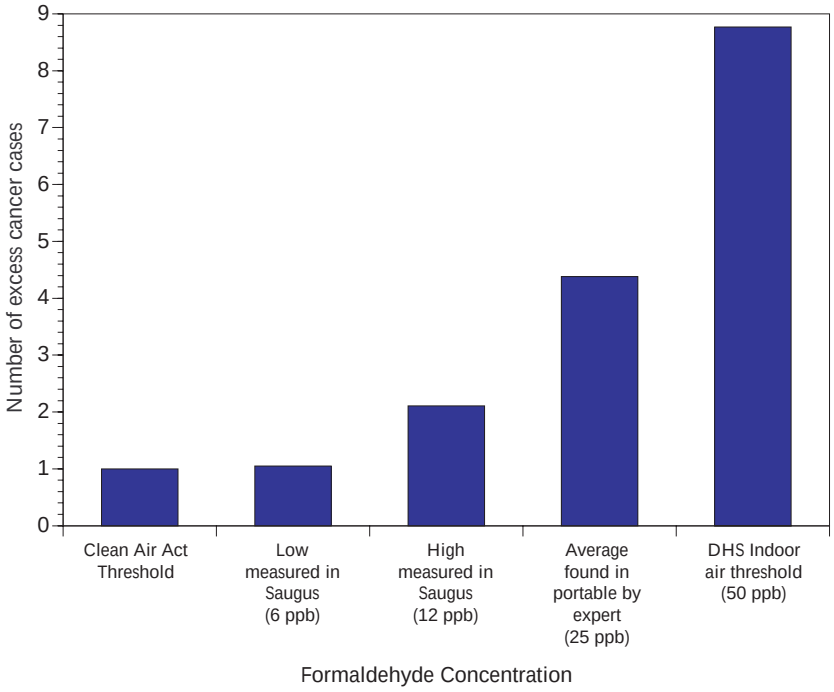
The majority of portable classrooms in use in California today were likely built after

1986. Very few formaldehyde measurements on these portables have been made. A San Francisco consultant on indoor air quality told EWG he has monitored the air in approximately 20 portables, including some new ones, and usually finds formaldehyde concentrations of 20 to 30 ppb (Offerman 1999). A 1998 study on four new mobile homes found a median formaldehyde concentration of 37 ppb — a level one indoor air quality expert told EWG was several times lower than what he would expect in a new mobile home (Godish 1999). Formaldehyde concentrations in the Saugus portables implicated in student illness were measured as low as 12 ppb and 6 ppb.

These measurements indicate that portables and materials manufacturers have reduced formaldehyde emissions to levels generally within state-recommended limits for short-term health effects. Unfortunately, the state's standards do not adequately protect children: Concentrations at or below acute indoor standards can cause health effects. One study, for example, shows that even levels well below the most protective standard can exacerbate health symptoms. In another, levels as low as 12.5 ppb were shown to worsen the symptoms of asthma and allergies in children (M.H. Garrett 1996).

Perhaps more worrisome is the fact that these standards ignore long-term health effects.

Figure 2. Expected excess cases of cancer from formaldehyde exposure.



Source: Environmental Working Group, from U.S. EPA, Machado Environmental Corp., Offerman 1999, California Dept. of Health Services.

No chronic indoor air thresholds have been set by state or federal agencies, despite the fact that pollutants tend to accumulate in indoor air and children spend most of their time indoors. Uniform, science-based guidelines that consider chronic and cancer risks for formaldehyde in outdoor air, however, indicate that children in portables may be exposed to levels of formaldehyde that increase their likelihood of developing certain chronic health ailments including cancer (OEHHA 1997).

In a response to the formaldehyde levels found in the Saugus portable, a toxicologist with the California Office of Environmen-

Daily exposure to formaldehyde at levels measured in portables may increase cancer risk.

tal Health Hazard Assessment warned that although the state's chronic safety levels are still in draft form, the levels found in those portables "are well above [chronic] levels and appear to be of concern if it represents a concentration to which the children are chronically exposed." (Dawson 1999)

In addition, based on the state's cancer risk assessment standards, continuous exposure to as little as 0.13 ppb of formaldehyde – 46 times lower than the lowest amount measured in the Saugus school portable — carries a lifetime increased risk of cancer of one in 1 million, the limit permitted under the U.S. Clean Air Act. An EWG analysis of cancer risk based on the 12 ppb of formaldehyde found in Saugus shows that spending four hours or more per day in a portable classroom throughout an average child's education can result in an increased cancer risk (EWG 1999a). For a small girl, just three hours of exposure per day will increase her cancer risk. For children who spend seven hours a day in portable classrooms, their cancer risks are two to three times greater than what is deemed acceptable under the Clean Air Act. (Figure 2)

Benzene

Another toxic chemical found in portable construction is benzene. As a component of glues and paints, benzene is frequently found in indoor air. But because benzene measurements are frequently lumped together with other volatile organic compounds (as TVOC) few measurements of benzene alone have been recorded in the literature.

Nevertheless, even at levels as low as 1 ppb, a level that has been measured in new mobile homes, benzene increases a child's risk of cancer. As with formaldehyde, just four hours in a portable for an average child and three hours for a small girl can expose them to unsafe levels of benzene according to the Clean Air Act. Exposure to seven hours a day carries an increased risk of cancer two to three times higher than the cancer level deemed acceptable under the Clean Air Act (EWG 1999b).

Toluene

Like benzene and formaldehyde, toluene, which is used in aerosols, nail polish, paints and paint thinner, is often found in indoor air. Exposure at high levels causes irritation of the skin, eye and lungs. Long-term exposure at high levels can produce irreversible changes in brain structure and function. Toluene is also a developmental toxin. According to state studies, children whose mothers, while pregnant, deliberately inhaled toluene fumes to get high suffered facial and limb abnormalities, attention deficits, hyperactivity and growth retardation (OEHHA 1997).

Styrene

Newly installed carpet and rubber padding can emit styrene, a chemical that can irritate the eyes and mucous membranes and may be toxic to the central nervous system. Some human studies suggest that chronic exposure can result in reproductive effects. The human liver breaks down styrene into a potentially more harmful metabolite, styrene oxide, known by the state to cause cancer in humans. (OEHHA 1997).

Carbon Dioxide

Portable classrooms can also be a source of harmful levels of carbon dioxide (CO^2). Poor ventilation and airtight construction in manufactured buildings can trap carbon dioxide exhaled by the occupants and result in concentrations that can have significant physiological effects including fatigue, drowsiness, lack of concentration and breathing difficulty (Bayer 1999b). Most students, whether in portables or permanent classrooms, have experienced problems staying awake in class, particularly on a hot day; evidence is growing that a boring teacher may not be the only cause. But carbon dioxide is also an indicator of other problems. It is often used as a "surrogate for other occupant-generated pollutants" and a "crude indicator of ventilation efficiency," meaning that high levels of carbon dioxide may suggest buildup of other more toxic pollutants. (Daisey 1998, Batterman 1995).

Studies in Maine found average carbon dioxide levels in portable classrooms of more than twice the concentration that is "generally regarded as unacceptable with respect to body odors" (Daisey 1998). This study also found that a percentage of the classroom measurements of CO^2 — about one in 16 — exceeded the levels recommended for adults working in a room for eight hours. In 1989, Canadian research found that average CO^2 levels in portable classrooms were more than twice the average levels measured in conventional classrooms (Daisey 1998b).

And children and other sensitive populations may be affected by even lower levels of CO^2. A U.S. Air Force study found that 15 to 33 percent of the population will suffer health effects when exposed to carbon dioxide concentrations as small as eight times lower than the recommended adult workday exposure and 40 percent lower than body odor thresholds. To combat this problem, the researchers recommend a ventilation rate that is three times the current national standards for classrooms and eight times the level provided by portables built before 1996 (Bayer 1999c).

Microbiological Contamination

Toxins from manufactured materials are not the only contaminants found in indoor air.

Portable classrooms trap carbon dioxide and other harmful gases that build up to levels that can harm health.

Toxic molds can cause nausea, respiratory illness, and even death.

Microbiological contaminants, including viruses, bacteria, allergens and molds contaminate indoor air and cause human disease and adverse health effects. And molds are themselves capable of producing VOCs commonly associated with solvents and cleaning products. In fact, some molds can produce dozens of different kinds of VOCs, including known carcinogens such as benzene (Bayer 1999). According to the U.S. EPA:

> "There are significant problems associated with exposure to airborne substances of biological origin in the indoor environment. It now seems clear that a significant percentage of the diseases associated with indoor air pollution are related to bioaerosols and that the diseases can be more serious and cause more distress in terms of mortality and morbidity than those diseases attributed to the common outdoor air pollutants." (EPA 1992)

Schools can have considerably higher levels of microbiological contaminants than offices. A 1993 study found average bacterial concentrations in schools at nearly 20 times levels found in other working areas and offices (Gallup 1993). Mold can be a particular problem in portables where high moisture can lead to a buildup in microorganisms.

In Canada, thousands of students have been forced from mold-infested portables (Sun 1998). A 1997 provincial health department report found that 30 percent of the portables in the Ottawa region had mold. And in Toronto, the school district was forced to repair or replace 157 portables containing the toxic mold *Stachybotrys* (Jaimet 1999). This same mold, connected to infant deaths in Cleveland, Ohio, also led the Elk Grove School District in Sacramento County to remove a portable classroom from an elementary school.

Safer Alternatives: Kids Are Worth It

Some of the toxins emitted in portable classrooms — formaldehyde in particular — are so widely used that avoiding them altogether is difficult. But it is possible to reduce the use of toxic construction materials, limit their harmful emissions and make sure portables are properly ventilated. Although safer alternatives may cost more, the expense must be weighed against the investment in children's health.

Most of the particleboard, plywood and fiberboard sold in the U.S. is made with one of two types of glue: formaldehyde mixed with synthetic urea (urinary acid) or formaldehyde mixed with phenol, a petroleum product. The urea formulation has a propensity to emit formaldehyde when exposed to heat and humidity; phenol forms a stronger bond, permitting less formaldehyde to escape into the air. John Bower, author of The Healthy House, a guide for the chemically sensitive, says products with urea-formaldehyde "should never be considered for use in an ecologically safe house, and those containing phenol-formaldehyde should be avoided if at all possible." (Fagin & Lavelle 1998)

Formaldehyde-free particleboard is available from several manufacturers, although it costs about 30 percent more because few chemical companies make non-toxic construction glues. Hospitals and libraries often use formaldehyde-free particleboard, a precaution that makes obvious sense for schools. Architects specializing in environmentally sensitive design also use the products; some choose lower-emission phenol-formaldehyde products coated with a sealant that reduces off-gassing. Although some solid woods actually cost less than some wood-veneer products, Bower cautions that much of the wood on the market is itself chemically treated. Untreated redwood and cedar, however, are available.

Bower says a toxic-free building should not use carpeting, which not only can lead to mold but contains formaldehyde and other chemicals also found in wood products. Although current California building standards require portables to be carpeted, state health officials agree it's a bad policy. Says Jed Waldman, chief of indoor air quality at the California Department of Health: "We shouldn't use carpeting in school [portables] at all. You turn carpets into mold factories. And most molds, under various conditions, will produce toxins."

Southern California Edison Co. in Los Angeles is joining forces with a portables manufacturer to develop a unit that will be both better ventilated and more energy efficient. (Hardy 1999.) Some ventilation problems in current portables may be the result of the more airtight construction standards adopted during the 1980s to improve energy efficiency.

Unintended Consequences

Portables have been a part of California school facilities planning since before World War II, but their use multiplied with the state's population growth during the war years and the decades afterward. Portables were seen as a flexible way to deal with fluctuating enrollments, and beginning in 1976, state law required that as a condition for districts to receive state construction funds, 30 percent of the classroom space to be added must be in portables. The law was amended in 1998, so that school districts may not raise the construction fees charged to developers unless 20 percent of all classroom space in the district – not just new facilities – is in portables.

In 1991, a survey by the State Auditor General found 43,000 portable classrooms in use in California. The auditor reported that many districts had begun acquiring portables in the baby-boom 1960s, but at least one school was still using a portable acquired in 1934 (Auditor Gen. 1991). The age of portables is important because although both old and new portables emit toxins at levels that may harm human health, construction materials used in units built before 1986 contained significantly higher levels of formaldehyde.

In the early 1990s, California had the largest average classroom size in the nation (Auditor Gen. 1991). This was one of the unforeseen consequences of Proposition 13, as California's school spending per pupil dropped from among the highest in the country to 41st among the states by 1995. School crowding became a major issue in the 1994 gubernatorial campaign, when teachers' unions ran ads opposing Pete Wilson's re-election that focused on overcrowded classrooms. When Wilson won, he launched "perhaps the most popular education initiative undertaken in California in the past generation" – a state program to pay school districts $800 per student if they reduced class sizes in kindergarten through third grade to 20 students or less (Schrag 1998).

But California schools were in no position to absorb the thousands of new classes that would be required under classroom size reduction. The existing facilities were crumbling. In 1989 the state's director of school facilities

Although both old and new portables emit toxins at levels that may harm human health, units built before 1986 contained significantly higher levels of formaldehyde.

If the state exercises oversight over earthquake safety in portables, it should protect children from exposure to toxic chemicals as well.

planning had estimated that 55 percent of California school buildings were in poor condition (Schrag 1998.) In 1996, the year the Legislature passed Wilson's plan, schools in California reported the worst physical conditions of any state (GAO 1996).

In 1996, the schools were given so little time and flexibility in implementing the class-size reduction program they were forced to choose the cheapest and easiest solution. The state legislative analyst determined that California's school districts had to somehow create an additional 18,400 classrooms in the first year of the program (Leg. Analyst 1997). Building a permanent structure can take a year or more, but portables can be delivered and installed in one or two months. What's more, building a single new classroom costs between $115,000 and $175,000, while a new portable can be had for $35,000 or less, although some custom units may run as high as $80,000 (EdSource 1998).

In the first year thousands of cafeterias, conference rooms and other spaces were converted to classrooms, but in yet another example of unintended consequences, the majority of school districts turned to portables. In 1997 alone, California schools purchased or rented more than 10,300 portable buildings at a cost of $360 million to $1 billion, based on average portables prices. The boom has slowed slightly as more schools reach their class-size reduction goals, but with an additional one million students expected in California schools in the next 10 years, one analyst says: "There is nothing so permanent as a portable." (Schrag 1998)

You Get What You Pay For

Indeed, the vast majority of portables in the state are built to meet the same earthquake safety standards as permanent school facilities. The Department of the State Architect (DSA) has the authority to determine structural safety standards, review plans and conduct inspections during both the manufacture and installation of portables. DSA-approved portables may be either purchased or leased. Other units, intended for lease only up to 18 months, still must meet the somewhat less rigorous seismic standards of the state Department of Housing. If the state exercises oversight over earthquake safety in portables, it should protect children from exposure to toxic chemicals as well.

Portables rarely win praise for their aesthetics. Many are plagued by poor lighting, few windows or inadequate ventilation — design and construction problems that can lead to or exacerbate air quality problems. An expert on childhood poverty says use of portables sends "the wrong message" to students: "It reminds children that their society doesn't think of them very highly." (Johnson 1999) Most adults seem to agree: A

national poll, commissioned by a Maryland-based portables manufacturer, found that only 15 percent of respondents considered portables an acceptable solution to school crowding (PRN 1998).

These aesthetic concerns have often triggered community protests against portables. In 1995, parents in the Oakland school district kept 500 students out of school for three weeks to protest the continued use of 40-year-old portable classrooms (Kershaw 1995). In June 1998, after an outcry from parents, the Palo Alto school board limited the number of portables allowed at any school and promised to spend the interest income from a bond issue on replacing portables with permanent classrooms (Breitrose 1998).

In several states, including Florida, where an estimated 16,000 portables classrooms house about 10 percent of the state's students, the anti-portables movement has become a potent political force. (Schrag 1998). Alabama's new governor, Don Siegelman, included the elimination of portables among his campaign promises. "My first official act," he said, "will be to issue an executive order to get rid of portable classrooms, absolutely. When I took my son to [elementary school], it looked like a colony of trailers. We've got to get the kids out of those." (Johnson 1998) A few months later, Vice President Al Gore addressed the issue in a speech at an Alabama school: "What are we going to do about it, all these portables? . . . All around the country, this is a great problem." (Cason 1999.)

'A Safe, Healthy Learning Environment'?

After class size reduction sparked the portables explosion in California, it didn't take long for state regulators to recognize the state had an indoor air quality problem. In December 1996, the California Department of Health Services issued an advisory to the state's approximately 9,700 public and private schools on the "potential health impacts" from portables. It noted that while portables leased from the state were required to meet certain construction and ventilation standards, the class size reduction program had exhausted the state's inventory, so "many school districts will instead obtain relocatable classrooms directly from manufacturers. . . . [T]hese relocatable units may not adhere to the [state] specifications, and their design and quality can vary." (DHS 1996)

A follow-up survey showed that most districts had never taken note of the advisory. DHS and the state Department of Education, joined in an interagency task force by a number of officials from local school districts, then produced a report – *Indoor Environmental Quality in California Schools: Critical Needs* — that warned: "There is no program to systematically inspect

"There is no program to systematically inspect relocatable classrooms to monitor their continued suitability to provide a safe, healthy learning environment for students and teachers." (California Department of Health Services)

The Portables Industry: If You Build Them, Cash Will Come

SACRAMENTO, Oct. 14, 1996 — Builders of portable classrooms can't stop grinning these days.

> *"Yes, I have a smile on my face," said Gary Doupnik Sr., chairman of Doupnik Manufacturing Inc. . . . [Class-size reduction] "is great for my company and the whole industry. . . . We used to cut back in the winter. Now we'll be going at full steam all year." (Heath 1996)*

Doupnik Manufacturing of Loomis, Placer County, one of at least 19 portables makers in California, is privately held, so its revenues and earnings are not available. But in 1996 Gary Doupnik predicted his annual sales would top $15 million in 1997, increasing by one-third over the previous year. Even before class-size reduction took effect, Doupnik Manufacturing grew by 300 percent from 1981 to 1990 (Durkin 1990).

From all reports, portable classroom makers in California – an industry that ranges from large companies doing business nationwide to mom-and-pop entrepreneurs – are enjoying a boom. The number of portables produced in the state increased from about 4,000 in 1996 to about 20,000 in 1997. At the end of that year, manufacturers reported a backlog of almost 5,400 unfilled orders, and one executive said 24-hour production shifts would not meet all the demand (Rutledge 1997, Peoples 1997, Crider 1996). Since portables makers' receipts are paid from public funds, their windfall argues that the industry bears responsibility for improving safety.

Of all the portables manufacturers in California, only the largest, Modtech Inc. of Perris, Riverside County, is publicly held. In 1998, Modtech's total sales were $127.6 million – 98 percent of it from sales to school districts. Between 1996 and 1998, Modtech's quarterly earnings increased by

relocatable classrooms to monitor their continued suitability to provide a safe, healthy learning environment for students and teachers, or to determine optimal design/operation parameters for them." (DHS 1998)

The task force's report was still being reviewed in May 1999, when the story broke about toxic classrooms in the Saugus schools. In an interview with the Los Angeles Daily News, a DHS spokesman explained the delay:

nearly 1,000 percent and its quarterly earnings rose by more than 4,500 percent. In that period the price of its stock soared by more than 815 percent, from $2.13 to $19.50 a share. Wall Street analysts predicted the company's earnings will continue to grow by at least 17 percent a year (Benson 1998).

The second-largest California portables maker is believed to be Aurora Modular Industries of Riverside. Based on reports of its annual production and back orders, it appears at least somewhat comparable in size to Modtech. Aurora produced the portables that may have made children ill in Saugus. It also produced units where children or teachers were affected in Riverside, Corona, San Clemente and Mission Viejo**.**

In 1990, a Riverside teacher sued the company, claiming she was sickened by formaldehyde fumes in one of its portables (Lovekin 1997). An investigation by county health officials found that partitions placed in the unit by the school were the source of formaldehyde, and there is no evidence that Aurora's classrooms have more problems than others. But neither is there evidence that the state conducted an investigation of the recurring incidents or informed local districts who bought portables from Aurora.

The industry's lobbying group is the School Facilities Manufacturers' Association (SFMA) in Sacramento, which includes Modtech, Aurora, Doupnik and eight other California companies. SFMA is represented by and housed in the K Street offices of Murdoch, Walrath & Holmes.

Compared to many industry lobbying groups at the Capitol, SFMA keeps a low profile. From 1995 to 1998, Murdoch, Walrath & Holmes reported lobbying expenditures of about $38,000 on behalf of SFMA. From 1993 to 1998, members of the SFMA contributed $5,900 to the campaigns of state officials and candidates (FPPC 1999).

"Because the report involved significant policy issues, the outgoing [Wilson] administration did not think it was appropriate [to act]. It was decided the new [Davis] administration should have the opportunity to make those decisions." (Hardy 1999) In an editorial, the Daily News asked: "Since when is the change of administration more important than the health of students and teachers?" (Daily News 1999)

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