1.2 Indoor Pollutants

Americans spend approximately 90 percent of their time indoors where air contaminants and associated health risks are generally greater (EPA, 2008a). Major sources of indoor pollutants include:

- Combustion (carbon monoxide and fine particles from cooking, heating)
- Building materials and furnishings, such as treated wood, lead paint, and carpeting
- Products used indoors (cleaning products, pesticides, glues and adhesives, paints)
- Biological sources (mold, mildew, pet dander, insects and arthropods)
- Environmental tobacco smoke
- Outside sources (through windows, doors, walls)
- Vapors or gases coming into the crawl space or basement from underground (including radon)

Indoor air pollutants can cause or worsen certain children's health problems, such as allergies, asthma, respiratory irritation, and middle ear conditions. Long-term risks may include increased risk of cancer, heart disease, and reduced lung function later in life. In this report we focus on two particular pollutants, environmental tobacco smoke and lead, because of their significant health effects and the concerted historical efforts to reduce exposures and health outcomes. It should be noted that unlike outdoor air pollutants, there is no mandated federal or state surveillance system for indoor air pollutants, so there is no systematic collection of data on indoor environmental air pollutants.

Environmental Tobacco Smoke

Environmental tobacco smoke (ETS), also known as secondhand smoke, is a mixture of more than 3,800 different chemical compounds generated by the burning of tobacco products (NRC, 1986). Where it occurs, it can be an important contributor to illnesses in children. In 2005, estimated medical costs associated with illnesses and deaths due to passive smoking were $523.8 million for adults and $73.8 million for children (Waters, 2006). The lungs of children appear to be most susceptible to the effects of ETS due to the fact that children are still developing physically and have higher breathing rates than adults. Children who are exposed to ETS are at increased risk for asthma, bronchitis, pneumonia, middle ear infections, and sudden infant death syndrome.

The harmful effects of exposure to ETS among children may vary by race. Despite the lower levels of reported exposure to ETS, African American children have higher levels of serum cotinine (a marker of tobacco exposure in the blood) (Wilson et al., 2005). The reasons for this are not understood, but it has been hypothesized that racial differences in the metabolism of tobacco toxicants as well as housing may explain the differences.

Lead Exposures in the Home

Lead is a heavy metal with no known biological function in the human body. Lead causes a number of health problems, including learning disabilities and behavioral problems (see also section 4.1). Children can be exposed to lead from the air, soil, and drinking water, but the highest exposures in the population are from lead paint in houses and apartments built before 1978, when lead paint was banned in the United States. Houses built before 1950 can contain paint with even higher amounts of lead. As of 2000, approximately 20 percent of U.S. homes had significant

lead-based paint hazards in the form of deteriorated paint, dust lead, or bare soil lead (Jacobs et al., 2002).

Much effort is directed toward abatement and enforcement of regulations related to lead-contaminated housing in Maryland. Multi-agency partnerships with the local and state agencies, schools, and healthcare providers focus on active follow up of at-risk children, moving families to safer housing, and enforcement of lead paint laws. As of 2006, Maryland requires all pre-1950 rental dwellings to be in compliance with the Full Risk Reduction Standard. Landlords must perform risk reduction work when conditions warrant and verify that properties are lead-free at the time of turnover to new occupants.

Indicator E6: Percentage of Households Where Minors Age Less Than Five Have an Adult Smoker Resident

This indicator for ETS shows the percentage of homes with children less than five years of age in which there is an adult smoker resident (see Figures 7 and 8). The data are derived from the Maryland Annual Tobacco Survey and are available for 2000 and 2002(DHMH, 2002; DHMH, 2003). This is an indirect measure because it reflects the percentage of homes, which is expected to track closely with the number of children. Serum cotinine is a better measure to quantify exposure to ETS and its health effects, but these data are not available for young children; the National Health and Nutrition Examination Survey (NHANES)

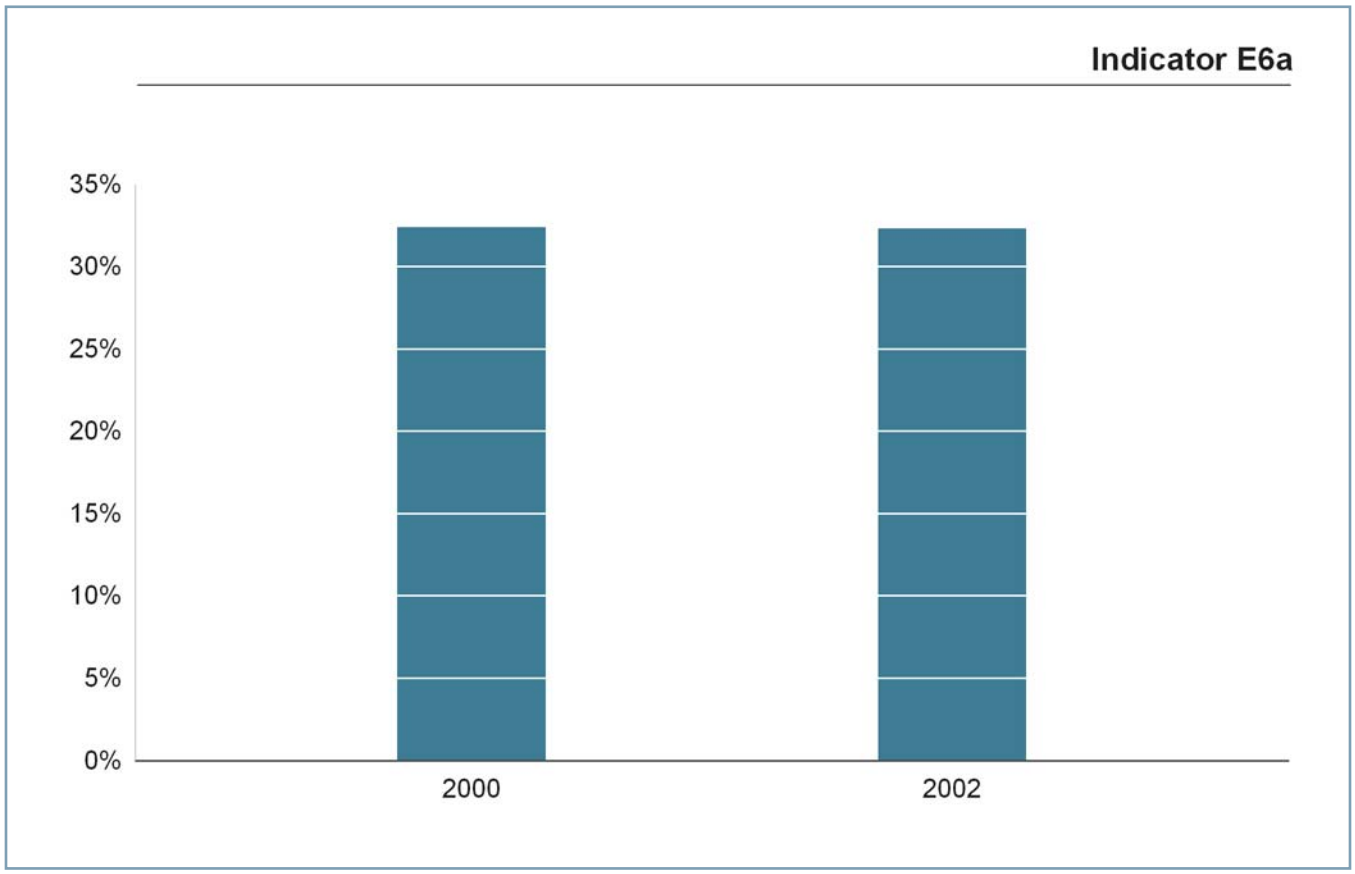

Figure 7. Percentage of Homes with Children Under 5 Years and Smoking, 2000 & 2002
Source: Maryland Tobacco Survey, Department of Health and Mental Hygiene

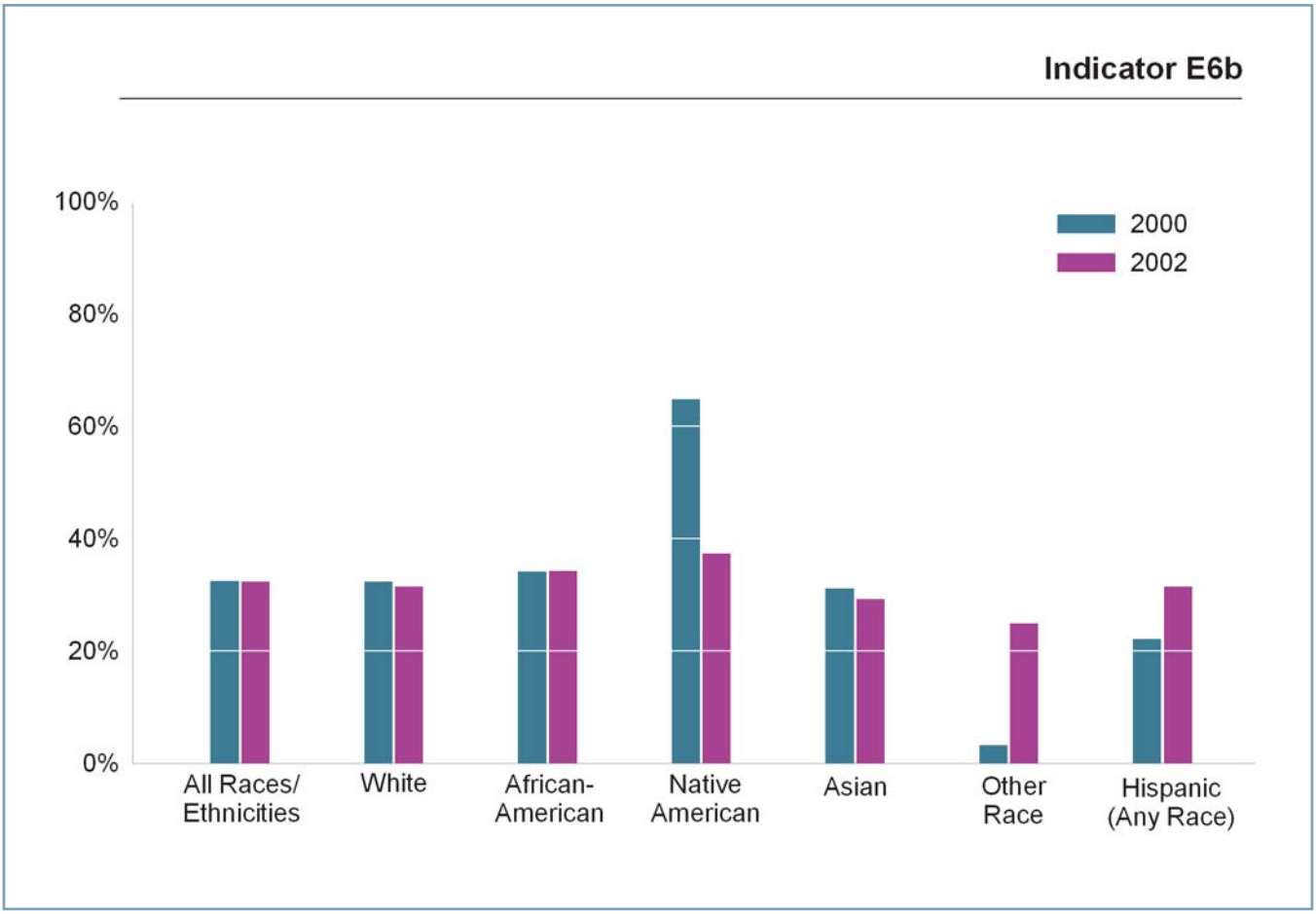

Figure 8. Percentage of Homes with Children Under 5 Years and Smoking by Race, 2000 & 2002
Source: Maryland Tobacco Survey, Department of Health and Mental Hygiene

sponsored by the Centers for Disease Control and Prevention (CDC) collects data for children six years old and older.

- In Maryland, approximately 32 percent of children were exposed to ETS in their own homes in both 2000 and 2002. By comparison, a national EPA survey in 2003 showed that 11 percent of children under age six were exposed regularly to ETS (EPA, 2004).
- African-American children were slightly more likely to be living in a household with a smoker (34.1 percent in 2000 and 32.3 percent in 2002) than were White children (32.3 percent in 2000 and 31.5 percent in 2002). It is important to note that there were only small numbers of children surveyed that were categorized as minorities other than Black; thus it is difficult to interpret these findings.

Healthy People 2010: Objective 27-09 of Healthy People 2010 focuses on reducing the proportion of children who are regularly exposed to tobacco smoke at home.

Indicator E7: Percentage of Women Who Smoke During Pregnancy

This indicator shows the percentage of expectant mothers who smoke in the last months of a pregnancy (see Figures 9 and 10). Smoking during pregnancy is associated with low birth weight, preterm birth, and neonatal and infant mortality. In addition, mothers who smoke during pregnancy put their babies at an increased risk of sudden infant death syndrome.

- In Maryland, the proportion of mothers who smoked during the last three months of pregnancy over a five-year period of 2001 – 2005 was approximately 10 percent.
- White pregnant women were more likely to smoke than Black women at 12 percent compared to 7 percent, respectively.

Healthy People 2010: Objective 27-06 of Healthy People 2010 focuses on increasing smoking cessation during pregnancy.

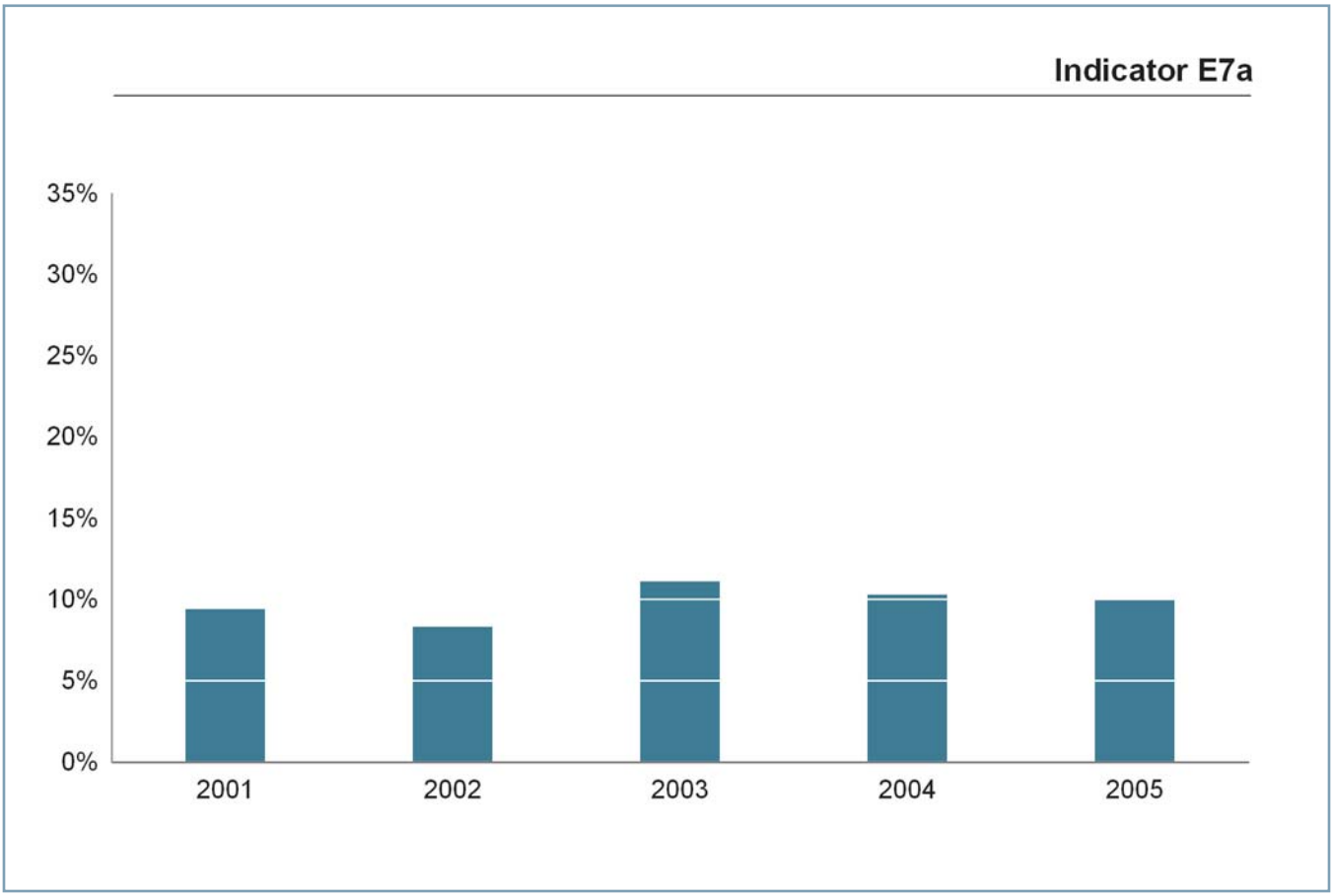

Figure 9. Percentage of Women who Smoked During the Final 3 Months of Pregnancy, 2001 – 2005

Source: Maryland Tobacco Survey, Department of Health and Mental Hygiene, 2000 & 2002

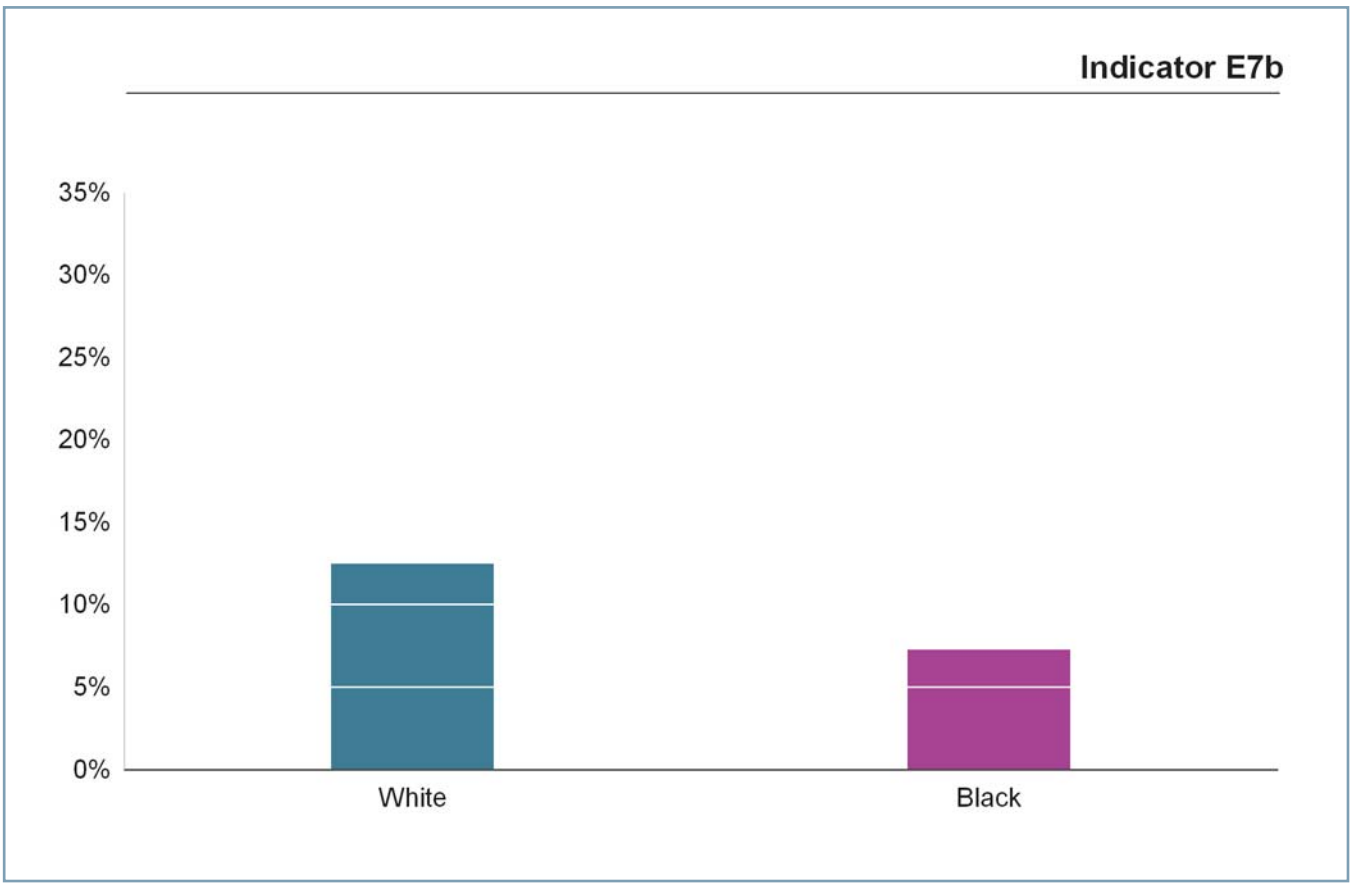

Figure 10. Percentage of Women who Smoked During the Final 3 Months of Pregnancy, by Race, 2001 – 2005

Source: Maryland Tobacco Survey, Department of Health and Mental Hygiene, 2000 & 2002

Indicator E8: Proportion of Housing Stock Built Before 1950

This indicator shows the trend in the percentage of housing units built before 1950 (see Figure 11) and therefore potentially posing a significant risk to children from lead dust and paint chips. The number of housing units is the total number of units, because data on the number of pre-1950 units with children are not available.

- In Maryland, the relative proportion of housing units built before 1950 decreased from 25 to 18.5 percent between 1990 and 2005. This is partly due to the availability of new houses built after 2000 and partly due to demolition of old units.
- The percentage of total housing units built before 1950 is slightly lower in Maryland than in the overall U.S.

Healthy People 2010: Objective 8-22 of Healthy People 2010 focuses on increasing the proportions of persons living in pre-1950s housing that has been tested for the presence of lead-based paint.

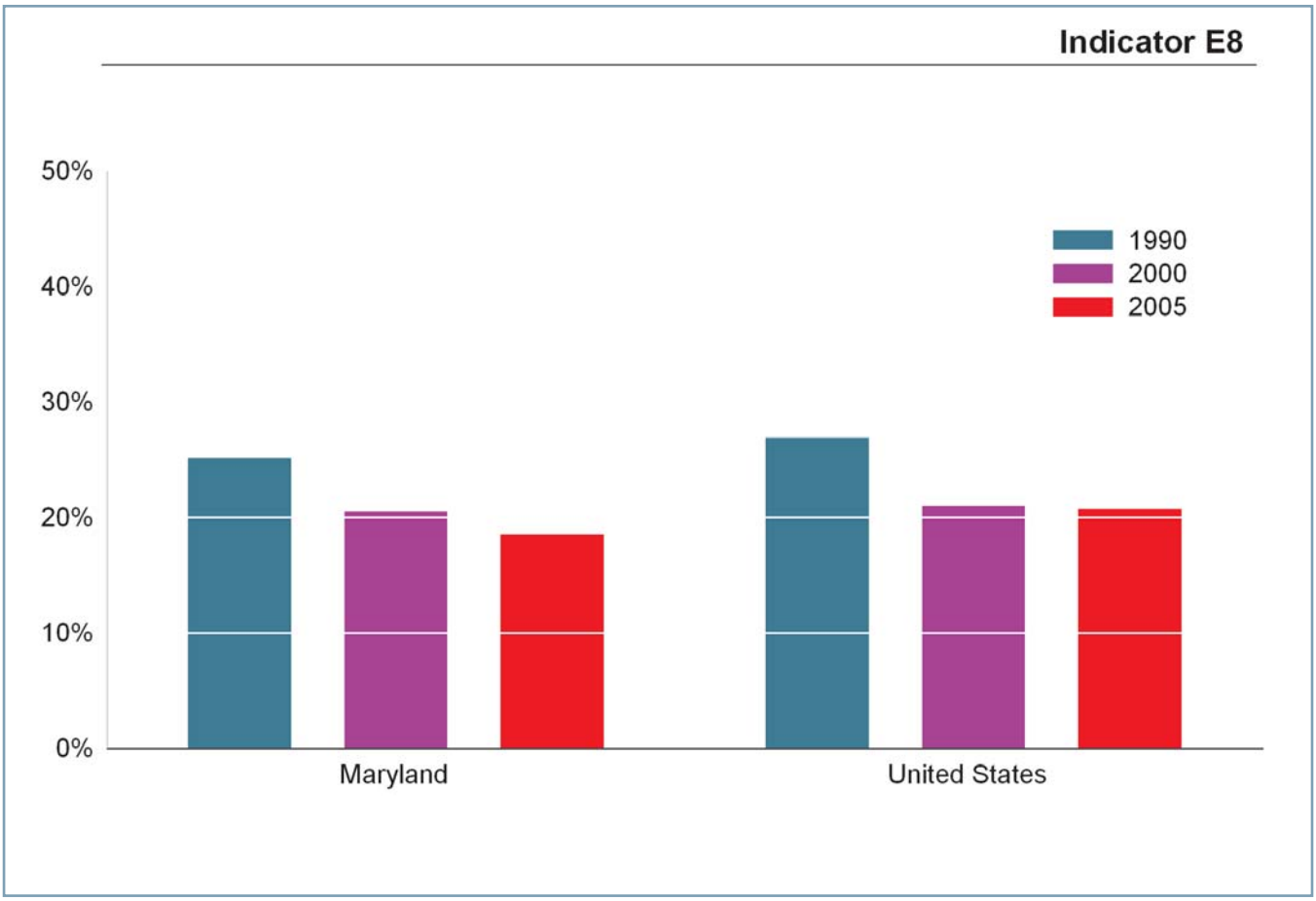

Figure 11. Percentage of Total Housing Units Built Before 1950
Source: U.S. Census 2000

Radon

Radon is a colorless, odorless radioactive gas which is found in almost all soil. The concentrations in soils vary geographically depending on soil chemistry. This gas can seep into homes and buildings through cracks in the foundation, where it can accumulate in high concentrations. The risk for exposure to radon is usually highest in basements and rooms with ground contact, as the gas dissipates in the upper floors of buildings.

Radon has been classified as a known human carcinogen by the International Agency for Research on Cancer (IARC). Evidence for this classification is based on studies of uranium miners exposed to high concentrations of radon gas. These studies demonstrated an increased risk of lung cancer when exposed to increasing levels of radon. The studies also showed a synergistic effect between radon exposure and smoking, with smokers exposed to radon having much higher rates of lung cancer compared with nonsmokers exposed to radon (IARC, 1998).

Recently, analyses of studies performed in the U.S. and Europe have confirmed that there are increased rates of lung cancer among residents of homes found to contain elevated concentrations of radon (Darby et al., 2005; Krewski et al., 2005). Radon is believed to be the second leading cause of lung cancer, after smoking, and the leading cause of lung cancer among non-smokers. The EPA estimates that radon is responsible for approximately 21,000 lung cancer deaths in the U.S. each year, including 2,900 deaths among non-smokers (EPA, 2003).

The EPA strongly recommends that homeowners take action to reduce home radon levels if concentrations exceed 4 pCi/L (pico Curies per Liter). There is no known safe level for radon exposure, so the EPA encourages homeowners to reduce radon levels even if their homes are found to contain radon levels between 2 to 4 pCi/L. The average U.S. home is estimated to

Table 2. Lifetime Risk* for Lung Cancer Due to Radon

Radon Level	Risk for Never Smokers	Risk for Smokers
20 pCi/L	36 per 1,000	260 per 1,000
10 pCi/L	18 per 1,000	150 per 1,000
8 pCi/L	15 per 1,000	120 per 1,000
4 pCi/L	7 per 1,000	62 per 1,000
2 pCi/L	4 per 1,000	32 per 1,000
1.3 pCi/L	2 per 1,000	20 per 1,000
0.4 pCi/L		3 per 1,000

*Risk if exposed to specific radon level over a lifetime
Source: EPA

have radon levels of 1.3 pCi/L (Marcinowski et al., 2004), while the average outdoor concentration of radon is 0.4 pCi/L (EPA, 2008b).

There is currently no evidence that children are at increased risk from radon exposure compared to adults. However, like adults, children who spend large amounts of time in basements or rooms with ground contact will be at increased risk for lung cancer if the rooms have elevated radon levels. They are at further increased risk if they are also exposed to second-hand smoke.

Figure 12 shows the predicted county averages for indoor radon levels.

No indicator is proposed in this report for radon. However, as a recognized carcinogen and environmental hazard, radon should be considered for inclusion in future indicator activities or deliberations.

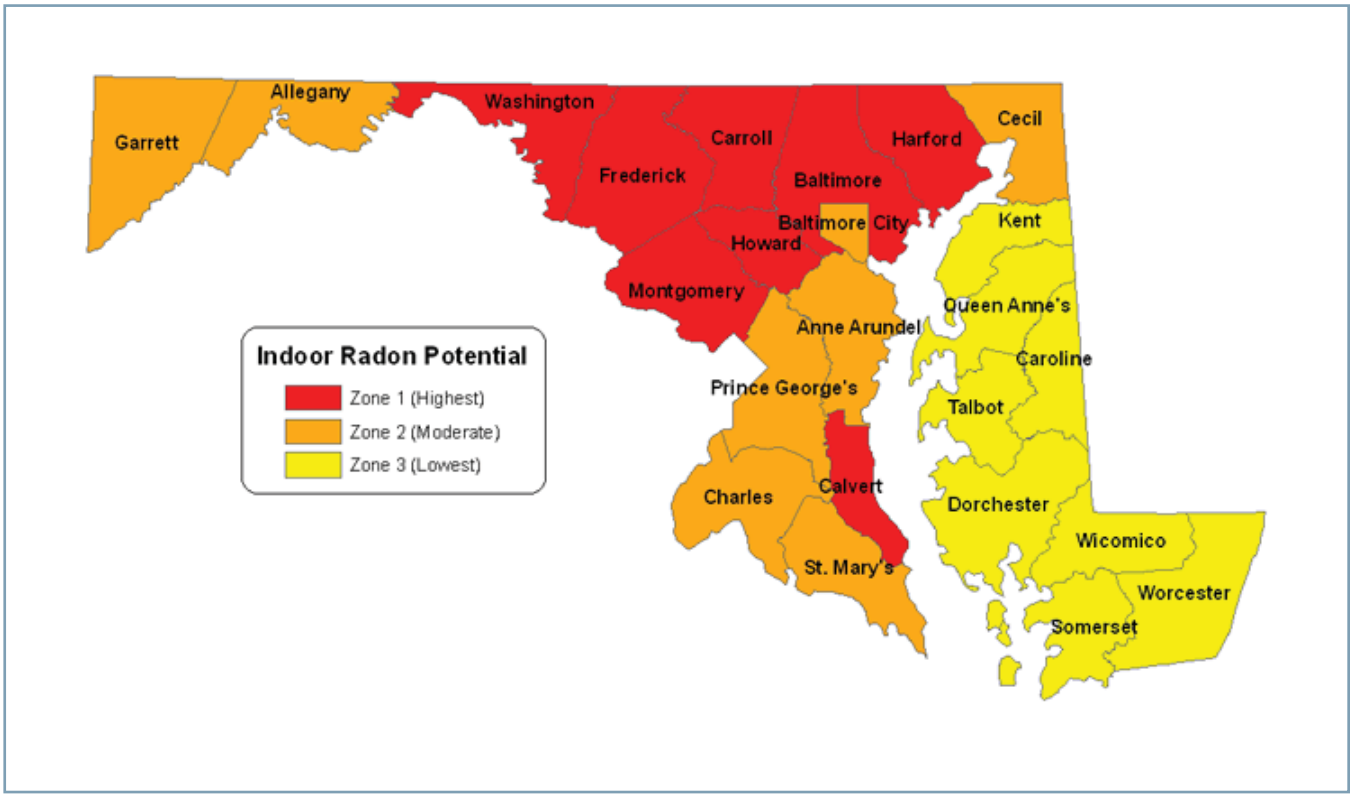

Figure 12. Maryland Radon Zones
Source: EPA at http://www.epa.gov/radon/zonemap/maryland.htm

Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L (pico curies per liter). Zone 2 counties have a predicted average indoor radon screening level between 3 and 4 pCi/L. Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L.

Note: This map is not intended to be used to determine if a home in a given zone should be tested for radon. Homes with elevated levels of radon have been found in all three zones. All homes should be tested regardless of geographic location.