

have been identified by the EPA as among the 33 HAP of greatest concern under the Integrated Urban Air Toxics Strategy published in the **Federal Register** on July 19, 1999 (64 FR 38706).

The petitioner concluded that insignificant amounts of these compounds are formed as a result of secondary transformation of EGBE. After reviewing the petitioner's analysis, we concluded that it was a reasonable effort to determine whether EGBE transformation products are likely to be of concern. However, there were data gaps and additional questions which we judged to need further attention. Consequently, we undertook an independent analysis to estimate typical urban ambient air concentrations of formaldehyde, acetaldehyde, and propionaldehyde due to EGBE transformation. Our evaluation, summarized below, indicates that atmospheric transformation of EGBE emissions may not reasonably be anticipated to cause adverse effects to human health. The full transformation assessment is contained in the docket.

A large percentage of ambient formaldehyde and acetaldehyde is due to atmospheric transformation of VOC. In fact, the State of California has estimated that as much as 88 percent of the ambient formaldehyde and 41 to 67 percent of the ambient acetaldehyde arise from atmospheric transformation from VOC. The remainder is attributed to direct emissions. A previous analyses carried out as part of the EPA's Cumulative Exposure Project (CEP) in the mid-1990s suggests that EGBE transformation is not among the most significant contributors to ambient formaldehyde and acetaldehyde. The CEP analysis identified two pollutants (propene and ethene) as major contributors to ambient concentrations of formaldehyde, and two pollutants (propene and 2-butene) as the major contributors to acetaldehyde. Several other VOCs including EGBE were considered only minor precursors to formaldehyde and acetaldehyde in the CEP analysis.

Secondary formaldehyde is formed from EGBE via a two step process. First, EGBE with an average half-life of approximately 18 hours and a life time of about 25 hours transforms into intermediate compounds, such as formate esters and propionaldehyde. Second, these compounds transform into formaldehyde. Based on the information contained in the petition, formate esters have half-lives ranging from 21 hours to 55 hours. Propionaldehyde has a half-life of about 12 hours. Due to the relatively long time required to complete the

process, and the resulting large dilution of the EGBE reaction products in the atmosphere, we do not anticipate elevated concentrations of formaldehyde formation due to EGBE transformation near EGBE emissions points that will cause adverse effects to human health.

We have estimated that the half-life for EGBE to convert to formaldehyde through the two step process is approximately 37 hours. Assuming the average wind speed is about 3 miles per hour (mph), a plume from any given EGBE emission will travel about 111 miles in a 37-hour period. A conservative dispersion calculation at this point in time indicates that the plume is well dispersed such that EGBE concentrations are decreased by at least 300-fold from the predicted maximum fence line concentrations. Considering dispersion alone and the maximum fence line concentration for the largest EGBE emission source presented in the petition of approximately 330 micrograms per meter cube ( $\text{ug}/\text{m}^3$ ) (*i.e.*,  $0.3 \text{ mg}/\text{m}^3$ ), we can conservatively estimate that EGBE levels in typical urban areas might be as high as  $1 \text{ ug}/\text{m}^3$ . Concurrent with this dispersion, EGBE emissions transform relatively slowly into formaldehyde which, in turn, decomposes much more quickly. We estimate that the concentrations of formaldehyde due to EGBE transformation at this point would be roughly  $0.06 \text{ ug}/\text{m}^3$ .

Based on available ambient monitoring data for 82 urban area monitoring sites in 17 States, we determined that the ambient average concentration of formaldehyde in urban areas is about  $2.8 \text{ ug}/\text{m}^3$ . Therefore, we estimate that roughly 2 percent (*i.e.*,  $0.06 \text{ ug}/\text{m}^3$ ) of the ambient formaldehyde could be due to EGBE transformation. However, due to the conservatism built into the estimation procedure, we feel this is an overestimate. We feel that the actual contribution of EGBE to formaldehyde levels is much less than 2 percent.

We also considered the risk to human health posed by ambient formaldehyde. Using EPA default exposure and risk assumptions (such as the assumption that there is no threshold for the carcinogenic effect and that the dose-response relationship is linear at low doses), the increased risk of cancer for people assumed to be exposed for a lifetime to the ambient concentration can be calculated by multiplying the ambient concentration by the cancer Unit Risk Estimate (URE). The URE is an upper bound estimate of the increased risk of cancer per unit of exposure for a lifetime. (The IRIS glossary defines

upper-bound as "a plausible upper limit to the value of a quantity. This is usually not a true statistical confidence limit".) The current URE for formaldehyde, as listed by IRIS, is  $1.3 \times 10^{-5}$  per microgram per cubic meter (per  $\text{ug}/\text{m}^3$ ). (Note: The EPA periodically reviews and updates the toxicological information for chemicals on IRIS. Currently we are reviewing formaldehyde. As such, the URE may change, but based on currently available information, it is not likely to become higher than what is currently on IRIS.) This means that if people are exposed to 1 microgram of formaldehyde per cubic meter of air ( $1 \text{ ug}/\text{m}^3$ ) for a lifetime, we estimate that they would have an estimated upper bound increased risk of cancer of  $1.3 \times 10^{-5}$  or 13 in a million. Therefore, if we assume people are exposed to the average ambient concentration of formaldehyde (*i.e.*,  $2.8 \text{ ug}/\text{m}^3$ ) for a lifetime, we calculate the upper bound increased cancer risk for these people to be about 30 in a million, or  $3 \times 10^{-5}$ . Thus, while the total level of risk from ambient levels of formaldehyde is greater than one in a million (or  $1 \times 10^{-6}$ ), a relatively small portion of these ambient levels is likely to be attributable to EGBE transformation.

Given the level of risk from formaldehyde generally, and because EGBE is likely to contribute less than 2 percent to the total ambient concentration of formaldehyde, we do not anticipate that formaldehyde from EGBE transformation will have an adverse impact on human health.

We also assessed the potential for adverse health effects other than cancer. No EPA RfC is available for formaldehyde for an assessment of noncancer risks. Therefore, we compared ambient levels to the minimal risk level (MRL) for formaldehyde, produced by the Agency for Toxic Substances and Disease Registry. The MRL for formaldehyde is  $10 \text{ ug}/\text{m}^3$ . The ambient outdoor levels of formaldehyde used for this analysis are less than the MRL, which suggests that adverse noncancer effects are not likely to result from exposures to these ambient outdoor concentrations.

Propionaldehyde is also produced by the secondary transformation of EGBE. The half-life of propionaldehyde is about 1.4 times shorter than the half-life of EGBE, which indicates that propionaldehyde degrades about 1.4 times faster than it is formed from EGBE. Assuming steady state, we have determined that the concentration of propionaldehyde (in  $\text{ug}/\text{m}^3$ ) is expected to be roughly 2.8 times lower than the concentration of EGBE. Assuming that 1