



Environmental Fact Sheet

Summary of the Acute Behavioral Effects of Exposure to Toluene and Carbon Monoxide from Snowmobile Exhaust

The U.S. Environmental Protection Agency (EPA) has completed an analysis that estimates potential acute health risks to snowmobile riders from exposures to carbon monoxide and volatile hydrocarbon emissions present in snowmobile exhaust. This analysis was intended to allow an assessment of the monetary benefits associated with reductions in behavioral impairment from these exposures and comprises a portion of the benefit-cost analysis for the final rule making on emission controls of off-road recreational vehicles. It is not intended as risk characterization because of uncertainties associated with estimates of exposure. The Regulatory Support Document for the final rulemaking on emission controls of off-road recreational vehicles is available to the public (www.epa.gov/otaq/cleanrec.htm).

Summary

The EPA analysis suggests that blood carbon monoxide (CO) and toluene concentrations resulting from following a lead snowmobile in typical snowmobile use are within the range associated with measurable deficits in behavioral performance. Based on these results, it is predicted that the behavioral deficits may be linked to increased rates of accidents during and after snowmobile use. The EPA anticipates that substantial benefits may be achieved by controlling this exposure.

The analysis's conclusions are based on modeling the potential neurological deficits associated with hydrocarbon and CO emissions from 2-stroke engines. This was accomplished by using emissions data and modeling to estimate exposures to a snowmobile rider following behind a lead sled in plausible group riding scenarios. The EPA also used physiologically-based pharmacokinetic models to estimate blood concentrations resulting from these exposure conditions. Following that, changes in performance of behavioral tasks were estimated using a meta-analysis of the existing scientific literature for exposures to two exhaust components, toluene and carbon monoxide, the only constituents with a sufficient behavioral database to enable modeling. Finally, the effects of toluene, but not CO, were compared to equivalent doses of ethanol in order to facilitate estimates of monetary costs.

Background

The Clean Air Act gives EPA the responsibility and authority to control emissions from off-road recreational vehicles such as snowmobiles and other similar machines. The EPA previously proposed a rule for controlling emissions from new off-road recreational vehicles and other equipment. After its review of the rule, the Office of Management and Budget suggested that the EPA had not sufficiently quantified the monetary benefits of the proposed emission controls (http://www.whitehouse.gov/omb/inforeg/other_letter.html).

In response to OMB's request, the Office of Transportation and Air Quality (OTAQ) in the EPA Office of Air and Radiation and the National Health and Environmental Effects Research Laboratory (NHEERL) in the EPA Office of Research and Development have completed a three part analysis that includes: (1) estimating emissions from off-road recreational vehicle engines and exposures to operators during typical use (OTAQ); (2) estimating health effects of exposures with emphasis on acute impairments in performance of behavioral tasks (NHEERL); and (3) developing techniques for estimating monetary costs associated with behavioral impairment from these exposures (OTAQ).

The two-stroke engines typically used in snowmobiles emit large amounts CO and of hydrocarbons, a major component of which is toluene. Because of limitations in available exposure models, the analysis focused on a scenario in which a snowmobile rider follows in the exhaust plume of a lead snowmobile down a fixed trail, as is common practice in national parks. Measurements of snowmobile engine emissions and

modeling were used to estimate exposures to the second rider in the wake of the first vehicle. Although there are uncertainties with the exposure predictions, the estimated blood concentrations of CO and of toluene rose enough to impair behavioral performance. Therefore, these analyses suggest that snowmobile exhaust emissions present an exposure situation of potential concern.

In order to better understand the costs of behavioral deficits from toluene exposure, a comparison was made to ethanol consumption because it was not possible to evaluate the costs associated with behavioral deficits directly. The effects of exposure to toluene were compared to those of alcohol on the basis of blood concentrations causing equivalent degrees of behavioral impairment. This novel approach would enable estimates of accident rates and associated benefits resulting from the ethanol equivalent to toluene exposure.

For calculation of the monetary value of controls, two components could be evaluated: accidents while operating snowmobiles and accidents while driving motor vehicles on the way home. There are substantial uncertainties in baseline exposure estimates, snowmobile accident data, in knowing how quickly people get into their cars and how far they drive. Based on published U.S. Department of Transportation, National Highway Traffic and Safety Administration data on relative risks for accidents, the range of effects is consistent with increased relative risk of fatal, non-fatal injury and property damage accidents while driving home.

For More Information

You can access documents on the summary of the acute behavioral effects of exposure to toluene and carbon Monoxide from snowmobile exhaust electronically on the Office of Transportation and Air Quality Web site at:

<http://www.epa.gov/otaq/cleanrec.htm>

You can also contact:

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