"Assessing Chronic Health Risks from Stationary Source Air Emissions in Volgograd, Russia: A Case Study in Quantitative Risk Assessment"
The Volgograd Health Risk Assessment Working Group
Environment Discussion Paper No. 18

Brief by Nat Keohane
July 23, 1997

Air pollution in the Russian city of Volgograd may pose a serious long-term health risk to the city's one million people, according to a report released by the **Newly Independent States Environmental Economics and Policy Project (NIS-EEP)** of the Harvard Institute for International Development. The study, by the Volgograd Health Risk Assessment Working Group, is the first of its kind in Russia and provides a model for similar assessments in other Russian cities.

As the report explains, current Russian environmental regulatory policy focuses on short-term, or "acute," effects of air pollution. This approach addresses short-term spikes in pollution, but ignores the potential health effects from a lifetime of breathing polluted air. As a result, environmental authorities have been unable to take chronic effects into account when determining allowable pollution limits for factories and other stationary sources. As the study shows, however, long-term exposure to carcinogens and particulates in the air may have serious health consequences for Volgograd's inhabitants.

Despite a high degree of uncertainty, the Working Group's estimates are striking: 2,700 deaths each year from particulates, in a city of about one million people

Estimating risks to health

Using estimates of 1995 emissions levels from 29 utilities and factories in Volgograd, the Working Group modeled the concentrations of carcinogens and particulates (soot, dust, and other suspended particles) at locations scattered across the city. At ten sites, annual average particulate concentrations from a single factory alone exceeded 100 micrograms per cubic meter (twice the U.S. standard), with one location receiving more than 1,000 micrograms per cubic meter on average. In contrast, concentrations of particulates in the United States are much lower, with annual averages in the 30-60 micrograms/cubic meter range.

Such high concentrations of airborne particulates carry a considerable health risk. At 1995 levels, particulates may be responsible for as many as 2,700 additional deaths per year, in a population of about 1

million. Carcinogens, meanwhile, posed a substantially lower (but still not negligible) risk, with current emissions levels causing an estimated 13 cancer cases each year.

The authors of the study emphasize that considerable uncertainty surrounds these mortality estimates, which for that reason are best viewed as upper bounds on the true risk. Much of the uncertainty results from the use of data and modeling techniques already existing in Russia -- a choice made to make the study replicable in other Russian cities. Indeed, one of the stated goals of the study was to provide a model for similar assessments elsewhere in Russia. For this reason, the study offers a detailed account of the methods and calculations used to generate the estimates (*see box below*).

The road ahead for Russia's regulators

The risks from cancer-causing chemicals probably do not warrant immediate attention, especially given the budget constraints facing Volgograd. Particulates, on the other hand, appear to be a serious health problem worthy of more stringent regulation. Of course, any new pollution controls should be cost-effective: measures with the lowest marginal costs ought to be chosen first. A full-scale study of control options has not been completed; initial analysis, however, suggests that marginal costs would remain low even if emissions were reduced by a third.

The study's results also reveal a fundamental flaw with existing regulations: *even while operating within legal limits, Volgograd's factories and utilities are emitting dangerous amounts of pollution when considered over the long run*. The report explains that this anomaly results from two problems with the current approach. First, regulators now set limits separately for a number of different pollutants, all of which can be classified as particulates. By treating these different types of particulates independently, the law ignores their serious cumulative effects. As the study points out, "proposed emissions rates for individual substances could thus all satisfy the individual [legal limits], but the summed ambient concentrations representing all particles could be enormous."

Second, as discussed above, environmental policy in Russia addresses short-term air pollution but leaves chronic effects out of the picture. The current study begins to address this gap by offering a framework for incorporating long-term health risks into the existing regulatory framework. Nonetheless, in the years ahead, much work remains. In particular, the study's authors say, regulators need to develop more

accurate models of air emissions and dispersion, and to continue research into the effects of air pollution on human health.

Highlight: The Risk Assessment Process

The Volgograd study provides a primer on the methodology of risk assessment. The risk assessment process used in the study, following EPA guidelines, includes four steps:

(1) *Hazard identification*. Researchers first identify the specific chemicals and sources to be included in the assessment -- focusing on the most toxic substances. In Volgograd, researchers concentrated on carcinogens and particulates. Data used were reported emissions in 1995 from 29 stationary sources, together accounting for over 90 percent of the city's emissions.

(2) *Exposure assessment*. The next step in risk assessment involves analyzing human exposure to the chemicals under study: who is affected; how they come into contact with the chemicals; and what the levels of exposure are. This last step was the most difficult of all for the current study: the goal was to assess chronic exposure, but available data and modeling techniques were designed to produce short-term estimates. Researchers used weighting factors, based on the fraction of time a source was in operation and the "steadiness" of its emissions, to convert estimates of short-term concentrations to annual averages. These annual concentrations were estimated for twenty locations in the city and used to generate estimates of "chronic daily intake" -- how much of a given pollutant a typical person is exposed to each day over their lifetime.

(3) *Dose-response assessment*. The third step links the level of the exposure (the "dose") to the likely health effects (the "response"). For carcinogens, the authors used EPA "slope factors," coefficients relating increases in exposure to the increase in probability of cancer. For particulates, the authors estimated a similar mortality coefficient based on the existing literature.

(4) *Risk characterization*. The final step combines the estimates of daily intake and the dose-response coefficients to estimate health effects. Health effects can be estimated as individual lifetime risk or as annual population risk; the authors here focused on the latter, estimating the expected additional cancers (or, in the case of particulates, deaths) each year due to air pollution.