US controls hig

Volatile organic compounds, or 'air toxics', have been studied by scientists at CSIRO's Division of Coal and Energy Technology for more than 20 years. Traditionally, this research has focussed on the collective role played by air toxics as precursors of photochemical smog formation. But as overseas controls on the emission of particular air toxics tighten, assessing the risks posed by individual compounds is becoming increasingly important. The division is upgrading its air toxics analysing capabilities to meet these needs.

Much of the impetus for assessing and controlling air toxics comes from the United States. In 1986, US manufacturers were given a list of about 330 chemicals and asked what quantities of each they released to air, water, land or transportation. In 1987, the total amount was 2.4 billion pounds, more than 30 times higher than originally expected. In Australia, the Commonwealth Environment Protection Authority plans to carry out a National Pollutant Inventory for similar purposes.

Legislation on the emission standards for air toxics is becoming more stringent. Amendments to the US Clean Air Act (CAA), passed in November 1990, aim to reduce emissions of 189 hazardous substances by some 90% by the year 2000. These air toxics are chemicals, including heavy metals and organic compounds, known or suspected to pose a risk to human health or to the environment. Thus, air toxics are a new class of air pollutants separate from, and in addition, to the 'traditional' criteria pollutants such as ozone, nitrogen oxides, carbon monoxide and sulfur oxides.

To achieve a 90% reduction in emissions by the year 2000, the US Environmental Protection Authority was directed to regulate air toxics from all major sources. Most of these are volatile organic compounds (such as benzene, formaldehyde, chlorinated hydrocarbons, PAHs, PCBs and dioxins) and are associated with chemical and energy use, including transport and industrial activity.

Legislation in Australia generally follows the US lead. The message for Australian regulators, industries and the community is that it is time to face this emerging concern, not only in air, but in water, soil and other media.

One area where we are beginning to confront the problem of toxic organics in air is in the level of benzene and other aromatic compounds in petrol and motor-vehicle exhaust. Because of the demonstrated activity of benzene as a carcinogen, some countries have strict guidelines for ambient air concentrations of this compound. Meeting these guidelines in Australia will probably require changes to refinery practice.

Similar controls on industrial emissions (incineration, recycling and sorbent capture) will present formidable technical problems and require large capital investment. Concerns also exist with respect to the products of combustion of fossil fuels, paint manufacture and use, dry cleaning, incinerators, chlorination of waste waters, pulp mill bleaching, use of chemicals generally and waste disposal in landfills and waterways.

In selecting which specific toxic air pollutants to regulate, emphasis has historically focussed on a contaminant's ability to cause cancer. Over time, better toxicological information is becoming available. This is due in part to the increased knowledge of chronic health effects (for example, those associated with accumulation of toxics in various target organs) and the synergistic effects of exposure to a number of different toxic compounds. Additionally, the focus is turning toward those contaminants which have non-carcinogenic adverse effects (such as birth defects, immune suppression and neurological effects) as well as cancer. The total effect will, however, depend on the cumulative effect of a number of compounds.

Making an accurate assessment of the risks of these compounds, and deciding on appropriate controls, is difficult. Few measurements of the atmospheric concentrations of these species have been made, and this means that development of a policy for their effective management is presently not possible.

It is also important to distinguish between the hazard posed by highly

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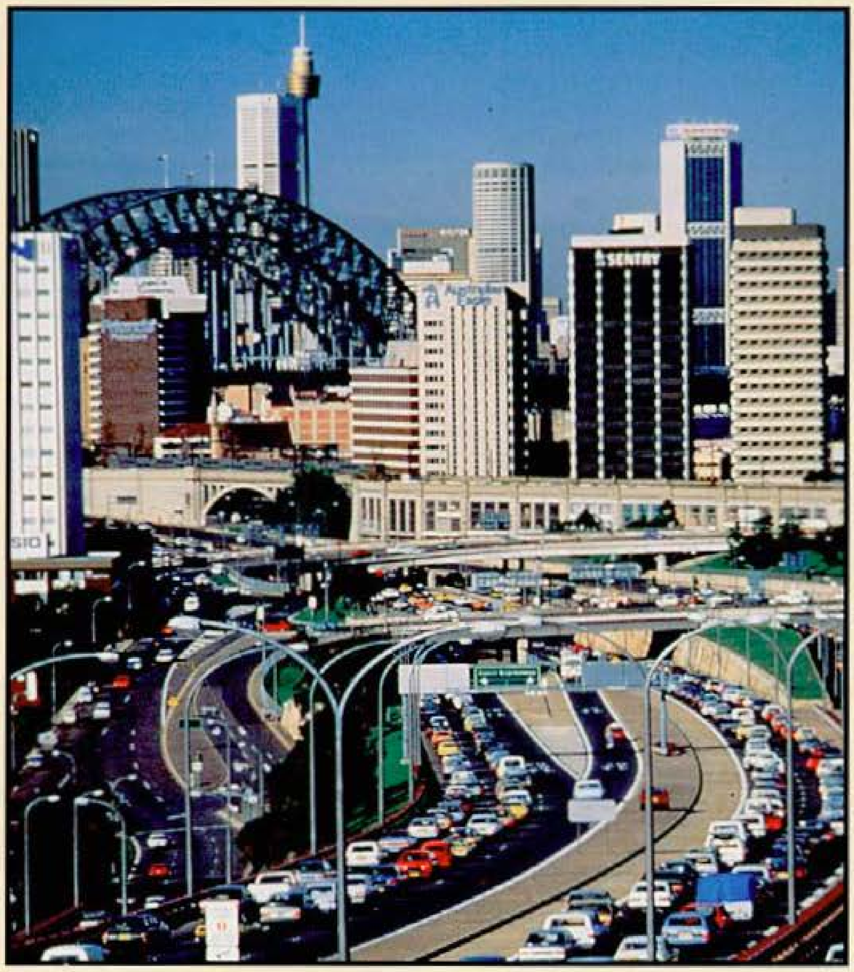

Thirty-six compounds classified as air toxics have been observed in air samples collected at a variety of sites in the Sydney region in the period 1976-1993. To provide further data on average levels of air toxics in Sydney, the Division of Coal and Energy Technology is planning a complete study of the organic fraction of the air.

toxic contaminants (such as dioxins) and the risk posed by the emission of large volumes of less hazardous contaminants (such as ozone and sulfur dioxide). In terms of inherent toxicity and overall quantity emitted to the environment, a few chemicals consistently present concern. These include benzene, 1,3-butadiene, carbon tetrachloride, chloroform, formaldehyde, lead and radon.

The Division of Coal and Energy Technology has sampled and analysed atmospheric organic compounds in the Sydney region for some 20 years. Similar work has been done in Melbourne by the Division of Atmospheric Research. Studies at and around chemical plants, waste incinerators, car parks and landfills, and on motor-vehicle exhaust, have been conducted.

Thirty-six compounds classified as air toxics have been observed in air samples collected at a variety of sites in the Sydney region from 1976-1993. The compounds cover a wide range of aliphatic and aromatic hydrocarbons, chlorinated hydrocarbons and oxygenates. This analysis gives some indication of the extent of the air toxics emissions in the Sydney region, and the complexity of the organic constituents of the atmosphere.

These previous analyses were designed to evaluate hydrocarbon sources as photochemical smog precursors, and not to completely categorise the composition of the air. To provide further data on average levels of air toxics in Sydney, the division is planning a study of the organic fraction of the air.

The analyses also revealed the contribution of large point sources of emission to the total organic concentrations in Sydney's air. As a result, coordinated measurements of organics and other pollutants near large point sources will be conducted.

Characterisation of air toxics emitted from specific sources have also been initiated. Municipal landfills are one source category. There is increasing concern about the composition, production quantities and the potential effects of gases formed in, and released from, landfills and other waste deposits. The concern about landfills as a source of air toxics is such that California, for example, now requires testing to determine the chemical composition of air contaminants above, within and adjacent to waste depot sites.

The nature and production rates of volatile organic compounds depends on local conditions. A comprehensive assessment of the implications of the composition and quantities of trace organic constituents of landfill gas for Australian conditions is therefore needed. The division has funding from the NSW Environmental Research Trusts to study the trace organic composition of landfill gases.

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More about air toxics

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