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Science for Environment Policy

Individual non-methane VOCs have large impacts on human health

Emissions of non-methane volatile organic compounds (NMVOCs) can have damaging effects on human health. New research has now revealed that only three substances out of a large number of NMVOCs are responsible for almost all damaging effects on human health. Air pollution policies should be designed to target these substances specifically, rather than overall NMVOC emissions, the researchers recommend.

NMVOCs, emitted mainly by road transport, as well as paints and solvents, can have a number of damaging impacts on human health. Some have direct toxic effects; benzene and formaldehyde, for example, are known to cause cancer. NMVOCs can also have indirect effects on health by contributing to the formation of ground-level ozone, which causes respiratory and cardiovascular problems.

In Europe, NMVOC emissions are controlled by legislation, including the EU's National Emission Ceilings Directive[1]. EU Member States typically report emissions as a group of substances from each sector and not as individual compounds arising from a particular source. This makes it difficult to estimate the health impacts of specific NMVOC substances.

In this study, funded by the European Commission's Joint Research Centre, the researchers produced national emission inventories of individual NMVOCs for the EU-27, plus Norway, Switzerland, Croatia and Turkey. The inventories were produced using information on individual NMVOC substances for 107 sectors, combined with the total NMVOC emissions for each sector from 2000-2010. The researchers analysed these inventories to assess the life cycle impact of NMVOCs on human health. Human toxicity was assessed using the USEtox model.

The assessment revealed that road transport, residential combustions (e.g. heating), solvent use in the home and electricity generation were the sectors with the highest impact. The researchers were also able to show a significant direct impact on human health from relatively few NMVOCs from the 323 types considered.

Although there are uncertainties in both the inventories and the impact assessment methods, the study singled out formaldehyde and furan, which account for 90% and 7% respectively of the total NMVOC contribution to cancer effects, and acrolein, which is responsible for 89% of the total NMVOC contribution to non-cancer related health effects, such as respiratory and cardiovascular problems.

Formaldehyde only accounted for 6% of the total NMVOC emissions and acrolein and furan contributed to less than 0.2% of the total NMVOCs emitted across the 31 countries in 2010. This indicates that relatively small emissions of these substances cause significant damage to health. It also suggests that total NMVOC emissions reported for each sector may not be indicative of their actual impacts.

The study also found that, although total NMVOC emissions declined in most of the countries during 2000-2010, cancer-related effects increased in some. For example, in Italy between 2005 and 2010, the total NMVOC emissions decreased by 18% while cancer-related effects increased by 40%. This suggests that emissions of carcinogenic NMVOCs, such as formaldehyde, have not been reduced to sufficiently low levels.

In addition to reducing total NMVOC emissions, air pollution policies should also target individual NMVOC substances that have been shown to cause the most damage to human health, the study recommends. The researchers suggest using quantitative impact assessments to identify these substances, as well as the most polluting sectors.

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1. The National Emission Ceilings Directive (2001/81/EC) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32001L0081:EN:NOT