COMMITTEE ON THE MEDICAL EFFECTS OF AIR POLLUTANTS

Working paper for COMEAP 'Statement on airborne nano- and microplastic particles and fibres'

Interim assessment for the Synthesis and Integration of Epidemiological and Toxicological Evidence (SETE) for the population health effects from the inhalation of traffic-related air pollution (TRAP).

Approach

1. This paper presents an assessment of the strength of evidence for health risks in humans due to inhalation exposure to current environmental levels of traffic-related air pollution (TRAP). The assessment has used the COT/COC framework for the Synthesis and Integration of Epidemiological and Toxicological Evidence (SETE), and was undertaken to provide context for the SETE assessment of the health effects from inhalation exposure to current environmental levels of nano-microplastics (NMPs). Unlike NMPs, there is ample evidence available on the risk from exposure to TRAP.

2. This SETE assessment draws on a number of previous COMEAP papers: the 'Statement on the differential toxicity of particulate matter according to source or constituents: 2022'[1]; 'The evidence for health effects associated with exposure to non-exhaust particulate matter from road transport'[2]; and the 'Statement on the evidence for the effects of nitrogen dioxide on health'[3]. Full details of the evidence used in this assessment can be found in these reports.

3. The SETE framework is described in a report by the Joint COT and COC Synthesis and Integration of Epidemiological and Toxicological Evidence subgroup (SETE), which reviewed approaches for synthesising and integrating epidemiological

[1] Statement on the differential toxicity of particulate matter according to source or constituents: 2022
[2] COMEAP statement on the evidence for health effects associated with exposure to non-exhaust particulate matter from road transport
[3] Statement on the evidence for the effects of nitrogen dioxide on health

and toxicological evidence[4]. COMEAP discussed the application of this framework to its work at the May and November 2022 COMEAP meetings, details of which can be found in the meeting minutes[5]. Discussion points included that it may be more difficult to apply the approach to a complex mixture, such as particulate air pollution, than to a well-defined chemical entity. Additionally, COMEAP's approach to integrating epidemiological and toxicological evidence may be different from that used in other chemical risk assessment settings: it was suggested that COMEAP interpreted the axis "epidemiological evidence for causation" as the strength of epidemiological evidence for a risk to health and the axis "experimental evidence for causation" as the strength of experimental evidence for a risk to health. Following discussion at the COMEAP meeting held in March 2025, the labelling of the axes has been amended to make it clear that the evaluation is of a risk to health from current environmental exposures.

4. The SETE approach requires that the integration of evidence, and visualisation, reflect the considered views of all of those evaluating the evidence, as discussed at each stage of the review process. This SETE assessment has been developed following an evaluation of the evidence (as described in paragraph 2 above). The epidemiological and mechanistic evidence reviewed is not comprehensive and, therefore, the assessment of health risk should be considered provisional.

5. The diagram shown provides a means of visually indicating the consensus view of the Committee on the overall strength of the epidemiological and experimental (mechanistic) evidence that the inhalation of current levels of environmental TRAP poses a risk to human health. The diagram is not intended to reflect a probabilistic or numerical approach but, rather, it provides a representation of how the different lines of evidence assessed influence the overall conclusions on risk.

Lines of evidence

6. It is not practical or feasible to measure all of the components of the traffic pollutant mix, therefore, surrogates of traffic-related pollution have been used for assessing the contribution of traffic emissions to ambient air pollution and for estimating traffic exposure. The most commonly used traffic-pollutant surrogates include CO, NO_2, elemental carbon (EC) (or black carbon (BC), or black smoke [BS]), particulate matter (PM), benzene, and ultrafine particles (UFP). However, none of these pollutants is unique to emissions from motor vehicles.

[4] SETE | Committee on Toxicity (food.gov.uk)
[5] Minutes of COMEAP meetings are available at: Committee on the Medical Effects of Air Pollutants.

7. The BC/EC-content of particulate matter has been the subject of extensive research and is often used as an indicator of PM from combustion, for example, from traffic exhaust (or in some countries from coal burning).

8. Specific sources of PM such as diesel exhaust are rich in ultrafine particles. For example, in controlled conditions, more than 85% of the particle numbers in diesel exhaust were ultrafine. Sources such as those from vehicle exhaust, may contain a number of harmful constituents (for example organic carbon compounds, constituents with high oxidative capacity) that could increase their potential toxicity. UFPs also have a greater surface area per unit mass, which some studies have suggested as important in driving toxicity, alongside UFP surface reactivity and number.

Table 1: Summary of the strengths and weaknesses of the data examined for health effects from the inhalation of traffic-related air pollution (TRAP) and the influence of the lines of evidence on the overall conclusion.

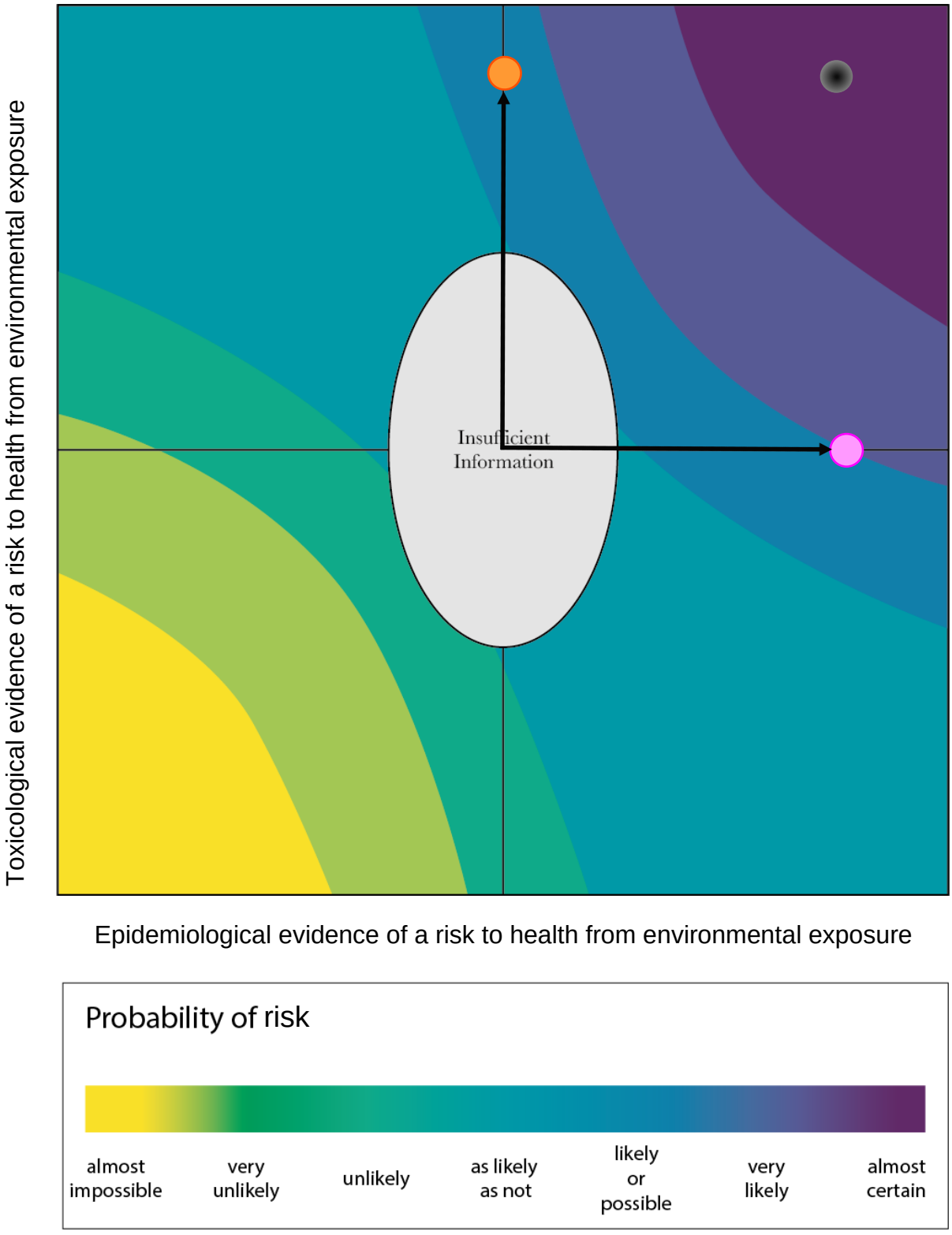
Lines of evidence and their main strengths (S) and weaknesses (W)	**Influence on Conclusion**
<u>Epidemiological data</u> S – There is evidence linking traffic pollutants to adverse health parameters or outcomes. The highest levels of evidence in humans are for short-term exposure to traffic-related BC (mortality, respiratory and cardiovascular) and road dust (respiratory). S – There is evidence to support an association between exposure to TRAP and respiratory disease. For example, there are a number of studies that show a consistent positive association with exacerbation of childhood asthma. There is some evidence to suggest an association between exposure to TRAP and onset of childhood asthma, non-asthma respiratory symptoms, and impaired lung function. S – There is consistent evidence for short-term exposure to NO_2 having direct effects on respiratory morbidity. In addition, there is some suggestive evidence of a positive (adverse) association between short-term exposure to NO_2 and hospital admissions for cardiovascular disease and all-cause mortality. These associations have been shown to be robust to adjustments for other pollutants.	There is strong evidence linking TRAP to adverse health effects, particularly short-term exposure to black carbon (BC) and road dust affecting respiratory and cardiovascular health. TRAP is consistently associated with childhood asthma exacerbation and may contribute to its onset, non-asthma symptoms, and reduced lung function. The evidence is more limited linking TRAP to cardiovascular issues like heart rate variability and atherosclerosis. There is consistent, strong evidence of an association of both short and long-term exposure to NO_2 and a range of health effects. Research on non-exhaust particles and health effects remains sparse and inconclusive.

S – Studies of long-term exposure to NO_2 have reported associations with all-cause respiratory and cardiovascular mortality, children's respiratory symptoms and lung function. S/W – There is some but limited evidence that there is an association between exposure to TRAP and cardiovascular morbidity, for example, heart rate variability and atherosclerosis. W – A number of epidemiological studies have sought to measure associations between non-exhaust particle concentrations from road transport and adverse health outcomes. Taken as a whole, the current body of published work is small and does not provide a coherent and convincing narrative of adverse health effects of exposure to non-exhaust particles.	
<u>Mechanistic data</u> S/W - A modest amount of evidence exists from animal studies, confirming the capacity of vehicle exhaust to have detrimental biological effects. S/W - It has already been established that diesel exhaust can induce lung inflammation and adverse effects on the cardiovascular system in human controlled exposure studies. However, this approach has not been used to ascertain the biological effects of lower exposure regimes or directly compare different sources, constituents or sizes of PM. S – There is some evidence from experimental studies of adults and animals for airway hyperresponsiveness associated with long-term exposure to NO_2 and an allergic response from repeated long-term and short-term exposure. W – There is a general paucity of toxicological studies considering the potential health effects of the non-exhaust PM from road transport.	Evidence from human exposure studies have established that exposure to diesel exhaust can cause adverse respiratory and cardiovascular effects. Evidence from animal and cellular studies show that vehicle exhaust PM can cause inflammation and oxidative stress. There is experimental evidence for biological plausibility between NO_2 expsure and respiratory effects, particlualrly asthma exacerbaton. There is limited data on low exposure regimes and non-exhaust PM.
<u>Conclusions on risk to health</u>	Many aspects of the epidemiological and toxicological evidence relating adverse human health effects to exposure to primary traffic-generated air pollution remain incomplete.

	Nonetheless, evidence from epidemiological and toxicological studies gives a high level of confidence that exposure to TRAP as a whole leads to adverse health effects. The highest levels of evidence of an adverse effect in humans are obtained for road traffic BC (respiratory health, cardiovascular health, which is less convincing, and all-cause mortality); and road dust (respiratory health). This is consistent with evidence for individual components, such as, black carbon, inorganic carbon and some metals. There is extensive evidence of the harmful effects of diesel engine exhaust, diesel PM and gasoline engine exhaust. There is also sufficient evidence of exposure to NO_2 resulting in respiratory effects, particularly exacerbation of asthma.

9. The diagram is a visual representation of the consensus view of the Committee on the overall strength of the epidemiological and experimental (mechanistic) evidence that inhalation of current levels of environmental TRAP poses a risk to human health. The axes do not portray probabilistic or numerical estimates but, rather, reflect the views of the Committee on how the different lines of evidence assessed influence the overall conclusion on risk.

Figure 1: Interim assessment and visualisation of the risk to health from inhalation exposure to environmental levels of TRAP.



The pink circle is representative of all epidemiological evidence assessed; the orange circle of all toxicological evidence assessed. The black circle represents the conclusion of the risk to health of the integrated evidence.