Diesel vehicles and health damage due to air pollution in Colombo

In the municipality of Colombo and adjacent highly urbanized areas with the population of 820,000, the annual average level of exposure to PM10, comprising particles of less than 10 microns in diameter, is reported to be 40-50 $\mu g/m^3$. Such exposure will cause approximately 150 excess deaths each year relative to a target exposure of 20 $\mu g/m^3$ which reflects the goals of air quality management in the U.S. and the European Union. In addition, the annual burden of disease will include 700 to 1000 new cases of chronic bronchitis, and nearly 3 million episodes of respiratory symptoms. The social cost of this health damage will be about US$30 million per year.

Using the limited information that is available, we estimate that emissions from diesel-powered vehicles account for annual average exposure to PM10 of 25-30 $\mu g/m^3$. About 70% of this is due to primary emissions of PM10, while the remaining 30% is due to the secondary formation of sulfates and, to a lesser extent, nitrates as a result of SO_2 and NO_2 emissions. Recent epidemiological evidence strongly suggests that exposure to PM10 is responsible for almost all of the health damage caused by air pollution in urban areas.

These estimates are based on the current average sulfur content in motor diesel of 0.7%. Table 1 shows the results of the same calculations if the average sulfur content of motor diesel were reduced without implementing other measures to reduce vehicle emissions.

Table 1 -- Impact of sulfur content of diesel on exposure levels and health damages/benefits in Colombo

Sulfur content in motor diesel (wt%)	Exposure to PM10 from diesel vehicles	Health damage, US $ million/year	Incremental benefits, US $ million/year
0.7 (current)	29	27.4	
0.5	28	26.3	1.1
0.3	26	24.3	2.0
0.05	23	21.4	2.9

The reductions in the social cost of health damage are modest because the influence of the level of sulfur in diesel on average exposure to PM10 is quite limited unless vehicle maintenance and operation are improved. The main link between the sulfur content of diesel and exposure to PM10 operates via levels of SO_2 and the formation of secondary sulfate particles.

In contrast, better maintenance of diesel vehicles would lead to a much larger reduction in PM10 emissions and, thus, in average exposure. Table 2 illustrates the benefits of a vehicle maintenance program which reduced direct emissions of PM10 from diesel vehicles by 50% on average. Note that PM10 emissions for well-maintained diesel vehicles may be no more than 5-10% of the emissions from poorly maintained vehicles.

Table 2 -- Health benefits of improved maintenance of diesel vehicles

Vehicle maintenance/ Sulfur content scenarios	Exposure to PM10 from diesel vehicles	Health damage, US $ million/year	Incremental benefits, US $ million/year
Current situation (low maintenance, 0.7% S)	29	27.4	
Improved maintenance, 0.7% S	14	13.0	14.4
Improved maintenance, 0.5% S	11	10.5	2.5
Improved maintenance, 0.3% S	8	7.9	2.6