

# HEALTH EFFECTS OF PM IN DENMARK

## - DO PARTICLE FILTERS ON HEAVY-DUTY VEHICLES SOLVE THE PROBLEM ?

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### Aims

- 1) To quantify the health effects related to particulate air pollution in Denmark, and
- 2) To estimate the health gains from supplying particle filters to all heavy-duty vehicles (>3.5 tons) in Denmark.

### Methods

We used methods similar to those of Künzli et al. (1): Relative risk estimates in relation to PM<sub>10</sub> were estimated from the epidemiological literature. Population exposure to PM<sub>10</sub> was calculated. Cases attributable to man-made PM<sub>10</sub> was calculated for mortality, hospital admissions, chronic and acute bronchitis, restricted activity days and asthma attacks.

Health gains of equipping all Danish heavy-duty vehicles with particle filters were estimated under different assumptions:

- 1) Health effects of particles depend entirely on their number concentration, and
- 2) Health effects of particles, also ultra fine particles (UFP), depend entirely on their mass concentration (PM<sub>10</sub>).



Two examples of the many commercially available particle filters: Johnson Matthey CRT (left) and Engelhard DPX (right). In general, these filters are all claimed to be more than 80 % effective under field conditions. See for example [www.dieselnet.com](http://www.dieselnet.com) for further information.

### Results

In 2000, the average exposure of the 5 million Danes to PM<sub>10</sub> was estimated to 22.26 µg/m<sup>3</sup>. Particle filters would reduce this PM<sub>10</sub> exposure only marginally, namely to 22.17 µg/m<sup>3</sup>.

In contrast, particle filters on all heavy-duty vehicles in Denmark would reduce population exposure to UFP by about 20%.

Health gains (per year) for three scenarios of reduced PM concentrations in Denmark. Data first published in (2).

Health effect	Age group (y)	No man-made PM (PM <sub>10</sub> = 7.5µg/m <sup>3</sup> )	Particle filters on all heavy-duty vehicles in Denmark	
			Assumption 1: Health effects depend on particle number (~UFP)	Assumption 2: Health effects depend on particle mass (~PM <sub>10</sub> )
Total mortality	≥30	3,400	1,000	22
Cardiovascular hospital admission	All	2,200	650	14
Respiratory hospital admission	All	1,500	450	10
Chronic bronchitis incidence	≥25	3,300	1,000	22
Acute bronchitis	≤15	11,600	3,500	76
Restricted activity days	≥20	1,800,000	550,000	12,000
Asthma attacks	≥15	141,000	40,000	920
Asthma attacks	<15	18,700	5,500	120

### Conclusion

Large numbers of health effects can be related to atmospheric PM. Particle filters on all heavy-duty vehicles in Denmark are expected to reduce these numbers substantially (app. 20%) if the health effects depend entirely on the number concentration, but only marginally (app. 0.5%) if the effects depend entirely on the mass concentration (PM<sub>10</sub>). The truth probably lies somewhere between these two extreme assumptions.

### Policy

The health effects of particulate air pollution has been discussed intensely in Denmark during the last years, and the Government has acknowledged the problem.

Policy-making has focused on 1) enforced use of particle filters on all heavy duty vehicles in Denmark and 2) environmental zones in densely populated parts of larger Danish cities.

Although the government wishes to reduce particle pollution, Danish legislation enforcing the use of particle filters on heavy-duty vehicles seems clash with that of the European Union. On the other hand, the government is keen to promote environmental zones in larger Danish cities with exclusive access to heavy-duty vehicles equipped with particle filters.

The municipality of Copenhagen has already taken up the challenge and aims to establish an environmental zone in the central part of Copenhagen by the autumn of 2004.

### References

1. Künzli N et al. Public health impact of outdoor and traffic-related air pollution: a European assessment. Lancet 2000; 556(9232):795-801.
2. Raaschou-Nielsen O, et al. Health effects of ambient particulate matter – a quantitative assessment (in Danish, English summary). Ugeskr Laeger 2002; 164:3959-63.