

What's behind a fall in the impact of diesel engine exhaust emissions on worker health?

The impact of increasingly stringent engine emission restrictions will continue to outstrip that of new occupational health rules for diesel engine exhaust emissions (DEEE), says Hans Marquart of Triskelion Bv.

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'Work involving diesel engine exhaust emissions' was officially added to Annex I of the EU carcinogens and mutagens directive (CMD) at the start of 2019. The annex lists process-generated carcinogen exposures. At the same time an occupational exposure limit value was set at 0.05mg elemental carbon/m³ in Annex III of the CMD.

In order to assess the likely significance of these measures, it makes sense to look at the development of exposure levels in the past and what is expected in the future. An impact study in 2016 on behalf of DG Employment produced results which provide this information.

Diesel engine exhaust emissions (DEEE) include a complex and variable mixture of gases (carbon monoxide, nitrogen oxides) as well as particulates (elemental and organic carbon). The exact composition depends on the specific fuel and fuel efficiency of the engines under consideration. Exposure is often expressed in units of elemental carbon.

Based on a large number of epidemiological studies, it is generally agreed that DEEE is carcinogenic to humans. Exposure occurs in many workplaces and jobs including mining, rail transport, road construction, dock and warehouse work, maintenance and garage work.

Carcinogenic impact

Specific information on cancer incidence due to DEEE is currently unavailable. Instead, carcinogenic impact has to be estimated based on exposure levels, exposure-response-relations and the number of workers exposed at these levels. With this information the number of additional cancer cases in a population can be estimated.

Data from a variety of sources were used to estimate the number of workers in exposed groups, while literature data was used to analyse actual exposure levels and trends. All sources present only a partial view on some aspects and multiple extrapolations are necessary leading to substantial uncertainty. Hence the impact study worked with a range of low to high estimates of expected new cancer cases.

Data on exposure to DEEE for the baseline year 2015 is patchy. Levels were therefore derived from the development of exposure in the decades prior to 2015. Clear downward trends were visible for train drivers, tunnel construction workers and garage and railcar maintenance workers. For road construction workers there was insufficient information to analyse a trend. No clear trend could be seen for dock and warehouse workers – nor professional road drivers.

Exposure in most occupations depends on the number of emissions per engine and the number of these in use. Emission restrictions for new diesel engines have become increasingly stringent resulting in a large decrease in emissions per new engine. However, the overall decrease in exposure does not exactly follow the emission restrictions. New engines may have lower emissions, but older engines remain in use for a long time. Also, there may be an increase in use of diesel engines that partly counteracts the reduction in emission per engine.

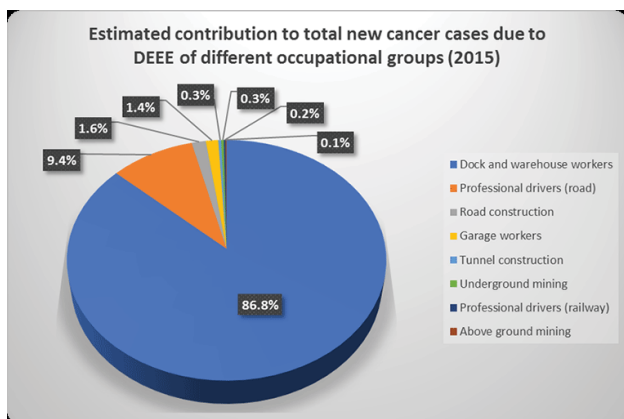
Old for new

However, it is clear that the replacement of old diesel engines with new diesel (or non-diesel) engines will have a substantial effect on future DEEE exposure levels. Due to this, exposures below 1µg elemental carbon/m3, a level considered to have very low risk, are expected for most exposed groups in 2036 and for all groups in 2056.

Most of the expected reduction in worker exposure is from factors independent of occupational health rules. For example, when compared with 2015, there is an expected reduction in exposure levels for professional road drivers in 2036 of approximately 98.3% without, and approximately 99.4% with, additional occupational health rules.

Uncertainty over input values, and the effect of new rules, makes it extremely difficult to estimate the number of cancer cases due to DEEE. In the impact study the ranges in the estimates were therefore very wide. The baseline estimate for working life exposure, at 2015 exposure levels, ranged from 38,000 to 3.9m additional cancer cases in Europe.

Dock and warehouse workers are responsible for the most cases (> 80%) due to their high exposure levels and number of workers. These workers often used diesel forklifts with older engines. The next major group (around 9%) are professional road drivers. While they have relatively low exposure, their number is very large, so even a small fraction affected results in a large total number. Other



Graphic - DEEE cancer impact

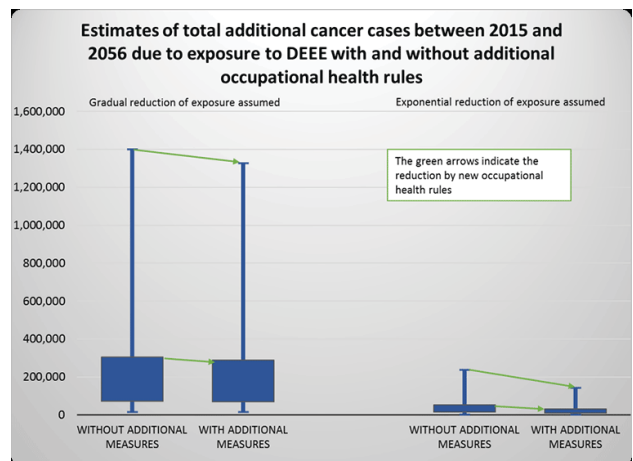
groups are relatively small, therefore their contribution to the total number of cancer cases likewise compared with their exposure level.

The number of new cancer cases due to working life exposure to DEEE at expected 2036 exposure levels, and without additional occupational health rules, ranged from around 600 to around 32,000. For 2056 exposure levels, this ranged between 300 and 11,000. Most groups would have exposure levels well below 1µg/m3 and therefore very low risk.

Stringent emission criteria

As indicated, the expected reduction of exposures is largely because of more stringent emission criteria for new diesel engines. The assumed additional effects of adding DEEE exposures to Annex I of the CMD are a higher rate of replacement of older diesel vehicles and the improvement of general ventilation in underground mining, tunnel construction, and dock, warehouse and garage work. Local exhaust ventilation can contribute to further reductions in garages and workshops.

Depending on assumptions and whether exposure reduction was assumed to be gradual or exponential, the estimated total number of new cancer cases due to DEEE between 2015 and 2056 – without new occupational health rules – varies from around 3,000 to 1.4m. New occupational health rules are estimated to lower these values by between 700 and 95,000 cases.



Graphic - DEEE cancer additional

And what about the new occupational exposure limit of 50µg elemental carbon/m3? The analysis of available exposure data shows that, already in 2015, most of the exposed groups were at below that new limit value. The exceptions are tunnel construction and dock and warehouse workers. However, exposure levels in tunnel construction have been decreasing very rapidly in recent

decades, and are expected to be very soon below the new limit.

For dock and warehouse workers, no trend was seen in the data from 1990 to 2006, but even for this group the emission rules on new engines will lead to a decline; old machines will be replaced and many companies now use electrical forklifts. The new limit is therefore expected to have limited impact on the incidences of cancer cases in the future. Of course, this does not mean that the limit has no value. It provides authorities and inspectors with additional means

to require changes from unwilling companies. And while a few cases in 2056 represent just a very small fraction of all estimated cases at 2015 exposure levels, every avoidable case is one too many.

The views expressed in this article are those of the expert author and are not necessarily shared by Chemical Watch.

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