City of Rotterdam

Acoustic benefits form urban freight traffic electrification

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Traffic noise from freight vehicles

Zero Emission of air pollutants at the local level is often the main positive aspect considered when the case for electrification of urban freight traffic is made. The additional advantage of less noise production is often mentioned, but seldom quantified. This article presents a tentative quantification of the acoustic benefits. The analysis strongly suggests that the effect is significant. This enhances the case for urban freight traffic electrification as a means to promote urban public health and liveability of city centres.

Traffic noise production depends on many factors. An important one is the noise produced by the engine, which is virtually absent in electric freight vehicles. This is the dominant factor at low speeds. As speed increases, the relative contribution of engine noise decreases. However, at 50 km/h it still contributes approximately 4 dB to the sound level produced by a passing freight vehicle [lit. 1,2. The contribution to the total sound level produced by freight traffic depends on the ratio between passenger cars and freight vehicles. In the city centre of Rotterdam, freight vehicles account for between 10 and 20% of all traffic. This gives rise to the assumption that electrification of freight traffic may significantly contribute to traffic noise reduction. To investigate this, a spatial analysis has been made for a part of the inner city of Rotterdam, as part of Rotterdam's involvement in the FREVUE project (www.frevue.eu).

Desciption of analysis

The network of roads with a 50 km/h speed limit is shown in figure I. The total length of analysed roads comprises 18 km approximately. The traffic situation for these roads (composition and intensity) for an average working day in 2015 has been derived from the calibrated traffic simulation model in use by the city.

Figure I Road network for the analysis

With these data, the acoustic effect of electrification of freight traffic has been determined. One analysis has been carried out for the situation where all traffic passes at a constant speed of 50 km/h, and another for intersections with traffic lights. In order to indicatively determine the effect in terms of urban health and living

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conditions, an inventory has been made of the houses (dwellings) and other buildings along these roads in which noise sensitive activity is located (health care institutions and educational buildings). The total number in the analysed area amounts to 6485 dwellings (15438 inhabitants) and 165 other noise sensitive buildings. For each of these buildings, situated within a zone of 40 m from the nearest traffic lane axis, the noise reduction level has been determined.

Results

Figure II shows a map of noise reduction levels brought about by electrification of freight traffic for the case of traffic passing at a constant speed of 50 km/h.

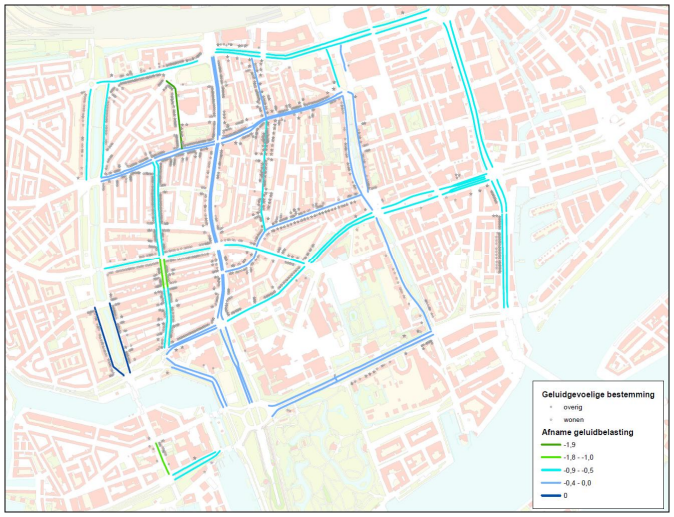

Figure II Noise reduction levels along 50 km/h roads

A total of 2770 dwellings (6371 inhabitants) would benefit from a noise reduction of 0,5 to 1 dB. This is also the case for 35 buildings which house noise sensitive activities. For 317 houses (729 inhabitants) and 11 buildings the reduction level would be 1 to 2 dB.

At intersections, vehicles have to accelerate. Freight vehicles are heavier than passenger cars and hence require more energy to accelerate them. As mentioned, the noise of the engine is the dominant part of the sound production at low speeds. A separate analysis for intersections with traffic lights is justified because the engine has to work harder to accelerate the vehicle from standstill to 50 km/h than to maintain this speed. The results of this analysis are shown in figure III.

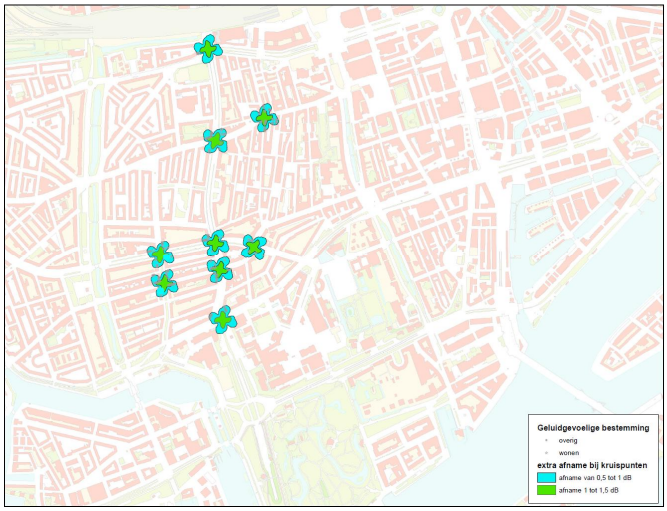

Figure III Additional noise reduction levels at and around intersections

For the 9 intersections with traffic lights of urban roads under scrutiny, an additional reduction of 1 to 2 dB in noise level would result. 399 dwellings (918 inhabitants) would benefit from an additional noise reduction of 0,5 to 1 dB. For 80 dwellings (194 inhabitants) within the intersection's sphere of influence the additional noise level reduction would be 1 to 1,5 dB.

Conclusion

Before extrapolating the results to city level, it should be noted that the computed effect depends on the layout of the intersection and the traffic flows. Nevertheless, the results strongly suggest that cities should seriously consider the acoustic benefit of freight traffic electrification as an additional element in their noise reduction programs. Conversely, a city with traffic noise hindrance might exploit this situation to give an additional boost to its freight traffic electrification ambitions.

Literature:

[1] (*In Dutch*) E. de Graaf, F.J. Blokland, 'Akoestische kansen en bedreigingen elektrische voertuigen', Geluidnieuws nr .2; Juli 2011. Based on [2]

[2] D.F. de Graaff, G.J. van Blokland; 'Noise emission of passenger cars and vans during urban driving, Vehicle driving conditions, Source distribution and Emission values'; M+P report MVM.00.9.1; 2003

[3] (*In Dutch*) H.J.A. van Leeuwen, 'Milieufacetten van binnenstedelijk wegverkeer: de motor uit en rustig doorrijden', bijdrage verkeerskundige congres (B29); 2010.