FAIRMODE CT5

20211008, TM

Joint Research Centre

How to implement a low emission zone, to reduce NO2 and BC

- Document prepared and reviewed:

Key Challenge: Low Emission Zone
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Introduction

Motivation and general description of the approach
LEZ as an Option
Emissions
Concentrations
Exposure / Impacts

Annex 1: Evaluation of the Antwerp LEZ (*Lieslotte Wackenier, VMM*)

Annex 2: What are the Impacts on Air Quality of Low Emission Zones in Denmark?
(*Steen Solvang Jensen, Matthias Ketzel, Jacob Klenø Nøjgaard, Thomas Becker, AU)*

Motivation and general description of the approach

- Address the local contribution
  - Large local increment for BC and NO_2 20..60%
    for PM2.5 limited to 5..10%
- Traffic as most important source is addressed by LEZ
- Wide variety of LEZ are already implement

Parameters influencing the design of an LEZ

- **Type of vehicles** allowed in the LEZ. This can be based on fuel type, engine technology and car type.
- **Timing** of the implementation. This is important because it determines which share of the fleet is affected in practise.
- **Geographical extent** and size of the zone. This is important to avoid rebound effects and to have a zone of sufficient efficiency.
- **Dynamic (progressive) regulation**. This determines whether the effect of the LEZ is sustainable over time or only a leap or kink in the long-term concentration trends.
- **Method of enforcement**

LEZ as option

- Exemptions allowed to enter the LEZ: how many non-compliant cars are still entering the LEZ?
- Impact on traffic volumes: is the LEZ resulting in a reduction of vehicle kilometres in the city centre, is it driving a modal shift?
- New car fleet composition: how are the banned vehicle types replaced? By new cars, second-hand cars?
- What happens outside the LEZ: are the old cars polluting in other areas? Is there a spill-over effect in the surroundings of the LEZ and how large is this effect?

Emissions

- COPERT or HBEFA
- Taking traffic flow, speed, composition into account

Table 1: the Flemish access criteria within a low-emission zone for passenger cars and light vans

Passenger cars and light vans		**phase 1** until 1/1/2020	**phase 2** 1/1/2020-31/12/2024	**phase 3** 1/1/2025-31/8/2027	**phase 4** 1/9/2027-31/12/2027	**phase 5** from 1/1/2028
Diesel	Admitted	Euro 4 and higher	Euro 5 and higher	Euro 6, 6dt and 6d	Euro 6d	Euro 6d
	Prohibited	Euro 0- 3°	Euro 0- 4	Euro 0-5	Euro 0-6 and euro 6dt	Euro 0-6 and euro 6dt
Petrol/Gas	Admitted	Euro 1 and higher	Euro 2 and higher	Euro 3 and higher	Euro 3 and higher	Euro 4 and higher
	Prohibited	Euro 0	Euro 0 - 1	Euro 0 – 2	Euro 0 – 2	Euro 0 – 3

° Euro 3 diesel cars with a (retrofit) particulate filter were also allowed until 31/12/2019.

Concentrations

	Averaged impact in Copenhagen (2010)	Max impact in Antwerp (2019)
$PM_{2.5}$	0.2 µg/m³ → 1 – 1.5%	
BC		0.15 µg/m³ → 8%
NO_2	2 µg/m³ → 5%	1.7 µg/m³ → 3%

Concentrations - DK

Table 1. Comparison of air quality measurements and emission calculations (not including the effect of the low emission zones)

Parameter	Measurements		Emission calculations						
	Street concentration	Street contribution	Total	Passenger car	Taxi	Van	Truck <32t	Truck >32t	Bus
NO_X		-8%	-12%	-11%	-29%	-5%	-14%	-16%	-13%
CO		-9%	-22%	-23%	-2%	-19%	-21%	-35%	-21%
Benzene	-10%	-20%	-24%	-24%	-10%	-24%	-24%	-37%	-23%
N (10-700 nm)	-17%								
$PM_{2.5}$ exhaust			-19%	2%	-91%	-14%	-26%	-31%	-24%
$PM_{2.5}$ total		-23%	-11%						
EC	-13%	-16%							
PAH	-21%								

Exposure / Impact

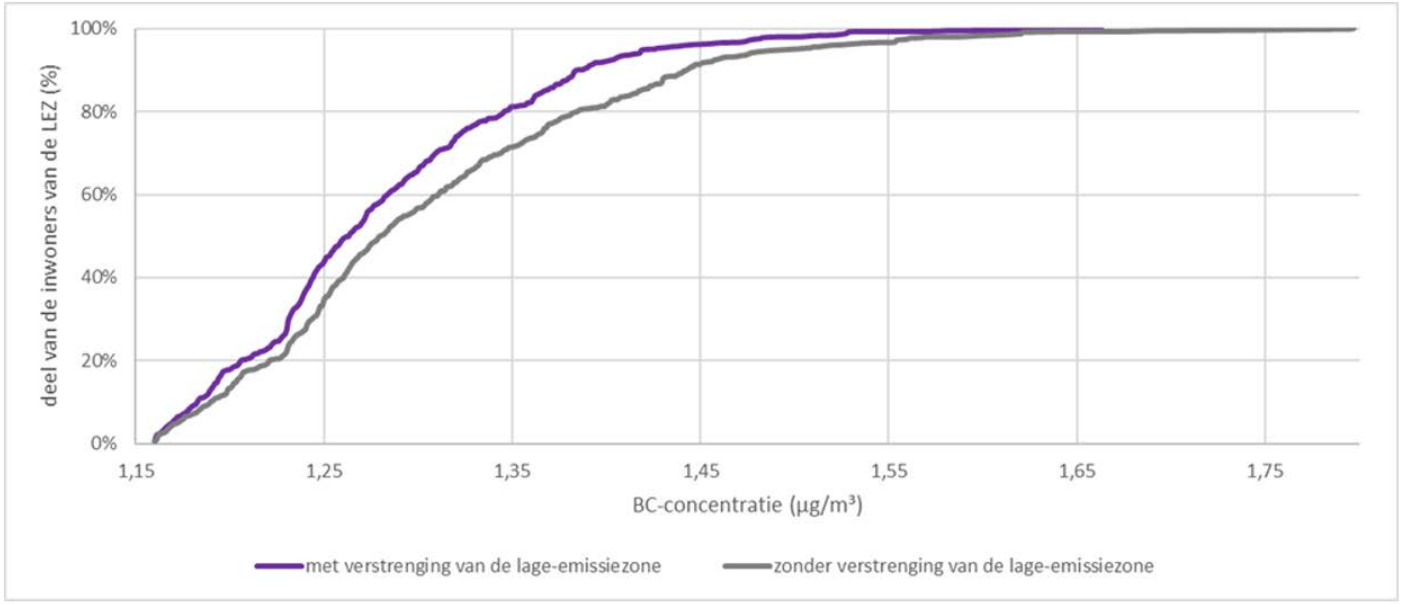

Figure 4: Exposure curve for soot with and without the tightening of the LEZ access criteria

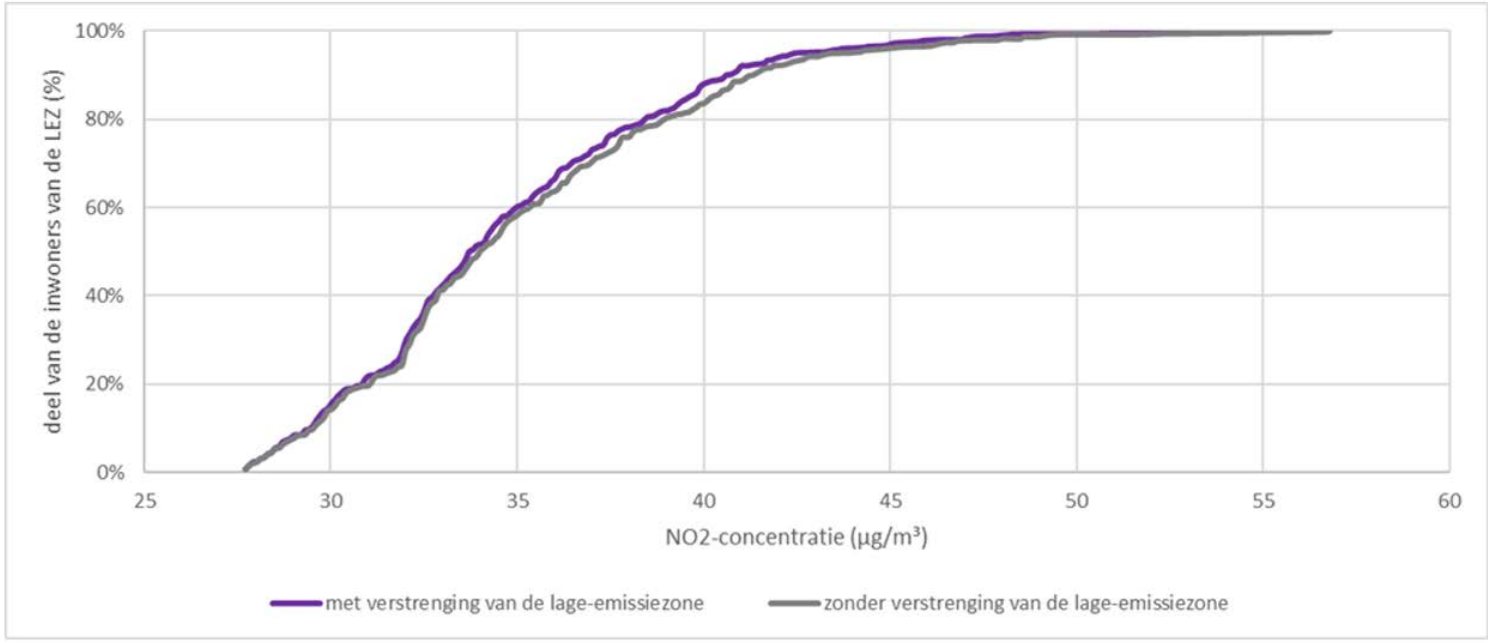

Figure 5: Exposure curve for nitrogen dioxide with and without the tightening of the LEZ access criteria