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# Scenarios for proposed updated Low Emission Zone in Denmark - impacts to emissions and air quality in Copenhagen

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## Introduction

A number of European countries have implemented Low Emission Zones as a policy measure to reduce emissions from road transport, to improve air quality and to reduce the health burden of air pollution in cities ([www.urbanaccessregulations.eu](http://www.urbanaccessregulations.eu)). A Low Emission Zone (LEZ) is a limited geographic area with special emission requirements typically based on banning vehicles with older Euro emission standards. LEZs are typical urban areas characterized by a combination of relatively high density of emissions and population.

In Denmark, LEZs were implemented in the four largest cities in a two-stage process in 2008 and 2010. Trucks and buses have to comply with at least the Euro IV emission standard or have to be retrofitted with a diesel particle filter (DPF). Due to the renewal of the car fleet almost all heavy-duty vehicles comply to the requirements and hence the present LEZ has no or marginal remaining impact on emissions.

The Ministry of Environment and Food of Denmark conducted a study during first half of 2018 on different scenarios for updating the LEZs in Denmark. Aarhus University carried out the study (Jensen et al., 2018). The ministry defined five scenarios as shown in Figure 1. The scenarios are different concerning the vehicle types they include and the Euro emission classes required to enter the LEZ.

In October 2018, the Danish government proposed updated LEZ to be implemented in stages leading to requirements for Euro 6 for vans in 2025 and Euro VI for trucks and buses in 2022. These requirements are very close to scenario E, and hence impacts are comparable.

Fuel	Vehicle type	Euro class	Sc. A	Sc. B	Sc. C	Sc. D	Sc. E
			2022	2022	2022	2022	2022
Diesel	Passenger car	Euro <=4	Red	Red	Green	Green	Green
Diesel	Passenger car	Euro 5	Green	Red	Green	Green	Green
Diesel	Passenger car	Euro 6	Green	Green	Green	Green	Green
Petrol	Passenger car	Euro <=6	Green	Green	Green	Green	Green
Diesel	Van	Euro <=3	Red	Red	Green	Red	Red
Diesel	Van	Euro 4	Red	Red	Green	Red	Red
Diesel	Van	Euro 5	Green	Red	Green	Green	Red
Diesel	Van	Euro 6	Green	Green	Green	Green	Green
Petrol	Van	Euro <=6	Green	Green	Green	Green	Green
Diesel	Truck and bus	Euro <=IV	Red	Red	Red	Red	Red
Diesel	Truck and bus	Euro V	Green	Red	Red	Red	Red
Diesel	Truck and bus	Euro VI	Green	Green	Green	Green	Green

Red indicates an exemption if retrofit with DPF, and for scenario C-E for trucks and buses if retrofit with DPF and SCR (Selective Catalytic Reduction).

Figure 1 Emission requirements in 5 scenarios for Low Emission Zones

## Methodology

The effect on emissions of the five scenarios are based on emission factors (g/km) derived from the Danish national emission inventory for the different vehicle categories and scenario years. The effect is illustrated for one of the busiest streets in Copenhagen, H.C. Andersen Boulevard, and therefore reflects the vehicle distribution for this road that is typical for streets in Copenhagen. The calculations are carried out for the baseline year 2017 and the scenario year 2022.

The impact of the scenarios on the air quality of NO<sub>2</sub>, PM<sub>2.5</sub> and PM<sub>10</sub> has also been calculated for H.C. Andersens Boulevard for 2022. The calculations are based on air quality modelling for 2017 with the DEHM, UBM and OSPM models (Ellermann et al. 2018). The concentration contribution from traffic for 2017 is scaled with the emission reduction between 2017 and 2022 to estimate the reduction in concentrations due to emission reduction.

## Results

The emission reductions for the different scenarios are shown in Table 1. The presentation will also report on impacts to air quality.

Table 1 Percentage change in emissions for 5 scenarios in 2022 in relation to baseline.

Scenario	NO <sub>x</sub>	PM	PM <sub>2.5</sub>	PM <sub>10</sub>
		Exhaust	Total	Total
Baseline 2022	0	0	0	0
Scenario A	-4	-59	-19	-12
Scenario B	-21	-64	-20	-13
Scenario C	-5	-4	-1	-1
Scenario D	-5	-25	-8	-5
Scenario E	-11	-25	-8	-5

The presentation will also report on the results for air quality.

## References

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