CLEANER AIR FOR SCOTLAND – NATIONAL MODELLING FRAMEWORK

Consideration of Carbon Dioxide emissions within an LEZ scheme: Dundee

The main objective of a Low Emission Zone (LEZ) is to improve air quality to meet current statutory air quality standards and objectives. Access to the LEZ is restricted on the basis of the vehicle Euro classification, which is designed to control emissions of Nitrogen Oxides (NO_x), Total Hydrocarbons, Non-methyl Hydrocarbons, Carbon Monoxide and Particulate Matter (PM) See EU Commission Regulation.

Carbon Dioxide (CO_2) emissions are not currently controlled by the Euro classification, although CO_2 emissions will be included in upcoming Euro 7 standards which are expected to come into force in 2025. The Transport (Scotland) Act (2019) includes a statutory obligation to consider the contributions made towards greenhouse gas emissions.

CO_2 emissions are linked to the quantity of fuel burnt by a vehicle and therefore reductions in emissions are mostly linked to improved fuel efficiency. No vehicles currently include CO_2 emission abatement, and therefore no significant changes in CO_2 emissions are expected following implementation of an LEZ.

Lower CO_2 emissions could be achieved by reducing the number of vehicle journeys made by petrol/diesel vehicles and increasing the proportion of journeys made using alternative technologies (e.g. electric and hydrogen vehicles) and active travel. This move to zero carbon emissions could be achieved by actions set out in CAFS2 or the introduction of zero emission zones.

Euro class emissions standards are outlined in Tables 1, 2 and 3. CO_2 is not included in this framework.

Table 1: Car Emission Standards (NO_x and PM) for different Euro Classes

g/km	Diesel Car		Petrol Car	
	NO_x	PM	NO_x	PM
Euro 1	-	0.14	-	-
Euro 2	-	0.08	-	-
Euro 3	0.5	0.05	0.15	-
Euro 4	0.25	0.025	0.08	0.005
Euro 5 (incl 5a and 5b)	0.18	0.0045	0.06	0.005 (5a) 0.0045 (5b)
Euro 6 (incl 6b, 6c, 6d-TEMP and 6d)	0.08	0.0045	0.06	0.0045

Table 2: LGV Emission Standards (NO_x and PM) for different Euro Classes

g/km	<1305kg		1305-1760kg		1760-3500kg	
	NO_x	PM	NO_x	PM	NO_x	PM
Euro 1	-	0.14	-	0.19	-	0.25
Euro 2	-	0.08	-	0.12	-	0.17
Euro 3	0.5	0.05	0.65	0.07	0.78	0.10
Euro 4	0.25	0.025	0.33	0.04	0.39	0.06
Euro 5 (incl 5a and 5b)	0.18	0.0045	0.235	0.005 (5a) 0.0045 (5b)	0.28	0.005 (5a) 0.0045 (5b)
Euro 6 (incl 6b, 6c, 6d-TEMP and 6d)	0.08	0.0045	0.105	0.0045	0.125	0.0045

Table 3: Bus and HGV Emission Standards (NO_x and PM) for different Euro Classes. Note that Bus and HGV emissions standards are defined as g/kWh)

	Vehicle Type	NO_x (g/kWh)	PM (g/kWh)
Euro I	All	8	0.36
Euro II	All	7	0.15
Euro III	EEV	2	0.02
	Non EEV	5	0.1
Euro IV	All	3.5	0.02
Euro V	All	2	0.02
Euro VI	All	0.4	0.01
Note: EEV is Environmentally Enhanced Vehicle			

The Emissions Factor Toolkit (EfT) is published by Defra and the Devolved Administrations so that emission factors can be calculated for different vehicle speeds. These have been extracted from EfT v10.1 for vehicles travelling at an average speed of 20km/h, to show the effect of the Euro classification on emissions of NO_x and CO_2.

Figure 1 confirms that between Euro classes 5 and 6d there is a reduction in NO_x emissions from diesel cars of around 70%, compared with a reduction in CO_2 emissions of 8%. From petrol cars there is a small increase in NO_x emissions between Euro classes 5 and 6d of 13%, compared with an 8% reduction of CO_2. From diesel LGVs there is a reduction in NO_x emissions of around 90% between Euro classes 5 and 6, whereas CO_2 emissions remain unchanged.

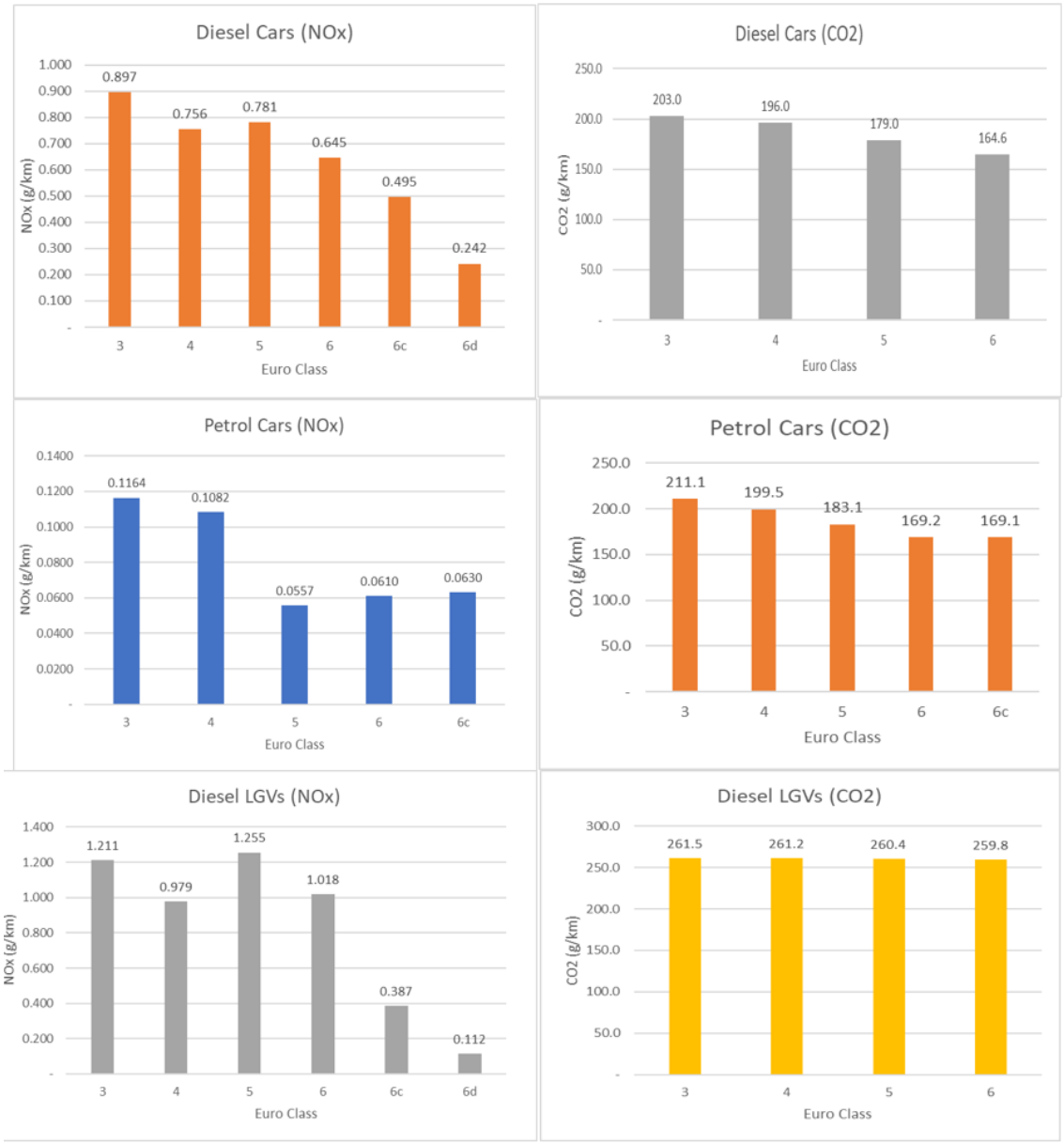

Figure 1: NOx and CO2 emission factors for Cars and LGV's

Figure 2 shows comparable data for heavy duty vehicles. For buses, rigid HGVs and articulated HGVs there is a reduction in NO_x emissions between Euro classes 5 and 6 of between 85-90%. CO_2 emissions remain unchanged.

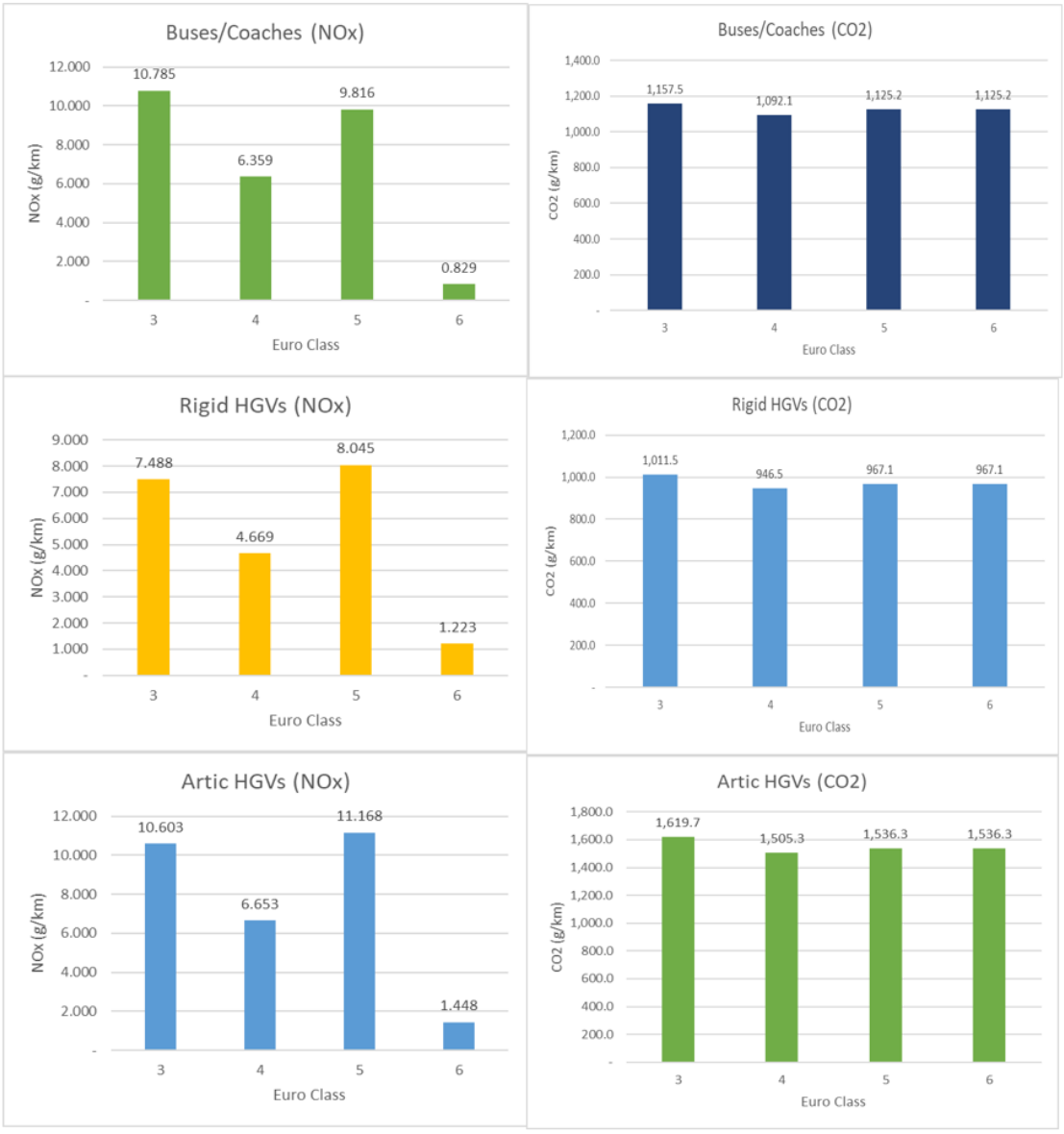

Figure 2: NO_x and CO_2 emission factors for Buses and HGV's

Analysis for Dundee

Emissions of CO_2 have been calculated on the roads shown in Figure 3 for the Reference and LEZ scenarios. The methodology used to calculate emissions has been consistent with that used to calculate emissions of NO_x and PM in previous LEZ analyses and the National Modelling Framework (NMF). This includes the assumption that all buses and taxis in the LEZ scenario will be compliant.

Emission calculations were made in EMIT using emission factors from NAEI (2014). Emission factors from EfT are not currently available in EMIT.

Figure 3: The Dundee model road network.

Figure 4 shows total CO_2 emissions from all roads for Reference and LEZ scenarios. This shows that there are only negligible changes, with a total reduction of 170 tonnes of CO_2 following implementation, corresponding to a reduction of less than 1%.

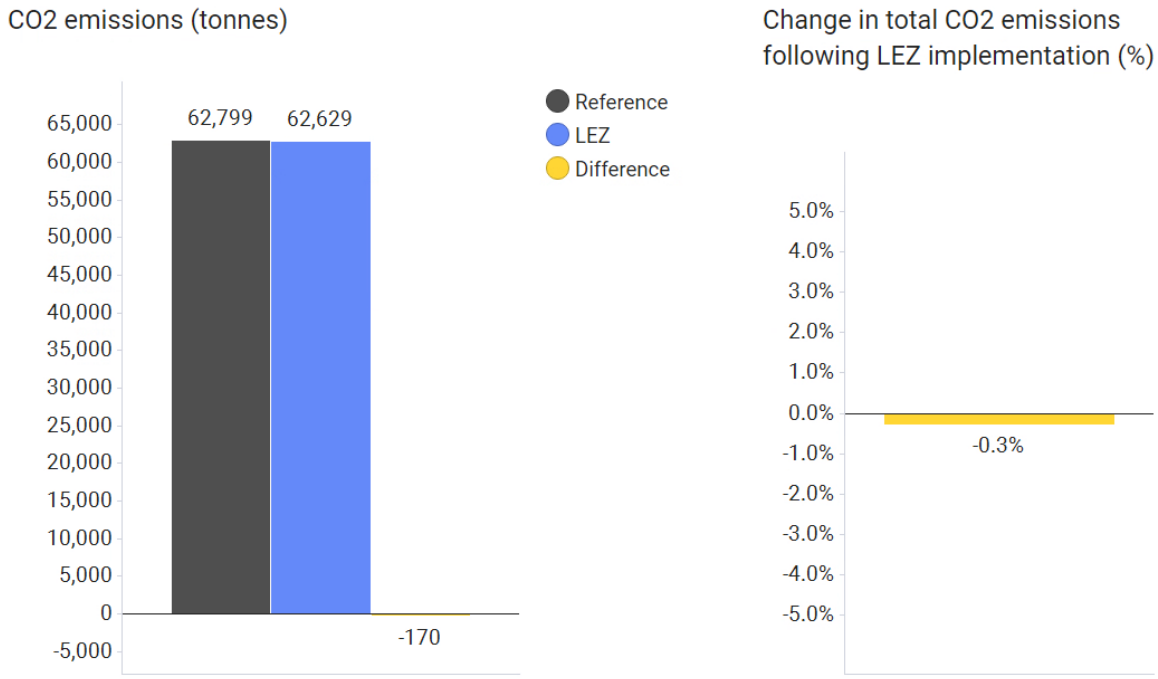

Figure 4: Total CO_2 emitted (tonnes) for the Reference and LEZ scenarios.

CO_2 emissions in Figure 5 have been split between roads inside, and outside, the LEZ boundary. This shows a reduction in emissions of 360 tonnes inside the boundary and an increase of 190 tonnes outside the boundary. The change inside the boundary corresponds with a relatively large percentage change, because total emissions are substantially smaller than those outside the boundary.

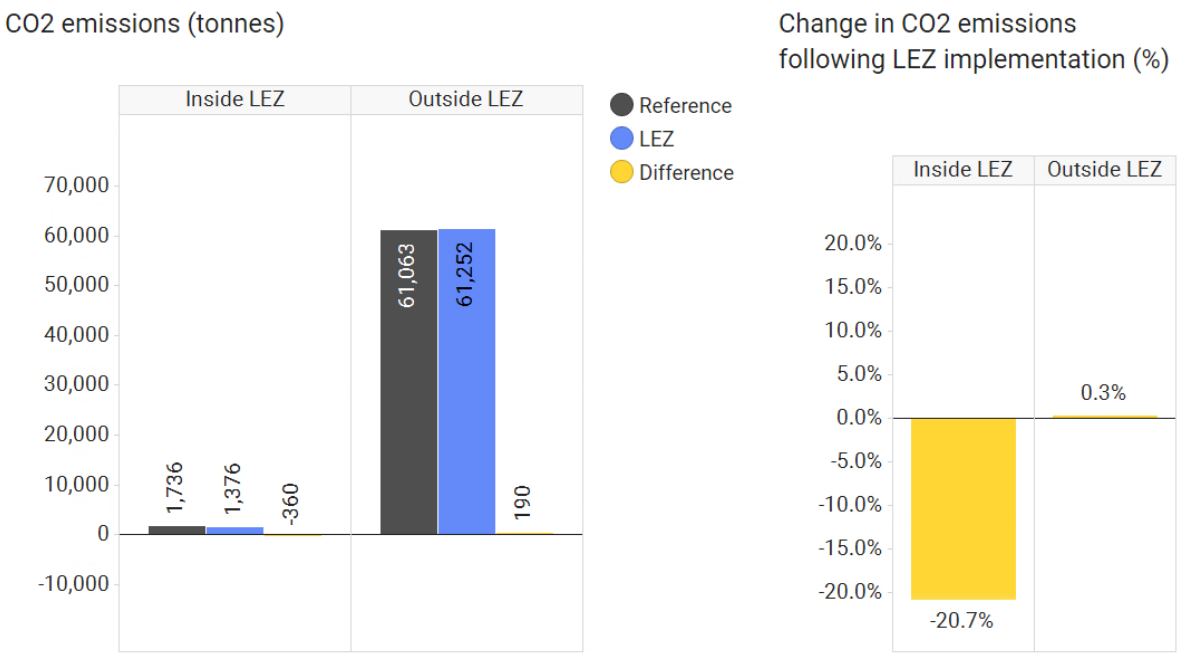

Figure 5: Total CO_2 emitted (tonnes) for the Reference and LEZ scenarios, on roads inside and outside the LEZ.

Summary of CO_2 Emissions

Access to the LEZ is restricted on the basis of vehicle Euro classifications, which do not include controls on emissions of CO_2. The Dundee NMF model has been used to compare emissions of CO_2 before and after implementation of the LEZ. This has confirmed that there are negligible changes, corresponding to an overall reduction in CO_2 emissions of less than 1%.