Appendix 7 Euro Standards

The terms of reference, given in Appendix 1, requested a determination of:

> an average "grams of emission per megajoule" for both greenhouse emissions and air quality emissions for both light and heavy vehicle Euro Standards I to IV. (The light vehicle Euro Standards are measured in grams per kilometer and each of the light vehicle Euro standards has three vehicle categories.)

We have obtained the Euro standards from Greening (2000, 2001) and from Arcoumanis (2000). Each section of the appendix provides the relevant Euro standard, as promulgated, and then converts the standard to a representative emission per megajoule of fuel consumed.

A7.1 Heavy duty vehicles

The EU standards for heavy duty vehicles (both gas and diesel) are given in Table A7.1.

Table A7.1
EU standards for heavy duty vehicles (g/kWh)

	CO	NOx	PM	THC	NMVOC	CH_4 NGV only	Test cycle
Euro1	4.5	8*	0.36*	1.1			ECE R-49
Euro2	4	7	0.15*	1.1			ECE R-49
Euro3	2.1	5	0.1	0.66			ESC/ELR
Euro3	5.45	5	0.16		0.78	1.6	ETC
Euro4-Level1	1.5	3.5	0.02	0.46			ESC/ELR
Euro4-Level1	4	3.5	0.03		0.55	1.1	ETC
Euro4-Level2	1.5	2	0.02	0.25			ESC/ELR
Euro4-Level2	3	2	0.02		0.4	0.65	ETC

* lowest value is given.

The heavy-duty vehicle standards are converted to g/MJ fuel consumed in Table A7.2 for a vehicle in which the efficiency of conversion of fuel energy to wheel energy is 33%. This value may be compared to the truck and bus data found in Chapter 2 of Part 3 where the fuel to wheel efficiency of the bus ranged from 24 to 35% and for the truck ranged from 32 to 38% over the extreme range of driving conditions, congested-urban to highway cycles respectively, as identified (by means of the average speed) in the base of the CO_2 and NOx graphs.

Table A7.2
EU standards for heavy duty vehicles converted to g/MJ fuel

	CO	NOx	PM	THC	NMVOC	CH_4 NGV only	Test cycle
Euro1	3.75	6.67	0.30	0.92			ECE R-49
Euro2	3.33	5.83	0.13	0.92			ECE R-49
Euro3	1.75	4.17	0.08	0.55			ESC/ELR
Euro3	4.54	4.17	0.13		0.65	1.33	ETC
Euro4-Level1	1.25	2.92	0.02	0.38			ESC/ELR
Euro4-Level1	3.33	2.92	0.03		0.46	0.92	ETC
Euro4-Level2	1.25	1.67	0.02	0.21			ESC/ELR
Euro4-Level2	2.50	1.67	0.02		0.33	0.54	ETC

A7.2 Diesel light commercial vehicles with weight below 1305 kg

The EU standards for diesel passenger cars and diesel light commercial vehicles below 1305 kg mass are given in Table A7.3

Table A7.3
EU standards for light duty vehicles (g/km)

	CO	NOx	PM	THC+NOx
Euro1				
Euro2	1		0.08	0.7
Euro3	0.64	0.5	0.05	0.56
Euro4	0.5	0.25	0.025	0.3

The light duty vehicle standards are converted to g/MJ fuel consumed in Table A7.4 for a vehicle in which the efficiency of conversion of fuel energy to wheel energy is 10.5 MJ/km.

Table A7.4
EU standards for light duty vehicles converted to g/MJ fuel

	CO	NOx	PM	THC+NOx
Euro1				
Euro2	0.10		0.01	0.07
Euro3	0.061	0.048	0.005	0.053
Euro4	0.048	0.024	0.002	0.029

A7.3 Diesel light commercial vehicles with weight between 1305 kg and 1760 kg

The EU standards for diesel passenger cars and diesel light commercial vehicles between 1305 kg and 1760 kg mass are given in Table A7.5

Table A7.5
EU standards for light duty vehicles (g/km)

	CO	NOx	PM	THC+NOx
Euro1				
Euro2				
Euro3	0.8	0.65	0.07	0.72
Euro4	0.63	0.33	0.04	0.39

The light duty vehicle standards are converted to g/MJ fuel consumed in Table A7.6 for a vehicle in which the efficiency of conversion of fuel energy to wheel energy is 10.5 MJ/km.

Table A7.6
EU standards for light duty vehicles converted to g/MJ fuel

	CO	NOx	PM	THC+NOx
Euro1				
Euro2				
Euro3	0.076	0.062	0.007	0.069
Euro4	0.060	0.031	0.004	0.037

A7.4 Diesel light commercial vehicles with weight greater than 1760 kg

The EU standards for diesel passenger cars and diesel light commercial vehicles above 1760 kg kg mass are given in Table A7.7

Table A7.7
EU standards for light duty vehicles (g/km)

	CO	NOx	PM	THC+NOx
Euro1				
Euro2				
Euro3	0.95	0.78	0.1	0.86
Euro4	0.74	0.39	0.06	0.46

The light duty vehicle standards are converted to g/MJ fuel consumed in Table A7.8 for a vehicle in which the efficiency of conversion of fuel energy to wheel energy is 10.5 MJ/km.

Table A7.8
EU standards for light duty vehicles converted to g/MJ fuel

	CO	NOx	PM	THC+NOx
Euro1				
Euro2				
Euro3	0.090	0.074	0.010	0.082
Euro4	0.070	0.037	0.006	0.044

A7.5 Petrol light commercial vehicles with weight below 1305 kg

The EU standards for petrol passenger cars and petrol light commercial vehicles below 1305 kg mass are given in Table A7.9.

Table A7.9
EU standards for light duty vehicles (g/km)

	CO	NOx	PM	THC+NOx
Euro1				
Euro2	2.2	0.252		0.341
Euro3	2.3	0.15		0.2
Euro4	1	0.08		0.1

The light duty vehicle standards are converted to g/MJ fuel consumed in Table A7.10 for a vehicle in which the efficiency of conversion of fuel energy to wheel energy is 2.4 MJ/km.

Table A7.10
EU standards for light duty vehicles converted to g/MJ fuel

	CO	NOx	PM	THC+NOx
Euro1				
Euro2	0.92			0.14
Euro3	0.96	0.06		0.08
Euro4	0.42	0.03		0.04

A7.6 Petrol light commercial vehicles with weight between 1305 kg and 1760 kg

The EU standards for petrol passenger cars and petrol light commercial vehicles between 1305 kg and 1760 kg mass are given in Table A7.11

Table A7.11
EU standards for light duty vehicles (g/km)

	CO	NOx	PM	THC+NOx
Euro1				
Euro2				
Euro3	4.17	0.18		0.25
Euro4	1.81	0.1		0.13

The light duty vehicle standards are converted to g/MJ fuel consumed in Table A7.12 for a vehicle in which the efficiency of conversion of fuel energy to wheel energy is 2.4 MJ/km.

Table A7.12
EU standards for light duty vehicles converted to g/MJ fuel

	CO	NOx	PM	THC+NOx
Euro1				
Euro2				
Euro3	1.74	0.08		0.10
Euro4	0.75	0.04		0.05

A7.7 Petrol light commercial vehicles with weight greater than 1760 kg

The EU standards for petrol passenger cars and petrol light commercial vehicles above 1760 kg kg mass are given in Table A7.13

Table A7.13
EU standards for light duty vehicles (g/km)

	CO	NOx	PM	THC+NOx
Euro1				
Euro2				
Euro3	5.22	0.21		0.29
Euro4	2.27	0.11		0.16

The light duty vehicle standards are converted to g/MJ fuel consumed in Table A7.14 for a vehicle in which the efficiency of conversion of fuel energy to wheel energy is 2.4 MJ/km.

Table A7.14
EU standards for light duty vehicles converted to g/MJ fuel

	CO	NOx	PM	THC+NOx
Euro1				
Euro2				
Euro3	2.18	0.09		0.12
Euro4	0.95	0.05		0.07