

Annex 4.1 CO₂ reference approach and comparison with the sectoral approach

4.1.1 CO₂ Reference Approach

The National Institute for Statistics annually provides the statistics on fuels, through the published document Energy Balance (see Annex 4.2).

For the reference approach CO₂ emissions estimation, were considered both, fuels for which there was reported energy and non-energy consumption.

LIQUID FUELS:

- Crude Oil,
- Natural Gas Liquids,
- LPG,
- Motor Gasoline,
- Aviation Gasoline,
- Kerosene Type Jet Fuel,
- Other Kerosene,
- Transport Diesel,
- Heating and Other Gasoil,
- Residual Fuel Oil,
- Petroleum Coke,
- Other Products,
- Naphtha,
- White spirit,
- Lubricants,
- Bitumen,
- Paraffin waxes,
- Refinery Gas,
- Refinery Feedstocks.

SOLID FUELS:

- Anthracite,
- Coking Coal,
- Other Bituminous Coal,
- Sub-bituminous Coal,
- Lignite/Brown Coal,
- Peat,
- Coke Oven Coke,
- Patent Fuel,
- BKB/PB.

GASEOUS FUELS:

- Natural Gas.

OTHER FUELS:

- Industrial Wastes.

The biomass (solid, liquid and gas) was calculated and reported separated.

The apparent consumption for different reported fuels was calculated according to the 1996 IPCC Reference manual, Ch. 1, p. 1.12, Table 1-1., taking into account the production for the primary fuels, import, export, international aviation and marine bunkers and the variation of the stock.

Since the Energy Balance provides the variation of the stock calculated as the difference between the opening stock level and closing stock level for stocks held on national territory (a stock build is shown as a negative number and a stock draw is shown as a positive number - see the documentation of the IEA/EUROSTAT questionnaires), in the CRF reporter the “stock change” parameter was introduced with the sign changed (in order to respect the methodology: the increasing of the stock must be subtracted from the calculation of the apparent consumption).

For the energetic apparent consumption calculation, the conversion factors provided through the Energy Balance are used.

For the purposes of the reference approach only, were calculated weighted averages of the net calorific power values for solid fuels, from production, imports and exports, for each fuel and each year, as are presented in the following table:

Table 4. 1 Weighted arithmetic average of the Net Calorific Power for the solid fuels [MJ/t]

Year	Anthracite	Coking Coal	Other Bituminous Coal	Sub-bituminous Coal	Lignite/Brown Coal	Peat	Coke Oven Coke	Patent Fuel	BKB/PB
1989	NO	21113.8	18384.3	NO	7243.0	NO	25121.0	14654.0	14654.0
1990	NO	26864.8	24233.4	NO	7582.9	NO	26384.0	20860.0	14654.0
1991	NO	27106.2	24295.4	NO	7561.7	NO	26384.0	20860.0	14654.0
1992	NO	27147.2	15604.4	NO	7067.0	NO	26384.0	20860.0	NO
1993	NO	27227.6	24373.8	NO	7506.4	15348.0	26378.0	26372.0	NO
1994	NO	27429.2	23067.1	NO	7489.5	8791.0	26378.0	15348.0	NO
1995	NO	26775.5	25406.5	22737.1	7583.2	8791.0	26378.0	20860.0	NO
1996	NO	26308.0	24720.0	23045.0	7675.7	8785.0	26370.0	NO	NO
1997	NO	27447.6	25320.4	19615.4	7513.0	NO	26370.0	NO	NO
1998	NO	27409.9	27284.3	18662.0	7615.5	8793.0	26364.2	NO	NO
1999	NO	27432.2	25535.0	18712.5	7947.0	8793.4	26378.3	NO	NO
2000	NO	27491.5	24617.7	NO	7878.7	8790.0	26385.9	NO	NO
2001	NO	27478.1	24881.3	NO	7196.8	8717.2	26370.0	NO	NO
2002	NO	27486.9	24826.0	NO	8385.0	8790.0	26386.4	NO	NO
2003	NO	27486.1	25951.0	NO	8487.5	NO	26370.0	NO	NO
2004	25533.0	27500.0	NO	24213.9	8284.5	NO	26370.0	NO	NO
2005	25533.0	27500.0	NO	24432.9	7801.0	NO	26370.0	NO	NO
2006	25533.0	27500.0	NO	24497.5	7783.8	8790.0	26370.0	NO	NO
2007	25533.0	27500.0	NO	24592.4	8047.0	8790.0	26370.0	NO	NO
2008	25533.0	27500.0	NO	24571.8	8132.3	8790.0	26370.0	NO	NO
2009	25533.0	27500.0	NO	24562.5	8092.5	8790.0	26358.0	NO	NO
2010	25533.0	27500.0	NO	24584.8	7942.0	8790.0	26370.0	NO	NO

For the liquid fuels was used the net calorific power provided through the Energy Balance for each fuel and each year.

For Natural Gas and Industrial Wastes was taken into consideration the energetic consumption provided through the Energy Balance (converting the gross to net consumption for natural gas).

For the fuels having reported consumption as non-energy, the carbon stored was calculated using the following values for the fraction of carbon stored (default values according to the 1996 IPCC Reference manual, Ch. 1, p. 1.28, Table 1-5):

Table 4. 2 Fraction Carbon Stored

Fraction Carbon Stored	
Lubricants	0.50
Bitumen	1.00
Coal Oils and Tars from Coking	0.75
Naphtha as Feedstock	0.75
Gas/Diesel Oil as Feedstock	0.50
Natural Gas as Feedstock	0.33
LPG as Feedstock	0.80
Ethane as Feedstock	0.80
Other products	0.80

The emission factors for the analyzed fuels were applied as default, using Tier 1 approach, according with the IPCC provision (IPCC 1996 Guidelines, Vol. II, Ch. 1, Table 1-2).

For the following fuels were calculated and applied corresponding country specific emission factors, in the context of the using the Tier 2 approach:

Table 4. 3 Carbon Content Country Specific Emission Factors

Fuel Type	Carbon content EFs [t/TJ]
Lignite	26.99
Natural gas	15.13
Refinery gas	15.3
Other bituminous coal	25.79
Coking coal	24.88
Transport diesel	19.99
Residual fuel oil	21.31
Heating and other gasoil	20.23
Petroleum Coke	25.54
Motor Gasoline	19.533

The carbon content was calculated applying the following oxidation factors (IPCC 1996 Guidelines, Vol. II, Ch. 1):

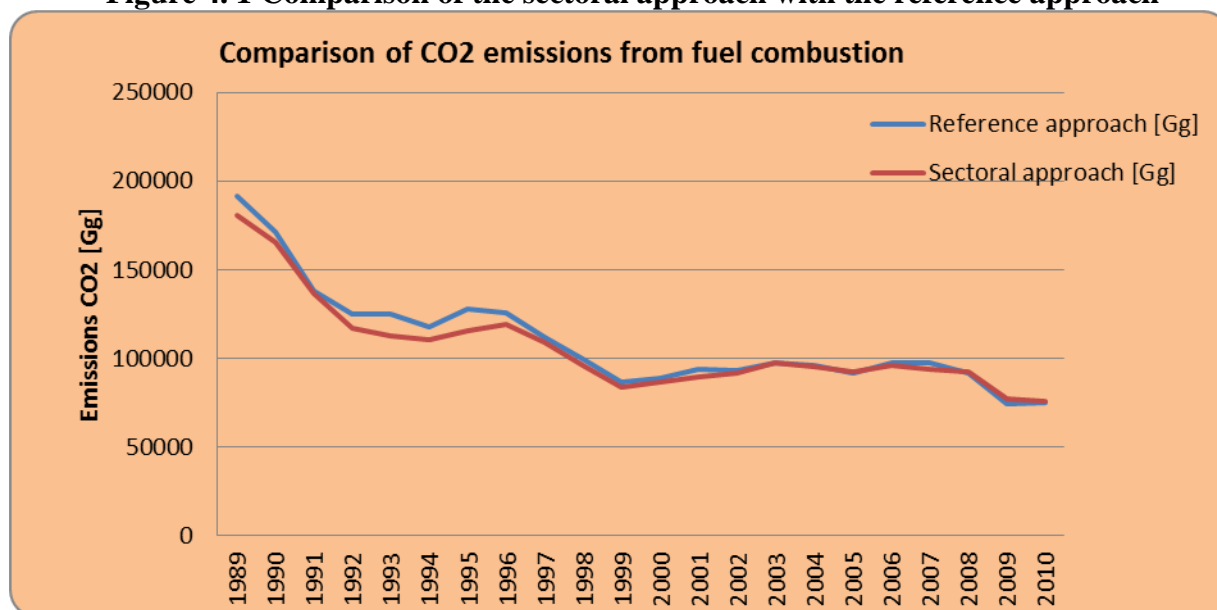
Table 4. 4 Using of the oxidation factor

Oxidation factors	
Coal	0.98
Oil and Oil Products	0.99
Gas	0.995
Peat for electricity generation	0.99

4.1.2 Comparison between the Reference Approach and the Sectoral Approach

Results of the comparison

Figure 4. 1 Comparison of the sectoral approach with the reference approach



Explanation of the differences

A comparison between the Reference Approach (RA) and the Sectoral Approach (RA) indicates differences in both, the energy consumption data and CO₂ emissions, – 3.1% in terms of energy consumption and, – 0.5 % in terms of CO₂ emissions for 2010.

One of the reasons for these differences refers to the fact that the Reference Approach deals with the non-energy uses of fuels as if they are combustion activities. A correction is done by the carbon stored from non-energy use of fuel.

An explanation for the differences between the two approaches is provided in the Energy Balance, for some of the years being a significant statistical differences reported, differences generated by the statistical investigation system (while the energy producers are exhaustive recorded, the consumers are inquired on a sampling base, admitting a margin of error). Also there are reported losses for the consumption of the fuels.

The highest differences between the two approaches are observed in the period 1992-1996, and most notably 1993, 1995. The analysis showed that the main reason for this are the differences in liquid fuels consumption resulting from the significant amounts of refinery losses reported (5.5% of total refinery intake in 1995 was reported as refinery losses).

The following table compares the energy consumption and the emissions according to both approaches in terms of all fuels.

Table 3. 1 Comparison of the sectoral approach with the reference approach (all fuels)

Year	Energy consumption [PJ]		Difference [%]	CO ₂ Emissions [Gg]		Difference [%]
	Reference approach	Sectoral approach		Reference approach	Sectoral approach	
1989	2792.38	2506.61	9.2	191421.48	180344.15	6.1
1990	2511.26	2286.31	8.3	171362.59	165241.33	3.7
1991	2042.48	1898.87	4.8	137801.32	136773.24	0.8
1992	1837.16	1616.52	6.1	124631.43	116886.81	6.6
1993	1817.99	1557.59	10.7	124927.01	112790.61	10.8
1994	1703.80	1530.05	7.4	117759.57	110364.53	6.7
1995	1828.42	1593.30	11.4	127653.36	115570.54	10.5
1996	1817.94	1639.38	6.6	125625.28	119241.58	5.4
1997	1610.72	1485.62	3.1	111878.49	108702.69	2.9
1998	1457.27	1332.17	4.8	99659.37	96260.63	3.5
1999	1277.22	1155.86	4.5	86547.82	83391.20	3.8
2000	1293.81	1187.15	2.7	88652.84	86735.84	2.2
2001	1343.21	1223.18	4.4	93675.82	89522.84	4.6
2002	1338.66	1249.01	1.6	93152.06	91764.07	1.5
2003	1396.37	1321.66	0.9	97531.30	97405.18	0.1
2004	1382.82	1310.67	-0.4	96250.51	95387.86	0.9
2005	1337.82	1253.98	-1.3	91771.74	92060.02	-0.3
2006	1408.24	1300.87	0.8	97105.86	95901.77	1.3
2007	1391.38	1250.92	2.4	97687.54	93939.44	4.0
2008	1329.97	1241.75	-1.9	91968.44	92340.53	-0.4
2009	1082.35	1063.95	-7.0	74290.82	77400.61	-4.0
2010	1096.66	1043.13	-3.1	75093.41	75499.84	-0.5