Annex 4.1 CO_2 reference approach and comparison with sectoral approach

4.1.1 CO_2 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 CO_2 emissions estimation, were considered fuels for which there was reported both energy and non-energy consumption.

LIQUID FUELS:

- crude oil;
- other hydrocarbons;
- additives oxygenates;
- 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 includes 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
2011	25533.0	27500.0	NO	24443.4	7841.0	8790.0	26370.0	NO	NO

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

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 of carbon stored

Fuel	Fraction of 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, based on the Study "Elaboration/documentation of national emission factors/other parameters relevant to National Greenhouse Gas Inventory (NGHGI) Sectors Energy, Industrial Processes, Agriculture and Waste, values to allow for the higher tier calculation methods implementation" and EU-ETS operators reporting, the carbon content country-specific emission factors were calculated, in the context of the using the Tier 2 approach:

- lignite;
- natural gas;
- refinery gas;
- other bituminous coal;
- coke oven coke;
- transport diesel;
- residual fuel oil;
- heating and other gasoil;

- petroleum coke;
- industrial wastes.

The carbon country-specific emission factors values used for estimating emissions within the Reference Approach for 1989-2006 period, values based on EU-ETS related values for 2007-2010 period, are presented in Table 4.3.

Table 4.3 Carbon country-specific emission factors as weighted averages corresponding to the 2007–2010 determination period

Fuel Type	Carbon EFs [t C/TJ]
Lignite	26.99
Natural gas	15.13
Refinery gas	15.30
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*	19.53

* motor gasoline country-specific related value is calculated based on a country-specific carbon content value, using the formula provided through the above mentioned study.

The annual carbon country-specific emission factors values used for estimating emissions within the Reference Approach for 2007-2010 period, values based on EU-ETS related values for 2007-2010 period, are presented in Table 4.4.

Table 4.4 Carbon country-specific emission factors corresponding to each year of the 2007–2011 determination period

Type of fuel/Carbon CS EF [t C/TJ]	Year				
	2007	2008	2009	2010	2011
Lignite	27.86	26.96	26.65	26.33	25.77
Natural gas	15.05	15.16	15.13	15.21	15.14
Refinery gas	15.03	14.74	15.82	15.66	15.66
Other bituminous coal	25.43	25.73	25.96	25.88	25.04
Coke oven coke	25.34	23.00	25.33	25.27	25.95
Transport diesel	20.18	19.73	20.19	19.84	19.89
Residual fuel oil	21.43	20.95	21.26	21.73	21.68
Heating and other gasoil	20.31	21.24	20.30	20.09	19.99
Petroleum coke	-	25.73	25.05	25.64	26.86
Motor gasoline*	19.53	19.53	19.53	19.53	19.53
Industrial wastes	-	-	-	-	22.77

* motor gasoline country-specific related value is calculated based on a country-specific carbon content value, using the formula provided through the above mentioned study.

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

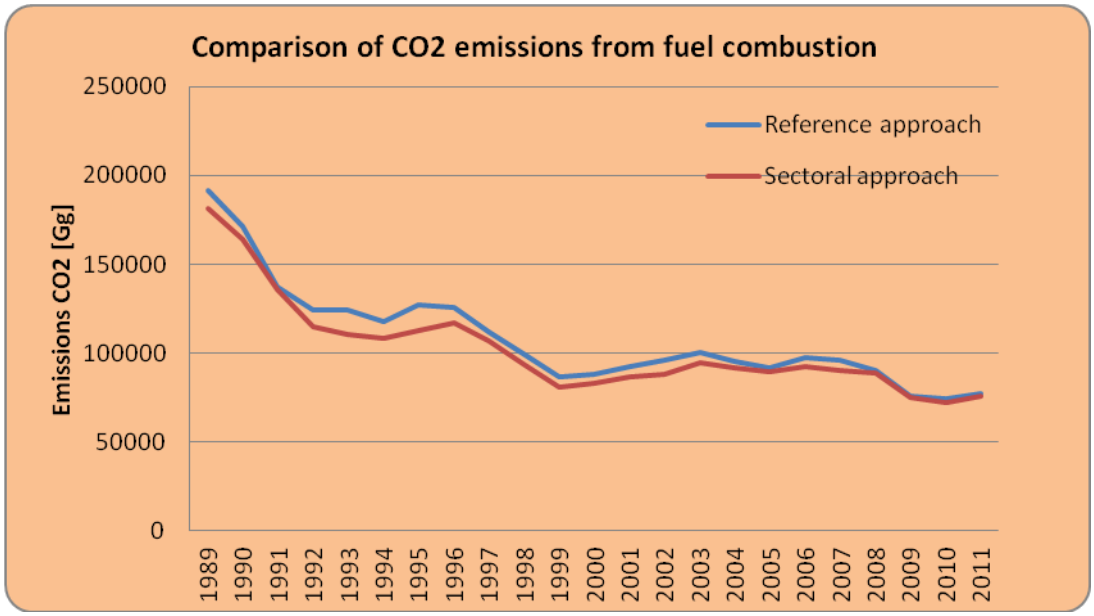
Table 4.5 Use of the oxidation factor

Fuel	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 (RA) and Sectoral Approach (SA)

Results of the comparision

Figure 4. 1 Comparison of the Reference Approach with the Sectoral Approach



Explanation of the differences

The comparison between the RA and the SA indicates differences in both the energy consumption data and CO_2 emissions, -1.34% in terms of energy consumption and, 1.69 % in terms of CO_2 emissions for 2011.

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 census or on a sampling base, admitting a margin of error). Data are collected by county statistical offices (40 counties) and compiled to regional totals before being sent to the national agency. Electronic checking procedures allow to eliminate

errors in compiling the national total. Statistical procedures allow to match missing data. The response rate is above 90%, however. Supply (from census) and consumption (from census and survey) are being reconciled by checking the energy balance. Transformation factors allow to assess losses, again input versus outputs are being checked. In reconciling, statistical errors are being corrected but company information is maintained.

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

The following table includes elements on the comparison of the energy consumption and the emissions, according to both approaches in terms of all fuels.

Table 4.6 Comparison of the RA with SA (all fuels)

Year	Energy consumption [PJ]		Difference [%]	CO_2 emissions [Gg]		Difference [%]
	RA	SA		RA	SA	
1989	2,792.38	2,531.74	8.11	191,465.17	181,469.96	5.51
1990	2,511.26	2,340.60	5.64	171,078.86	164,358.61	4.09
1991	2,042.17	1,945.44	2.13	137,378.62	135,846.05	1.13
1992	1,837.16	1,626.57	5.27	124,149.16	115,126.93	7.84
1993	1,817.94	1,556.01	10.74	124,362.04	110,621.65	12.42
1994	1,703.79	1,526.00	7.46	117,785.16	108,513.89	8.54
1995	1,828.38	1,581.02	11.98	126,945.80	112,667.42	12.67
1996	1,818.09	1,631.00	6.85	125,631.85	116,883.06	7.49
1997	1,610.72	1,486.56	2.71	111,922.53	106,881.61	4.72
1998	1,457.41	1,313.66	5.97	99,792.60	93,661.74	6.55
1999	1,277.22	1,138.05	5.70	86,351.99	81,070.19	6.52
2000	1,293.89	1,160.14	4.58	87,989.04	83,035.29	5.97

Year	Energy consumption [PJ]		Difference [%]	CO_2 emissions [Gg]		Difference [%]
	RA	SA		RA	SA	
2001	1,343.21	1,198.46	5.82	92,425.05	86,639.87	6.68
2002	1,388.78	1,212.25	8.19	95,972.47	87,769.32	9.35
2003	1,449.08	1,295.07	6.47	100,433.39	94,232.12	6.58
2004	1,382.93	1,251.97	3.49	95,101.58	91,801.27	3.60
2005	1,348.41	1,215.59	1.59	91,387.78	89,107.19	2.56
2006	1,423.99	1,257.41	4.44	97,169.92	92,485.13	5.07
2007	1,388.21	1,205.96	4.83	96,108.19	90,414.02	6.30
2008	1,324.07	1,197.16	0.04	90,479.62	88,589.21	2.13
2009	1,114.99	1,029.35	-1.40	75,820.79	74,607.69	1.63
2010	1,103.03	1,003.36	0.29	74,177.36	71,712.64	3.44
2011	1,137.45	1,055.63	-1.34	77,075.25	75,793.52	1.69