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:

For the liquid fuels the net calorific power provided through the Energy Balance for each fuel and each year, was used. For those liquid fuels reported on the EU-ETS reports, national values of the net calorific power were derived and used as conversion parameters in the concerned activities. Therefore, for the liquid fuels, transport diesel, refinery gas, residual fuel oil, petroleum coke, heating and other gasoil, national values of the net calorific power were derived from the EU-ETS reports. For EU-ETS period 2007-2012, annually determination of the NCVs weighted averages values were used and, for the rest of the time series, the averages of the EU-ETS period were used. For the above liquid fuels, the averages of the net calorific values in correspondence with the Energy Balance sectoral activities were 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 4.1 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.

Table 4.3. presents: the country-specific carbon content values used for estimating emissions within the Reference Approach for 1989-2006 period, averages of the EU-ETS related activity categories values: column of "**2007-2010 averages"**; the annual country-specific carbon content values used for estimating emissions within the Reference Approach for each year of 2007-2012 period, values based on weighted averages EU-ETS activity categories of the above period.

Table 4.2 Country-specific carbon content values[t C/ TJ]

Year / Type of fuel	2007	2008	2009	2010	2007-2010 averages	2011	2012
Lignite	27.86	26.96	26.65	26.33	26.99	25.77	25.74
Natural gas	15.08	15.19	15.13	15.17	15.14	15.14	15.16
Refinery gas	14.82	14.92	15.85	15.80	15.38	15.66	15.52
Other bituminous coal	25.43	25.73	25.96	25.88	25.79	25.04	23.97
Coke_Oven_Coke	25.34	23.00	25.33	25.27	24.88	25.95	25.60
Transport diesel	20.18	19.73	20.19	19.84	19.99	19.89	20.06
Residual fuel oil	21.43	20.95	21.26	21.73	21.31	21.68	21.68
Heating and other gasoil	20.31	21.24	20.30	20.09	20.23	19.99	20.20
Petroleum Coke	-	25.73	25.05	25.64	25.54	26.86	26.41
Motor gasoline*							19.53
Industrial Wastes	-	-	-	-	-	22.77	22.86

* motor gasoline country-specific carbon content is calculated based on the carbon content provided by the Romanian Ministry of Economy.

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

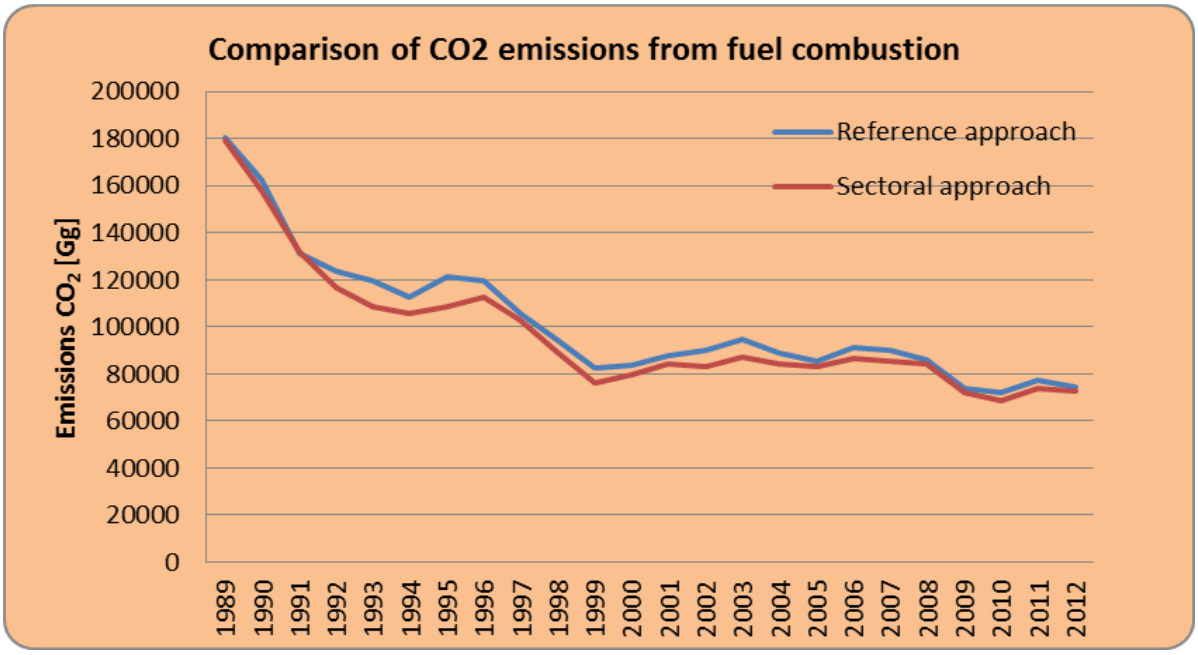
Table 4.3 Use of the oxidation factor

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

A comparison between the RA and the SA indicates differences in both the energy consumption data and CO_2 emissions, -1.09 % in terms of energy consumption and, 2.43 % in terms of CO_2 emissions for 2012.

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.

Due to the fact that recalculations were performed in the Sectoral Approach in regards of the subtraction of the non-energy use from the 1A1b Petroleum refining - petroleum coke, the RA-SA difference was affected in the sense of decreasing of this difference. Further to a dialog between energy sector experts and the operators from Refineries domain, it was concluded that the petroleum coke is reported in the Energy Balance as refinery fuel, in fact being the quantity

of the "catalyst coke" deposited on the catalyst during refining processes and representing process emissions which are accounted as fugitive emissions.

Also, due to the fact that Coke Oven Coke is used as reduction agent in Blast Furnace, Iron and Steel Production activity, this non-energy use of the fuel from the Reference Approach, was subtracted. The result is a balanced approach in respect of the used methodology for the CO_2 emissions estimation in the Reference Approach in comparison with the Sectoral Approach.

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.

For the natural gas consumption in the Petroleum Refineries category the Energy Balance – gaseous fuels provided revised values for the period of 2007-2011, the consumption being decreased on this years and having as results the increasing of the difference RA-SA on the natural gas consumption.

For the NCVs of the solid fuels a reconciliation between the national vaules determined in the Sectoral approach from the EU-ETS monitorin reports and the NCVs used in the corresponding activities, production, import, export, must be made for the next submission. It is the motivation for which in some years of the time series the consumption of the solid fuels in the sectoral

approach is higher than those obtained for the reference approach (it is the case of the 1989-1996 period).

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 4.4 Comparison of the RA with SA (all fuels)

Year	Energy consumption [PJ]		Difference [%]	CO_2 emissions [Gg]		Difference [%]
	RA	SA		RA	SA	
1989	2614.495	2601.38	0.50	180495.7	179090.2	0.78
1990	2373.499	2325.407	2.07	162221.8	157709.6	2.86
1991	1920.016	1937.941	-0.92	131414.1	131552.8	-0.11
1992	1692.289	1678.066	0.85	123927.8	116858.9	6.05
1993	1670.462	1562.88	6.88	119642.4	108431.4	10.34
1994	1581.287	1529.857	3.36	112533.6	105665	6.50
1995	1705.19	1578.109	8.05	121097.9	108790.5	11.31
1996	1676.301	1626.305	3.07	119663.4	112837.7	6.05
1997	1460.848	1482.756	-1.48	105956.5	102984.1	2.89
1998	1325.165	1298.862	2.03	93862.63	88937.87	5.54
1999	1158.146	1107.616	4.56	82384.72	76049.79	8.33
2000	1165.982	1145.702	1.77	83829.79	79484.4	5.47
2001	1217.258	1203.388	1.15	87865.93	84494.48	3.99
2002	1247.964	1198.863	4.10	90319.36	83320.8	8.40
2003	1312.197	1256.091	4.47	94536.71	87370.88	8.20
2004	1225.728	1210.045	1.30	88882.58	84518.3	5.16
2005	1164.486	1190.147	-2.16	85214.57	83314.27	2.28
2006	1244.986	1228.215	1.37	91218.68	86612.25	5.32
2007	1193.464	1187.545	0.50	89886.6	85369.49	5.29
2008	1146.192	1172.926	-2.28	86258.02	84093.54	2.57
2009	994.6397	1012.801	-1.79	73758.27	71997.48	2.45

Year	Energy consumption [PJ]		Difference [%]	CO_2 emissions [Gg]		Difference [%]
	RA	SA		RA	SA	
2010	985.5713	977.0165	0.88	72047.75	68561.67	5.08
2011	1048.471	1045.51	0.28	77096.02	73902.84	4.32
2012	1014.84	1026.022	-1.09	74579.98	72810.63	2.43