

## ***ANNEX 4***

## Annex 4: CO<sub>2</sub> reference approach and comparison with sectoral approach, and relevant information on the national energy balance

### 1.1 Total Emission of CO<sub>2</sub> - Reference approach and comparison with sectorial approach

The total difference of CO<sub>2</sub> emissions between the sectoral approach and the reference approach in 2010 amounted to less than -0.2% which is deemed satisfactory.

**Table 1: Differences in energy consumption (Reference approach/National Approach)**

	1986	1990	1995	2000	2005	2008	2009	2010
liquid	-2.02	2.84	1.84	-0.02	2.22	-0.36	0.86	1.76
solid	0.24	1.76	0.32	1.18	-0.49	-0.02	-0.05	0.14
gaseous	4.46	-4.97	-2.65	-0.50	0.63	0.002	-0.002	-0.008
total	-0.03	0.93	0.61	0.16	0.86	-0.44	0.09	0.28

**Table 2: Differences in CO<sub>2</sub> emissions (Reference approach/National Approach)**

	1986	1990	1995	2000	2005	2008	2009	2010
liquid	-1.58	3.39	7.17	-2.76	2.88	-0.15	0.20	1.10
solid	0.17	1.80	0.39	1.22	-1.15	0.12	-0.14	-0.29
gaseous	-4.15	-8.37	-0.53	0.29	0.54	-0.13	-0.06	-0.49
total	-0.87	-1.49	3.52	0.45	0.75	-0.25	-0.29	-0.19

## **1.2 Reference approach –data and EF used**

Emission of CO<sub>2</sub> has been calculated on the basis of the formula and factors from IPCC guidelines (Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p. I.13., I. 30)

Basic sources do not specify any uncertainties. All utilized input data are taken from official inventories, while calculations take into account the factor of calorific value of a fuel as specified by the Ministry of the Economy of the Republic of Slovenia, hence the uncertainties are supposed to be low. For emission factors, the uncertainties are somewhat higher. The emission factors applied are taken from IPCC methodology (and are not obtained by measurements performed in Slovenia).

### **1.2.1 Gasoline**

Preparing consumption balances for this report took a relatively long period, 17 years. During this period, the modes of presentation and aggregation of data on the consumption of gasoline (motor gasoline and primary gasoline), jet kerosene (kerosene), fuel oil, and gas oil have in part undergone a change. Consequently, this necessitated a different approach to the calculation of consumption for individual years.

Balances of consumption for those fuels have been done on the basis of the following presumptions:

PERIOD 1986 to 1990

Gasoline consumption is split into two groups, one comprising auto and primary gasoline, the other aviation gasoline for turboprop and piston engine aircraft.

1. Under the category Purchase for motor gasoline, quantities reported in LEG-85 to 90 are the sum of purchases in other republics of the former Yugoslavia and total production in Slovenia. The balances on pages Tg/1 (LEG) are illogical, since they make it appear as if there was no production of oil products in Slovenia for the period 1986 to 90, which is not correct. It is evident that the category "Purchase" includes the total production of Nafta Lendava (both quantities sold in Slovenia as well as internal consumption and sales in other republics of the former Yugoslavia) from the reports for the period 1991 to 1996, when the entire production has been presented in the category "Production" (compare Tables Tg/1 in LEG 1986 - 1990 to tables Tg/1 in LEG 1991 - 2003).

Not so for the primary gasoline: quantities produced in Nafta Lendava have not been reported in the category Purchase. Consequently, these quantities are not subtracted later (item 3).

2. This is how total available quantities of an individual refined petroleum product in Slovenia have been obtained.

3. From the total available quantity of an individual refined petroleum product in Slovenia, the total final production of Nafta-Lendava, which has been taken into account in category Purchase in LEG, Table Tg/5, is subtracted. Thus:

- production of auto gasoline sold in Slovenia
- production of auto Gasoline exported.

The production of primary gasoline, which is reported under items Processing and Internal Consumption is not taken into account, since these quantities are processed further into other products.

#### **Outline of the Calculation of Consumption of Oil Products 1986 to 1990**

Purchase	Purchase in other republics of the former Yugoslavia. This category for the period 1986 to 1990 includes also production in Slovenia
+Import	
=Available quantities	
- Production in Nafta Lendava (i.e. production in Slovenia)	Subtract all quantities of motor gasoline produced in Nafta Lendava (sold in Slovenia, in other republics of the former Yugoslavia or used for internal consumption). These quantities are subtracted because they are reported in the category Purchase (and should not be). Primary gasoline is not reported in the category Purchase, and is therefore not subtracted here (!!!!!).
Real Import	Thus are obtained quantities which are available in Slovenia and the emissions of which are taken into account in the processing of crude oil.
- Real Export	It is necessary to subtract quantities which are not used in Slovenia and which have been taken into account for emissions from the processing of crude oil. This is the quantity that is exported – that part of the production of refined petroleum products of Nafta Lendava, which is sold to other republics of the former Yugoslavia: motor gasoline and primary gasoline. Export is also that quantity of motor gasoline that is sold to other republics of the former Yugoslavia as reported by Elektrogospodarstvo (LEG, Tg/1 and Tg/2) – i.e. sales of Istrabenz in other republics of the former Yugoslavia. For gasoline for the period 1986 to 1991, the sum of both exports is taken into account (from tables Tg/1 and Tg/5). Taken into account is also the export of motor gasoline (emissions from its consumption will be reported by the country which will retail this gasoline) and export of raw gasoline (which will be processed into motor gasoline in the exporting country and reported within the framework of the consumption of motor gasoline in that country). In the same way, the export of fuel oil and gas oil is calculated.
- (+) Stock Change	
Consumption in Slovenia	The result are quantities consumed in Slovenia which have not been taken into account for the processing of crude oil, minus quantities of refined petroleum products, which are exported.

4. Quantities obtained are the actual import and purchase from other republics of the former Yugoslavia. The produced quantities of auto gasoline are subtracted because CO<sub>2</sub> emissions from them have already have been taken into account in the processing of crude oil. Should they not be subtracted, then they are presented twice: in the category Oil Products (gasoline, gas oil and fuel oil) and Crude Oil Consumption.

5. Subsequently all exported values must be subtracted since these emissions do not arise in Slovenia,

- export or sales outside the Republic of Slovenia, as reported by Nafta-Lendava (Table Tg/5 – for gasoline the export of motor gasoline and primary gasoline is taken into account).
- values that are reported as export by Elektrogospodarstvo: these are the quantities, which are exported by Istrabenz to its agencies abroad.

Export of oil products (gasoline, gas oil and fuel oil) must therefore be subtracted twice: firstly because the quantities consumed have already been reported in the category Purchase, and secondly, because emissions have already been taken into account in the consumption of crude oil.

Stock change is obtained by subtracting the stocks for the end of the period from stock at the beginning of the period.

6. The obtained quantities are taken into account for the calculation of emissions of CO<sub>2</sub>.

Data calculated as the consumption of oil products for 1990 in this report differ from those specified in Seljak 1998, where those quantities of refined petroleum products which had been sold by Istrabenz in other republics of the former Yugoslavia or abroad have not been taken into account as export.

#### YEAR 1991

In calculating the consumption of refined petroleum products in Slovenia for 1991, an error has occurred in LEG. Production of Nafta Lendava has been reported twice: under the category Purchase (as was the case in LEG 1986-1990) and under the category Production (as reported since 1992). Consequently, the quantities of motor gasoline, gas oil, fuel oil and residual fuel oil, which were produced in Nafta Lendava, have been subtracted from the category Purchase (or import from other republics of the former Yugoslavia) of motor gasoline (or gas oil / fuel oil).

**Table 1: Calculation of Purchase of Oil Products in other Republics of the Former Yugoslavia in 1991**

	Quantities reported in LEG (TG/1)- tonnes	Sales in Slovenia – LEG /Tg/5	Real Purchase in other Republics of the Former Yugoslavia
Motor Gasoline	324000	113932	210068
Gas oil	251401	104717	146684
Fuel Oil and Residual Fuel Oil	494219	235106	259113
Fuel Oil	302524	143885	158577
Residual Fuel Oil	191695	91221	100536

The ratio has been calculated on the basis of reported quantities in column: Reported Quantities in LEG (TG/1): 38.8 % residual fuel oil – 61.2 % fuel oil.

The export of oil products in 1991 is obtained by summing up the export as reported by Nafta Lendava (motor gasoline and primary gasoline) and export as reported by Elektrogospodarstvo (sales of Istrabenz in other republics of the former Yugoslavia).

#### PERIOD 1992-2003

1. In LEG 1992-1996 under the category Purchase, only those values were reported which had actually been purchased in other republics of the former Yugoslavia (since 1994 these quantities are no more). Under the category Production, the quantities produced in Slovenia

(Nafta Lendava) are reported. Calculations must not take into account the oil products that were produced in Slovenia (since both calorific values as well as emissions of CO<sub>2</sub> have already been taken into account for the consumption of crude oil). Hence, further calculations take into account only quantities either purchased in other republics of the former Yugoslavia or imported.

2. Subtract all export from the obtained quantities. This is the value that was provided by Elektrogospodarstvo as sales into other republics of former Yugoslavia (until 1993) as well as export (since 1994).

Stock changes are obtained by subtracting the stocks for the end of the period from the stocks for the beginning of the period.

3. Thus are obtained the quantities taken into account in calculating emissions of CO<sub>2</sub>.

#### Outline of Consumption of Oil Products 1992-2000

Purchase	Under this category in LEG-91 to 96 the quantities purchased in other republics of the former Yugoslavia have been reported
+Import	Import from other countries
Real Import	Quantities which have been available in Slovenia and which have not been taken into account in processing of crude oil.
- Real Export	Minus quantities which have not been consumed in Slovenia and which have been taken into account for emissions from the processing of crude oil. This quantity is exported. For gasoline, the export of both motor gasoline as well as primary gasoline is subtracted.
- (+) Stock Change	
Consumption in Slovenia	Quantities which have been consumed in Slovenia and which have been taken into account for the processing of crude oil, minus quantities of refined petroleum products that have been exported.

IPCC guidelines (Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p. I.21) suggest a conversion factor from natural units to Joules of 44.8 TJ/1000 t. The factors specified in LEG for individual years ranged from 42.87 to 43.14 TJ/1000 t (Ministry of the Economy: Statistični letopis energetskega gospodarstva republike Slovenije 1986-1996, Ljubljana: Ministry of the Economy, Table Zb/1). Based on measurements, the emission factor of the Ministry of the Economy has been taken into account in calculations for individual years. Since the year 2004 we have obtained data from SORS in electronic format (file name E\_8\_YYYY.xls).

The emission of CO<sub>2</sub> has been calculated on the basis of the formula and emission factors from IPCC guidelines (Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p. I.13., I. 30)

**Table 2: Consumption of Gasoline and Calculation of Emission of CO<sub>2</sub> from Consumption of Gasoline in Slovenia for the Period 1986 to 2005.**

	1986	1990	1995
Purchase (kt)	445	497	0
Production of Motor Gasoline (kt)			
Import (kt)	6	78	697
Available Quantity in Slovenia (kt)	451	575	697
- Production of Motor Gasoline by Lendava, sold in Slovenia	17248	40204	
- Export of Gasoline by Lendava			
- Internal Consumption of Gasoline	0	0	
Total production of Motor Gasoline in Slovenia	17	40	0
Real Import (kt)	434	535	697
Export, as reported by Elektrogospodarstvo - Sales of Istrabenz Abroad (kt)	7	9	
Export, as Reported by Nafta Lendava (kt)			
Export – Total (kt)	7	9	25
Stock Change (kt)	5	0	-12
Consumption in Slovenia minus Production of Lendava (kt)	422	527	684
Factor MJ/kg	43.19	43.07	43.08
Consumption (TJ)	18228	22677	29445
Emission Factor (t C/TJ)	20.09	20.09	20.11
Emission (Gg C)	366	456	592
Oxidised Fraction	0.99	0.99	0.99
Conversion of C to CO <sub>2</sub>	3.6667	3.6667	3.6667
Emission (Gg CO <sub>2</sub> )	1330	1654	2149

Data Source: Ministry of the Economy: Statistični letopis energetskega gospodarstva republike Slovenije 1986-2003, Ljubljana: Ministry of the Economy, Table Tg/1, Tg/5 and electronic files ZBIRNA E8 YYYY.xls from SORS for 2004-2009.

Source of Emission Factors: Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p.1.13, estimates of an expert group.

Basic sources do not specify any uncertainties. The utilized input data are calculated on the basis of two balances: the balance sheets of Nafta Lendava and Elektrogospodarstvo Slovenije. With regard to the fact that many categories of consumption and of production have not been harmonized, the estimated total uncertainty of input data amounts to 10 %. The uncertainty of input data differs for individual years:

- 5% for the period 1993 to 2004,
- 10 % for the period 1986 to 1990, 1992
- 20 % for year 1991.

Calculations account for the factor of calorific value of fuels issued by the Ministry of the Economy of the Republic of Slovenia, hence the uncertainties are supposed to be low. For emission factors, the uncertainties are somewhat higher. The emission factors applied are taken from IPCC methodology (and are not a result of measurements in Slovenia).

## 1.2.2 Gas/Diesel oil

**Table 3: Consumption of Gas Oil and Calculation of Emission of CO<sub>2</sub> from Consumption of Gas Oil in Slovenia for the Period 1986 to 1995.**

	1986	1990	1995
Purchase (kt)	336	349	0
Production (kt)	0	0	0
Import (kt)	45	7	359
Purchase +Import (kt)	381	356	359
- Production of Lendava, sold in Slovenia (kt)	53	48	
- Export Lendava			
- Internal Consumption (kt)	0	169	
Total Production in Slovenia (kt)	53	48	0
Real Import (kt)	328	307	359
Export, as reported by Elektrogospodarstvo - Sales of Istrabenz abroad (kt)	4	9	
Export, as reported by Nafta Lendava (kt)	0	0	0
Export - Total (kt)	4	9	2
Stock Change (kt)	6	0	-14
Consumption in Slovenia minus Production of Lendava (kt)	318	298	371
Factor MJ/kg	42.7	42.7	42.7
Consumption (TJ)	13584	12719	15825
Emission Factor (t C/TJ)	20.29	20.29	20.20
Emission (Gg C)	276	258	320
Oxidised Fraction	0.99	0.99	0.99
Conversion of C to CO <sub>2</sub>	3.6667	3.6667	3.6667
Emission (Gg CO <sub>2</sub> )	1001	937	1160

Data Source: Ministry of the Economy: Statistični letopis energetskega gospodarstva republike Slovenije 1986-2003, Ljubljana: Ministry of the Economy, Table Tg/1, Tg/5 and in the electronic files ZBIRNA\_E8\_YYYY.xls for 2004-2009

Source of Emission Factors: Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p.1.13

**From 2009 heating oil is included under Gas/Diesel oil while in the previous years it was included under Residual Fuel oil.**



### 1.2.3 (Residual) Fuel Oil

**Table 4: Consumption of (Residual) Fuel Oil and Calculation of Emission of CO<sub>2</sub> from Consumption of Fuel Oil in Slovenia for the Period 1986 to 1995.**

	1986	1990	1995
Purchase (kt)	610	713	
Production (kt)			
Import (kt)	81	103	577
Purchase +Import (kt)	691	816	577
- Production of Lendava, sold in Slovenia (kt)	135	76	
- Export Lendava	59	75	
- Internal Consumption (kt)			
Total Production in Slovenia (kt)	194	151	
Real Import (kt)	497	665	577
Export, as reported by Elektrogospodarstvo - Sales of Istrabenz abroad (kt)	2	4	
Export, as reported by Nafta Lendava (kt)	9	34	
Export - Total (kt)	11	38	1
Stock Change (kt)	2	36	-9
Consumption in Slovenia minus Production of Lendava (kt)	484	591	585
Factor MJ/kg	41.02	41.30	41.64
Consumption (TJ)	19861	24414	24374
Emission Factor (t C/TJ)	20.61	20.48	20.33
Emission (Gg C)	409	500	495
Oxidised Fraction	0.99	0.99	0.99
Conversion of C to CO <sub>2</sub>	3.6667	3.6667	3.6667
Emission (Gg CO <sub>2</sub> )	1486	1815	1798

Data Source: Ministry of the Economy: Statistični letopis energetskega gospodarstva republike Slovenije 1986-2003, Ljubljana: Ministry of the Economy, Table Tg/1, Tg/5 for the period 2004 we have obtained data from SORS in electronic format (file name E\_8\_YYYY.xls).

Source of Emission Factors: Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p.1.13

Because of the differing definitions for individual categories within the category "Fuel Oil" (extra light, light, residual) a direct presentation of separate data for the production of fuel oil and residual fuel oil is not possible. Those data after 1992 are not even necessary for the presentation of consumption in the reference approach. For the period 1986 to 1991, estimation is necessary. LEG (Table TG/5) brings only data for the total production of fuel oil and residual fuel oil in Nafta Lendava. The Statistical Office of the Republic of Slovenia (Statistical Office of the Republic of Slovenia: SL-86 to 91) publishes data on the production of fuel oil in its publications. However, data on the production of residual fuel oil are reported under the category Fuel Oil (cf. data on production for the period 1992 to 2002 in LEG and SL-96, p. 287). For the period 1986 to 1991 data have been estimated.

**Since 2009 heavy fuel oil have been included under residual fuel oil, while heating oil is included under Fuel/Diesel oil.**

## 1.2.4 Bitumen and Lubricants

IPCC methodology (Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p. I.21) enables reporting the consumption of secondary fuels or products only in the case of their being imported. In Slovenia, the exact data on the import of bitumen are available since 1998. This section takes into account the presumption that all consumed quantities of bitumen have been imported. The consumption of imported bitumen has no influence on the final emissions of CO<sub>2</sub> as all carbon is stored in products.

For the consumption of lubricants, only imported quantities should be specified, since emissions of other quantities have already been taken into account for the processing of crude oil. Since these data (on import) are available in Slovenia only for 2004-2009 in satisfactory quality, the quantities on the consumption of lubricants are not specified for other years.

Emissions from lubricants are reported in manufacturing industry as combustion of waste oils. The remaining CO<sub>2</sub> is stored in the product. Emissions are also included in the road transport where EFs from Copert model take into account also use of motor oil.

## 1.2.5 Petroleum Coke

The calculation of consumption of petroleum coke in Slovenia has been done on the basis of data from the research of the Institute of Metals and Technology (Breskvar, Torkar 1999) and the report of the Treibacher Schleifmittel d.o.o. (Nekrep 1999). No adequate data are available for Slovenia, which would enable presentation similar to that for other secondary liquid fuels. Most petroleum coke is consumed in Talum, Kidričevo for the production of electrodes and in Salonit for cement production, whereas until 1994 small quantities were used in the production of silicon carbide by Tovarna Dušika Ruše. The balance for Slovenia has been done on the basis of the reports of those three enterprises.

## 1.2.6 Hard Coal

The calculation of the consumption of hard coal in Slovenia has been done on the basis of data from Table P/1, Statistični letopis energetskega gospodarstva republike Slovenije 1986-1996, Ljubljana: Ministry of the Economy.

IPCC guidelines (Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p. I.14 -I.20) suggest a conversion factor from natural units to Joules from 18.00 to 33.5 TJ/1000 t, for the former Yugoslavia from 23.6 to 30.7 TJ/1000 tonnes. LEG reports specify for different years emission factors from 25 to 27.86 TJ/1000 tonnes (Ministry of the Economy: Statistični letopis energetskega gospodarstva republike Slovenije 1986-2003, Ljubljana: Ministry of the Economy, Table Zb/1). Based on measurements, the emission factor of the Ministry of the Economy has been taken into account in calculations for individual years.

Emission of CO<sub>2</sub> has been calculated based on the formula and factors from IPCC guidelines (Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p. I.13., I. 30)

Basic sources do not specify any uncertainties. All utilized input data are taken from official inventories, while calculations take into account the factor of calorific value of a fuel as specified by the Ministry of the Economy of the Republic of Slovenia, hence the uncertainties

are supposed to be low. For emission factors, the uncertainties are somewhat higher. The emission factors applied are taken from IPCC methodology (and are not a result of measurements in Slovenia).

### 1.2.7 Lignite and Brown Coal

The calculation of consumption of brown coal and lignite in Slovenia has been done on the basis of data from Table Zb/1. , Statistični letopis energetskega gospodarstva republike Slovenije 1986-2003, Ljubljana: Ministry of the Economy. For the year 2004 we have obtained data from SORS in electronic format (file names: E\_10\_2004.xls, E\_11\_2004.xls).

Lignite (CRF) = Lignite (LEG) + Domestic Brown Coal (LEG)  
Sub bituminous coal (CRF) = Imported Brown Coal (LEG)

IPCC guidelines (Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p. I.14 -I.20) suggest a conversion factor from natural units to Joules from 7.8 to 20.0 TJ/1000 t, for former Yugoslavia from 8.9 to 16.7 TJ/1000 t.

LEG reports for individual years specify a calorific value from 9.39 to 10.66 TJ/1000 t for lignite, from 11.25 to 12.76 for domestic brown coal, whereas no factors are specified for imported brown coal. (Ministry of the Economy: Statistični letopis energetskega gospodarstva republike Slovenije 1986-2003, Ljubljana: Ministry of the Economy, Tables Zb/1, Pr/1 and EL/7-0). Calorific values for domestic coal have been taken from SORS.

For 2004-2009 data in electronic format have been obtained from SORS.

For imported brown coal (from America, Russia, Indonesia and the Czech Republic), calorific values have been calculated on the basis of data from main importers.

The imported coal has thus been disaggregated into three consumption segments. Data for the biggest consumer of imported coal, the combined heat and power plant Ljubljana, have been obtained directly from this consumer.

In industry, imported coal is practically used by only one enterprise; consequently, data for the net calorific value (NCV) as reported by that enterprise have been taken into account. For lesser quantities of coal, consumed in general consumption, average net calorific values as reported by the providers to the Statistical Office of the Republic of Slovenia have been considered.

### 1.2.8 Coke Oven/Gas Coke

The calculation of the consumption of coke in Slovenia was done on the basis of data from Table Pr/1, Statistični letopis energetskega gospodarstva republike Slovenije 1986-1996, Ljubljana: Ministry of the Economy. This chapter takes into account the total consumed quantities of coke: both those consumed in production processes as well as those consumed in power generation.

In IPCC guidelines (Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p. I.14 -I.20) the suggested conversion factors from natural units to Joules range from 20.8 to 30.1 TJ/1000 t, for former Yugoslavia 26.9 TJ/1000 t. LEG reports specify for all those years a conversion factor of 29.3

TJ/1000 t (Ministry of the Economy: Statistični letopis energetskega gospodarstva republike Slovenije 1986-2003, Ljubljana: Ministry of the Economy, Table Zb/1). Since the conversion factor is specified on the basis of measurements, the calculations take into account the factor of the Ministry of the Economy. For the period 2004-2007 we have obtained data from SORS in electronic format (file name ZBIRNA\_E\_10\_YYYY.xls).

Emission of CO<sub>2</sub> has been calculated on the basis of the formula and factors from IPCC guidelines (Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p. I.13., I. 30)

Basic sources do not specify any uncertainties. All utilized input data are taken from official inventories, whilst calorific values are in the majority of cases the results of measurements. For the consumption of coke, the major problem is the consumption of petroleum coke, which in some inventories is accounted for while in others it is not. Consequently, the uncertainty is higher than for other solid fuels. The emission factors applied have been taken from IPCC methodology (and are not a result of measurements in Slovenia).

### **1.2.9 Anthracite**

The calculation of the consumption of anthracite in Slovenia has been done on the basis of data from Table Pr/1, Statistični letopis energetskega gospodarstva republike Slovenije 1986-1996, Ljubljana: Ministry of the Economy. This chapter takes into account the total consumed quantities of anthracite: both those consumed in production processes, as well as those consumed in power generation.

In IPCC guidelines (Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p. I.14 -I.20) the suggested conversion factors from natural units to Joules range from 20.8 to 30.1 TJ/1000 t, for former Yugoslavia 26.9 TJ/1000 t. Emission factors specified in LEG range from 29.3 to 31.9 TJ/1000 t (Ministry of the Economy: Statistični letopis energetskega gospodarstva republike Slovenije 1986-2003, Ljubljana: Ministry of the Economy, Table Zb/1). Based on measurements, the emission factor of the Ministry of the Economy has been taken into account in calculations. For the year 2004 we have obtained data from SORS in electronic format (file name E\_10\_2004.xls).

Emission of CO<sub>2</sub> has been calculated on the basis of the formula and factors from IPCC guidelines (Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p. I.13., I. 30)

Basic sources do not specify any uncertainties. All utilized input data are taken from official inventories, while calculations take into account the factor of calorific value of a fuel as specified by the Ministry of the Economy of the Republic of Slovenia, hence the uncertainties are supposed to be low. For emission factors, the uncertainties are somewhat higher. The emission factors applied are taken from IPCC methodology (and are not a result of measurements in Slovenia).

### **1.2.10 Natural Gas**

The calculation of the consumption of natural gas in Slovenia has been done on the basis of data from Table Z/1, Statistični letopis energetskega gospodarstva republike Slovenije 1986-2003, Ljubljana: Ministry of the Economy. For the period 2004-2009 we have obtained data from SORS in electronic format (file name ZBIRNA\_E\_9\_YYYY.xls).

IPCC guidelines (Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996) have required from the very beginning inventories to be compiled in Joules and therefore suggested no conversion factors from natural units to Joules. The factors of calorific value specified in LEG range from 33.5 to 34.1 TJ/1000 t (Ministry of the Economy: Statistični letopis energetskega gospodarstva republike Slovenije 1986-2002, Ljubljana: Ministry of the Economy, Table Zb/1). Based on measurements, the emission factor of the Ministry of the Economy has been taken into account in calculations.

Emission of CO<sub>2</sub> has been calculated on the basis of the formula from IPCC guidelines (Intergovernmental Panel on Climate Change: Greenhouse Gas Inventory - Reference manual, UNEP-OECD-IEA-IPCC, Bracknell 1996, p. I.13., I. 30). Emission factors have been taken from the documents of the Institute of Energy Industries (Gasperič M., Dornik M.: Določitev emisijskega faktorja CO<sub>2</sub> pri energetske izrabi ter emisijskega faktorja CH<sub>4</sub> pri transportu in distribuciji zemeljskega plina, Ljubljana: Institute of Energy Industries, 1998).

Basic sources do not specify any uncertainties. All utilized input data are taken from official inventories, while calculations take into account the factor of calorific value of a fuel as specified by the Ministry of the Economy of the Republic of Slovenia, hence the uncertainties are supposed to be low. For emission factors, the uncertainty is low since they are the result of measurements in Slovenia.

#### **Energy balance available on the SORS web page.**

Since 2000 data about balance of solid, liquid and gas fuels supply, Slovenia are available also on SORS web page:

[http://www.stat.si/pxweb/Database/Environment/18\\_energy/04\\_18180\\_fuels/04\\_18180\\_fuels.asp](http://www.stat.si/pxweb/Database/Environment/18_energy/04_18180_fuels/04_18180_fuels.asp)

This data are rounded on thousand tonnes and not all types of fuel are presented in this source. For this reason we did not use these data for reference approach.

**Balance of solid, liquid and gas fuels supply, Slovenia, as reportet on SORS web page**

[http://www.stat.si/pxweb/Database/Environment/18\\_energy/04\\_18180\\_fuels/04\\_18180\\_fuels.asp](http://www.stat.si/pxweb/Database/Environment/18_energy/04_18180_fuels/04_18180_fuels.asp)

<b>Domestic lignite (1000 t)</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
Production	3743	3448	4048	4222	4198	3945	3934	4052	4032	3918	4011
Import	...	...	...	...	...	...	...	...	...	...	...
Export	-1	...	...	...	...	...	...	...	...	...	...
International Marine Bunkers	...	...	...	...	...	...	...	...	...	...	...
Stock change	-24	562	313	-131	-24	69	58	26	20	-53	-54
Total primary supply	3718	4010	4361	4091	4174	4014	3992	4078	4052	3865	3957
Transformation	3718	3983	4344	4078	4174	4014	3992	4078	4052	3865	3957
Total final consumption	0	27	17	13	...	...	...	...	...	...	...
Final consumption-Energy sector	...	...	...	...	...	...	...	...	...	...	...
Final consumption-Manufacturing and construction	...	...	...	...	...	...	...	...	...	...	...
Final consumption-Transport	...	...	...	...	...	...	...	...	...	...	...
Final consumption-Households	0	27	17	13	...	...	...	...	...	...	...
Final consumption-Other consumers	...	...	...	...	...	...	...	...	...	...	...
Non-energy use	...	...	...	...	...	...	...	...	...	...	...

<b>Domestic brown coal (1000 t)</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
Production	737	685	639	608	611	595	588	483	489	511	419
Import	...	...	...	...	...	...	...	...	...	...	...
Export	0	...	...	...	...	...	...	...	...	...	...
International Marine Bunkers	...	...	...	...	...	...	...	...	...	...	...
Stock change	23	43	23	45	-6	-29	64	72	-49	1	-68
Total primary supply	760	728	662	653	605	566	652	555	440	512	351
Transformation	749	724	659	651	605	566	652	555	440	512	351
Total final consumption	11	4	3	2	0	...	...	...	...	...	...
Final consumption-Energy sector	...	...	...	...	...	...	...	...	...	...	...
Final consumption-Manufacturing and construction	7	...	...	...	...	...	...	...	...	...	...
Final consumption-Transport	...	...	...	...	...	...	...	...	...	...	...
Final consumption-Households	4	4	3	2	0	...	...	...	...	...	...
Final consumption-Other consumers	...	...	...	...	...	...	...	...	...	...	...
Non-energy use	...	...	...	...	...	...	...	...	...	...	...

Imported lignite (1000 t)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Production	...	...	...	...	...	...	...	...	...	...	...
Import	...	...	...	...	...	...	31	70	141	110	58
Export	...	...	...	...	...	...	...	...	...	...	...
International Marine Bunkers	...	...	...	...	...	...	...	...	...	...	...
Stock change	...	...	...	...	...	...	-10	-33	-32	-37	37
Total primary supply	...	...	...	...	...	...	21	37	109	73	95
Transformation	...	...	...	...	...	...	21	37	109	73	95
Total final consumption	...	...	...	...	...	...	...	...	...	...	...
Final consumption-Energy sector	...	...	...	...	...	...	...	...	...	...	...
Final consumption-Manufacturing and construction	...	...	...	...	...	...	...	...	...	...	...
Final consumption-Transport	...	...	...	...	...	...	...	...	...	...	...
Final consumption-Households	...	...	...	...	...	...	...	...	...	...	...
Final consumption-Other consumers	...	...	...	...	...	...	...	...	...	...	...
Non-energy use	...	...	...	...	...	...	...	...	...	...	...

Imported brown coal (1000 t)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Production	...	...	...	...	...	...	...	...	...	...	...
Import	-	431	537	514	584	544	558	497	694	396	490
Export	-	-29	...	-11	-49	-20	-34	-2	0	0	0
International Marine Bunkers	...	...	...	...	...	...	...	...	...	...	...
Stock change	...	61	0	43	14	39	-2	31	-161	71	10
Total primary supply	-	463	537	546	549	563	522	526	533	467	500
Transformation	-	402	463	477	479	489	454	470	485	414	436
Total final consumption	...	...	...	...	...	...	...	...	...	...	...
Final consumption-Energy sector	...	...	...	...	...	...	...	...	...	...	...
Final consumption-Manufacturing and construction	-	53	71	68	70	74	68	56	48	53	64
Final consumption-Transport	...	...	...	...	...	...	...	...	...	...	...
Final consumption-Households	-	8	3	1	0	...	...	...	...	...	...
Final consumption-Other consumers	...	...	...	...	...	...	...	...	...	...	...
Non-energy use	...	...	...	...	...	...	...	...	...	...	...

<b>Liquefied petroleum gas (1000 t)</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
Production	-	-	-	-	-	-	-	-	-	-	-
Import	93	86	86	88	86	87	97	90	100	93	95
Export	0	0	0	0	0	0	-5	-8	-13	-11	-9
International Marine Bunkers	...	...	...	...	...	...	...	...	...	...	...
Stock change	-1	2	-2	0	-3	2	-9	2	-2	-1	-2
Total primary supply	92	88	84	88	83	89	83	84	85	81	84
Transformation	0	...	...	...	...	...	...	...	...	...	...
Total final consumption	92	88	84	88	83	89	83	84	85	81	84
Final consumption-Energy sector	-	-	-	-	-	-	-	-	-	-	-
Final consumption-Manufacturing and construction	12	12	10	19	20	25	29	18	21	19	20
Final consumption-Transport	-	-	-	-	-	-	1	2	2	4	5
Final consumption-Households	41	41	50	50	43	45	34	35	40	34	33
Final consumption-Other consumers	39	35	24	19	20	19	17	27	21	23	25
Non-energy use	...	...	...	...	...	...	2	2	1	1	1

<b>Unleaded motor gasoline 95 (1000 t)</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
Production	...	...	...	...	...	...	...	...	...	...	...
Import	-	732	727	731	669	688	642	605	703	603	663
Export	-	-20	-14	-16	-18	-59	-74	-69	-100	-100	-142
International Marine Bunkers	-	...	...	...	...	...	...	...	...	...	...
Stock change	-	7	8	-7	-22	-11	14	25	-22	29	-11
Total primary supply	-	719	721	708	629	618	582	561	581	532	510
Transformation	-	-	-	-	-	-	-	-	-	-	-
Total final consumption	-	719	721	708	629	618	582	561	581	532	510
Final consumption-Energy sector	-	-	-	-	-	-	-	-	-	-	-
Final consumption-Manufacturing and construction	-	5	5	5	4	2	1	0	0	0	0
Final consumption-Transport	-	714	716	703	625	616	581	561	581	532	510
Final consumption-Households	-	-	-	-	-	-	-	-	-	-	-
Final consumption-Other consumers	-	-	-	-	-	-	-	-	-	-	-
Non-energy use	-	-	-	-	-	-	-	-	-	-	-



Unleaded motor gasoline 98 (1000 t)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Production	...	...	...	...	...	...	...	...	...	...	...
Import	-	58	47	40	39	39	58	62	72	69	65
Export	-	0	0	0	0	0	-1	-2	-1	-4	-5
International Marine Bunkers	-	...	...	...	...	...	...	...	...	...	...
Stock change	-	-3	0	0	0	0	0	0	0	1	0
Total primary supply	-	55	47	40	39	39	57	60	71	66	60
Transformation	-	-	-	-	-	-	-	-	-	-	-
Total final consumption	-	55	47	40	39	39	57	60	71	66	60
Final consumption-Energy sector	-	-	-	-	-	-	-	-	-	-	-
Final consumption-Manufacturing and construction	-	0	0	0	0	0	0	0	0	0	0
Final consumption-Transport	-	55	47	40	39	39	57	60	71	66	60
Final consumption-Households	-	-	-	-	-	-	-	-	-	-	-
Final consumption-Other consumers	-	-	-	-	-	-	-	-	-	-	-
Non-energy use	-	-	-	-	-	-	-	-	-	-	-

  

Biogasoline (1000 t)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Production	...	...	...	...	...	...	...	...	...	...	...
Import	...	...	...	...	...	...	...	1	4	3	5
Export	...	...	...	...	...	...	...	...	...	...	...
International Marine Bunkers	...	...	...	...	...	...	...	...	...	...	...
Stock change	...	...	...	...	...	...	...	0	0	0	0
Total primary supply	...	...	...	...	...	...	...	1	4	3	5
Transformation	...	...	...	...	...	...	...	-	-	-	-
Total final consumption	...	...	...	...	...	...	...	1	4	3	5
Final consumption-Energy sector	...	...	...	...	...	...	...	-	-	-	-
Final consumption-Manufacturing and construction	...	...	...	...	...	...	...	-	-	-	-
Final consumption-Transport	...	...	...	...	...	...	...	1	4	3	5
Final consumption-Households	...	...	...	...	...	...	...	-	-	-	-
Final consumption-Other consumers	...	...	...	...	...	...	...	-	-	-	-
Non-energy use	...	...	...	...	...	...	...	-	-	-	-

<b>Diesel oil (1000 t)</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
Production	25	...	...	...	...	...	...	...	...	...	...
Import	519	582	630	689	830	981	1203	1475	1801	1457	1571
Export	-87	-73	-73	-49	-61	-132	-286	-304	-356	-278	-395
International Marine Bunkers	...	...	...	...	...	...	...	...	...	...	...
Stock change	-11	-6	11	-20	-19	-3	45	-18	-26	8	9
Total primary supply	446	503	568	620	750	846	962	1153	1419	1187	1185
Transformation	-	-	-	-	-	-	-	-	-	-	-
Total final consumption	446	503	568	620	750	846	962	1153	1419	1187	1185
Final consumption-Energy sector	-	-	-	-	-	-	-	-	-	-	-
Final consumption-Manufacturing and construction	33	34	32	46	42	41	65	50	53	43	30
Final consumption-Transport	413	469	536	574	708	805	897	1103	1366	1144	1155
Final consumption-Households	-	-	-	-	-	-	-	-	-	-	-
Final consumption-Other consumers	-	-	-	-	-	-	-	-	-	-	-
Non-energy use	...	...	...	...	...	...	...	...	...	...	...

<b>Biodiesel oil (1000 t)</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
Production	...	...	...	...	...	...	...	5	8	7	19
Import	...	...	...	...	...	...	...	10	17	25	42
Export	...	...	...	...	...	...	...	...	...	0	-13
International Marine Bunkers	...	...	...	...	...	...	...	...	...	...	...
Stock change	...	...	...	...	...	...	...	0	0	0	0
Total primary supply	...	...	...	...	...	...	...	15	25	32	48
Transformation	...	...	...	...	...	...	...	-	-	-	-
Total final consumption	...	...	...	...	...	...	...	15	25	32	48
Final consumption-Energy sector	...	...	...	...	...	...	...	-	-	-	-
Final consumption-Manufacturing and construction	...	...	...	...	...	...	...	-	-	-	-
Final consumption-Transport	...	...	...	...	...	...	...	15	25	32	48
Final consumption-Households	...	...	...	...	...	...	...	-	-	-	-
Final consumption-Other consumers	...	...	...	...	...	...	...	-	-	-	-
Non-energy use	...	...	...	...	...	...	...	-	-	-	-

Light fuel oil (1000 t)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Production	31	...	...	...	...	...	...	...	...	...	...
Import	738	787	747	705	690	660	595	414	550	541	588
Export	-42	-47	-14	-6	-20	-9	-18	-10	-33	-62	-101
International Marine Bunkers	...	...	...	...	...	...	...	...	...	...	...
Stock change	-21	26	-33	-3	11	-21	16	17	-3	8	-6
Total primary supply	706	766	700	696	681	630	593	421	514	487	481
Transformation	6	25	7	7	6	6	9	9	6	9	7
Total final consumption	700	741	693	689	675	624	584	412	508	478	474
Final consumption-Energy sector	-	-	-	-	-	-	0	0	0	0	0
Final consumption-Manufacturing and construction	129	86	48	63	58	70	70	51	46	40	42
Final consumption-Transport	-	-	-	-	-	-	-	-	-	-	-
Final consumption-Households	334	313	372	414	397	345	334	243	267	254	267
Final consumption-Other consumers	237	342	273	212	219	208	178	117	195	182	165
Non-energy use	-	-	-	-	1	1	2	1	0	2	0

Heavy fuel oil (1000 t)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Production	42	-	-	-	-	-	-	-	-	-	-
Import	88	110	82	63	52	71	84	78	85	53	27
Export	-3	-1	0	0	-2	0	0	-10	-3	0	0
International Marine Bunkers	...	...	...	...	...	-22	-30	-49	-67	-33	-18
Stock change	0	3	0	-2	2	3	-2	0	2	0	0
Total primary supply	127	112	82	61	52	52	52	19	17	20	9
Transformation	10	10	10	9	7	8	9	2	2	4	1
Total final consumption	117	102	72	52	45	44	43	17	15	16	8
Final consumption-Energy sector	14	-	-	-	-	-	-	-	-	-	-
Final consumption-Manufacturing and construction	96	82	50	52	45	44	43	17	15	16	8
Final consumption-Transport	-	-	-	-	-	-	-	-	-	-	-
Final consumption-Households	-	-	-	-	-	-	-	-	-	-	-
Final consumption-Other consumers	7	20	22	-	-	-	-	-	-	-	-
Non-energy use	...	...	...	...	...	...	...	...	...	...	...

Natural gas (mio Sm3)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Production	7	6	6	5	5	4	4	3	3	3	7
Import	1007	1038	1001	1109	1099	1137	1101	1120	1076	1019	1053
Export	...	...	...	...	...	...	...	...	...	...	...
International Marine Bunkers	...	...	...	...	...	...	...	...	...	...	...
Stock change	...	...	...	...	...	...	...	...	...	...	...
Total primary supply	1014	1044	1007	1114	1104	1141	1105	1123	1079	1022	1060
Transformation	164	161	156	180	155	165	154	166	171	202	193
Total final consumption	850	883	851	934	949	976	951	957	908	820	867
Final consumption-Energy sector	7	6	6	5	5	4	4	4	3	3	8
Final consumption-Manufacturing and construction	604	563	529	613	628	665	676	674	646	552	593
Final consumption-Transport	-	-	-	-	-	-	-	-	-	-	-
Final consumption-Households	72	76	84	106	112	121	115	105	126	130	140
Final consumption-Other consumers	23	98	112	59	68	31	17	13	15	24	29
Non-energy use	144	140	120	151	136	155	139	161	118	111	97

Domestic lignite (1000 t)

Sulphur from year 2000 to 2008 is 1,36%.

Domestic brown coal (1000 t)

Sulphur by years: 1.53% (in 2000), 1.53% (in 2001), 2.47% (in 2002), 2.99% (in 2003), 3.07% (in 2004), 2,49% (in 2005), 2,88% (in 2006), 2,96% (in 2007), 2,04% (in 2008), 2,19% (in 2009).

Liquefied petroleum gas (1000 t)

Liquefied Petroleum Gases (LPG): LPG are light saturated paraffinic hydrocarbons derived from the refinery processes, crude oil stabilisation and natural gas processing plants. They consist mainly of propane (C<sub>3</sub>H<sub>8</sub>) and butane (C<sub>4</sub>H<sub>10</sub>) or a combination of the two. They are normally liquefied under pressure for transportation and storage.

Unleaded motor gasoline 95 (1000 t)

Unleaded motor gasoline is motor gasoline where lead compounds have not been added to enhance octane rating. It may contain traces of organic lead. We distinguish between unleaded 95-octane motor gasoline and unleaded 98-octane motor gasoline.

Unleaded motor gasoline 98 (1000 t)

Unleaded motor gasoline is motor gasoline where lead compounds have not been added to enhance octane rating. It may contain traces of organic lead. We distinguish between unleaded 95-octane motor gasoline and unleaded 98-octane motor gasoline.

Diesel oil (1000 t)

Diesel oil for diesel compression ignition (cars, trucks, marine, etc.), is primarily one of medium distillates of Fuel Oil.

Light fuel oil (1000 t)

Fuel oil, light is primarily a medium distillate and is used in heating systems for warmth and heat for industrial and commercial uses

Fuel oil (1000 t)

Fuel oil covers all residual (heavy) fuel oils (including those obtained by blending). Kinematic viscosity is above 10 cSt at 80°C. The flash point is always above 50°C and density is always more than 0.90 kg/l.

Low sulphur content: Heavy fuel oil with sulphur content lower than 1%.

High sulphur content: Heavy fuel oil with sulphur content of 1% or higher.

Natural gas (mio Sm<sup>3</sup>)

Natural gas is a fossil fuel comprised of gases, occurring in underground deposits, whether liquefied or gaseous, consisting mainly of methane. Gas consumption is measured with gas meters in Sm<sup>3</sup>. GCV = 37862 kJ/Sm<sup>3</sup>