

ANNEXES TO THE NATIONAL INVENTORY REPORT
2008

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Annex 1 Key Categories

A1.1. Description of methodology used for identifying key sources

The IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000) recommend as good practice the identification of key source categories of emissions. As a result of the adoption (Decision 13/CP.9) of the LULUCF Good Practice Guidance (IPCC, 2003) the concept of key sources has been expanded in order to cover LULUCF emissions by sources and removals by sinks. Therefore the term key category is used in order to include both sources and sinks.

Generally, inventory uncertainty is lower when emissions are estimated using the available most rigorous methods, but due to finite resources this may not be feasible for every category. Therefore it is good practice to identify those categories (key categories) that have the greatest contribution to overall inventory uncertainty in order to make the most efficient use of available resources. In that context, a "key category" is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions (level assessment) or/and to the trend of emissions (trend assessment).

This annex describes the key category analysis conducted for the 2008 Hungarian inventory. Good practice first requires that inventories be disaggregated into categories from which key sources and sinks may be identified. Adopting the detailed categorization of sources/sinks that is recommended by the European Union (see *Table A1-1*), analysis of key categories was conducted according to the Tier1 methodology described in the IPCC Good Practice Guidance. This approach identifies key categories from two perspectives. The first analyzes the emission contribution that each category makes to the national total (with LULUCF). The second perspective analyzes the trend of emission contributions from each category to identify where the greatest absolute changes (either increases or reductions) have taken place over a given time (with LULUCF categories). The percent contributions to both levels and trends in emissions are calculated and sorted from greatest to least. A cumulative total is calculated for both approaches. IPCC has determined that a cumulative contribution threshold of 95% for both level and trend assessments is a reasonable approximation of 90% uncertainty for the Tier 1 method of determining key categories (IPCC, 2000). The 95% cumulative contribution threshold has been used in this analysis to define an upper boundary for key category identification. Therefore, when source and/or sink contributions are sorted in decreasing order of importance, those that contribute to 95% of the cumulative total are considered quantitatively to be key. Results for these analysis are shown in *Table A1-3* and *Table A1-4*.

Since uncertainty estimates are not available for the LULUCF sector Tier 2 method was applied to find key categories only for source categories (without LULUCF) and for more aggregated categories, which were used in the previous submissions (see *Table A1-2*). The required uncertainty values for source categories are listed in *Table A7-1*. The calculation was performed using the spreadsheet 6.1 described in the IPCC Good Practice Guidance (IPCC, 2000). The percent contributions to both levels and trends in emissions are calculated and sorted from greatest to least. A cumulative total is calculated for both approaches and the key source categories are identified by accounting for those that add up to 90 % of the cumulative total. Results from Tier 2 approach can be seen in *Table A1-5*, *Table A1-6*.

A1.2. Reference to the key source tables in the CRF

Table A1-1. IPCC source/sink categories for Tier 1 key source analysis

CRF code	sub-categories	IPCC Source/Sink Categories	Direct Greenhouse Gas
1A1a	li, so, ga, ot	Energy - Stationary Combustion - Public electricity and heat production	CO ₂
1A1a	li, so, ga, ot, bi	Energy - Stationary Combustion - Public electricity and heat production	CH ₄
1A1a	li, so, ga, ot, bi	Energy - Stationary Combustion - Public electricity and heat production	N ₂ O
1A1b	li, ga, ot	Energy - Stationary Combustion - Petroleum refining	CO ₂
1A1b	li, ga, ot, bi	Energy - Stationary Combustion - Petroleum refining	CH ₄
1A1b	li, ga, ot, bi	Energy - Stationary Combustion - Petroleum refining	N ₂ O
1A1c	li, so, ga	Energy - Stationary Combustion - Manuf. of solid fuels and other energy industries	CO ₂
1A1c	li, so, ga, bi	Energy - Stationary Combustion - Manuf. of solid fuels and other energy industries	CH ₄
1A1c	li, so, ga, bi	Energy - Stationary Combustion - Manuf. of solid fuels and other energy industries	N ₂ O
1A2a	li, so, ga	Energy - Stationary Combustion - Iron and steel	CO ₂
1A2a	li, so, ga, bi	Energy - Stationary Combustion - Iron and steel	CH ₄
1A2a	li, so, ga, bi	Energy - Stationary Combustion - Iron and steel	N ₂ O
1A2b	li, so, ga, ot	Energy - Stationary Combustion - Non-ferrous metals	CO ₂
1A2b	li, so, ga, ot, bi	Energy - Stationary Combustion - Non-ferrous metals	CH ₄
1A2b	li, so, ga, ot, bi	Energy - Stationary Combustion - Non-ferrous metals	N ₂ O
1A2c	li, so, ga	Energy - Stationary Combustion - Chemicals	CO ₂
1A2c	li, so, ga, bi	Energy - Stationary Combustion - Chemicals	CH ₄
1A2c	li, so, ga, bi	Energy - Stationary Combustion - Chemicals	N ₂ O
1A2d	li, so, ga	Energy - Stationary Combustion - Pulp, paper and print	CO ₂
1A2d	li, so, ga, bi	Energy - Stationary Combustion - Pulp, paper and print	CH ₄
1A2d	li, so, ga, bi	Energy - Stationary Combustion - Pulp, paper and print	N ₂ O
1A2e	li, so, ga	Energy - Stationary Combustion - Food processing, beverages and tobacco	CO ₂
1A2e	li, so, ga, bi	Energy - Stationary Combustion - Food processing, beverages and tobacco	CH ₄
1A2e	li, so, ga, bi	Energy - Stationary Combustion - Food processing, beverages and tobacco	N ₂ O
1A2f	li, so, ga, ot	Energy - Stationary Combustion - Other	CO ₂
1A2f	li, so, ga, ot, bi	Energy - Stationary Combustion - Other	CH ₄
1A2f	li, so, ga, ot, bi	Energy - Stationary Combustion - Other	N ₂ O
1A3a	lg, lk	Energy - Mobile combustion - Civil aviation	CO ₂
1A3a	lg, lk	Energy - Mobile combustion - Civil aviation	CH ₄
1A3a	lg, lk	Energy - Mobile combustion - Civil aviation	N ₂ O
1A3b	lg, ld, ll, gn	Energy - Mobile combustion - Road transportation	CO ₂
1A3b	lg, ld, ll, gn, bi	Energy - Mobile combustion - Road transportation	CH ₄
1A3b	lg, ld, ll, gn, bi	Energy - Mobile combustion - Road transportation	N ₂ O
1A3c	li, so, ga	Energy - Mobile combustion - Railways	CO ₂
1A3c	li, so, ga	Energy - Mobile combustion - Railways	CH ₄

Table A1-1. IPCC source/sink categories for Tier 1 key source analysis

CRF code	sub-categories	IPCC Source/Sink Categories	Direct Greenhouse Gas
1A3c	li, so, ga	Energy - Mobile combustion - Railways	N ₂ O
1A3d	lr, ld, lg, lu, sc	Energy - Mobile combustion - Navigation	CO ₂
1A3d	lr, ld, lg, lu, sc	Energy - Mobile combustion - Navigation	CH ₄
1A3d	lr, ld, lg, lu, sc	Energy - Mobile combustion - Navigation	N ₂ O
1A4a	li, so, ga	Energy - Stationary Combustion - Commercial/institutional	CO ₂
1A4a	li, so, ga, bi	Energy - Stationary Combustion - Commercial/institutional	CH ₄
1A4a	li, so, ga, bi	Energy - Stationary Combustion - Commercial/institutional	N ₂ O
1A4b	li, so, ga	Energy - Stationary Combustion - Residential	CO ₂
1A4b	li, so, ga, bi	Energy - Stationary Combustion - Residential	CH ₄
1A4b	li, so, ga, bi	Energy - Stationary Combustion - Residential	N ₂ O
1A4c	li, so, ga	Energy - Stationary Combustion - Agriculture/Forestry/Fisheries	CO ₂
1A4c	li, so, ga, bi	Energy - Stationary Combustion - Agriculture/Forestry/Fisheries	CH ₄
1A4c	li, so, ga, bi	Energy - Stationary Combustion - Agriculture/Forestry/Fisheries	N ₂ O
1B1a		Energy - Fugitive Emissions from Fuels - Solid Fuels	CO ₂
1B1a		Energy - Fugitive Emissions from Fuels - Solid Fuels	CH ₄
1B1a		Energy - Fugitive Emissions from Fuels - Solid Fuels	N ₂ O
1B2a		Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	CO ₂
1B2b		Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	CO ₂
1B2c		Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	CO ₂
1B2d		Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	CO ₂
1B2a		Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	CH ₄
1B2b		Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	CH ₄
1B2c		Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	CH ₄
1B2d		Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	CH ₄
1B2a		Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	N ₂ O
1B2b		Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	N ₂ O
1B2c		Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	N ₂ O
1B2d		Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	N ₂ O
2A1		Industrial Processes - Mineral Products - Cement production	CO ₂
2A2		Industrial Processes - Mineral Products - Lime production	CO ₂
2A3		Industrial Processes - Mineral Products - Limestone and dolomit use	CO ₂
2A5		Industrial Processes - Mineral Products - Asphalt roofing	CO ₂
2A6		Industrial Processes - Mineral Products - Road paving with asphalt	CO ₂
2A7		Industrial Processes - Mineral Products - Other	CO ₂
2A7		Industrial Processes - Mineral Products - Other	CH ₄
2A7		Industrial Processes - Mineral Products - Other	N ₂ O
2B1		Industrial Processes - Chemical Industry - Ammonia production	CO ₂
2B1		Industrial Processes - Chemical Industry - Ammonia production	CH ₄

Table A1-1. IPCC source/sink categories for Tier 1 key source analysis

CRF code	sub-categories	IPCC Source/Sink Categories	Direct Greenhouse Gas
2B1		Industrial Processes - Chemical Industry - Ammonia production	N ₂ O
2B2		Industrial Processes - Chemical Industry - Nitric acid production	CO ₂
2B2		Industrial Processes - Chemical Industry - Nitric acid production	N ₂ O
2B5		Industrial Processes - Chemical Industry - Other	CO ₂
2B5		Industrial Processes - Chemical Industry - Other	CH ₄
2B5		Industrial Processes - Chemical Industry - Other	N ₂ O
2C1		Industrial Processes - Metal Production - Iron and steel production	CO ₂
2C1		Industrial Processes - Metal Production - Iron and steel production	CH ₄
2C2		Industrial Processes - Metal Production - Ferroalloys production	CO ₂
2C2		Industrial Processes - Metal Production - Ferroalloys production	CH ₄
2C3		Industrial Processes - Metal Production - Aluminium production	CO ₂
2C3		Industrial Processes - Metal Production - Aluminium production	CH ₄
2C4		Industrial Processes - Metal Production - Aluminium production	PFCs
2D		Industrial Processes - Other Production	CO ₂
2E		Industrial Processes - Production of Halocarbons and SF6	HFCs
2E		Industrial Processes - Production of Halocarbons and SF6	PFCs
2E		Industrial Processes - Production of Halocarbons and SF6	SF ₆
2Fa1		Industrial Processes - Consumption of Halocarbons and SF6 - Refrigeration and air conditioning equipment	HFCs
2Fa1		Industrial Processes - Consumption of Halocarbons and SF6 - Refrigeration and air conditioning equipment	PFCs
2Fa1		Industrial Processes - Consumption of Halocarbons and SF6 - Refrigeration and air conditioning equipment	SF ₆
2Fa2		Industrial Processes - Consumption of Halocarbons and SF6 - Foam blowing	HFCs
2Fa2		Industrial Processes - Consumption of Halocarbons and SF6 - Foam blowing	PFCs
2Fa2		Industrial Processes - Consumption of Halocarbons and SF6 - Foam blowing	SF ₆
2Fa4		Industrial Processes - Consumption of Halocarbons and SF6 - Aerosols	HFCs
2Fa4		Industrial Processes - Consumption of Halocarbons and SF6 - Aerosols	PFCs
2Fa4		Industrial Processes - Consumption of Halocarbons and SF6 - Aerosols	SF ₆
2Fa8		Industrial Processes - Consumption of Halocarbons and SF6 - Electrical equipment	HFCs
2Fa8		Industrial Processes - Consumption of Halocarbons and SF6 - Electrical equipment	PFCs
2Fa8		Industrial Processes - Consumption of Halocarbons and SF6 - Electrical equipment	SF ₆
2Fa9		Industrial Processes - Consumption of Halocarbons and SF6 - Other	HFCs
2Fa9		Industrial Processes - Consumption of Halocarbons and SF6 - Other	PFCs
2Fa9		Industrial Processes - Consumption of Halocarbons and SF6 - Other	SF ₆
2G1		Industrial Processes - Feedstocks	CO ₂
2G2		Industrial Processes - Non-energy use of fuels	CO ₂
3a		Solvent and Other Product Use - Paint Application	CO ₂

Table A1-1. IPCC source/sink categories for Tier 1 key source analysis

CRF code	sub-categories	IPCC Source/Sink Categories	Direct Greenhouse Gas
3b		Solvent and Other Product Use - Degreasing and Dry Cleaning	CO ₂
3d		Solvent and Other Product Use - Other	N ₂ O
4A1	ca	Agriculture - Enteric Fermentation	CH ₄
4A2	bu	Agriculture - Enteric Fermentation	CH ₄
4A3	sh	Agriculture - Enteric Fermentation	CH ₄
4A4	ot	Agriculture - Enteric Fermentation	CH ₄
4A	ot	Agriculture - Enteric Fermentation	CH ₄
4B1	ca	Agriculture - Manure Management	CH ₄
4B2	bu	Agriculture - Manure Management	CH ₄
4B3	sh	Agriculture - Manure Management	CH ₄
4B4	ot	Agriculture - Manure Management	CH ₄
4B8	sw	Agriculture - Manure Management	CH ₄
4B13	so	Agriculture - Manure Management	CH ₄
4B	ot	Agriculture - Manure Management	CH ₄
4B1	ca	Agriculture - Manure Management	N ₂ O
4B2	bu	Agriculture - Manure Management	N ₂ O
4B3	sh	Agriculture - Manure Management	N ₂ O
4B4	ot	Agriculture - Manure Management	N ₂ O
4B8	sw	Agriculture - Manure Management	N ₂ O
4B13	so	Agriculture - Manure Management	N ₂ O
4B	ot	Agriculture - Manure Management	N ₂ O
4C		Agriculture - Rice Cultivation	CH ₄
4D1		Agriculture - Agricultural Soils - Direct soil emissions	CH ₄
4D1		Agriculture - Agricultural Soils - Direct soil emissions	N ₂ O
4D2		Agriculture - Agricultural Soils - Pasture, range and paddock manure	N ₂ O
4D3		Agriculture - Agricultural Soils - Indirect emissions	CH ₄
4D3		Agriculture - Agricultural Soils - Indirect emissions	N ₂ O
4F		Agriculture - Field Burning of Agricultural Residues	CH ₄
4F		Agriculture - Field Burning of Agricultural Residues	N ₂ O
5A1		Land Use, Land-Use Change and Forestry - Forest Land - remaining	CO ₂
5A1		Land Use, Land-Use Change and Forestry - Forest Land - remaining	CH ₄
5A1		Land Use, Land-Use Change and Forestry - Forest Land - remaining	N ₂ O
5A2		Land Use, Land-Use Change and Forestry - Forest Land - converted to	CO ₂
5A2		Land Use, Land-Use Change and Forestry - Forest Land - converted to	CH ₄
5A2		Land Use, Land-Use Change and Forestry - Forest Land - converted to	N ₂ O
5B1		Land Use, Land-Use Change and Forestry - Cropland - remaining	CO ₂
5B1		Land Use, Land-Use Change and Forestry - Cropland - remaining	CH ₄
5B1		Land Use, Land-Use Change and Forestry - Cropland - remaining	N ₂ O

Table A1-1. IPCC source/sink categories for Tier 1 key source analysis

CRF code	sub-categories	IPCC Source/Sink Categories	Direct Greenhouse Gas
5B2		Land Use, Land-Use Change and Forestry - Cropland - converted to	CO ₂
5B2		Land Use, Land-Use Change and Forestry - Cropland - converted to	CH ₄
5B2		Land Use, Land-Use Change and Forestry - Cropland - converted to	N ₂ O
5C1		Land Use, Land-Use Change and Forestry - Grassland remaining Grassland	CO ₂
5C2		Land Use, Land-Use Change and Forestry - Land converted to Grassland	CO ₂
5F2		Land Use, Land-Use Change and Forestry - Land converted to Other Land	CO ₂
6A		Waste - Solid Waste Disposal on Land	CO ₂
6A		Waste - Solid Waste Disposal on Land	CH ₄
6B1		Waste - Waste-water Handling - Industrial	CH ₄
6B2		Waste - Waste-water Handling - Domestic and Commercial	CH ₄
6B1		Waste - Waste-water Handling - Industrial	N ₂ O
6B2		Waste - Waste-water Handling - Domestic and Commercial	N ₂ O
6C		Waste - Waste Incineration	CO ₂
6C		Waste - Waste Incineration	CH ₄
6C		Waste - Waste Incineration	N ₂ O

Abbreviations in this table:

li – liquid fuels
so – solid fuels/category
ga – gaseous fuels
ot – other fuels/category
bi – biomass
lr – liquid fuels, residual fuel oil
ld – liquid fuel, diesel oil
lg – liquid fuel, gasoline
lu – liquid fuel, lubricants
sc – solid fuel, coal
lk – liquid fuel, kerosene
ll – liquid fuel, LPG
gn – gaseous fuel, natural gas
ca – cattle
bu – buffalo
sh – sheep
sw – swine

Table A1-2. IPCC source/sink categories for Tier 2 key source analysis

CRF code	IPCC Source/Sink Categories	Direct Greenhouse Gas
1. A	Stationary Combustion - Gas	CO ₂
1. A	Stationary Combustion - Coal	CO ₂
1. A	Stationary Combustion - Oil	CO ₂
1. A	Non-CO ₂ Emission from Stationary Fuel Combustion	N ₂ O
1. A	Non-CO ₂ Emission from Stationary Fuel Combustion	CH ₄
1. A	Stationary Combustion - Other Fuel	CO ₂
1. A. 3	Mobile Combustion	N ₂ O
1. A. 3	Mobile Combustion - Other	CO ₂
1. A. 3	Mobile Combustion	CH ₄
1. A. 3. B	Mobile Combustion - Road Vehicles	CO ₂
1. B. 1	Fugitive Emissions from Coal Mining and Handling	CH ₄
1. B. 1	Fugitive Emissions from Coal Mining and Handling	CO ₂
1. B. 2	Fugitive Emissions from Oil and Gas Operations (Main Source: Gas Distribution)	CH ₄
1. B. 2	Fugitive Emissions from Oil and Gas Operations	CO ₂
1. B. 2	Fugitive Emissions from Oil and Gas Operations	N ₂ O
2.	N ₂ O Emission from Industry	N ₂ O
2.	CH ₄ Emission from Industry	CH ₄
2. A. 1	CO ₂ Emissions from Cement Production	CO ₂
2. A. 2	CO ₂ Emissions from Lime Production	CO ₂
2. A. 3	CO ₂ Emission from Limestone and Dolomit Use	CO ₂
2. A. 7	CO ₂ Emission from Other Mineral Products	CO ₂
2. B. 1	CO ₂ Emissions from Ammonia Processes	CO ₂
2. B. 2	CO ₂ Emissions from Nitric Acid Production	CO ₂
2. C	CO ₂ Emissions from Metal Production	CO ₂
2. C. 3	PFCs Emissions from Industry	PFCs
2. F	Emissions from HFCs consumption	HFCs
2. F. 7	SF ₆ Emissions from Electrical Equipment	SF ₆
2. G	Feedstocks and non-energy use of fuels	CO ₂
3.	N ₂ O Emission from Solvent and Other Product Use	N ₂ O
3.	CO ₂ Emission from Solvent and Other Product Use	CO ₂
4. A	CH ₄ Emissions from Enteric Fermentation in Domestic Livestock	CH ₄
4. B	CH ₄ Emissions from Manure Management	CH ₄
4. B	N ₂ O Emissions from Manure Management	N ₂ O
4. C	CH ₄ Emission from Rice Cultivation	CH ₄
4. D. 1	Direct N ₂ O Emissions from Agricultural Soils	N ₂ O
4. D. 2	Pasture, Range and Paddock Manure	N ₂ O

Table A1-2. IPCC source/sink categories for Tier 2 key source analysis

CRF code	IPCC Source/Sink Categories	Direct Greenhouse Gas
4. D. 3	Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O
4. F	Field Burning of Agricultural Residues	N ₂ O
4. F	Field Burning of Agricultural Residues	CH ₄
6. A	CH ₄ Emissions from Solid Waste Disposal Sites	CH ₄
6. B	Emissions from Wastewater Handling	CH ₄
6. B	Emissions from Wastewater Handling	N ₂ O
6. C	Non-biogenic CO ₂ from Waste	CO ₂
6. C	Emissions from Waste Incineration	CH ₄
6. C	Emissions from Waste Incineration	N ₂ O

A1.3. Results of the key category analysis**Table A1-3. Key Categories with LULUCF, Tier 1 Level Assessment**

CRF Code + subcat.	IPCC Categories	Direct Greenhouse Gas	Emission (Gg)	Emission (Gg CO ₂ eq.)	Level Assessment	Cumulative Total
1A1aga	Energy - Stationary Combustion - Public electricity and heat production	CO ₂	8 620.71	8620.71	0.1090	0.1090
1A1aso	Energy - Stationary Combustion - Public electricity and heat production	CO ₂	8 495.91	8495.91	0.1074	0.2164
1A4bga	Energy - Stationary Combustion - Residential	CO ₂	7 983.95	7983.95	0.1010	0.3174
1A3bld	Energy - Mobile combustion - Road transportation	CO ₂	7 764.46	7764.46	0.0982	0.4156
5A1	Land Use, Land-Use Change and Forestry - Forest Land - remaining	CO ₂	-4 885.83	4885.83	0.0618	0.4774
1A3blg	Energy - Mobile combustion - Road transportation	CO ₂	4 414.87	4414.87	0.0558	0.5332
1A4aga	Energy - Stationary Combustion - Commercial/institutional	CO ₂	3 367.48	3367.48	0.0426	0.5758
4D1	Agriculture - Agricultural Soils - Direct soil emissions	N ₂ O	10.14	3141.92	0.0397	0.6155
6A	Waste - Solid Waste Disposal on Land	CH ₄	139.65	2932.58	0.0371	0.6526
1A2aso	Energy - Stationary Combustion - Iron and steel	CO ₂	2 367.66	2367.66	0.0299	0.6825
4D3	Agriculture - Agricultural Soils - Indirect emissions	N ₂ O	6.05	1875.82	0.0237	0.7063
1B2b	Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	CH ₄	70.82	1487.29	0.0188	0.7251
1A2fga	Energy - Stationary Combustion - Other	CO ₂	1 357.00	1357.00	0.0172	0.7422
4A1ca	Agriculture - Enteric Fermentation	CH ₄	60.05	1261.04	0.0159	0.7582
2A1	Industrial Processes - Mineral Products - Cement production	CO ₂	1 260.65	1260.65	0.0159	0.7741
1A1bli	Energy - Stationary Combustion - Petroleum refining	CO ₂	919.21	919.21	0.0116	0.7857
4B13so	Agriculture - Manure Management	N ₂ O	2.93	909.82	0.0115	0.7972
2G1	Industrial Processes - Feedstocks	CO ₂	855.36	855.36	0.0108	0.8081
4B8sw	Agriculture - Manure Management	CH ₄	39.80	835.90	0.0106	0.8186
1A4cli	Energy - Stationary Combustion - Agriculture/Forestry/Fisheries	CO ₂	789.51	789.51	0.0100	0.8286
1A2cga	Energy - Stationary Combustion - Chemicals	CO ₂	689.64	689.64	0.0087	0.8373
2Fa1	Industrial Processes - Consumption of Halocarbons and SF ₆ - Refrigeration and air conditioning equipment	HFCs	687.57	687.57	0.0087	0.8460

Table A1-3. Key Categories with LULUCF, Tier 1 Level Assessment

CRF Code + subcat.	IPCC Categories	Direct Greenhouse Gas	Emission (Gg)	Emission (Gg CO ₂ eq.)	Level Assessment	Cumulative Total
1A4bso	Energy - Stationary Combustion - Residential	CO ₂	667.41	667.41	0.0084	0.8545
1A2fli	Energy - Stationary Combustion - Other	CO ₂	564.49	564.49	0.0071	0.8616
1A2ega	Energy - Stationary Combustion - Food processing, beverages and tobacco	CO ₂	560.87	560.87	0.0071	0.8687
1A2aga	Energy - Stationary Combustion - Iron and steel	CO ₂	476.29	476.29	0.0060	0.8747
1B2d	Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	CH ₄	22.27	467.69	0.0059	0.8806
6B2	Waste - Waste-water Handling - Domestic and Commercial	CH ₄	22.19	466.06	0.0059	0.8865
1A2fso	Energy - Stationary Combustion - Other	CO ₂	449.14	449.14	0.0057	0.8922
1A1bga	Energy - Stationary Combustion - Petroleum refining	CO ₂	417.19	417.19	0.0053	0.8975
2B1	Industrial Processes - Chemical Industry - Ammonia production	CO ₂	393.28	393.28	0.0050	0.9025
1A4cga	Energy - Stationary Combustion - Agriculture/Forestry/Fisheries	CO ₂	388.28	388.28	0.0049	0.9074
5C1	Land Use, Land-Use Change and Forestry - Grassland remaining Grassland	CO ₂	377.68	377.68	0.0048	0.9121
2A7	Industrial Processes - Mineral Products - Other	CO ₂	374.94	374.94	0.0047	0.9169
3d	Solvent and Other Product Use - Other	N ₂ O	1.10	340.93	0.0043	0.9212
2A2	Industrial Processes - Mineral Products - Lime production	CO ₂	318.50	318.50	0.0040	0.9252
1A1ali	Energy - Stationary Combustion - Public electricity and heat production	CO ₂	316.84	316.84	0.0040	0.9292
2A3	Industrial Processes - Mineral Products - Limestone and dolomit use	CO ₂	315.60	315.60	0.0040	0.9332
1A1aot	Energy - Stationary Combustion - Public electricity and heat production	CO ₂	285.10	285.10	0.0036	0.9368
2C1	Industrial Processes - Metal Production - Iron and steel production	CO ₂	271.60	271.60	0.0034	0.9403
1A3blg	Energy - Mobile combustion - Road transportation	N ₂ O	0.87	269.13	0.0034	0.9437
5B2	Land Use, Land-Use Change and Forestry - Cropland - converted to	CO ₂	266.04	266.04	0.0034	0.9470
1A4bli	Energy - Stationary Combustion - Residential	CO ₂	229.30	229.30	0.0029	0.9499
4A3sh	Agriculture - Enteric Fermentation	CH ₄	10.16	213.28	0.0027	0.9526

Table A1-4. Key Categories with LULUCF, Tier 1 Trend Assessment

CRF Code + subcat.	IPCC Categories	Direct GHG	Base Years (1985-87) Emission (Gg CO ₂ eq.)	Current Year (2008) Emission (Gg CO ₂ eq.)	Trend Assessment	% Contribution to Trend	Cumulative Total
1A4bso	Energy - Stationary Combustion - Residential	CO ₂	10 622.06	667.41	0.1221	0.1103	0.1103
1A4bga	Energy - Stationary Combustion - Residential	CO ₂	2 737.18	7 983.95	0.1114	0.1006	0.2109
1A3bld	Energy - Mobile combustion - Road transportation	CO ₂	2 950.93	7 764.46	0.1046	0.0945	0.3054
1A1aga	Energy - Stationary Combustion - Public electricity and heat production	CO ₂	6 212.71	8 620.71	0.0790	0.0714	0.3767
2B2	Industrial Processes - Chemical Industry - Nitric acid production	N ₂ O	4 541.51	5.08	0.0573	0.0518	0.4285
5A1	Land Use, Land-Use Change and Forestry - Forest Land - remaining	CO ₂	-2 922.73	-4 885.83	0.0524	0.0473	0.4758
1A1ali	Energy - Stationary Combustion - Public electricity and heat production	CO ₂	4 429.88	316.84	0.0502	0.0454	0.5212
1A4aga	Energy - Stationary Combustion - Commercial/institutional	CO ₂	1 535.43	3 367.48	0.0421	0.0381	0.5592
1A3blg	Energy - Mobile combustion - Road transportation	CO ₂	3 856.51	4 414.87	0.0319	0.0289	0.5881
1A4bli	Energy - Stationary Combustion - Residential	CO ₂	2 831.45	229.30	0.0316	0.0286	0.6166
6A	Waste - Solid Waste Disposal on Land	CH ₄	1917.3	2932.581	0.0294	0.0265	0.6432
1A1aso	Energy - Stationary Combustion - Public electricity and heat production	CO ₂	14 582.44	8 495.91	0.0291	0.0263	0.6694
1A2aso	Energy - Stationary Combustion - Iron and steel	CO ₂	5 378.60	2 367.66	0.0247	0.0223	0.6918
1A4cli	Energy - Stationary Combustion - Agriculture/Forestry/Fisheries	CO ₂	2 887.15	789.51	0.0221	0.0199	0.7117
1A2fga	Energy - Stationary Combustion - Other	CO ₂	1 603.51	591.54	0.0217	0.0196	0.7313
1A2aga	Energy - Stationary Combustion - Iron and steel	CO ₂	1 980.58	476.29	0.0163	0.0148	0.7461
1A4aso	Energy - Stationary Combustion - Commercial/institutional	CO ₂	1 295.15	15.81	0.0161	0.0145	0.7606
1A4ali	Energy - Stationary Combustion - Commercial/institutional	CO ₂	1 395.85	131.84	0.0152	0.0138	0.7744
1B2b	Energy - Fugitive Emissions from Fuels - Oil and Natural Gas	CH ₄	946.54	1 487.29	0.0152	0.0137	0.7881
4D3	Agriculture - Agricultural Soils - Indirect emissions	N ₂ O	3 851.08	1 875.82	0.0144	0.0130	0.8011
2Fa1	Industrial Processes - Consumption of Halocarbons and SF ₆ - Refrigeration and air conditioning equipment	HFCs	0.78	687.57	0.0126	0.0113	0.8125
4D1	Agriculture - Agricultural Soils - Direct soil emissions	N ₂ O	5 481.04	3 141.92	0.0119	0.0107	0.8232

Table A1-4. Key Categories with LULUCF, Tier 1 Trend Assessment

CRF Code + subcat.	IPCC Categories	Direct GHG	Base Years (1985-87) Emission (Gg CO ₂ eq.)	Current Year (2008) Emission (Gg CO ₂ eq.)	Trend Assessment	% Contribution to Trend	Cumulative Total
2B1	Industrial Processes - Chemical Industry - Ammonia production	CO ₂	1 502.70	393.28	0.0118	0.0107	0.8338
1B1a	Energy - Fugitive Emissions from Fuels - Solid Fuels	CH ₄	923.01	21.10	0.0113	0.0102	0.8440
1A2eli	Energy - Stationary Combustion - Food processing, beverages and tobacco	CO ₂	916.21	19.84	0.0112	0.0101	0.8542
4A1ca	Agriculture - Enteric Fermentation	CH ₄	2 664.41	1 261.04	0.0106	0.0096	0.8638
4B8sw	Agriculture - Manure Management	CH ₄	2 035.74	835.90	0.0105	0.0094	0.8732
2G1	Industrial Processes - Feedstocks	CO ₂	468.07	855.36	0.0097	0.0088	0.8820
1A2ali	Energy - Stationary Combustion - Iron and steel	CO ₂	722.92	7.72	0.0090	0.0081	0.8901
5B1	Land Use, Land-Use Change and Forestry - Cropland - remaining	CO ₂	651.03	13.39	0.0080	0.0072	0.8973
4B13so	Agriculture - Manure Management	N ₂ O	1 860.58	909.82	0.0069	0.0062	0.9036
5C1	Land Use, Land-Use Change and Forestry - Grassland remaining Grassland	CO ₂	-1.00	377.68	0.0069	0.0062	0.9098
1A1bli	Energy - Stationary Combustion - Petroleum refining	CO ₂	919.97	919.21	0.0052	0.0047	0.9145
1A3cli	Energy - Mobile combustion - Railways	CO ₂	677.35	187.57	0.0051	0.0046	0.9191
1A4cso	Energy - Stationary Combustion - Agriculture/Forestry/Fisheries	CO ₂	363.55	7.79	0.0045	0.0040	0.9231
1A3blg	Energy - Mobile combustion - Road transportation	N ₂ O	42.49	269.13	0.0044	0.0040	0.9271
3d	Solvent and Other Product Use - Other	N ₂ O	154.17	340.93	0.0043	0.0039	0.9310
5B2	Land Use, Land-Use Change and Forestry - Cropland - converted to	CO ₂	-52.89	266.04	0.0042	0.0038	0.9347
1A2cli	Energy - Stationary Combustion - Chemicals	CO ₂	381.00	45.40	0.0040	0.0036	0.9384
1A1aot	Energy - Stationary Combustion - Public electricity and heat production	CO ₂	97.62	285.10	0.0040	0.0036	0.9419
1A2eso	Energy - Stationary Combustion - Food processing, beverages and tobacco	CO ₂	310.47	3.18	0.0039	0.0035	0.9454
1A2fli	Energy - Stationary Combustion - Other	CO ₂	437.85	467.05	0.0036	0.0033	0.9487
5C2	Land Use, Land-Use Change and Forestry - Land converted to Grassland	CO ₂	1.3906248	-184.915	0.0034	0.0030	0.9517

Table A1-5. Key Categories without LULUCF, Tier 2 Level Assessment

IPCC Categories	Direct Greenhouse Gas	Base Years (1985-87) Emission (Gg CO ₂ eq.)	Current Year (2008) Emission (Gg CO ₂ eq.)	Activity Data Uncertainty	Emission Factor Uncertainty	Level Assessment with Uncertainty	Contribution to Total Uncertainty (%)	Cumulative Total (%)
Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	5 481.04	3 141.92		154.09	6.62	28.72	28.72
Emissions from Wastewater Handling	N ₂ O	207.70	199.58	10	1000	2.73	11.84	40.56
Stationary Combustion - Gas	CO ₂	19 924.15	23 981.08	5	5	2.32	10.06	50.62
Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	3 851.08	1 875.82		61.16	1.57	6.81	57.43
Fugitive Emissions from Oil and Gas Operations (Main Source: Gas Distribution)	CH ₄	1 613.47	2 045.80	2.00	50.00	1.40	6.07	63.51
CH ₄ Emissions from Solid Waste Disposal Sites	CH ₄	1 917.30	2 932.58	10	30	1.27	5.50	69.01
Mobile Combustion - Road	CO ₂	6 807.45	12 262.09	5	5	1.19	5.14	74.15
Stationary Combustion - Coal	CO ₂	34 678.65	12 167.30	2	5	0.90	3.89	78.04
N ₂ O Emissions from Manure Management	N ₂ O	1 899.61	925.04		70.07	0.89	3.85	81.88
CH ₄ Emissions from Enteric Fermentation in Domestic Livestock	CH ₄	3 435.62	1 636.94		28.66	0.64	2.78	84.67
CH ₄ Emissions from Manure Management	CH ₄	2 398.17	1 020.12		42.24	0.59	2.56	87.22
Mobile Combustion	N ₂ O	112.07	410.29	5	100	0.56	2.44	89.66
Pasture, range and paddock manure	N ₂ O	336.01	172.61		152.82	0.36	1.57	91.23
Non-CO ₂ Emission from Stationary Fuel Combustion	N ₂ O	797.34	424.41	3	50	0.29	1.26	92.49
SF ₆ Emissions from Electrical Equipment	SF ₆	70.15	231.89	80	20	0.26	1.13	93.62
Emissions from Wastewater Handling	CH ₄	847.03	526.63	20	30	0.26	1.13	94.75
Stationary Combustion - Oil	CO ₂	16 277.89	3 233.75	2	5	0.24	1.03	95.78
Emissions from Substitutes for Ozone Depleting Substances	HFCs	0.78	703.38	10	20	0.22	0.93	96.72
CO ₂ Emission from Other Mineral Products	CO ₂	642.13	374.94	10	30	0.16	0.70	97.42
Fugitive Emissions from Oil and Gas Operations	CO ₂	195.68	74.90	100	80	0.13	0.57	97.99
Feedstocks and non-energy use of fuels	CO ₂	550.97	855.36	5	10	0.13	0.57	98.55

Table A1-5. Key Categories without LULUCF, Tier 2 Level Assessment

IPCC Categories	Direct Greenhouse Gas	Base Years (1985-87) Emission (Gg CO ₂ eq.)	Current Year (2008) Emission (Gg CO ₂ eq.)	Activity Data Uncertainty	Emission Factor Uncertainty	Level Assessment with Uncertainty	Contribution to Total Uncertainty (%)	Cumulative Total (%)
Stationary Combustion - Other Fuel	CO ₂	96.89	394.05	5	10	0.06	0.26	98.82
CO ₂ Emissions from Cement Production	CO ₂	1 778.28	1 260.65	2	2	0.05	0.21	99.03
CH ₄ Emission from Rice Cultivation	CH ₄	50.54	10.64	201.62	80	0.03	0.14	99.16
Non-CO ₂ Emission from Stationary Fuel Combustion	CH ₄	578.52	246.67	3	8	0.03	0.13	99.29
CO ₂ Emissions from Lime Production	CO ₂	645.03	318.50	5	2	0.02	0.10	99.39
CO ₂ Emissions from Metal Production	CO ₂	641.57	271.60	2	5	0.02	0.09	99.48
CO ₂ Emission from Solvent and Other Product Use	CO ₂	130.36	65.37	10	20	0.02	0.09	99.57
Non-biogenic CO ₂ from Waste	CO ₂	NA,NO	64.12	10	20	0.02	0.09	99.65
Mobile Combustion - Other	CO ₂	814.20	190.84	5	5	0.02	0.08	99.73
Mobile Combustion	CH ₄	45.35	23.44	5	50	0.02	0.07	99.80
CO ₂ Emissions from Ammonia Processes	CO ₂	1 502.70	393.28	2	2	0.02	0.07	99.87
N ₂ O Emission from Solvent and Other Product Use	N ₂ O	154.17	340.93	2	1	0.01	0.05	99.91
CO ₂ Emission from Limestone and Dolomit Use	CO ₂	248.68	315.60	2	1	0.01	0.04	99.95
CH ₄ Emission from Industry	CH ₄	7.84	15.26	1	20	0.00	0.02	99.97
Fugitive Emissions from Coal Mining and Handling	CH ₄	923.01	21.10	3	10	0.00	0.01	99.98
N ₂ O Emissions from Waste Incineration	N ₂ O	NA,NO	1.97	5	100	0.00	0.01	100.00
CH ₄ Emissions from Waste Incineration	CH ₄	NA	0.49	10	50	0.00	0.00	100.00
Fugitive Emissions from Oil and Gas Operations	N ₂ O	0.60	0.23	2	100	0.00	0.00	100.00
N ₂ O Emission from Industry	N ₂ O	4 541.51	5.08	2	1	0.00	0.00	100.00
PFCs Emissions	PFCs	166.82	2.41	1	2	0.00	0.00	100.00
Fugitive Emissions from Coal Mining and Handling	CO ₂	3.60		3	10	0.00	0.00	100.00
CO ₂ Emissions from Nitric Acid Production	CO ₂	0.082	0.000	0	0	0.00	0.00	100.00

Table A1-5. Key Categories without LULUCF, Tier 2 Level Assessment

IPCC Categories	Direct Greenhouse Gas	Base Years (1985-87) Emission (Gg CO ₂ eq.)	Current Year (2008) Emission (Gg CO ₂ eq.)	Activity Data Uncertainty	Emission Factor Uncertainty	Level Assessment with Uncertainty	Contribution to Total Uncertainty (%)	Cumulative Total (%)
Field Burning of Agricultural Residues	CH ₄	45.51		NE	NE	0.00	0.00	100.00
Field Burning of Agricultural Residues	N ₂ O	13.34		NE	NE	0.00	0.00	100.00

Table A1-6. Key Categories without LULUCF, Tier 2 Trend Assessment

IPCC Categories	Direct Greenhouse Gas	Base Years (1985-87) Emission (Gg CO ₂ eq.)	Current Year (2008) Emission (Gg CO ₂ eq.)	Activity Data Uncertainty	Emission Factor Uncertainty	Trend Assessment with Uncertainty	Contribution to Total Uncertainty (%)	Cumulative Total (%)
Stationary Combustion - Gas	CO ₂	19 924.15	23 981.08	5	5	1.70	12.03	12.03
Emissions from Wastewater Handling	N ₂ O	207.70	199.58	10	1000	1.43	10.11	22.14
Mobile Combustion - Road	CO ₂	6 807.45	12 262.09	5	5	1.20	8.46	30.60
Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	5 481.04	3 141.92		154.09	1.19	8.42	39.02
CH ₄ Emissions from Solid Waste Disposal Sites	CH ₄	1 917.30	2 932.58	10	30	1.15	8.17	47.19
Stationary Combustion - Coal	CO ₂	34 678.65	12 167.30	2	5	1.15	8.14	55.33
Fugitive Emissions from Oil and Gas Operations (Main Source: Gas Distribution)	CH ₄	1 613.47	2 045.80	2	50	1.09	7.68	63.01
Stationary Combustion - Oil	CO ₂	16 277.89	3 233.75	2	5	0.83	5.84	68.85
Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	3 851.08	1 875.82		61.16	0.77	5.42	74.27
Mobile Combustion	N ₂ O	112.07	410.29	5	100	0.73	5.13	79.40
CH ₄ Emissions from Manure Management	CH ₄	2 398.17	1 020.12		42.24	0.46	3.28	82.67
N ₂ O Emissions from Manure Management	N ₂ O	1 899.61	925.04		70.07	0.43	3.06	85.74
CH ₄ Emissions from Enteric Fermentation in Domestic Livestock	CH ₄	3 435.62	1 636.94		28.66	0.34	2.42	88.16
Emissions from Substitutes for Ozone Depleting Substances	HFCs	0.78	703.38	10	20	0.34	2.38	90.54
SF ₆ Emissions from Electrical Equipment	SF ₆	70.15	231.89	80	20	0.33	2.33	92.87
Pasture, range and paddock manure	N ₂ O	336.01	172.61		152.82	0.14	0.97	93.85
Fugitive Emissions from Oil and Gas Operations	CO ₂	195.68	74.90	100	80	0.14	0.97	94.82
Fugitive Emissions from Coal Mining and Handling	CH ₄	923.01	21.10	3	10	0.13	0.90	95.72
Feedstocks and non-energy use of fuels	CO ₂	550.97	855.36	5	10	0.12	0.85	96.57
CH ₄ Emission from Rice Cultivation	CH ₄	50.54	10.64	201.62	80	0.10	0.71	97.28
Non-CO ₂ Emission from Stationary Fuel Combustion	N ₂ O	797.34	424.41	3	50	0.09	0.65	97.92

Table A1-6. Key Categories without LULUCF, Tier 2 Trend Assessment

IPCC Categories	Direct Greenhouse Gas	Base Years (1985-87) Emission (Gg CO ₂ eq.)	Current Year (2008) Emission (Gg CO ₂ eq.)	Activity Data Uncertainty	Emission Factor Uncertainty	Trend Assessment with Uncertainty	Contribution to Total Uncertainty (%)	Cumulative Total (%)
Stationary Combustion - Other Fuel	CO ₂	96.89	394.05	5	10	0.08	0.56	98.48
Mobile Combustion - Other	CO ₂	814.20	190.84	5	5	0.05	0.35	98.84
CO ₂ Emissions from Ammonia Processes	CO ₂	1 502.70	393.28	2	2	0.03	0.24	99.08
CO ₂ Emission from Other Mineral Products	CO ₂	642.13	374.94	10	30	0.02	0.17	99.25
Non-CO ₂ Emission from Stationary Fuel Combustion	CH ₄	578.52	246.67	3	8	0.02	0.16	99.41
CO ₂ Emissions from Metal Production	CO ₂	641.57	271.60	2	5	0.02	0.11	99.52
N ₂ O Emission from Solvent and Other Product Use	N ₂ O	154.17	340.93	2	1	0.01	0.08	99.60
Emissions from Wastewater Handling	CH ₄	847.03	526.63	20	30	0.01	0.08	99.68
CO ₂ Emissions from Lime Production	CO ₂	645.03	318.50	5	2	0.01	0.08	99.76
CO ₂ Emission from Solvent and Other Product Use	CO ₂	130.36	65.37	10	20	0.01	0.06	99.82
CO ₂ Emissions from Cement Production	CO ₂	1 778.28	1 260.65	2	2	0.01	0.05	99.87
CO ₂ Emission from Limestone and Dolomit Use	CO ₂	248.68	315.60	2	1	0.01	0.05	99.93
Mobile Combustion	CH ₄	45.35	23.44	5	50	0.01	0.04	99.97
CH ₄ Emission from Industry	CH ₄	7.84	15.26	1	20	0.00	0.03	100.00
Non-biogenic CO ₂ from Waste	CO ₂	NA,NO	64.12	10	20	0.00	0.00	100.00
N ₂ O Emissions from Waste Incineration	N ₂ O	NA,NO	1.97	5	100	0.00	0.00	100.00
CH ₄ Emissions from Waste Incineration	CH ₄	NA	0.49	10	50	0.00	0.00	100.00
Fugitive Emissions from Oil and Gas Operations	N ₂ O	0.60	0.23	2	100	0.00	0.00	100.00
N ₂ O Emission from Industry	N ₂ O	4 541.51	5.08	2	1	0.00	0.00	100.00
PFCs Emissions	PFCs	166.82	2.41	1	2	0.00	0.00	100.00
Fugitive Emissions from Coal Mining and Handling	CO ₂	3.60		3	10	0.00	0.00	100.00
CO ₂ Emissions from Nitric Acid Production	CO ₂	0.082	0.000	0	0	0.00	0.00	100.00

Table A1-6. Key Categories without LULUCF, Tier 2 Trend Assessment

IPCC Categories	Direct Greenhouse Gas	Base Years (1985-87) Emission (Gg CO ₂ eq.)	Current Year (2008) Emission (Gg CO ₂ eq.)	Activity Data Uncertainty	Emission Factor Uncertainty	Trend Assessment with Uncertainty	Contribution to Total Uncertainty (%)	Cumulative Total (%)
Field Burning of Agricultural Residues	CH ₄	45.51		NE	NE	0.00	0.00	100.00
Field Burning of Agricultural Residues	N ₂ O	13.34		NE	NE	0.00	0.00	100.00

A1.4. Summary assessment

Table A1-7. Key category analysis summary – with LULUCF

SOURCE CATEGORY ANALYSIS SUMMARY – WITH LULUCF				
Quantitative Method Used: <input checked="" type="checkbox"/> Tier 1 <input type="checkbox"/> Tier 2				
A	B	C	D	E
IPCC Source Categories	Direct Greenhouse Gas	Key Source Category Flag (Yes or No)	If C Yes. Criteria for Identification	Comments
1. Energy				
Stationary Combustion - Public electricity and heat production	CO ₂	Yes	L, T	ga, li, so, ot
Stationary Combustion - Public electricity and heat production	CH ₄	No		
Stationary Combustion - Public electricity and heat production	N ₂ O	No		
Stationary Combustion - Petroleum refining	CO ₂	Yes	L, T	L: li, ga; T: li
Stationary Combustion - Petroleum refining	CH ₄	No		
Stationary Combustion - Petroleum refining	N ₂ O	No		
Stationary Combustion - Manuf. of solid fuels and other energy industries	CO ₂	No		
Stationary Combustion - Manuf. of solid fuels and other energy industries	CH ₄	No		
Stationary Combustion - Manuf. of solid fuels and other energy industries	N ₂ O	No		
Stationary Combustion - Iron and steel	CO ₂	Yes	L, T	L: so, ga; T: so, ga, li
Stationary Combustion - Iron and steel	CH ₄	No		
Stationary Combustion - Iron and steel	N ₂ O	No		
Stationary Combustion - Non-ferrous metals	CO ₂	No		re-allocated
Stationary Combustion - Non-ferrous metals	CH ₄	No		
Stationary Combustion - Non-ferrous metals	N ₂ O	No		
Stationary Combustion - Chemicals	CO ₂	Yes	L, T	L: ga; T: li
Stationary Combustion - Chemicals	CH ₄	No		
Stationary Combustion - Chemicals	N ₂ O	No		
Stationary Combustion - Pulp, paper and print	CO ₂	No		
Stationary Combustion - Pulp, paper and print	CH ₄	No		
Stationary Combustion - Pulp, paper and print	N ₂ O	No		
Stationary Combustion - Food processing, beverages and tobacco	CO ₂	Yes	L, T	L: ga; T: li, so
Stationary Combustion - Food processing, beverages and tobacco	CH ₄	No		
Stationary Combustion - Food processing, beverages and tobacco	N ₂ O	No		
Stationary Combustion - Other	CO ₂	Yes	L, T	L: so, ga, li; T: ga, li
Stationary Combustion - Other	CH ₄	No		
Stationary Combustion - Other	N ₂ O	No		
Mobile combustion - Civil aviation	CO ₂	No		IE,NO
Mobile combustion - Civil aviation	CH ₄	No		IE,NO
Mobile combustion - Civil aviation	N ₂ O	No		IE,NO
Mobile combustion - Road transportation	CO ₂	Yes	L, T	L: ld, lg; T: ld, lg

Table A1-7. Key category analysis summary – with LULUCF

SOURCE CATEGORY ANALYSIS SUMMARY – WITH LULUCF				
Quantitative Method Used: <input checked="" type="checkbox"/> Tier 1 <input type="checkbox"/> Tier 2				
A	B	C	D	E
IPCC Source Categories	Direct Greenhouse Gas	Key Source Category Flag (Yes or No)	If C Yes. Criteria for Identification	Comments
Mobile combustion - Road transportation	CH ₄	No		
Mobile combustion - Road transportation	N ₂ O	Yes	L, T	lg
Mobile combustion - Railways	CO ₂	Yes	T	li
Mobile combustion - Railways	CH ₄	No		
Mobile combustion - Railways	N ₂ O	No		
Mobile combustion - Navigation	CO ₂	No		
Mobile combustion - Navigation	CH ₄	No		
Mobile combustion - Navigation	N ₂ O	No		
Stationary Combustion - Commercial/institutional	CO ₂	Yes	L, T	L: ga; T: ga, li, so
Stationary Combustion - Commercial/institutional	CH ₄	No		
Stationary Combustion - Commercial/institutional	N ₂ O	No		
Stationary Combustion - Residential	CO ₂	Yes	L, T	ga, li, so
Stationary Combustion - Residential	CH ₄	No		
Stationary Combustion - Residential	N ₂ O	No		
Stationary Combustion - Agriculture/Forestry/Fisheries	CO ₂	Yes	L, T	L: li, ga; T: li, so
Stationary Combustion - Agriculture/Forestry/Fisheries	CH ₄	No		
Stationary Combustion - Agriculture/Forestry/Fisheries	N ₂ O	No		
Fugitive Emissions from Fuels - Solid Fuels	CO ₂	No		IE,NA,NO
Fugitive Emissions from Fuels - Solid Fuels	CH ₄	Yes	T	coal mining
Fugitive Emissions from Fuels - Solid Fuels	N ₂ O	No		NA, NO
Fugitive Emissions from Fuels - Oil and Natural Gas	CO ₂	No		
Fugitive Emissions from Fuels - Oil and Natural Gas	CH ₄	Yes	L, T	natural gas
Fugitive Emissions from Fuels - Oil and Natural Gas	N ₂ O	No		
2. Industrial Processes				
Mineral Products - Cement production	CO ₂	Yes	L	
Mineral Products - Lime production	CO ₂	Yes	L	
Mineral Products - Limestone and dolomite use	CO ₂	Yes	L	
Mineral Products - Asphalt roofing	CO ₂	No		NA
Mineral Products - Road paving with asphalt	CO ₂	No		NA
Mineral Products - Other	CO ₂	Yes	L	
Mineral Products - Other	CH ₄	No		IE, NA
Mineral Products - Other	N ₂ O	No		IE, NA
Chemical Industry - Ammonia production	CO ₂	Yes	L, T	
Chemical Industry - Ammonia production	CH ₄	No		NO
Chemical Industry - Ammonia production	N ₂ O	No		NO
Chemical Industry - Nitric acid production	CO ₂	No		
Chemical Industry - Nitric acid production	N ₂ O	Yes	T	
Chemical Industry - Other	CO ₂	No		
Chemical Industry - Other	CH ₄	No		NO

Table A1-7. Key category analysis summary – with LULUCF

SOURCE CATEGORY ANALYSIS SUMMARY – WITH LULUCF				
Quantitative Method Used: <input checked="" type="checkbox"/> Tier 1 <input type="checkbox"/> Tier 2				
A	B	C	D	E
IPCC Source Categories	Direct Greenhouse Gas	Key Source Category Flag (Yes or No)	If C Yes. Criteria for Identification	Comments
Chemical Industry - Other	N ₂ O	No		NO
Metal Production - Iron and steel production	CO ₂	Yes	L	
Metal Production - Iron and steel production	CH ₄	No		IE, NA
Metal Production - Ferroalloys production	CO ₂	No		NO
Metal Production - Ferroalloys production	CH ₄	No		NO
Metal Production - Aluminium production	CO ₂	No		NO
Metal Production - Aluminium production	CH ₄	No		NO
Metal Production - Aluminium production	PFCs	No		NO
Other Production	CO ₂	No		
Production of Halocarbons and SF ₆	HFCs	No		NA, NO
Production of Halocarbons and SF ₆	PFCs	No		NA
Production of Halocarbons and SF ₆	SF ₆	No		NA, NO
Consumption of Halocarbons and SF ₆ - Refrigeration and air conditioning equipment	HFCs	Yes	L, T	
Consumption of Halocarbons and SF ₆ - Refrigeration and air conditioning equipment	PFCs	No		
Consumption of Halocarbons and SF ₆ - Refrigeration and air conditioning equipment	SF ₆	No		NO
Consumption of Halocarbons and SF ₆ - Foam blowing	HFCs	No		
Consumption of Halocarbons and SF ₆ - Foam blowing	PFCs	No		NO
Consumption of Halocarbons and SF ₆ - Foam blowing	SF ₆	No		NO
Consumption of Halocarbons and SF ₆ - Aerosols	HFCs	No		
Consumption of Halocarbons and SF ₆ - Aerosols	PFCs	No		NO
Consumption of Halocarbons and SF ₆ - Aerosols	SF ₆	No		NO
Consumption of Halocarbons and SF ₆ - Electrical equipment	HFCs	No		NO
Consumption of Halocarbons and SF ₆ - Electrical equipment	PFCs	No		NO
Consumption of Halocarbons and SF ₆ - Electrical equipment	SF ₆	No		
Consumption of Halocarbons and SF ₆ - Other	HFCs	No		NA
Consumption of Halocarbons and SF ₆ - Other	PFCs	No		NA
Consumption of Halocarbons and SF ₆ - Other	SF ₆	No		
Feedstocks and non-energy use of fuels	CO ₂	Yes	L, T	feedstocks
3. Solvent and Other Product Use				
Solvent and Other Product Use	CO ₂	No		
Solvent and Other Product Use	N ₂ O	Yes	L, T	other
4. Agriculture				
Enteric Fermentation	CH ₄	Yes	L, T	L: ca, sh; T: so
Manure Management	CH ₄	Yes	L, T	sw
Manure Management	N ₂ O	Yes	L, T	so
Rice Cultivation	CH ₄	No		

Table A1-7. Key category analysis summary – with LULUCF

SOURCE CATEGORY ANALYSIS SUMMARY – WITH LULUCF				
Quantitative Method Used: <input checked="" type="checkbox"/> Tier 1 <input type="checkbox"/> Tier 2				
A	B	C	D	E
IPCC Source Categories	Direct Greenhouse Gas	Key Source Category Flag (Yes or No)	If C Yes. Criteria for Identification	Comments
Agricultural Soils - Direct soil emissions	CH ₄	No		NO
Agricultural Soils - Direct soil emissions	N ₂ O	Yes	L, T	
Agricultural Soils - Pasture, range and paddock manure	N ₂ O	No		
Agricultural Soils - Indirect emissions	CH ₄	No		NO
Agricultural Soils - Indirect emissions	N ₂ O	Yes	L, T	
Field Burning of Agricultural Residues	CH ₄	No		NA, NO
Field Burning of Agricultural Residues	N ₂ O	No		NA, NO
5. Land Use, Land-Use Change and Forestry				
Forest Land - remaining	CO ₂	Yes	L, T	
Forest Land - remaining	CH ₄	No		
Forest Land - remaining	N ₂ O	No		
Forest Land - converted to	CO ₂	No		
Forest Land - converted to	CH ₄	No		NE, NO
Forest Land - converted to	N ₂ O	No		NE, NO
Cropland - remaining	CO ₂	Yes	T	
Cropland - remaining	CH ₄	No		IE, NE
Cropland - remaining	N ₂ O	No		IE, NE
Cropland - converted to	CO ₂	Yes	L, T	
Cropland - converted to	CH ₄	No		NO
Cropland - converted to	N ₂ O	No		NE, NO
Grassland - remaining	CO ₂	Yes	L, T	
Grassland - remaining	CH ₄	No		NE, NO
Grassland - remaining	N ₂ O	No		NE, NO
Grassland - converted to	CO ₂	Yes	T	
Grassland - converted to	CH ₄	No		NO
Grassland - converted to	N ₂ O	No		NO
Other Land - converted to	CO ₂	No		
6. Waste				
Solid Waste Disposal on Land	CO ₂	No		NA, NO
Solid Waste Disposal on Land	CH ₄	Yes	L, T	
Waste-water Handling	CH ₄	Yes	L	
Waste-water Handling	N ₂ O	No		
Waste Incineration	CO ₂	No		
Waste Incineration	CH ₄	No		
Waste Incineration	N ₂ O	No		

Abbreviations in this table:

li – liquid fuels
so – solid fuels/category
ga – gaseous fuels

ot – other fuels/category
bi – biomass
lr – liquid fuels, residual fuel oil
ld – liquid fuel, diesel oil
lg – liquid fuel, gasoline
lu – liquid fuel, lubricants
sc – solid fuel, coal
lk – liquid fuel, kerosene
ll – liquid fuel, LPG
gn – gaseous fuel, natural gas
ca – cattle
bu – buffalo
sh – sheep
sw – swine

A1.5. References

Intergovernmental Panel on Climate Change (IPCC), 2000: Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. *Intergovernmental Panel on Climate Change National Greenhouse Gas Inventories Programme*. Institute for Global Environmental Strategies, Japan.

Available online at: <http://www.ipcc-nggip.iges.or.jp/public/gp/english/>

Intergovernmental Panel on Climate Change (IPCC), 2003: Good practice guidance for Land Use, Land Use Change and Forestry. *Intergovernmental Panel on Climate Change National Greenhouse Gas Inventories Programme*. Institute for Global Environmental Strategies, Japan.

Available online at: <http://www.ipcc-nggip.iges.or.jp/public/gp/lulucf/gp/lulucf.htm>

Annex 2 Detailed discussion of methodology and data for estimating CO₂ emissions from fossil fuel combustion

A2.1. Fuel Consumption Data

The GHG emission calculations of fossil fuel combustion are based on the Hungarian energy balance prepared by Energia Központ Kht. The summary table of the energy balance for 2008 can be seen in *Table A2-6*.

Energia Központ Kht. collects fuel consumption data from users and prepares the energy balance and other statistics. Independent experts check the raw data of the energy balance and they compare them with energy consumption data from other sources (e.g. data from MVM Rt.). After the quality check the Energy Statistics is published.

The energy statistics has a chapter about the energy carries balances by branches. Nowadays, division into branches (*Table A2-1*) follows mainly the structure of ISIC 3.1. Detailed EU-conform statistics from industrial and energy industrial activities help to compile the *sectoral approach*.

Branches	ISIC 3.1 code	IPCC code as treated in the Hungarian inventory
Manufacture of food, beverage and tobacco products	DA	1.AA.2.E
Man. of textiles and textile products	DB	1.AA.2.F
Man. of leather and leather products	DC	1.AA.2.F
Man. of wood and wood products	DD	1.AA.2.F
Man. of pulp, paper and paper products	DE	1.AA.2.D
Man of coke, refined petroleum products	DF	1.AA.1.B and 1.AA.1.C
Man. of chemicals, chemical products	DG	1.AA.2.C
Man. of rubber and plastic products	DH	1.AA.2.C
Man. of other non-metallic mineral products	DI	1.AA.2.F**
Man. of basic metals and fabricated metal products	DJ	1.AA.2.A
Man. of machinery and equipment n.e.c.	DK	1.AA.2.F
Man. of electrical and optical equipment	DL	1.AA.2.F
Manufacture of transport equipment	DM	1.AA.2.F
Manufacturing n.e.c.	DN	1.AA.2.F
<i>Total of manufacture industries</i>	<i>D</i>	
Mining and Quarrying	C	1.AA.2.F
Electr., Gas, Steam and Hot Water Supply	E40	1.AA.1.A and 1.AA.4.A
Water Management	E41	1.AA.4.A
<i>Total Industry</i>		
Construction	F	1.AA.2.F
Agriculture	A 01	1.AA.4.C
Forestry and Logging	A 02	1.AA.4.C
<i>Agriculture, Forestry and Logging</i>	<i>A</i>	
Transport and Storage	I 60–63	1.AA.4.A
Communications	I 64	1.AA.4.A
<i>Transport, Storage and Communication</i>	<i>I</i>	
Residential	P	1.AA.4.B
Public Services and Commerce *	G, H, J–O	1.AA.4.A
<i>Total Inland Consumption</i>		

Table A2-1. Categories in the energy carries balances of the Energy Statistics

* included Real estate activities, Public administration and Sewage and refuse disposal sections

** for the first time it is reported in the appropriate CRF category

A2.2. EU ETS Data

In January 2005 the European Union Greenhouse Gas Emission Trading Scheme (EU ETS) commenced operation as the largest multi-country, multi-sector Greenhouse Gas emission trading scheme world-wide. The scheme is based on Directive 2003/87/EC, which entered into force on 25 October 2003 in the EU. This law came into force in the Hungarian legal system in 2005 (2005/XV.).

A2.3. Comparison of energy statistics and EU ETS Data

For the sake of transparency and comparability with EU ETS data the ERT recommended to report NCVs of both data sources. All of the coal based power plants are under the regulation of emission trading, so the comparison can be performed. The results are in the table (Table A2-2) below.

Consumption of public electricity and heat plants	EU ETS		Energy statistics	
	kt	TJ	kt	TJ
Other bituminous or sub-bituminous coal (NCV: 17-33 MJ/kg)	251.9	5,932	259	5,935
Lignite (NCV: 10-17 MJ/kg)*	1,561.6	20,991	1,642	20,557
Lignite (NCV: 3.5-10 MJ/kg)	7,893.6	53,814	7,893	54,246
Total Coal	9,708	80,737	9,794	80,738

Table A2-2. Power plants' coal consumption from EU ETS and energy statistics

* One power plant reported brown coal to ETS with 25.6 TJ/kt NCV, therefore this amount of ETS in NCV is higher than the amount of the energy statistics with higher fuel consumption in physical unit.

A2.4. Source of the Country Specific Emission Factors

Fuel type	Emission factor (CO ₂ t/TJ)	Oxidation factor
Other Bituminous Coal	95.76	0.98
Lignite (brown coal + lignite)	107.86	0.977
Coke Oven Gas	43.5	0.98
Gas/Diesel Oil	74.06	0.99
Residual Fuel Oil	81.96	0.99
Other Oil	80.50	0.99
Waste	55.71	1.00

Table A2-3. Country specific emission factors in the Energy Industries subsector

The Act 2005/XV. appoints which installation have to join in the EU ETS. It is required, for establishments that emit more than 500 kt CO₂/year, to measure the calorific value, the carbon content and oxidation factor of used coal in accredited laboratory. Last years installations with lower emission rate also began to report measured carbon content of used fuels to EU ETS.

The official laboratory reports of the measured values in the EU ETS are available for internal use for the GHG team, we use this data to define new emission factors that suit better to the Hungarian conditions. Instead of IPCC default emission factors we can calculate the national emissions using more appropriate values. These country specific emission factors are listed in Table A2-3.

A2.4.1. Solid fuels

The Hungarian coal terminology differs slightly from that of IPCC. The partitioning is created according to the age of coal; *Table A2-4.* shows the classification according to the Hungarian and IPCC (2006) categories.

Hungarian Terminology	Net Calorific Values	IPCC Category (Gross calorific value)
Hard Coal	17-33 MJ/kg	Other Bituminous Coal (>23.865 MJ/kg)
Hard Coal	17-33 MJ/kg	Sub-Bituminous Coal (17.435 MJ/kg -23.865 MJ/kg)
Brown Coal	10-17 MJ/kg	Lignite (<17.435 MJ/kg)
Lignite (young brown coal)	3.5-10 MJ/kg	Lignite (<17.435 MJ/kg)

Table A2-4. Comparison of Hungarian and IPCC terminology for coal
(Sources: Bihari, 1998; IPCC, 2006)

In the CRF the lignite category is a mix of brown coal and lignite with very low NCV, so the reported emission factor vary for two different reasons in the time-series:

- share of the two coal types
- changes in carbon content.

Fott (1999) published his research about the emission factors for the European coal (especially for Czech coal). It was found that carbon emission factor of coals and lignite are dependent especially on the net calorific value. For brown coal-lignite with the lowest net calorific values (lower than 12 MJ/kg) the default (IPCC, 1997) value 27.6 t C/TJ (101.2 t CO₂/TJ) seems to be too small.

Measured carbon contents and oxidation factors of coals in 2008 are listed in *Table A2-5.* NCVs of coals in the energy statistics were different than the measured values from EU ETS (see *Table A2-2*), therefore emission factors were corrected to achieve consistency in the energy balance and verified emissions, too. Measured oxidation factors was also applied in the calculation to have consistent datasets.

Fuel type	Measured carbon content (C t/TJ)	Oxidation factor
Hard Coal (17-33 MJ/kg)	26.1	0.9795
Brown coal (10-17 MJ/kg)	26.6	0.9800
Lignite (3.5-10 MJ/kg)	30.5	0.9756
Coke oven gas	11.86	default

Table A2-5. Measured carbon contents and oxidation factors from EU ETS for solid fuels and derived gas

A2.4.2. Liquid fuels

Measured EFs from EU ETS were also taken into account in the calculation of CO₂ emissions of main electricity plants – as recommended by the ERT. For the harmonization of the ETS and inventory the applied emission factors were determined from the weighted average of EFs from reports of power plants. As measurement is not required for all power plants and for all fuel types, the resulted EFs (in *Table A2-3*) is a mixture of IPCC default and real measured values.

A2.5. Reference approach

Energy Centre publishes Energy Statistics Yearbooks, which contain the used activity data (production, imports, exports, stock change, non-energy use) for each fuel type in summary tables (see *Table A2-6*), individual tables for time-series of each fuel type from 1985 until the previous year of publishing date (whole time-series can be seen only in the electronic format). Conversion factor was taken as 1.0 in all categories, because Energy Statistics Yearbook represents fuels in energy units (TJ), as well. Default emission factors were used in most cases. There are only two exceptions, namely, the category of lignite and other bituminous coal (see explanation above in *section A2.3*). Calculation and fraction of carbon oxidized are in accordance with Revised Guidelines (IPCC, 1997).

A2.6. References

Bihari, P., 1998: Energetics II. – university manuscript (In Hungarian: Energetika II., kézirat), *Budapesti Műszaki Egyetem*, Budapest.

Fott, P., 1999: Carbon emission factors of coal and lignite: analysis of Czech coal data and comparison to European values. *Environmental Science & Policy*, 2, 347-354.

Intergovernmental Panel on Climate Change (IPCC), 1997: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, *Intergovernmental Panel on Climate Change, Organisation for Economic Cooperation and Development, and International Energy Agency. (IPCC/OECD/IEA)*, UK Meteorological Office, Bracknell.

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Intergovernmental Panel on Climate Change, 2006: 2006 IPCC Guidelines for National Greenhouse Gas Inventories. *Prepared by the National Greenhouse Gas Inventories Programme*, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). ISBN 4-88788-032-4, published: IGES, Japan.

Available online at: <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm>

Hungarian Energy Balance for 2008

Unit: TJ	Primary Energy Production	Import	From Stock Decreasing	From Transformation	Waste Energy	Total Source and Distribution	Domestic Consumption	Direct Consumption	Direct: Non-energy use	For Transformation	Exports	For Stock Increasing	Statistical Differences	Transformation Losses
PRIMARY ENERGY	435 855	743 549	0			1 179 404	948 802	330 310	14 719	618 492	24 602	35 203		
Coal	70 884	70 961	0			141 845	137 659	11 577		126 082	1 891	2 295		
Crude OIL	33 908	278 578	0			312 486	291 198	1 422		289 776	19 855	1 433		
Natural Gas	83 981	390 442	0			474 423	442 161	279 152	14 719	163 009	787	31 475		
NGL	7 770					7 770				see LPG				
Hydro Power	767					767				see Electricity				
Nuclear Power	161 521					161 521				see Electricity				
Prod. of Wind Power Plant	738					738				see Electricity				
Firewood	25 079	1 044				26 123	24 053	10 662		13 391	2 070			
Other Primary Energy	10 891					10 891	10 891	0		10 891				
Estimated Renewables Energy ¹⁾	37 050					37 050	37 050	25 570		11 480				
Municipal Solid Waste	3 266	2 524				5 790	5 790	1 927		3 863				
SECONDARY ENERGY	0	124 524	5 384	487 470	6 823	624 200	563 595	540 539	67 766	23 056	120 734	2 493		
Briquette		335	77	149		561	561	547		14		0		
Ahydrated Lignite						0	0	0						
Coke		453	0	29 447		29 900	21 666	21 608		58	7 390	844		
Other Product from Coal Proc.				2 754		2 754	2 754	2 754	2 754					
LPG		9 917	0	3 688		13 605	15 829	15 829	8 136		5 123	423		
Gasoline		31 290	0	97 272		128 562	110 586	110 586	42 882		16 800	1 176		
Petroleum		450	326	10 960		11 736	11 303	11 303	0		433	0		
Gas / Diesel Oil		58 296	3 318	124 236		185 850	129 570	126 914	2 468	2 656	56 280	0		
Heavy Fuel Oil		490	241	15 276		16 007	14 045	11 105		2 940	1 962	0		
Bitumen		2 775	0	21 527		24 302	9 338	9 317	9 317	21	14 949	15		
Other Refinery Product		6 467	1 421	19 004		26 892	11 776	3 961	2 209	7 815	15 115	0		
Coke Oven Gas				8 097		8 097	8 097	3 147		4 950				
Blast Furnace Gas					6 823	6 823	6 823	2 513		4 310				
Heat energy				56 126		56 126	56 126	56 126						
Electricity				89 240		89 240	158 142	158 142						
Import Electricity		14 051				14 051				see Electricity				
Petroleum Coke		0	0	9 694		9 694	6 977	6 685		292	2 682	35		
TOTAL ENERGY	435 855	868 073	5 384	487 470	6 823	1 803 605	1 512 397	870 849	82 485	641 548	145 336	37 697	108 175	154 079
Unaccumulated Consumption	435 855	868 073	5 384			1 309 312	1 126 279							

1) incl. the estimated firewood, biomass and waste, geothermal, biogas, wind, solar, etc. energy

Source: Energia Központ Kht., 2009: Energy Statistics Yearbook, 2008 (In Hungarian: Energia Statisztika Évkönyv, 2008), Table 19/a and 19/b

Table A2-6. Hungarian energy balance for 2008

Annex 3 Other detailed methodological descriptions for individual source or sink categories

A3.1. Energy

CH₄ and N₂O emission calculation for road transport

The used method for emission estimation of road transport consist of the following steps:

1. Quantification of stock of each road vehicle type is based on data obtained from HCSO and KTI. The categories are the following:
 - Gasoline:
 - a. Passenger car, uncontrolled
 - b. Passenger car, early oxidation catalyst
 - c. Passenger car, 2-stroke engine
 - d. Passenger car, three-way catalyst
 - e. Motorcycles
 - f. Light duty vehicle
 - g. Light duty vehicle, catalyst
 - h. Heavy duty vehicle
 - i. Heavy duty vehicle, catalyst
 - j. Bus
 - LPG
 - Natural Gas
 - Other fuel
 - Diesel
 - a. Passenger car
 - b. Light duty vehicle
 - c. Heavy duty vehicle
 - d. Bus
2. Identification of fuel consumption for 100 km of each category is based on default values from Revised Guidelines, 2006 IPCC Guidelines and official fuel consumption database.
3. Correction of fuel consumption of each vehicle type with real sharing in traffic is based on KTI reports.
4. Calculation of proportion in total annual fuel consumption for each category and fuel type. Total annual fuel consumption for each fuel type is given in the Energy Statistics Yearbook.
5. Calculation of total annual fuel consumption for each category and fuel type.
6. Calculation of total annual emission from category specific emission factors (see *Table 3.9 in Chapter 3.4*) and total annual fuel consumption for each category and fuel type .
7. Addition of emissions in each fuel type.

A3.2. Industry

Specific emission factors for aluminium production

According to the recommendations of the Revised Guidelines (IPCC, 1997) and the Good Practice Guidance (IPCC, 2000), the value of the specific emission factor was determined using a Tabereaux approximation as follows:

$$EF = \text{Slope} \cdot AEF \cdot AED \quad \text{Equation A3-1.}$$

where *EF* means the emission factor (kg/t). Slope is derived from

$$\text{Slope} = \begin{cases} 1.698 \cdot \frac{p}{CE} & \text{for } CF_4 \\ 0.1698 \cdot \frac{p}{CE} & \text{for } C_2F_6 \end{cases} \quad \text{Equation A3-2.}$$

According to the Revised Guidelines for the given technology $p=0.04$ and $CE=0.91$ were used as constants. In *Equation A3-1*, *AEF* means the effect number, *AED* is the effect time. On the basis of factory data, the value of *AEF* is between 0.8 to 2.8 pcs/pot-day and the value of *AED* is 4 minutes. Information on the pot types, effect number and effect time were supplied by the factories. Currently, only vertical-stud pots are used in Hungary, although horizontal-stud pots were also present in the beginning of the period. *Table A3-1* shows the calculated specific emission factors.

Emission factor (kg/t)	BY	1990	1991	1992	1993	1994	1995	1996	1997	1998
CF₄	0.4907	0.4856	0.5010	0.6775	0.7045	0.7225	0.7046	0.6419	0.6359	0.6837
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
CF₄	0.7015	0.8390	0.7732	0.7703	0.7242	0.7849	0.8813	0.0000	0.0000	0.0000

Table A3-1. Specific emission factors for aluminium production

A3.3. Solvent and Other Product Use

Carbon and NMVOC ratio of solvents

The Revised Guidelines (IPCC, 1997) provide little help for calculation of specific emission factor for solvents. Compositions and solvent contents were previously coordinated with the Paint Industry. Due to these discussions, paints, lacquers, kits etc. were classified into several groups according to the mean solvent content and NMVOC emissions were taken to be equal to the amount of solvent.

On the basis of solvent composition, the mean carbon content of each category was determined using the method described in the following exemplary calculation.

“Usual” solvent composition of solvent based paints: 48 % white spirit, 40% xylene, 12 % esters. In accordance with the empirical formula of chemical substance, the carbon content can be calculated. E.g., the empirical formula of xylene is C₈H₁₀. From this, the carbon content is 90.5 % w/w. Similarly, carbon contents were obtained by calculating the other components and their carbon contents, and weighting it according to the solvent composition. These are shown in the second column of *Table A3-2*.

	Carbon content (%)	Solvent content (%)
Solvent based paints	81.4	50
Water based paints	57.0	6-8
Other paints, lacquers etc.	80.0	25
Glues etc.	57.0	8
Solvents	81.6	100

Table A3-2. Solvent and carbon contents of paints, lacquers, glues etc.

By this, the amount of carbon (C) from NMVOC (for each type of paint) and, upon multiplying it by 44/12, the amount of CO₂ may be calculated. In *Table A3-3* the mean carbon and NMVOC ratios are shown for the last 8 years. The decreasing numbers indicate the increasing proportion of water based paints. However, the proportion of water based paints has continued to increase in 2005, this C/NMVOC ratio has increased due to decreasing amount of the group of glues and thinners, which has changed the previous ratio of solvents' composition.

	2001	2002	2003	2004	2005	2006	2007	2008
C/NMVOC	0.7690	0.7607	0.7540	0.7426	0.7650	0.7682	0.7705	0.7607

Table A3-3. Mean carbon and NMVOC ratio of solvents for the last 8 years

A3.4. LULUCF

Implementation of the consistent area representation in Hungary

Land-use change database covering the total land area of the country according to six broad IPCC land-use categories, which contains information about former land-use categories of the converted areas as well, was not available for Hungary. Therefore the main steps of the implementation of consistent area representation were the classification of total area of the country into six IPCC land-use categories using the available land-use and land-cover statistics for the whole time series, and then the specification of land-use changes using the available land-cover datasets. This type of land-use representation resulted in a mix of the Approach 1 and Approach 2 area representation methods.

To achieve a complete territorial coverage of the country, three different dataset were used. The next table summarises the coverage of the IPCC land-use categories relating to Hungary, along with data sources.

Table A3-4 Coverage and data sources of IPCC land-use categories in Hungary

IPCC land-use categories	Category used in the database	Data sources
Forest Land	Land under Forest Management	NFI (CAO Forestry Directorate)
Cropland	Arable land	HCSO's land-use statistics
	Kitchen garden	
	Orchard	
	Vineyard	
Grassland	Grassland	HCSO's land-use statistics
Settlements	Artificial surfaces	HCL85, CLC90, CLC2000, CLC2006
Wetlands	Wetlands and Water bodies	HCL85, CLC90, CLC2000, CLC2006

Databases used for this purpose are delineated in the NIR Chapter 7.1.2.

The NFI and the HCSO's land-use statistics provide data annually for the whole GHG inventory time series, although the HCSO's land-use statistics had to be adjusted due to the methodological changes of data collection and other data collection problems (for more details see the next chapter of the Annexes). The land-cover inventories were available for four year of the time series; data for other years were interpolated.

The area of the Other Land category was calculated as the difference between the sum of the areas of the other five land-use categories and the official area of the country. The area of abandoned agricultural areas was estimated from annual changes of the areas of Grassland and Cropland.

The combination of these three types of statistics resulted in a complete spatial coverage of the country for the whole inventory period with net area data. For specification of inter-category changes supplementary data were used.

Assumptions made and steps of harmonization of net land-use data with the land-use change datasets were as follows:

- The CLC-change₁₉₉₀₋₂₀₀₀ and CLC-change₂₀₀₀₋₂₀₀₆ were supplemented with a third database referring to 1985-1990. The supplementary database was implemented by processing satellite images (HCL-change₁₉₈₅₋₁₉₉₀). The other existing two databases were standardized according to the new one. The standardization and the processing of satellite images were developed according to the requirements of the LULUCF GHG inventory, and it was implemented by the Institute of Geodesy, Cartography and Remote Sensing (FÖMI, 2009b).

- The standardized land-cover categories implemented by the FÖMI were classified into the IPCC categories. The classification is shown in Table A3.-5.

Table A3-5 Classification of the land-cover categories into IPCC land-use categories

Standardized land-cover categories	IPCC category
100	Forest land
210, 220	Cropland
230	Grassland
310	Settlements
400, 500	Wetlands
330	Other land

- The land-cover data were taken into account according to their acquisition date. The acquisition dates of 1985, 1990, 2000 and 2006 databases are 1986, 1992, 2000 and 2006, respectively. (FÖMI, 2004; FÖMI, 2009a; FÖMI, 2009b)
- In the next step the net changes calculated from the three land-use change matrices derived from land-cover databases for the periods 1986-1992, 1992-2000 and 2000-2006 were compared with the net changes in the HCSO's land-use statistics calculated for the similar periods.
- It was assumed that the land-use change in a certain managed transformation category was equal to the land-cover change in that category, and the difference between the net changes in the land-cover databases and in the land-use databases derived from land-use changes in Other Land categories. This is because the Other Land category in the land-use database contains the abandoned agricultural lands while the Other Land category in the land-cover database does not contain them. Accordingly, the difference was eliminated in the Land converted to Other Land and in the Other Land converted to other land-use categories.
- From the three land-use change matrices, the land conversions were calculated for each year, so that the sum of the land-use changes in each land-use categories in the time period should be equal to the land-cover changes indicated by the land-cover database in that category for the given period.
- The procedures delineated above resulted in the gross annual changes of the needed land-use change categories. These matrices provided the activity data for the calculation of carbon stock changes in living non-woody biomass in Grassland and Cropland category.
- In the next step the 20 year transition period were taken into account. It was assumed that all land-use transitions originated from the remaining categories, and the conversion categories are not converted again during the 20 year transition period. This assumption can not be made for the set-aside category, because the land area which would have to be converted exceeded the area in the remaining category. Probably, the abandoned croplands are afforested, or cultivated again within 20 years time. Therefore it was assumed, that the set-aside croplands reach equilibrium in ten years time after abandonment, and they are converted again. (It has to be noted that the HCSO reports abandoned lands, which are not cultivated less than five years in the Arable land category. Therefore areas which have been in our set-aside category for ten years have not been cultivated for 15 years, actually.) Although, this assumption contradicts the IPCC default 20 years conversion period, but the estimation reference with the set asides were conservative. Elements of our conservative estimations, which guarantee, that the shorter transition period does not result in over estimation of the removals or under estimation of emissions are the follows:

- Only ten times the 1/20 of the increment of carbon stock of mineral soils is accounted for Cropland converted to set-aside croplands.
- If a set-aside cropland is cultivated again (Other Land converted to Cropland conversion) it is assumed that the carbon stock of mineral soils of the Set-aside Cropland at the time of conversion have already reached the carbon-stock of a Set-Aside Cropland that have not been cultivated for 20 years (i.e. $F_{LU}=0.93$).
- Mineralization is also accounted for in the Set-Aside Cropland converted to Cropland conversions.
- The biomass of Set-Aside Croplands is considered to be similar to a non-improved grassland, if the Set-Aside Cropland is cultivated again. It is a conservative approach, because of the overestimation of the carbon stock of living biomass before the conversion.

Adjustment of HCSO's land use data applied for area representation

One of the most important land-use dataset for the implementation of the consistent area representation in Hungary was the HCSO's land-use statistics. This database is collected annually, by questionnaires, but it is adjusted by the HCSO whenever more detailed dataset is available. Sometimes this adjustment of the HCSO causes significant drops in the year of the adjustment in the time series. Sometimes the time series are reconsidered by the HCSO, and the data for the years before the year of the adjustment are fitted backward to the adjusted, but sometimes not. (The HCSO's land-use statistics are published on the website of the office

http://portal.ksh.hu/pls/ksh/docs/eng/xstadat/xstadat_annual/tab14_01_04iea.html where the green colour signs the reconsideration.)

After the change of the regime in Hungary at the beginning of the 1990's, the land of the former large collective farms was mainly distributed among individual farmers. This transformation, when changes in ownership took place, was not entirely transparent (Laczka and Soós, 2003) and it made the data collection more difficult. The changes in the ownership resulted in changes of the system and the method of data collection. (Kecskés, 1997)

Significant changes in the time series derived from the problem of data collection which could cause emissions/removals from artefacts. In order to avoid these unreal effects, the dataset was further adjusted by the HMS before making GHG inventory. The adjustment was implemented after consultation with the HCSO's expert. The following paragraphs describe the steps and assumptions in developing the activity data from the HCSO's land-use statistics:

- Between 1985 and 1990 the system of landowners and data collection can be considered as to be in steady state, therefore the annual data was accepted without adjustment.
- The most significant changes of the landownership occurred in the period 1990-2000; therefore the annual dataset for the all categories with exception of orchards and vineyards was replaced with the interpolated values between the two general agricultural censuses which were held in 1990 and 2000. For the vineyards and orchard category the results of the more detailed and reliable census on vineyards and orchards were accepted instead of the results of the general agricultural census. Therefore the interpolation was applied for the years between 1990 and 2001.
- For the years after 2000, in case of orchard and vineyards after 2001, in each land-use categories only those values were accepted in the time series, which were confirmed by other more detailed data collection. Between the years with confirmed data interpolated values were taken into account. For the arable land and kitchen garden category the data published for 2008 were accepted, because the farm structure survey in 2007 confirmed the result of the annual data collection. (The results of the farm structure survey had not been available yet when the land-use

statistics for 2007 were published.) For the orchard category the values published for 2008 were accepted. A survey of the most important fruit species was implemented in 2007. The orchard land area published for 2008 was adjusted using the result of the survey. For the vineyard area the data published for 2006 and 2008 were accepted. Data, published for 2006 is a reconsidered data, and data published in 2008 was confirmed by the farm structure survey in 2007. For grassland areas data published for 2006 and 2008 were accepted, which were adjusted reflecting the results of the farm structure surveys in 2005, and in 2007.

Activity data for estimation of carbon stock change in Cropland living biomass

Table A3-6 Vineyard activity data for calculation of carbon stock change in living biomass on Cropland (ha) (note: * interpolated value)

Year	Vineyard Total Area	Adjusted Vineyard Area	Vineyard Area of Agricultural Enterprises	Vineyard Area of Private Farms	Adjusted Vineyard Area of Private Farms	Vineyard Removal of Agricultural Enterprises	Vineyard Removal of Private Farms	Total vineyard Removal
1985	153,600	153,600	69,553	84,011	84,011	7,706	no	7,706
BY	148,633	148,633	64,535	84,088	84,088	6,706	no	6,706
1986	147,400	147,400	63,501	83,943	83,943	6,267	no	6,267
1987	144,900	144,900	60,551	84,310	84,310	6,144	no	6,144
1988	142,200	142,200	55,231	86,937	86,937	3,485	no	3,485
1989	140,300	140,300	50,771	89,574	89,574	2,101	no	2,101
1990	138,500	138,500	47,050	91,350	91,350	2,152	3,042	5,194
1991	136,400	134,355	41,800	94,600	90,640	1,873	3,728	5,601
1992	135,000	130,209	43,500	91,500	89,930	1,384	3,705	5,089
1993	131,700	126,064	34,300	97,400	89,220	543	3,681	4,224
1994	131,900	121,918	20,500	111,400	88,510	404	3,657	4,061
1995	131,300	117,773	13,900	117,400	87,800	49	3,634	3,683
1996	130,900	113,627	14,600	116,300	87,090	58	3,610	3,668
1997	130,900	109,482	9,140	121,740	86,380	567	3,586	4,153
1998	129,700	105,336	8,100	121,600	85,670	127	3,563	3,690
1999	127,000	101,191	8,350	118,650	84,960	97	3,539	3,636
2000	105,900	97,045	8,740	97,140	84,250	139	3,516	3,655
2001	92,900	92,900	9,340	83,540	83,540	198	3,492	3,690
2002	92,800	91,520	10,000	82,800	81,382	202	4,090	4,292
2003	93,300	90,140	10,500	82,800	79,224	230	4,018	4,248
2004	94,500	88,760	11,300	83,200	77,066	258	3,946	4,204
2005	86,000	87,380	12,840	73,140	74,908	68	3,874	3,942
2006	86,000	86,000	13,250	72,750	72,750	500	3,803	4,303
2007	86,000	84,300	13,250	72,750	71,175	230	3,945	4,175
2008	82,600	82,600	13,000	69,600	69,600	100	3,893	3,993

Table A3-7 Orchard Activity data for calculation of carbon stock change in living biomass on Cropland (ha) (note: * interpolated value)

Year	Orchard Total Area	Adjusted Orchard Area	Orchard Area of Agricultural Enterprises	Orchard Area of Private Farms	Adjusted Orchard Area of Private Farms	Orchard Removal of Agricultural Enterprises	Orchard Removal of Private Farms	Total Orchard Removal
1985	103,500	103,500	71,210	7,706,000	32,290	5,628		5,628
BY	99,667	99,667	65,908	6,705,667	33,759	3,777		3,777
1986	99,000	99,000	65,013	6,267,000	33,987	2,998		2,998
1987	96,500	96,500	61,500	6,144,000	35,000	2,705		2,705
1988	94,900	94,900	59,347	3,485,000	35,553	2,015		2,015
1989	94,300	94,300	56,178	2,101,000	38,122	1,208		1,208
1990	95,100	95,100	61,100	5,193,955	34,000	2,142	1,132	3,274
1991	94,100	95,318	53,100	5,601,312	37,964	1,955	1,264	3,219
1992	94,500	95,536	52,100	5,088,669	41,927	973	1,396	2,369
1993	93,000	95,755	43,700	4,224,026	45,891	596	1,528	2,124
1994	92,700	95,973	37,400	4,061,383	49,855	469	1,660	2,129
1995	93,900	96,191	26,200	3,682,740	53,818	680	1,792	2,472
1996	94,300	96,409	27,700	3,668,097	57,782	526	1,924	2,450
1997	95,600	96,627	20,700	4,153,454	61,745	198	2,056	2,254
1998	96,300	96,845	19,800	3,689,811	65,709	538	2,188	2,726
1999	96,400	97,064	22,000	3,636,168	69,673	523	2,320	2,843
2000	95,400	97,282	21,200	3,654,525	73,636	350	2,452	2,802
2001	97,500	97,500	19,900	3,689,882	77,600	518	2,584	3,102
2002	97,400	97,643	21,200	4,292,021	77,186	803	2,570	3,373
2003	98,300	97,786	23,650	4,248,159	76,771	492	2,556	3,048
2004	102,600	97,929	24,700	4,204,298	76,357	181	2,543	2,724
2005	102,800	98,071	27,100	3,942,436	75,943	778	2,529	3,307
2006	102,800	98,214	26,600	4,302,575	75,529	100	2,515	2,615
2007	101,900	98,357	26,100	4,175,128	75,114	200	2,501	2,701
2008	98,500	98,500	23,700	3,992,680	74,700	300	2,488	2,788

Determination of activity data (A_G , A_L) from HCSO statistics for calculation of carbon stock change in living biomass in Cropland

The method recommended by the GPG for LULUCF (IPCC, 2003) requires agricultural statistics on land areas of growing stock and harvested land in perennial woody crops (orchard and vineyards in Hungary) and land conversion data from and to perennial woody Cropland.

The following statistics concerned are published by the HCSO, annually:

- Vineyard total area and areas by legal forms
- Orchard total area and areas by legal forms
- Vineyard removal in the area of agricultural enterprises
- Orchard removal in the area of agricultural enterprises

It can be seen that the HCSO statistics cannot provide information on land conversion by previous and following land-use. Only the total vineyard and orchard areas and removals are known. In addition to that removal statistics are published for the agricultural enterprises only, and this statistic is not available for the private farms that have increasing importance since 1990. (Areas reported as 'area unidentifiable with holdings' in the HCSO statistics was considered as area of private farms.) Thus an estimation procedure was developed for the estimation of removal of private farms as described below.

The following assumptions were made in the course of the estimation procedure:

1. Until 1989 the data on removal in the areas of agricultural enterprises comprises the removed areas by private farms as well. Before the economic change in 1989-90 the land areas of private farms were negligible, and the few private farms used mostly the land of agricultural enterprises thus the agricultural statistics on enterprises contains the activity of mostly private farms as well.
2. According to the Tier 1 methodology of GPG for LULUCF (IPCC, 2003), a 30 year harvest cycle is assumed for perennial woody crops as orchards and vineyards in temperate climate region on the area of private farms. It means that 3.33% of these cultures are removed and replanted in every year.
3. The change of the extent of orchard and vineyard area on private farms derives partially from legal acts (landowner change) instead of plantation and removal. It is evident from *Figure A3-1*. After the economic change the land area of agricultural enterprises decreased continuously while the area of private farms increased. According to the farm structure survey in 2007 the private farms held possession of 74 percent of the total orchard area and 85 percent of the vineyard area. A significant restructuring (landowner changes) took place in the nineties, thus the growing of land areas of private farms derived from the landowner change instead of plantation and on the contrary, the decrease of land areas of agricultural enterprises is not primarily the result of removals.

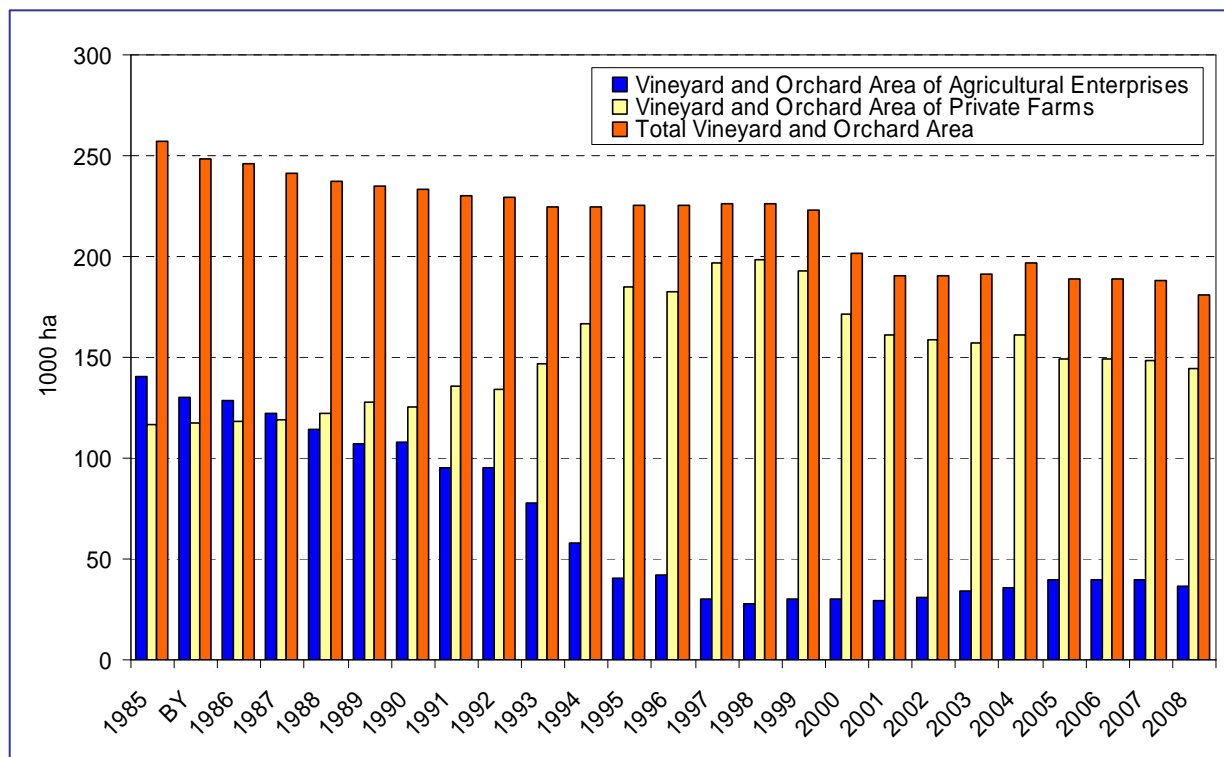


Figure A3-1. Landowner changes of vineyards and orchards in Hungary 1985-2008

To separate the area decrease resulting from the landowner change from real removals, the area decrease of private farms was considered as removal in a certain year if the total vineyard/ orchard area decreased as well. If the decrease of the area of private farms exceeds the decrease of the total area, the area decrease is considered as removal in private farms to such an extent that the total area decreased. (Eq. A3-7, A3-8, A3-9)

(To estimate the removal from land area decrease, the total vineyard area was adjusted similarly to the area of private farms, as described below.)

The HCSO collects statistics on vineyard and orchard areas by questionnaire, annually, but in the year of the agricultural censuses, these data derives from a more detailed and more widespread data collection. (There were General Agricultural Censuses in 1990 and 2000. There was a Census on Orchards and Vineyard in 2001, which is the most detailed data collection on Hungarian vineyard and orchard. There was a Census on the most significant fruit plantation in 2007 as well). As a result of the more widespread data collection in the years of censuses, the differences between the values given for the year of census and the values given for the previous and subsequent years are sometimes significant, especially in the time series of the vineyard area of private farms. Big differences in the time series are the result of the uncertainty of annual data collection among the private farms, as revealed on the course of the General Agricultural Census in 2000. The private farms often reported abandoned vineyards as managed vineyards in the nineties (HCSO, 2001). To insure the consistency of the time series of the area of private farms, this data set was adjusted by linear interpolation between the values given for 1990 and 2001, and between 2001 and 2007, only the most detailed and reliable data collection were taken into account. Results of annual data collection were ignored.

Determination of A_G

Following the assumptions described above, A_G was obtained from the subtracting vineyard and orchard total area (agricultural enterprises and private farms areas summed) the areas of orchard and vineyard plantation in the inventory year (Equation A3-3).

$$A_G = A_{VAE} + A_{VPPF} + A_{OAE} + A_{OPF}$$

Equation A3-3.

Where:

A_G land areas of growing stock

A_{VAE} vineyard areas of agricultural enterprises

A_{VPPF} vineyard areas of private farms

A_{OAE} orchard areas of agricultural enterprises

A_{OPF} orchard areas of private farms

These time series are available from the HCSO statistics (*Table A3-6, Table A3-7*), although there is a data gap in the year of 2003, which was eliminated by interpolation from the values of the previous and the next years data.

Determination of A_L

The removal of perennial woody crops derives from the vineyard and orchard removal on the area of the agricultural enterprises and on the areas of private farms. The removal arises from rotation (replantation) and the area decrease (abandonment of vineyards and orchards)

$$A_L = A_{VRAE} + A_{VRPF} + A_{ORAE} + A_{ORPF}$$

Equation A3-4.

Where:

A_{VRAE} vineyard removal on the areas agricultural enterprises

A_{VRPF} vineyard removal on the areas private farms

A_{ORAE} orchard removal on the areas of agricultural enterprises

A_{ORPF} orchard removal on the areas of private farms

The time series of vineyard and orchard removal on the areas of agricultural enterprises are available from the HCSO statistics (*Table A3-6 and Table A3-7*), although there is a data gap in the year of 2003, which was eliminated by linear interpolation.

Estimation of removal of private farms as follows:

$$A_{VRPF} = \{0 \text{ until } 1989 \text{ and } A_{VPPF} \cdot 0.333 + \min(f(A_{VT}), f(A_{VPPF})) \text{ since } 1990\}$$

Equation A3-5.

$$A_{ORPF} = \{0 \text{ until } 1989 \text{ and } A_{VPPF} \cdot 0.333 + \min(f(A_{OT}), f(A_{OPF})) \text{ since } 1990\}$$

Equation A3-6.

Where:

A_{VT} vineyard total area

A_{OT} orchard total area

$f(x)$ area decrease function

$$f(x) = \{x_{iy-1} - x_{iy} \text{ if } x_{iy-1} - x_{iy} > 0 \text{ else } 0\}$$

Equation A3-7.

Where:

x_{iy} area in the inventory year

x_{iy-1} area one year before the inventory year

Activity data and estimated carbon stocks for calculation in carbon stock change in mineral soils of Cropland, Grassland and Other Land

Table A3-8 Cropland areas by climate zones, soil type and management practices and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
	Climate	Soil	Management	Input																
Cropland	cold dry	HAC	full till	low	50	0.8	1.00	0.92	968.1	966.8	964.0	961.7	960.3	958.5	955.8	953.6	951.8	943.0	941.6	937.4
	cold dry	HAC	full till	medium	50	0.8	1.00	1.00	704.1	703.1	701.1	699.4	698.4	697.1	695.2	693.5	692.2	685.8	684.8	681.8
	cold dry	HAC	full till	high with no manure	50	0.8	1.00	1.07	88.0	87.9	87.6	87.4	87.3	87.1	86.9	86.7	86.5	85.7	85.6	85.2
	cold dry	HAC	reduced till	medium	50	0.8	1.03	1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	warm dry	HAC	full till	low	38	0.8	1.00	0.92	1431.4	1429.5	1425.3	1422.0	1420.0	1417.2	1413.3	1410.0	1407.4	1394.4	1392.2	1386.1
	warm dry	HAC	full till	medium	38	0.8	1.00	1.00	1041.0	1039.6	1036.6	1034.2	1032.7	1030.7	1027.9	1025.5	1023.6	1014.1	1012.5	1008.0
	warm dry	HAC	full till	high with no manure	38	0.8	1.00	1.07	130.1	130.0	129.6	129.3	129.1	128.8	128.5	128.2	127.9	126.8	126.6	126.0
	warm dry	HAC	reduced till	medium	38	0.8	1.03	1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	cold dry	LAC	full till	low	33	0.8	1.00	0.92	37.2	37.2	37.0	37.0	36.9	36.8	36.7	36.6	36.6	36.2	36.2	36.0
	cold dry	LAC	full till	medium	33	0.8	1.00	1.00	27.1	27.0	26.9	26.9	26.8	26.8	26.7	26.7	26.6	26.4	26.3	26.2
	cold dry	LAC	full till	high with no manure	33	0.8	1.00	1.07	3.4	3.4	3.4	3.4	3.4	3.3	3.3	3.3	3.3	3.3	3.3	3.3
	warm dry	LAC	full till	low	24	0.8	1.00	0.92	29.6	29.6	29.5	29.4	29.4	29.3	29.2	29.2	29.1	28.8	28.8	28.7
	warm dry	LAC	full till	medium	24	0.8	1.00	1.00	21.5	21.5	21.4	21.4	21.4	21.3	21.3	21.2	21.2	21.0	20.9	20.8
	warm dry	LAC	full till	high with no manure	24	0.8	1.00	1.07	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6
	cold dry	sandy	full till	low	34	0.8	1.00	0.92	74.2	74.1	73.9	73.7	73.6	73.5	73.3	73.1	73.0	72.3	72.2	71.9
	cold dry	sandy	full till	medium	34	0.8	1.00	1.00	54.0	53.9	53.7	53.6	53.5	53.4	53.3	53.2	53.1	52.6	52.5	52.3
	cold dry	sandy	full till	high with no manure	34	0.8	1.00	1.07	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.6	6.6	6.6	6.6	6.5
	warm dry	sandy	full till	low	19	0.8	1.00	0.92	89.2	89.1	88.8	88.6	88.5	88.3	88.1	87.9	87.7	86.9	86.8	86.4
	warm dry	sandy	full till	medium	19	0.8	1.00	1.00	64.9	64.8	64.6	64.5	64.4	64.3	64.1	63.9	63.8	63.2	63.1	62.8
	warm dry	sandy	full till	high with no manure	19	0.8	1.00	1.07	8.1	8.1	8.1	8.1	8.0	8.0	8.0	8.0	8.0	7.9	7.9	7.9
	cold dry	aquic	full till	low	87	0.8	1.00	0.92	188.9	188.7	188.1	187.7	187.4	187.0	186.5	186.1	185.7	184.0	183.7	182.9
	cold dry	aquic	full till	medium	87	0.8	1.00	1.00	137.4	137.2	136.8	136.5	136.3	136.0	135.7	135.3	135.1	133.8	133.6	133.0
	cold dry	aquic	full till	high with no manure	87	0.8	1.00	1.07	17.2	17.2	17.1	17.1	17.0	17.0	17.0	16.9	16.9	16.7	16.7	16.6
	warm dry	aquic	full till	low	88	0.8	1.00	0.92	288.7	288.3	287.5	286.8	286.4	285.8	285.0	284.4	283.8	281.2	280.8	279.5
warm dry	aquic	full till	medium	88	0.8	1.00	1.00	210.0	209.7	209.1	208.6	208.3	207.9	207.3	206.8	206.4	204.5	204.2	203.3	
warm dry	aquic	full till	high with no manure	88	0.8	1.00	1.07	26.2	26.2	26.1	26.1	26.0	26.0	25.9	25.9	25.8	25.6	25.5	25.4	
Total Cropland area (ha)									5649.7	5642.2	5625.60	5612.7	5604.5	5593.8	5578.3	5565.3	5554.9	5503.5	5495.1	5470.7
Carbon stock (Gg C ha⁻¹)									38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2

Table A3-8 (continued) Cropland areas by climate zones, soil type and management practices and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	
	Climate	Soil	Management	Input					Area (ha)												
Cropland	cold dry	HAC	full till	low	50	0.8	1.00	0.92	929.2	923.3	905.7	892.5	880.1	876.8	874.7	873.4	907.0	906.4	906.3	906.0	
	cold dry	HAC	full till	medium	50	0.8	1.00	1.00	675.8	671.5	658.7	649.1	640.1	637.7	636.2	635.2	659.6	659.2	659.1	658.9	
	cold dry	HAC	full till	high with no manure	50	0.8	1.00	1.07	84.5	83.9	82.3	81.1	80.0	79.7	79.5	79.4	82.5	82.4	82.4	82.4	
	cold dry	HAC	reduced till	medium	50	0.8	1.03	1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	warm dry	HAC	full till	low	38	0.8	1.00	0.92	1373.9	1365.3	1339.1	1319.6	1301.4	1296.4	1293.4	1291.5	1341.1	1340.2	1340.0	1339.6	
	warm dry	HAC	full till	medium	38	0.8	1.00	1.00	999.2	992.9	973.9	959.7	946.4	942.8	940.6	939.3	975.4	974.7	974.6	974.3	
	warm dry	HAC	full till	high with no manure	38	0.8	1.00	1.07	124.9	124.1	121.7	120.0	118.3	117.9	117.6	117.4	121.9	121.8	121.8	121.8	
	warm dry	HAC	reduced till	medium	38	0.8	1.03	1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	cold dry	LAC	full till	low	33	0.8	1.00	0.92	35.7	35.5	34.8	34.3	33.8	33.7	33.6	33.6	34.9	34.8	34.8	34.8	
	cold dry	LAC	full till	medium	33	0.8	1.00	1.00	26.0	25.8	25.3	24.9	24.6	24.5	24.4	24.4	25.4	25.3	25.3	25.3	
	cold dry	LAC	full till	high with no manure	33	0.8	1.00	1.07	3.2	3.2	3.2	3.1	3.1	3.1	3.1	3.1	3.1	3.2	3.2	3.2	3.2
	warm dry	LAC	full till	low	24	0.8	1.00	0.92	28.4	28.2	27.7	27.3	26.9	26.8	26.7	26.7	27.7	27.7	27.7	27.7	
	warm dry	LAC	full till	medium	24	0.8	1.00	1.00	20.7	20.5	20.1	19.8	19.6	19.5	19.5	19.4	20.2	20.2	20.2	20.1	
	warm dry	LAC	full till	high with no manure	24	0.8	1.00	1.07	2.6	2.6	2.5	2.5	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	
	cold dry	sandy	full till	low	34	0.8	1.00	0.92	71.2	70.8	69.4	68.4	67.5	67.2	67.1	67.0	69.5	69.5	69.5	69.5	
	cold dry	sandy	full till	medium	34	0.8	1.00	1.00	51.8	51.5	50.5	49.8	49.1	48.9	48.8	48.7	50.6	50.5	50.5	50.5	
	cold dry	sandy	full till	high with no manure	34	0.8	1.00	1.07	6.5	6.4	6.3	6.2	6.1	6.1	6.1	6.1	6.3	6.3	6.3	6.3	
	warm dry	sandy	full till	low	19	0.8	1.00	0.92	85.6	85.1	83.5	82.3	81.1	80.8	80.6	80.5	83.6	83.5	83.5	83.5	
	warm dry	sandy	full till	medium	19	0.8	1.00	1.00	62.3	61.9	60.7	59.8	59.0	58.8	58.6	58.5	60.8	60.8	60.8	60.7	
	warm dry	sandy	full till	high with no manure	19	0.8	1.00	1.07	7.8	7.7	7.6	7.5	7.4	7.3	7.3	7.3	7.6	7.6	7.6	7.6	
	cold dry	aquic	full till	low	87	0.8	1.00	0.92	181.3	180.2	176.7	174.2	171.7	171.1	170.7	170.4	177.0	176.9	176.8	176.8	
	cold dry	aquic	full till	medium	87	0.8	1.00	1.00	131.9	131.0	128.5	126.7	124.9	124.4	124.1	124.0	128.7	128.6	128.6	128.6	
	cold dry	aquic	full till	high with no manure	87	0.8	1.00	1.07	16.5	16.4	16.1	15.8	15.6	15.6	15.5	15.5	16.1	16.1	16.1	16.1	
	warm dry	aquic	full till	low	88	0.8	1.00	0.92	277.1	275.3	270.1	266.1	262.5	261.5	260.8	260.5	270.5	270.3	270.3	270.2	
	warm dry	aquic	full till	medium	88	0.8	1.00	1.00	201.5	200.3	196.4	193.6	190.9	190.2	189.7	189.4	196.7	196.6	196.6	196.5	
	warm dry	aquic	full till	high with no manure	88	0.8	1.00	1.07	25.2	25.0	24.6	24.2	23.9	23.8	23.7	23.7	24.6	24.6	24.6	24.6	
Total Cropland area (ha)									5422.7	5388.6	5285.5	5208.4	5136.4	5116.9	5104.8	5097.4	5293.3	5289.9	5289.0	5287.4	
Carbon stock (Gg C ha⁻¹)									38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	

Table A3-8 (continued) Cropland areas by climate zone, soil type and management practices and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	
	Climate	Soil	Management	Input															Area (ha)
Cropland	cold dry	HAC	full till	low	50	0.8	1.00	0.92	905.9	906.0	897.6	889.2	880.7	872.3	863.9	855.5	847.0	838.6	
	cold dry	HAC	full till	medium	50	0.8	1.00	1.00	658.8	658.9	652.8	646.7	640.5	634.4	628.3	622.2	616.0	596.7	
	cold dry	HAC	full till	high with no manure	50	0.8	1.00	1.07	82.4	82.4	81.6	80.8	80.1	79.3	78.5	77.8	77.0	76.2	
	cold dry	HAC	reduced till	medium	50	0.8	1.03	1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.2
	warm dry	HAC	full till	low	38	0.8	1.00	0.92	1339.4	1339.7	1327.2	1314.7	1302.3	1289.8	1277.4	1264.9	1252.4	1240.0	
	warm dry	HAC	full till	medium	38	0.8	1.00	1.00	974.1	974.3	965.2	956.2	947.1	938.0	929.0	919.9	910.9	882.0	
	warm dry	HAC	full till	high with no manure	38	0.8	1.00	1.07	121.8	121.8	120.7	119.5	118.4	117.3	116.1	115.0	113.9	112.7	
	warm dry	HAC	reduced till	medium	38	0.8	1.03	1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.8
	cold dry	LAC	full till	low	33	0.8	1.00	0.92	34.8	34.8	34.5	34.2	33.8	33.5	33.2	32.9	32.6	32.2	32.2
	cold dry	LAC	full till	medium	33	0.8	1.00	1.00	25.3	25.3	25.1	24.9	24.6	24.4	24.1	23.9	23.7	23.4	
	cold dry	LAC	full till	high with no manure	33	0.8	1.00	1.07	3.2	3.2	3.1	3.1	3.1	3.0	3.0	3.0	3.0	3.0	2.9
	warm dry	LAC	full till	low	24	0.8	1.00	0.92	27.7	27.7	27.4	27.2	26.9	26.7	26.4	26.2	25.9	25.6	
	warm dry	LAC	full till	medium	24	0.8	1.00	1.00	20.1	20.2	20.0	19.8	19.6	19.4	19.2	19.0	18.8	18.7	
	warm dry	LAC	full till	high with no manure	24	0.8	1.00	1.07	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4	2.4	2.4	2.3
	cold dry	sandy	full till	low	34	0.8	1.00	0.92	69.4	69.5	68.8	68.2	67.5	66.9	66.2	65.6	64.9	64.3	
	cold dry	sandy	full till	medium	34	0.8	1.00	1.00	50.5	50.5	50.0	49.6	49.1	48.6	48.2	47.7	47.2	46.8	
	cold dry	sandy	full till	high with no manure	34	0.8	1.00	1.07	6.3	6.3	6.3	6.2	6.1	6.1	6.0	6.0	5.9	5.8	
	warm dry	sandy	full till	low	19	0.8	1.00	0.92	83.5	83.5	82.7	82.0	81.2	80.4	79.6	78.8	78.1	77.3	
	warm dry	sandy	full till	medium	19	0.8	1.00	1.00	60.7	60.7	60.2	59.6	59.0	58.5	57.9	57.3	56.8	56.2	
	warm dry	sandy	full till	high with no manure	19	0.8	1.00	1.07	7.6	7.6	7.5	7.5	7.4	7.3	7.2	7.2	7.1	7.0	
	cold dry	aquic	full till	low	87	0.8	1.00	0.92	176.8	176.8	175.2	173.5	171.9	170.2	168.6	166.9	165.3	163.6	
	cold dry	aquic	full till	medium	87	0.8	1.00	1.00	128.6	128.6	127.4	126.2	125.0	123.8	122.6	121.4	120.2	119.0	
	cold dry	aquic	full till	high with no manure	87	0.8	1.00	1.07	16.1	16.1	15.9	15.8	15.6	15.5	15.3	15.2	15.0	14.9	
	warm dry	aquic	full till	low	88	0.8	1.00	0.92	270.1	270.2	267.7	265.2	262.6	260.1	257.6	255.1	252.6	250.1	
warm dry	aquic	full till	medium	88	0.8	1.00	1.00	196.5	196.5	194.7	192.8	191.0	189.2	187.4	185.5	183.7	181.9		
warm dry	aquic	full till	high with no manure	88	0.8	1.00	1.07	24.6	24.6	24.3	24.1	23.9	23.6	23.4	23.2	23.0	22.7		
Total Cropland area (ha)									5286.6	5287.6	5238.4	5189.2	5140.0	5090.9	5041.7	4992.5	4943.3	4894.1	
Carbon stock (Gg C ha⁻¹)									38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	

Table A3-8 (continued) Cropland areas by climate zone, soil type and management practices and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
	Climate	Soil	Management	Input															Area (ha)
Cropland	cold dry	HAC	full till	low	50	0.8	1.00	0.92	830.2	821.8	821.2	821.1	821.0	820.9	820.8	820.7	819.9	744.6	
	cold dry	HAC	full till	medium	50	0.8	1.00	1.00	582.8	569.1	561.0	553.1	545.3	537.5	529.6	521.8	513.5	579.7	
	cold dry	HAC	full till	high with no manure	50	0.8	1.00	1.07	75.5	74.7	74.7	74.6	74.6	74.6	74.6	74.6	74.6	74.5	74.5
	cold dry	HAC	reduced till	medium	50	0.8	1.03	1.00	21.0	28.5	36.3	44.0	51.8	59.6	67.3	75.1	82.8	90.4	
	warm dry	HAC	full till	low	38	0.8	1.00	0.92	1227.5	1215.0	1214.2	1214.1	1214.0	1213.8	1213.7	1213.5	1212.3	1101.0	
	warm dry	HAC	full till	medium	38	0.8	1.00	1.00	861.3	840.9	828.7	816.9	805.2	793.4	781.7	770.0	757.5	855.2	
	warm dry	HAC	full till	high with no manure	38	0.8	1.00	1.07	111.6	110.5	110.4	110.4	110.4	110.3	110.3	110.3	110.2	110.1	
	warm dry	HAC	reduced till	medium	38	0.8	1.03	1.00	31.4	42.8	54.4	66.1	77.7	89.3	101.0	112.6	124.1	135.6	
	cold dry	LAC	full till	low	33	0.8	1.00	0.92	31.9	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.6
	cold dry	LAC	full till	medium	33	0.8	1.00	1.00	23.2	23.1	23.1	23.1	23.1	23.1	23.0	23.0	23.0	23.0	23.0
	cold dry	LAC	full till	high with no manure	33	0.8	1.00	1.07	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
	warm dry	LAC	full till	low	24	0.8	1.00	0.92	25.4	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2
	warm dry	LAC	full till	medium	24	0.8	1.00	1.00	18.5	18.4	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3
	warm dry	LAC	full till	high with no manure	24	0.8	1.00	1.07	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
	cold dry	sandy	full till	low	34	0.8	1.00	0.92	63.6	61.9	61.9	61.9	61.9	61.9	61.9	61.8	61.8	61.7	
	cold dry	sandy	full till	medium	34	0.8	1.00	1.00	46.3	45.0	45.0	45.0	45.0	45.0	45.0	45.0	44.9	44.9	
	cold dry	sandy	full till	high with no manure	34	0.8	1.00	1.07	5.8	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
	warm dry	sandy	full till	low	19	0.8	1.00	0.92	76.5	74.4	74.4	74.4	74.4	74.4	74.4	74.4	74.3	74.2	
	warm dry	sandy	full till	medium	19	0.8	1.00	1.00	55.6	54.1	54.1	54.1	54.1	54.1	54.1	54.1	54.0	54.0	
	warm dry	sandy	full till	high with no manure	19	0.8	1.00	1.07	7.0	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.7	
	cold dry	aquic	full till	low	87	0.8	1.00	0.92	162.0	161.2	161.1	161.1	161.0	161.0	161.0	160.8	160.7		
	cold dry	aquic	full till	medium	87	0.8	1.00	1.00	117.8	117.2	117.2	117.1	117.1	117.1	117.1	117.0	116.8		
	cold dry	aquic	full till	high with no manure	87	0.8	1.00	1.07	14.7	14.7	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
	warm dry	aquic	full till	low	88	0.8	1.00	0.92	247.6	246.3	246.2	246.1	246.1	246.1	246.0	245.8	245.5		
warm dry	aquic	full till	medium	88	0.8	1.00	1.00	180.0	179.1	179.0	179.0	179.0	178.9	178.9	178.7	178.6			
warm dry	aquic	full till	high with no manure	88	0.8	1.00	1.07	22.5	22.4	22.4	22.4	22.4	22.4	22.4	22.3	22.3			
Total Cropland area (ha)									4844.9	4795.7	4792.5	4792.0	4791.4	4790.9	4790.4	4789.8	4784.9	4780.0	
Carbon stock (Gg C ha⁻¹)									38.2	38.2	38.2	38.2	38.2	38.3	38.3	38.3	38.3	38.4	

Table A3-9 Set-Aside Cropland areas by climate zone and soil type and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
	Climate	Soil	Management	Input					Area (ha)													
Set-Aside Cropland	cold dry	HAC	-	-	50	0.93	1	1	0.0	2.3	7.5	11.5	14.1	17.4	22.2	26.3	29.5	45.5	48.2	55.8	70.7	81.3
	warm dry	HAC			38	0.93	1	1	0.0	3.5	11.1	17.0	20.8	25.8	32.9	38.9	43.7	67.3	71.2	82.5	104.6	120.3
	cold dry	LAC			33	0.93	1	1	0.0	0.1	0.3	0.4	0.5	0.7	0.9	1.0	1.1	1.8	1.9	2.1	2.7	3.1
	warm dry	LAC			24	0.93	1	1	0.0	0.1	0.2	0.4	0.4	0.5	0.7	0.8	0.9	1.4	1.5	1.7	2.2	2.5
	cold dry	sandy			34	0.93	1	1	0.0	0.2	0.6	0.9	1.1	1.3	1.7	2.0	2.3	3.5	3.7	4.3	5.4	6.2
	warm dry	sandy			19	0.93	1	1	0.0	0.2	0.7	1.1	1.3	1.6	2.1	2.4	2.7	4.2	4.4	5.1	6.5	7.5
	cold dry	aquic			87	0.93	1	1	0.0	0.5	1.5	2.2	2.7	3.4	4.3	5.1	5.8	8.9	9.4	10.9	13.8	15.9
	warm dry	aquic			88	0.93	1	1	0.0	0.7	2.2	3.4	4.2	5.2	6.6	7.8	8.8	13.6	14.4	16.6	21.1	24.3
Total Set-Aside Cropland area (ha)									0.0	7.5	24.1	37.0	45.2	55.9	71.4	84.4	94.8	146.2	154.6	179.0	227.0	261.1
Carbon stock (Gg C ha⁻¹)									45.1	45.1	45.1	45.1	45.1	45.1	45.1	45.1	45.1	45.1	45.1	45.1	45.1	45.1

Table A3-9 (continued) Set-Aside Cropland areas by climate zone and soil type and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
	Climate	Soil	Management	Input					Area (ha)									
Set-Aside Cropland	cold dry	HAC	-	-	50	0.93	1	1	113.5	137.5	159.9	166.0	169.8	172.1	111.0	112.1	112.4	112.9
	warm dry	HAC			38	0.93	1	1	167.7	203.3	236.4	245.4	251.0	254.4	164.2	165.7	166.2	166.9
	cold dry	LAC			33	0.93	1	1	4.4	5.3	6.1	6.4	6.5	6.6	4.3	4.3	4.3	4.3
	warm dry	LAC			24	0.93	1	1	3.5	4.2	4.9	5.1	5.2	5.3	3.4	3.4	3.4	3.5
	cold dry	sandy			34	0.93	1	1	8.7	10.5	12.3	12.7	13.0	13.2	8.5	8.6	8.6	8.7
	warm dry	sandy			19	0.93	1	1	10.5	12.7	14.7	15.3	15.6	15.9	10.2	10.3	10.4	10.4
	cold dry	aquic			87	0.93	1	1	22.1	26.8	31.2	32.4	33.1	33.6	21.7	21.9	21.9	22.0
	warm dry	aquic			88	0.93	1	1	33.8	41.0	47.7	49.5	50.6	51.3	33.1	33.4	33.5	33.7
Total Set-Aside Cropland area (ha)									364.2	441.3	513.3	532.8	544.9	552.3	356.4	359.8	360.7	362.3
Carbon stock (Gg C ha⁻¹)									45.1	45.1	45.1	45.1	45.1	45.1	45.1	45.1	45.1	45.1

Table A3-9 (continued) Set-Aside Cropland areas by climate zone and soil type and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Climate	Soil	Management	Input														
Set-Aside Cropland	cold dry	HAC	-	-	50	0.93	1	1	113.1	112.8	128.1	143.5	158.8	174.1	189.4	204.8	220.1	235.4
	warm dry	HAC			38	0.93	1	1	167.3	166.8	189.5	212.1	234.8	257.4	280.1	302.8	325.4	348.1
	cold dry	LAC			33	0.93	1	1	4.3	4.3	4.9	5.5	6.1	6.7	7.3	7.9	8.5	9.0
	warm dry	LAC			24	0.93	1	1	3.5	3.4	3.9	4.4	4.9	5.3	5.8	6.3	6.7	7.2
	cold dry	sandy			34	0.93	1	1	8.7	8.6	9.8	11.0	12.2	13.3	14.5	15.7	16.9	18.0
	warm dry	sandy			19	0.93	1	1	10.4	10.4	11.8	13.2	14.6	16.0	17.5	18.9	20.3	21.7
	cold dry	aquic			87	0.93	1	1	22.1	22.0	25.0	28.0	31.0	34.0	37.0	40.0	42.9	45.9
warm dry	aquic			88	0.93	1	1	33.7	33.6	38.2	42.8	47.4	51.9	56.5	61.1	65.6	70.2	
Total Set-Aside Cropland area (ha)									363.1	362.1	411.3	460.5	509.7	558.8	608.0	657.2	706.4	755.6
Carbon stock (Gg C ha⁻¹)									45.1	45.1	45.1	45.1	45.1	45.1	45.1	45.1	45.1	45.1

Table A3-9 (continued) Set-Aside Cropland areas by climate zone and soil type and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU(0)}	F _{MG}	F _I	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Climate	Soil	Management	Input														
Set-Aside Cropland	cold dry	HAC	-	-	50	0.93	1	1	250.7	266.1	267.1	267.2	267.4	267.6	267.7	267.9	269.4	271.0
	warm dry	HAC			38	0.93	1	1	370.7	393.4	394.9	395.1	395.4	395.6	395.9	396.1	398.4	400.6
	cold dry	LAC			33	0.93	1	1	9.6	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.1	10.1
	warm dry	LAC			24	0.93	1	1	7.7	7.9	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.1
	cold dry	sandy			34	0.93	1	1	19.2	22.4	22.4	22.4	22.5	22.5	22.5	22.5	22.6	22.7
	warm dry	sandy			19	0.93	1	1	23.1	26.9	27.0	27.0	27.0	27.0	27.0	27.0	27.2	27.3
	cold dry	aquic			87	0.93	1	1	48.9	50.4	50.6	50.6	50.7	50.7	50.7	50.8	51.1	51.4
warm dry	aquic			88	0.93	1	1	74.8	77.0	77.3	77.4	77.4	77.5	77.5	77.6	78.0	78.5	
Total Set-Aside Cropland area (ha)									804.8	854.0	857.2	857.7	858.3	858.8	859.3	859.9	864.8	869.7
Carbon stock (Gg C ha⁻¹)									45.1	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9

Table A3-10 Grassland areas by climate zone and soil type and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	
	Climate	Soil	Management	Input																			Area (ha)
Grassland	cold dry	HAC	non-degraded	-	50	1	1	1	233.6	230.3	230.7	231.1	230.0	229.6	228.7	229.5	229.3	229.2	228.4	230.5	234.1	234.6	
	cold dry	HAC	improved	medium	50	1	1.14	1	155.7	153.5	153.8	154.1	153.3	153.0	152.5	153.0	152.9	152.8	152.3	153.7	156.1	156.4	
	warm dry	HAC	non-degraded	-	38	1	1	1	345.4	340.5	341.1	341.7	340.0	339.4	338.2	339.4	339.1	338.9	337.7	340.8	346.2	346.8	
	warm dry	HAC	improved	medium	38	1	1.14	1	230.3	227.0	227.4	227.8	226.7	226.3	225.5	226.3	226.1	225.9	225.1	227.2	230.8	231.2	
	cold dry	LAC	non-degraded	-	33	1	1	1	21.6	21.3	21.3	21.4	21.3	21.2	21.2	21.2	21.2	21.2	21.2	21.1	21.3	21.6	21.7
	cold dry	LAC	improved	medium	33	1	1.14	1	9.3	9.1	9.1	9.2	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.3	9.3
	warm dry	LAC	non-degraded	-	24	1	1	1	12.3	12.1	12.1	12.1	12.1	12.1	12.0	12.1	12.1	12.0	12.0	12.1	12.3	12.3	
	warm dry	LAC	improved	medium	24	1	1.14	1	12.3	12.1	12.1	12.1	12.1	12.1	12.0	12.1	12.1	12.0	12.0	12.1	12.3	12.3	
	cold dry	sandy	non-degraded	-	34	1	1	1	14.6	14.4	14.4	14.4	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.2	14.4	14.6	14.6
	cold dry	sandy	improved	medium	34	1	1.14	1	9.7	9.6	9.6	9.6	9.6	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.6	9.7	9.8
	warm dry	sandy	non-degraded	-	19	1	1	1	20.4	20.1	20.2	20.2	20.1	20.1	20.0	20.1	20.1	20.0	20.0	20.2	20.5	20.5	
	warm dry	sandy	improved	medium	19	1	1.14	1	8.8	8.6	8.6	8.7	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.8	8.8
	cold dry	aquic	non-degraded	-	87	1	1	1	77.3	76.2	76.4	76.5	76.1	76.0	75.7	76.0	75.9	75.9	75.6	76.3	77.5	77.7	
	cold dry	aquic	improved	medium	87	1	1.14	1	13.6	13.5	13.5	13.5	13.4	13.4	13.4	13.4	13.4	13.4	13.3	13.5	13.7	13.7	
	warm dry	aquic	non-degraded	-	88	1	1	1	111.2	109.6	109.9	110.0	109.5	109.3	108.9	109.3	109.2	109.1	108.7	109.7	111.5	111.7	
warm dry	aquic	improved	medium	88	1	1.14	1	27.8	27.4	27.5	27.5	27.4	27.3	27.2	27.3	27.3	27.3	27.2	27.4	27.9	27.9		
Total Grassland area (ha)									1303.9	1285.3	1287.8	1289.9	1283.6	1281.3	1276.8	1281.2	1280.1	1279.2	1274.8	1286.5	1306.8	1309.3	
Carbon stock (Gg C ha⁻¹)									51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	

Table A3-10 (continued) Grassland areas by climate zone and soil type and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
	Climate	Soil	Management	Input														
Grassland	cold dry	HAC	non-degraded	-	50	1	1	1	232.3	231.9	230.0	229.9	229.2	226.6	223.3	221.0	219.0	216.8
	cold dry	HAC	improved	medium	50	1	1.14	1	154.9	154.6	153.4	153.3	152.8	151.1	148.9	147.4	146.0	144.5
	warm dry	HAC	non-degraded	-	38	1	1	1	343.5	342.8	340.1	339.9	338.9	335.1	330.2	326.8	296.8	293.8
	warm dry	HAC	improved	medium	38	1	1.14	1	229.0	228.6	226.8	226.6	225.9	223.4	220.1	217.9	242.8	240.4
	cold dry	LAC	non-degraded	-	33	1	1	1	21.5	21.4	21.3	21.3	21.2	21.0	20.6	19.9	18.8	18.6
	cold dry	LAC	improved	medium	33	1	1.14	1	9.2	9.2	9.1	9.1	9.1	9.0	8.8	9.3	10.1	10.0
	warm dry	LAC	non-degraded	-	24	1	1	1	12.2	12.2	12.1	12.1	12.0	11.9	11.7	11.6	11.5	11.4
	warm dry	LAC	improved	medium	24	1	1.14	1	12.2	12.2	12.1	12.1	12.0	11.9	11.7	11.6	11.5	11.4
	cold dry	sandy	non-degraded	-	34	1	1	1	14.5	14.5	14.3	14.3	14.3	14.1	13.9	13.8	12.5	12.4
	cold dry	sandy	improved	medium	34	1	1.14	1	9.7	9.6	9.6	9.6	9.5	9.4	9.3	9.2	10.2	10.1
	warm dry	sandy	improved	medium	19	1	1.14	1	8.7	8.7	8.6	8.6	8.6	8.5	8.4	9.7	9.6	9.5
	cold dry	aquic	non-degraded	-	87	1	1	1	76.9	76.8	76.2	76.1	75.9	75.0	73.9	74.9	72.5	73.4
	cold dry	aquic	improved	medium	87	1	1.14	1	13.6	13.5	13.4	13.4	13.4	13.2	13.0	11.2	12.8	11.0
	warm dry	aquic	non-degraded	-	88	1	1	1	110.6	110.4	109.5	109.5	109.1	107.9	106.3	102.6	117.3	113.5
warm dry	aquic	improved	medium	88	1	1.14	1	27.7	27.6	27.4	27.4	27.3	27.0	26.6	28.9	13.0	15.5	
Total Grassland area (ha)									1296.6	1294.2	1284.0	1283.3	1279.2	1264.9	1246.4	1233.7	1222.3	1209.9
Carbon stock (Gg C ha⁻¹)									51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7

Table A3-10 (continued) Grassland areas by climate zone and soil type and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Climate	Soil	Management	Input														
Grassland	cold dry	HAC	non-degraded	-	50	1	1	1	214.5	212.4	213.5	224.9	246.2	258.5	270.5	277.1	293.3	296.2
	cold dry	HAC	improved	medium	50	1	1.14	1	143.0	141.6	136.5	121.1	95.8	79.4	63.5	52.8	32.6	25.8
	warm dry	HAC	non-degraded	-	38	1	1	1	296.0	314.1	310.5	317.2	348.9	404.8	424.6	434.2	443.4	447.4
	warm dry	HAC	improved	medium	38	1	1.14	1	232.6	209.4	207.0	194.4	156.8	94.9	69.1	53.7	38.6	28.6
	cold dry	LAC	non-degraded	-	33	1	1	1	18.4	18.2	18.0	18.1	19.2	21.2	22.2	22.5	23.2	23.5
	cold dry	LAC	improved	medium	33	1	1.14	1	9.9	9.8	9.7	9.3	7.9	5.6	4.2	3.7	2.6	2.0
	warm dry	LAC	non-degraded	-	24	1	1	1	11.3	12.5	12.4	12.9	14.2	15.8	17.1	17.3	17.7	18.3
	warm dry	LAC	improved	medium	24	1	1.14	1	11.3	9.8	9.7	8.9	7.3	5.5	4.0	3.5	2.9	2.0
	cold dry	sandy	non-degraded	-	34	1	1	1	12.3	13.2	13.1	13.2	14.3	16.0	16.9	17.5	17.9	18.3
	cold dry	sandy	improved	medium	34	1	1.14	1	10.0	8.8	8.7	8.4	7.0	5.1	4.0	3.1	2.4	1.8
	warm dry	sandy	non-degraded	-	19	1	1	1	17.4	16.7	16.5	16.6	17.4	19.0	20.3	21.3	22.0	22.4
	warm dry	sandy	improved	medium	19	1	1.14	1	9.4	9.8	9.7	9.3	8.2	6.3	4.8	3.5	2.4	1.7
	cold dry	aquic	non-degraded	-	87	1	1	1	72.7	74.5	73.6	75.2	75.9	77.4	76.5	75.6	74.6	74.5
	cold dry	aquic	improved	medium	87	1	1.14	1	10.9	8.3	8.2	5.7	4.0	1.6	1.6	1.5	1.5	0.8
	warm dry	aquic	non-degraded	-	88	1	1	1	112.3	113.8	112.5	111.2	112.3	112.2	112.1	113.1	111.7	111.5
	warm dry	aquic	improved	medium	88	1	1.14	1	15.3	12.6	12.5	12.4	9.8	8.4	7.2	4.7	4.7	3.4
Total Grassland area (ha)									1197.3	1185.6	1172.2	1158.7	1145.3	1131.8	1118.4	1105.0	1091.5	1078.1
Carbon stock (Gg C ha⁻¹)									51.7	51.6	51.5	51.4	51.0	50.6	50.3	50.2	50.0	49.8

Table A3-10 (continued) *Grassland areas by climate zone and soil type and estimated average carbon stocks*

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Climate	Soil	Management	Input														
Grassland	cold dry	HAC	non-degraded	-	50	1	1	1	295.6	293.5	302.7	305.6	305.3	305.0	301.7	301.4	300.7	300.0
	cold dry	HAC	improved	medium	50	1	1.14	1	22.3	20.4	9.4	4.7	3.1	1.5	3.0	1.5	1.5	1.5
	warm dry	HAC	non-degraded	-	38	1	1	1	451.2	447.9	449.9	451.8	453.7	451.0	448.4	445.7	444.6	443.6
	warm dry	HAC	improved	medium	38	1	1.14	1	18.8	16.2	11.5	6.9	2.3	2.3	2.3	2.2	2.2	2.2
	cold dry	LAC	non-degraded	-	33	1	1	1	23.4	23.4	23.5	23.9	24.2	24.1	23.9	23.9	23.8	23.8
	cold dry	LAC	improved	medium	33	1	1.14	1	1.8	1.5	1.2	0.7	0.2	0.2	0.2	0.1	0.1	0.1
	warm dry	LAC	non-degraded	-	24	1	1	1	18.4	18.3	18.5	18.8	19.3	19.1	19.0	19.0	19.0	18.9
	warm dry	LAC	improved	medium	24	1	1.14	1	1.6	1.5	1.2	0.8	0.2	0.2	0.2	0.1	0.1	0.1
	cold dry	sandy	non-degraded	-	34	1	1	1	18.2	18.0	18.9	19.0	18.8	19.1	19.0	18.9	18.8	18.8
	cold dry	sandy	improved	medium	34	1	1.14	1	1.6	1.6	0.6	0.4	0.4	0.0	0.0	0.0	0.0	0.0
	warm dry	sandy	non-degraded	-	19	1	1	1	22.4	22.4	22.7	22.8	22.7	23.0	22.8	22.7	22.7	22.6
	warm dry	sandy	improved	medium	19	1	1.14	1	1.4	1.2	0.7	0.5	0.5	0.0	0.0	0.0	0.0	0.0
	cold dry	aquic	non-degraded	-	87	1	1	1	73.5	72.6	72.2	71.8	72.1	71.6	71.2	70.8	70.6	70.5
	cold dry	aquic	improved	medium	87	1	1.14	1	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0
warm dry	aquic	non-degraded	-	88	1	1	1	110.1	109.8	110.3	109.7	110.1	109.5	108.8	108.2	107.9	107.7	
warm dry	aquic	improved	medium	88	1	1.14	1	3.4	2.2	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	
Total Grassland area (ha)									1064.6	1051.2	1045.1	1039.0	1032.9	1026.7	1020.6	1014.5	1012.2	1009.8
Carbon stock (Gg C ha⁻¹)									49.8	49.7	49.6	49.5	49.5	49.5	49.5	49.5	49.5	49.5

Table A3-11 Set-Aside Grassland areas by climate zone and soil type and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	
	Climate	Soil	Management	Input					Area (ha)														
Set-Aside Grassland	cold dry	HAC	-	-	50	1	1	1	3.9	9.4	8.7	8.1	10.0	10.6	12.0	10.7	11.0	11.3	12.6	9.1	3.0	2.3	
	warm dry	HAC			38	1	1	1	5.8	14.0	12.9	11.9	14.7	15.7	17.7	15.8	16.3	16.7	18.6	13.4	4.5	3.4	
	cold dry	LAC			33	1	1	1	0.3	0.7	0.7	0.6	0.8	0.8	0.9	0.8	0.9	0.9	1.0	0.7	0.2	0.2	
	warm dry	LAC			24	1	1	1	0.2	0.6	0.5	0.5	0.6	0.7	0.8	0.7	0.7	0.7	0.7	0.8	0.6	0.2	0.1
	cold dry	sandy			34	1	1	1	0.2	0.6	0.5	0.5	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.6	0.2	0.1
	warm dry	sandy			19	1	1	1	0.3	0.7	0.7	0.6	0.7	0.8	0.9	0.8	0.8	0.8	0.8	0.9	0.7	0.2	0.2
	cold dry	aquic			87	1	1	1	0.9	2.2	2.0	1.9	2.3	2.5	2.8	2.5	2.6	2.6	2.9	2.1	0.7	0.5	
	warm dry	aquic			88	1	1	1	1.4	3.4	3.1	2.9	3.6	3.8	4.3	3.8	3.9	4.0	4.5	3.2	1.1	0.8	
Total Set-Aside Grassland area (ha)									13.0	31.6	29.1	27.0	33.3	35.6	40.1	35.7	36.8	37.7	42.1	30.4	10.1	7.6	
Carbon stock (Gg C ha⁻¹)									49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5

Table A3-11 (continued) Set-Aside Grassland areas by climate zone and soil type and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
	Climate	Soil	Managemen	Input					Area (ha)									
Set-Aside Grassland	cold dry	HAC	-	-	50	1	1	1	6.1	6.8	9.8	10.0	11.3	15.5	21.1	24.9	28.3	32.0
	warm dry	HAC			38	1	1	1	9.0	10.0	14.5	14.9	16.7	23.0	31.1	36.8	41.8	47.3
	cold dry	LAC			33	1	1	1	0.5	0.5	0.8	0.8	0.9	1.2	1.7	2.0	2.2	2.5
	warm dry	LAC			24	1	1	1	0.4	0.4	0.6	0.6	0.7	1.0	1.3	1.6	1.8	2.0
	cold dry	sandy			34	1	1	1	0.4	0.4	0.6	0.6	0.7	1.0	1.3	1.5	1.8	2.0
	warm dry	sandy			19	1	1	1	0.5	0.5	0.7	0.8	0.8	1.2	1.6	1.9	2.1	2.4
	cold dry	aquic			87	1	1	1	1.4	1.6	2.3	2.3	2.6	3.6	4.9	5.8	6.6	7.5
	warm dry	aquic			88	1	1	1	2.2	2.4	3.5	3.6	4.0	5.5	7.5	8.9	10.1	11.4
Total Set-Aside Grassland area (ha)									20.3	22.7	32.9	33.6	37.7	52.0	70.5	83.2	94.6	107.0
Carbon stock (Gg C ha⁻¹)									49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5

Table A3-11 (continued) Set-Aside Grassland areas by climate zone and soil type and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Climate	Soil	Management	Input														
Set-Aside Grassland	cold dry	HAC	-	-	50	1	1	1	35.7	39.2	43.2	47.2	51.3	55.3	59.3	63.3	67.3	71.3
	warm dry	HAC			38	1	1	1	52.8	58.0	63.9	69.9	75.8	81.7	87.7	93.6	99.5	105.5
	cold dry	LAC			33	1	1	1	2.8	3.1	3.4	3.7	4.1	4.4	4.7	5.0	5.3	5.7
	warm dry	LAC			24	1	1	1	2.3	2.5	2.7	3.0	3.2	3.5	3.7	4.0	4.2	4.5
	cold dry	sandy			34	1	1	1	2.2	2.4	2.7	2.9	3.2	3.4	3.7	3.9	4.2	4.4
	warm dry	sandy			19	1	1	1	2.7	2.9	3.2	3.5	3.8	4.1	4.4	4.7	5.0	5.3
	cold dry	aquic			87	1	1	1	8.3	9.2	10.1	11.0	12.0	12.9	13.9	14.8	15.7	16.7
	warm dry	aquic			88	1	1	1	12.8	14.0	15.4	16.9	18.3	19.7	21.2	22.6	24.0	25.5
Total Set-Aside Grassland area (ha)									119.6	131.3	144.8	158.2	171.7	185.1	198.5	212.0	225.4	238.9
Carbon stock (Gg C ha⁻¹)									12.6	11.7	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4

Table A3-11 (continued) Set-Aside Grassland areas by climate zone and soil type and estimated average carbon stocks

Land-use	sub-categories				SOC _{ref}	F _{LU}	F _{MG}	F _I	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Climate	Soil	Management	Input														
Set-Aside Grassland	cold dry	HAC	-	-	50	1	1	1	75.3	79.3	81.2	83.0	84.8	86.7	88.5	90.3	91.0	91.7
	warm dry	HAC			38	1	1	1	111.4	117.3	120.0	122.7	125.4	128.1	130.8	133.5	134.6	135.6
	cold dry	LAC			33	1	1	1	6.0	6.3	6.4	6.6	6.7	6.9	7.0	7.2	7.2	7.3
	warm dry	LAC			24	1	1	1	4.8	5.0	5.1	5.2	5.4	5.5	5.6	5.7	5.7	5.8
	cold dry	sandy			34	1	1	1	4.7	4.9	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.7
	warm dry	sandy			19	1	1	1	5.6	5.9	6.1	6.2	6.4	6.5	6.6	6.8	6.8	6.9
	cold dry	aquic			87	1	1	1	17.6	18.5	19.0	19.4	19.8	20.2	20.7	21.1	21.3	21.4
	warm dry	aquic			88	1	1	1	26.9	28.3	29.0	29.6	30.3	30.9	31.6	32.2	32.5	32.7
Total Set-Aside Grassland area (ha)									252.3	265.7	271.9	278.0	284.1	290.2	296.3	302.4	304.8	307.1
Carbon stock (Gg C ha⁻¹)									49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5

A3.5. References

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Annex 4 Comparison of Sectoral and Reference Approaches

Analysis in case of total fuel consumption and total CO₂ emissions

The quantity of CO₂ from energy consumption was determined on national level (Reference Approach) and on sectoral level (Sectoral Approach) as well.

The UNFCCC reference approach was compared with the sectoral approach as a check of combustion-related emissions. The check was performed for all years from 1985 to 2008 and is an integral part of reporting to the UNFCCC. The analysis includes also the comparison from the base year (1985-87).

The reference approach, in theory, includes all CO₂ emissions from all fossil fuel uses in a country and should be compared with a set of emissions from the sectoral approach that includes all CO₂ emissions from energy and non-energy (including feedstock) use of fossil fuels. In the CRF reporting software, the reference approach is directly compared with the sectoral fuel combustion total.

This direct comparison of the energy outputs from the reference approach and the sectoral approach used in the Common Reporting Format (CRF) shows a reference approach total that is consistently larger than the sectoral approach total (*Figure A4-1.*).

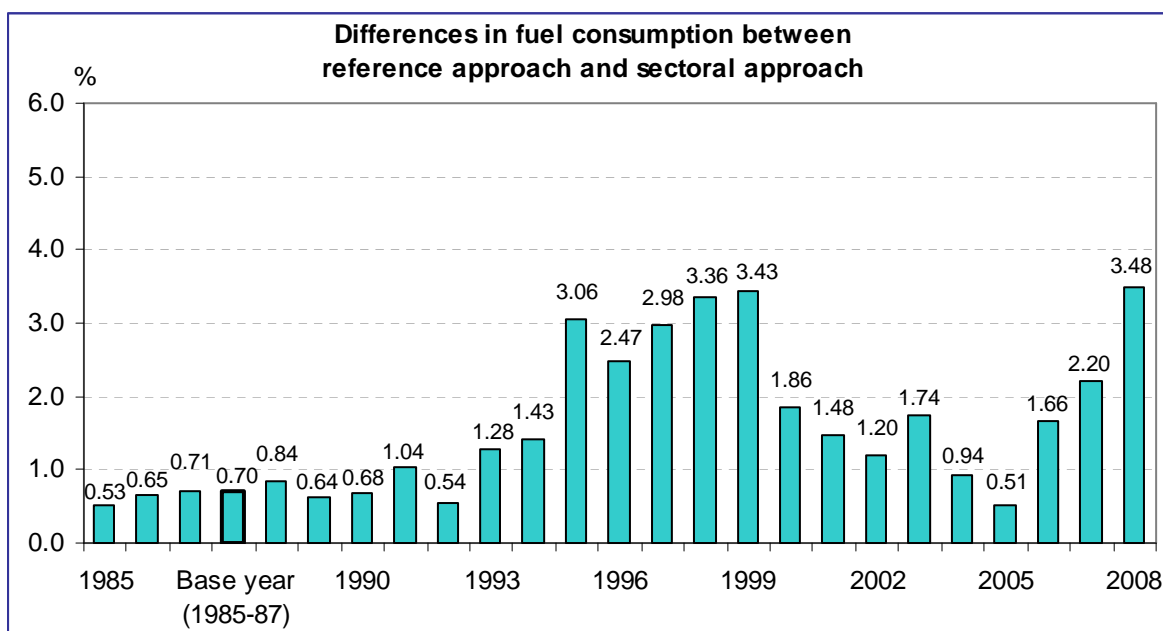


Figure A4-1. Comparison of sectoral and reference approach – fuel consumption

In 2008, comparing the two approaches the difference was 3.5% in energy consumption (*Figure A4-1.*) and 5.6% as regards CO₂ emission (*Figure A4-1.*). The differences in each fuel types were analyzed thoroughly and - summarize the results of this verification.

In spite of the fact that the difference between top-down and bottom-up approaches are relatively high, more than 2 percent for both parameters, these comparisons tell that the sectoral approach covers the total amount of combusted fossil fuels in Hungary.

The range of differences are between 0.5% (2005) and 3.5% (2008) with a 1.6% mean value as regards the fuel consumptions, and 1.8 % (1995) and 5.6 (2008) with a 3.1% mean value as regards the CO₂ emissions.

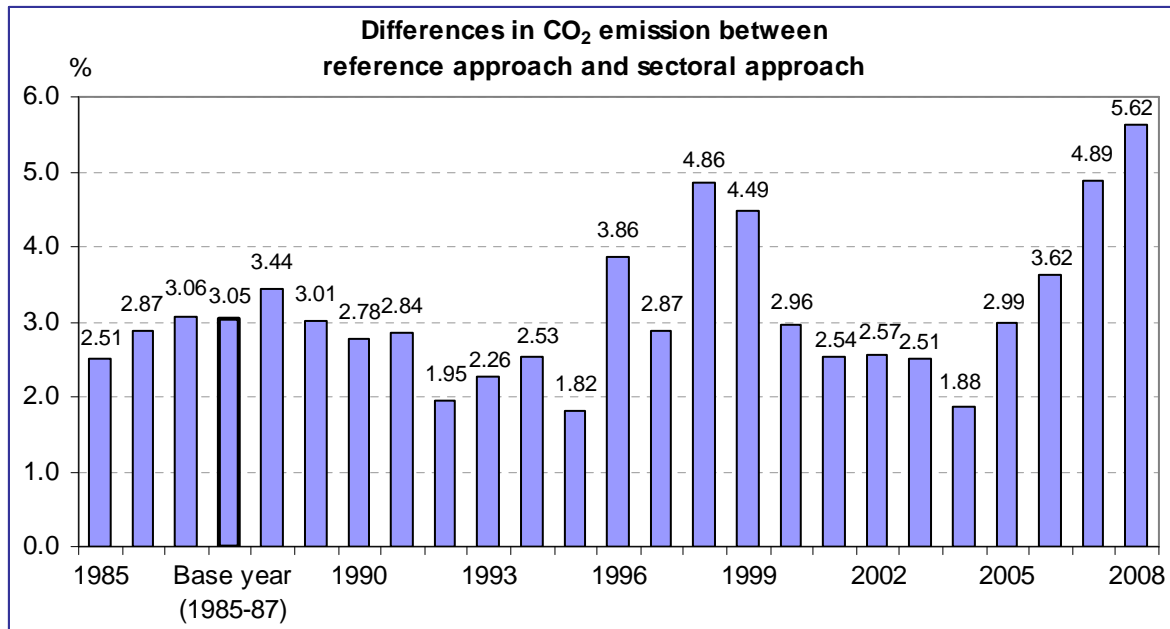


Figure A4-1. Comparison of sectoral and reference approach – CO₂ emission

Table A4-1. Differences in liquid fuel consumption

Fuel consumption in PJ	Reference approach	Sectoral approach
Liquid fuels	298.477	215.905
2.G feedstock and non-energy use of fuels (Industrial processes)	-55.695	0
Bitumen used as asphalt and road paving (Industrial processes)	-9.317	0
Petroleum coke used as feedstock in industrial processes (2.A.7)	-0.316	0
Liquid fuels used as feedstock in solid fuel transformation	-0.313	0
Other non-energy use of other oils (not included in CRF)	0	1.752
Transformation losses (not included in CRF)	0	8.351
Blending of refinery products (not included in CRF)	0	6.865
Total	232.836	232.873

Table A4-2. Differences in solid fuel, fuel consumption

<i>Fuel consumption in PJ</i>	Reference approach	Sectoral approach
Solid fuels	130.290	114.203
Derived gases	0	8.097
Feedstock in industrial processes	-0.131	0
Other coal product used as feedstock (not included in CRF)	0	2.754
Liquid fuels used as feedstock in solid fuel transformation	0	-0.313
Transformation and network losses (not included in CRF)	0	5.418
Total	130.159	130.159

Table A4-3. Differences in gaseous fuel (natural gas), fuel consumption and CO₂ emission

<i>Fuel consumption in PJ</i>	Reference approach	Sectoral approach
Fuel consumption – energy sector	442.161	429.691
Fuel consumption – feedstock	-14.719* + 4.418**	0
Network losses – fugitive emission	0	2.169
Total	431.860	431.860
<i>CO₂ emission in Gg</i>	Reference approach	Sectoral approach
Fuel consumption – energy sector	24,491.47	23,985.153
Emission from nat. gas in the Industrial Processes sector***	(-393.281-130.438) -(185.635-60.953) *0.995	0
Network losses– fugitive emission	0	121.073
Total	24,105.883	24,106.226

* Reported value in energy statistics (national, IEA)

** Fuel gas for process heater in the chemical industry, separated from feedstocks

*** During the ammonia production the total carbon content of natural gas is assumed to be emitted, however in other chemical process the total C-content is stored in the product.

Table A4-4. Other fuels (waste), fuel consumption and CO₂ emission

<i>Fuel consumption in PJ</i>	Reference approach	Sectoral approach
Fuel consumption – energy sector	7.0734	7.0734
<i>CO₂ emission in Gg</i>	Reference approach	Sectoral approach
Fuel consumption – energy sector	394.048	394.048

Annex 5 Assessment of completeness

To date, no detailed information is available on assessment of completeness and of potentially excluded sources and sinks of greenhouse gas emissions.

Annex 6 Quality Assurance and Quality Control

QA/QC activities are explained in Chapter 1.6. The following registers are used for documenting data sources, calculation methods, reason and effect of recalculations etc.

Documentation for the National Inventory Report/ Módszertan		Recalculation/Újraszámolás	
Validity/Érvényesség		Validity/Érvényesség	
IPCC Sector		IPCC Sector	
IPCC category code		IPCC category	
Data and sources/ Adatok és források		Reasons for recalculations/Az újraszámolás okai	
Input data (activity data, conversion factors, etc./ Bemenő adatok			
Uncertainties (upper and lower) associated with activity data/Bizonytalanság			
Source of input data/Adatforrás			
Type of emission factor		Description of the new method/ Az új módszer leírása	
Uncertainties (upper and lower) associated with emission factor/Bizonytalanság		Alternative recalculation techniques can be applied/ Alternatív új kalkulációs technika alkalmazható igen/yes <input type="checkbox"/> nem/no <input type="checkbox"/>	
Used method/Alkalmazott eljárás		Comparison of the methods/A régi és az új módszer összehasonlítása	
Type of method /A módszer típusa			
Source or description of method/A módszer leírása			
Documented by/Készítette		Documented by/Készítette	
Name/Név		Name/Név	
Signature/Aláírás		Signature/Aláírás	
Date/Dátum	Budapest,	Date/Dátum	Budapest,

Figure A6-1. Register of used data, data sources and calculation methods and register of recalculations

Errata/ Hibajegyzék Quality Control		Developing plan/Intézkedési terv Quality Control			
Inventory year		Inventory year			
IPCC Sector or other		IPCC Sector or other			
List of errata		List of developing plan			
				Documented by/Készítette	
				Documented by/Készítette	
Name/Név		Name/Név			
Signature/Aláírás		Signature/Aláírás			
Date/Dátum	Budapest,	Date/Dátum	Budapest,		

Figure A6-2. Register for errata and developing plan

Quality Control of the National Inventory Report/ Adatminőség ellenőrzés	
A./ General QC activity/ Általános QC tevékenység	
IPCC code of the audited sector/ Vizsgált szektor és IPCC kódja:	
Inventory year/Vizsgált év:	
Controller/Ellenőrző neve:	
Summary of general findings/ Általános megállapítások összefoglalása	
Date/ Dátum: auditor sectoral expert ellenőr szektorfelelős	
Measures suggested by the sectoral expert/ A szektorfelelős javaslata alapján teendő intézkedések	
Date/ Dátum: head of division sectoral expert osztályvezető szektorfelelős	
Verification, after the implemented measures still existing problems/ Utellenőrzés, a javító intézkedések után is fennálló problémák	
Date/ Dátum: auditor sectoral expert ellenőr szektorfelelős	
Launch of new procedure/Új eljárás indítása:	End of the audit/A vizsgálat lezárása:
Date/ Dátum: head of division osztályvezető	Date/ Dátum: head of division osztályvezető

Figure A6-3. Registers for quality control

B./ CHECKLIST		
QC activity/ QC tevékenység	Procedure of audit/ Az ellenőrzés folyamata	Result of audit/ Az ellenőrzés eredménye
1. Check that assumptions and criteria for the selection of activity data and emission factors are documented. (Ellenőrizze, hogy az alkalmazott tevékenység adatok, emissziós faktorkok, módszertanok dokumentálásra kerültek.)		
2. Confirm that bibliographical data references are properly cited in the internal documentation. (Ellenőrizze, hogy a könyvtári adatokra történő hivatkozásokat pontosan idézték a belső dokumentációban.)		
3. Check that activity data could be reproduced. (Ellenőrizze, hogy a tevékenységi adatok reprodukálhatóak.)		
4. Check that emission factors could be reproduced. (Ellenőrizze, hogy az emissziós faktorkok reprodukálhatóak.)		
5. Check that emissions/removals are calculated correctly. (Ellenőrizze, hogy az emissziókat/nyeléseket helyesen számították ki.)		
6. Compare estimates to previous estimates. (Hasonlítsa össze a becsléseket a korábbi becslésekkel.)		
7. Undertake completeness checks. (Check completeness elvégzése.)		
8. Check methodological and data changes resulting in recalculations. (Ellenőrizze az újraszámításokból előálló módszertani és adatváltozásokat.)		

Annex 7 Uncertainty

Description of methodology used for uncertainty calculation

The first uncertainty calculation for the Hungarian greenhouse gas inventory was reported in 2006 for the year 2004 to fulfill the IPCC requirements for a complete emission inventory. "Uncertainty estimates are an essential element of a complete emissions inventory. Uncertainty information is not intended to dispute the validity of the inventory estimates, but to help prioritise efforts to improve the accuracy of inventories in the future and guide decisions on methodological choice." (IPCC, 2000)

There are two methods for the uncertainty estimation suggested by the IPCC Good Practice Guidance (2000), a basic method (Tier 1) which is mandatory and an analytic one (Tier 2). The uncertainty analysis for the Hungarian inventory was carried out on the basis of Tier 1 method without the LULUCF sector since uncertainty estimates for activity data are not available for this sector. The disaggregation of the inventory into categories is the same listed in *Table A1-2* and reported in previous submissions, because the uncertainty values were available only for those categories.

The uncertainty calculation was performed using Table 6.1 of the IPCC Good Practice Guidance (2000).

The calculations of the emissions estimates uncertainty are presented, without the sector of LULUCF, in *Table A7-1*.

Table A7-1. Uncertainty calculation without LULUCF, Tier 1 method

CRF code	IPCC source category	Direct greenhouse gas	Base year emission (Gg CO ₂ eq.)	Current year (2008) emission (Gg CO ₂ eq.)	Activity data uncertainty (%)	Emission factor uncertainty (%)	Combined uncertainty (%)	Combined uncertainty as % of total emissions in 2005
	A	B	C	D	E	F	G	H
			Input data	Input data	Input data	Input data	$\sqrt{E^2 + F^2}$	$\frac{G \cdot D}{\sum D}$
1. A.	Stationary Combustion - Gas	CO ₂	19 924.15	23 981.08	5	5	7.071	2.318
1. A.	Stationary Combustion - Coal	CO ₂	34 678.65	12 167.30	2	5	5.385	0.896
1. A.	Stationary Combustion - Oil	CO ₂	16 277.89	3 233.75	2	5	5.385	0.238
1. A.	Non-CO ₂ Emission from Stationary Fuel Combustion	N ₂ O	797.34	424.41	3	50	50.090	0.291
1. A.	Non-CO ₂ Emission from Stationary Fuel Combustion	CH ₄	578.52	246.67	3	8	8.544	0.029
1. A.	Stationary Combustion - Other Fuel	CO ₂	96.89	394.05	5	10	11.180	0.060
1. A. 3.	Mobile Combustion - Other	CO ₂	814.20	190.84	5	5	7.071	0.018
1. A. 3.	Mobile Combustion	N ₂ O	112.07	410.29	5	100	100.125	0.562
1. A. 3.	Mobile Combustion	CH ₄	45.35	23.44	5	50	50.249	0.016
1. A. 3. B.	Mobile Combustion - Road	CO ₂	6 807.45	12 262.09	5	5	7.071	1.186
1. B. 1.	Fugitive Emissions from Coal Mining and Handling	CH ₄	923.01	21.10	3	10	10.440	0.003
1. B. 1.	Fugitive Emissions from Coal Mining and Handling	CO ₂	3.60	NO	3	10	10.440	0.000
1. B. 2.	Fugitive Emissions from Oil and Gas Operations (Main Source: Gas Distribution)	CH ₄	1 613.47	2 045.80	2	50	50.040	1.400
1. B. 2.	Fugitive Emissions from Oil and Gas Operations	N ₂ O	0.60	0.23	2	100	100.020	0.000
1. B. 2.	Fugitive Emissions from Oil and Gas Operations	CO ₂	195.68	74.90	100	80	128.062	0.131
2.	N ₂ O Emission from Industry	N ₂ O	4 541.51	5.08	2	1	2.236	0.000
2.	CH ₄ Emission from Industry	CH ₄	7.84	15.26	1	20	20.025	0.004

Table A7-1. Uncertainty calculation without LULUCF, Tier 1 method

CRF code	IPCC source category	Direct greenhouse gas	Base year emission (Gg CO ₂ eq.)	Current year (2008) emission (Gg CO ₂ eq.)	Activity data uncertainty (%)	Emission factor uncertainty (%)	Combined uncertainty (%)	Combined uncertainty as % of total emissions in 2005
	A	B	C	D	E	F	G	H
			Input data	Input data	Input data	Input data	$\sqrt{E^2 + F^2}$	$\frac{G \cdot D}{\sum D}$
2. A. 1.	CO ₂ Emissions from Cement Production	CO ₂	1 778.28	1 260.65	2	2	2.828	0.049
2. A. 2.	CO ₂ Emissions from Lime Production	CO ₂	645.03	318.50	5	2	5.385	0.023
2. A. 3.	CO ₂ Emission from Limestone and Dolomit Use	CO ₂	248.68	315.60	2	1	2.236	0.010
2. A. 7.	CO ₂ Emission from Other Mineral Products	CO ₂	642.13	374.94	10	30	31.623	0.162
2. B. 1.	CO ₂ Emissions from Ammonia Processes	CO ₂	1 502.70	393.28	2	2	2.828	0.015
2. B. 3.	CO ₂ Emissions from Nitric Acid Production	CO ₂	0.082	0.000	0	0	0.000	0.000
2. C.	CO ₂ Emissions from Metal Production	CO ₂	641.57	271.60	2	5	5.385	0.020
2. C. 3.	PFCs Emissions	PFCs	166.82	2.41	1	2	2.236	0.000
2. F.	Emissions from Substitutes for Ozone Depleting Substances	HFCs	0.78	703.38	10	20	22.361	0.215
2. F. 7.	SF ₆ Emissions from Electrical Equipment	SF ₆	70.15	231.89	80	20	82.462	0.261
2. G.	Feedstocks and non-energy use of fuels	CO ₂	550.97	855.36	5	10	11.180	0.131
3.	N ₂ O Emission from Solvent and Other Product Use	N ₂ O	154.17	340.93	2	1	2.236	0.010
3.	CO ₂ Emission from Solvent and Other Product Use	CO ₂	130.36	65.37	10	20	22.361	0.020
4. A	CH ₄ Emissions from Enteric Fermentation in Domestic Livestock	CH ₄	3 435.62	1 636.94		28.66	28.66	0.641
4. B	CH ₄ Emissions from Manure Management	CH ₄	2 398.17	1 020.12		42.24	42.24	0.589
4. B.	N ₂ O Emissions from Manure Management	N ₂ O	1 899.61	925.04		70.07	70.07	0.886
4. C.	CH ₄ Emission from Rice Cultivation	CH ₄	50.54	10.64	201.62	80.00	216.91	0.032
4. D. 1.	Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	5 481.04	3 141.92		154.09	154.09	6.619

Table A7-1. Uncertainty calculation without LULUCF, Tier 1 method

CRF code	IPCC source category	Direct greenhouse gas	Base year emission (Gg CO ₂ eq.)	Current year (2008) emission (Gg CO ₂ eq.)	Activity data uncertainty (%)	Emission factor uncertainty (%)	Combined uncertainty (%)	Combined uncertainty as % of total emissions in 2005
	A	B	C	D	E	F	G	H
			Input data	Input data	Input data	Input data	$\sqrt{E^2 + F^2}$	$\frac{G \cdot D}{\sum D}$
4. D. 2.	Pasture, range and paddock manure	N ₂ O	336.01	172.61		152.82	152.82	0.361
4. D. 3.	Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	3 851.08	1 875.82		61.16	61.16	1.569
4. F.	Field Burning of Agricultural Residues	CH ₄	45.51	NO	NE	NE	0.000	0.000
4. F.	Field Burning of Agricultural Residues	N ₂ O	13.34	NO	NE	NE	0.000	0.000
6. A.	CH ₄ Emissions from Solid Waste Disposal Sites	CH ₄	1 917.30	2 932.58	10	30	31.623	1.268
6. B.	Emissions from Wastewater Handling	CH ₄	847.03	526.63	20	30	36.056	0.260
6. B.	Emissions from Wastewater Handling	N ₂ O	207.70	199.58	10	1000	1000.050	2.729
6. C.	Non-biogenic CO ₂ from Waste	CO ₂	NA,NO	64.12	10	20	22.361	0.020
6. C.	CH ₄ Emissions from Waste Incineration	CH ₄	NA	0.49	10	50	50.990	0.000
6. C.	N ₂ O Emissions from Waste Incineration	N ₂ O	NA,NO	1.97	5	100	100.125	0.003

Note A

$$\frac{0.01 \cdot D_x + \sum D_i - (0.01 \cdot C_x + \sum C_i)}{(0.01 \cdot C_x + \sum C_i)} \cdot 100 - \frac{\sum D_i - \sum C_i}{\sum C_i} \cdot 100$$

Table A7-2. Uncertainty calculation without LULUCF, Tier 1 method

CRF code	IPCC source category	Direct greenhouse gas	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend in emissions introduced by emission factor uncertainty (%)	Uncertainty in trend in emissions introduced by activity data uncertainty (%)	Uncertainty introduced into the trend in total emissions (%)
	A	B	I	J	K	L	M
			Note A	$\frac{D}{\sum C}$	I · F	$J \cdot E \cdot \sqrt{2}$	$\sqrt{K^2 + L^2}$
1. A.	Stationary Combustion - Gas	CO ₂	0.098	0.210	0.491	1.482	1.561
1. A.	Stationary Combustion - Coal	CO ₂	-0.087	0.106	-0.435	0.301	0.529
1. A.	Stationary Combustion - Oil	CO ₂	-0.063	0.028	-0.313	0.080	0.323
1. A.	Non-CO ₂ Emission from Stationary Fuel Combustion	N ₂ O	-0.001	0.004	-0.037	0.016	0.040
1. A.	Non-CO ₂ Emission from Stationary Fuel Combustion	CH ₄	-0.001	0.002	-0.009	0.009	0.013
1. A.	Stationary Combustion - Other Fuel	CO ₂	0.003	0.003	0.029	0.024	0.038
1. A. 3.	Mobile Combustion - Other	CO ₂	-0.003	0.002	-0.014	0.012	0.019
1. A. 3.	Mobile Combustion	N ₂ O	0.003	0.004	0.296	0.025	0.297
1. A. 3.	Mobile Combustion	CH ₄	0.000	0.000	-0.002	0.001	0.003
1. A. 3. B.	Mobile Combustion - Road	CO ₂	0.069	0.107	0.345	0.758	0.833
1. B. 1.	Fugitive Emissions from Coal Mining and Handling	CH ₄	-0.005	0.000	-0.050	0.001	0.050
1. B. 1.	Fugitive Emissions from Coal Mining and Handling	CO ₂	0.000	0.000	0.000	0.000	0.000
1. B. 2.	Fugitive Emissions from Oil and Gas Operations (Main Source: Gas Distribution)	CH ₄	0.009	0.018	0.443	0.051	0.446
1. B. 2.	Fugitive Emissions from Oil and Gas Operations	N ₂ O	0.000	0.000	0.000	0.000	0.000
1. B. 2.	Fugitive Emissions from Oil and Gas Operations	CO ₂	0.000	0.001	-0.035	0.093	0.099
2.	N ₂ O Emission from Industry	N ₂ O	-0.025	0.000	-0.025	0.000	0.025
2.	CH ₄ Emission from Industry	CH ₄	0.000	0.000	0.002	0.000	0.002

Table A7-2. Uncertainty calculation without LULUCF, Tier 1 method

CRF code	IPCC source category	Direct greenhouse gas	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend in emissions introduced by emission factor uncertainty (%)	Uncertainty in trend in emissions introduced by activity data uncertainty (%)	Uncertainty introduced into the trend in total emissions (%)
	A	B	I	J	K	L	M
			Note A	$\frac{D}{\sum C}$	I · F	$J \cdot E \cdot \sqrt{2}$	$\sqrt{K^2 + L^2}$
2. A. 1.	CO ₂ Emissions from Cement Production	CO ₂	0.001	0.011	0.002	0.031	0.031
2. A. 2.	CO ₂ Emissions from Lime Production	CO ₂	-0.001	0.003	-0.002	0.020	0.020
2. A. 3.	CO ₂ Emission from Limestone and Dolomit Use	CO ₂	0.001	0.003	0.001	0.008	0.008
2. A. 7.	CO ₂ Emission from Other Mineral Products	CO ₂	0.000	0.003	-0.009	0.046	0.047
2. B. 1.	CO ₂ Emissions from Ammonia Processes	CO ₂	-0.005	0.003	-0.010	0.010	0.014
2. B. 3.	CO ₂ Emissions from Nitric Acid Production	CO ₂	0.000	0.000	0.000	0.000	0.000
2. C.	CO ₂ Emissions from Metal Production	CO ₂	-0.001	0.002	-0.006	0.007	0.009
2. C. 3.	PFCs Emissions	PFCs	-0.001	0.000	-0.002	0.000	0.002
2. F.	Emissions from Substitutes for Ozone Depleting Substances	HFCs	0.006	0.006	0.123	0.087	0.150
2. F. 7.	SF ₆ Emissions from Electrical Equipment	SF ₆	0.002	0.002	0.033	0.229	0.232
2. G.	Feedstocks and non-energy use of fuels	CO ₂	0.004	0.007	0.044	0.053	0.069
3.	N ₂ O Emission from Solvent and Other Product Use	N ₂ O	0.002	0.003	0.002	0.008	0.009
3.	CO ₂ Emission from Solvent and Other Product Use	CO ₂	0.000	0.001	-0.003	0.008	0.009
4. A	CH ₄ Emissions from Enteric Fermentation in Domestic Livestock	CH ₄	-0.005	0.014	-0.140	0.000	0.140
4. B	CH ₄ Emissions from Manure Management	CH ₄	-0.004	0.009	-0.189	0.000	0.189
4. B.	N ₂ O Emissions from Manure Management	N ₂ O	-0.003	0.008	-0.177	0.000	0.177
4. C.	CH ₄ Emission from Rice Cultivation	CH ₄	0.000	0.000	-0.015	0.027	0.031
4. D. 1.	Direct N ₂ O Emissions from Agricultural Soils	N ₂ O	-0.003	0.027	-0.486	0.000	0.486

Table A7-2. Uncertainty calculation without LULUCF, Tier 1 method

CRF code	IPCC source category	Direct greenhouse gas	Type A sensitivity (%)	Type B sensitivity (%)	Uncertainty in trend in emissions introduced by emission factor uncertainty (%)	Uncertainty in trend in emissions introduced by activity data uncertainty (%)	Uncertainty introduced into the trend in total emissions (%)
	A	B	I	J	K	L	M
			Note A	$\frac{D}{\sum C}$	I · F	$J \cdot E \cdot \sqrt{2}$	$\sqrt{K^2 + L^2}$
4. D. 2.	Pasture, range and paddock manure	N ₂ O	0.000	0.002	-0.056	0.000	0.056
4. D. 3.	Indirect N ₂ O Emissions from Nitrogen Used in Agriculture	N ₂ O	-0.005	0.016	-0.313	0.000	0.313
4. F.	Field Burning of Agricultural Residues	CH ₄	0.000	0.000	0.000	0.000	0.000
4. F.	Field Burning of Agricultural Residues	N ₂ O	0.000	0.000	0.000	0.000	0.000
6. A.	CH ₄ Emissions from Solid Waste Disposal Sites	CH ₄	0.015	0.026	0.447	0.362	0.576
6. B.	Emissions from Wastewater Handling	CH ₄	0.000	0.005	-0.004	0.130	0.130
6. B.	Emissions from Wastewater Handling	N ₂ O	0.001	0.002	0.584	0.025	0.584
6. C.	Non-biogenic CO ₂ from Waste	CO ₂		0.001	0.000	0.008	0.008
6. C.	CH ₄ Emissions from Waste Incineration	CH ₄		0.000	0.000	0.000	0.000
6. C.	N ₂ O Emissions from Waste Incineration	N ₂ O		0.000	0.000	0.000	0.000

Annex 8 Responses to the review of the 2009 inventory submission

CRF	Comment	Hungary's response	Where in the NIR
1.AA.2. Manufacturing industries and construction	45. Hungary has removed natural gas used as feedstock and for non-energy purposes from the energy sector. The ERT reiterates the recommendation from the previous review that Hungary reallocate the AD for feedstocks and non-energy use of fuel for all fuels to the industrial processes sector. The change should include the implementation of appropriate QA/QC procedures.		
1.AA.2.C Chemicals/liquid fuels	46. The ERT noted that the inter-annual changes of the CO ₂ IEF for chemicals for liquid fuel show large variations (ranging from -34.4 to 52.6 per cent) over the entire time series. The CO ₂ IEF (18.18 t/TJ) reported by Hungary for 2007 is the lowest of reporting Parties (ranging from 18.18.78.30 t/TJ) and below the IPCC default range (63.1.100.8 t/TJ), attributed to the inclusion of feedstocks in the AD. The ERT recommends that Hungary include available underlying AD for the subcategory in its next submission and to exclude feedstocks from the energy sector and report it in the industrial processes sector in line with the Revised 1996 IPCC Guidelines.	Feedstocks and non-energy use of fuels were allocated to 2G (industrial processes sector) in line with the Revised 1996 IPCC Guidelines. QA/QC check was performed.	Chapter 3.2.7.5 and 4.9

CRF	Comment	Hungary's response	Where in the NIR
1.AA.3.B Road transportation	<p>48. The ERT noted that the time series for the N₂O IEF for gasoline and diesel used in road transportation as well as the CH₄ IEF for gasoline used in road transportation are not consistent for the years 1988.2003. Hungary stated that it is waiting for more information to correct the emissions data for previous years. There were no changes in this category since the previous submission, so the ERT reiterates the recommendation of the previous review that Hungary update the entire time series for gasoline and diesel used in road transportation. The ERT encourages Hungary to use the recalculation approaches suggested by the IPCC good practice guidance (e.g. trend extrapolation), until better data are available.</p>	<p>The entire time-series was updated.</p>	<p>Chapter 3.2.8.5</p>
1.B.2.A.5. Distribution of oil products	<p>51. The ERT commends Hungary's efforts to improve completeness of reporting of this category, including CH₄ and N₂O emissions from flaring. The ERT noted that Hungary reports fugitive CH₄ emissions from the distribution of oil products as 'NE'. The ERT encourages Hungary to explore the possibility of reporting these emissions in its next submission.</p>	<p>We couldn't find appropriate emission factors for these categories.</p>	

CRF	Comment	Hungary's response	Where in the NIR
1.AA.3.A Civil aviation	<p>50. The previous ERT noted that emissions and AD for civil aviation are only reported for the base year, 1999, 2000, 2001 and 2006. Hungary reported that, in recent years, aviation gasoline has not been separated from other gasoline due to a lack of information in national statistics. Emissions from civil aviation are reported with road transportation in the missing years. The ERT recommends Hungary to report both fuels separately and suggests that aviation data could be used to correlate energy statistics data with actual aviation activity. During the review the ERT noted inconsistencies in the aviation gasoline EF for the entire time series. In response to a question by the ERT, Hungary stated that it is aware of the inconsistencies and will correct the data in the next submission. The ERT recommends that Hungary recalculate the emissions from domestic aviation for the entire time series and document in the next NIR the EFs, methodology and any assumptions made. The ERT also noted that there is no information in the NIR and CRF tables on where aviation fuel used for military activity is allocated. The ERT recommends that Hungary include such information in the next annual submission.</p>	<p>The inconsistency problem was solved, default EFs were used for all reported years.</p> <p>Emissions from civil aviation is equal to the emissions from aviation gasoline in Hungary. According to the new government decree (from the end of 2009) those companies from air transport, who emit more than 100 t CO₂ eq./year, have to report their domestic and international fuel consumption. Hopefully, we will be able to fill in this category with the new information.</p> <p>As the top-down and bottom-up approaches in the Hungarian energy statistics are harmonized, the aviation fuels used for military activities are also included somewhere in the transport sector.</p>	Chapter 3.2.8.5

CRF	Comment	Hungary's response	Where in the NIR
1.AC Difference – Reference and Sectoral Approach	43. In 2007, Hungary reported a difference of 3.18 per cent in CO ₂ emissions and a 1.81 per cent difference in energy consumption between the reference and the sectoral approaches. Due to the reallocation of natural gas used as feedstocks, the differences in fuel consumption have decreased since the 2008 submission. The ERT encourages Hungary to follow the UNFCCC reporting guidelines and include explanations on causes for differences in CO ₂ emissions higher than 2 per cent in the documentation box to CRF table 1.A(c).	We presented some explanations on causes for differences in CO ₂ emissions higher than 2 per cent in the documentation box to CRF table, and also the references of the detailed analysis written in the NIR.	In the CRF table
2.F.	53. Potential emissions of HFCs from foam blowing are reported as „NE” and potential HFC emissions from aerosols/metered dose inhalers are reported as not occurring „NO”, while actual emissions from these categories are reported.	Potential emissions were added.	Chapter 4.8 and CRF table
2.F.	53. The HFC emissions from fire extinguishers are reported as „NE” for the years up to 2006 and „NO” for 2007, and HFC-134a emissions from hard foam disposal are reported as „IE” till 2004 and as „NO” for years 2004-2007. The ERT recommends that Hungary further examine the occurrence of the emission sources reported as „NO” and to provide estimates for the categories reported as „NE”.	Corrections were made.	Chapter 4.8 and CRF table

CRF	Comment	Hungary's response	Where in the NIR
2.A.1 Cement	56. CO ₂ emissions from cement production are estimated based on plant-specific data from EU ETS for the years 2005.2007. The plant-specific data are derived from a derivatographic analysis of carbonates. This method corresponds to the IPCC tier 2 method.	Corrected to T2.	CRF table
2.F.	60. The NIR includes information on methodology, AD sources and EFs; however, the methodology and parameters used are not described transparently in the NIR. In response to a question by the ERT, Hungary clarified the principles on which the emissions are estimated. The ERT recommends that Hungary improve the transparency of the NIR by explaining which IPCC tiers are used for the estimation of emissions and by reporting the relevant parameters used for each subcategory.	More details are provided in the NIR.	Chapter 4.8

CRF	Comment	Hungary's response	Where in the NIR
2.C.	<p>63. As indicated in the previous review, process emissions from iron and steel production are included partly in the industrial processes, and partly in the energy sector. CO₂ emissions from steel production are reported in industrial processes sector, but CO₂ and CH₄ emissions from pig iron and sinter production and coke consumption are reported as included elsewhere (.IE.), as are CH₄ emissions from steel production. In CRF table 9, it is explained that these emissions are included in the chemicals category in the energy sector. The ERT recommends that Hungary correctly allocate the emissions from the consumption of the reducing agent to the industrial processes sector in accordance with the IPCC good practice guidance.</p>	<p>Allocation is corrected in the CRF (1.AA.2.A Iron and Steel)</p>	<p>Chapter 4.5.1 and CRF table 9.</p>
4.	<p>65. The inventory for the agriculture sector is complete and the NIR included descriptions of the methods, uncertainty estimates and QA/QC procedures. Hungary applied higher tier methodologies to key categories. The ERT encourages Hungary to improve the transparency of the NIR by including additional information on assumptions and rationale for choices of parameters for developing EFs, particularly where tier 2 methodologies are used.</p>	<p>The NIR chapters have been supplemented with more details.</p>	<p>Chapter Chapter 6.1.7</p>

CRF	Comment	Hungary's response	Where in the NIR
4.A	<p>68. For dairy cattle, the average gross energy intake was determined based on data from the Hungarian Nutrition Codex (2004). The time series for the methane conversion rate (Ym) and gross energy intake (GE) were provided in NIR. However, there is insufficient information in the NIR describing how these time series were developed. In response to a question from the ERT, Hungary provided additional information and a calculation sheet on Ym and GE. The ERT recommends that Hungary include this information in its next annual submission.</p>	<p>The NIR chapters have been supplemented with more details.</p>	Chapter 6.2.2.1
4.A	<p>69. Using a tier 2 method for non-dairy cattle, Hungary used average values from the IPCC default ranges to develop EFs. There is no indication whether Eastern or Western Europe parameters on feed digestibility and average weight were applied for non-dairy cattle. In response to a question from the ERT, Hungary clarified that the default values for Western Europe were applied. Hungary stated that it plans to use country-specific data in its next submission. The ERT encourages Hungary's efforts to develop country-specific data.</p>		Chapter 6.2.6

CRF	Comment	Hungary's response	Where in the NIR
4.B	<p>71. The ERT noted inconsistencies with volatile solid values between CRF table 6.6 (for dairy) and CRF table 6.8 (for poultry) in the NIR and CRF table 4.B(a). For example, the volatile solid excretion rates for poultry in the NIR and CRF table were 0.014 kg dm/day and 0.10 kg dm/day, respectively, and the volatile solid excretion rates for dairy cattle in the NIR and CRF tables were 0.057.0.059 kg dm/day and 4.5.4.9 kg dm/day. In response to a question from the ERT, Hungary clarified that there are errors in the volatile solid excretion rates for dairy cattle in the NIR and in the volatile solid excretion rates for poultry in the CRF. The ERT recommends that Hungary improve category-specific QA/QC procedures for inventory preparation in order to remove inconsistencies in future submissions.</p>	<p>In the 2008 inventory cycle the QA/QC procedures was implemented according to the QA/QC plan. A member of the inventory team undertook a re-examination of the activity data and the calculation sheet. The main goal of the QA/QC process to avoid the over and the under estimation of the emissions. The QA/QC procedures have resulted in improvements and recalculations that are taken into account in the 2010 inventory submission. The effect of the QA/QC procedures is described in the recalculation chapter. (It is important to note that the revealed inconsistencies in course of centralized review were in the CRF additional information table, so they did not influence on the results of the estimations.)</p>	Chapter 6.1

CRF	Comment	Hungary's response	Where in the NIR
4.B	<p>72. Hungary used an IPCC tier 1 method to estimate the N₂O emissions from manure management.</p> <p>The ERT noted there was insufficient information in the NIR to support the allocation of waste to animal waste management systems. In response to a question from ERT, Hungary explained that the allocation is based on a country-specific study. The ERT recommends that Hungary support the allocation of waste to animal waste management systems by including a summary of the country-specific study in its next submission.</p>	<p>The NIR chapters have been supplemented with more details; although the referred study has not been translated into English.</p>	<p>Chapter 6.1.7 Chapter 6.3.2 Chapter 6.3.6</p>
4.D.1	<p>73. In accordance with the IPCC good practice guidance, a tier 1b method was applied to calculate the direct N₂O emissions from agricultural soil. The NIR includes a table that includes the EFs and most parameters used in the calculations. The ERT noted that there is no information supporting the parameters used for calculating emissions from nitrogen fixing crops and crop residues. The ERT recommends that Hungary include additional documentation and a justification of the parameters in its next submission.</p>	<p>The parameters used have been outlined in Table 6.23</p>	<p>Chapter 6.5.2</p>

CRF	Comment	Hungary's response	Where in the NIR
4.D.3	<p>74. Hungary uses IPCC tier 1 and default values to calculate indirect N₂O emissions from agricultural soil. The ERT noted that there is an inconsistency in the values of fraction of nitrogen input to soils that is lost through leaching and run-off (FracLEACH) between the NIR and CRF tables (FracLEACH values in the NIR and CRF tables for 2006 and 2007 are 0.3 and 0.0, respectively). In response to a question from the ERT, Hungary clarified that it is due to an error in the CRF table. The ERT recommends that Hungary correct this in next submission and improve QA/QC for inventory preparation.</p>	<p>See the response for the paragraph 71.</p>	<p>Chapter 6.1</p>
4.C	<p>75. Tier 1 method and an IPCC default EF were applied to estimate CH₄ emissions from rice cultivation without any explanation. The ERT recommends that Hungary include information to support its choice of EF and related parameters in the next NIR.</p>	<p>The NIR chapter has been supplemented with more details.</p>	<p>Chapter 6.4.2</p>

CRF	Comment	Hungary's response	Where in the NIR
5.A	<p>80. While Hungary has made continuous improvements to reporting in this sector, it is still not reporting changes between land-use categories, aside from land converted to forest land. In the NIR Hungary references a new approach to estimate changes in land use. Hungary stated in its 2008 and 2009 NIR that improvements are planned for the identification of deforested areas, as well as inventory system improvements for reporting activities under Article 3, paragraphs 3 and 4 of the Kyoto Protocol. In the 2009 NIR, Hungary states that it is currently in the evaluation phase of a new data collection method that was initiated in 2008, and that this method should allow Hungary to describe the location and volume of deforested areas, including damage caused by fires.</p>	<p>Forest fires are separately reported in NIR 2008. Deforestations in 2008 (294 ha) are localized, digitally mapped and will be reported in KP LULUCF tables 2008.</p>	<p>Chapter 7.2. Forest Land (CRF sector 5.A) Table 7.4. Chapter 7.2.1. Forest Land remaining Forest Land (CRF sector 5.A.1) Table 7.7.</p>

CRF	Comment	Hungary's response	Where in the NIR
5.A	<p>81. In response to a question from the ERT, Hungary has described this new approach. However, the approach was only started in 2008 and Hungary states that the tracking of deforestation is only possible from 2008. The new land use of deforested land is not known. The ERT noted that an inability to estimate deforestation before 2008 will cause a problem with time-series consistency when the new method is implemented. The ERT encourages the Party to explore alternative means to estimate historical changes from forest land to other land uses so that time-series consistency can be ensured.</p> <p>Hungary noted the need to improve reporting of disaggregated land-use changes and has described plans for improved reporting of land-use changes from forest land to other land uses in its next submission.</p>	<p>(1) Emissions of deforestations between 1990-2007 are reported elsewhere (IE), in the category of forest land remaining forest land. Because of the stand based inventory-system and the continuous forest planning, the losses of deforestations appears in the GHG-inventory as losses of FL-FL growing stock and this way as emission.</p> <p>(2) Historical data of area (ha) of deforestations are available from 2003, but these areas can not be exactly localized. A rough estimation of the growing stock of deforestations between 2003-2007 can be given based on country-specific average growing stock (m3/ha).</p>	Chapter 7.2. Forest Land (CRF sector 5.A) Table 7.4.

CRF	Comment	Hungary's response	Where in the NIR
5.A.1	<p>83. Hungary allocates afforested areas from land converted to forest land to forest land remaining forest land in a time frame less than the 20 year default value provided by the IPCC good practice guidance for LULUCF. Hungary stated that the length of time between category changes varies between species, and that the range is 2-15 years. In response to questions from the ERT, Hungary described an afforestation subsidy programme that uses these time ranges for verification for successful afforestation.</p>	<p>The subsidy-system required a detailed inventory of afforestations, and intensive surveys took place year-by-year by the Forest Authority. Every afforestation (exceptions are administrative errors) can be tracked year-by-year in these records.</p> <p>The time of the various stands in this category, i.e. the time that elapses from soil preparation until the stand is regarded as forest, changes by species, site, as well as climatic conditions and the appearance of pests/pathogens. This time can change between 2-3 years to 10+ years, the average being 8 years for slow growing species, 4-5 years for the faster growing Black Locust (<i>Robinia pseudoacacia</i>), and even less for poplars. The ratio of the various species in the afforestations in any given year of course keeps fluctuating over time.</p>	Chapter 7.2.2. Land converted to Forest Land (CRF sector 5.A.2)
5.A.1	<p>85. The NIR reports that dead organic matter pools are assumed not to be sources. Hungary uses a tier 1 approach assuming that its carbon stock changes are zero and lists them as .NE. in the CRF tables. The assumptions listed in the NIR support the proposal that these pools are not sources. However, the ERT reiterates the recommendation made by the previous ERT that Hungary continue its efforts to improve information on dead organic matter. The ERT encourages Hungary to use tier 2 method for forest land remaining forest land, as a key category.</p>	<p>To demonstrate, that DOM is not emitter, we can present the results published in IPC-Forest, Forest Focus and Life+ programs on forest health (based on systematic sampling) showing the expectable constant accumulation of biomass of standing dead trees.</p> <p>There are plans to collect data on some DOM pools (i.e., litter and lying deadwood based on a systematic sampling grid of 4x4 km, used in ICP Forest, Forest Focus and Life+ programs. Over a thousand plots will be surveyed in 2010.</p>	Chapter 7.2.1 Forest Land remaining Forest Land (CRF sector 5.A.1) Figure 7.4. Chapter 7.2.6 Category-specific planned improvements

CRF	Comment	Hungary's response	Where in the NIR
5.A.1	<p>86. Hungary is still not reporting information on carbon stock changes due to wildfires, although it was noted in the last review report that Hungary intended to begin this reporting in 2009. In response to a question from the ERT, Hungary has provided preliminary information on a new database that will be used to estimate emissions from wildfires. This information suggests that data will only be available from 2007. Hungary states that these emissions will be included in the next inventory submission. The ERT welcomes this planned improvement and encourages its inclusion in the next submission and recommends that Hungary seek methods to estimate these emissions for the entire time-series.</p>	<p>Forest fires are separately reported in the NIR 2008.</p>	<p>Chapter 7.2. Forest Land (CRF sector 5.A) Table. 7.4</p>
6:A	<p>97. The ERT noted some inconsistencies between the CRF tables and the NIR (different values for fraction of degradable organic carbon (DOC) in MSW and the DOC value for food and beverage)</p>	<p>Inconsistencies were removed</p>	<p>Chapter 8.2.2</p>
6.B	<p>100. The ERT noted that Hungary used chemical oxygen demand (COD) values per wastewater streams for industrial wastewater for previous years. However, CRF table 6.B does not contain COD or wastewater output values, and the notation key .NE. is reported for 2007.</p>	<p>COD and wastewater output values were added to CRF for 2008</p>	

CRF	Comment	Hungary's response	Where in the NIR
6.C	104. There were no recalculations for this category. Therefore, the ERT reiterates the recommendations from the previous review for allocation of the emissions from incineration with energy recovery to the energy sector with clear explanation of the allocation of emissions in the NIR.	Emissions from incineration with energy recovery were re-allocated to the energy sector	Chapter 3.2.6.5, 3.2.7.5 and 8. 8.4.1.

Annex 9 List of abbreviations and units

Abbreviations

AED	anode effect duration in minutes
AEF	number of anode effects per cellday
BOF	basic oxygen furnace
CAO	Central Agricultural Office
CE	current efficiency
CLC	CORINE Land Cover inventory
CLC-changes	CORINE Land Cover-changes databases
CORINAIR	CORe INventory of AIR emissions
CKD	cement kiln dust
CRF	common reporting format
EAF	electric arc furnace
EF	emission factor
ERT	expert review team
EU	European Union
ETS	Emission Trading Scheme
FÖMI	Institute of Geodesy, Cartography and Remote Sensing (Földmérési és Távérzékelési Intézet)
GDP	gross domestic product
HCSO	Hungarian Central Statistical Office
HKVSZ	Association of Cooling and Air Conditioning Businesses (Hűtő- és Klimatechnikai Vállalkozások Szövetsége)
HLC	Land cover inventory implemented for GHG-inventory purposes
HLC-change	Land cover-change database implemented for GHG-inventory purposes
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
KTI	Institute for Transport Sciences (Közlekedéstudományi Intézet Kht.)
LULUCF	land use, land-use change and forestry
LPG	liquified petroleum gas
MVM Rt.	Hungarian Power Companies Ltd.
NCV	net calorific value
NFI	National Forest Inventory
OHF	open hearth furnace
QA	quality assurance
QC	quality control
UNFCCC	United Nations Framework Convention on Climate Change

Chemical formulas

C	carbon
CH ₄	methane
CO	carbon monoxide
CO ₂	carbon dioxide
HFCs	hydrofluorocarbons
NMVOc	non-methane volatile organic compound
N ₂ O	nitrous oxide
NO _x	nitrogen oxide
PFCs	perfluorocarbons
SF ₆	sulphur hexafluoride
SO ₂	sulphur dioxide

CaCO_3	calcium carbonate, limestone
MgCO_3	magnesium carbonate
CaO	calcium oxide, quicklime
Ca(OH)_2	slack lime
NH_3	ammonia
HNO_3	nitric acid
CF_4	tetrafluoromethane
C_2F_6	hexafluoroethane

Units

PJ	petajoule (10^{15} J)
TJ	terajoule (10^{12} J)
Gg	gigagram (10^9 g)
kt	kilotonnes (1000 t)