

 Ministry of
Environment
Republic
of Lithuania



LITHUANIA'S NATIONAL INVENTORY DOCUMENT 2026

GREENHOUSE GAS EMISSIONS 1990-2024

ANNEXES

VILNIUS, 2026

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ANNEX I. Approach 1 and Approach 2 key categories analysis

Approach 1 Level Assessment for 1990

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>GHG emissions, kt CO₂ eq.</i>	<i>Level assessment</i>	<i>Cumulative total</i>
4.A.1 Forest land remaining forest land - carbon stock change in biomass	CO2	-6,892.19	0.11	0.11
1.A.1.a Public electricity and heat production - Liquid Fuels	CO2	6,021.25	0.10	0.21
1.A.1.a Public electricity and heat production - Gaseous Fuels	CO2	5,796.59	0.09	0.30
1.A.3.b Road transportation	CO2	5,247.15	0.08	0.38
3.A.1 Enteric Fermentation - Cattle	CH4	4,717.44	0.08	0.46
1.A.2 Manufacturing industries and construction-Liquid fuels	CO2	3,873.72	0.06	0.52
1.A.4 Other sectors-Solid fuels	CO2	2,760.55	0.04	0.57
1.A.4 Other sectors-Liquid fuels	CO2	2,736.38	0.04	0.61
1.A.2 Manufacturing industries and construction-Gaseous fuels	CO2	2,042.93	0.03	0.64
4.C Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	1,843.88	0.03	0.67
2.A.1 Cement Production	CO2	1,668.07	0.03	0.70
1.A.1.b Petroleum refining - Liquid Fuels	CO2	1,509.64	0.02	0.72
1.A.4 Other sectors-Gaseous fuels	CO2	1,379.27	0.02	0.75
2.B.1 Ammonia Production	CO2	1,236.56	0.02	0.77
5.A Solid Waste Disposal	CH4	1,152.29	0.02	0.78
4.D.1 Wetlands remaining wetlands -net carbon stock change in organic soils	CO2	1,129.39	0.02	0.80
4.A Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	1,087.18	0.02	0.82
3.D.1.1 Direct N2O Emissions From Managed Soils - Inorganic N Fertilizers	N2O	882.83	0.01	0.83
2.B.2 Nitric Acid Production	N2O	794.12	0.01	0.85
4.C.2 Land converted to grassland - carbon stock change in biomass	CO2	-611.19	0.01	0.86
4.B.2 Land converted to cropland- carbon stock change in biomass	CO2	439.13	0.01	0.86
4.C.1 Grassland remaining grassland - carbon stock change in biomass	CO2	-431.86	0.01	0.87
4.A.2 Land converted to forest land - carbon stock change in biomass	CO2	-410.94	0.01	0.88
3.D.1.3 Direct N2O Emissions From Managed Soils - Urine and dung deposited by grazing animals	N2O	377.12	0.01	0.88
3.B.1.3 Manure Management - Swine	CH4	368.76	0.01	0.89
3.D.1.2 Direct N2O Emissions From Managed Soils - Organic N Fertilizers	N2O	353.68	0.01	0.89
4.B Cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	351.56	0.01	0.90
1.A.3.c Railways	CO2	349.97	0.01	0.91

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>GHG emissions, kt CO₂ eq.</i>	<i>Level assessment</i>	<i>Cumulative total</i>
4.A.1 Forest land remaining forest land - net carbon stock change in dead wood	CO2	-306.59	0.00	0.91
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CH4	291.81	0.00	0.92
3.D.1.4 Direct N2O Emissions From Managed Soils - Crop Residues	N2O	290.77	0.00	0.92
3.B.1.1 Manure Management - Cattle	CH4	286.33	0.00	0.93
4.A Forest land	N2O	270.93	0.00	0.93
4.G Harvested wood products	CO2	-240.15	0.00	0.93
2.A.4 Other process use of carbonates	CO2	239.53	0.00	0.94
3.D.2.2 Indirect N2O Emissions From Managed Soils - Nitrogen leaching and run-off	N2O	225.62	0.00	0.94
2.A.2 Lime Production	CO2	210.27	0.00	0.94
3.B.2 Manure Management - Indirect N2O Emissions	N2O	198.51	0.00	0.95
4.F Other land	CO2	195.66	0.00	0.95
4.E.1 Settlements remaining settlements	CO2	-188.91	0.00	0.95
3.B.2 Manure Management - Cattle	N2O	186.05	0.00	0.96
1.A.1. Energy industries-Solid fuels	CO2	174.05	0.00	0.96
.....				
Total		43,559.2		

Approach 1 Level Assessment for 1990 using a subset (LULUCF was excluded from analysis)

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>GHG emissions, kt CO₂ eq.</i>	<i>Level assessment</i>	<i>Cumulative total</i>
1.A.1.a Public electricity and heat production - Liquid Fuels	CO2	6,021.25	0.13	0.13
1.A.1.a Public electricity and heat production - Gaseous Fuels	CO2	5,796.59	0.12	0.25
1.A.3.b Road transportation	CO2	5,247.15	0.11	0.36
3.A.1 Enteric Fermentation - Cattle	CH4	4,717.44	0.10	0.46
1.A.2 Manufacturing industries and construction- Liquid fuels	CO2	3,873.72	0.08	0.54
1.A.4 Other sectors-Solid fuels	CO2	2,760.55	0.06	0.60
1.A.4 Other sectors-Liquid fuels	CO2	2,736.38	0.06	0.66
1.A.2 Manufacturing industries and construction- Gaseous fuels	CO2	2,042.93	0.04	0.70
2.A.1 Cement Production	CO2	1,668.07	0.04	0.73
1.A.1.b Petroleum refining - Liquid Fuels	CO2	1,509.64	0.03	0.77
1.A.4 Other sectors-Gaseous fuels	CO2	1,379.27	0.03	0.79
2.B.1 Ammonia Production	CO2	1,236.56	0.03	0.82
5.A Solid Waste Disposal	CH4	1,152.29	0.02	0.85
3.D.1.1 Direct N2O Emissions From Managed Soils - Inorganic N Fertilizers	N2O	882.83	0.02	0.86
2.B.2 Nitric Acid Production	N2O	794.12	0.02	0.88
3.D.1.3 Direct N2O Emissions From Managed Soils - Urine and dung deposited by grazing animals	N2O	377.12	0.01	0.89
3.B.1.3 Manure Management - Swine	CH4	368.76	0.01	0.90
3.D.1.2 Direct N2O Emissions From Managed Soils - Organic N Fertilizers	N2O	353.68	0.01	0.90
1.A.3.c Railways	CO2	349.97	0.01	0.91
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CH4	291.81	0.01	0.92
3.D.1.4 Direct N2O Emissions From Managed Soils - Crop Residues	N2O	290.77	0.01	0.92
3.B.1.1 Manure Management - Cattle	CH4	286.33	0.01	0.93
2.A.4 Other process use of carbonates	CO2	239.53	0.01	0.93
3.D.2.2 Indirect N2O Emissions From Managed Soils - Nitrogen leaching and run-off	N2O	225.62	0.00	0.94
2.A.2 Lime Production	CO2	210.27	0.00	0.94
3.B.2 Manure Management - Indirect N2O Emissions	N2O	198.51	0.00	0.95
3.B.2 Manure Management - Cattle	N2O	186.05	0.00	0.95
1.A.1. Energy industries-Solid fuels	CO2	174.05	0.00	0.96
1.A.2 Manufacturing industries and construction- Solid fuels	CO2	171.63	0.00	0.96
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Total		47,494.1		

Approach 1 Level Assessment for 2024

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>GHG emissions, kt CO₂ eq.</i>	<i>Level assessment</i>	<i>Cumulative total</i>
1.A.3.b Road transportation	CO2	5,694.18	0.15	0.15
4.A.1 Forest land remaining forest land - carbon stock change in biomass	CO2	-4,889.74	0.13	0.29
4.G Harvested wood products	CO2	-2,105.85	0.06	0.34
4.A.2 Land converted to forest land - carbon stock change in biomass	CO2	-1,833.38	0.05	0.39
4.C Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	1,650.17	0.04	0.44
3.A.1 Enteric Fermentation - Cattle	CH4	1,646.58	0.04	0.48
4.B.1 Cropland remaining cropland - net carbon stock change in mineral soils	CO2	-1,616.97	0.04	0.53
4.A.1 Forest land remaining forest land - net carbon stock change in dead wood	CO2	-1,412.70	0.04	0.56
1.A.1.b Petroleum refining - Liquid Fuels	CO2	1,320.16	0.04	0.60
4.A Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	1,245.31	0.03	0.63
2.B.1 Ammonia Production	CO2	1,088.73	0.03	0.66
1.A.4 Other sectors-Liquid fuels	CO2	927.96	0.03	0.69
4.B.2 Land converted to cropland- carbon stock change in biomass	CO2	813.49	0.02	0.71
4.D.1 Wetlands remaining wetlands -net carbon stock change in organic soils	CO2	719.86	0.02	0.73
1.A.4 Other sectors-Gaseous fuels	CO2	682.57	0.02	0.75
1.A.2 Manufacturing industries and construction-Gaseous fuels	CO2	605.93	0.02	0.76
2.A.1 Cement Production	CO2	575.74	0.02	0.78
5.A Solid Waste Disposal	CH4	538.28	0.01	0.79
3.D.1.1 Direct N2O Emissions From Managed Soils - Inorganic N Fertilizers	N2O	519.96	0.01	0.81
1.A.1.a Public electricity and heat production - Gaseous Fuels	CO2	507.37	0.01	0.82
2.F.1 Refrigeration and Air Conditioning Equipment	HFCs	454.60	0.01	0.83
4.C.1 Grassland remaining grassland - carbon stock change in biomass	CO2	-425.27	0.01	0.85
4.B Cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	408.95	0.01	0.86
4.C.2 Land converted to grassland - carbon stock change in biomass	CO2	-353.22	0.01	0.87
3.D.1.4 Direct N2O Emissions From Managed Soils - Crop Residues	N2O	350.73	0.01	0.88
4.A Forest land	N2O	310.14	0.01	0.88
1.A.2 Manufacturing industries and construction-Solid fuels	CO2	265.17	0.01	0.89
1.A.1 Energy industries-Other fossil fuels	CO2	230.19	0.01	0.90
4.A.2 Land converted to forest land - net carbon stock change in mineral soils	CO2	-216.50	0.01	0.90
1.B.2 Oil, natural gas and other emissions from energy production	CO2	200.81	0.01	0.91

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>GHG emissions, kt CO₂ eq.</i>	<i>Level assessment</i>	<i>Cumulative total</i>
3.B.1.1 Manure Management - Cattle	CH4	189.85	0.01	0.91
4.E.1 Settlements remaining settlements	CO2	-176.61	0.00	0.92
3.D.1.6 Direct N2O Emissions From Managed Soils - Cultivation of organic soils	N2O	169.39	0.00	0.92
3.D.1.2 Direct N2O Emissions From Managed Soils - Organic N Fertilizers	N2O	147.73	0.00	0.93
1.A.2 Manufacturing industries and construction-Liquid fuels	CO2	144.90	0.00	0.93
2.B.2 Nitric Acid Production	N2O	144.83	0.00	0.94
3.D.2.2 Indirect N2O Emissions From Managed Soils - Nitrogen leaching and run-off	N2O	137.48	0.00	0.94
4.B.2 Land converted to cropland- net carbon stock change in dead organic matter	CO2	129.09	0.00	0.94
3.D.1.3 Direct N2O Emissions From Managed Soils - Urine and dung deposited by grazing animals	N2O	111.46	0.00	0.95
1.A.4 Other sectors-Biomass	CH4	93.05	0.00	0.95
4.F Other land	CO2	88.55	0.00	0.95
1.A.4 Other sectors-Solid fuels	CO2	86.79	0.00	0.95
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CH4	86.07	0.00	0.96
1.A.2 Manufacturing industries and construction-Other fossil fuels	CO2	85.35	0.00	0.96
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Total		10,423.0		

Approach 1 Level Assessment for 2024 using a subset (LULUCF was excluded from analysis)

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>GHG emissions, kt CO₂ eq.</i>	<i>Level assessment</i>	<i>Cumulative total</i>
1.A.3.b Road transportation	CO2	5,694.18	0.31	0.31
3.A.1 Enteric Fermentation - Cattle	CH4	1,646.58	0.09	0.40
1.A.1.b Petroleum refining - Liquid Fuels	CO2	1,320.16	0.07	0.47
2.B.1 Ammonia Production	CO2	1,088.73	0.06	0.53
1.A.4 Other sectors-Liquid fuels	CO2	927.96	0.05	0.58
1.A.4 Other sectors-Gaseous fuels	CO2	682.57	0.04	0.62
1.A.2 Manufacturing industries and construction-Gaseous fuels	CO2	605.93	0.03	0.66
2.A.1 Cement Production	CO2	575.74	0.03	0.69
5.A Solid Waste Disposal	CH4	538.28	0.03	0.72
3.D.1.1 Direct N2O Emissions From Managed Soils - Inorganic N Fertilizers	N2O	519.96	0.03	0.74
1.A.1.a Public electricity and heat production - Gaseous Fuels	CO2	507.37	0.03	0.77
2.F.1 Refrigeration and Air Conditioning Equipment	HFCs	454.60	0.02	0.80
3.D.1.4 Direct N2O Emissions From Managed Soils - Crop Residues	N2O	350.73	0.02	0.82
1.A.2 Manufacturing industries and construction-Solid fuels	CO2	265.17	0.01	0.83
1.A.1 Energy industries-Other fossil fuels	CO2	230.19	0.01	0.84
1.B.2 Oil, natural gas and other emissions from energy production	CO2	200.81	0.01	0.85
3.B.1.1 Manure Management - Cattle	CH4	189.85	0.01	0.87
3.D.1.6 Direct N2O Emissions From Managed Soils - Cultivation of organic soils	N2O	169.39	0.01	0.87
3.D.1.2 Direct N2O Emissions From Managed Soils - Organic N Fertilizers	N2O	147.73	0.01	0.88
1.A.2 Manufacturing industries and construction-Liquid fuels	CO2	144.90	0.01	0.89
2.B.2 Nitric Acid Production	N2O	144.83	0.01	0.90
3.D.2.2 Indirect N2O Emissions From Managed Soils - Nitrogen leaching and run-off	N2O	137.48	0.01	0.91
3.D.1.3 Direct N2O Emissions From Managed Soils - Urine and dung deposited by grazing animals	N2O	111.46	0.01	0.91
1.A.4 Other sectors-Biomass	CH4	93.05	0.01	0.92
1.A.4 Other sectors-Solid fuels	CO2	86.79	0.00	0.92
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CH4	86.07	0.00	0.93
1.A.2 Manufacturing industries and construction-Other fossil fuels	CO2	85.35	0.00	0.93
1.A.3.c Railways	CO2	82.30	0.00	0.94
3.D.2.1 Indirect N2O Emissions From Managed Soils - Atmospheric deposition	N2O	73.10	0.00	0.94
1.A.1.a Public electricity and heat production - Liquid Fuels	CO2	72.99	0.00	0.94
3.A. Enteric Fermentation - Others	CH4	72.24	0.00	0.95
5.B Biological Treatment of Solid Waste	CH4	71.93	0.00	0.95
3.B.2 Manure Management - Cattle	N2O	70.79	0.00	0.96
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Total		18,260.1		

Approach 1 Trend Assessment for 2024

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>1990 kt CO₂ eq.</i>	<i>2024 kt CO₂ eq.</i>	<i>Trend assessment</i>	<i>% Contribution to Trend</i>	<i>Cumulative total</i>
4.A.1 Forest land remaining forest land - carbon stock change in biomass	CO2	-6,892.19	-4,889.74	0.09	0.18	0.18
1.A.3.b Road transportation	CO2	5,247.15	5,694.18	0.05	0.10	0.28
1.A.1.a Public electricity and heat production - Liquid Fuels	CO2	6,021.25	72.99	0.04	0.08	0.36
1.A.1.a Public electricity and heat production - Gaseous Fuels	CO2	5,796.59	507.37	0.04	0.07	0.43
4.G Harvested wood products	CO2	-240.15	-2,105.85	0.03	0.05	0.48
1.A.2 Manufacturing industries and construction-Liquid fuels	CO2	3,873.72	144.90	0.03	0.05	0.53
4.B.1 Cropland remaining cropland - net carbon stock change in mineral soils	CO2	0.00	-1,616.97	0.03	0.05	0.58
1.A.4 Other sectors-Solid fuels	CO2	2,760.55	86.79	0.02	0.04	0.62
4.A.2 Land converted to forest land - carbon stock change in biomass	CO2	-410.94	-1,833.38	0.02	0.04	0.66
4.A.1 Forest land remaining forest land - net carbon stock change in dead wood	CO2	-306.59	-1,412.70	0.02	0.03	0.69
4.C Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	1,843.88	1,650.17	0.01	0.02	0.71
4.A Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	1,087.18	1,245.31	0.01	0.02	0.73
1.A.1.b Petroleum refining - Liquid Fuels	CO2	1,509.64	1,320.16	0.01	0.02	0.75
4.B.2 Land converted to cropland- carbon stock change in biomass	CO2	439.13	813.49	0.01	0.02	0.77
4.C.2 Land converted to grassland - carbon stock change in biomass	CO2	-611.19	-353.22	0.01	0.02	0.79
3.A.1 Enteric Fermentation - Cattle	CH4	4,717.44	1,646.58	0.01	0.02	0.81
2.B.1 Ammonia Production	CO2	1,236.56	1,088.73	0.01	0.02	0.82
2.F.1 Refrigeration and Air Conditioning Equipment	HFCs	0.00	454.60	0.01	0.01	0.84
1.A.4 Other sectors-Liquid fuels	CO2	2,736.38	927.96	0.01	0.01	0.85
1.A.2 Manufacturing industries and construction-Gaseous fuels	CO2	2,042.93	605.93	0.01	0.01	0.86
4.B Cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	351.56	408.95	0.00	0.01	0.87
4.C.1 Grassland remaining grassland - carbon stock change in biomass	CO2	-431.86	-425.27	0.00	0.01	0.87
1.A.1 Energy industries-Other fossil fuels	CO2	0.00	230.19	0.00	0.01	0.88
2.B.2 Nitric Acid Production	N2O	794.12	144.83	0.00	0.01	0.89
3.D.1.4 Direct N2O Emissions From Managed Soils - Crop Residues	N2O	290.77	350.73	0.00	0.01	0.89
2.A.1 Cement Production	CO2	1,668.07	575.74	0.00	0.01	0.90
4.D.1 Wetlands remaining wetlands -net carbon stock change in organic soils	CO2	1,129.39	719.86	0.00	0.01	0.91
1.B.2 Oil, natural gas and other emissions from energy production	CO2	23.88	200.81	0.00	0.01	0.91
1.A.2 Manufacturing industries and construction-Solid fuels	CO2	171.63	265.17	0.00	0.01	0.92

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>1990 kt CO₂ eq.</i>	<i>2024 kt CO₂ eq.</i>	<i>Trend assessment</i>	<i>% Contribution to Trend</i>	<i>Cumulative total</i>
4.A Forest land	N2O	270.93	310.14	0.00	0.01	0.92
3.B.1.3 Manure Management - Swine	CH4	368.76	28.79	0.00	0.00	0.93
4.E.1 Settlements remaining settlements	CO2	-188.91	-176.61	0.00	0.00	0.93
3.D.1.1 Direct N2O Emissions From Managed Soils - Inorganic N Fertilizers	N2O	882.83	519.96	0.00	0.00	0.94
2.A.4 Other process use of carbonates	CO2	239.53	10.05	0.00	0.00	0.94
4.B.2 Land converted to cropland- net carbon stock change in dead organic matter	CO2	63.62	129.09	0.00	0.00	0.94
2.A.2 Lime Production	CO2	210.27	1.75	0.00	0.00	0.94
3.D.1.6 Direct N2O Emissions From Managed Soils - Cultivation of organic soils	N2O	165.66	169.39	0.00	0.00	0.95
4.B.1 Cropland remaining cropland - carbon stock change in biomass	CO2	-85.47	-45.01	0.00	0.00	0.95
1.A.2 Manufacturing industries and construction-Other fossil fuels	CO2	0.00	85.35	0.00	0.00	0.95
1.A.3.c Railways	CO2	349.97	82.30	0.00	0.00	0.96
1.A.1. Energy industries-Solid fuels	CO2	174.05	1.62	0.00	0.00	0.96
.....						
Total		43,559.2	10,423.0	0.52	1.00	

Approach 1 Trend Assessment for 2024 using a subset (LULUCF was excluded from analysis)

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>1990 kt CO₂ eq.</i>	<i>2024 kt CO₂ eq.</i>	<i>Trend assessment</i>	<i>% Contribution to Trend</i>	<i>Cumulative total</i>
1.A.3.b Road transportation	CO2	5,247.15	5,694.18	0.08	0.24	0.24
1.A.1.a Public electricity and heat production - Liquid Fuels	CO2	6,021.25	72.99	0.05	0.15	0.39
1.A.1.a Public electricity and heat production - Gaseous Fuels	CO2	5,796.59	507.37	0.04	0.11	0.50
1.A.2 Manufacturing industries and construction-Liquid fuels	CO2	3,873.72	144.90	0.03	0.09	0.59
1.A.4 Other sectors-Solid fuels	CO2	2,760.55	86.79	0.02	0.06	0.65
1.A.1.b Petroleum refining - Liquid Fuels	CO2	1,509.64	1,320.16	0.02	0.05	0.70
2.B.1 Ammonia Production	CO2	1,236.56	1,088.73	0.01	0.04	0.74
2.F.1 Refrigeration and Air Conditioning Equipment	HFCs	0.00	454.60	0.01	0.03	0.77
3.D.1.4 Direct N2O Emissions From Managed Soils - Crop Residues	N2O	290.77	350.73	0.01	0.02	0.78
1.A.1 Energy industries-Other fossil fuels	CO2	0.00	230.19	0.00	0.02	0.80
1.A.2 Manufacturing industries and construction-Solid fuels	CO2	171.63	265.17	0.00	0.01	0.81
1.B.2 Oil, natural gas and other emissions from energy production	CO2	23.88	200.81	0.00	0.01	0.82
3.D.1.1 Direct N2O Emissions From Managed Soils - Inorganic N Fertilizers	N2O	882.83	519.96	0.00	0.01	0.84
1.A.2 Manufacturing industries and construction-Gaseous fuels	CO2	2,042.93	605.93	0.00	0.01	0.85
3.A.1 Enteric Fermentation - Cattle	CH4	4,717.44	1,646.58	0.00	0.01	0.86
2.B.2 Nitric Acid Production	N2O	794.12	144.83	0.00	0.01	0.87
1.A.4 Other sectors-Gaseous fuels	CO2	1,379.27	682.57	0.00	0.01	0.88
1.A.4 Other sectors-Liquid fuels	CO2	2,736.38	927.96	0.00	0.01	0.89
3.B.1.3 Manure Management - Swine	CH4	368.76	28.79	0.00	0.01	0.89
3.D.1.6 Direct N2O Emissions From Managed Soils - Cultivation of organic soils	N2O	165.66	169.39	0.00	0.01	0.90
5.A Solid Waste Disposal	CH4	1,152.29	538.28	0.00	0.01	0.91
1.A.2 Manufacturing industries and construction-Other fossil fuels	CO2	0.00	85.35	0.00	0.01	0.91
2.A.4 Other process use of carbonates	CO2	239.53	10.05	0.00	0.01	0.92
3.B.1.1 Manure Management - Cattle	CH4	286.33	189.85	0.00	0.01	0.92
2.A.2 Lime Production	CO2	210.27	1.75	0.00	0.01	0.93
5.B Biological Treatment of Solid Waste	CH4	0.23	71.93	0.00	0.00	0.93
2.A.1 Cement Production	CO2	1,668.07	575.74	0.00	0.00	0.94
1.A.1. Energy industries-Solid fuels	CO2	174.05	1.62	0.00	0.00	0.94
1.A.4 Other sectors-Biomass	CH4	78.71	93.05	0.00	0.00	0.95
3.G Liming	CO2	20.59	61.84	0.00	0.00	0.95
1.A.3.c Railways	CO2	349.97	82.30	0.00	0.00	0.95

3.D.2.2 Indirect N2O Emissions From Managed Soils - Nitrogen leaching and run-off	N2O	225.62	137.48	0.00	0.00	0.96
1.A.4 Other sectors-Solid fuels	CH4	143.99	6.06	0.00	0.00	0.96
1.A.3.b Road transportation	N2O	44.27	61.28	0.00	0.00	0.96
1.A.1 Energy industries-Biomass	N2O	0.56	36.60	0.00	0.00	0.96
Total		47,494.1	18,260.1	0.32	1.00	

Approach 2 Level Assessment for 1990

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>GHG emissions, kt CO₂ eq.</i>	<i>Level assessment with uncertainty</i>	<i>Cumulative total</i>
4.A.1 Forest land remaining forest land - carbon stock change in biomass	CO2	-6,892.19	0.05	0.19
4.D.1 Wetlands remaining wetlands -net carbon stock change in organic soils	CO2	1,129.39	0.04	0.33
5.A Solid Waste Disposal	CH4	1,152.29	0.02	0.41
3.A.1 Enteric Fermentation - Cattle	CH4	4,717.44	0.02	0.49
4.C Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	1,843.88	0.02	0.55
3.D.1.1 Direct N2O Emissions From Managed Soils - Inorganic N Fertilizers	N2O	882.83	0.01	0.59
4.A Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	1,087.18	0.01	0.63
3.B.2 Manure Management - Indirect N2O Emissions	N2O	198.51	0.01	0.65
3.D.2.2 Indirect N2O Emissions From Managed Soils - Nitrogen leaching and run-off	N2O	225.62	0.01	0.67
3.D.1.3 Direct N2O Emissions From Managed Soils - Urine and dung deposited by grazing animals	N2O	377.12	0.01	0.69
3.D.1.2 Direct N2O Emissions From Managed Soils - Organic N Fertilizers	N2O	353.68	0.00	0.71
4.C.2 Land converted to grassland - carbon stock change in biomass	CO2	-611.19	0.00	0.72
3.D.2.1 Indirect N2O Emissions From Managed Soils - Atmospheric deposition	N2O	171.05	0.00	0.74
3.D.1.4 Direct N2O Emissions From Managed Soils - Crop Residues	N2O	290.77	0.00	0.75
3.B.2 Manure Management - Cattle	N2O	186.05	0.00	0.77
4.B Cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	351.56	0.00	0.78
4.A.2 Land converted to forest land - carbon stock change in biomass	CO2	-410.94	0.00	0.79
4.C.1 Grassland remaining grassland - carbon stock change in biomass	CO2	-431.86	0.00	0.80
1.A.1.a Public electricity and heat production - Liquid Fuels	CO2	6,021.25	0.00	0.81
1.A.1.a Public electricity and heat production - Gaseous Fuels	CO2	5,796.59	0.00	0.82
1.A.4 Other sectors-Solid fuels	CO2	2,760.55	0.00	0.83
5.D Wastewater Treatment and Discharge	CH4	161.97	0.00	0.84
1.A.3.b Road transportation	CO2	5,247.15	0.00	0.85
4.G Harvested wood products	CO2	-240.15	0.00	0.86
4.A.1 Forest land remaining forest land - net carbon stock change in dead wood	CO2	-306.59	0.00	0.86

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>GHG emissions, kt CO₂ eq.</i>	<i>Level assessment with uncertainty</i>	<i>Cumulative total</i>
3.D.1.6 Direct N ₂ O Emissions From Managed Soils - Cultivation of organic soils	N ₂ O	165.66	0.00	0.87
4.B.2 Land converted to cropland- carbon stock change in biomass	CO ₂	439.13	0.00	0.88
3.B.2 Manure Management - Other	N ₂ O	113.37	0.00	0.89
1.A.4 Other sectors-Biomass	CH ₄	78.71	0.00	0.90
4.A Forest land	N ₂ O	270.93	0.00	0.90
1.A.2 Manufacturing industries and construction-Liquid fuels	CO ₂	3,873.72	0.00	0.91
1.A.4 Other sectors-Liquid fuels	CO ₂	2,736.38	0.00	0.91
.....				
Total		43,559.2		

Approach 2 Level Assessment for 1990 using a subset (LULUCF was excluded from analysis)

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>GHG emissions, kt CO₂ eq.</i>	<i>Level assessment with uncertainty</i>	<i>Cumulative total</i>
5.A Solid Waste Disposal	CH4	1,152.29	0.03	0.18
3.A.1 Enteric Fermentation - Cattle	CH4	4,717.44	0.03	0.34
3.D.1.1 Direct N2O Emissions From Managed Soils - Inorganic N Fertilizers	N2O	882.83	0.02	0.43
3.B.2 Manure Management - Indirect N2O Emissions	N2O	198.51	0.01	0.48
3.D.1.2 Indirect N2O Emissions From Managed Soils - Nitrogen leaching and run-off	N2O	225.62	0.01	0.52
3.D.1.3 Direct N2O Emissions From Managed Soils - Urine and dung deposited by grazing animals	N2O	377.12	0.01	0.56
3.D.1.2 Direct N2O Emissions From Managed Soils - Organic N Fertilizers	N2O	353.68	0.01	0.60
3.D.2.1 Indirect N2O Emissions From Managed Soils - Atmospheric deposition	N2O	171.05	0.01	0.63
3.D.1.4 Direct N2O Emissions From Managed Soils - Crop Residues	N2O	290.77	0.01	0.66
3.B.2 Manure Management - Cattle	N2O	186.05	0.00	0.68
1.A.1.a Public electricity and heat production - Liquid Fuels	CO2	6,021.25	0.00	0.71
1.A.1.a Public electricity and heat production - Gaseous Fuels	CO2	5,796.59	0.00	0.73
1.A.4 Other sectors-Solid fuels	CO2	2,760.55	0.00	0.75
5.D Wastewater Treatment and Discharge	CH4	161.97	0.00	0.77
1.A.3.b Road transportation	CO2	5,247.15	0.00	0.78
3.D.1.6 Direct N2O Emissions From Managed Soils - Cultivation of organic soils	N2O	165.66	0.00	0.80
3.B.2 Manure Management - Other	N2O	113.37	0.00	0.82
1.A.4 Other sectors-Biomass	CH4	78.71	0.00	0.83
1.A.2 Manufacturing industries and construction-Liquid fuels	CO2	3,873.72	0.00	0.85
1.A.4 Other sectors-Liquid fuels	CO2	2,736.38	0.00	0.86
2.G Other product manufacture and use	N2O	85.41	0.00	0.87
2.A.1 Cement Production	CO2	1,668.07	0.00	0.88
2.B.2 Nitric Acid Production	N2O	794.12	0.00	0.89
1.A.4 Other sectors-Solid fuels	CH4	143.99	0.00	0.90
1.A.4 Other sectors-Liquid fuels	N2O	141.71	0.00	0.91
.....				
Total		47,494.1		

Approach 2 Level Assessment for 2024

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>GHG emissions, kt CO₂ eq.</i>	<i>Level assessment with uncertainty</i>	<i>Cumulative total</i>
4.A.1 Forest land remaining forest land - carbon stock change in biomass	CO2	-4,889.74	0.06	0.16
4.D.1 Wetlands remaining wetlands -net carbon stock change in organic soils	CO2	719.86	0.04	0.26
4.G Harvested wood products	CO2	-2,105.85	0.03	0.36
4.C Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	1,650.17	0.03	0.42
4.A.2 Land converted to forest land - carbon stock change in biomass	CO2	-1,833.38	0.02	0.49
4.A Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	1,245.31	0.02	0.54
5.A Solid Waste Disposal	CH4	538.28	0.02	0.58
4.A.1 Forest land remaining forest land - net carbon stock change in dead wood	CO2	-1,412.70	0.02	0.63
4.B.1 Cropland remaining cropland - net carbon stock change in mineral soils	CO2	-1,616.97	0.01	0.67
3.A.1 Enteric Fermentation - Cattle	CH4	1,646.58	0.01	0.70
3.D.1.1 Direct N2O Emissions From Managed Soils - Inorganic N Fertilizers	N2O	519.96	0.01	0.73
3.D.1.4 Direct N2O Emissions From Managed Soils - Crop Residues	N2O	350.73	0.01	0.75
4.B.2 Land converted to cropland- carbon stock change in biomass	CO2	813.49	0.01	0.77
4.B Cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	408.95	0.01	0.78
3.D.2.2 Indirect N2O Emissions From Managed Soils - Nitrogen leaching and run-off	N2O	137.48	0.01	0.80
4.C.1 Grassland remaining grassland - carbon stock change in biomass	CO2	-425.27	0.00	0.81
1.A.3.b Road transportation	CO2	5,694.18	0.00	0.82
4.C.2 Land converted to grassland - carbon stock change in biomass	CO2	-353.22	0.00	0.83
3.D.1.6 Direct N2O Emissions From Managed Soils - Cultivation of organic soils	N2O	169.39	0.00	0.84
1.A.4 Other sectors-Biomass	CH4	93.05	0.00	0.85
4.A Forest land	N2O	310.14	0.00	0.86
2.F.1 Refrigeration and Air Conditioning Equipment	HFCs	454.60	0.00	0.87
3.D.1.2 Direct N2O Emissions From Managed Soils - Organic N Fertilizers	N2O	147.73	0.00	0.88
3.B.2 Manure Management - Indirect N2O Emissions	N2O	57.21	0.00	0.89
4.A.2 Land converted to forest land - net carbon stock change in mineral soils	CO2	-216.50	0.00	0.90
3.D.2.1 Indirect N2O Emissions From Managed Soils - Atmospheric deposition	N2O	73.10	0.00	0.90

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>GHG emissions, kt CO₂ eq.</i>	<i>Level assessment with uncertainty</i>	<i>Cumulative total</i>
3.D.1.3 Direct N ₂ O Emissions From Managed Soils - Urine and dung deposited by grazing animals	N ₂ O	111.46	0.00	0.91
1.B.2 Oil, natural gas and other emissions from energy production	CO ₂	200.81	0.00	0.92
3.B.2 Manure Management - Cattle	N ₂ O	70.79	0.00	0.92
.....				
Total		10,423.0		

Approach 2 Level Assessment for 2024 using a subset (LULUCF was excluded from analysis)

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>GHG emissions, kt CO₂ eq.</i>	<i>Level assessment with uncertainty</i>	<i>Cumulative total</i>
5.A Solid Waste Disposal	CH4	538.28	0.04	0.17
3.A.1 Enteric Fermentation - Cattle	CH4	1,646.58	0.02	0.28
3.D.1.1 Direct N2O Emissions From Managed Soils - Inorganic N Fertilizers	N2O	519.96	0.02	0.39
3.D.1.4 Direct N2O Emissions From Managed Soils - Crop Residues	N2O	350.73	0.02	0.46
3.D.2.2 Indirect N2O Emissions From Managed Soils - Nitrogen leaching and run-off	N2O	137.48	0.01	0.51
1.A.3.b Road transportation	CO2	5,694.18	0.01	0.55
3.D.1.6 Direct N2O Emissions From Managed Soils - Cultivation of organic soils	N2O	169.39	0.01	0.58
1.A.4 Other sectors-Biomass	CH4	93.05	0.01	0.62
2.F.1 Refrigeration and Air Conditioning Equipment	HFCs	454.60	0.01	0.65
3.D.1.2 Direct N2O Emissions From Managed Soils - Organic N Fertilizers	N2O	147.73	0.01	0.68
3.B.2 Manure Management - Indirect N2O Emissions	N2O	57.21	0.01	0.71
3.D.2.1 Indirect N2O Emissions From Managed Soils - Atmospheric deposition	N2O	73.10	0.01	0.73
3.D.1.3 Direct N2O Emissions From Managed Soils - Urine and dung deposited by grazing animals	N2O	111.46	0.01	0.76
1.B.2 Oil, natural gas and other emissions from energy production	CO2	200.81	0.00	0.78
3.B.2 Manure Management - Cattle	N2O	70.79	0.00	0.80
5.B Biological Treatment of Solid Waste	CH4	71.93	0.00	0.82
1.A.1 Energy industries-Biomass	N2O	36.60	0.00	0.83
1.A.1 Energy industries-Biomass	CH4	29.01	0.00	0.84
1.A.1.b Petroleum refining - Liquid Fuels	CO2	1,320.16	0.00	0.85
3.B.1.1 Manure Management - Cattle	CH4	189.85	0.00	0.86
1.A.4 Other sectors-Liquid fuels	N2O	68.17	0.00	0.87
1.A.4 Other sectors-Biomass	N2O	22.51	0.00	0.88
1.A.4 Other sectors-Liquid fuels	CO2	927.96	0.00	0.89
3.G Liming	CO2	61.84	0.00	0.89
5.D Wastewater Treatment and Discharge	CH4	33.24	0.00	0.90
2.A.1 Cement Production	CO2	575.74	0.00	0.91
2.B.1 Ammonia Production	CO2	1,088.73	0.00	0.92
5.B Biological Treatment of Solid Waste	N2O	28.56	0.00	0.92
1.A.3.b Road transportation	N2O	61.28	0.00	0.93
1.A.4 Other sectors-Gaseous fuels	CO2	682.57	0.00	0.94
.....				
Total		18,260.1		

Approach 2 Trend Assessment for 2024

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>1990 kt CO₂ eq.</i>	<i>2024 kt CO₂ eq.</i>	<i>Trend assessment with uncertainty</i>	<i>% Contribution to Trend</i>	<i>Cumulative total</i>
4.A.1 Forest land remaining forest land - carbon stock change in biomass	CO2	-6,892.19	-4,889.74	0.04	0.27	0.27
4.G Harvested wood products	CO2	-240.15	-2,105.85	0.02	0.11	0.39
4.A.2 Land converted to forest land - carbon stock change in biomass	CO2	-410.94	-1,833.38	0.01	0.06	0.45
4.B.1 Cropland remaining cropland - net carbon stock change in mineral soils	CO2	0.00	-1,616.97	0.01	0.05	0.50
4.C Grassland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	1,843.88	1,650.17	0.01	0.05	0.55
4.A.1 Forest land remaining forest land - net carbon stock change in dead wood	CO2	-306.59	-1,412.70	0.01	0.05	0.59
4.A Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	1,087.18	1,245.31	0.01	0.04	0.64
4.D.1 Wetlands remaining wetlands -net carbon stock change in organic soils	CO2	1,129.39	719.86	0.01	0.04	0.68
4.C.2 Land converted to grassland - carbon stock change in biomass	CO2	-611.19	-353.22	0.00	0.03	0.70
4.B.2 Land converted to cropland- carbon stock change in biomass	CO2	439.13	813.49	0.00	0.02	0.72
3.D.1.4 Direct N2O Emissions From Managed Soils - Crop Residues	N2O	290.77	350.73	0.00	0.02	0.74
3.A.1 Enteric Fermentation - Cattle	CH4	4,717.44	1,646.58	0.00	0.02	0.76
4.B Cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO2	351.56	408.95	0.00	0.01	0.77
2.F.1 Refrigeration and Air Conditioning Equipment	HFCs	0.00	454.60	0.00	0.01	0.79
4.C.1 Grassland remaining grassland - carbon stock change in biomass	CO2	-431.86	-425.27	0.00	0.01	0.80
1.A.3.b Road transportation	CO2	5,247.15	5,694.18	0.00	0.01	0.81
3.D.1.1 Direct N2O Emissions From Managed Soils - Inorganic N Fertilizers	N2O	882.83	519.96	0.00	0.01	0.82
1.A.4 Other sectors-Biomass	CH4	78.71	93.05	0.00	0.01	0.82
1.B.2 Oil, natural gas and other emissions from energy production	CO2	23.88	200.81	0.00	0.01	0.83
1.A.1.a Public electricity and heat production - Liquid Fuels	CO2	6,021.25	72.99	0.00	0.01	0.84
5.B Biological Treatment of Solid Waste	CH4	0.23	71.93	0.00	0.01	0.85

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>1990 kt CO₂ eq.</i>	<i>2024 kt CO₂ eq.</i>	<i>Trend assessment with uncertainty</i>	<i>% Contribution to Trend</i>	<i>Cumulative total</i>
3.D.1.6 Direct N2O Emissions From Managed Soils - Cultivation of organic soils	N2O	165.66	169.39	0.00	0.01	0.86
4.A Forest land	N2O	270.93	310.14	0.00	0.01	0.87
3.B.2 Manure Management - Indirect N2O Emissions	N2O	198.51	57.21	0.00	0.01	0.87
1.A.4 Other sectors-Solid fuels	CO2	2,760.55	86.79	0.00	0.01	0.88
1.A.1.a Public electricity and heat production - Gaseous Fuels	CO2	5,796.59	507.37	0.00	0.01	0.89
1.A.1 Energy industries-Biomass	N2O	0.56	36.60	0.00	0.01	0.89
3.D.1.3 Direct N2O Emissions From Managed Soils - Urine and dung deposited by grazing animals	N2O	377.12	111.46	0.00	0.01	0.90
1.A.2 Manufacturing industries and construction-Liquid fuels	CO2	3,873.72	144.90	0.00	0.00	0.90
3.B.2 Manure Management - Other	N2O	113.37	12.52	0.00	0.00	0.91
3.D.2.2 Indirect N2O Emissions From Managed Soils - Nitrogen leaching and run-off	N2O	225.62	137.48	0.00	0.00	0.91
.....						
Total		43,559.2	10,423.0	0.15	1.00	

Approach 2 Trend Assessment for 2024 using a subset (LULUCF was excluded from analysis)

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>1990 kt CO₂ eq.</i>	<i>2024 kt CO₂ eq.</i>	<i>Trend assessment with uncertainty</i>	<i>% Contribution to Trend</i>	<i>Cumulative total</i>
3.D.1.4 Direct N2O Emissions From Managed Soils - Crop Residues	N2O	290.77	350.73	0.00	0.10	0.10
3.D.1.1 Direct N2O Emissions From Managed Soils - Inorganic N Fertilizers	N2O	882.83	519.96	0.00	0.07	0.17
2.F.1 Refrigeration and Air Conditioning Equipment	HFCs	0.00	454.60	0.00	0.06	0.24
5.A Solid Waste Disposal	CH4	1,152.29	538.28	0.00	0.06	0.30
1.A.3.b Road transportation	CO2	5,247.15	5,694.18	0.00	0.05	0.35
1.A.4 Other sectors-Biomass	CH4	78.71	93.05	0.00	0.05	0.39
3.D.1.6 Direct N2O Emissions From Managed Soils - Cultivation of organic soils	N2O	165.66	169.39	0.00	0.04	0.44
1.B.2 Oil, natural gas and other emissions from energy production	CO2	23.88	200.81	0.00	0.04	0.48
5.B Biological Treatment of Solid Waste	CH4	0.23	71.93	0.00	0.04	0.51
3.D.2.2 Indirect N2O Emissions From Managed Soils - Nitrogen leaching and run-off	N2O	225.62	137.48	0.00	0.04	0.55
1.A.1.a Public electricity and heat production - Liquid Fuels	CO2	6,021.25	72.99	0.00	0.03	0.58
1.A.4 Other sectors-Solid fuels	CO2	2,760.55	86.79	0.00	0.03	0.61
1.A.1 Energy industries-Biomass	N2O	0.56	36.60	0.00	0.03	0.64
1.A.1.a Public electricity and heat production - Gaseous Fuels	CO2	5,796.59	507.37	0.00	0.02	0.66
3.A.1 Enteric Fermentation - Cattle	CH4	4,717.44	1,646.58	0.00	0.02	0.68
1.A.1 Energy industries-Biomass	CH4	0.44	29.01	0.00	0.02	0.70
3.B.2 Manure Management - Indirect N2O Emissions	N2O	198.51	57.21	0.00	0.02	0.72
1.A.2 Manufacturing industries and construction-Liquid fuels	CO2	3,873.72	144.90	0.00	0.02	0.74
3.B.2 Manure Management - Other	N2O	113.37	12.52	0.00	0.02	0.76
2.G Other product manufacture and use	N2O	85.41	3.59	0.00	0.02	0.77

<i>IPCC Category</i>	<i>Greenhouse gas</i>	<i>1990 kt CO₂ eq.</i>	<i>2024 kt CO₂ eq.</i>	<i>Trend assessment with uncertainty</i>	<i>% Contribution to Trend</i>	<i>Cumulative total</i>
5.B Biological Treatment of Solid Waste	N2O	0.13	28.56	0.00	0.02	0.79
3.D.1.3 Direct N2O Emissions From Managed Soils - Urine and dung deposited by grazing animals	N2O	377.12	111.46	0.00	0.01	0.80
3.G Liming	CO2	20.59	61.84	0.00	0.01	0.82
1.A.4 Other sectors-Biomass	N2O	11.54	22.51	0.00	0.01	0.83
5.D Wastewater Treatment and Discharge	CH4	161.97	33.24	0.00	0.01	0.84
1.A.4 Other sectors-Solid fuels	CH4	143.99	6.06	0.00	0.01	0.86
1.A.3.b Road transportation	N2O	44.27	61.28	0.00	0.01	0.87
3.B.1.3 Manure Management - Swine	CH4	368.76	28.79	0.00	0.01	0.88
1.A.1.b Petroleum refining - Liquid Fuels	CO2	1,509.64	1,320.16	0.00	0.01	0.89
2.B.1 Ammonia Production	CO2	1,236.56	1,088.73	0.00	0.01	0.90
2.B.2 Nitric Acid Production	N2O	794.12	144.83	0.00	0.01	0.90
3.B.1.1 Manure Management - Cattle	CH4	286.33	189.85	0.00	0.01	0.91
1.A.1 Energy industries-Other fossil fuels	CO2	0.00	230.19	0.00	0.01	0.92
.....						
Total		47,494.1	18,261.0	0.04	1.00	

ANNEX II. Tier 1 Uncertainty assessment

Table 1a. Uncertainty evaluation including LULUCF

IPCC Source category	Gas	Base year (1990) emissions	Emissions in 2024	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor	Uncertainty in trend in national emissions introduced by	Uncertainty introduced into the trend in total national emissions
		kt CO ₂ eq.	kt CO ₂ eq.	%	%	%	%	%	%	%	%	%
1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO ₂	7 540.2	1 401.2	2%	2%	3%	0.000	0.009	0.032	0.000	0.001	0.000
1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CH ₄	7.7	0.9	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	N ₂ O	14.3	1.4	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO ₂	174.0	1.6	2%	5%	5%	0.000	0.001	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CH ₄	0.1	0.0	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Solid Fuels	N ₂ O	0.7	0.0	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO ₂	5,796.6	544.4	2%	2%	3%	0.000	0.019	0.012	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CH ₄	2.9	0.3	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	N ₂ O	2.8	0.3	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	CO ₂	0.0	230.2	2%	5%	5%	0.000	0.005	0.005	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	CH ₄	0.0	2.1	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	N ₂ O	0.0	2.6	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000

<i>IPCC Source category</i>	<i>Gas</i>	<i>Base year (1990) emissions</i>	<i>Emissions in 2024</i>	<i>Activity data uncertainty</i>	<i>Emission factor uncertainty</i>	<i>Combined uncertainty</i>	<i>Combined uncertainty as % of total national</i>	<i>Type A sensitivity</i>	<i>Type B sensitivity</i>	<i>Uncertainty in trend in national emissions introduced by emission factor</i>	<i>Uncertainty in trend in national emissions introduced by</i>	<i>Uncertainty introduced into the trend in total national emissions</i>
		<i>kt CO₂ eq.</i>	<i>kt CO₂ eq.</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>
1.A.1 Fuel combustion - Energy Industries - Peat	CO ₂	11.1	8.7	2%	5%	5%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Peat	CH ₄	0.0	0.0	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Peat	N ₂ O	0.0	0.0	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Biomass	CO ₂	0.0	0.0	5%	15%	16%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Biomass	CH ₄	0.4	29.0	5%	150%	150%	0.000	0.001	0.001	0.001	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Biomass	N ₂ O	0.6	36.6	5%	150%	150%	0.000	0.001	0.001	0.001	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO ₂	3,873.7	144.9	2%	2%	3%	0.000	0.018	0.003	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CH ₄	5.0	0.2	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	N ₂ O	42.5	5.8	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO ₂	171.6	265.2	2%	5%	5%	0.000	0.005	0.006	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CH ₄	0.5	0.8	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000

IPCC Source category	Gas	Base year (1990) emissions	Emissions in 2024	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor	Uncertainty in trend in national emissions introduced by	Uncertainty introduced into the trend in total national emissions
		kt CO ₂ eq.	kt CO ₂ eq.	%	%	%	%	%	%	%	%	%
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	N ₂ O	0.7	1.1	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO ₂	2,042.9	605.9	2%	2%	3%	0.000	0.003	0.014	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CH ₄	1.0	0.3	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	N ₂ O	1.0	0.3	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction -Other fossil fuels	CO ₂	0.0	85.3	2%	2%	3%	0.000	0.002	0.002	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction -Other fossil fuels	CH ₄	0.0	0.8	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction -Other fossil fuels	N ₂ O	0.0	1.1	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	CO ₂	17.5	0.0	2%	5%	5%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	CH ₄	0.0	0.0	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000

IPCC Source category	Gas	Base year (1990) emissions	Emissions in 2024	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor	Uncertainty in trend in national emissions introduced by	Uncertainty introduced into the trend in total national emissions
		kt CO ₂ eq.	kt CO ₂ eq.	%	%	%	%	%	%	%	%	%
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	N ₂ O	0.0	0.0	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Biomass	CO ₂	0.0	0.0	5%	15%	16%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Biomass	CH ₄	0.4	5.3	5%	150%	150%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Biomass	N ₂ O	0.5	6.7	5%	150%	150%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.a Domestic Aviation	CO ₂	8.2	1.5	10%	2%	10%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.a Domestic Aviation	CH ₄	0.0	0.0	10%	79%	79%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.a Domestic Aviation	N ₂ O	0.1	0.0	10%	110%	110%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.b Road Transportation	CO ₂	5,247.2	5,694.2	2%	2%	3%	0.000	0.101	0.130	0.002	0.004	0.000
1.A.3.b Road Transportation	CH ₄	44.2	7.7	2%	40%	40%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.b Road Transportation	N ₂ O	44.3	61.3	2%	50%	50%	0.000	0.001	0.001	0.001	0.000	0.000
1.A.3.c Railways	CO ₂	350.0	82.3	5%	2%	5%	0.000	0.000	0.002	0.000	0.000	0.000
1.A.3.c Railways	CH ₄	0.6	0.1	5%	75%	75%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.c Railways	N ₂ O	36.4	8.5	5%	75%	75%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.d Domestic Navigation - Liquid Fuels	CO ₂	15.5	7.5	5%	3%	6%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.d Domestic Navigation - Liquid Fuels	CH ₄	0.0	0.0	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.d Domestic Navigation - Liquid Fuels	N ₂ O	0.1	0.1	5%	90%	90%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.e.i Other Transportation	CO ₂	64.3	42.5	5%	2%	5%	0.000	0.001	0.001	0.000	0.000	0.000

IPCC Source category	Gas	Base year (1990) emissions	Emissions in 2024	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor	Uncertainty in trend in national emissions introduced by	Uncertainty introduced into the trend in total national emissions
		kt CO ₂ eq.	kt CO ₂ eq.	%	%	%	%	%	%	%	%	%
1.A.3.e.i Other Transportation	CH ₄	0.0	0.0	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.e.i Other Transportation	N ₂ O	0.0	1.9	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors - Liquid Fuels	CO ₂	2,736.4	928.0	3%	2%	4%	0.000	0.006	0.021	0.000	0.001	0.000
1.A.4 Other Sectors - Liquid Fuels	CH ₄	7.9	1.9	3%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors - Liquid Fuels	N ₂ O	141.7	68.2	3%	50%	50%	0.000	0.001	0.002	0.000	0.000	0.000
1.A.4 Other Sectors - Solid Fuels	CO ₂	2,760.5	86.8	3%	5%	6%	0.000	0.013	0.002	0.001	0.000	0.000
1.A.4 Other Sectors - Solid Fuels	CH ₄	144.0	6.1	3%	50%	50%	0.000	0.001	0.000	0.000	0.000	0.000
1.A.4 Other Sectors - Solid Fuels	N ₂ O	11.6	0.4	3%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors - Gaseous Fuels	CO ₂	1,379.3	682.6	3%	2%	4%	0.000	0.008	0.016	0.000	0.001	0.000
1.A.4 Other Sectors - Gaseous Fuels	CH ₄	3.5	1.7	3%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors - Gaseous Fuels	N ₂ O	0.7	0.3	3%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors - Peat	CO ₂	27.1	33.4	3%	5%	6%	0.000	0.001	0.001	0.000	0.000	0.000
1.A.4 Other Sectors - Peat	CH ₄	1.3	1.6	3%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors - Peat	N ₂ O	0.1	0.1	3%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors- Biomass	CO ₂	0.0	0.0	10%	15%	18%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors- Biomass	CH ₄	78.7	93.1	10%	150%	150%	0.000	0.002	0.002	0.003	0.000	0.000
1.A.4 Other Sectors- Biomass	N ₂ O	11.5	22.5	10%	150%	150%	0.000	0.000	0.001	0.001	0.000	0.000
1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	CO ₂	23.3	199.9	5%	50%	50%	0.000	0.004	0.005	0.002	0.000	0.000
1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	CH ₄	4.8	2.5	5%	75%	75%	0.000	0.000	0.000	0.000	0.000	0.000
1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	N ₂ O	0.0	0.0	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CO ₂	0.0	0.0	5%	10%	11%	0.000	0.000	0.000	0.000	0.000	0.000

IPCC Source category	Gas	Base year (1990) emissions	Emissions in 2024	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor	Uncertainty in trend in national emissions introduced by	Uncertainty introduced into the trend in total national emissions
		kt CO ₂ eq.	kt CO ₂ eq.	%	%	%	%	%	%	%	%	%
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CH ₄	291.8	86.1	5%	10%	11%	0.000	0.000	0.002	0.000	0.000	0.000
1.B.2.c Fugitive Emissions from Fuels - Venting and flaring	CO ₂	0.6	0.9	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.B.2.c Fugitive Emissions from Fuels - Venting and flaring	CH ₄	0.3	0.5	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.B.2.c Fugitive Emissions from Fuels - Venting and flaring	N ₂ O	0.0	0.0	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
2.A.1 Cement Production	CO ₂	1,668.1	575.7	2%	5%	5%	0.000	0.004	0.013	0.000	0.000	0.000
2.A.2 Lime Production	CO ₂	210.3	1.8	5%	5%	7%	0.000	0.001	0.000	0.000	0.000	0.000
2.A.3 Glass Production	CO ₂	11.7	7.0	7%	5%	9%	0.000	0.000	0.000	0.000	0.000	0.000
2.A.4.a Ceramics	CO ₂	227.9	0.0	5%	5%	7%	0.000	0.001	0.000	0.000	0.000	0.000
2.A.4.b Other use of soda ash	CO ₂	5.2	0.6	15%	5%	16%	0.000	0.000	0.000	0.000	0.000	0.000
2.A.4.d Mineral wool production	CO ₂	6.4	9.4	7%	5%	9%	0.000	0.000	0.000	0.000	0.000	0.000
2.B.1 Ammonia Production	CO ₂	1,236.6	1,088.7	2%	2%	3%	0.000	0.018	0.025	0.000	0.001	0.000
2.B.2 Nitric Acid Production	N ₂ O	794.1	144.8	2%	10%	10%	0.000	0.001	0.003	0.000	0.000	0.000
2.B.8.a Methanol	CO ₂	24.4	0.0	5%	30%	30%	0.000	0.000	0.000	0.000	0.000	0.000
2.B.8.a Methanol	CH ₄	5.9	0.0	5%	30%	30%	0.000	0.000	0.000	0.000	0.000	0.000
2.C.1 Iron and Steel Production	CO ₂	17.0	0.0	10%	10%	14%	0.000	0.000	0.000	0.000	0.000	0.000
2.D.1 Lubricant use	CO ₂	0.0	15.5	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
2.D.2 Paraffin wax use	CO ₂	6.9	1.1	5%	100%	100%	0.000	0.000	0.000	0.000	0.000	0.000
2.D.3 Urea-based catalyst	CO ₂	0.0	3.3	10%	2%	10%	0.000	0.000	0.000	0.000	0.000	0.000
2.E.1 Semiconductor	SF ₆	0.0	3.0	5%	5%	7%	0.000	0.000	0.000	0.000	0.000	0.000
2.E.3 Photovoltaics	NF ₃	0.0	0.0	5%	20%	21%	0.000	0.000	0.000	0.000	0.000	0.000
2.F.1.a Commercial Refrigeration	HFCs	0.0	147.3	20%	50%	54%	0.000	0.003	0.003	0.002	0.001	0.000
2.F.1.b Domestic Refrigeration	HFCs	0.0	2.3	20%	50%	54%	0.000	0.000	0.000	0.000	0.000	0.000

IPCC Source category	Gas	Base year (1990) emissions	Emissions in 2024	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor	Uncertainty in trend in national emissions introduced by	Uncertainty introduced into the trend in total national emissions
		kt CO ₂ eq.	kt CO ₂ eq.	%	%	%	%	%	%	%	%	%
2.F.1.c. Industrial Refrigeration	HFCs	0.0	42.0	20%	50%	54%	0.000	0.001	0.001	0.000	0.000	0.000
2.F.1.d. Transport Refrigeration	HFCs	0.0	76.3	20%	50%	54%	0.000	0.002	0.002	0.001	0.000	0.000
2.F.1.e. Mobile air-conditioning	HFCs	0.0	152.7	20%	50%	54%	0.000	0.003	0.003	0.002	0.001	0.000
2.F.1.f. Stationary Air Conditioning	HFCs	0.0	34.1	20%	50%	54%	0.000	0.001	0.001	0.000	0.000	0.000
2.F.2 Foam Blowing Agents	HFCs	0.0	14.9	30%	30%	42%	0.000	0.000	0.000	0.000	0.000	0.000
2.F.3 Fire Protection	HFCs	0.0	4.0	20%	20%	28%	0.000	0.000	0.000	0.000	0.000	0.000
2.F.4 Aerosols/metered dose inhalers	HFCs	0.0	8.3	5%	5%	7%	0.000	0.000	0.000	0.000	0.000	0.000
2.G.1 Manufacture of electrical equipments	SF ₆	0.0	0.4	5%	5%	7%	0.000	0.000	0.000	0.000	0.000	0.000
2.G.2.b Accelerators	SF ₆	0.0	0.1	5%	5%	7%	0.000	0.000	0.000	0.000	0.000	0.000
2.G.3.a Medical applications	N ₂ O	83.0	1.7	5%	5%	7%	0.000	0.000	0.000	0.000	0.000	0.000
2.G.3.b Propellant for pressure and aerosol products	N ₂ O	2.4	1.9	20%	100%	102%	0.000	0.000	0.000	0.000	0.000	0.000
3.A Enteric Fermentation	CH ₄	4,879.6	1,718.8	4%	25%	26%	0.002	0.012	0.039	0.003	0.002	0.000
3.B Manure Management	CH ₄	750.4	246.1	14%	11%	18%	0.000	0.001	0.006	0.000	0.001	0.000
3.B Manure Management	N ₂ O	497.9	140.5	27%	203%	204%	0.001	0.000	0.003	0.001	0.001	0.000
3.D.1 Direct N ₂ O Emissions From Managed Soils	N ₂ O	2,070.1	1,299.3	11%	69%	70%	0.007	0.018	0.030	0.013	0.004	0.000
3.D.2 Indirect N ₂ O Emissions From Managed Soils	N ₂ O	396.7	210.6	37%	135%	140%	0.001	0.003	0.005	0.004	0.003	0.000
3.G Liming	CO ₂	20.6	61.8	10%	50%	51%	0.000	0.001	0.001	0.001	0.000	0.000
3.H Urea Application	CO ₂	59.6	21.7	10%	50%	51%	0.000	0.000	0.000	0.000	0.000	0.000
4.A.1 Forest Land Remaining Forest Land	CO ₂	-6,205.1	-5,151.4	3%	46%	46%	0.051	0.084	0.118	0.038	0.005	0.001
4.A.1 Forest Land Remaining Forest Land	CH ₄	0.5	0.2	32%	40%	51%	0.000	0.000	0.000	0.000	0.000	0.000

IPCC Source category	Gas	Base year (1990) emissions	Emissions in 2024	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor	Uncertainty in trend in national emissions introduced by	Uncertainty introduced into the trend in total national emissions
		kt CO ₂ eq.	kt CO ₂ eq.	%	%	%	%	%	%	%	%	%
4.A.1 Forest Land Remaining Forest Land	N ₂ O	247.3	286.5	32%	27%	42%	0.000	0.005	0.007	0.001	0.003	0.000
4.A.2 Land Converted to Forest Land	CO ₂	-448.9	-2,018.7	15%	46%	48%	0.009	0.044	0.046	0.020	0.010	0.000
4.A.2 Land Converted to Forest Land	CH ₄	0.0	0.0	32%	40%	51%	0.000	0.000	0.000	0.000	0.000	0.000
4.A.2 Land Converted to Forest Land	N ₂ O	23.6	23.6	32%	27%	42%	0.000	0.000	0.001	0.000	0.000	0.000
4.B Cropland	CO ₂	768.8	-310.4	5%	31%	31%	0.000	0.011	0.007	0.003	0.000	0.000
4.B Cropland	CH ₄	0.6	0.5	6%	85%	85%	0.000	0.000	0.000	0.000	0.000	0.000
4.B Cropland	N ₂ O	21.5	26.4	15%	151%	151%	0.000	0.000	0.001	0.001	0.000	0.000
4.C Grassland	CO ₂	724.9	760.8	7%	42%	42%	0.001	0.013	0.017	0.006	0.002	0.000
4.C Grassland	CH ₄	4.8	1.8	6%	85%	85%	0.000	0.000	0.000	0.000	0.000	0.000
4.C Grassland	N ₂ O	24.9	16.4	6%	76%	76%	0.000	0.000	0.000	0.000	0.000	0.000
4.D Wetlands	CO ₂	1,129.1	704.8	6%	205%	205%	0.019	0.010	0.016	0.020	0.001	0.000
4.D Wetlands	N ₂ O	5.4	0.1	15%	151%	151%	0.000	0.000	0.000	0.000	0.000	0.000
4.E Settlements	CO ₂	-189.1	-170.5	10%	15%	18%	0.000	0.003	0.004	0.000	0.001	0.000
4.E Settlements	N ₂ O	0.0	5.5	18%	151%	152%	0.000	0.000	0.000	0.000	0.000	0.000
4.F Other Land	CO ₂	195.7	88.6	17%	15%	23%	0.000	0.001	0.002	0.000	0.000	0.000
4.F Other Land	N ₂ O	2.7	5.2	23%	151%	152%	0.000	0.000	0.000	0.000	0.000	0.000
4.G Harvested Wood Products	CO ₂	-240.2	-2,105.9	15%	59%	61%	0.015	0.047	0.048	0.028	0.010	0.001
5.A Solid Waste Disposal	CH ₄	1,152.3	538.3	10%	125%	125%	0.004	0.006	0.012	0.007	0.002	0.000
5.B Biological Treatment of Solid Waste	CH ₄	0.2	71.9	10%	100%	100%	0.000	0.002	0.002	0.002	0.000	0.000
5.B Biological Treatment of Solid Waste	N ₂ O	0.1	28.6	10%	100%	100%	0.000	0.001	0.001	0.001	0.000	0.000

<i>IPCC Source category</i>	<i>Gas</i>	<i>Base year (1990) emissions</i>	<i>Emissions in 2024</i>	<i>Activity data uncertainty</i>	<i>Emission factor uncertainty</i>	<i>Combined uncertainty</i>	<i>Combined uncertainty as % of total national</i>	<i>Type A sensitivity</i>	<i>Type B sensitivity</i>	<i>Uncertainty in trend in national emissions introduced by emission factor</i>	<i>Uncertainty in trend in national emissions introduced by</i>	<i>Uncertainty introduced into the trend in total national emissions</i>
		<i>kt CO₂ eq.</i>	<i>kt CO₂ eq.</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>
5.C Incineration and Open Burning of Waste	CO ₂	2.7	2.2	10%	33%	34%	0.000	0.000	0.000	0.000	0.000	0.000
5.C Incineration and Open Burning of Waste	CH ₄	0.0	0.0	10%	60%	61%	0.000	0.000	0.000	0.000	0.000	0.000
5.C Incineration and Open Burning of Waste	N ₂ O	0.1	0.1	10%	60%	61%	0.000	0.000	0.000	0.000	0.000	0.000
5.D Wastewater Treatment and Discharge	CH ₄	162.0	33.2	54%	73%	91%	0.000	0.000	0.001	0.000	0.001	0.000
5.D Wastewater Treatment and Discharge	N ₂ O	22.9	6.5	20%	50%	54%	0.000	0.000	0.000	0.000	0.000	0.000
Indirect emissions (2. Industrial processes and product use)	Indirect CO ₂	34.3	36.8	30%	20%	36%	0.000	0.001	0.001	0.000	0.000	0.000
Total emission		43,560.6	10,423.6	Overall uncertainty (%)			33.5	Trend uncertainty (%)				6.1

Table 1b. Uncertainty evaluation excluding LULUCF

IPCC Source category	Gas	Base year (1990) emissions	Emissions in 2024	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in 2019	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor	Uncertainty in trend in national emissions introduced by	Uncertainty introduced into the trend in total national emissions
		kt CO ₂ eq.	kt CO ₂ eq.	%	%	%	%	%	%	%	%	%
1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CO ₂	7,540.2	1,401.2	2%	2%	3%	0.000	0.031	0.030	0.001	0.001	0.000
1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	CH ₄	7.7	0.9	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Liquid Fuels	N ₂ O	14.3	1.4	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CO ₂	174.0	1.6	2%	5%	5%	0.000	0.001	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Solid Fuels	CH ₄	0.1	0.0	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Solid Fuels	N ₂ O	0.7	0.0	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CO ₂	5,796.6	544.4	2%	2%	3%	0.000	0.035	0.011	0.001	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	CH ₄	2.9	0.3	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Gaseous Fuels	N ₂ O	2.8	0.3	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	CO ₂	0.0	230.2	2%	5%	5%	0.000	0.005	0.005	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	CH ₄	0.0	2.1	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Other Fossil Fuels	N ₂ O	0.0	2.6	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000

IPCC Source category	Gas	Base year (1990) emissions	Emissions in 2024	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in 2019	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor	Uncertainty in trend in national emissions introduced by	Uncertainty introduced into the trend in total national emissions
		kt CO ₂ eq.	kt CO ₂ eq.	%	%	%	%	%	%	%	%	%
1.A.1 Fuel combustion - Energy Industries - Peat	CO ₂	11.1	8.7	2%	5%	5%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Peat	CH ₄	0.0	0.0	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Peat	N ₂ O	0.0	0.0	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Biomass	CO ₂	0.0	0.0	5%	15%	16%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Biomass	CH ₄	0.4	29.0	5%	150%	150%	0.000	0.001	0.001	0.001	0.000	0.000
1.A.1 Fuel combustion - Energy Industries - Biomass	N ₂ O	0.6	36.6	5%	150%	150%	0.000	0.001	0.001	0.001	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CO ₂	3,873.7	144.9	2%	2%	3%	0.000	0.028	0.003	0.001	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	CH ₄	5.0	0.2	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Liquid Fuels	N ₂ O	42.5	5.8	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CO ₂	171.6	265.2	2%	5%	5%	0.000	0.004	0.006	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	CH ₄	0.5	0.8	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Solid Fuels	N ₂ O	0.7	1.1	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000

IPCC Source category	Gas	Base year (1990) emissions	Emissions in 2024	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in 2019	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor	Uncertainty in trend in national emissions introduced by	Uncertainty introduced into the trend in total national emissions
		kt CO ₂ eq.	kt CO ₂ eq.	%	%	%	%	%	%	%	%	%
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CO ₂	2,042.9	605.9	2%	2%	3%	0.000	0.004	0.013	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	CH ₄	1.0	0.3	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Gaseous Fuels	N ₂ O	1.0	0.3	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction -Other fossil fuels	CO ₂	0.0	85.3	2%	2%	3%	0.000	0.002	0.002	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction -Other fossil fuels	CH ₄	0.0	0.8	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction -Other fossil fuels	N ₂ O	0.0	1.1	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	CO ₂	17.5	0.0	2%	5%	5%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	CH ₄	0.0	0.0	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Peat	N ₂ O	0.0	0.0	2%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Biomass	CO ₂	0.0	0.0	5%	15%	16%	0.000	0.000	0.000	0.000	0.000	0.000

IPCC Source category	Gas	Base year (1990) emissions	Emissions in 2024	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in 2019	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor	Uncertainty in trend in national emissions introduced by activity data	Uncertainty introduced into the trend in total national emissions
		kt CO ₂ eq.	kt CO ₂ eq.	%	%	%	%	%	%	%	%	%
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Biomass	CH ₄	0.4	5.3	5%	150%	150%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.2 Fuel combustion - Manufacturing Industries and Construction - Biomass	N ₂ O	0.5	6.7	5%	150%	150%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.a Domestic Aviation	CO ₂	8.2	1.5	10%	2%	10%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.a Domestic Aviation	CH ₄	0.0	0.0	10%	79%	79%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.a Domestic Aviation	N ₂ O	0.1	0.0	10%	110%	110%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.b Road Transportation	CO ₂	5,247.2	5,694.2	2%	2%	3%	0.000	0.077	0.120	0.002	0.003	0.000
1.A.3.b Road Transportation	CH ₄	44.2	7.7	2%	40%	40%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.b Road Transportation	N ₂ O	44.3	61.3	2%	50%	50%	0.000	0.001	0.001	0.000	0.000	0.000
1.A.3.c Railways	CO ₂	350.0	82.3	5%	2%	5%	0.000	0.001	0.002	0.000	0.000	0.000
1.A.3.c Railways	CH ₄	0.6	0.1	5%	75%	75%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.c Railways	N ₂ O	36.4	8.5	5%	75%	75%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.d Domestic Navigation - Liquid Fuels	CO ₂	15.5	7.5	5%	3%	6%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.d Domestic Navigation - Liquid Fuels	CH ₄	0.0	0.0	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.d Domestic Navigation - Liquid Fuels	N ₂ O	0.1	0.1	5%	90%	90%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.e.i Other Transportation - Pipeline Transportation	CO ₂	64.3	42.5	5%	2%	5%	0.000	0.000	0.001	0.000	0.000	0.000
1.A.3.e.i Other Transportation - Pipeline Transportation	CH ₄	0.0	0.0	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.3.e.i Other Transportation - Pipeline Transportation	N ₂ O	0.0	1.9	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors - Liquid Fuels	CO ₂	2,736.4	928.0	3%	2%	4%	0.000	0.003	0.020	0.000	0.001	0.000
1.A.4 Other Sectors - Liquid Fuels	CH ₄	7.9	1.9	3%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors - Liquid Fuels	N ₂ O	141.7	68.2	3%	50%	50%	0.000	0.000	0.001	0.000	0.000	0.000
1.A.4 Other Sectors - Solid Fuels	CO ₂	2,760.5	86.8	3%	5%	6%	0.000	0.021	0.002	0.001	0.000	0.000

IPCC Source category	Gas	Base year (1990) emissions	Emissions in 2024	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in 2019	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor	Uncertainty in trend in national emissions introduced by	Uncertainty introduced into the trend in total national emissions
		kt CO ₂ eq.	kt CO ₂ eq.	%	%	%	%	%	%	%	%	%
1.A.4 Other Sectors - Solid Fuels	CH ₄	144.0	6.1	3%	50%	50%	0.000	0.001	0.000	0.001	0.000	0.000
1.A.4 Other Sectors - Solid Fuels	N ₂ O	11.6	0.4	3%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors - Gaseous Fuels	CO ₂	1,379.3	682.6	3%	2%	4%	0.000	0.003	0.014	0.000	0.001	0.000
1.A.4 Other Sectors - Gaseous Fuels	CH ₄	3.5	1.7	3%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors - Gaseous Fuels	N ₂ O	0.7	0.3	3%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors - Peat	CO ₂	27.1	33.4	3%	5%	6%	0.000	0.000	0.001	0.000	0.000	0.000
1.A.4 Other Sectors - Peat	CH ₄	1.3	1.6	3%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors - Peat	N ₂ O	0.1	0.1	3%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors- Biomass	CO ₂	0.0	0.0	10%	15%	18%	0.000	0.000	0.000	0.000	0.000	0.000
1.A.4 Other Sectors- Biomass	CH ₄	78.7	93.1	10%	150%	150%	0.000	0.001	0.002	0.002	0.000	0.000
1.A.4 Other Sectors- Biomass	N ₂ O	11.5	22.5	10%	150%	150%	0.000	0.000	0.000	0.001	0.000	0.000
1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	CO ₂	23.3	199.9	5%	50%	50%	0.000	0.004	0.004	0.002	0.000	0.000
1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	CH ₄	4.8	2.5	5%	75%	75%	0.000	0.000	0.000	0.000	0.000	0.000
1.B.2.a Fugitive Emissions from Fuels - Oil and Natural Gas - Oil	N ₂ O	0.0	0.0	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CO ₂	0.0	0.0	5%	10%	11%	0.000	0.000	0.000	0.000	0.000	0.000
1.B.2.b Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas	CH ₄	291.8	86.1	5%	10%	11%	0.000	0.001	0.002	0.000	0.000	0.000
1.B.2.c Fugitive Emissions from Fuels - Venting and flaring	CO ₂	0.6	0.9	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
1.B.2.c Fugitive Emissions from Fuels - Venting and flaring	CH ₄	0.3	0.5	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000

IPCC Source category	Gas	Base year (1990) emissions	Emissions in 2024	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in 2019	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor	Uncertainty in trend in national emissions introduced by activity data	Uncertainty introduced into the trend in total national emissions
		kt CO ₂ eq.	kt CO ₂ eq.	%	%	%	%	%	%	%	%	%
1.B.2.c Fugitive Emissions from Fuels - Venting and flaring	N ₂ O	0.0	0.0	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
2.A.1 Cement Production	CO ₂	1,668.1	575.7	2%	5%	5%	0.000	0.001	0.012	0.000	0.000	0.000
2.A.2 Lime Production	CO ₂	210.3	1.8	5%	5%	7%	0.000	0.002	0.000	0.000	0.000	0.000
2.A.3 Glass Production	CO ₂	11.7	7.0	7%	5%	9%	0.000	0.000	0.000	0.000	0.000	0.000
2.A.4.a Ceramics	CO ₂	227.9	0.0	5%	5%	7%	0.000	0.002	0.000	0.000	0.000	0.000
2.A.4.b Other use of soda ash	CO ₂	5.2	0.6	15%	5%	16%	0.000	0.000	0.000	0.000	0.000	0.000
2.A.4.d Mineral wool production	CO ₂	6.4	9.4	7%	5%	9%	0.000	0.000	0.000	0.000	0.000	0.000
2.B.1 Ammonia Production	CO ₂	1,236.6	1,088.7	2%	2%	3%	0.000	0.013	0.023	0.000	0.001	0.000
2.B.2 Nitric Acid Production	N ₂ O	794.1	144.8	2%	10%	10%	0.000	0.003	0.003	0.000	0.000	0.000
2.B.8.a Methanol	CO ₂	24.4	0.0	5%	30%	30%	0.000	0.000	0.000	0.000	0.000	0.000
2.B.8.a Methanol	CH ₄	5.9	0.0	5%	30%	30%	0.000	0.000	0.000	0.000	0.000	0.000
2.C.1 Iron and Steel Production	CO ₂	17.0	0.0	10%	10%	14%	0.000	0.000	0.000	0.000	0.000	0.000
2.D.1 Lubricant use	CO ₂	0.0	15.5	5%	50%	50%	0.000	0.000	0.000	0.000	0.000	0.000
2.D.2 Parafin wax use	CO ₂	6.9	1.1	5%	100%	100%	0.000	0.000	0.000	0.000	0.000	0.000
2.D.3 Urea-based catalyst	CO ₂	0.0	3.3	10%	2%	10%	0.000	0.000	0.000	0.000	0.000	0.000
2.E.1 Semiconductor	SF ₆	0.0	3.0	5%	5%	7%	0.000	0.000	0.000	0.000	0.000	0.000
2.E.3 Photovoltaics	NF ₃	0.0	0.0	5%	20%	21%	0.000	0.000	0.000	0.000	0.000	0.000
2.F.1.a Commercial Refrigeration	HFCs	0.0	147.3	20%	50%	54%	0.000	0.003	0.003	0.002	0.001	0.000
2.F.1.b Domestic Refrigeration	HFCs	0.0	2.3	20%	50%	54%	0.000	0.000	0.000	0.000	0.000	0.000
2.F.1.c. Industrial Refrigeration	HFCs	0.0	42.0	20%	50%	54%	0.000	0.001	0.001	0.000	0.000	0.000
2.F.1.d. Transport Refrigeration	HFCs	0.0	76.3	20%	50%	54%	0.000	0.002	0.002	0.001	0.000	0.000
2.F.1.e. Mobile air-conditioning	HFCs	0.0	152.7	20%	50%	54%	0.000	0.003	0.003	0.002	0.001	0.000
2.F.1.f. Stationary Air Conditioning	HFCs	0.0	34.1	20%	50%	54%	0.000	0.001	0.001	0.000	0.000	0.000
2.F.2 Foam Blowing Agents	HFCs	0.0	14.9	30%	30%	42%	0.000	0.000	0.000	0.000	0.000	0.000
2.F.3 Fire Protection	HFCs	0.0	4.0	20%	20%	28%	0.000	0.000	0.000	0.000	0.000	0.000

IPCC Source category	Gas	Base year (1990) emissions	Emissions in 2024	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in 2019	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor	Uncertainty in trend in national emissions introduced by	Uncertainty introduced into the trend in total national emissions
		kt CO ₂ eq.	kt CO ₂ eq.	%	%	%	%	%	%	%	%	%
2.F.4 Aerosols/metered dose inhalers	HFCs	0.0	8.3	5%	5%	7%	0.000	0.000	0.000	0.000	0.000	0.000
2.G.1 Manufacture of electrical equipments	SF ₆	0.0	0.4	5%	5%	7%	0.000	0.000	0.000	0.000	0.000	0.000
2.G.2.b Accelerators	SF ₆	0.0	0.1	5%	5%	7%	0.000	0.000	0.000	0.000	0.000	0.000
2.G.3.a Medical applications	N ₂ O	83.0	1.7	5%	5%	7%	0.000	0.001	0.000	0.000	0.000	0.000
2.G.3.b Propellant for pressure and aerosol products	N ₂ O	2.4	1.9	20%	100%	102%	0.000	0.000	0.000	0.000	0.000	0.000
3.A Enteric Fermentation	CH ₄	4,879.6	1,718.8	4%	25%	26%	0.001	0.003	0.036	0.001	0.002	0.000
3.B Manure Management	CH ₄	750.4	246.1	14%	11%	18%	0.000	0.001	0.005	0.000	0.001	0.000
3.B Manure Management	N ₂ O	497.9	140.5	27%	203%	204%	0.000	0.001	0.003	0.002	0.001	0.000
3.D.1 Direct N ₂ O Emissions From Managed Soils	N ₂ O	2,070.1	1,299.3	11%	69%	70%	0.002	0.011	0.027	0.007	0.004	0.000
3.D.2 Indirect N ₂ O Emissions From Managed Soils	N ₂ O	396.7	210.6	37%	135%	140%	0.000	0.001	0.004	0.002	0.002	0.000
3.G Liming	CO ₂	20.6	61.8	10%	50%	51%	0.000	0.001	0.001	0.001	0.000	0.000
3.H Urea Application	CO ₂	59.6	21.7	10%	50%	51%	0.000	0.000	0.000	0.000	0.000	0.000
5.A Solid Waste Disposal	CH ₄	1,152.3	538.3	10%	125%	125%	0.001	0.002	0.011	0.003	0.002	0.000
5.B Biological Treatment of Solid Waste	CH ₄	0.2	71.9	10%	100%	100%	0.000	0.002	0.002	0.002	0.000	0.000
5.B Biological Treatment of Solid Waste	N ₂ O	0.1	28.6	10%	100%	100%	0.000	0.001	0.001	0.001	0.000	0.000
5.C Incineration and Open Burning of Waste	CO ₂	2.7	2.2	10%	33%	34%	0.000	0.000	0.000	0.000	0.000	0.000
5.C Incineration and Open Burning of Waste	CH ₄	0.0	0.0	10%	60%	61%	0.000	0.000	0.000	0.000	0.000	0.000
5.C Incineration and Open Burning of Waste	N ₂ O	0.1	0.1	10%	60%	61%	0.000	0.000	0.000	0.000	0.000	0.000
5.D Wastewater Treatment and Discharge	CH ₄	162.0	33.2	54%	73%	91%	0.000	0.001	0.001	0.000	0.001	0.000

<i>IPCC Source category</i>	<i>Gas</i>	<i>Base year (1990) emissions</i>	<i>Emissions in 2024</i>	<i>Activity data uncertainty</i>	<i>Emission factor uncertainty</i>	<i>Combined uncertainty</i>	<i>Combined uncertainty as % of total national emissions in 2019</i>	<i>Type A sensitivity</i>	<i>Type B sensitivity</i>	<i>Uncertainty in trend in national emissions introduced by emission factor</i>	<i>Uncertainty in trend in national emissions introduced by...</i>	<i>Uncertainty introduced into the trend in total national emissions</i>
		<i>kt CO₂ eq.</i>	<i>kt CO₂ eq.</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>
5.D Wastewater Treatment and Discharge	N ₂ O	22.9	6.5	20%	50%	54%	0.000	0.000	0.000	0.000	0.000	0.000
Indirect emissions (2. Industrial processes and product use)	Indirect CO ₂	34.3	36.8	30%	20%	36%	0.000	0.000	0.001	0.000	0.000	0.000
Total emission		47,494.1	18,260.1	Overall uncertainty (%)			7.2	Trend uncertainty (%)				1.2

ANNEX III. Lithuanian energy balance

Table 3-1. Balance of crude oil, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production		502	5358	13491	9217	4909	3065	1313	1165	967	484	789
Liquid biofuels for blending												
Import		396707	131189	199709	380035	385276	356108	331780	338910	347889	383804	378083
Export			335	13254	6312	4736	2067	1556	1131	965	1387	
International marine bunkers												
Changes in stocks		2093	-4730	-1169	9169	-1081	-1194	567	-2332	1533	5464	-1187
Gross consumption		399302	131482	198777	392109	384368	355912	332104	336612	349424	388365	377685
Statistical difference			-42									
Transformed in power, heat and other plants:		399302	131440	198777	392101	384357	355912	332104	336612	349424	388365	377685
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants	1.A.1.a iii	84	167	99								
- in geothermal plants												
- in other industries		399218	131273	198678	392101	384357	355912	332104	336612	349424	388365	377685
Consumed in energy sector:					3							
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries	1.A.1.b				3							
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses*					5	11						
Final consumption:												
- in industry												
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-2. Balance of motor gasoline, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production		87988	37709	68838	112699	123626	107664	95230	106842	107706	127730	123991
Liquid biofuels for blending					26	445	600	931	844	797	764	1085
Import		220	14328	736	1115	2616	2881	2125	4375	1811	2106	1625
Export		42104	23601	50765	95698	114237	101063	87753	101157	97886	115504	112344
International marine bunkers												
Changes in stocks		-2725	-1758	-2012	-3193	506	-1256	96	-226	-572	-1975	-268
Gross consumption		43379	26678	16797	14949	12956	8826	10629	10678	11856	13121	14089
Statistical difference												
Transformed in power, heat and other plants:												
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:				15	5		2	1				
- in peat extraction enterprises	1.A.1.c.i				1		1	1				
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises	1.A.1.c.iii			15	4		1					
Non energy use												
Distribution and transmission losses*		308	176	68	61	22	5	4	2	4	3	2
Final consumption:		43071	26502	16714	14883	12934	8819	10624	10676	11852	13118	14087
- in industry	1.A.2.g.vii	44	88	48	31	15	8	13	8	14	14	14
- in construction	1.A.2.g.vii	439	176	101	69	28	16	14	17	16	15	13
- in transport*****	1.A.3	41840	25887	16337	14711	12841	8761	10581	10629	11805	13064	14044
- in agriculture	1.A.4.c.ii	440	307	170	53	43	28	12	18	14	22	14
- in fishing												
- in commercial / public services	1.A.4.a.ii	308	44	58	19	7	6	4	4	3	3	2
- in households												

Table 3-3. Balance of aviation gasoline, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production												
Liquid biofuels for blending												
Import				14	20	18	19	18	18	17	22	9
Export												
International marine bunkers												
Changes in stocks												
Gross consumption				14	20	18	19	18	18	17	22	9
Statistical difference												
Transformed in power, heat and other plants:												
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses												
Final consumption:				14	20	18	19	18	18	17	22	9
- in industry												
- in construction												
- in transport	1.A.3			14	20	18	19	18	18	17	22	9
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-4. Balance of gasoline type jet fuel, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production												
Liquid biofuels for blending												
Import				65	3							
Export												
International marine bunkers												
Changes in stocks				-65								
Gross consumption					3							
Statistical difference												
Transformed in power, heat and other plants:												
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses												
Final consumption:					3							
- in industry												
- in construction												
- in transport	1.A.3				3							
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-5. Balance of kerosene type jet fuel, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production		28125	9088	18566	24705	10352	7780	6732	9304	7689	9568	9766
Liquid biofuels for blending												
Import		387	948	846		837	2244		5	141		
Export		22956	8442	16673	21406	9062	6113	4455	5959	3310	4515	4701
International marine bunkers												
Changes in stocks		86	129	-1651	-1185	115	10	386	-371	152	-21	158
Gross consumption		5642	1723	1088	2114	2242	3921	2663	2979	4672	5032	5223
Statistical difference												
Transformed in power, heat and other plants:												
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses*					14	5						
Final consumption:		5642	1723	1088	2100	2237	3921	2663	2979	4672	5032	5223
- in industry												
- in construction												
- in transport	1.A.3	5642	1723	1088	2100	2237	3921	2663	2979	4672	5032	5223
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-6. Balance of transport diesel, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production		107712	42490	56232	127985	150168	156249	135526	126772	137435	153053	146751
Liquid biofuels for blending					119	1478	2393	3777	4122	3626	3430	4336
Import		8923	9475	1670	2840	7882	68750	23206	26570	30109	19262	13002
Export		49416	27364	28516	92877	116251	169375	85924	83679	99680	103851	88408
International marine bunkers				942								
Changes in stocks		-1997	1573	-4819	-2586	31	-768	-3894	-243	141	-24	390
Gross consumption		65222	26174	23625	35481	43308	57249	72691	73542	71631	71327	76071
Statistical difference			213	853								
Transformed in power, heat and other plants:		7521	1742	36								
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants	1.A.1.a iii	7521	1615	28								
- in autoproducer heat plants	1.A.1.a iii		127	8								
- in geothermal plants												
- in other industries												
Consumed in energy sector:		128	43	136	194	144	174	177	140	95	107	111
- in peat extraction enterprises	1.A.1.c.i	128	43	60	125	109	153	172	136	91	103	106
- in crude oil extraction enterprises	1.A.1.c.ii			22	49	23	13					
- in refineries	1.A.1.b			5			2					1
- in electricity, gas, steam and air conditioning enterprises	1.A.1.c.ii			49	20	12	6	5	4	4	4	4
Non energy use	1.AD			6								
Distribution and transmission losses*		297	128	55	122	73	22	13	9	12	10	11
Final consumption:		57276	24474	24245	35165	43091	57053	72501	73393	71524	71753	75949
- in industry	1.A.2.g.vii	2124	1827	510	499	190	248	309	305	323	369	502
- in construction	1.A.2.g.vii	2507	935	613	589	382	320	266	217	212	224	250
- in transport*****	1.A.3	34289	14489	21476	32515	41030	55021	70436	71274	69452	69751	66247
- in agriculture	1.A.4.c.ii	14277	4207	1327	1362	1444	1438	1437	1530	1485	1350	8848
- in fishing	1.A.4.c.iii				14	5	6	7	8	6	5	5
- in commercial / public services	1.A.4.a.ii	2889	2804	319	186	40	20	46	59	46	54	97
- in households	1.A.4.b.ii	1190	212									

Table 3-7. Balance of heating and other gasoil, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production					2125	1130	4777	6740	8357	8141	6545	6146
Liquid biofuels for blending						2	73	99	179	78	72	74
Import			717		915	854	701	848	1214	731	261	111
Export					985		206	35	523	703	790	774
International marine bunkers					770	756	1738	3206	4480	3200	1935	1637
Changes in stocks			-717	65	-225	-7	-61	92	51	-240	76	-8
Gross consumption				65	1060	1223	3546	4538	4798	4807	4229	3912
Statistical difference												
Transformed in power, heat and other plants:				22	102	55	38	26	107	344	274	141
- in public CHP plants	1.A.1.a ii					1				15		3
- in autoproducer CHP plants								2		16		
- in public heat plants	1.A.1.a iii			22	64	52	37	24	107	275	264	138
- in autoproducer heat plants	1.A.1.a iii				38	2	1			38	10	
- in geothermal plants												
- in other industries												
Consumed in energy sector:						5	4					
- in peat extraction enterprises	1.A.1.c.i					5	4					
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises	1.A.1.c.ii											
Non energy use												
Distribution and transmission losses												
Final consumption:				43	958	1163	3504	4512	4691	4463	3955	3771
- in industry	1.A.2			7	405	220	228	328	378	483	433	399
- in construction	1.A.2.g.v			7	25	47	67	64	75	216	149	123
- in transport*****	1.A.3				226	235	2413	2475	2438	1352	1350	1300
- in agriculture	1.A.4.c.i			23	137	230	264	672	671	1085	739	774
- in fishing	1.A.4.c.i				59	73	76	21	26	23	18	9
- in commercial / public services	1.A.4.a			6	55	69	48	29	33	35	37	22
- in households	1.A.4.b				51	289	408	923	1070	1269	1229	1144

Table 3-8. Balance of liquefied petroleum gases (LPG), TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production		12006	7636	11026	21046	12720	12155	13767	13422	10617	12877	13354
Liquid biofuels for blending												
Import		2208	1056	3972	3110	5024	4882	2387	2553	5979	6557	5705
Export		7038	4646	5793	11596	8114	9662	10111	10268	9915	12587	12135
International marine bunkers												
Changes in stocks		46	230	-420	163	-111	31	-8	31	-585	568	-55
Gross consumption		7222	4276	8785	12723	9519	7406	6035	5738	6096	7415	6869
Statistical difference												
Transformed in power, heat and other plants:		46		51	90	90	81	83	100	92	108	50
- in public CHP plants	1.A.1.a ii					3						
- in autoproducer CHP plants												
- in public heat plants	1.A.1.a iii			21	19	18	36	43	45	78	91	47
- in autoproducer heat plants	1.A.1.a iii	46		31	71	69	45	40	55	14	17	3
- in geothermal plants												
- in other industries												
Consumed in energy sector:		552	138	36	4							
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries	1.A.1.b	552	138	22								
- in electricity, gas, steam and air conditioning enterprises	1.A.1.c.ii			14	4							
Non energy use												
Distribution and transmission losses*		322	92	103	47	26	14	24	21	30	19	17
Final consumption:		6302	4046	8595	12580	9403	7311	5928	5617	5974	7288	6802
- in industry	1.A.2			201	229	273	326	281	335	529	841	650
- in construction	1.A.2.g.v	92	46	74	77	122	38	72	58	62	80	82
- in transport	1.A.3	920	1058	5032	9593	7275	5573	4058	3867	3872	3944	4097
- in agriculture	1.A.4.c.i	230	46	19	38	41	54	150	202	196	194	136
- in fishing												
- in commercial / public services	1.A.4.a	460	92	62	23	6	20	30	35	18	36	17
- in households	1.A.4.b	4600	2804	3207	2620	1686	1300	1337	1120	1297	2193	1820

Table 3-9. Balance of residual fuel oil (RFO) – high sulphur (>1%), TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production		133867	33356	39422	71994	65373	60871	44554	45303	43460	36393	38111
Liquid biofuels for blending												
Import		293464	47887	4110	5056	7883	1377	2707	2795	3272	3190	1654
Export		277769	8148	16608	56627	60139	57774	41314	42681	41872	34684	38447
International marine bunkers		3894	5780	2857	4712	2801	1255	2700	2697	2779	2673	
Changes in stocks		-8951	-11159	-4689	-1824	-3450	926	-1074	-1446	882	-439	714
Gross consumption		136717	56156	19378	13887	6866	4145	2173	1274	2963	1787	2032
Statistical difference			40	5592								
Transformed in power, heat and other plants:		70406	39377	14650	5536	4648	1634	516	1249	1100	428	311
- in public CHP plants	1.A.1.a ii	44195	20511	7233	3837	4157	493					
- in autoproducer CHP plants	1.A.1.a ii	642	201	27			1115	495	185	1100	410	283
- in public heat plants	1.A.1.a iii	20190	16618	6813	1659	491	26	21	18		18	28
- in autoproducer heat plants	1.A.1.a iii	5379	2047	577	40							
- in geothermal plants												
- in other industries												
Consumed in energy sector:		8068	3693	4899	6716	2005	2444	1630	1046	1847	1352	1706
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries	1.A.1.b	8068	3693	4899	6716	2005	2444	1628	1046	1847	1352	1706
- in electricity, gas, steam and air conditioning enterprises								2				
Non energy use												
Distribution and transmission losses*		361			38							
Final consumption:		57882	13126	5421	1597	213	67	27	25	16	7	15
- in industry	1.A.2	43993	11520	5202	1486	148	67	27	25	16	7	15
- in construction	1.A.2.g.v	1044	201	11	17							
- in transport	1.A.3			3	4							
- in agriculture	1.A.4.c.i	1084	201	114	80	41						
- in fishing												
- in commercial / public services	1.A.4.a	11641	1204	91	10	24						
- in households	1.A.4.b	120										

Table 3-10. Balance of residual fuel oil (RFO) – low sulphur (<1%), TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production						4306	267	217	255	249	79	-2
Liquid biofuels for blending												
Import				1407	1191	2779	516	1728	715	1709	1783	
Export					23	40	10	27	59	89	50	1
International marine bunkers				29	451	2224	203	1738	709	440	400	
Changes in stocks				56	-60	-308	196	250	420	-202	283	76
Gross consumption				1434	657	4513	766	430	622	1227	1695	73
Statistical difference												
Transformed in power, heat and other plants:				755	328	1232	436	159	426	1213	1685	73
- in public CHP plants	1.A.1.a ii					18	348	136	212	989	1598	
- in autoproducer CHP plants	1.A.1.a ii					1017						
- in public heat plants	1.A.1.a iii			713	318	197	87	23	214	224	87	73
- in autoproducer heat plants	1.A.1.a iii			42	10		1					
- in geothermal plants												
- in other industries												
Consumed in energy sector:						3042						
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries	1.A.1.b					3042						
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses									12			
Final consumption:				679	329	239	330	271	184	14	10	
- in industry	1.A.2			363	220	147	275	253	174	14	10	
- in construction	1.A.2.g.v			47	93	75	35	8	6			
- in transport												
- in agriculture	1.A.4.c.i			15	2	5	17	10	4			
- in fishing	1.A.4.c.i				9							
- in commercial / public services	1.A.4.a			254	5	12	3					
- in households												

Table 3-11. Balance of refinery gas, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production		11032	5318	8253	15250	14127	14007	11148	12763	13979	17008	15804
Liquid biofuels for blending												
Import												
Export												
International marine bunkers												
Changes in stocks												
Gross consumption		11032	5318	8253	15250	14127	14007	11148	12763	13979	17008	15804
Statistical difference												
Transformed in power, heat and other plants:						109	175	228	364	1041	869	524
- in public CHP plants												
- in autoproducer CHP plants	1.A.1.a ii						175	228	364	1041	869	524
- in public heat plants												
- in autoproducer heat plants	1.A.1.a iii					109						
- in geothermal plants												
- in other industries												
Consumed in energy sector:		11032	5318	8253	15250	14018	13832	10920	12399	12938	16139	15280
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries	1.A.1.b	11032	5318	8253	15250	14018	13832	10920	12399	12938	16139	15280
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses												
Final consumption:												
- in industry												
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-12. Balance of bitumen, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production		9534	1108	3117	6804	4938	5449	14289	11618	11843	19034	18288
Liquid biofuels for blending												
Import		40	791	474	1150	1814	1812	3658	2442	1888	1403	1466
Export		1662	356	839	2587	2896	3506	11449	8236	10102	14567	13435
International marine bunkers												
Changes in stocks		40	39	71	28	-165	-143	-112	-153	165	55	-35
Gross consumption		7952	1582	2823	5395	3691	3612	6386	5671	3794	5925	6284
Statistical difference												
Transformed in power, heat and other plants:												
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use	1.AD	7952	1582	2823	5395	3691	3612	6386	5671	3794	5925	6284
Distribution and transmission losses												
Final consumption:												
- in industry												
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-13. Balance of lubricants, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production				1226	847	1504	1931	3506	4246	4150	4176	4148
Liquid biofuels for blending												
Import		413	620	602	1121	1709	1655	1489	1616	2177	1951	1583
Export				924	843	2350	2781	4053	4884	5548	5162	4950
International marine bunkers												
Changes in stocks				129	-14	-17	3	4	53	-88	-167	273
Gross consumption		413	620	1033	1111	846	808	946	1031	691	798	1054
Statistical difference				-84								
Transformed in power, heat and other plants:												
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use	1.AD	413	620	949	1111	846	808	946	1031	691	798	1054
Distribution and transmission losses												
Final consumption:												
- in industry												
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-14. Balance of petroleum coke, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production		1962	1393	2740	3940	3856	3745	3340	3626	3423	3750	3556
Liquid biofuels for blending												
Import					1100	9						
Export												
International marine bunkers												
Changes in stocks					-1054	102						
Gross consumption		1962	1393	2740	3986	3967	3745	3340	3626	3423	3750	3556
Statistical difference												
Transformed in power, heat and other plants:												
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:		1962	1393	2740	3940	3856	3745	3340	3626	3423	3750	3556
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries	1.A.1.b	1962	1393	2740	3940	3856	3745	3340	3626	3423	3750	3556
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses												
Final consumption:					46	111						
- in industry	1.A.2				46	111						
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-15. Balance of refinery feedstock, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production			8513	418	1827		640	1374				
Liquid biofuels for blending												
Import		1304	17209	13934	3568	12171	24815	7923	9439	9712	5724	5459
Export							33			57	25	3
International marine bunkers												
Changes in stocks		-1220	-8470	213	-1121	614	-1420	-1592	762	-947	454	1576
Gross consumption		84	17252	14565	4274	12785	24002	7705	9340	9450	5806	5603
Statistical difference			-43									
Transformed in power, heat and other plants:		84	17209	14565	4274	12785	24002	7705	9340	9450	5806	5603
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries		84	17209	14565	4274	12785	24002	7705	9340	9450	5806	5603
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses												
Final consumption:												
- in industry												
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-16. Balance of naphtha, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production					3477				31	5110	644	286
Liquid biofuels for blending												
Import												
Export					3257				31	5099	655	300
International marine bunkers												
Changes in stocks					-220					-11	11	14
Gross consumption												
Statistical difference												
Transformed in power, heat and other plants:												
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses												
Final consumption:												
- in industry												
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-17. Balance of orimulsion, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production												
Liquid biofuels for blending												
Import			729	1383	1681							
Export												
International marine bunkers												
Changes in stocks				-734	700							
Gross consumption			729	649	2381							
Statistical difference												
Transformed in power, heat and other plants:			729	649	2381							
- in public CHP plants	1.A.1.a ii		729	649	2381							
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses												
Final consumption:												
- in industry												
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-18. Balance of shale oil, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production												
Liquid biofuels for blending												
Import					73	19						
Export						18						
International marine bunkers												
Changes in stocks					-7	31						
Gross consumption					66	32						
Statistical difference												
Transformed in power, heat and other plants:					9	10						
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants	1.A.1.a iii				9	1						
- in autoproducer heat plants	1.A.1.a iii					9						
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses												
Final consumption:					57	22						
- in industry	1.A.2				13							
- in construction												
- in transport												
- in agriculture	1.A.4.c.i				23	4						
- in fishing												
- in commercial / public services	1.A.4.a				21	18						
- in households												

Table 3-19. Balance of other bituminous coal, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production												
Liquid biofuels for blending												
Import		31752	6506	176	53	4343	5701	4420	5653	7400	2902	3265
Export			50			438						
International marine bunkers												
Changes in stocks		980	2889			-275	640	674	545	-1799	434	-101
Gross consumption		32732	9345	176	53	3630	6341	5094	6198	5601	3336	3164
Statistical difference												
Transformed in power, heat and other plants:		1834	452	25	53	55	88	56	61	54	36	17
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants	1.A.1.a iii	904	126	25	53	32	88	56	61	54	36	17
- in autoproducer heat plants	1.A.1.a iii	930	326			23						
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use	1.AD		25									
Distribution and transmission losses			25				10					
Final consumption:		30898	8843	151		3575	6243	5038	6137	5547	3300	3147
- in industry	1.A.2	1583	703	137		2860	3602	3169	3859	4011	2608	2269
- in construction	1.A.2.g.v	226	25	14			6	3	3	2		
- in transport												
- in agriculture	1.A.4.c.i	1557	50			3	86	48	35	72	15	24
- in fishing												
- in commercial / public services	1.A.4.a	12359	6632			406	1089	786	973	358	101	163
- in households	1.A.4.b	15173	1433			305	1460	1032	1267	1104	576	691

Table 3-20. Balance of anthracite, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production												
Liquid biofuels for blending												
Import				100		90						
Export						1						
International marine bunkers												
Changes in stocks						-74						
Gross consumption				100		15						
Statistical difference												
Transformed in power, heat and other plants:				100								
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants	1.A.1.a iii			100								
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses												
Final consumption:						15						
- in industry	1.A.2					5						
- in construction	1.A.2.g.v					2						
- in transport												
- in agriculture	1.A.4.c.i					3						
- in fishing												
- in commercial / public services	1.A.4.a					4						
- in households	1.A.4.b					1						

Table 3-21. Balance of sub-bituminous coal, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production												
Liquid biofuels for blending												
Import				2698	6618	3248				575	394	
Export					37	406						
International marine bunkers												
Changes in stocks				11	-168	672	1	4		-47	13	34
Gross consumption				2709	6413	3514	1	4		528	407	34
Statistical difference												
Transformed in power, heat and other plants:				154	207	100	1					
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants	1.A.1.a iii			85	147	66	1					
- in autoproducer heat plants	1.A.1.a iii			69	60	34						
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use				7	3							
Distribution and transmission losses				11	6	8						
Final consumption:				2537	6197	3406		4		528	407	34
- in industry	1.A.2			5	3059	207						
- in construction	1.A.2.g.v				18	2						
- in transport												
- in agriculture	1.A.4.c.i			14	36	8						
- in fishing												
- in commercial / public services	1.A.4.a			1867	2036	1417		4		528	407	34
- in households	1.A.4.b			651	1048	1772						

Table 3-22. Balance of coke, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production												
Liquid biofuels for blending												
Import				445	440	466	391	533	504	446	416	438
Export												
International marine bunkers												
Changes in stocks				-52	96	7	8	2	-1	12	-27	14
Gross consumption				393	536	473	399	535	503	458	389	452
Statistical difference												
Transformed in power, heat and other plants:												
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use	A.AD			47	2							
Distribution and transmission losses												
Final consumption:				346	534	473	399	535	503	458	389	452
- in industry	1.A.2			346	534	473	399	535	503	458	389	452
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-23. Balance of lignite, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production												
Liquid biofuels for blending												
Import				15	40	14				25	26	19
Export												
International marine bunkers												
Changes in stocks				1	2	-6	1					
Gross consumption				16	42	8	1			25	26	19
Statistical difference												
Transformed in power, heat and other plants:												
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use										25	26	19
Distribution and transmission losses												
Final consumption:				16	42	8	1					
- in industry												
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services	1.A.4.a			16	25							
- in households	1.A.4.b				17	8	1					

Table 3-24. Balance of peat, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production		580	600	494	825	364	872	207	197	141	204	53
Liquid biofuels for blending												
Import										5		
Export				76	1	104	94	12	21	14	8	3
International marine bunkers												
Changes in stocks		116	222	51	-235	94	-510	40	96	170	13	85
Gross consumption		696	822	469	589	354	268	235	272	302	209	135
Statistical difference												
Transformed in power, heat and other plants:		445	357	258	299	202	141	185	229	275	172	121
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants	1.A.1.a iii	67	96	80	128	102	67	139	179	118	76	83
- in autoproducer heat plants	1.A.1.a iii	39	10	14								
- in geothermal plants												
- in other industries		339	251	163	171	100	74	46	50	157	96	38
Consumed in energy sector:			126	36	11		3	1	3	1	2	
- in peat extraction enterprises	1.A.c.i			20	11		3	1	3	1	2	
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises	1.A.c.ii		126	15								
Non energy use												
Distribution and transmission losses**		9	10	5	7			2				
Final consumption:		242	329	170	272	152	124	47	40	26	35	14
- in industry	1.A.2	155	174	43	7	9	33					
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services	1.A.4.a	87	58		21	44	51	31	28	17	23	8
- in households	1.A.4.b		97	127	244	99	40	16	12	9	12	6

Table 3-25. Balance of peat briquettes and peat pellets, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production		239	186	138	147	84	63	39	43	135	80	34
Liquid biofuels for blending												
Import			119	2	143	696	604	513	681	768	480	265
Export							26	4	8	93	35	17
International marine bunkers												
Changes in stocks		-53	-13	-1	-35	-44	9	16	-27	5	-1	24
Gross consumption		186	292	139	255	736	650	564	689	815	524	306
Statistical difference												
Transformed in power, heat and other plants:					9	3		3	2	3		
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants	1.A.1.a iii				2	1		3	2	3		
- in autoproducer heat plants	1.A.1.a iii				7	2						
- in geothermal plants												
- in other industries												
Consumed in energy sector:				2					3	1	1	
- in peat extraction enterprises	1.A.c.i			2					3	1	1	
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses**												
Final consumption:		186	293	137	246	733	650	561	684	811	523	306
- in industry	1.A.2	13	53		8	27	16	4	3	1		
- in construction												
- in transport												
- in agriculture	1.A.4.c.i				3	16	13	7	12	19	8	4
- in fishing												
- in commercial / public services	1.A.4.a	27	53	1	28	193	173	136	170	235	206	132
- in households	1.A.4.b	146	186	136	207	497	448	414	499	556	309	170

Table 3-26. Balance of paraffin and waxes, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production												
Liquid biofuels for blending												
Import					176	520	1776	608	607	674	485	126
Export					106	384	1427	538	394	491	208	112
International marine bunkers												
Changes in stocks						3	-202	75	17	4	-61	62
Gross consumption					70	139	147	145	230	187	216	76
Statistical difference												
Transformed in power, heat and other plants:												
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use	1.AD				70	139	147	145	230	187	216	76
Distribution and transmission losses												
Final consumption:												
- in industry												
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-27. Balance of natural gas, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production												
Injected to the natural gas network											152	411
Import		201957	84929	86453	104363	104017	89642	99751	83854	123951	116239	94859
Export		6102					3335	18080	4651	69647	66105	38024
International marine bunkers												
Changes in stocks				-37	-671	304	255	884	-647	-652	2113	464
Gross consumption		195855	84929	86416	103692	104321	86562	82555	78556	53652	52399	57710
Statistical difference												
Transformed in power, heat and other plants:		105124	41480	47241	57134	58186	24104	16417	16209	7945	7866	9122
- in public CHP plants	1.A.1.a ii	62825	17664	29650	42536	45755	17354	11960	10694	4474	4197	5578
- in autoproducer CHP plants	1.A.1.a ii	1787	473	324	1160	1003	1970	2072	1572	986	1114	1019
- in public heat plants	1.A.1.a iii	34248	21952	16272	11414	10525	4357	2052	3631	2232	2286	2136
- in autoproducer heat plants	1.A.1.a iii	6265	1391	688	667	558	327	333	312	253	269	389
- in geothermal plants	1.A.1.a iii				819	345	96					
- in other industries	1.AD			307	538							
Consumed in energy sector:				140	130	65	1298	3823	2160	1167	770	665
- in peat extraction enterprises												
- in crude oil extraction enterprises	1.A.1.c.ii			3	3	3	2	1				
- in refineries	1.A.1.b			28	28	4	15	2869	1577	359	212	211
- in electricity, gas, steam and air conditioning enterprises	1.A.1.c.ii			109	99	58	1281	953	583	808	558	454
Non energy use	1.AD	26934	20167	22716	21335	20139	39432	37913	33059	20012	19792	23556
Distribution and transmission losses***		1688	1935	1119	420	5					3	32
Final consumption:		62109	21347	15200	24673	25926	21728	24402	27128	24528	23968	24335
- in industry	1.A.2	36065	8916	8285	14573	13670	11417	11439	11887	10507	9811	10261
- in construction	1.A.2.g.v	1030	219	266	513	501	477	712	725	665	639	638
- in transport	1.A.3				647	1028	1250	1198	1286	1226	1221	1164
- in agriculture	1.A.4.c.i	2946	1197	991	1192	1309	872	849	989	850	845	837
- in fishing												
- in commercial / public services	1.A.4.a	12831	3319	1302	2118	2793	2575	2904	3034	3009	3842	3832
- in households	1.A.4.b	9237	7696	4356	5630	6625	5137	7300	9207	8271	7610	7603

Table 3-28. Balance of charcoal, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production					18	24	26	15	8			
Liquid biofuels for blending												
Import					14	61	210	198	200	156	188	182
Export					15	38	163	98	86	40	40	57
International marine bunkers												
Changes in stocks					3	1	-7	-7	39	-5		10
Gross consumption					20	48	66	108	161	111	148	135
Statistical difference												
Transformed in power, heat and other plants:												
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses												
Final consumption:					20	48	66	108	161	111	148	135
- in industry												
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services	1.A.4.a				20	48	66	108	161	111	148	135
- in households												

Table 3-29. Balance of wood and wood waste, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production		11930	19632	27324	35293	41734	49852	51852	56892	52650	52081	56000
Liquid biofuels for blending												
Import			61	4	727	2008	5628	6214	6502	5227	5589	4509
Export				255	710	5102	5725	5751	5795	5321	5456	4534
International marine bunkers												
Changes in stocks		-14	-381	-54	-498	444	457	420	673	164	287	328
Gross consumption		11916	19312	27019	34812	39084	50212	52735	58272	52720	52501	56303
Statistical difference					457							
Transformed in power, heat and other plants:		527	558	1640	6273	10408	24371	26456	31739	27356	27753	28809
- in public CHP plants	1.A.1.a ii				191	2472	6365	7665	7881	7629	8047	11526
- in autoproducer CHP plants												
- in public heat plants	1.A.1.a iii	274	156	1060	4906	7121	16987	16041	21496	17340	18053	16289
- in autoproducer heat plants	1.A.1.a iii	253	402	580	1128	772	980	2750	2351	2387	1653	994
- in geothermal plants												
- in other industries					48	43	39	27	11			
Consumed in energy sector:				25	13	19	2					
- in peat extraction enterprises	1.A.1.c.i				13	4						
- in crude oil extraction enterprises												
- in refineries	1.A.1.b					1						
- in electricity, gas, steam and air conditioning enterprises	1.A.1.c.ii			25		14	2					
Non energy use												
Distribution and transmission losses				12	4							
Final consumption:		11389	18754	25342	28979	28657	25839	26252	26533	25364	24748	27494
- in industry	1.A.2	453	756	1218	4007	2920	3520	4944	5138	4921	5086	5331
- in construction	1.A.2.g.v	51	105	100	185	143	62	91	88	84	90	103
- in transport												
- in agriculture	1.A.4.c.i	187	211	272	253	399	383	674	724	714	699	739
- in fishing												
- in commercial / public services	1.A.4.a	1699	1104	1703	1278	1178	1332	1273	1230	1195	1243	1231
- in households	1.A.4.b	8999	16578	22049	23256	24017	20542	19270	19353	18450	17630	20090

Table 3-30. Balance of agricultural waste, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production					96	228	585	608	577	528	479	395
Liquid biofuels for blending												
Import							10	10		3	2	12
Export							386	423	417	323	276	186
International marine bunkers												
Changes in stocks					16	11	-31	2	23	15	-35	-19
Gross consumption					112	239	178	197	183	223	170	202
Statistical difference												
Transformed in power, heat and other plants:					64	144	68	66	64	88	52	70
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants	1.A.1.a iii				55	131	68	66	64	88	52	70
- in autoproducer heat plants	1.A.1.a iii				9	13						
- in geothermal plants												
- in other industries												
Consumed in energy sector:						3						
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises	1.A.1.c.ii					3						
Non energy use												
Distribution and transmission losses												
Final consumption:					48	92	110	131	119	135	118	132
- in industry	1.A.2				41	11	16	61	71	75	69	76
- in construction												
- in transport												
- in agriculture	1.A.4.c.i				2	56	73	47	25	31	29	33
- in fishing												
- in commercial / public services	1.A.4.a					18	20	23	23	29	20	23
- in households	1.A.4.b				5	7	1					

Table 3-31. Balance of bioethanol, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production					195	1060	470	854	597	475	379	525
Liquid biofuels for blending												
Import						106	269	257	438	458	619	748
Export					162	649	308	445	338	140	140	323
International marine bunkers												
Changes in stocks					-7	-3	11	-7	-5	32	-1	
Gross consumption					26	514	442	659	692	825	857	950
Statistical difference												
Transformed in power, heat and other plants:												
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use						78	37					
Distribution and transmission losses												
Final consumption:					26	436	405	659	692	825	857	950
- in industry												
- in construction												
- in transport	1.A.3				26	436	405	659	692	825	857	950
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-32. Balance of biodiesel, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production					260	3299	4353	6020	5772	5885	5861	5839
Liquid biofuels for blending												
Import						527	2035	3355	5101	5401	4715	5290
Export					168	2538	3865	5588	6379	7159	6626	5842
International marine bunkers												
Changes in stocks					27	166	-101	-137	122	61	139	-348
Gross consumption					119	1454	2422	3650	4616	4188	4089	4939
Statistical difference												
Transformed in power, heat and other plants:												
- in public CHP plants												
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses												
Final consumption:					119	1454	2422	3650	4616	4188	4089	4939
- in industry												
- in construction												
- in transport	1.A.3				119	1454	2422	3650	4616	4188	4089	4939
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-33. Balance of sludge biogas, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production					57	125	294	300	340	344	338	508
Liquid biofuels for blending												
Import												
Export												
International marine bunkers												
Changes in stocks												
Gross consumption					57	125	294	300	340	344	338	508
Statistical difference												
Transformed in power, heat and other plants:					36	55	106	116	106	113	111	203
- in public CHP plants	1.A.1.a ii				17	8	21					
- in autoproducer CHP plants	1.A.1.a ii				3	47	85	116	106	113	111	203
- in public heat plants	1.A.1.a iii				16							
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses												
Final consumption:					21	70	188	184	234	231	227	305
- in industry												
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services	1.A.4.a				21	70	188	184	234	231	227	305
- in households												

Table 3-34. Balance of landfill biogas, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production						83	343	274	231	230	137	143
Liquid biofuels for blending												
Import												
Export												
International marine bunkers												
Changes in stocks												
Gross consumption						83	343	274	231	230	137	143
Statistical difference												
Transformed in power, heat and other plants:						83	338	262	224	220	127	108
- in public CHP plants	1.A.1.a ii					35	266	180	148	140	116	100
- in autoproducer CHP plants	1.A.1.a ii					48	72	82	76	80	11	8
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses												
Final consumption:							5	12	7	10	10	35
- in industry	1.A.2						2	1				
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services	1.A.4.a						3	11	7	10	10	35
- in households												

Table 3-35. Balance of other biogas from agricultural waste, TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production					20	210	344	1043	1111	1176	1002	498
Liquid biofuels for blending												
Import												
Export												
International marine bunkers												
Changes in stocks												
Gross consumption					20	210	344	1043	1111	1176	1002	498
Statistical difference												
Transformed in power, heat and other plants:					7	91	225	858	924	960	811	460
- in public CHP plants	1.A.1.a ii							604	690	724	484	368
- in autoproducer CHP plants	1.A.1.a ii				7	91	225	254	234	236	327	92
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries											161	
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses												
Final consumption:					13	119	119	185	187	216	191	38
- in industry	1.A.2					104	119	185	187	216	191	38
- in construction												
- in transport												
- in agriculture	1.A.4.c.i				13	15						
- in fishing												
- in commercial / public services												
- in households												

Table 3-36. Balance of emulsified vacuum residue, TJ

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2020	2021	2022	2023	2024
Production						19		40							
Liquid biofuels for blending															
Import															
Export						19		40							
International marine bunkers															
Changes in stocks															
Gross consumption															
Statistical difference															
Transformed in power, heat and other plants:															
- in public CHP plants															
- in autoproducer CHP plants															
- in public heat plants															
- in autoproducer heat plants															
- in geothermal plants															
- in other industries															
Consumed in energy sector:															
- in peat extraction enterprises															
- in crude oil extraction enterprises															
- in refineries															
- in electricity, gas, steam and air conditioning enterprises															
Non energy use															
Distribution and transmission losses															
Final consumption:															
- in industry															
- in construction															
- in transport															
- in agriculture															
- in fishing															
- in commercial / public services															
- in households															

Table 3-37. Balance of industrial waste (non-biomass fraction), TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production							303	1010	1312	1279	1265	1348
Liquid biofuels for blending												
Import												
Export												
International marine bunkers												
Changes in stocks							-13	-12	-3	12	-3	4
Gross consumption							290	998	1309	1291	1262	1352
Statistical difference												
Transformed in power, heat and other plants:							290	927	1196	1180	1205	1288
- in public CHP plants	1.A.1.a ii						290	831	1059	1055	1082	1086
- in autoproducer CHP plants								96	137	125	123	202
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses****								4	4	3		
Final consumption:								67	109	108	57	64
- in industry	1.A.2.f							67	109	108	57	64
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-38. Balance of industrial waste (biomass fraction), TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production								823	965	1129	1182	1488
Liquid biofuels for blending												
Import												
Export												
International marine bunkers												
Changes in stocks								-12	2	3	2	-10
Gross consumption								811	967	1132	1184	1478
Statistical difference												
Transformed in power, heat and other plants:								782	930	1092	1166	1458
- in public CHP plants	1.A.1.a ii							782	930	1092	1166	1458
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses****								4	3	6		
Final consumption:								25	34	34	18	20
- in industry								25	34	34	18	20
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-39. Balance of municipal waste (non-biomass fraction), TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production							661	1511	2465	2396	1674	2136
Liquid biofuels for blending												
Import												
Export												
International marine bunkers												
Changes in stocks							-8	-56	24	18	5	2
Gross consumption							653	1455	2489	2414	1679	2138
Statistical difference												
Transformed in power, heat and other plants:							653	1451	2484	2410	1214	1208
- in public CHP plants	1.A.1.a ii						653	1451	2484	2410	1214	1208
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses****								4	5	4		
Final consumption:											465	930
- in industry											465	930
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

Table 3-40. Balance of municipal waste (biomass fraction), TJ

	CRT	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Production							676	1182	2268	2214	4172	4928
Liquid biofuels for blending												
Import												
Export												
International marine bunkers												
Changes in stocks							-17	-17	16	-1	-3	-11
Gross consumption							659	1165	2284	2213	4169	4917
Statistical difference												
Transformed in power, heat and other plants:							659	1161	2280	2207	3749	4168
- in public CHP plants	1.A.1.a ii						659	1161	2280	2207	3749	4168
- in autoproducer CHP plants												
- in public heat plants												
- in autoproducer heat plants												
- in geothermal plants												
- in other industries												
Consumed in energy sector:												
- in peat extraction enterprises												
- in crude oil extraction enterprises												
- in refineries												
- in electricity, gas, steam and air conditioning enterprises												
Non energy use												
Distribution and transmission losses****								4	4	6		
Final consumption:											420	749
- in industry											420	749
- in construction												
- in transport												
- in agriculture												
- in fishing												
- in commercial / public services												
- in households												

*According to Lithuania Statistics, transmission losses of liquid fuels arise during the primary refining of oil, but fugitive emissions from oil refining are calculated using Tier 1, on the basis of crude oil refined.

**Losses of peat are not related to fugitive emissions.

*** Part of natural gas losses is natural gas combustion for technological needs; therefore, not all the losses are treated as fugitive emissions.

****Waste losses occur from delivery to a landfill up to the moment of utilization. Waste loses humidity, evaporates, rots and decomposes during that time. These losses are not accounted in fugitive emissions.

*****Fossil fuels are provided together with mixed biofuels in transport, in line with data provided in Official statistics portal of Lithuania. On the contrary, only fossil parts of transport fuels are provided in CRT as fossil fuel.

ANNEX IV. Lithuanian energy consumption in manufacturing industries

Table 4-1. Energy consumption by fuel type in Chemicals industries, TJ

Fuel type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Heating and other gasoil	0	0	0	0	0	0	2	0	39	9	4
Residual fuel oil (RFO)	883	281	20	0	47	0	0	0	0	0	0
Liquefied petroleum gases (LPG)	0	0	0	7	17	31	55	69	73	256	192
Other bituminous coal	0	0	0	0	0	0	0	0	0	0	0
Sub-bituminous coal	0	0	0	0	0	0	0	0	0	0	0
Natural gas	6001	1563	191	4972	5476	5489	4992	5003	4264	3447	3765
Wood and wood waste	0	0	3	0	0	66	445	454	447	462	445
Biogas	0	0	0	0	94	84	124	142	170	150	0
Total	6884	1844	214	4980	5634	5670	5618	5668	4993	4324	4406

Table 4-2. Energy consumption by fuel type in Pulp, paper and print industries, TJ

Fuel type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Heating and other gasoil	0	0	4	0	0	0	8	9	9	4	0
Residual fuel oil (RFO)	883	401	64	0	0	0	0	0	0	0	0
Liquefied petroleum gases (LPG)	0	0	42	4	3	6	3	6	5	5	5
Coke	0	0	0	0	0	0	0	0	0	0	0
Other bituminous coal	0	75	18	0	0	0	0	0	0	0	0
Sub-bituminous coal	0	0	0	0	0	0	0	0	0	0	0
Natural gas	3388	749	1162	448	1172	384	556	520	492	415	425
Wood and wood waste	3	5	1	0	128	161	766	762	804	829	845
Peat	0	0	0	0	0	0	2	3	1	0	0
Total	4274	1231	1291	453	1303	551	1335	1300	1311	1253	1275

Table 4-3. Energy consumption by fuel type in Food Processing, Beverages and Tobacco industries, TJ

Fuel type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Heating and other gasoil	0	0	3	148	94	99	112	129	228	249	232
Residual fuel oil (RFO)	2248	1606	1567	334	212	271	249	169	14	17	15
Liquefied petroleum gases (LPG)	0	0	121	158	192	209	124	140	162	247	212
Shale oil	0	0	0	13	0	0	0	0	0	0	0
Coke	0	0	105	64	54	45	82	58	49	64	77
Other bituminous coal	352	151	68	0	3	36	16	17	5	10	8
Anthracite	0	0	0	0	0	0	0	0	0	0	0
Sub-bituminous coal	0	0	0	50	38	0	0	0	0	0	0
Natural gas	8498	2077	2890	3695	4005	3379	3536	3535	3166	3973	4126
Wood and wood waste	36	57	77	297	93	668	545	610	552	568	617
Other solid biomass	0	0	0	0	0	16	41	46	50	46	69
Biogas	0	0	0	0	10	35	61	45	46	41	38
Peat	0	0	0	6	15	7	0	0	0	0	0
Total	11134	3890	4831	4765	4716	4765	4766	4749	4272	5215	5394

Table 4-4. Energy consumption by fuel type in Machinery industries, TJ

Fuel type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Heating and other gasoil	0	0	0	4	8	2	7	16	17	22	17
Residual fuel oil (RFO)	1565	482	48	0	0	3	0	0	0	0	0
Liquefied petroleum gases (LPG)	0	0	5	15	9	7	9	12	10	9	9
Coke	0	0	23	17	3	0	0	0	0	0	0
Other bituminous coal	50	0	8	0	0	5	3	2	5	2	0
Anthracite	0	0	0	0	3	0	0	0	0	0	0
Sub-bituminous coal	0	0	0	13	2	0	0	0	0	0	0
Natural gas	2923	1036	924	1099	262	238	372	373	431	296	328
Wood and wood waste	14	68	108	373	36	14	12	10	18	19	30
Other solid biomass	0	0	0	0	9	0	17	25	25	23	7
Peat	0	0	0	1	3	1	0	0	0	0	0
Total	4553	1586	1116	1522	335	270	420	438	506	371	391

Table 4-5. Energy consumption by fuel type in Non-Metallic Minerals industries, TJ

Fuel type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Heating and other gasoil	0	0	0	148	65	75	109	135	129	90	94
Residual fuel oil (RFO)	35444	7787	3522	1180	1	57	24	25	16	0	0
Liquefied petroleum gases (LPG)	0	0	5	5	2	3	4	8	128	182	134
Petroleum coke	0	0	0	46	111	0	0	0	0	0	0
Coke	0	0	190	402	387	336	453	445	409	325	375
Other bituminous coal	628	327	8	0	2847	3545	3138	3829	3999	2580	2250
Anthracite	0	0	0	0	0	0	0	0	0	0	0
Sub-bituminous coal	0	0	0	2924	153	0	0	0	0	0	0
Natural gas	6934	1833	1775	1615	909	945	901	933	678	487	483
Wood and wood waste	19	63	152	566	345	266	436	457	336	345	365
Other solid biomass	0	0	0	0	0	0	3	0	0	0	0
Peat	168	227	43	7	11	33	1	0	0	0	0
Industrial waste (used tires)	0	0	0	0	209	0	67	109	108	57	64
Industrial waste (biomass)	0	0	0	0	0	0	25	34	34	18	20
Municipal waste (non-RES)	0	0	0	0	0	0	0	0	0	465	930
Municipal waste (RES)	0	0	0	0	0	0	0	0	0	420	749
Total	43193	10237	5695	6894	5040	5260	5161	5975	5837	4969	5464

Table 4-6. Energy consumption by fuel type in Transport Equipment industries, TJ

Fuel type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Heating and other gasoil	0	0	0	1	1	1	7	5	4	8	8
Residual fuel oil (RFO)	0	0	0	0	0	0	0	0	0	0	0
Liquefied petroleum gases (LPG)	0	0	9	8	1	2	0	0	0	9	0
Other bituminous coal	0	0	0	0	1	4	1	0	0	0	0
Sub-bituminous coal	0	0	0	4	1	0	0	0	0	0	0
Natural gas	189	102	171	238	105	47	71	86	89	71	53
Wood and wood waste	0	0	0	1	1	0	4	0	1	1	2
Other solid biomass	0	0	0	0	0	0	0	0	0	0	0
Total	189	102	180	252	110	54	83	91	94	89	63

Table 4-7. Energy consumption by fuel type in Mining and Quarrying industries, TJ

Fuel type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Heating and other gasoil	0	0	0	5	0	1	2	2	0	0	0
Residual fuel oil (RFO)	80	40	56	0	0	0	3	0	0	0	0
Liquefied petroleum gases (LPG)	0	0	0	0	0	0	5	5	19	55	28
Other bituminous coal	0	0	3	0	0	1	1	0	0	0	0
Anthracite	0	0	0	0	0	0	0	0	0	0	0
Sub-bituminous coal	0	0	0	2	0	0	0	0	0	0	0
Natural gas	270	264	20	41	17	11	44	48	33	5	7
Wood and wood waste	0	0	2	5	4	18	12	25	43	42	34
Peat	0	0	0	0	1	0	1	0	0	0	0
Total	350	304	80	53	22	31	68	80	95	102	69

Table 4-8. Energy consumption by fuel type in Wood and Wood Products industries, TJ

Fuel type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Heating and other gasoil	0	0	0	3	0	0	7	11	9	13	9
Residual fuel oil (RFO)	1204	321	148	147	31	0	0	0	0	0	0
Liquefied petroleum gases (LPG)	0	0	5	3	19	7	8	10	55	5	6
Other bituminous coal	0	0	0	0	0	0	0	0	0	0	0
Anthracite	0	0	0	0	0	0	0	0	0	0	0
Sub-bituminous coal	0	0	0	12	0	0	0	0	0	0	0
Natural gas	1167	451	288	1046	944	131	315	397	397	333	376
Wood and wood waste	240	284	466	2081	1905	1670	2213	2316	2128	2226	2371
Other solid biomass	0	0	0	0	0	0	0	0	0	0	0
Peat	0	0	0	1	1	1	0	0	0	0	0
Total	2611	1056	906	3294	2900	1809	2543	2734	2589	2577	2762

Table 4-9. Energy consumption by fuel type in Construction industries, TJ

Fuel type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Heating and other gasoil	0	0	7	25	47	67	64	75	216	149	123
Residual fuel oil (RFO)	1044	201	58	110	75	35	8	6	0	0	0
Liquefied petroleum gases (LPG)	92	46	74	77	122	38	72	58	62	80	82
Other bituminous coal	226	25	14	0	0	6	3	3	2	0	0
Anthracite	0	0	0	0	2	0	0	0	0	0	0
Sub-bituminous coal	0	0	0	18	2	0	0	0	0	0	0
Natural gas	1030	219	266	513	501	477	712	725	665	639	638
Wood and wood waste	51	105	100	185	143	62	91	88	84	90	103
Peat	0	0	0	0	0	0	0	0	0	0	0
Total	2443	596	519	928	892	685	950	955	1029	958	946

Table 4-10. Energy consumption by fuel type in Textile and Leather industries, TJ

Fuel type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Heating and other gasoil	0	0	0	76	41	26	37	32	22	16	13
Residual fuel oil (RFO)	1365	442	140	40	4	11	4	5	0	0	0
Liquefied petroleum gases (LPG)	0	0	5	2	12	14	12	17	18	14	14
Other bituminous coal	528	100	35	0	7	10	6	7	2	16	11
Anthracite	0	0	0	0	2	0	0	0	0	0	0
Sub-bituminous coal	0	0	0	49	8	0	0	0	0	0	0
Natural gas	2467	646	810	1228	591	568	397	580	579	444	425
Wood and wood waste	20	50	109	37	18	35	26	21	26	19	36
Other solid biomass	0	0	0	41	2	0	0	0	0	0	0
Peat	0	0	0	1	1	0	0	0	0	0	0
Total	4379	1238	1099	1474	686	664	482	662	647	509	499

Table 4-11. Energy consumption by fuel type in Non-Specified Industry, TJ

Fuel type	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
Heating and other gasoil	0	0	0	20	11	24	37	39	26	22	22
Residual fuel oil (RFO)	321	161	0	3	0	0	0	0	0	0	0
Liquefied petroleum gases (LPG)	0	0	9	26	18	47	61	68	59	59	50
Coke	0	0	28	52	29	18	0	0	0	0	0
Other bituminous coal	25	50	0	0	2	1	4	4	0	0	0
Anthracite	0	0	0	0	0	0	0	0	0	0	0
Sub-bituminous coal	0	0	5	5	5	0	0	0	0	0	0
Natural gas	4228	195	54	189	189	225	255	412	378	340	268
Wood and wood waste	121	229	300	646	390	622	485	483	566	575	586
Other solid biomass	0	0	0	0	0	0	0	0	0	0	0
Biogas	0	0	0	0	0	2	1	0	0	0	0
Peat	0	0	0	1	4	7	0	0	0	0	0
Total	4695	635	396	943	648	946	843	1006	1029	996	926

ANNEX V. Energy sector country specific CO₂ emission factors

Country specific CO₂ emission factors have been derived in studies to determine and update national GHG emission factors for energy sector performed in 2012, 2016 and 2023 by Lithuanian Energy Institute. Results of 2012 study are presented in scientific publication “Assessment of national carbon dioxide emission factors for the Lithuanian fuel combustion sector” published in journal “Greenhouse Gas Measurement and Management”, Volume 4, 2014 – Issue 1 <https://www.tandfonline.com/doi/full/10.1080/20430779.2014.905243>. Summary of 2016 study "Update of country specific GHG emission factors for energy sector" is presented in Annex VI.

According to the agreement with Ministry of Environment the accredited Laboratory of Quality Research Centre of AB “ORLEN Lietuva” (petroleum refining company) performed measurements for CO₂ emission factors for all oil products produced at this refinery in 2017. Refinery provided measurements’ protocols for all samples of their products. AB “ORLEN Lietuva” performed measurements for 6 samples of diesel, jet fuel, gasoline (A-95), LPG (summer and winter types), 4 samples of gasoline (A-98) and 6 samples of liquefied petroleum gas for residential sector (BT and SPBT types). Standard practice for sampling petroleum products has been used as presented in Table 5-1.

Table 5-1. Sampling and test methods used by AB „ORLEN Lietuva“

Product	Sampling method	Test method for CO ₂ emission factor evaluation
Diesel	LST EN ISO 3170:2004 ASTM D5291-16 D	Thermo Fisher Scientific method No. 85
Gasoline	LST EN ISO 3170:2004 PIANO method	Thermo Fisher Scientific method No. 85
Jet fuel	ASTM D4057-12 ASTM D5291-16 D	Thermo Fisher Scientific method No. 85
Liquefied petroleum gas	LST EN ISO 4257:2002 LST EN SIO 4257:2002/AC:2007	Thermo Fisher Scientific method No. 85

In 2023, new study “Update of country specific GHG emission factors for energy sector” was performed by Lithuanian Energy Institute. The summary of this 2023 study "Update of country specific GHG emission factors for energy sector" is presented in Annex VII.

Country specific CO₂ emission factors for all fuel types are presented in Table 5-2 and Table 5-3.

Table 5-2. Country specific CO₂ emission factors, t/TJ

Fuel type	1990-2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Liquid fuel											
Heating and other gasoil	72.89	72.73	72.73	72.80	72.80	72.80	72.80	72.80	72.80	72.95	72.95
Residual fuel oil (RFO)	77.60	78.40	78.40	78.40	78.40	78.40	78.40	78.40	78.40	79.15	79.15
Liquefied petroleum gases (LPG) – 1.A.1, 1.A.2, 1.A.4	65.42	66.34	66.34	66.81	66.81	66.81	66.81	66.81	66.81	66.78	66.78
Liquefied petroleum gases (LPG) – 1.A.3	65.42	66.34	66.34	66.81	66.81	66.81	66.81	66.81	66.81	66.44	66.44
Shale oil	77.40	76.60	76.60	76.60	76.60	76.60	76.60	76.60	76.60	76.60	76.60
Crude oil	77.74	77.74	77.74	77.74	77.74	77.74	77.74	77.74	77.74	77.74	77.74
Petroleum coke	94.06	94.06	94.06	94.06	94.06	94.06	94.06	94.06	94.06	94.06	94.06
Diesel oil	72.89	72.73	72.73	72.80	72.80	72.80	72.80	72.80	72.80	72.95	72.95
Motor gasoline	72.97	72.77	72.77	70.13	70.13	70.13	70.13	70.13	70.13	70.03	70.03
Aviation gasoline and gasoline type jet fuel	71.62	70.81	70.81	70.81	70.81	70.81	70.81	70.81	70.81	70.81	70.81
Jet kerosene	72.24	71.74	71.74	71.67	71.67	71.67	71.67	71.67	71.67	72.00	72.00
Solid fuel											
Coke	109.11	109.11	109.11	109.11	109.11	109.11	109.11	109.11	109.11	109.11	109.11
Other bituminous coal	94.90	95.10	95.10	95.10	95.10	95.10	95.10	95.10	95.10	95.10	95.10
Anthracite	106.55	106.55	106.55	106.55	106.55	106.55	106.55	106.55	106.55	106.55	106.55
Sub-bituminous coal	96.10	96.10	96.10	96.10	96.10	96.10	96.10	96.10	96.10	96.10	96.10
Lignite	101.2	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
Peat	104.34	104.34	104.34	104.34	104.34	104.34	104.34	104.34	104.34	104.34	104.34
Biomass											
Wood and wood waste	101.34	101.34	101.34	101.34	101.34	101.34	101.34	101.34	101.34	104.1	104.1
Other solid biomass	103.69	103.69	103.69	103.69	103.69	103.69	103.69	103.69	103.69	88.50	88.50
Biogas	58.45	58.45	58.45	58.45	58.45	58.45	58.45	58.45	58.45	58.45	58.45
Charcoal	109.9	109.9	109.9	109.9	109.9	109.9	109.9	109.9	109.9	109.9	109.9
Waste											
Municipal waste (non-biomass fraction)	111.65	111.65	111.65	111.65	111.65	111.65	111.65	111.65	111.65	115.63	115.63
Municipal and industrial waste (biomass fraction)	109.03	109.03	109.03	109.03	109.03	109.03	109.03	109.03	109.03	115.63	115.63
Industrial waste – used tires (rubber)	85.00	-	-	84.40	88.70	88.70	88.70	66.40	66.40	66.40	66.40

Table 5-3. Country specific CO₂ emission factors of natural gas, t/TJ

Fuel type	1990-2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Natural gas	55.14	55.09	55.09	55.12	55.11	55.11	55.16	55.12	55.12	55.16	55.21	55.24	55.53

Fuel type	2016	2017	2018	2019	2020	2021	2022	2023	2024
Natural gas	55.73	55.57	55.54	55.59	55.34	55.34	55.40	55.59	55.62

ANNEX VI. Summary of study "Update of country specific GHG emission factors for energy sector" (2016)

During combustion a great share of carbon is removed immediately as CO₂, therefore conditions of combustion process practically have no influence on CO₂ emission factors. CO₂ emission factors depend on the type of fuel, i.e. on the amount of carbon content in this fuel. After the summarization of performed comparative analysis of applied emission factors in other EU countries, summarization of data provided by the operators under the EU ETS system and aggregation of results provided by the accredited research laboratories, the study determined country specific CO₂ emission factors for energy sector (fuel combustion). Updated values of country specific CO₂ emission factors are set considering the results of analysis performed. Besides, determined values of emission factors assure low as possible uncertainty of emission factors.

CH₄ and N₂O emission factors are influenced by type of technology, operating conditions, age of equipment and other combustion conditions, therefore values of these emission factors significantly differ between the individual technologies. Seeking to precisely set country specific CH₄ and N₂O emission factors of energy technologies used in Lithuania, it is essential to perform comprehensive and multiplex measurements of emissions by differencing in accordance with the group of equipment and fuel type. However, the measurements should be long-lasting, therefore in this study recommended values of CH₄ and N₂O emission factors are based on the default IPCC (2006) values.

Updated CO₂ emission factors and previously applied CO₂ emission factors (presented in the study on "Determination of national GHG emission factors for energy sector", 2012) for energy sector are provided in Tables 6-1.

Table 6-1. GHG emission factors for energy industries

1.A.1 Energy industries	CO₂ emission factors in the study of 2016, t/TJ	CO₂ emission factors in the study of 2012, t/TJ
Liquid fuel		
Motor gasoline	72.77	72.97
Diesel	72.73	72.89
Gasoil	72.73	72.89
Residual fuel oil (RFO)	78.4	77.6
Petroleum coke	94.06	94.06
Refinery gas	56.9	55.82
Orimulsion	81.74	81.74
Shale oil	76.6	77.4
Liquified petroleum gas (LPG)	66.34	65.42
Crude oil	77.74	77.74
Solid fuel		
Other bituminous coal	95.1	94.9
Anthracite	106.55	-
Sub-bituminous coal	96.1	-
Peat	104.34	104.34
Natural gas		
Natural gas	55.14*	55.23
Biomass		
Wood and wood waste	101.34	109.9
Other solid biomass	103.69	-
Biogas	58.45	58.45
Waste		
Municipality waste (RES)	109.03	-
Municipality waste (non-RES)	111.65	-

Industrial waste	143	-
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Remark: * Seeking to ensure higher accuracy of GHG emissions accounting, it is valuable to apply time series of CO₂ emission factor for a period 2004-2014, but an average value of 55,14 t/TJ for a period 1990-2003. Since 2015, country will have to calculate CO₂ emission factor for natural gas considering to the chemical composition of natural gas imported through the pipeline and the liquefied natural gas terminal by applying the method of weighted average.

Updated country specific CO₂ emission factor for natural gas is determined considering to the chemical composition of natural gas during 2004-2014 that was provided by Central Calibration and Test Laboratory of AB "Lietuvos dujos". Seeking to ensure higher accuracy of GHG inventory, it is valuable to apply time series of CO₂ emission factor for a period 2004-2014, but an average value of 55.14 t/TJ – for a period 1990-2003. Since 2015, country specific CO₂ emission factor for natural gas should be estimated considering chemical composition of natural gas imported through the pipeline and the liquefied natural gas terminal. The CO₂ emission factor for natural gas since 2015 should be calculated applying the method of weighted average and considering the import structure and chemical composition of natural gas.

Values of country specific CO₂ emission factors for gasoline, diesel, gasoil, jet kerosene, residual fuel oil and liquefied petroleum gas are updated considering the results of measurements of petroleum products that were performed by the accredited Laboratory of Quality Research Centre of AB „ORLEN Lietuva“. When accounting GHG emissions, it is valuable to apply the updated CO₂ emission factors for a specified in this paragraph fuels for a period after 2015 and for a period 1990-2014 to use the emission factors determined in the study of 2012.

Values of country specific CO₂ emission factors for other bituminous coal, petroleum coke, orimulsion, refinery gas and coke are updated on the basis of data provided by the operators under EU ETS and considering to the Tier 3 reliability that ensures the lowest uncertainty of emission factor. Sustaining to data base of EU ETS, in some cases it is possible to apply emission factors set at the plant-specific level. For example, this can be applied for orimulsion or residual fuel oil combusted in CHP of the AB "ORLEN Lietuva". The application of plant-specific emission factors enables to use higher Tiers in the national GHG inventory.

Value of CO₂ emission factor for shale oil is based on national Estonian emission factor, considering the fact that shale oil is imported to Lithuania from Estonia. When preparing the inventory of GHG emissions, it is recommended to apply the updated CO₂ emission factor for shale oil after 2015.

Country specific CO₂ emission factors for wood, wood waste, agricultural waste and municipality waste (renewable and non-renewable) are specified by performed measurements in the Laboratory of Heat Equipment Research and Testing (Lithuanian Energy Institute). The Laboratory of Heat Equipment Research and Testing performed measurements for 17 samples of municipal waste (non-biomass fraction); 6 samples of municipal waste (biomass fraction); 21 samples of agricultural waste and 4 samples of wood/wood waste. It is recommended to apply the updated CO₂ emission factors for the specified in this paragraph fuels when recalculating GHG emissions from 1990. This will ensure higher reliability of accounting, considering the significantly lower uncertainties of the updated CO₂ emission factors.

The Value of CO₂ emission factor for biogas and industrial waste is updated in accordance with the results of analysis on applied emission factors in other EU countries and considering the results of long-lasting research analysis performed in other countries. However, seeking to ensure low uncertainty of emission factor for biogas, it is essential to perform long-lasting measurements for different types of biogas in Lithuania.

The reliability of the updated CO₂ emission factors is assessed considering default values given in *2006 IPCC Guidelines* and results of performed comparative analysis, where the updated CO₂ emission factors were compared with the emission factors applied in EU countries. The comparison of updated CO₂ emission factors with default values of *2006 IPCC Guidelines* is presented in Figure 6-1.

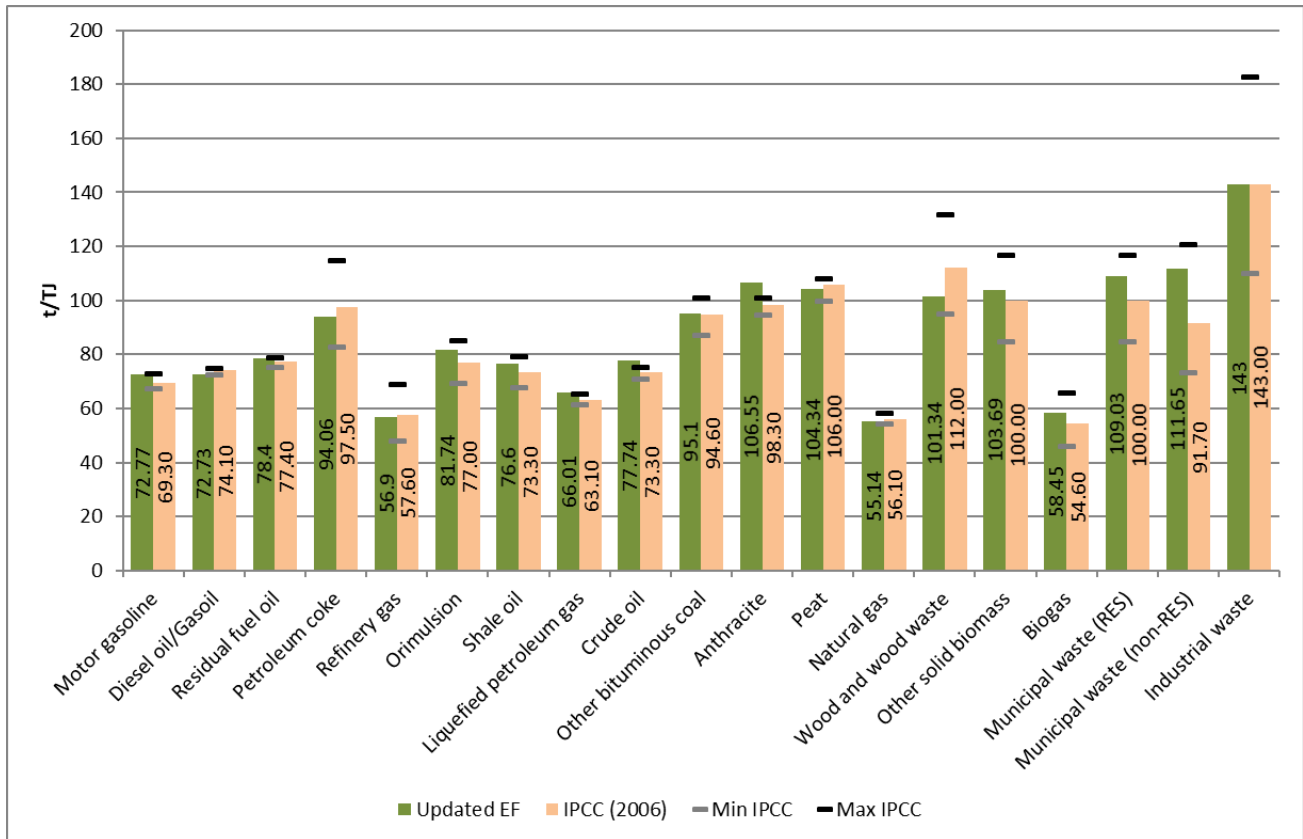


Figure 6-1. Comparison of updated country specific CO₂ emission factors and default 2006 IPCC Guidelines emission factors: energy industries

As it is seen from Figure 6-1, the updated values of country specific CO₂ emission factors for fuels fall into the uncertainty ranges of default 2006 IPCC Guidelines, except for crude oil and anthracite. The updated values of country specific CO₂ emission factors for crude oil and anthracite are by 5.71% and 7.74% higher than default 2006 IPCC Guidelines values, respectively.

CO₂ emission factors for manufacturing industries and construction are recommended the same as for energy industries sector (Table 6-2).

Table 6-2. GHG emission factors for manufacturing industries and construction

1.A.2 Manufacturing industries and construction	CO ₂ emission factors in the study of 2016, t/TJ	CO ₂ emission factors in the study of 2012, t/TJ
Liquid fuel		
Gasoil	72.73	72.89
Residual fuel oil	78.4	77.60
Petroleum coke	94.06	94.06
Shale oil	76.6	77.40
Liquified petroleum gas	66.34	65.42
Jet kerosene	71.74	72.24
Solid fuel		
Other bituminous coal	95.1	94.90
Anthracite	106.55	-
Sub-bituminous coal	96.1	-
Peat	104.34	104.34
Coke	109.11	109.11
Natural gas		
Natural gas	55.14*	55.23
Biomass		

Wood and wood waste	101.34	109.9
Other solid biomass	103.69	-
Biogas	58.45	58.45
Waste		
Industrial waste (used tires)	85.00	-

Remark: * Seeking to ensure higher accuracy of GHG emissions accounting, it is valuable to apply time series of CO₂ emission factor for a period 2004-2014, but an average value of 55,14 t/TJ for a period 1990-2003. Since 2015, country will have to calculate CO₂ emission factor for natural gas considering to the chemical composition of natural gas imported through the pipeline and the liquefied natural gas terminal by applying the method of weighted average.

Updated values of CO₂ emission factors for transport sector are presented in Table 6-3. CO₂ emission factors of fuels (except aviation gasoline) used in transport sector are updated on the basis of measurement performed by the accredited Laboratory of Quality Research Centre of AB „ORLEN Lietuva“. AB ORLEN Lietuva performed measurements for 1 sample of diesel, jet fuel, RFO, gasoil; 3 samples of gasoline and 2 samples of liquefied petroleum gas. Aviation gasoline is not produced in Lithuania. Minor volume of this fuel is imported from Sweden and other EU countries; therefore, it is recommended for aviation gasoline to apply average value of emission factors applied in EU countries.

Table 6-3. GHG emission factors for transport sector

1.A.3 Transport	CO ₂ emission factors in the study of 2016, t/TJ	CO ₂ emission factors in the study of 2012, t/TJ
Aviation gasoline	70.81	71.62
Jet kerosene	71.74	72.24
Motor gasoline	72.77	72.97
Gasoline with bioethanol	72.76	-
Gasoline with MTBE	72.23	-
Diesel	72.73	72.89
Liquefied petroleum gas (LPG)	66.01	65.42
Residual fuel oil	78.4	77.60

The comparison of updated country specific CO₂ emission factors with default 2006 IPCC Guidelines emission factors are presented in Figure 6-2.

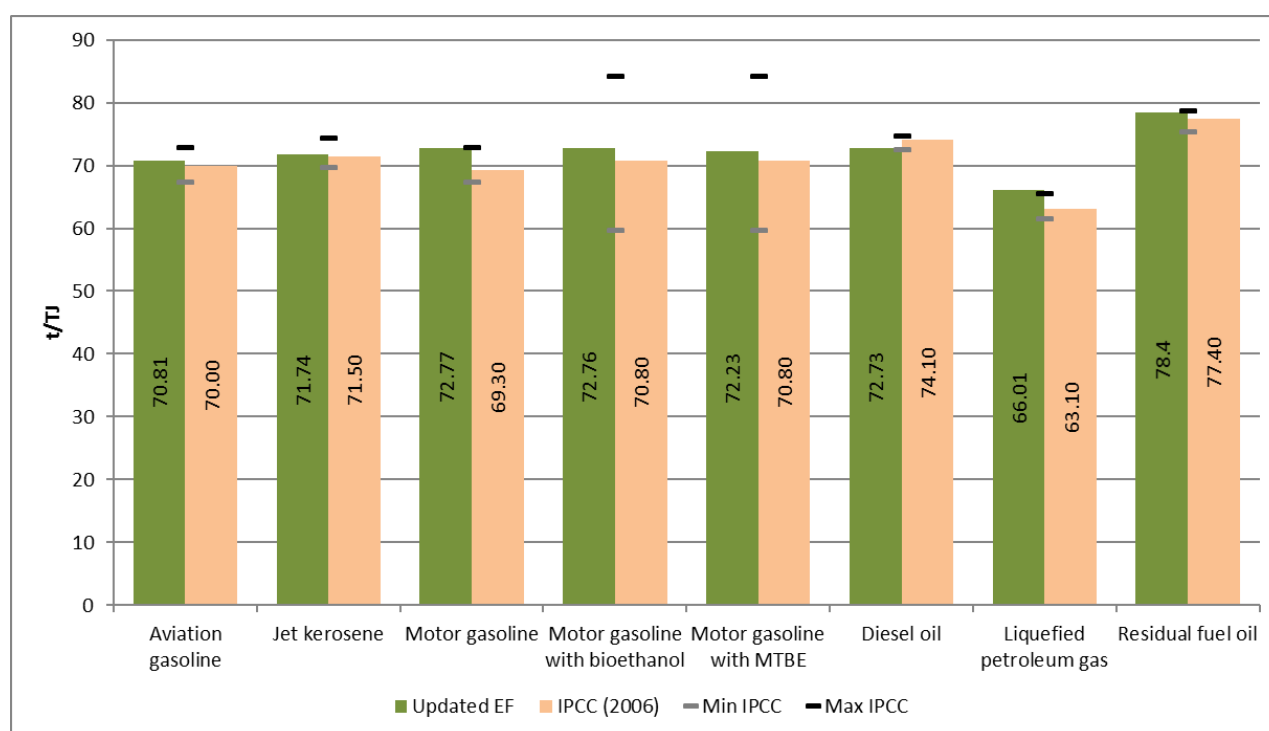


Figure 6-2. Comparison of updated country specific CO₂ emission factors with default 2006 IPCC Guidelines emission factors: transport sector

As it is seen from Figure 6-2, updated values of country specific CO₂ emission factors for fuels in transport sector fall into the uncertainty ranges of 2006 IPCC Guidelines, except for liquefied petroleum gas. The updated value of CO₂ emission factor for liquefied petroleum gas is by 4.41% higher than its default value.

Recommended values of CO₂ emission factors for commercial/institutional, household, agriculture/forestry/fishing sector are presented in Table 6-4.

Table 6-4. GHG emission factors for *commercial/institutional, household, agriculture/forestry and fishing sectors*

1.A.4 Other sectors	CO₂ emission factors in the study of 2016, t/TJ	CO₂ emission factors in the study of 2012, t/TJ
Commercial/ institutional sector		
Other bituminous coal	95.1	94.9
Anthracite	106.55	-
Sub-bituminous coal	96.1	-
Biogas	58.45	58.45
Peat	104.34	104.34
Natural gas	55.14*	55.23
Gasoil	72.73	72.89
Lignite	101	101.2
Wood and wood waste	101.34	109.9
Other solid biomass	103.69	-
Residual fuel oil	78.4	77.6
Charcoal	109.9	109.9
Shale oil	76.6	77.4
Liquified petroleum gas	66.34	65.42
Household sector		
Other bituminous coal	95.1	94.9
Anthracite	106.55	-
Sub-bituminous coal	96.1	-
Peat	104.34	104.34
Natural gas	55.14*	55.23
Gasoil	72.73	72.89
Lignite	101	101.2
Wood and wood waste	101.34	109.9
Other solid biomass	103.69	-
Residual fuel oil	78.4	77.6
Liquified petroleum gas	66.34	65.42
Agriculture/forestry and fishing sector		
Other bituminous coal	95.1	94.9
Anthracite	106.55	-
Sub-bituminous coal	96.1	-
Biogas	58.45	58.45
Peat	104.34	104.34
Natural gas	55.14*	55.23
Gasoil	72.73	72.89
Wood and wood waste	101.34	109.9
Other solid biomass	103.69	-

Residual fuel oil	78.4	77.6
Shale oil	76.6	77.4
Liquefied petroleum gas	66.34	65.42

Remark: * Seeking to ensure higher accuracy of GHG emissions accounting, it is valuable to apply time series of CO₂ emission factor for a period 2004-2014, but an average value of 55.14 t/TJ for a period 1990-2003. Since 2015, country will have to calculate CO₂ emission factor for natural gas considering to the chemical composition of natural gas imported through the pipeline and the liquefied natural gas terminal by applying the method of weighted average.

Preparing the national GHG inventory, it is essential to evaluate the overall inventory uncertainty. For this purpose, it is needed to have uncertainty estimates of emission factors, therefore in this study expert valuations of determined national emission factors uncertainties are performed.

Considering international practice, uncertainty assessment of CO₂, CH₄ and N₂O emission factors is performed at aggregated sector-specific and fuel type-specific (liquid, solid, gaseous fuel and biomass) levels. Uncertainty estimations of recommended GHG emission factors are presented in Table 6-5.

Table 6-5. Uncertainties of recommended GHG emission factors

<i>IPCC source category</i>	<i>Fuel type</i>	<i>CO₂, %</i>
1.A.1 Energy industries	Liquid fuel	± 2.0
	Solid fuel	± 5.0
	Natural gas	± 2.0
	Biomass	± 15.0
1.A.2 Manufacturing industry and construction	Liquid fuel	± 2.0
	Solid fuel	± 5.0
	Natural gas	± 2.0
	Biomass	± 15.0
1.A.3 Transport	Liquid fuel	± 2.0
1.A.4 Other sectors: commercial/institutional, household, agriculture and fishing	Liquid fuel	± 2.0
	Solid fuel	± 5.0
	Natural gas	± 2.0
	Biomass	± 15.0

Assessment of uncertainty of CO₂ emission factors is performed considering the fact that carbon share of some types of fuels is relatively stable. Emission factors for liquid fuels mainly are identified at the accredited laboratory that satisfies the requirements of LST EN ISO/IEC 17025:2005 standard or are based on data provided by EU ETS applying the Tier 3. Chemical composition of natural gas is determined in the laboratory, which is accredited by the National Accreditation Bureau, too. This has an influence on low uncertainties of emission factors for liquid fuels and natural gas (±2,0%). Uncertainties of emission factors for solid fuels are remarkably higher, because, for example, carbon share in peat is variable, therefore uncertainties of emission factors for solid fuels are estimated considering the recommendations provided in *2006 IPCC Guidelines*. The Uncertainty of CO₂ emission factor for biomass is the highest and reaches ±15%.

ANNEX VII. Summary of study “Update of country specific GHG emission factors for energy sector” (2023)

Updated CO₂ EFs for energy sector and CH₄ and N₂O EFs of biomass for residential and commercial/institutional sectors are provided in Table 7-1 and Table 7-2.

Table 7-1. CO₂ emission factors for energy sector

<i>Fuel type</i>	<i>CO₂ emission factors in the study of 2023, t/TJ</i>
Liquid fuel	
Motor gasoline	70.03
Diesel / gasoil	72.95
Jet kerosene	72.00
Residual fuel oil (RFO)	79.15
Petroleum coke	94.06
Refinery gas	57.11
Liquified petroleum gas (LPG)	66.44 (1.A.3) / 66.78 (1.A.1, 1.A.2, 1.A.4)
Solid fuel	
Other bituminous coal	95.13
Biomass	
Wood and wood waste	104.10
Other solid biomass	88.50
Waste	
Municipality waste (non-RES)	115.63
Municipality waste (RES)	
Industrial waste (non-RES)	
Industrial waste (RES)	

Table 7-2. CH₄ and N₂O EFs of biomass for residential and commercial/institutional sectors

<i>IPCC category</i>	<i>Fuel type</i>	<i>Emission factors, kg/TJ</i>		<i>IPCC (2006), kg/TJ</i>	
		<i>CH₄</i>	<i>N₂O</i>	<i>CH₄</i>	<i>N₂O</i>
Residential	Wood logs	206.60	4.12	300	4
	Wood waste	19.80	6.10		
	Wood pellets	3.84	0.33		
Commercial/institutional	Wood logs	11.10	0.00		
	Wood waste	16.90	1.67		
	Wood pellets	0.24	0.06		

The national CO₂ EFs for petroleum products (gasoline, diesel, gasoil, jet kerosene fuel, residual fuel oil and liquefied petroleum gas) have been revised considering the results of measurements of petroleum products that were performed by the accredited Laboratory of the Quality Research Centre of AB "ORLEN Lietuva" in 2023. Refinery provided measurements' protocols for all samples of their products. Standard practice for sampling petroleum products has been used as presented in Table 7-3.

Table 7-3. Sampling and test methods used by AB „ORLEN Lietuva“

<i>Product</i>	<i>Sampling method</i>	<i>Test method for CO₂ EFs evaluation</i>	<i>Number of samples</i>
Gasoline	LST EN ISO 3170	Thermo Fisher Scientific	12
Diesel	LST EN ISO 3170	Thermo Fisher Scientific	8

Jet kerosene	ASTM D 4057	Thermo Fisher Scientific	6
Residual fuel oil	LST EN ISO 3170	Thermo Fisher Scientific	6
Liquefied petroleum gas (transport)	LST EN ISO 4257	Thermo Fisher Scientific	12
Liquefied petroleum gas (other)	GOST 14921	Thermo Fisher Scientific	12

The comparison of updated country specific CO₂ EFs of petroleum products with default 2006 IPCC Guidelines emission factors are presented in Figure 7-1.

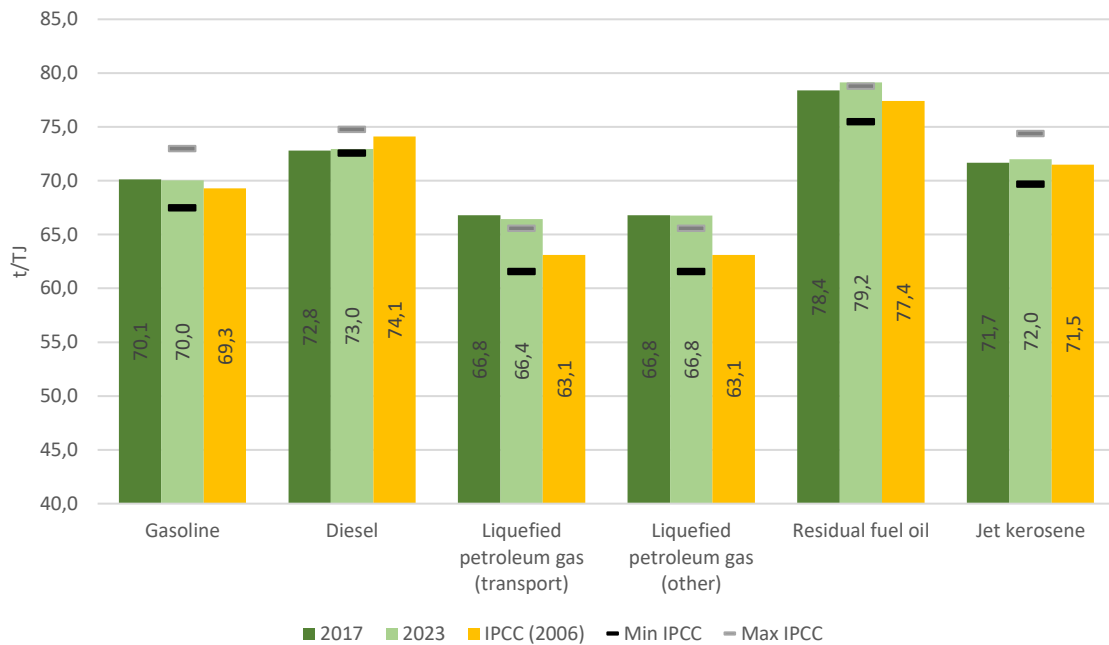


Figure 7-1. Comparison of updated CS CO₂ EFs of petroleum products with default 2006 IPCC Guidelines emission factors

As it seen from Figure 7-1, updated values of CS CO₂ EFs of petroleum products fall into the uncertainty ranges of 2006 IPCC Guidelines, except for liquefied petroleum gas and residual fuel oil. When accounting GHG emissions, it is appropriate to apply these revised CO₂ EFs for petroleum products from 2023.

Country specific CO₂ EFs for wood, wood waste, agricultural waste, municipal and industrial waste (renewable and non-renewable) have been updated at the Laboratory of Heat Equipment Research and Testing (Lithuanian Energy Institute). CO₂ EFs for wood and wood waste, wood pellets and agricultural waste have been updated by direct measurement. The following equipment was used for measurements: S type Pito tube for the determination of the combustion products flow; a moisture meter and a pressure sensor with secondary instruments; a portable gas analyser Testo 350XL for the measurement of the concentrations of the combustion products (CO₂, CH₄, N₂O) and a portable FTIR analyser Gaset DX-4000.

The concentration of combustion products (CO₂ %, CH₄ and N₂O mg/m³) was directly measured using combustion product analysers. Then, taking into account the flue gas volume flow (Nm³/h) from the boiler and the fuel consumption (kg/h) and calorific value (TJ/kg), the amount of emissions (mg/h) were calculated.

CO₂ emissions concentration was measured from the combustion of different fuels: biomass (wood logs, wood chips, wood pellets) and agricultural waste. In order to update the national CO₂ EFs for biomass, the concentration of emissions and other parameters were measured at:

- 11 wood logs burning equipment with a capacity ranging from 5 kW to 1200 kW;
- 8 wood waste (chips) burning equipment with a capacity ranging from 5 kW to 24 MW;

- 29 wood pellet burning equipment with a capacity ranging from 4 kW to 500 kW;
- 5 agricultural waste burning equipment with a capacity ranging from 5 kW to 32 kW.

CH₄ and N₂O emissions concentration from the combustion of biomass (wood logs, wood chips and pellets) were also measured at the stationary combustion equipment: residential sector and commercial/institutional sector. In order to determine the national CH₄ and N₂O EFs for biomass, the concentrations of CH₄ and N₂O emissions and other parameters were measured at 15 biomass burning equipment in residential sector with a capacity ranging from 4 to 24 kW and 11 biomass burning equipment in commercial/institutional sector with a capacity ranging from 30 to 1200 kW. Direct measurements of CH₄ and N₂O emissions from wood, wood waste and wood pellets combusted in equipment of residential and commercial/institutional sectors have shown that modern biofuel (especially wood pellets) boilers are characterised by low CH₄ and N₂O emission factors (Table 7-2).

The comparison of country specific CH₄ and N₂O EFs of biomass for residential sector and commercial/institutional sector with default 2006 IPCC Guidelines emission factors are presented in Figure 7-2 and Figure 7-3.

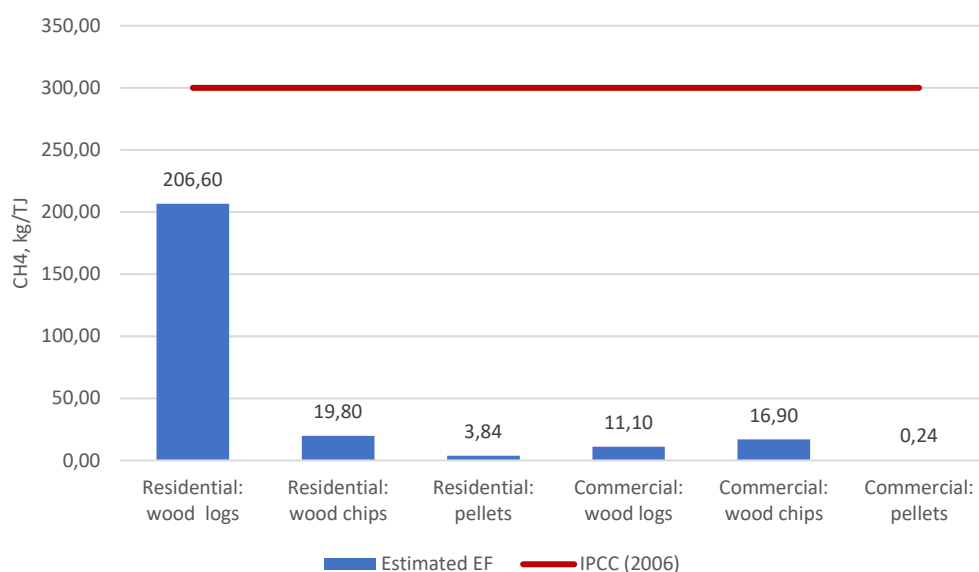


Figure 7-2. Comparison of country specific CH₄ EFs of biomass for residential sector and commercial/institutional sector with default 2006 IPCC Guidelines emission factors

As it seen from Figure 7-2, estimated CS CH₄ EFs for wood, wood chips and wood pellets burned in residential and commercial/institutional sector have been found to be well below the default (300 kg/TJ) 2006 IPCC Guidelines emission factors. Only CS CH₄ EF for wood logs burned in residential sector falls into the uncertainty ranges of default 2006 IPCC Guidelines (100-900 kg/TJ) emission factors.

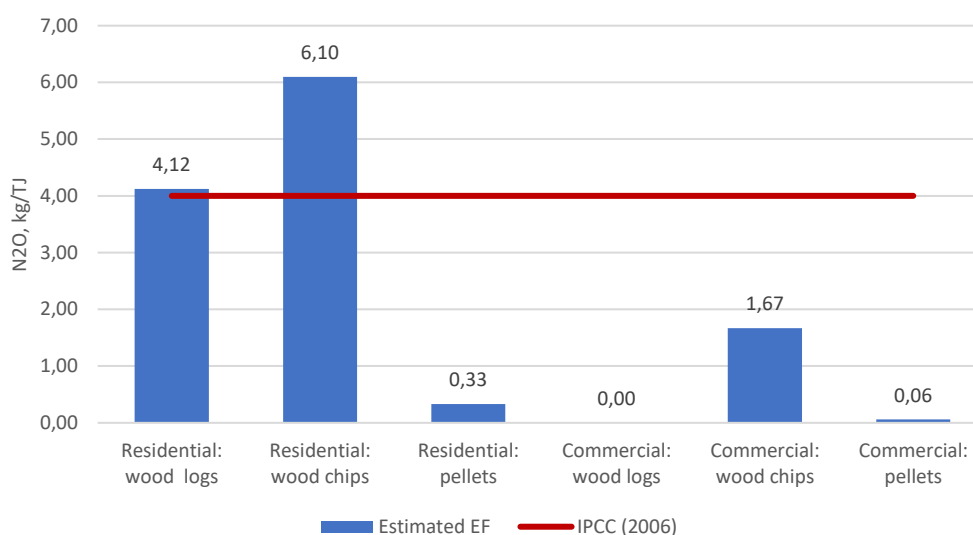


Figure 7-3. Comparison of country specific N₂O EFs of biomass for residential sector and commercial/institutional sector with default 2006 IPCC Guidelines emission factors

As it seen from Figure 7-3, estimated CS N₂O EFs for wood and wood chips burned in residential and commercial/institutional sector fall within the uncertainty range of 2006 IPCC Guidelines default values (1,5-15 kg/TJ), except wood pellets. CS N₂O EFs for wood pellets burned in residential and commercial/institutional sector are below the lower limit of 2006 IPCC Guidelines emission factor uncertainty range.

It is recommended to apply the updated CO₂ EFs and CH₄ and N₂O EFs for wood, wood waste and agricultural waste when accounting GHG emissions from 2023.

CO₂ EFs for municipal and industrial waste (renewable and non-renewable) have been determined on the basis of chemical composition of the fuel obtained from the waste. For the update of CO₂ EFs of municipal and industrial (non-renewable and renewable) waste, a drying oven (for moisture content), a calorimeter (for calorific value), an incinerator (for ash content) and an analyser for the main elements (C, H, N, S) were used.

It should be noted that the waste samples from Lithuanian incinerators were unsorted or only partially sorted during the study, resulting in a mix of municipal and industrial waste, as well as renewable and non-renewable wastes. The study analysed two groups of waste samples: 30 samples in I group and 13 samples in II group. Measurements of municipal and industrial waste (renewable and non-renewable) have shown that the results for the experimental sample of fuels derived from waste are scattered over a wide range due to the wide variation in the samples (Table 7-4).

Table 7-4. CO₂ EFs of municipal and industrial (RES and non-RES) waste

Fuel types	CO ₂ emission factor, t/TJ			Number of samples
	Min	Average	Max	
Municipal and industrial (RES and non-RES) waste	65.03	115.63	182.30	43
I group of samples	74.78	115.17	182.30	30
II group of samples	65.03	116.70	162.78	13

The comparison of updated country specific CO₂ EFs of biomass, municipal and industrial (RES and non-RES) waste with default 2006 IPCC Guidelines emission factors are presented in Figure 7-4.

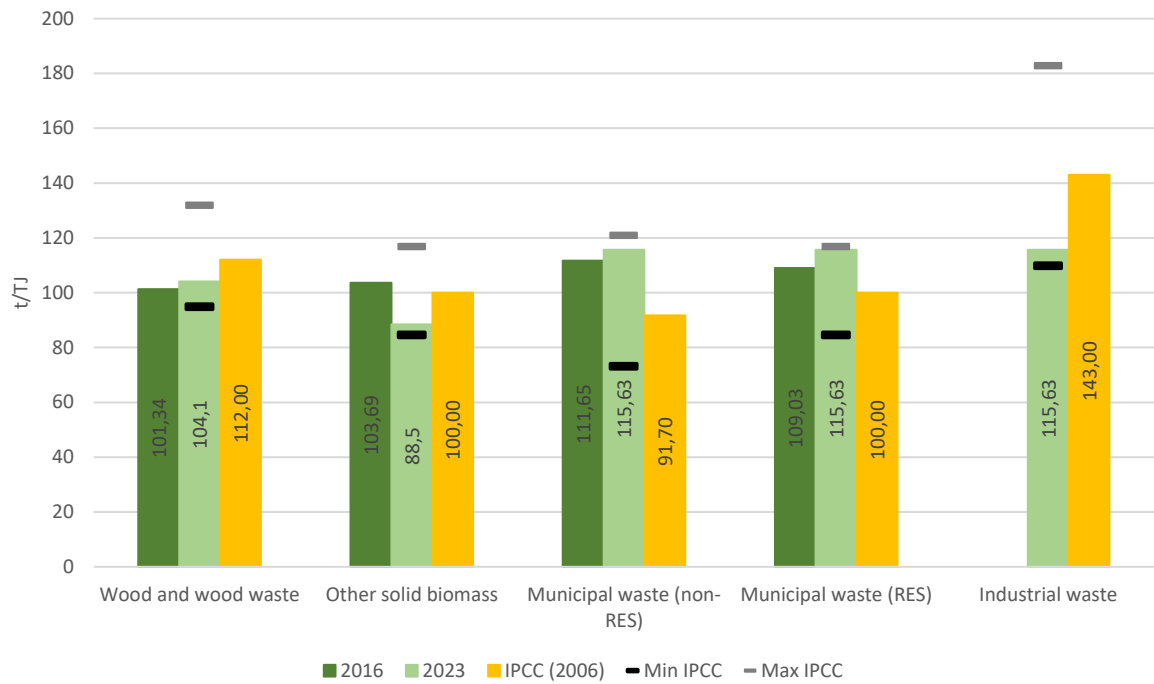


Figure 7-4. Comparison of updated CS CO₂ EFs of biomass, municipal and industrial (RES and non-RES) and default 2006 IPCC Guidelines emission factors

As it seen from Figure 7-4, updated values of CS CO₂ EFs of biomass, municipal and industrial (RES and non-RES) fall into the uncertainty ranges of 2006 IPCC Guidelines.

Values of country specific CO₂ EFs for other bituminous coal, petroleum coke and coke are updated on the basis of data provide by the operators under EU ETS and considering to the Tier 3 reliability that ensures the lowest uncertainty of emission factor. Sustaining to the data base of EU ETS, in some cases it is possible to apply EFs set at the plant-specific level. When accounting GHG emissions, it is appropriate to continue apply PS EFs based on the EU ETS Tier 3.

CHPs incinerating municipal and industrial waste use the instrumental measurement method (Tier 4) under EU ETS. Analysis of EU ETS reports of waste-fired CHPs for the period 2016-2022 showed that CO₂ emission factor for municipal and industrial waste varied between 72.46 and 106.76 t/TJ. The average value of CO₂ EF for municipal and industrial waste for the period 2016-2022 was 92.37 t/TJ. The average value of CO₂ EF for municipal and industrial waste is 0.7% higher than the default 2006 IPCC Guidelines emission factor for municipal waste and 35.4% lower than the default 2006 IPCC Guidelines emission factor for industrial waste. The instrumental measurement method (Tier 4) used under EU ETS ensures a low uncertainty ±2.5% through continuous monitoring of emissions, therefore it is appropriate to use these measured and verified emissions for the national GHG emissions accounting.

Country specific CO₂ EF for natural gas have not been analysed in this study, as in preparation of the national GHG inventory is applied CS CO₂ EF that varies from year to year, depending on the chemical composition of natural gas.

Preparing the national GHG inventory, it is necessary to evaluate the overall inventory uncertainty, therefore for this purpose, uncertainty estimates of updated EFs have been revised. Considering international practice, uncertainty assessment of CO₂, CH₄ and N₂O emission factors is performed at aggregated sector-specific and fuel type-specific (liquid, solid, gaseous fuel and biomass) levels. Uncertainty estimations of recommended GHG emission factors are presented in Table 7-5.

Table 7-5. Uncertainties of recommended GHG emission factors

<i>IPCC source category</i>	<i>Fuel type</i>	<i>CO₂, %</i>
1.A.1 Energy industries	Liquid fuel	± 2.0
	Solid fuel	± 5.0
	Natural gas	± 2.0
	Waste	± 2.5
	Biomass	± 8.1
1.A.2 Manufacturing industry and construction	Liquid fuel	± 2.0
	Solid fuel	± 5.0
	Natural gas	± 2.0
	Waste	± 4.0
	Biomass	± 8.1
1.A.3 Transport	Liquid fuel	± 2.0
1.A.4 Other sectors	Liquid fuel	± 2.0
	Solid fuel	± 5.0
	Natural gas	± 2.0
	Biomass	± 8.1

The uncertainties of the aggregated CH₄ and N₂O EFs are very high, as these emission factors are highly dependent on specific combustion technologies. Uncertainties of CH₄ and N₂O EFs for biomass are based on measurements results: CH₄ – ±60%, N₂O – ±40%.

ANNEX VIII. CO₂ emissions from the installations of the GHG registry, 2024

Table 8-1. CO₂ emissions from the installations registered in the GHG Emission Allowance Registry, 2024

No	Company	Name of the Installation	Verified emissions, t CO ₂	Corresponding CRT Sector (Fuel combustion)
1	AB "Akmenės cementas"	Boiler house, cement production furnace	869,485	1.A.2.F Non-Metallic Minerals
2	AB "Palemono keramikos gamykla"	Boiler house, ceramics combustion furnace	370	1.A.2.F Non-Metallic Minerals
3	UAB "Kauno stiklas"	Glass melting furnace	13,991	1.A.2.F Non-Metallic Minerals
4	AB "Panevėžio stiklas"	Glass melting furnace	18,047	1.A.2.F Non-Metallic Minerals
5	AB "ORLEN Lietuva"	Oil refining factory	1,605,458	1.A.1.B Petroleum Refining / 1.A.1.A Public electricity and heat production
6	AB "Grigeo Klaipėda"	Boiler house	11,134	1.A.2.D Pulp, Paper and Print
7	AB "Grigeo Tissue"	Boiler house	7,104	1.A.2.D Pulp, Paper and Print
8	AB "Achema"	Boiler houses, CHP	1,584,285	1.A.2.C Chemicals / 1.A.1.A Public electricity and heat production
9	AB "Nordic Sugar Kėdainiai"	Boiler house, oilcake desiccation	36,265	1.A.2.E Food processing, Beverages and Tobacco
10	AB "Lifosa"	Boiler house	7,334	1.A.2.C Chemicals
11	AB "KN Energies"	Boiler house	4,561	1.A.1.A Public electricity and heat production
12	UAB "Lietuvos cukraus fabrikas"	Boiler house	15,996	1.A.2.E Food processing, Beverages and Tobacco
13	AB "Jonavos šilumos tinklai"	Jonava boiler house	388	1.A.1.A Public electricity and heat production
14	UAB "Mažeikių šilumos tinklai"	Mazeikiai boiler house	307	1.A.1.A Public electricity and heat production
15	UAB "Raseinių šilumos tinklai"	Raseiniai boiler house No 4	12	1.A.1.A Public electricity and heat production
16	UAB "Šilutės šilumos tinklai"	Šilute boiler house	1	1.A.1.A Public electricity and heat production
17	UAB "Vilniaus šilumos tinklai"	Vilnius power plant No 2 (E-2)	106,209	1.A.1.A Public electricity and heat production
18	AB "Ignitis gamyba"	Vilnius power plant No 3 (E-3)	0	1.A.1.A Public electricity and heat production
19	UAB "Vilniaus šilumos tinklai"	Vilnius boiler house No 2	4,245	1.A.1.A Public electricity and heat production
20	UAB "Vilniaus šilumos tinklai"	Vilnius boiler house No 8	114	1.A.1.A Public electricity and heat production
21	UAB "Širvintų šiluma"	Širvintu boiler house No 3	0	1.A.1.A Public electricity and heat production

No	Company	Name of the Installation	Verified emissions, t CO₂	Corresponding CRT Sector (Fuel combustion)
22	AB "Šiaulių energija"	Šiauliai southern boiler house	12,546	1.A.1.A Public electricity and heat production
23	AB "Klaipėdos energija"	Power plant	0	1.A.1.A Public electricity and heat production
24	UAB "Radviliškio šiluma"	Radviliškis city boiler house	2	1.A.1.A Public electricity and heat production
25	UAB "Utenos šilumos tinklai"	Utena boiler house	1,287	1.A.1.A Public electricity and heat production
26	UAB "Tauragės šilumos tinklai"	Taurage - Beržė boiler house	21	1.A.1.A Public electricity and heat production
27	UAB "Šalčininkų šilumos tinklai"	Šalčininkai boiler house	89	1.A.1.A Public electricity and heat production
28	UAB "Varėnos šiluma"	Varena boiler house	0	1.A.1.A Public electricity and heat production
29	AB "Panevėžio energija"	Panevezio boiler house No 2	5,823	1.A.1.A Public electricity and heat production
30	AB "Panevėžio energija"	Rokiškio boiler house	0	1.A.1.A Public electricity and heat production
31	AB "Panevėžio energija"	Panevezio boiler house No 1	1	1.A.1.A Public electricity and heat production
32	AB "Panevėžio energija"	Pasvalio boiler house	83	1.A.1.A Public electricity and heat production
33	AB "Kauno energija"	Petrašiunai PP	1,821	1.A.1.A Public electricity and heat production
34	AB "Kauno energija"	Pergalė boiler house	4,683	1.A.1.A Public electricity and heat production
35	AB "Kauno energija"	Šilkas boiler house	1,843	1.A.1.A Public electricity and heat production
36	AB "Kauno energija"	Garliava boiler house	220	1.A.1.A Public electricity and heat production
37	AB "Kauno energija"	Jurbarkas boiler house	1,277	1.A.1.A Public electricity and heat production
38	UAB "Plungės šilumos tinklai"	Plunge boiler house No 1	288	1.A.1.A Public electricity and heat production
39	UAB "Litesko"	Druskininkai industry boiler house	1,257	1.A.1.A Public electricity and heat production
40	UAB "Vilkaviškio šilumos tinklai"	Vilkaviškis boiler house	119	1.A.1.A Public electricity and heat production
41	UAB "Litesko"	Luoke boiler house	20	1.A.1.A Public electricity and heat production
42	UAB "Palangos šilumos tinklai"	Palanga boiler house	860	1.A.1.A Public electricity and heat production
43	UAB "Litesko"	Marijampole region boiler house	2,885	1.A.1.A Public electricity and heat production
44	UAB "Alytaus šilumos tinklai"	Alytus boiler house	3,079	1.A.1.A Public electricity and heat production
45	AB "Ignitis gamyba"	Lietuvos PP	207,414	1.A.1.A Public electricity and heat production

No	Company	Name of the Installation	Verified emissions, t CO₂	Corresponding CRT Sector (Fuel combustion)
46	UAB "Kauno termofikacijos elektrinė"	Kaunas PP	402	1.A.1.A Public electricity and heat production
47	UAB "Kaišiadorių šiluma"	Kaišiadoriai boiler house	0	1.A.1.A Public electricity and heat production
48	UAB "Kretingos šilumos tinklai"	Kretinga boiler house No 3	0	1.A.1.A Public electricity and heat production
49	AB "Klaipėdos energija"	Klaipėda region boiler house	9,584	1.A.1.A Public electricity and heat production
50	AB "Klaipėdos energija"	Lypkiai region boiler house	551	1.A.1.A Public electricity and heat production
51	VĮ "Ignalinos atominė elektrinė"	Boiler house	3.895	1.A.4.A Commercial/institutional
52	UAB "Gren Trakai"	Lentvaris boiler house	0	1.A.1.A Public electricity and heat production
53	UAB "Gren Akmenė"	Zalgiris boiler house	1,036	1.A.1.A Public electricity and heat production
54	AB "Panevėžio energija"	Panevėžys thermal PP	5,519	1.A.1.A Public electricity and heat production
55	UAB "IKEA Industry Lietuva"	Fuel combustion plants	14,834	1.A.2.G.iv Wood and wood products
56	UAB "NEO Group"	Boiler house	25,534	1.A.2.C Chemicals
57	AB "Panevėžio energija"	Kėdainiai region boiler house	10,592	1.A.1.A Public electricity and heat production
58	UAB "Paroc"	Plants producing stone-wool	55,530	1.A.2.F Non-Metallic Minerals
59	AB "Vilniaus GKG-3"	Boiler house	11	1.A.2.G.v Construction
60	AB "Vilniaus šilumos tinklai"	Boiler house No 7	0	1.A.1.A Public electricity and heat production
61	VĮ "Visagino energija"	Thermal boiler house	6,229	1.A.1.A Public electricity and heat production
62	AB "Roquette Amilina"	Boiler house and driers	649	1.A.2.E Food processing, Beverages and Tobacco
63	AB "Amber Grid"	Jauniūnų gas compressor station	9,396	1.A.3.E.i Pipeline transport
64	UAB "Hoegh LNG Klaipėda"	LNG ship	79,262	1.A.1.C.iii Other energy industries / 1.A.4.A Commercial/institutional
65	UAB "Gren Klaipėda"	Power plant	121,182	1.A.1.A Public electricity and heat production
66	UAB "Idex Biruliškių"	Boiler house	146	1.A.1.A Public electricity and heat production
67	UAB "Idex Paneriškių"	Boiler house	143	1.A.1.A Public electricity and heat production
68	UAB "Kauno kogeneracine jėgainė"	Power plant	85,650	1.A.1.A Public electricity and heat production
69	UAB "VMG Wood Solutions"	Boiler house and dryer	825	1.A.2.G.iv Wood and Wood Products

<i>No</i>	<i>Company</i>	<i>Name of the Installation</i>	<i>Verified emissions, t CO₂</i>	<i>Corresponding CRT Sector (Fuel combustion)</i>
Total			4,961,894	

Source: <https://apva.lrv.lt/lt/veiklos-sritys/sesd-registras/naujienos/>

ANNEX IX. Additional information of Agriculture sector

Other relevant information

Figure below shows impact of milk yield on GE and EFs.

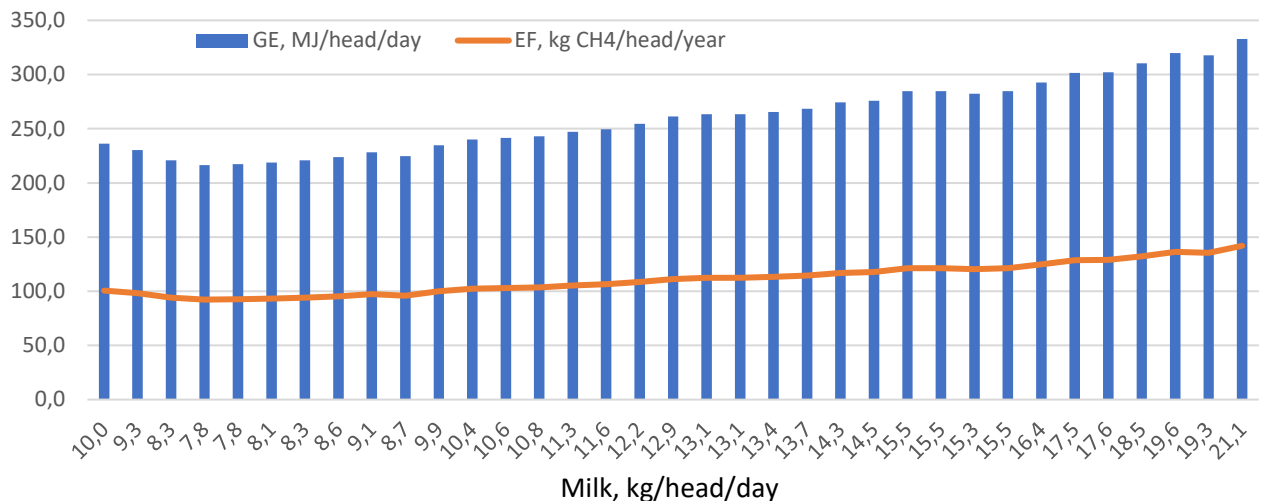


Figure A.5-1. Impact of milk yield on GE and EF's

Milk yield, gross energy, and emission factors are indeed closely related. There are positive relationships between milk production and gross energy, meaning that higher milk yield is often associated with higher levels of gross energy. Similarly, there are positive relationships between milk yield and emission factors, indicating that higher milk production can result in increased emission factors.

Figure below shows distribution of horses by breeds in 2024.

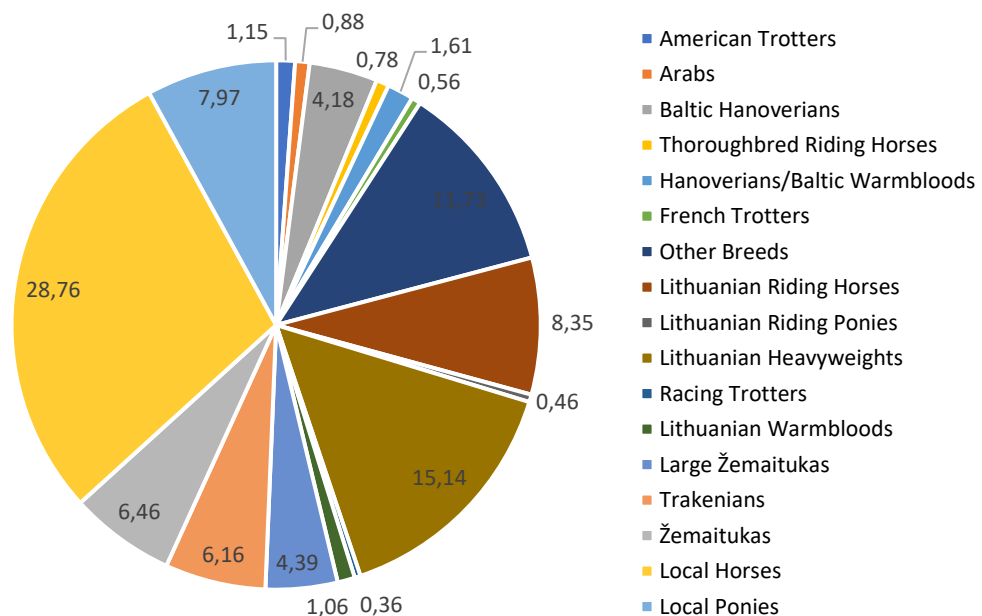


Figure A.5-2. Distribution by breeds of horses, %

Local breeds horses with no known origins constitute about 28.8% of grown horses breeds in Lithuania.

Table A. 5-1. Methane conversion factors values estimated in enteric fermentation category

Year	Methane conversion factor, %			
	Dairy cattle	Non-dairy cattle	Sheep	Swine
1990	6.50	6.44	5.98	0.596
1995	6.50	6.44	5.98	0.596
2000	6.50	6.43	5.98	0.597
2005	6.50	6.42	5.98	0.597
2010	6.50	6.43	5.98	0.596
2015	6.50	6.44	6.00	0.597
2020	6.50	6.44	5.97	0.597
2021	6.50	6.45	5.97	0.597
2022	6.50	6.45	5.97	0.597
2023	6.50	6.45	5.98	0.597
2024	6.50	6.45	5.99	0.597

Table A. 5-2. Changes in dairy cattle population, milk yield, GE, CH₄ EF per cow and methane emission, % (1990=100%)

Year	Population of Dairy cattle	Milk production (4% of milk fat, 3.4% of milk protein)	GE	CH ₄ EF	Emissions
1990	100	100	100	100	100
1995	71	81	93	93	66
2000	55	99	99	99	55
2005	50	116	106	106	53
2010	43	134	112	112	49
2015	36	155	120	120	44
2020	28	176	128	128	36
2021	27	185	131	131	36
2022	27	196	135	135	36
2023	26	193	134	134	35
2024	24	211	141	141	34

Table A. 5-3. The fraction of swine and dairy cattle manure managed in liquid MMS

	Liquid manure, %		Liquid manure, % (Anaerobic digesters)	
	Swine	Dairy cattle	Swine	Dairy cattle
1990	16.00	12.00	-	-
1995	32.07	15.68	-	-
2000	48.13	19.35	-	-
2005	61.05	23.03	3.15	-
2010	76.47	26.71	3.80	-
2015	81.29	30.38	6.13	-
2020	55.51	34.21	34.16	-
2021	57.54	35.60	32.58	-
2022	56.53	36.74	34.04	0.05
2023	53.47	38.08	37.55	-
2024	52.95	38.82	38.52	0.45

Table A. 5-4. The number of breeding and market swine in the population, thous. head

Year	Breeding swine	Marked swine	Weight, kg
1990	257.5	2,319.9	64.8
1995	171.8	1,094.4	70.1
2000	84.2	811.7	63.9
2005	99.3	994.7	63.4

2010	84.1	844.7	63.4
2015	55.5	645.4	61.7
2020	44.3	521.3	61.6
2021	45.2	531.9	61.6
2022	42.2	503.4	61.5
2023	39.9	467.4	61.6
2024	39.9	457.1	61.9

Nutritional value of diet for cattle subcategories

Table A. 5 – 5. Nutritional standards for dairy cattle (Livestock manual¹)

Item	Quantity of milk/day (4% of milk fat, 3.4% of milk protein)		
	10	15	20
Dry matter, kg	12.7	15.1	17.0
Crude protein, g	1,524.0	2,038.0	2,550.0
Crude fat, g	279.0	362.0	459.0
Crude fiber, g	3,048.0	3,473.0	3,740.0
Nitrogen-free extract, g (in accordance by used feeds, identified based on the study data)	6,350.0	7,420.0	8,990.0

Table A. 5 – 6. Nutritional value of diet for dairy cattle (The study data²)

Item	Quantity of milk/day (4% of milk fat, 3.4% of milk protein)		
	25	15	25
Dry matter, kg	18.8	Dry matter, kg	18.8
Crude protein, g	2,914.0	Crude protein, g	2,914.0
Crude fat, g	602.0	Crude fat, g	602.0
Crude fiber, g	3,948.0	Crude fiber, g	3,948.0
Nitrogen-free extract, g	10,186.0	Nitrogen-free extract, g	10,186.0

Table A. 5 - 7. Nutritional value of diet for dairy cattle in 1990-2024

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	13.35	1,717.13	314.33	3,035.51	6,955.10
1995	12.53	1,529.95	271.15	2,915.18	6,442.19
2000	13.28	1,701.53	310.73	3,025.48	6,912.36
2005	13.96	1,857.52	346.72	3,125.75	7,339.79
2010	14.71	2,029.10	386.30	3,236.05	7,809.96
2015	15.59	2,231.87	433.09	3,366.41	8,365.61
2020	16.41	2,419.05	476.27	3,486.74	8,878.53
2021	16.78	2,504.84	496.07	3,541.89	9,113.61
2022	17.22	2,606.23	519.46	3,607.07	9,391.44
2023	17.12	2,582.83	514.06	3,592.03	9,327.33
2024	17.83	2,752.00	554.28	3,693.64	9,764.27

Table A. 5 - 8. Nutritional value of diet for Non-dairy cattle suckler cows

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
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¹ Gyvulininkystės žinynas. Baisogala (en. Livestock manual. Institute of Animal Science of LVA), 2007.

² Studija „Pašarų virškinamumo nacionalinių verčių nustatymas klasikiniu in vivo metodu, tobulinant Lietuvos šiltnamio efektą sukeliančių dujų apskaitos metodologiją“ (en. The study "Determination of national values of feed digestibility by the classic in vivo method, improving the Lithuanian greenhouse gas accounting methodology"), Baisogala, 2022

1997³	11.98	1,671.26	399.07	3,461.35	5,477.45
2000	12.28	1,701.23	402.45	3,442.22	5,774.96
2005	12.79	1,751.17	408.08	3,410.33	6,270.80
2010	13.29	1,801.12	413.71	3,378.45	6,766.64
2015	13.80	1,851.06	419.34	3,346.56	7,262.49
2020	14.30	1,901.01	424.97	3,314.68	7,758.33
2021-2024	14.40	1,911.00	426.10	3,308.30	7,857.50

Non-dairy cattle less than 1 year old

Table A. 5 - 9. Nutritional value of diet for Calves for slaughter

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	4.98	777.76	194.24	1,143.80	2,374.46
1995	5.05	751.20	190.47	1,181.96	2,462.73
2000	5.26	744.10	185.91	1,261.38	2,621.39
2005	5.49	739.16	181.54	1,344.56	2,787.37
2010	5.69	731.87	177.54	1,420.86	2,941.69
2015	5.93	727.20	172.76	1,508.78	3,115.66
2020	6.16	720.12	167.57	1,592.34	3,281.00
2021	6.19	717.67	166.75	1,605.07	3,307.14
2022	6.21	719.50	166.78	1,610.42	3,317.11
2023	6.20	719.16	166.79	1,609.37	3,315.18
2024	6.21	719.41	166.77	1,610.20	3,316.68

Table A. 5 – 10. Nutritional value of diet for Bulls for breeding

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	5.49	873.22	215.24	1,271.96	2,602.31
1995	5.62	849.73	207.12	1,331.40	2,726.03
2000	5.75	826.24	199.00	1,390.84	2,849.76
2005	5.88	802.76	190.88	1,450.29	2,973.48
2010	6.01	779.27	182.76	1,509.73	3,097.21
2015	6.14	755.78	174.64	1,569.17	3,220.93
2020	6.27	732.30	166.52	1,628.61	3,344.66
2021-2024	6.30	727.60	164.90	1,640.50	3,369.40

Table A. 5 – 11. Nutritional value of diet for Heifers for breeding

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	4.28	706.39	178.80	981.12	2,014.97
1995	4.60	709.81	176.56	1,087.47	2,233.43
2000	4.93	713.23	174.32	1,193.83	2,451.89
2005	5.26	716.65	172.07	1,300.18	2,670.34
2010	5.58	720.07	169.83	1,406.53	2,888.80
2015	5.91	723.49	167.59	1,512.88	3,107.25
2020	6.23	726.92	165.35	1,619.23	3,325.71
2021-2024	6.30	727.60	164.90	1,640.50	3,369.40

Non-dairy cattle from 1 to 2 years old

Table A. 5 - 12. Nutritional value of diet for Bulls

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
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³ Jukna Č., Jukna V. Mėšinių galvijų auginimas (en. Beef cattle rearing), 2004, Kaunas

1990	10.15	1475.66	322.92	2,497.39	4,754.25
1995	10.01	1410.23	309.95	2,483.70	4,786.63
2000	9.86	1344.80	296.98	2,470.01	4,819.01
2005	9.72	1279.37	284.01	2,456.32	4,851.39
2010	9.58	1213.94	271.04	2,442.62	4,883.76
2015	9.44	1148.52	258.07	2,428.93	4,916.14
2020	9.30	1083.09	245.09	2,415.24	4,948.52
2021-2024	9.27	1070.00	242.50	2,412.50	4,955.00

Table A. 5 – 13. Nutritional value of diet for Heifers for slaughter

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	8.60	1,236.08	296.71	2,253.01	3,707.39
1995	8.71	1,209.29	287.97	2,278.73	3,908.62
2000	8.82	1,182.51	279.22	2,304.46	4,109.85
2005	8.93	1,155.72	270.48	2,330.18	4,311.07
2010	9.03	1,128.93	261.74	2,355.91	4,512.30
2015	9.14	1,102.14	252.99	2,381.63	4,713.53
2020	9.25	1,075.36	244.25	2,407.36	4,914.75
2021-2024	9.27	1,070.00	242.50	2,412.50	4,955.00

Table A. 5 – 14. Nutritional value of diet for Heifers for breeding

Year		Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990		7.66	1,078.59	243.91	2,162.28	3,336.85
1995		7.92	1,077.20	243.69	2,202.64	3,597.84
2000		8.18	1,075.82	243.46	2,243.00	3,858.83
2005		8.44	1,074.43	243.23	2,283.36	4,119.82
2010		8.70	1,073.05	243.00	2,323.71	4,380.82
2015		8.96	1,071.66	242.77	2,364.07	4,641.81
2020		9.22	1,070.28	242.55	2,404.43	4,902.80
2021-2024		9.27	1,070.00	242.50	2,412.50	4,955.00

Non-dairy cattle 2 years old and older

Table A. 5 – 15. Nutritional value of diet for Dairy and non-dairy cattle sires bulls

Item	Dairy cattle sires bulls		Non-dairy cattle sires bulls	
	Accounting year			
	1990 - 2024		1990 - 2024	
Dry matter, kg	12.00		11.00	
Crude protein, g	1,746.30		1,605.76	
Crude fat, g	380.38		387.34	
Crude fiber, g	3,165.50		3,229.45	
Nitrogen-free extract, g	5,816.16		4,820.43	

Table A. 5 – 16. Nutritional value of diet for other bulls

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	9.89	1,450.75	317.38	2,497.85	4,556.17
1995	10.08	1,423.85	313.13	2,561.91	4,780.34
2000	10.28	1,396.96	308.87	2,625.96	5,004.50
2005	10.47	1,370.06	304.62	2,690.02	5,228.67
2010	10.67	1,343.17	300.36	2,754.08	5,452.83
2015	10.86	1,316.27	296.11	2,818.13	5,677.00
2020	11.06	1,289.38	291.85	2,882.19	5,901.17
2021-2024	11.10	1,284.00	291.00	2,895.00	5,946.00

Table A. 5 – 17. Nutritional value of heifer diet for slaughter

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	9.25	1,405.66	303.75	2,385.28	4,442.66
1995	9.55	1,386.04	301.69	2,467.49	4,685.14
2000	9.85	1,366.41	299.64	2,549.70	4,927.61
2005	10.15	1,346.79	297.58	2,631.92	5,170.08
2010	10.44	1,327.17	295.52	2,714.13	5,412.56
2015	10.74	1,307.55	293.47	2,796.34	5,655.03
2020	11.04	1,287.92	291.41	2,878.56	5,897.51
2021-2024	11.10	1,284.00	291.00	2,895.00	5,946.00

Table A. 5 – 18. Nutritional value of diet for breeding heifers

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	9.24	1,384.40	304.08	2,483.01	4,342.80
1995	9.54	1,368.20	301.97	2,549.46	4,601.38
2000	9.84	1,352.01	299.86	2,615.91	4,859.96
2005	10.14	1,335.82	297.75	2,682.36	5,118.54
2010	10.44	1,319.62	295.64	2,748.81	5,377.12
2015	10.74	1,303.43	293.53	2,815.26	5,635.70
2020	11.04	1,287.24	291.42	2,881.71	5,894.28
2021-2024	11.10	1,284.00	291.00	2,895.00	5,946.00

Table A. 5 – 19. Nutritional value of diet for non-dairy cattle other cow

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	11.87	1,700.03	389.10	3,247.83	5,168.79
1995	11.94	1,690.02	384.89	3,181.24	5,418.98
2000	12.01	1,680.02	380.68	3,114.66	5,669.18
2005	12.08	1,670.01	376.47	3,048.07	5,919.37
2010	12.15	1,660.01	372.26	2,981.49	6,169.57
2015	12.22	1,650.01	368.05	2,914.90	6,419.77
2020	12.29	1,640.00	363.84	2,848.32	6,669.96
2021-2024	12.30	1,638.00	363.00	2,835.00	6,720.00

Nutritional value of diet for swine subcategories

Breeding Sows

Table A. 5- 20. Nutritional value of diet for Mated

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	1.80	273.41	69.12	142.23	1,206.98
1995	1.82	285.30	68.37	131.11	1,229.57
2000	1.84	297.20	67.62	119.98	1,252.16
2005	1.86	309.09	66.87	108.86	1,274.76
2010	1.88	320.99	66.11	97.73	1,297.35
2015	1.90	332.89	65.36	86.61	1,319.95
2020	1.92	344.78	64.61	75.48	1,342.54
2021-2024	1.92	347.16	64.46	73.26	1,347.06

Table A. 5- 21. Nutritional value of diet for Nursing young

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	4.67	919.00	171.49	330.28	2,944.03

1995	4.70	918.47	182.05	311.02	2,979.34
2000	4.73	917.95	192.62	291.77	3,014.65
2005	4.75	917.43	203.18	272.51	3,049.96
2010	4.78	916.90	213.75	253.26	3,085.27
2015	4.81	916.38	224.31	234.01	3,120.58
2020	4.83	915.85	234.88	214.75	3,155.89
2021-2024	4.84	915.75	236.99	210.90	3,162.95

Replacement Sows

Table A. 5- 22. Nutritional value of diet for mated

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	1.89	305.19	78.06	150.40	1,231.32
1995	1.92	315.78	76.58	138.76	1,264.80
2000	1.94	326.36	75.09	127.13	1,298.28
2009	1.99	345.42	72.42	106.18	1,358.55
2010	1.99	347.54	72.12	103.86	1,365.25
2015	2.02	358.13	70.64	92.22	1,398.73
2020	2.04	368.71	69.16	80.59	1,432.21
2021-2024	2.05	370.83	68.86	78.26	1,438.91

Table A. 5- 23. Nutritional value of diet for Nursing young

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	5.43	1,055.98	196.15	383.65	3,430.78
1995	5.39	1,044.01	205.49	358.24	3,424.35
2000	5.35	1,032.03	214.83	332.83	3,417.92
2005	5.31	1,020.06	224.17	307.41	3,411.49
2010	5.27	1,008.09	233.52	282.00	3,405.06
2015	5.24	996.12	242.86	256.59	3,398.63
2020	5.20	984.14	252.20	231.18	3,392.20
2021-2024	5.19	981.75	254.07	226.10	3,390.91

Growing swine

Table A. 5- 24. Nutritional value of diet for piglets till 20 kg

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	0.68	156.29	14.29	25.84	429.07
1995	0.64	147.84	15.70	23.40	408.47
2000	0.61	139.38	17.12	20.96	387.87
2005	0.58	130.93	18.53	18.52	367.27
2010	0.54	122.48	19.95	16.08	346.68
2015	0.51	114.02	21.36	13.64	326.08
2020	0.48	105.57	22.78	11.20	305.48
2021-2024	0.47	103.88	23.06	10.71	301.36

Table A. 5- 25. Nutritional value of diet for growing pigs (20-50 kg)

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	1.53	305.42	52.19	78.28	996.58
1995	1.56	315.3	52.17	75.00	1,021.91
2000	1.59	325.1	52.15	71.71	1,047.24
2005	1.62	334.9	52.14	68.43	1,072.57
2010	1.65	344.8	52.12	65.15	1,097.90

2015	1.67	354.6	52.10	61.86	1,123.23
2020	1.70	364.5	52.08	58.58	1,148.56
2021-2024	1.71	366.42	52.08	57.92	1,153.63

Table A. 5- 26. Nutritional value of diet for growing pigs (50-80 kg)

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	2.28	385.25	72.69	114.67	1,582.47
1995	2.30	399.93	72.20	111.91	1,599.27
2000	2.33	414.62	71.71	109.15	1,616.07
2005	2.35	429.31	71.22	106.39	1,632.87
2010	2.38	443.99	70.73	103.64	1,649.68
2015	2.40	458.68	70.24	100.88	1,666.48
2020	2.43	473.36	69.75	98.12	1,683.28
2021-2024	2.43	476.30	69.65	97.57	1,686.64

Table A. 5- 27. Nutritional value of diet for growing pigs 80-110 kg

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	2.50	418.26	78.32	124.89	1,735.60
1995	2.52	434.15	77.88	121.83	1,750.86
2000	2.54	450.05	77.44	118.76	1,766.11
2005	2.57	465.95	77.00	115.69	1,781.37
2010	2.59	481.85	76.55	112.63	1,796.63
2015	2.61	497.75	76.11	109.56	1,811.88
2020	2.64	513.65	75.67	106.49	1,827.14
2021-2024	2.64	516.83	75.58	105.88	1,830.19

Table A. 5-28. Nutritional value of diet for pigs >110 kg (8 month and more)

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	2.43	408.14	76.94	121.66	1,682.98
1995	2.46	425.67	76.72	119.11	1,706.72
2000	2.50	443.20	76.50	116.57	1,730.47
2005	2.53	460.73	76.28	114.02	1,754.21
2010	2.56	478.26	76.06	111.48	1,777.95
2015	2.60	495.79	75.84	108.93	1,801.70
2020	2.63	513.32	75.62	106.39	1,825.44
2021-2024	2.64	516.83	75.58	105.88	1,830.19

Table A. 5- 29. Nutritional value of diet for gilts for breed

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	1.93	341.14	73.16	137.64	1,220.78
1995	2.00	353.82	73.93	129.73	1,286.57
2000	2.06	366.50	74.70	121.82	1,352.37
2005	2.12	379.18	75.47	113.90	1,418.17
2010	2.18	391.86	76.24	105.99	1,483.97
2015	2.25	404.53	77.01	98.08	1,549.76
2020	2.31	417.21	77.79	90.16	1,615.56
2021-2024	2.32	419.75	77.94	88.58	1,628.72

Boars

Table A. 5- 30. Nutritional value of diet for mature

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	2.12	389.95	79.82	165.90	1,349.83
1995	2.20	408.37	81.22	158.84	1,409.54
2000	2.27	426.79	82.62	151.78	1,469.24
2005	2.34	445.21	84.02	144.72	1,528.95
2010	2.42	463.63	85.42	137.66	1,588.65
2015	2.49	482.05	86.82	130.60	1,648.35
2020	2.57	500.48	88.22	123.54	1,708.06
2021-2024	2.58	504.16	88.50	122.13	1,720.00

Table A. 5- 31. Nutritional value of diet for young for breed

Year	Dry matter, kg	Crude protein, g	Crude fat, g	Crude fibre, g	Nitrogen-free extract, g
1990	2.18	391.76	85.71	161.50	1,346.76
1995	2.21	403.00	84.95	153.48	1,382.86
2000	2.24	414.24	84.19	145.46	1,418.96
2005	2.27	425.47	83.43	137.44	1,455.06
2010	2.30	436.71	82.67	129.42	1,491.17
2015	2.33	447.95	81.91	121.40	1,527.27
2020	2.35	459.18	81.15	113.38	1,563.37
2021-2024	2.36	461.43	81.00	111.78	1,570.59

Average diet nutrition indicators for different livestock categories

Average diet nutrition indicators that were used to estimate gross energy for different livestock categories (dairy cattle, non-dairy cattle, swine and sheep)

Table A. 5-32. Digestibility coefficients for cattle diet, %

Item	Cattle less 1 year	Cattle from 1 to 2 years	Cattle 2 years and older	Dairy cows	Suckling cows	Other cows
Dry matter	63.97	65.13	65.13	67.68	66.51	66.51
Crude protein	53.97	55.84	55.84	65.21	64.95	64.95
Crude fat	59.85	62.70	62.70	60.57	60.06	60.06
Crude fiber	60.39	63.65	63.65	63.94	61.97	61.97
Nitrogen-free extract	71.51	72.45	72.45	73.20	72.50	72.50
Organic matter	66.20	67.79	67.79	69.59	67.64	67.64

Table A.5-33. Digestibility coefficients for swine diet, %

Sub-category of swine	Dry matter	Crude protein	Crude fat	Crude fiber	Nitrogen-free extract	Organic matter
Piglets till 20 kg	83.62	85.92	68.04	25.14	87.65	86.27
Growing pigs 20-50 kg	83.62	85.92	68.04	25.14	87.65	86.27
Growing pigs 50-80 kg	83.27	85.18	67.99	22.24	89.55	85.08
Growing pigs 80-110 kg	83.50	87.15	68.75	23.66	88.96	85.32
Pigs >8 month	83.50	87.15	68.75	23.66	88.96	85.32
Sows main mated	81.15	82.55	70.59	22.32	87.17	83.12
Sows main nursing young	81.15	82.55	70.59	22.32	87.17	83.12
Sows replacement mated	81.15	82.55	70.59	22.32	87.17	83.12
Sows replacement nursing young	81.15	82.55	70.59	22.32	87.17	83.12
Gilts for breeding	81.15	82.55	70.59	22.32	87.17	83.12
Boars Young for breeding	81.15	82.55	70.59	22.32	87.17	83.12
Boars mature	81.15	82.55	70.59	22.32	87.17	83.12

Table A. 5- 34. Nutritional value of diet for sheep subcategories in 1990-2024

Sub-category	Crude protein g/day	Crude fat g/day	Crude fiber g/day	Nitrogen-free Extracts g/day	DM kg/day
Mature ewes	254.55	56.20	461.03	882.67	1.78
Ewe over 1 years	215.95	48.37	377.40	765.12	1.51
Ewe to 1 years	133.56	33.33	213.64	460.75	0.90
Lambs to 1 years	117.69	29.66	164.94	406.31	0.77
Mature Rams	274.25	61.95	491.65	997.91	1.96
Rams over 1 years	247.55	56.05	438.96	886.06	1.75

Agricultural soils

All activity data used to estimate annual amount of N in crop residues (above and below ground), including N-fixing crops, and from forage/pasture renewal, returned to soils are provided in the tables below.

Table A.5-35. Harvested annual dry matter yield

	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
CROP(T)	kg d.m. ha ⁻¹										
Winter Wheat	2,943	2,117	3,083	3,338	2,927	4,910	4,857	4,132	4,213	4,274	4,613
Spring Wheat	2,208	2,193	2,265	2,803	2,634	3,622	3,475	2,557	2,943	2,522	2,713
Triticale	2,169	1,806	2,247	2,332	2,046	3,303	3,270	2,379	2,789	2,653	2,956
Rye	2,450	1,554	2,047	1,861	1,512	2,389	2,557	2,092	2,075	2,029	2,045
Barley	2,607	1,427	2,121	2,365	2,041	3,448	3,684	2,974	3,372	3,058	3,358
Oats	2,232	1,242	1,652	1,690	1,397	2,192	2,259	1,584	1,992	1,825	1,887
Grain maize	2,543	2,543	2,543	2,721	5,754	4,146	6,033	5,030	4,565	6,978	6,772
Winter Rape	2,060	1,267	2,051	2,338	1,820	3,223	3,168	2,738	2,397	2,473	2,429
Spring Rape	931	1,265	1,284	1,487	1,345	1,780	1,960	1,433	1,392	1,259	1,311
Flax	408	423	270	400	430	860	645	753	645	773	703
Buckwheat	581	523	772	482	627	855	818	570	644	742	847
Mixed cereals	2,335	1,338	1,573	1,600	1,510	2,130	2,023	1,579	1,956	2,220	2,056
Other cereals	1,720	1,720	3,440	1,290	1,106	860	1,147	1,023	938	1,060	1,018
Peas	2,389	1,625	1,752	1,524	1,349	2,477	2,103	1,693	1,831	1,806	1,907
Beans	1,251	1,959	1,679	1,295	1,433	2,696	3,224	1,539	3,277	2,042	2,228
Soya beans	753	753	753	753	753	573	1,082	1,228	970	1,190	1,660
Lupines	631	1,013	768	912	591	1,171	902	785	880	1,076	1,006
Vetches	2,061	1,597	1,445	1,488	1,270	1,852	1,003	860	1,107	873	725
Mixed dried pulses	1,618	1,618	1,618	1,609	1,437	1,964	1,864	1,728	1,895	1,629	1,711
Potatoes	3,114	2,850	3,650	2,692	2,867	3,737	3,449	2,867	3,269	3,981	3,953
Sugar beet	6,564	6,580	7,350	8,781	10,624	11,679	15,583	13,401	14,436	16,604	16,073
Fodder beet	6,175	4,249	4,488	4,026	3,264	3,785	2,788	2,563	2,688	4,295	4,684
Field vegetables (carrot, beetroot)	2,615	2,615	2,615	2,195	2,089	3,011	3,111	3,890	3,856	3,101	4,100
Alfalfa (for hay)	IE	IE	IE	3	2	2	4	2	3	4	3
Alfalfa (for green fodder, silage)	IE	IE	IE	6	7	4	6	5	5	5	5
Clover and their mixture (for hay)	IE	IE	IE	4	3	3	2	3	3	2	2
Clover and their mixture (for green fodder, silage)	IE	IE	IE	2	6	4	4	4	5	4	4
Silage crops	5	4	5	5	3	4	4	3	4	3	5
Maize for silage and green fodder	8,372	7,693	8,403	7,338	8,758	7,923	8,539	8,292	7,978	8,660	9,576
Annual grasses (for hay)	611	1,068	878	620	2,550	2,550	3,168	1,983	4,144	1,549	2,441
Annual grasses (for haylage)	5,411	7,587	6,648	3,708	4,190	2,975	3,313	3,232	3,492	2,254	3,087
Perennial grasses (for hey)	2,773	3,113	2,651	IE	IE	IE	IE	IE	IE	IE	IE

Perennial grasses heylage harvested	3,726	4,183	3,562	IE	IE	IE	IE	IE	IE	IE	IE
Perennial grasses (excl. alfalfa and clovers and their mixtures) (for hay)	IE	IE	IE	2,774	2,330	2,246	2,730	2,604	2,853	1,617	1,970
Perennial grasses (excl. alfalfa and clovers and their mixtures) (for green fodder and silage)	IE	IE	IE	1,716	4,047	2,964	3,695	3,311	4,220	2,309	2,931
Perennial pastures (for hay)	975	2,675	2,312	2,215	1,951	2,031	2,268	2,192	2,548	1,532	1,728
Perennial pastures (for silage and green fodder)	828	2,272	1,964	1,109	3,288	2,232	2,847	2,727	2,597	1,425	1,787
Meadows and natural pastures (for hey)	3,320	3,320	3,320	2,098	1,769	1,977	2,154	2,167	1,897	1,715	1,734
Meadows and natural pastures (for silage and green fodder)	3,489	3,489	3,489	1,352	2,766	2,172	2,508	2,024	2,106	1,709	1,999

Table A.5-36. Total annual area harvested

	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
AREA (T)	ha yr⁻¹										
Winter Wheat	34,3728	248,496	283,216	295,914	367,400	573,000	751,900	787,400	842,000	833,242	714,502
Spring Wheat	2,883	10,039	84,391	70,773	150,200	263,200	141,700	156,700	104,700	107,052	122,468
Triticale	13,357	22,185	50,089	74,147	108,600	122,000	115,000	74,500	63,098	67,215	81,878
Rye	165,046	132,410	130,837	50,035	49,500	38,800	37,000	26,100	29,471	28,088	25,434
Barley	394,701	537,422	348,608	344,858	231,800	202,400	164,800	144,700	133,124	159,430	191,720
Oats	75,388	46,168	43,148	58,050	57,800	64,100	104,900	92,400	80,361	91,749	107,880
Grain maize	2,807	2,807	2,807	1,549	7,100	11,700	20,200	17,900	18,800	11,255	14,190
Winter Rape	10,616	3,539	5,308	28,409	89,300	123,100	272,300	293,200	333,239	298,097	321,278
Spring Rape	393	10,125	49,248	79,132	162,600	40,400	11,300	17,300	15,185	6,844	7,320
Flax	21,500	13,200	8,600	4,300	400	300	800	800	800	789	779
Buckwheat	296	987	16,384	28,031	19,200	36,700	39,100	48,600	57,300	41,589	37,137
Mixed cereals	6,888	15,744	10,824	20,959	19,700	17,000	7,500	7,844	5,891	4,392	5,094
Other cereals	100	100	200	200	700	200	300	365	953	473	664
Peas	40,850	11,326	24,394	11,906	27,100	79,400	61,800	61,500	71,500	71,148	97,479
Beans	3,162	1,186	1,383	3,853	3,000	61,400	58,400	76,200	55,300	80,260	90,333
Soya beans	800	800	800	800	800	2,700	2,100	1,541	2,040	1,234	1,057
Lupines	2,452	849	1,792	4,621	9,900	3,600	4,100	4,600	4,300	3,665	5,015
Vetches	27,200	9,800	10,000	2,600	2,100	1,300	600	800	1,243	1,090	3,194
Mixed dried pulses	8,184	8,184	8,184	12,076	7,600	11,300	7,300	8,958	9,714	11,423	15,350
Potatoes	111,150	123,006	107,988	73,112	36,600	23,500	19,300	15,700	15,600	15,168	15,105
Sugar beet	31,972	24,203	27,589	20,916	15,300	12,200	14,000	14,700	11,600	14,423	16,025
Fodder beet	52,061	61,822	37,419	11,197	1,500	1,300	200	323	192	127	115
Field vegetables (carrot, beetroot)	12,300	12,300	12,300	8,800	4,200	3,700	4,200	3,900	4,063	3,576	4,197
Alfalfa (for hay)	IE	IE	IE	952	600	1,700	3,700	3,732	3,146	2,717	1,832
Alfalfa (for green fodder, silage)	IE	IE	IE	3,384	3,000	5,500	8,700	11,352	12,520	12,423	18,088
Clover and their mixture (for hay)	IE	IE	IE	60,278	15,700	14,100	15,400	15,900	13,500	12,089	13,038

Clover and their mixture (for green fodder, silage)	IE	IE	IE	100,502	18,300	28,000	25,800	34,325	33,041	31,329	42,811
Silage crops	82,700	13,600	5,500	7,300	1,100	4,000	4,200	4,200	3,800	3,603	3,462
Maize for silage and green fodder	77,800	4,200	10,300	13,900	17,600	29,200	29,900	29,400	32,900	39,567	42,514
Annual grasses (for hay)	9,328	3,898	2,226	5,755	5,00	300	1100	300	800	1,433	743
Annual grasses (for haylage)	93,131	38,922	22,228	57,460	6,700	7,600	9,000	9,000	8,400	8,248	12,959
Perennial grasses (for hey)	257,946	168,269	109,982	IE	IE	IE	IE	IE	IE	IE	IE
Perennial grasses heylage harvested	212,602	138,689	90,648	IE	IE	IE	IE	IE	IE	IE	IE
Perennial grasses (excl. alfalfa and clovers and their mixtures) (for hay)	IE	IE	IE	122,448	232,900	158,700	72,300	36,500	44,900	61,978	66,611
Perennial grasses (excl. alfalfa and clovers and their mixtures) (for green fodder and silage)	IE	IE	IE	90,512	150,100	120,500	72,700	74,000	74,400	64,514	79,254
Perennial pastures (for hay)	373,977	322,985	394,777	367,822	209,600	273,100	227,200	300,500	273,200	22,0662	214,811
Perennial pastures (for silage and green fodder)	185,565	160,263	195,886	182,511	68,400	237,500	158,500	125,200	133,200	14,1340	129,882
Meadows and natural pastures (for hey)	244,747	150,721	86,925	82,510	99,400	95,500	23,600	38,800	44,400	20,030	27,192
Meadows and natural pastures (for silage and green fodder)	81,850	50,405	29,070	27,594	21,700	30,200	13,200	12,400	17,800	12,569	12,569

Table A.5-37. Ratio of above-ground residues dry matter to harvested yield

	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
R_{AG(T)}	kg d.m.										
Winter Wheat	0.80	0.65	0.81	0.84	0.79	0.95	0.94	0.90	0.91	0.91	0.93
Spring Wheat	1.16	1.16	1.15	1.12	1.13	1.08	1.09	1.13	1.11	1.13	1.12
Triticale	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
Rye	1.67	1.70	1.68	1.69	1.71	1.67	1.66	1.68	1.68	1.68	1.68
Barley	0.99	1.10	1.02	1.00	1.03	0.96	0.95	0.97	0.96	0.97	0.96
Oats	1.50	1.07	1.31	1.33	1.18	1.49	1.51	1.28	1.44	1.38	1.40
Grain maize	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14
Winter Rape	1.81	1.21	1.81	1.93	1.69	2.16	2.15	2.05	1.95	1.98	1.96
Spring Rape	0.64	1.21	1.23	1.44	1.30	1.66	1.76	1.39	1.35	1.20	1.26
Flax	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30

Buckwheat	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Mixed cereals	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
Other cereals	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
Peas	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
Beans	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20
Soya beans	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
Lupines	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Vetches	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Mixed dried pulses	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
Potatoes	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Sugar beet	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Fodder beet	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Field vegetables (carrot, beetroot)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Alfalfa (for hay)	IE	IE	IE	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Alfalfa (for green fodder, silage)	IE	IE	IE	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Clover and their mixture (for hay)	IE	IE	IE	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Clover and their mixture (for green fodder, silage)	IE	IE	IE	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Silage crops	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Maize for silage and green fodder	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Annual grasses (for hay)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Annual grasses (for haylage)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Perennial grasses (for hey)	0.30	0.30	0.30	IE	IE	IE	IE	IE	IE	IE	IE
Perennial grasses heylage harvested	0.30	0.30	0.30	IE	IE	IE	IE	IE	IE	IE	IE
Perennial (excl. alfalfa and clovers and their mixtures) (for hay)	IE	IE	IE	0.30	0.30	0.30	0.3	0.3	0.3	0.3	0.3
Perennial (excl. alfaalfa and clovers and their mixtures) (for green fodder and silage)	IE	IE	IE	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Perennial pastures (for hay)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Perennial pastures (for silage and green fodder)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Meadows and natural pastures (for hey)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Meadows and natural pastures (for silage and green fodder)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30

Table A.5-38. Ratio of below-ground residues to harvested yield

	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024
R_{BG(T)}	kg d.m.										
Winter Wheat	0.41	0.38	0.42	0.42	0.41	0.45	0.45	0.44	0.44	0.44	0.44
Spring Wheat	0.60	0.60	0.60	0.59	0.60	0.58	0.58	0.60	0.59	0.60	0.59
Triticale	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51

Rye	0.59	0.59	0.59	0.59	0.60	0.59	0.59	0.59	0.59	0.59	0.59
Barley	0.44	0.46	0.44	0.44	0.45	0.43	0.43	0.43	0.43	0.43	0.43
Oats	0.63	0.52	0.58	0.58	0.54	0.62	0.63	0.57	0.61	0.60	0.60
Grain maize	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47
Winter Rape	0.84	0.66	0.84	0.88	0.81	0.95	0.95	0.92	0.88	0.89	0.89
Spring Rape	0.49	0.66	0.67	0.73	0.69	0.80	0.83	0.72	0.71	0.66	0.68
Flax	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Buckwheat	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
Mixed cereals	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Other cereals	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Peas	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
Beans	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
Soya beans	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Lupines	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Vetches	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Mixed dried pulses	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Potatoes	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Sugar beet	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Fodder beet	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Field vegetables (carrot, beetroot)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Alfalfa (for hay)	IE	IE	IE	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
Alfalfa (for green fodder, silage)	IE	IE	IE	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
Clover and their mixture (for hay)	IE	IE	IE	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Clover and their mixture (for green fodder, silage)	IE	IE	IE	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Silage crops	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Maize for silage and green fodder	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Annual grasses (for hay)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Annual grasses (for haylage)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Perennial grasses (for hay)	2.00	2.00	2.00	IE	IE	IE	IE	IE	IE	IE	IE
Perennial grasses heylage harvested	2.00	2.00	2.00	IE	IE	IE	IE	IE	IE	IE	IE
Perennial grasses (excl. alfalfa and clovers and their mixtures) (for hay)	IE	IE	IE	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Perennial (excl. alfalfa and clovers and their mixtures) (for green fodder and silage)	IE	IE	IE	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Perennial pastures (for hay)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Perennial pastures (for silage and green fodder)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Meadows and natural pastures (for hay)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Meadows and natural pastures (for silage and green fodder)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Table A.5-39. Other relevant parameters used for annual N in crop residues

	DRY	N _{AG(T)}	N _{BG(T)}	R _{BG-BIO(T)}	Frac _{REMOVE}	Frac _{RENEW}	Area burnt	Slope	Intercept	R _{AG(T)}	R _{BG(T)}	Emission factor
	kg d.m.	kg N	kg N	kg d.m.	kg N	-	-	-	-	kg d.m.	kg d.m.	kg N _{2O-N}
Non-N-fixing grain crops												
Winter Wheat	0.86	0.005	0.004	0.23	*	1	0	1.17	-1.1	Calculated	Calculated	0.01
Spring Wheat	0.86	0.008	0.005	0.28	*	1	0	0.96	0.44	Calculated	Calculated	0.01
Triticale	0.86	0.006	0.005	0.22	*	1	0	-	-	1.3	Calculated	0.01
Rye	0.86	0.006	0.005	0.22	*	1	0	1.6	0.16	Calculated	Calculated	0.01
Barley	0.86	0.006	0.005	0.22	*	1	0	0.86	0.34	Calculated	Calculated	0.01
Oats	0.86	0.007	0.005	0.25	*	1	0	2.05	-1.22	Calculated	Calculated	0.01
Grain maize	0.86	0.008	0.005	0.22	0	1	0	-	-	1.14	Calculated	0.01
Winter Rape	0.915	0.007	0.006	0.3	0	1	0	2.78	-1.99	Calculated	Calculated	0.01
Spring Rape	0.915	0.008	0.006	0.3	0	1	0	2.78	-1.99	Calculated	Calculated	0.01
Flax	0.86	0.006	0.005	0.22	0	1	0	-	-	1.3	Calculated	0.01
Buckwheat	0.86	0.007	0.005	0.22	0	1	0	-	-	2.3	Calculated	0.01
Mixed cereals	0.86	0.006	0.005	0.22	0	1	0	-	-	1.3	Calculated	0.01
Other cereals	0.86	0.006	0.005	0.22	0	1	0	-	-	1.3	Calculated	0.01
N fixing grains and pulses												
Peas	0.86	0.0167	0.0243	0.19	0	1	0	-	-	1.4	Calculated	0.01
Beans	0.86	0.012	0.016	0.19	0	1	0	-	-	2.2	Calculated	0.01
Soya beans	0.86	0.014	0.02	0.19	0	1	0	-	-	1.75	Calculated	0.01
Lupines	0.86	0.0136	0.0227	0.19	0	1	0	-	-	1.6	Calculated	0.01
Vetches	0.06	0.0129	0.02	0.19	0	1	0	-	-	1.6	Calculated	0.01
Mixed dried pulses	0.86	0.014	0.02	0.19	0	1	0	-	-	1.7	Calculated	0.01
Root/tuber crops												
Potatoes	0.22	0.014	0.0125	0.2	0	1	0	-	-	0.2	Calculated	0.01
Sugar beet	0.23	0.03	0.014	0.2	0	1	0	-	-	0.5	Calculated	0.01
Fodder beet	0.12	0.03	0.014	0.2	0	1	0	-	-	0.3	Calculated	0.01
Field vegetables	0.13	0.022	0.014	0.2	0	1	0	-	-	0.3	Calculated	0.01
N fixing forage crops												
Alfalfa hay	0.85	0.025	0.017	-	0	0.25	0	0.29	0	Calculated	1.7	0.01
Alfalfa haylage	0.35	0.025	0.017	-	0	0.25	0	0.29	0	Calculated	1.7	0.01
Clover and their mixture hay	0.85	0.025	0.016	-	0	0.3	0	0.3	0	Calculated	0.9	0.01
Clover and their mixture haylage	0.35	0.025	0.016	-	0	0.3	0	0.3	0	Calculated	0.9	0.01
Silage crops	0.3	0.008	0.022	0.4	0	1	0	0.3	0	Calculated	Calculated	0.01
Other industrial and forage crops, including annual and perennial pastures and meadows												
Maize for silage and green fodder	0.3	0.008	0.012	0.54	0	1	0	0.3	0	Calculated	Calculated	0.01
Annual grasses hay	0.85	0.015	0.012	-	0	1	0	0.3	0	Calculated	0.6	0.01
Annual grasses haylage	0.35	0.015	0.012	-	0	1	0	0.3	0	Calculated	0.6	0.01
Perennial grasses (excl. alfalfa, clover and their mixture) hay	0.85	0.02	0.015	-	0	0.2	0	0.3	0	Calculated	2	0.01
Perennial grasses (excl. alfalfa, clover and their mixture) haylage	0.35	0.02	0.015	-	0	0.2	0	0.3	0	Calculated	2	0.01
Perennial pasutes hay	0.85	0.02	0.015	-	0	0.07	0	0.3	0	Calculated	2	0.01
Perennial pastures haylage	0.35	0.02	0.015	-	0	0.07	0	0.3	0	Calculated	2	0.01
Meadows and natural pastures hay	0.85	0.02	0.015	-	0	0.07	0	0.3	0	Calculated	2	0.01

Meadows and natural pastures haylage	0.35	0.02	0.015	-	0	0.07	0	0.3	0	Calculated	2	0.01
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*Data provided in the Table A.5-40

Table A.5-40. N content in above-ground residues and N content in residues removed from fields

Year	N content in total amount of above ground residue, kg N yr	N content in total amount of above ground residues removed from field, kg N yr	Frac _{REMOVE} (from wheat, barley, triticale, oats and rye), %
1990	16,238,583	10,807,885	67%
1995	9,11,857	6,453,882	66%
2000	14,070,493	4,713,117	33%
2005	14,039,613	4,398,563	31%
2010	13,914,874	3,942,874	28%
2015	31,110,025	3,532,137	11%
2020	31,358,833	3,140,129	10%
2021	24,088,924	3,012,599	13%
2022	25,040,531	2,984,917	12%
2023	25,128,267	2,945,847	12%
2024	26,460,915	2,857,596	11%

ANNEX X. Summary of the study on estimation of nitrous oxide (N₂O) emissions from the crop residues category

Following the requirements of the United Nations Framework Convention on Climate Change (UNFCCC), Kyoto protocol, Regulation (EU) No 525/2013 of the European Parliament and of the Council, Member States have to submit their annual national greenhouse gas inventory reports to UNFCCC secretariat and European Commission (EC). GHG inventory agriculture sector must include N₂O emissions from crop residues estimated following 2006 IPCC Guidelines. The default methodology presented in the 2006 IPCC Guidelines for the assessment of N₂O emissions is based on the application of standard coefficients and values, thus it has a rather limited ability to represent country specific conditions in Lithuania and properly describe nitrogen amounts introduced to soil with crop residues. To follow the country's GHG emissions reduction progress, it is crucially important that GHG emissions are accounted for with the adequate accuracy. For this reason, countries are encouraged to develop their own methodologies, ensuring that calculation parameters represent country specific conditions.

In Lithuania, to quantify N₂O emissions from the crop residues two methodologies have been employed so far: by 2015, methodology provided in 2006 IPCC Guidelines was used for the assessment and later, for compilation of inventories for 2015, 2016, and 2017, alternative methodology was elaborated for better and more precise N₂O emissions accounting. The alternative methodology anticipated a modified way of N₂O emission assessment and was partly based on the nationally derived coefficients and parameters.

Lithuanian Environmental Protection Agency (EPA) experts however observe that these two methodologies come out with significantly different results. The assessment based on the 2006 IPCC Guidelines provides N₂O emission estimate which is by around 100 kt CO₂ eq larger if compared with the alternative methodology calculation results.

In relation to this, the main objective of the study was to identify the reasons and sources for errors and inconsistencies in previously used N₂O accounting methodologies and to elaborate revised national methodology for the assessment of N₂O emissions from the sub-category of crop residues in Lithuania that would cover main crops under the following crop groups 1. Non-N-fixing grain crops; 2. N-fixing grains and pulses; 3. Root and tuber crops; 4. N-fixing forage crops; 5. Other forages including perennial grasses and grass/clover pastures.

The initial stage of the study covered an extensive review and analysis of Lithuanian research studies and field experiments to retrieve national parameters for the assessment of N₂O emissions from crop residues. The analysis focused on available national data about crop above ground and below ground biomass, biomass nitrogen contents, residue management practices. The overview has covered all main crops under 5 groups of crops as suggested by the 2006 IPCC Guidelines.

In the next stage, a detailed analysis of methodologies used in Lithuania for N₂O emission assessment so far (i.e. methodology based on 2006 IPCC Guidelines and the alternative methodology) was conducted where input data and parameters of these methodologies were validated against available national data. This analysis has reveal that both methodologies possess some inconsistencies and shortcomings that may consequently lead to inaccurate and biased calculation results.

Some essential differences were observed when comparing parameter values recommended by 2006 IPCC Guidelines and those defined in the national studies. The largest difference was detected for above ground biomass parameters of the most popular crops (wheat, triticale, rye, barley, oat). The main reason for such inconsistency could be the fact that 2006 IPCC Guidelines rely on rather old and USA research based coefficients that eventually revealed as not suitable to describe nowadays crop production trends in Lithuania.

The alternative methodology which was developed to improve N₂O calculations by integrating more national parameters has demonstrated poor performance because of mistakes in the assessment of below ground biomass.

Taking into account shortcomings and gaps of both tested methodologies the study proposes revised national parameters for the assessment of N₂O emissions from crop residues in Lithuania. Emissions are developed according 2006 IPCC Guidelines; Equation 11.2 of the Guidelines which is simplified accounting for no burning of crop residues in Lithuania:

$$F_{CR} = \sum_T \{Crop_{(T)} * Frac_{Renew(T)} * Area_{(T)} [R_{AG(T)} * N_{AG(T)} * (1 - Frac_{Remove(T)}) + R_{BG(T)} * N_{BG(T)}]\}$$

here:

- F_{CR} - annual amount of N in crop residues (above and below ground), including N-fixing crops, and from forage/ pasture renewal, returned to soils annually, kg N/ year
- T - crop or forage type
- $Crop_{(T)}$ - harvested annual dry matter yield for crop T, kg d.m. / ha
- $Area_{(T)}$ - total annual area harvested of crop T, ha / year
- $Frac_{Renew(T)}$ - fraction of total area under crop T that is renewed annually. For countries where pastures are renewed on average every X years, $Frac_{Renew} = 1/X$. For annual crops $Frac_{Renew} = 1$
- $R_{AG(T)}$ - ratio of above-ground residues dry matter ($AG_{DM(T)}$) to harvested yield for crop T ($Crop_{(T)}$), $kg\ d.m. / kg\ d.m. = AG_{DM(T)} * 1000 / Crop_{(T)}$; $AG_{DM(T)} = (Crop_{(T)} / 1000) * a_{(T)} + b_{(T)}$
- $N_{AG(T)}$ - N content of above-ground residues for crop T, kg N / kg d.m.
- $Frac_{Remove(T)}$ - fraction of above-ground residues of crop T removed annually for purposes such as feed, bedding and construction, kg N / kg crop-N
- $R_{BG(T)}$ - ratio of belowground residues to harvest yield for crop T, kg d.m. / kg d. If alternative data is not available, $R_{BG(T)}$ can be calculated as $= R_{BG-BIO} * ((AG_{DM(T)} * 1000 / Crop_{(T)}) / Crop_{(T)})$
- $N_{BG(T)}$ - N content of below-ground residues for crop T, kg N / kg d.m.

Methodology integrates all available national data in order to ensure better assessment accuracy under the local conditions. Only in calculation stages for which national data is not available, it is recommended to use parameters from 2006 IPCC Guidelines.

Crops which are included into accounting and proposed calculation parameters are listed in the Table below.

In future, when new data is obtained, proposed parameters will need to be further revised by putting special emphasis on parameters which, according to sensitivity analysis, mostly affect accuracy of the N₂O emission assessment. Results of the latest investigations will need to be considered to revise linear regression coefficients describing ratios between above-ground residue biomass and harvested crop yields.

To improve assessment accuracy it would be useful to conduct representative field measurements of above-ground and below-ground biomass under different farming practices and crop productivity conditions. Today, no reliable information is available on usage of straw. Survey of farmers would help to answer the question which part of the residue is left on the fields after the harvest and which factors have impact on straw usage patterns in the country.

The study reveals that national data on grassland contribution to soil nitrogen pool is still rather poor. For better assessment of N₂O emissions from grasslands and meadows a representative study investigating composition and usage of grasslands, root biomass of grasslands of different age and productivity or ratios between root biomass and hay, silage or green fodder production would be very useful. In future Crop structure changes should be considered and new crops included into account, if needed.

Crops	DRY	$Frac_{Renew(T)}$	$R_{AG(T)}$	$a_{(T)}$	$b_{(T)}$	$Frac_{Remove(T)}$	$R_{BG(T)}$	R_{BG-BIO}	$N_{AG(T)}$	$N_{BG(T)}$
1. Non-N-fixing grain crops										
Winter Wheat	0.86	1	to be calculated	1.17	-1.1	0.3	to be calculated	0.23	0.005	0.004
Spring Wheat	0.86	1	to be calculated	0.96	0.44	0.3	to be calculated	0.28	0.008	0.005
Triticale	0.86	1	1.3	-	-	0.3	to be calculated	0.22	0.006	0.005
Rye	0.86	1	to be calculated	1.6	0.16	0.3	to be calculated	0.22	0.006	0.005
Barley	0.86	1	to be calculated	0.86	0.34	0.3	to be calculated	0.22	0.006	0.005
Oats	0.86	1	to be calculated	2.05	-1.22	0.3	to be calculated	0.25	0.007	0.005
Grain maize	0.86	1	1.14	-	-	0.3	to be calculated	0.22	0.008	0.005
Winter Rape	0.915	1	to be calculated	2.78	-1.99	0.3	to be calculated	0.3	0.007	0.006
Spring Rape	0.915	1	to be calculated	2.78	-1.99	0.3	to be calculated	0.3	0.008	0.006
Flax	0.86	1	1.3	-	-	0.3	to be calculated	0.22	0.006	0.005
Buckwheat	0.86	1	2.3	-	-	0.3	to be calculated	0.22	0.007	0.005
Mixed cereals	0.86	1	1.3	-	-	0.3	to be calculated	0.22	0.006	0.005
Other cereals	0.86	1	1.3	-	-	0.3	to be calculated	0.22	0.006	0.005
2. N fixing grains and pulses										
Peas	0.86	1	1.4	-	-	0	to be calculated	0.19	0.0167	0.0243
Beans	0.86	1	2.2	-	-	0	to be calculated	0.19	0.012	0.016
Soya beans	0.86	1	1.75	-	-	0	to be calculated	0.19	0.014	0.02
Lupines	0.86	1	1.6	-	-	0	to be calculated	0.19	0.0136	0.0227
Vetches	0.86	1	1.6	-	-	0	to be calculated	0.19	0.0129	0.02
Mixed dried pulses	0.86	1	1.7	-	-	0	to be calculated	0.19	0.014	0.02
3. Root/tuber crops										
Potatoes	0.22	1	0.2	-	-	0	to be calculated	0.2	0.014	0.0125
Sugar beet	0.23	1	0.5	-	-	0	to be calculated	0.2	0.03	0.014
Fodder beet	0.12	1	0.3	-	-	0	to be calculated	0.2	0.03	0.014
Field vegetables	0.13	1	0.3	-	-	0	to be calculated	0.2	0.022	0.014
4. N fixing forage crops										
Alfalfa (for hay)	0.85	0.25	to be calculated	0.29	0	0	1.7	-	0.025	0.017
Alfalfa (for green fodder, silage)	0.35	0.25	to be calculated	0.29	0	0	1.7	-	0.025	0.017
Clover and their mixtures (for hay)	0.85	0.3	to be calculated	0.3	0	0	0.9	-	0.025	0.016
Clover and their mixtures (for green fodder and silage)	0.35	0.3	to be calculated	0.3	0	0	0.9	-	0.025	0.016
Silage crops	0.3	1	to be calculated	0.3	0	0	to be calculated	0.4	0.008	0.022
5. Other industrial and forage crops, including annual and perennial pastures and meadows										

Crops	DRY	$Frac_{Renew}(T)$	$R_{AG}(T)$	$a_{(T)}$	$b_{(T)}$	$Frac_{Remove}(T)$	$R_{BG}(T)$	R_{BG-BIO}	$N_{AG}(T)$	$N_{BG}(T)$
Maize for silage and green fodder	0.3	1	to be calculated	0.3	0	0	to be calculated	0.54	0.008	0.012
Annual grasses (for hay)	0.85	1	to be calculated	0.3	0	0	0.6	-	0.015	0.012
Annual grasses (for hay)	0.35	1	to be calculated	0.3	0	0	0.6	-	0.015	0.012
Perennial grasses up to 5 years (apart from alfalafa and clovers and their mixtures) (for hay)	0.85	0.2	to be calculated	0.3	0	0	2	-	0.02	0.015
Perennial grasses up to 5 years (apart from alfalafa and clovers and their mixtures) (for green fodder and silage)	0.35	0.2	to be calculated	0.3	0	0	2	-	0.02	0.015
Perennial pastures (for hay)	0.85	0.07	to be calculated	0.3	0	0	2	-	0.02	0.015
Perennial pastures (for silage and green fodder)	0.35	0.07	to be calculated	0.3	0	0	2	-	0.02	0.015
Meadows and natural pastures (for hay)	0.85	0.07	to be calculated	0.3	0	0	2	-	0.02	0.015
Meadows and natural pastures (for silage and green fodder)	0.35	0.07	to be calculated	0.3	0	0	2	-	0.02	0.015

ANNEX XI. Summary of the study on determination of national values of feed digestibility by the classic in vivo method for the Lithuania GHG inventory methodology improvement

Food digestibility is the main parameter to evaluate the amounts of volatile solids methane (CH₄) and nitrous oxide (N₂O) emitted at manure handling. Lithuania has been recommended by UNFCCC secretariat experts to carry out a study and collect the national data on food digestibility that would help to estimate the amounts of CH₄ and N₂O emitted in manure management and included in the national inventory report. Therefore, the aim of this study was to analyze the structure, chemical composition and nutritive value of the rations used for fattening bulls, dairy cows and fattening pigs in Lithuania and, consequently, to estimate nutrient digestibility in vivo and nutrient digestibility coefficients of the average ration for each technological animal group.

Information about feedstuffs and ration structures applied to the animals of different technological groups has been collected in different regions of the country from randomly chosen farms. In 2021, the regions under investigation contained 81.22 % fattening bulls, 95.28 % dairy cows (2 years and older), 90.39 % suckler cows (2 years and older) and 83,74 % fattening pigs. The samples of standard rations collected from farms were analyzed at the Chemical laboratory of the Animal Science Institute of the Lithuanian University of Health Sciences (LUHS). The samples were analyzed for dry matter, crude protein, crude fat, crude fibre and energy (metabolizable, netto energy lactation) contents.

Nutrient digestibility in vivo studies were carried out at the Animal feed nutrient digestibility laboratory of Animal Science Institute of the LUHS with 6 Lithuanian Black-and-White fattening cattle, 6 dairy cows and 12 fattening pigs of different age and condition score according to methodical recommendations for balance-digestibility trials.

Fattening cattle

The study indicated that two different fattening cattle feeding technologies are used on Lithuanian farms, i. e. animals are fed on separate feeds or separate feeds are mixed to make a total mix ration (TMR). TMR was used to feed animals in 16 farms out of 23 (almost 70 %) investigated. Most farms use perennial grass and maize silages, compound feeds or grain mixtures for the production of TMR. In case of fibre shortage, meadow grass straw is added. A similar ration structure is applied on the farms where fattening cattle is given ration feeds separately. We have estimated the amounts of feeds given to different cattle groups, i.e. those up to one and up to 2 years old and older. Up to one year of age animals were fed on the average 14.5 kg feeds and received daily 4.70 – 8.04 kg dry matter (DM), 526 – 1114 g crude protein (CP), 1114 – 2354 g crude fibre (CF) and from 43.95 to 79.32 MJ of metabolizable energy (ME). Up to 2 years of age and older animals were given on the average 23.4 kg feeds of natural moisture and received daily 7.02 – 13.83 kg DM, 598 -2550 g CP, 1796 – 4185 g CF and 61.0 – 138.30 MJ ME. Estimation of the amounts of feeds as fed and the nutritive and energy value of rations indicated that the average rations should amount to 15.0 – 18.0 kg for the fattening cattle up to 12 month of age and for the bulls up to 2 years and old, the average rations should amount to 23 – 25 kg of TMR of natural moisture consisting of perennial grass and maize silages and compound feed. On this basis, we have formulated the average ration for cattle feeding comprising TMR made from maize and perennial grass silages and compound feed (37.1 % DM, 4.28 % CP, 0.9 7% crude fat, 9.65 % CF, 19.82 % NFE, 2.38 % crude ash (CA), 3.38 MJ/kg ME). It is recommended to give 17 and 25 kg of feed for cattle up to 12 month of age and up to 2 years and older, respectively.

The animals of the first age group digested on the average 63.97 % DM, 53.97 % CP, 59.85 % crude fat, 60.39 % CF, 51.24 % ADF, 68.69 % NDF, 71.51 % nitrogen free extracts (NFE) and 66.20 % organic matter

(OM) of total ration digestibility. The animals of the second age group digested on the average 65.13 % DM, 55.84 % CP, 62.70 % crude fat, 63.65 % CF, 52.85 % ADF, 71.27 % NDF, 72.45 % NFE and 67.79 % OM. The daily weight gain of the treated animals was 1.27 – 1.73 and 1.73 – 1.87 kg in, respectively, Group 1 and Group 2.

Dairy cattle

Two different technologies are used for feeding dairy cows in Lithuania, i. e. animals are given ration feeds separately or separate feeds are mixed to make a complete TMR. TMR technology was applied in 19 farms out of 31 under investigation (almost 61.2 %). Most farms use perennial grass and maize silages, compound feeds or grain mixtures for the production of TMR.

A similar ration structure is applied on the farms where cows are given separate ration feedstuffs. The analysis of feeding amounts showed that the average ration of milking cows was composed of 40 – 50 kg natural moisture feeds comprising perennial grass and maize silages and compound feed. In case of dry matter or fibre deficiency, straw or hay was added. The cows fed this type of ration received 18.1 – 28.2 kg DM, 102 – 178 MJ netto energy lactation (NEL), 2115 – 4131 g CP, 314 – 765 g crude fat, 3433 – 7608 g CF, 112 – 288 calcium and 53 – 152 g phosphorus. Dry and suckler cows are fed on the average 30 – 35 kg natural moisture feeds and receive 11.2 – 19.5 kg DM, 59 – 114 MJ NEL, 1383 – 2421 g CP, 290 – 515 g crude fat, 2376 – 5340 g CF, 53 – 226 g calcium and 21 – 76 g phosphorus. On this basis, we have formulated the average ration for cow feeding comprising TMR manufactured from maize and perennial grass silages and compound feed (41 – 47 % DM, 5.46 – 6.45 % CP, 1.21 – 1.39 % crude fat, 9.45 – 9.71 % CF, 22.45 – 25.97 % NFE, 2.43 – 3.48 % CA, 2.46 – 2.87 MJ/kg NEL). It is recommended to feed 50 kg for milking cows and 35 kg for dry and suckler cows. The cows of the first technological group digested on the average 67.68 % DM, 65.21 % CP, 60.57 % crude fat, 63.94 % CF, 57.68 % ADF, 66.49 % NDF, 73.20 % NFE and 69.59 % OM of total ration. The animals of the second technological group digested on the average 66.51 % DM, 64.95 % CP, 60.06 % crude fat, 61.97 % CF, 56.70 % ADF, 62.62 % NDF, 72.50 % NFE and 67.64 % OM. During the trial, the cows of Group 1 yielded daily 19.6 – 30.1 kg whole milk, whereas the cows of Group 2 8.71 – 12.9 kg milk daily.

Swine

On large scale of pig farms in Lithuania pigs are fed complete compound feeds. Three feeding technologies are being applied: feeding dry feeds, moistened feeds or slop feeds. On some farms that apply slop feeding the rations are additionally supplied with whey. Small individual farms with up to 10 – 20 pigs can also use mash feeding rations containing, besides grain feeds, also potatoes, feedroots and other feeds. However, such farms are not numerous and important.

All the 14 studied farms composed their pig rations using the feeds of their own production or purchased compound feeds. Besides, one farm also used whey together with compound feed. For the production of compound feeds, most farms use barley, wheat, triticale. Maize (for piglets and fattening pigs) and oats (for gilts and sows). As protein feeds, the farms use soybean oilmeal, rapeseed cake or meal, sunflower meal, leguminous seeds (peas or beans), also soya or potato protein concentrate (for piglets), fish meal (for piglets and lactating sows), protein-vitamin-mineral premix (for piglets and sows). Components with higher content of crude fiber for sows and gilts comprise wheat bran, dried sugarbeet pulp and soybean hulls. Fodder lime or limestone, monocalcium phosphate, common salt, premixes, aminoacid, trace element, vitamin, enzyme, etc. supplements, also mycotoxin binders are used as minerals and other additives. As an energy source, the farms use vegetable oil, sugarbeet molasses. It should be noted that there was a farm which used dry mixture made from only on farm grown feeds (barley, wheat, peas) and mineral-vitamin supplement. This farm fattens pigs from 45 kg weight.

Dry feeds are given to weaned pigs, fattening pigs and sows on, respectively, 7, 5 and 4 farms. Moistened feeds are given to fattening pigs and sows on, respectively, one and two farms. Weaned pigs, fattening pigs and sows were given slop feeds on, respectively four, eight and three farms. We have estimated the amounts of feeds given to separate groups of pigs, namely, weaned 20-30 kg pigs, fattening pigs, gilts, farrowing and lactating sows.

Weaned 20 to 30 kg pigs are given on the average 1.37-1.44 kg compound feed and get daily 1.20-1.25 kg DM, 18.34-19.48 MJ ME, 246.60-252.42 g CP, 15.98-18.20 g lysine (Lys), 7.73-10.92 g methionine + cystine (Met+Cys), 9.01-11.30 g threonine (Thr), 30.38-69.86 g crude fat, 38.50-53.71 g CF, 10.08-11.52 g calcium (Ca) and 5.96-9.01 g phosphorus (P).

Pigs in the first growing phase (30-60 kg) are offered on the average 2.22-2.45 kg compound feed and get daily 1.96-2.09 kg DM, 29.05-31.19 MJ ME, 343.74-391.08 g CP, 20.34-25.99 g Lys, 9.8-15.64 g Met+Cys, 12.74-17.02 g Thr, 57.56-115.00 g crude fat, 70.67-117.53 g CF, 15.44-18.86 g Ca and 9.59-12.19 g P.

Pigs in the second fattening phase (over 60 kg) are given on the average 2.85-3.10 kg compound feed and get daily 2.47-2.64 kg DM, 36.18-39.62 MJ ME, 434.93-456.00 g CP, 25.61-29.27 g Lys, 12.40-17.23 g Met+Cys, 16.12-19.49 g Thr, 58.98-97.03 g crude fat, 91.98-162.10 g CF, 18.81-21.08 g Ca and 11.39-15.30 g P.

Gilts of more than 50-60 kg weight are given on the average 2.50-2.70 kg compound feed and get daily 2.18-2.36 kg DM, 29.74-33.23 MJ ME, 359.84-401.50 g CP, 16.88-30.00 g Lys, 10.09-18.25 g Met+Cys, 11.26-14.75 g Thr, 51.74-101.00 g crude fat, 96.12-257.14 g CF, 17.85-20.80 g Ca and 11.48-14.56 g P.

Bred sows up to 85 farrowing days are given on the average 2.12-2.26 kg compound feed and get daily 1.87-1.98 kg DM, 25.17-28.16 MJ ME, 304.19-311.88 g CP, 13.67-17.79 g Lys, 8.54-11.07 g Met+Cys, 9.11-11.50 g Thr, 42.20-98.30 g crude fat, 76.32-217.58 g CF, 15.26-17.60 g Ca and 9.12-12.37 g P.

Bred sows having 30 days prior to farrowing days are offered on the average 2.62-2.90 kg compound feed and get daily 2.29-2.52 kg DM, 32.60-35.80 MJ ME, 393.82-435.66 g CP, 17.89-24.10 g Lys, 11.06-15.11 g Met+Cys, 11.93-16.96 g Thr, 56.00-129.11 g crude fat, 99.56-281.87 g CF, 20.16-22.80 g Ca and 12.04-16.25 g P.

Lactating sows are fed on the average 5.61-5.70 kg compound feeds and get daily 4.91-5.06 kg DM, 71.36-76.47 MJ ME, 929.10-935.37 g CP, 50.29-67.83 g Lys, 25.94-41.51 g Met+Cys, 32.77-41.51 g Thr, 216.03-456.65 g crude fat, 196.75-307.80 g CF, 45.20-56.10 g Ca and 27.22-35.34 g P.

Some farms also use whey for pig feeding (on average 1.5 kg for 20-30 kg weaned pigs, 3-4 kg for fattening pigs, gilts) In that case, the pigs are fed compound feeds: on average 1.25 kg for 20-30 kg weaned pigs, 2.15-2.90 kg for fattening pigs in, respectively, growing and finishing fattening phase, 2,50 kg for gilts.

Estimation of daily feed allowance, also nutritive and energy value of rations indicated that complete compound feeds in the average ration should amount to 1.37-1.44 kg for weaned 20-30 kg pigs, 2.22-2.45 kg for 30-65 kg pigs in the first fattening phase, 2.85-3.10 kg for over 60 kg weight pigs in the second fattening phase, 2.50-2.70 kg for over 50-60 kg weight gilts, 2.12-2.26 kg for bred sows up to 85 farrowing days, 2.62-2.90 kg for bred sows with 30 farrowing days left and 5.61-5.70 kg for lactating sows.

Complete compound feeds for fattening pigs and sows were used for nutrient digestibility in vivo studies. The pigs of first technological group were given compound feeds (86.67 % DM, 18.60 % CP, 2.68 % crude fat, 2.94 % CF, 9.80 g/kg Lys, 6.20 g/kg Met+Cys, 6.50 g/kg Thr, 12.96 MJ/kg ME)

formulated for the first fattening phase (30-60 kg weight) and composed of barley, wheat, triticale, soybean meal, rapeseed cake, sunflower meal, vegetable oil, fodder lime, monocalcium phosphate, common salt, vitamins, trace elements, aminoacids and enzyme additives. The pigs of the second and third technological groups (60-85 kg and over 85 kg weight) were given compound feeds (86.31 % DM, 16.89 % CP, 2.47 % crude fat, 3.46 % CF, 8.65 g/kg Lys, 5.05 g/kg Met+Cys, 5.90 g/kg Thr, 12.84 MJ/kg ME) formulated for the second fattening phase (over 60 kg weight) and composed of barley, wheat, wheat bran, soybean meal, rapeseed cake, sunflower meal, vegetable oil, fodder lime, monocalcium phosphate, common salt, vitamins, trace elements, aminoacids and enzyme additives. The pigs of the fourth technological group (sows) were given compound feeds (87.31 % DM, 15.78 % CP, 2.93 % crude fat, 3.33 % CF, 7.20 g/kg Lys, 4.50 g/kg Met+Cys, 4.70 g/kg Thr, 12.35 MJ/kg ME) formulated for farrowing sows and composed of barley, oats, triticale, wheat, wheat bran, soybean meal, rapeseed cake, sunflower meal, vegetable oil, fodder lime, monocalcium phosphate, common salt, vitamins, trace elements, aminoacids and enzyme additives. The chemical composition and nutritive value of the compound feeds used in the study were in agreement with the average values of compound feeds used in the country farms and the average ration which was formulated on the basis of the collected and systematized information about the feeds used for feeding fattening pigs and sows. The average ration used in the study is a reflection of the ration for fattening pigs and sows used in most of the farms in Lithuania and accounts for feeding 83.74 % of the animals of the above technological groups. The pigs of the first technological group digested on the average 83.62 % DM, 85.92 % CP, 68.04 % crude fat, 25.14 % CF, 32.70 % ADF, 52.54 % NDF, 87.65 % NFE and 86.27 % OM of total ration. The animals of the second technological group digested on the average 83.27 % DM, 85.18 % CP, 67.99 % crude fat, 22.24 % CF, 34.28 % ADF, 52.88 % NDF, 89.55 % NFE and 85.08 % OM. The animals of the third technological group digested on the average 83.50 % DM, 87.15 % CP, 68.75 % crude fat, 23.66 % CF, 38.58 % ADF, 51.82 % NDF, 88.96 % NFE and 85.32 % OM. The pigs of the fourth technological group digested on the average 81.15 % DM, 82.55 % CP, 70.59 % crude fat, 22.32 % CF, 33.29 % ADF, 50.62 % NDF, 87.17 % NFE and 83.12 % OM. The daily weight gain of the treated animals was 893-1057 g, 839-1314 g, 739-907 g and 432-604 g in, respectively, Group 1, Group 2, Group 3 and Group 4.

ANNEX XII. LULUCF area matrices

1990

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	v	NO	6,389	4,393	NO	NO	2,053,755	10,782
Cropland	NO	2,392,387	22,362	NO	NO	NO	2,414,749	-6,789
Grassland	NO	29,151	1,257,091	NO	NO	NO	1,286,242	399
Wetlands	NO	NO	NO	384,156	NO	NO	384,156	-4,393
Settlements	NO	NO	NO	NO	347,018	NO	347,018	NO
Other land	NO	NO	NO	NO	NO	42,728	42,728	NO
Initial	2,042,973	2,421,538	1,285,843	388,548	347,018	42,728	6,528,648	

1991

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,053,755	399	3,993	2,396	399	NO	2,060,943	7,188
Cropland	NO	2,352,454	22,362	NO	799	399	2,376,014	-38,735
Grassland	NO	60,698	1,257,091	2,795	799	4,393	1,325,776	39,534
Wetlands	NO	399	1,597	378,166	NO	NO	380,162	-3,195
Settlements	NO	799	1,198	NO	346,219	799	349,015	799
Other land	NO	NO	NO	NO	NO	36,738	36,738	-5,591
Initial	2,053,755	2,414,749	1,286,242	383,357	348,216	42,329	6,528,648	

1992

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,060,943	399	2,795	1,997	NO	399	2,066,533	5,591
Cropland	NO	2,311,722	25,158	NO	NO	799	2,337,679	-38,336
Grassland	NO	60,299	1,297,024	799	1,198	4,792	1,364,112	38,336
Wetlands	NO	399	NO	377,367	NO	1,997	379,763	NO
Settlements	NO	2,396	799	NO	347,817	399	351,411	2,396
Other land	NO	799	NO	NO	NO	28,352	29,151	-7,587
Initial	2,060,943	2,376,014	1,325,776	380,162	349,015	36,738	6,528,648	

1993

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,066,533	1,198	3,993	NO	NO	NO	2,071,725	5,191
Cropland	NO	2,275,383	22,762	1,198	399	1,597	2,301,340	-36,339
Grassland	NO	58,702	1,336,558	1,198	1,198	5,191	1,402,847	39,134
Wetlands	NO	799	NO	378,166	NO	NO	378,964	-1,597
Settlements	NO	799	399.33013	NO	349,015	NO	350,213	-399
Other land	NO	799	NO	NO	NO	22,762	23,560	-5,990
Initial	2,066,533	2,337,679	1,363,712	380,562	350,612	29,550	6,528,648	

1994

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,071,325	NO	2,396	399	NO	399	2,074,520	2,795
Cropland	NO	2,231,057	27,953	NO	NO	799	2,259,809	-41,530
Grassland	NO	66,688	1,370,900	799	799	4,792	1,443,978	41,131
Wetlands	NO	399	NO	377,766	NO	NO	378,166	-799
Settlements	NO	2,795	1,597	NO	349,414	NO	353,806	3,594
Other land	399	399	NO	NO	NO	17,571	18,369	-5,191
Initial	2,071,725	2,301,340	1,402,847	378,964	350,213	23,560	6,528,648	

1995

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,074,520	NO	1,597	799	NO	NO	2,076,916	2,396
Cropland	NO	2,197,514	24,758	NO	NO	399	2,222,672	-37,138
Grassland	NO	59,500	1,417,223	1,198	3,195	4,792	1,485,907	41,930
Wetlands	NO	399	399	376,169	NO	799	377,766	-399
Settlements	NO	1,997	NO	NO	350,612	NO	352,609	-1,198
Other land	NO	399	NO	NO	NO	12,379	12,779	-5,591
Initial	2,074,520	2,259,809	1,443,978	378,166	353,806	18,369	6,528,648	

1996

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,076,916	399	2,795	799	NO	NO	2,080,909	3,993
Cropland	NO	2,196,316	8,386	NO	NO	NO	2,204,702	-17,970
Grassland	NO	25,956	1,474,726	399	NO	399	1,501,481	15,574
Wetlands	NO	NO	NO	376,568	NO	NO	376,568	-1,198
Settlements	NO	NO	NO	NO	352,609	NO	352,609	NO
Other land	NO	NO	NO	NO	NO	12,379	12,379	-399
Initial	2,076,916	2,222,672	1,485,907	377,766	352,609	12,779	6,528,648	

1997

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,080,909	799	2,396	399	NO	NO	2,084,503	3,594
Cropland	NO	2,152,789	19,567	NO	NO	399	2,172,755	-31,946
Grassland	NO	50,715	1,478,719	NO	NO	NO	1,529,434	27,953
Wetlands	NO	NO	399	376,169	NO	NO	376,568	NO
Settlements	NO	399	399	NO	352,209	NO	353,008	399
Other land	NO	NO	NO	NO	399	11,980	12,379	NO
Initial	2,080,909	2,204,702	1,501,481	376,568	352,609	12,379	6,528,648	

1998

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,084,503	NO	2,795	NO	NO	399	2,087,698	3,195
Cropland	NO	2,088,097	37,138	NO	NO	NO	2,125,235	-47,520
Grassland	NO	83,859	1,489,102	NO	NO	NO	1,572,961	43,527
Wetlands	NO	NO	NO	376,568	NO	NO	376,568	NO
Settlements	NO	399	399	NO	353,008	NO	353,806	799
Other land	NO	399	NO	NO	NO	11,980	12,379	NO
Initial	2,084,503	2,172,755	1,529,434	376,568	353,008	12,379	6,528,648	

1999

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,087,299	399,330	1,597	1,198	NO	NO	2,090,493	2,795
Cropland	NO	2,028,198	51,913	NO	NO	NO	2,080,111	-45,124
Grassland	NO	96,239	1,518,652	NO	NO	NO	1,614,891	41,930
Wetlands	399	NO	NO	375,370	NO	NO	375,770	-799
Settlements	NO	399	799	NO	353,806	NO	355,004	1,198
Other land	NO	NO	NO	NO	NO	12,379	12,379	NO
Initial	2,087,698	2,125,235	1,572,961	376,568	353,806	12,379	6,528,648	

2000

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,090,493	NO	2,396	1,997	NO	399	2,095,285	4,792
Cropland	NO	1,969,496	50,715	NO	NO	NO	2,020,211	-59,900
Grassland	NO	108,618	1,558,186	399	1,198	NO	1,668,401	53,510
Wetlands	NO	NO	1,198	373,374	NO	NO	374,572	-1,198
Settlements	NO	1,997	2,396	NO	353,806	NO	358,199	3,195
Other land	NO	NO	NO	NO	NO	11,980	11,980	-399
Initial	2,090,493	2,080,111	1,614,891	375,770	355,004	12,379	6,528,648	

2001

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,095,285	399	1,997	NO	NO	NO	2,097,681	2,396
Cropland	NO	1,917,583	43,128	NO	NO	NO	1,960,711	-59,500
Grassland	NO	101,829	1,622,478	399	399	399	1,725,505	57,104
Wetlands	NO	NO	NO	374,172	NO	NO	374,172	-399
Settlements	NO	399	399	NO	357,800	NO	358,598	399
Other land	NO	NO	399	NO	NO	11,581	11,980	NO
Initial	2,095,285	2,020,211	1,668,401	374,572	358,199	11,980	6,528,648	

2002

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,097,681	NO	3,993	399	NO	NO	2,102,074	4,393
Cropland	NO	1,872,459	40,332	NO	NO	NO	1,912,791	-47,920
Grassland	NO	87,453	1,680,781	NO	NO	NO	1,768,234	42,728
Wetlands	NO	NO	399	373,773	NO	799	374,971	799
Settlements	NO	799	NO	NO	358,598	NO	359,397	799
Other land	NO	NO	NO	NO	NO	11,181	11,181	-799
Initial	2,097,681	1,960,711	1,725,505	374,172	358,598	11,980	6,528,648	

2003

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,101,674	799	3,195	799	399	NO	2,106,866	4,792
Cropland	NO	1,848,499	23,560	NO	NO	NO	1,872,060	-40,732
Grassland	NO	63,493	1,740,680	NO	NO	NO	1,804,174	35,940
Wetlands	399	NO	NO	374,172	NO	399	374,971	NO
Settlements	NO	NO	399	NO	358,998	NO	359,397	NO
Other land	NO	NO	399	NO	NO	10,782	11,181	NO
Initial	2,102,074	1,912,791	1,768,234	374,971	359,397	11,181	6,528,648	

2004

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,106,067	399	6,389	1,198	NO	NO	2,114,054	7,188
Cropland	NO	1,821,744	29,151	NO	NO	NO	1,850,895	-21,164
Grassland	NO	49,517	1,768,234	399	NO	NO	1,818,150	13,977
Wetlands	799	NO	NO	373,374	NO	399	374,572	-399
Settlements	NO	399	399	NO	359,397	NO	360,196	799
Other land	NO	NO	NO	NO	NO	10,782	10,782	-399
Initial	2,106,866	1,872,060	1,804,174	374,971	359,397	11,181	6,528,648	

2005

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,113,654	799	5,191	1,597	NO	399	2,121,641	7,587
Cropland	NO	1,810,962	23,161	NO	NO	NO	1,834,123	-16,772
Grassland	NO	38,336	1,787,402	NO	NO	NO	1,825,737	7,587
Wetlands	NO	NO	799	372,974	NO	399	374,172	-399
Settlements	399	799	1,597	NO	360,196	NO	362,991	2,795
Other land	NO	NO	NO	NO	NO	9,983	9,983	-799
Initial	2,114,054	1,850,895	1,818,150	374,572	360,196	10,782	6,528,648	

2006

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,121,242	799	5,591	1,597	NO	NO	2,129,228	7,587
Cropland	NO	1,798,184	76,272	NO	NO	NO	1,874,456	40,332
Grassland	NO	34,742	1,741,878	399	NO	NO	1,777,019	-48,718
Wetlands	NO	399	399	372,176	NO	NO	372,974	-1,198
Settlements	399	NO	1,597	NO	362,991	NO	364,988	1,997
Other land	NO	NO	NO	NO	NO	9,983	9,983	NO
Initial	2,121,641	1,834,123	1,825,737	374,172	362,991	9,983	6,528,648	

2007

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,129,228	2,396	2,795	1,997	NO	399	2,136,816	7,587
Cropland	NO	1,847,701	71,879	NO	NO	NO	1,919,580	45,124
Grassland	NO	24,359	1,699,948	NO	399	NO	1,724,707	-52,312
Wetlands	NO	NO	1,198	370,978	NO	NO	372,176	-799
Settlements	NO	NO	1,198	NO	364,588	NO	365,786	799
Other land	NO	NO	NO	NO	NO	9,584	9,584	-399
Initial	2,129,228	1,874,456	1,777,019	372,974	364,988	9,983	6,528,648	

2008

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,136,816	1,597	4,792	399	NO	NO	2,143,604	6,789
Cropland	NO	1,892,825	73,077	NO	399	NO	1,966,302	46,722
Grassland	NO	24,758	1,643,643	399	NO	NO	1,668,801	-55,906
Wetlands	NO	NO	799	371,377	NO	NO	372,176	NO
Settlements	NO	399	1,597	NO	365,387	NO	367,384	1,597
Other land	NO	NO	NO	NO	NO	9,584	10,383	799
Initial	2,136,816	1,919,580	1,724,707	372,176	365,786	9,584	6,528,648	

2009

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,143,205	NO	3,594	NO	NO	NO	2,146,799	3,195
Cropland	NO	1,949,929	50,316	NO	NO	NO	2,000,245	33,943
Grassland	NO	15,973	1,610,498	NO	399	399	1,627,270	-41,530
Wetlands	399	NO	NO	372,176	NO	NO	372,575	399
Settlements	NO	399	3,594	NO	366,984	NO	370,978	3,594
Other land	NO	NO	799	NO	NO	9,983	10,782	399
Initial	2,143,604	1,966,302	1,668,801	372,176	367,384	10,383	6,528,648	

2010

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,146,799	399	5,990	NO	NO	NO	2,153,188	6,389
Cropland	NO	1,896,818	5,191	NO	NO	NO	1,902,009	-98,235
Grassland	NO	103,027	1,612,096	399	1,198	NO	1,716,720	89,450
Wetlands	NO	NO	NO	372,176	NO	NO	372,176	-399
Settlements	NO	NO	3,993	NO	369,780	NO	373,773	2,795
Other land	NO	NO	NO	NO	NO	10,782	10,782	NO
Initial	2,146,799	2,000,245	1,627,270	372,575	370,978	10,782	6,528,648	

2011

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,153,188	2,396	5,591	NO	NO	NO	2,161,175	7,987
Cropland	NO	1,858,882	39,933	NO	NO	NO	1,898,815	-3,195
Grassland	NO	40,732	1,670,797	NO	399	NO	1,711,928	-4,792
Wetlands	NO	NO	NO	372,176	NO	399	372,575	399
Settlements	NO	NO	399	NO	373,374	NO	373,773	NO
Other land	NO	NO	NO	NO	NO	10,383	10,383	-399
Initial	2,153,188	1,902,009	1,716,720	372,176	373,773	10,782	6,528,648	

2012

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,161,175	1,198	8,386	1,597	NO	NO	2,172,356	11,181
Cropland	NO	1,863,674	37,138	NO	NO	NO	1,900,811	1,997
Grassland	NO	33,943	1,665,606	399	1,198	NO	1,701,146	-10,782
Wetlands	NO	NO	NO	370,578	NO	NO	370,578	-1,997
Settlements	NO	NO	799	NO	372,575	NO	373,374	-399
Other land	NO	NO	NO	NO	NO	10,383	10,383	NO
Initial	2,161,175	1,898,815	1,711,928	372,575	373,773	10,383	6,528,648	

2013

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,172,356	799	4,393	NO	799	NO	2,178,346	5,990
Cropland	NO	1,879,647	37,138	NO	NO	NO	1,916,785	15,973
Grassland	NO	19,967	1,654,824	NO	1198	NO	1,675,989	-25,158
Wetlands	NO	NO	NO	370,578	NO	399	370,978	399
Settlements	NO	399	4,393	NO	371,377	NO	376,169	2,795
Other land	NO	NO	399	NO	0	9,983	10,383	NO
Initial	2,172,356	1,900,811	1,701,146	370,578	373,374	10,383	6,528,648	

2014

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,178,346	1,997	3,594	2,396	NO	NO	2,186,332	7,987
Cropland	NO	1,892,825	42,728	NO	NO	NO	1,935,553	18,769
Grassland	NO	21,164	1,626,472	399	399	399	1,648,834	-27,154
Wetlands	NO	NO	1,198	368,182	NO	NO	369,380	-1,597
Settlements	NO	799	1,597	NO	375,770	NO	378,166	1,997
Other land	NO	NO	399	NO	NO	9,983	10,383	NO
Initial	2,178,346	1,916,785	1,675,989	370,978	376,169	10,383	6,528,648	

2015

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,186,332	799	7,587	799	NO	NO	2,195,517	9,185
Cropland	NO	1,924,771	15,973	NO	399	NO	1,941,144	5,591
Grassland	NO	9,584	1,622,878	NO	NO	1,198	1,633,660	-15,175
Wetlands	NO	NO	399	368,582	NO	NO	368,981	-399
Settlements	NO	399	1,997	NO	377,766	NO	380,162	1,997
Other land	NO	NO	NO	NO	NO	9,185	9,185	-1,198
Initial	2,186,332	1,935,553	1,648,834	369,380	378,166	10,383	6,528,648	

2016

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,195,118	399	3,993	1,198	NO	NO	2,200,708	5,191
Cropland	NO	1,930,761	11,980	NO	798.66026	NO	1,943,540	2,396
Grassland	NO	9,983	1,617,686	399	NO	799	1,628,868	-4,792
Wetlands	NO	NO	NO	367,384	NO	NO	367,384	-1,597
Settlements	399	NO	NO	NO	379,364	NO	379,763	-399
Other land	NO	NO	NO	NO	NO	8,386	8,386	-799
Initial	2,195,517	1,941,144	1,633,660	368,981	380,162	9,185	6,528,648	

2017

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,200,309	399	5,990	2,396	NO	NO	2,209,094	8,386
Cropland	NO	1,931,959	34,342	NO	NO	NO	1,966,302	22,762
Grassland	NO	10,782	1,587,737	399	1,198	399	1,600,515	-28,352
Wetlands	399	NO	NO	364,588	NO	NO	364,988	-2,396
Settlements	NO	399	799	NO	378,565	NO	379,763	NO
Other land	NO	NO	NO	NO	NO	7,987	7,987	-399
Initial	2,200,708	1,943,540	1,628,868	367,384	379,763	8,386	6,528,648	

2018

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,205,900	NO	3,594	399	NO	NO	2,209,893	799
Cropland	NO	1,955,520	33,144	NO	399	NO	1,989,063	22,762
Grassland	1,198	10,782	1,562,978	799	799	399	1,576,955	-23,560
Wetlands	NO	NO	NO	363,790	NO	NO	363,790	-1,198
Settlements	799	NO	799	NO	378,565	399	380,562	799
Other land	1,198	NO	NO	NO	NO	7,188	8,386	399
Initial	2,209,094	1,966,302	1,600,515	364,988	379,763	7,987	6,528,648	

2019

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,209,494	NO	3,594	399	NO	NO	2,213,487	3,594
Cropland	NO	1,975,486	30,748	NO	399	NO	2,006,634	17,571
Grassland	399	13,577	1,540,216	399	NO	NO	1,554,592	-22,362
Wetlands	NO	NO	NO	362,991	NO	NO	362,991	-799
Settlements	NO	NO	2,396	NO	380,162	NO	382,558	1,997
Other land	NO	NO	NO	NO	NO	8,386	8,386	NO
Initial	2,209,893	1,989,063	1,576,955	363,790	380,562	8,386	6,528,648	

2020

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,212,688	399	5,990	1,997	NO	NO	2,221,074	7,587
Cropland	NO	1,989,862	41,930	NO	399	NO	2,032,191	25,557
Grassland	799	16,373	1,503,478	NO	399	399	1,521,448	-33,144
Wetlands	NO	NO	NO	360,994	NO	NO	360,994	-1,997
Settlements	NO	NO	3,195	NO	381,760	NO	384,954	2,396
Other land	NO	NO	NO	NO	NO	7,987	7,987	-399
Initial	2,213,487	2,006,634	1,554,592	362,991	382,558	8,386	6,528,648	

2021

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,220,276	NO	9,185	399	399	NO	2,230,259	9,185
Cropland	NO	2,010,228	45,923	NO	NO	NO	2,056,151	23,960
Grassland	399	21,564	1,464,743	NO	399	NO	1,487,105	-34,342
Wetlands	NO	NO	NO	360,595	NO	NO	360,595	-399
Settlements	399	399	1,198	NO	384,156	NO	386,152	1,198
Other land	NO	NO	399	NO	NO	7,987	8,386	399
Initial	2,221,074	2,032,191	1,521,448	360,994	384,954	7,987	6,528,648	

2022

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,229,859	399	7,987	2,396	NO	NO	2,240,641	10,383
Cropland	399	2,041,376	60,299	NO	399	NO	2,102,473	46,322
Grassland	NO	13,977	1,417,223	NO	399	NO	1,431,599	-55,507
Wetlands	NO	NO	NO	358,199	399	NO	358,598	-1,997
Settlements	NO	399	1,198	NO	384,954	NO	386,552	399
Other land	NO	NO	399	NO	NO	8,386	8,785	399
Initial	2,230,259	2,056,151	1,487,105	360,595	386,152	8,386	6,528,648	

2023

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,240,242	399	6,789	399	NO	NO	2,247,829	7,188
Cropland	NO	2,086,500	58,302	NO	399	NO	2,145,201	42,728
Grassland	NO	15,175	1,363,313	NO	399	NO	1,378,887	-52,712
Wetlands	NO	NO	NO	358,199	NO	NO	358,199	-399
Settlements	399	399	3,195	NO	385,753	NO	389,746	3,195
Other land	NO	NO	NO	NO	NO	8,785	8,785	NO
Initial	2,240,641	2,102,473	1,431,599	358,598	386,552	8,785	6,528,648	

2024

Land category	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Final	Net change
Forest land	2,247,031	NO	4,393	1,198	NO	NO	2,252,621	4,792
Cropland	0	2,126,832	44,725	NO	NO	NO	2,171,557	26,356
Grassland	399.33013	17,571	1,325,776	NO	NO	NO	1,343,746	-35,141
Wetlands	NO	NO	1197.9904	357,001	399.33013	NO	358,598	399
Settlements	399	799	2,396	NO	389,347	NO	392,941	3,195
Other land	NO	NO	399.33013	NO	NO	8,785	9,185	399
Initial	2,247,829	2,145,201	1,378,887	358,199	389,746	8,785	6,528,648	

ANNEX XIII. Summary of the studies on carbon stock values in forest and non-forest land

In this annex the summaries of two studies performed by Lithuanian Centre of Agriculture and Forestry, Institute of Forestry under the partnership project between Lithuania and Norway.

Summaries do not provide all the studies' results (estimates of each sampling plot estimated carbon stock value) which were used to calculate average national values of carbon stocks in mineral soils of forest land, cropland and grassland as well as afforested/reforested lands mineral soils and carbon stocks in litter in forest remaining forest and land converted to forest land. Summaries are provided here as information item on the methodology used to estimate national carbon stock values in soil and litter.

OF THE STUDY “ASSESSMENT OF CARBON STOCKS IN MINERAL AND ORGANIC SOILS, AND ESTIMATION OF NATIONAL CARBON VALUES IN THE SOILS AFTER AFFORESTATION OF ABANDONED AGRICULTURAL LAND/REFORESTATION”

SHORT REPORT

(Supervised by dr. I.Varnagirytė-Kabašinskienė. Kaunas-Girionys, 2016)

Introduction

The afforestation (conversion to forest land actively promoted through planting of trees) is recognized as an eligible measure to achieve climate change mitigation, biodiversity protection and enhancement goals promoted by recent environmental policies. Generally, the mitigation policies aim to reduce greenhouse gas emissions from individual countries in order to prevent climate change. In accordance with various commitments, Lithuania aims to develop methodically reasonable estimates of national carbon stocks in mineral and organic soils.

This study aims to give an overview of soil organic carbon estimates in *Arenosols*, *Luvisols* and *Histosols* after afforestation of abandoned agricultural land/reforestation in Lithuania. Carbon concentrations and stocks in the coniferous and deciduous forest plantations of different 1–10, 11–20 and 21–30 years age are analysed. Recently obtained data of soil carbon estimates on conversion to forest land or plantations at Lithuanian level are presented.

Conversion to forest land is generally associated with positive effects on the carbon balance, particularly if former agricultural land with low soil organic matter content is afforested. The carbon benefits are produced by biomass accumulation during the conversion and by a potential increase of organic carbon in the soil. However, the carbon dynamics in the conversion to forest can vary a lot. While forest stands always contain more biomass above-ground compared to grassland or agricultural crops, this is not always true for below-ground biomass and soil organic matter.

Materials and methods

The study describes the method used for estimating carbon stocks for managed forest plantations (different tree species, different age classes) and the control – crops and/or grasslands. The effect of land-use change was investigated by applying the paired-site design, i.e. by comparing soil organic carbon in the forest plantation (afforested plot) with identical soil type but different land-use type (control – grassland or crop) at the same moment in time. The soil organic carbon stocks are derived from field measurements up to a depth of 30 cm (forest litter/organic horizon/Ao; mineral soil of 0–10, 10–30 and 0–30 cm depths). A comprehensive soil survey was undertaken in March–September, 2016. The study objectives were selected in Dubrava, Kaunas, Kretinga, Kazlų Rūda, Jonava, Marijampolė, Alytus, Prienai, Varėna, Veisiejai, Ukmergė, Kėdainiai and Valkininkai Forest Enterprises.

Totally soil samples were collected from 383 plots, of which 188 plots were selected in afforested sites (deciduous or conifers), other plots were selected as controls in permanent grassland or arable land.

In the field, the plot characteristics were given: ground vegetation assessment – species composition and projection area (%); projection area of forest litter, especially in young forest plantations; land-use type was described – natural or agricultural grasslands, arable land, etc. The litter layer was collected

from five places within 0.25×0.25 m frame. Mineral soil was sampled with a gauge from 10 places. Subsamples were combined both forest litter and mineral soil.

In the laboratory, collected composite samples were analysed: dry mass of forest or grassland litter, bulk density of mineral soil and dry mass of organic soil were determined according ISO 11272:1998. Samples were prepared for the chemical analyses according to the ISO 11464:1994. According to the requirements of LST EN ISO/IEC 17025:2005, total organic carbon was determined by ISO 10694:1995 (total concentrations of organic carbon were given for dry mass according ISO 11465:1993) in the accredited Agrochemical Research laboratory of Lithuanian Research Centre for Agriculture and Forestry.

Main findings and conclusions

1. The study results showed that mean mass of soil organic layer (forest litter) in the studied *Arenosols*, *Luvisols* and *Histosols* of afforested/reforested land (0–30-year-old coniferous and deciduous plantations) in all cases was higher than soil organic layer (mainly annual litter of grasses) of perennial grassland. The mass of soil organic layer in coniferous stands was 1.6 to 2.6 times higher than in deciduous stands.

2. The bulk density (of fine soil fraction, <2 mm) in the 0–10 cm layer of forest soil was $1.15 \pm 0.02 \text{ g cm}^{-3}$ in *Arenosols*, $1.24 \pm 0.02 \text{ g cm}^{-3}$ in *Luvisols*, and $0.33 \pm 0.02 \text{ g cm}^{-3}$ in *Histosols*. Deeper, in the 10–30 cm layer, the bulk density was 1.30 ± 0.02 (*Arenosols*); 1.43 ± 0.02 (*Luvisols*) and $0.35 \pm 0.03 \text{ g cm}^{-3}$ (*Histosols*). In all studied soils of afforested land the bulk density slightly differed from the bulk density in the perennial grasslands or arable land. Also, in many cases, the bulk density was lower in older forest plantations compared to the arable land. However, it did not significantly differ between forests and perennial grasslands.

The mean soil organic carbon concentrations in the soil organic layer (forest litter) of *Arenosols* and *Luvisols* varied in a range of 340–360 g kg^{-1} , while in the *Histosols* the carbon concentration was about 420 g kg^{-1} . However, in all cases C concentration in the soil organic layer of afforested land did not much differ from the C concentration in the perennial grasslands.

The stocks of organic carbon in the soils at 0–30 depths of afforested land exceeded the organic carbon values in the similar soils of the perennial grasslands. The carbon stocks in the soil of afforested land were by 1.3 times higher in the nutrient poor *Arenosols* and by 1.4 times higher in the *Histosols* compared to the similar grassland soils. The carbon stocks in more fertile *Luvisols* of afforested land were quite similar to the carbon stocks in the perennial grasslands. In the afforested land, the carbon stocks at 0–30 cm soil depth were significantly higher compared to the arable soils: they were about 1.3 times higher in *Arenosols*, by 1.7 times – in *Luvisols*, and by 1.2 times higher – in *Histosols*.

Our study showed that organic carbon more intensively accumulated in the deciduous forest compared to the coniferous forest in the nutrient poor *Arenosols*. In the deciduous forest organic carbon stocks were about 1.4 times lower than in the coniferous forest (Fig.1). However, no significant difference between conifers and deciduous forest were obtained in more fertile *Luvisols* and organic *Histosols*.

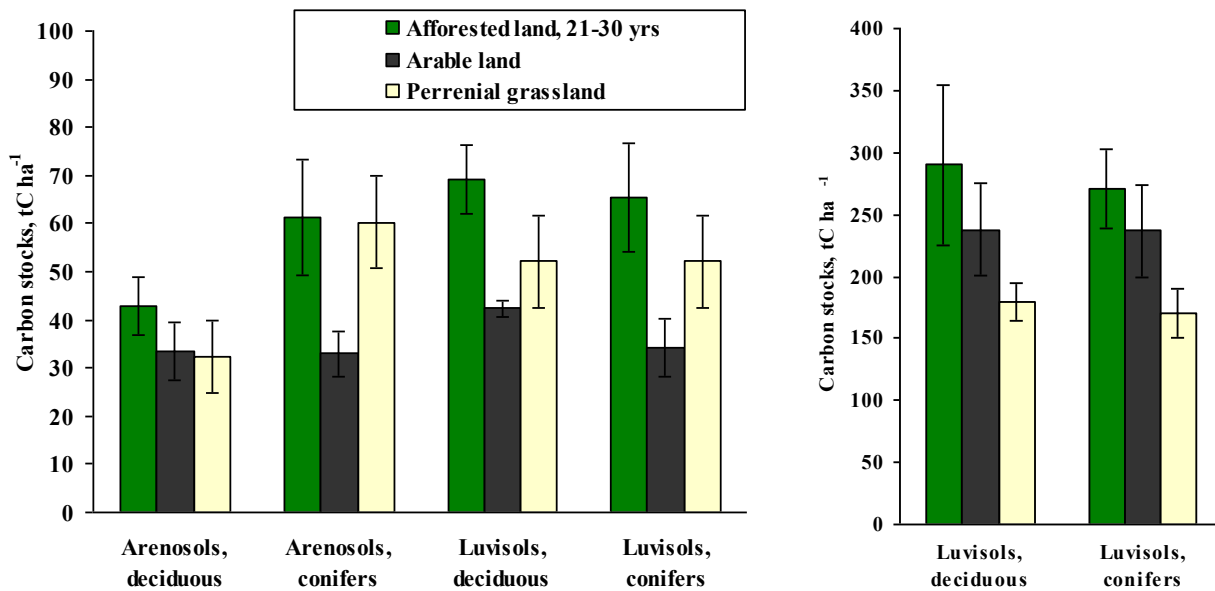


Fig.1. Stocks ($t\text{ ha}^{-1}$) of organic carbon in 0–30 cm mineral soil/peat layer in the afforested land in the 21–30-year old coniferous and deciduous forest plantations and the control (arable land and grassland).

Detailed estimates of national carbon stocks in mineral and organic soils in Lithuania are given in a summary Table 1 and Tables 2–4.

This study confirmed the results obtained in the similar surveys of foreign countries stating that the significant increase of organic carbon stocks up to 30–40 years after the afforestation/reforestation is not recorded. For this aim, older afforested sites should be studied.

Table 1. Organic carbon stocks (t ha⁻¹) in the 0–30 cm mineral soil/peat layer of afforested/reforested sites of different age groups and the control (arable land and permanent grasslands). The values are given as the means and standard errors (data of 2016 soil survey in Lithuania)

Land-use	Soil group (WRB, 2015)					
	Arenosols		Luvisols		Histosols	
	<i>n</i>	tC ha ⁻¹	<i>n</i>	tC ha ⁻¹	<i>n</i>	tC ha ⁻¹
Afforested land* (0-10 years old)	23	51.9±5.2	22	59.1±4.0	15	283.9±15.8
Arable land	10	44.9±7.1	13	33.6±3.9	7	227.7±47.0
Grassland	9	39.4±4.5	9	63.6±13.9	7	221.0±14.7
Afforested land (11-20 years old)	22	57.5±4.8	21	60.3±4.8	22	243.9±26.5
Arable land	12	40.4±4.1	12	40.1±5.4	6	171.6±18.5
Grassland	11	46.3±5.8	10	61.9±13.0	15	168.4±13.5
Afforested land (21-30 years old)	22	49.3±6.0	18	66.9±7.2	23	277.6±29.9
Arable land	11	33.3±3.9	14	36.9±4.2	7	199.7±32.3
Grassland	9	36.9±7.7	8	52.1±9.7	16	174.3±12.9
Afforested land (0-30 years old)	67	53.3±3.1	61	61.8±3.1	60	266.8±15.5
Arable land	33	40.0±2.8	39	36.9±2.2	22	221.3±23.2
Grassland	29	42.5±3.1	26	58.0±6.1	38	191.2±8.7

* Afforested land – conifers and deciduous plantations

Table 2. Soil organic carbon stocks (t ha⁻¹) in Arenosols (data of 2016 soil survey in Lithuania)

Land-use	Stock of soil organic carbon, tC ha ⁻¹			
	Soil organic layer / litter of grasses	Mineral soil 0–10 cm	Mineral soil 10–30 cm	Mineral soil 0–30 cm
Afforested land (0-10 yrs old)	1.2±0.2	19.2±2.0	32.7±3.5	51.9±5.2
Control	0.9±0.1	21.8±2.1	20.1±2.6	41.9±4.0
Conifers (0-10 yrs old)	0.8±0.3	17.4±2.7	29.0±4.9	46.4±7.5
Arable land	-	15.3±3.6	22.5±7.3	37.8±10.9
Grassland	0.9	18.0±3.3	15.1±3.6	33.1±6.9
Deciduous (0-10 yrs old)	1.5±0.3	20.7±2.8	35.7±5.0	56.4±7.3
Arable land	-	25.0±3.4	27.1±6.9	52.1±9.3
Grassland	0.8±0.2	28.5±4.1	17.1±2.4	45.7±5.3
Afforested land (11-20 yrs old)	2.9±0.3	20.3±1.4	37.2±3.8	57.5±4.8
Control	0.7±0.1	22.3±1.8	20.8±1.9	43.1±3.4
Conifers (11-20 yrs old)	3.3±0.4	22.6±1.5	36.8±3.8	59.4±5.2
Arable land	-	23.1±2.5	23.0±3.8	46.1±5.7
Grassland	0.7±0.2	29.9±3.6	24.6±3.5	54.5±6.8
Deciduous (11-20 yrs old)	2.3±0.3	17.3±2.5	37.7±7.6	55.0±9.2
Arable land	-	16.3±1.9	16.1±2.0	32.4±3.7
Grassland	-	19.4±3.9	18.7±4.9	38.1±8.6

Afforested land (21-30 yrs old)	4.1±0.4	19.2±2.4	30.2±4.0	49.3±6.0
Control	0.5	18.7±2.1	15.7±1.8	34.4±3.5
Conifers (21-30 yrs old)	4.8±0.5	17.8±3.0	25.0±3.9	42.8±6.1
Arable land	-	15.5±2.8	18.1±3.4	33.5±6.1
Grassland	-	20.3±4.3	12.0±3.6	32.2±7.5
Deciduous (21-30 yrs old)	2.9±0.4	21.7±4.1	39.6±8.1	61.3±12.1
Arable land	-	19.2±4.4	13.7±0.7	32.9±4.7
Grassland	0.5	32.7	27.7	60.3

Afforested land (0-30 yrs old)	2.6±0.2	19.6±1.1	33.7±2.2	53.3±3.1
Control	0.7±0.1	21.5±1.1	19.7±1.2	41.2±2.1
Conifers (0-30 yrs old)	3.1±0.4	19.6±1.4	30.8±2.5	50.3±3.7
Arable land	-	18.1±1.8	20.9±2.5	39.0±4.1
Grassland	0.7±0.1	22.4±2.4	17.1±2.4	39.5±4.6
Deciduous (0-30 yrs old)	2.1±0.2	19.7±1.7	37.3±3.8	56.9±5.1
Arable land	-	20.1±2.1	18.6±2.6	38.7±4.1
Grassland	0.7±0.1	25.1±2.9	18.7±2.4	43.7±4.6

Table 3. Soil organic carbon stocks (t ha⁻¹) in Luvisols (data of 2016 soil survey in Lithuania)

Land-use	Stock of soil organic carbon, tC ha ⁻¹			
	Soil organic layer / litter of grasses	Mineral soil 0–10 cm	Mineral soil 10–30 cm	Mineral soil 0–30 cm
Afforested land (0-10 yrs old)	1.0±0.2	22.8±1.8	36.3±2.6	59.1±4.0
Control	-	26.4±4.4	21.5±3.5	47.8±7.5
Conifers (0-10 yrs old)	1.4±0.3	22.6±2.9	34.6±4.1	57.2±6.4
Arable land	-	16.3±3.4	17.0±2.3	33.4±5.2
Grassland	-	41.3±14.3	32.5±16.5	73.8±30.7
Deciduous (0-10 yrs old)	0.7±0.2	23.0±2.3	37.6±3.5	60.6±5.3
Arable land	-	15.7±3.5	18.0±2.4	33.7±5.9
Grassland	-	35.3±7.6	20.2±2.7	55.5±9.4

Afforested land (11-20 yrs old)	2.1±0.3	23.7±1.9	36.7±3.0	60.3±4.8
Control	1.1±0.1	29.8±4.3	21.8±3.7	51.6±7.6
Conifers (11-20 yrs old)	2.2±0.5	25.0±3.0	38.1±5.0	63.0±7.8
Arable land	-	18.7±2.1	14.3±2.0	33.0±3.4
Grassland	1.2	39.7±11.8	17.8±3.5	57.5±14.8
Deciduous (11-20 yrs old)	1.9±0.3	22.4±2.6	35.3±3.6	57.7±5.9
Arable land	-	26.2±6.8	22.8±4.0	49.0±10.4
Grassland	1.0±0.1	34.8±9.7	30.0±10.8	64.8±20.4

Afforested land (21-30 yrs old)	2.5±0.3	26.7±2.5	40.2±5.1	66.9±7.2
Control	-	23.7±3.4	17.9±2.3	41.6±4.4
Conifers (21-30 yrs old)	3.4±0.5	28.0±4.1	41.1±4.2	69.1±7.1
Arable land	-	16.2±1.7	26.2±2.9	42.4±1.7
Grassland	-	30.7±7.7	21.4±2.7	52.1±9.7
Deciduous (21-30 yrs old)	1.9±0.4	25.8±3.3	39.7±8.1	65.4±11.2
Arable land	-	22.8±4.9	11.4±2.2	34.2±6.0
Grassland	-	-	-	-

Afforested land (0-30 yrs old)	1.8±0.2	24.2±1.2	37.6±2.0	61.8±3.1
Control	0.9±0.1	25.6±1.7	26.9±2.1	46.1±3.1
Conifers (0-30 yrs old)	2.2±0.3	25.1±1.8	37.6±2.5	62.7±4.0
Arable land	-	17.3±1.4	18.2±1.9	35.5±2.4
Grassland	1.2	37.2±6.2	23.9±5.5	61.1±11.0
Deciduous (0-30 yrs old)	1.5±0.2	23.7±1.6	37.6±3.1	61.3±4.5
Arable land	-	21.0±2.8	16.7±1.9	37.7±4.1
Grassland	1.0±0.1	35.0±6.0	25.6±6.0	60.6±11.5

Table 4. Soil organic carbon stocks (t ha⁻¹) in *Histosols* (data of 2016 soil survey in Lithuania)

Land-use	Stock of soil organic carbon, tC ha ⁻¹			
	Organic layer / litter of grasses	Peat layer 0– 10 cm	Peat layer 10–30 cm	Peat layer 0–30 cm
Afforested land (0-10 yrs old)	1.4±0.2	88.3±4.5	195.6±12.4	283.9±15.8
Control	-	113.4±12.3	110.9±12.7	224.3±22.8
Conifers (0-10 yrs old)	1.0±0.2	90.9±8.0	192.2±20.3	283.1±26.9
Arable land	-	110.7±31.0	131.4±35.7	242.1±66.6
Grassland	-	125.2±3.5	96.5±9.5	221.7±6.0
Deciduous (0-10 yrs old)	1.9±0.2	85.4±3.7	199.4±14.7	284.8±16.9
Arable land	-	90.9±2.4	100.7±14.9	191.6±12.5
Grassland	-	120.5±20.9	100.2±10.5	220.7±21.2

Afforested land (11-20 yrs old)	2.7±0.2	75.0±7.2	168.9±22.3	243.9±26.5
Control	2.1	81.2±4.9	87.7±7.3	168.9±11.5
Conifers (11-20 yrs old)	3.0±0.4	90.4±9.6	199.7±38.3	290.1±41.3
Arable land	-	71.3±12.3	84.6±4.8	155.9±17.1
Grassland	-	78.7±5.6	77.2±12.0	155.9±16.9
Deciduous (11-20 yrs old)	2.4±0.2	59.6±8.9	138.1±20.5	197.7±28.5
Arable land	-	71.3±12.3	84.6±4.8	155.9±17.1
Grassland	2.1	84.5±11.3	102.7±10.9	187.2±21.7

Afforested land (21-30 yrs old)	4.8±0.5	87.5±9.7	190.2±24.2	277.6±29.9
Control	-	112.8±11.5	90.3±10.2	206.0±19.0
Conifers (21-30 yrs old)	7.3±0.5	95.9±15.1	194.0±50.0	289.9±64.8
Arable land	-	121.2±21.4	116.3±16.0	237.5±37.2
Grassland	-	104.8±15.2	74.5±5.9	179.3±15.5
Deciduous (21-30 yrs old)	3.4±0.4	83.0±12.8	188.1±27.4	271.1±32.0
Arable land	-	121.2±21.4	116.3±16.0	237.0±37.0
Grassland	-	100.3±18.5	70.0±8.6	170.3±20.2

Afforested land (0-30 yrs old)	3.2±0.3	83.1±4.7	183.7±12.7	266.8±15.5
Control	2.1	98.3±5.6	104.0±6.4	202.2±10.2
Conifers (0-30 yrs old)	3.7±0.5	92.2±6.1	195.8±21.5	288.0±25.7
Arable land	-	128.1±28.2	144.2±31.1	272.4±59.1
Grassland	-	94.0±7.4	78.3±6.5	172.3±11.2
Deciduous (0-30 yrs old)	2.7±0.2	75.7±6.7	173.8±14.9	249.5±18.5
Arable land	-	103.4±13.7	105.8±9.9	209.2±23.3
Grassland	2.1	104.1±10.3	90.4±6.1	194.5±11.4

EVALUATION OF NATIONAL ORGANIC CARBON STOCKS AND THE DETERMINATION OF STOCK VALUES IN ORGANIC AND MINERAL SOILS IN FOREST AND NON-FOREST LAND

Short report

(LRCAF, Institute of Forestry in 2016. Supervisor - prof. dr. Kęstutis Armolaitis)

Introduction

It is essential in order to meet the requirements of the Land Use Land Use Change and Forestry (*LULUCF*) reporting under UNFCCC. At the moment Lithuania is using Tier 1 methodology and default values for carbon stock estimations in soil and forest litter in forest and non-forest land. Annual UNFCCC Expert Review Teams revisions encourage countries to follow guidelines of Intergovernmental Panel on Climate Change (IPCC) and to move to higher Tiers for estimation of carbon stock changes in soils and forest litter.

The aim of study was to estimate soil organic carbon (SOC) stocks in Lithuanian forests, croplands and grasslands. These specific national SOC values in forest floor and mineral or peat topsoil in the land of different use for Land Use, Land Use Change and Forestry (*LULUCF*) reporting under UNFCCC.

The study was funded by Ministry of Environment of the Republic of Lithuania in the frame of 2009-2014 European Economic Area or Norwegian Financial Mechanisms and Co-financing.

Materials and Methods

The study was performed in 2015 at National Forest Inventory (NFI) permanent sample plots grid that covers the whole territory of Lithuania (**Fig. 1**).

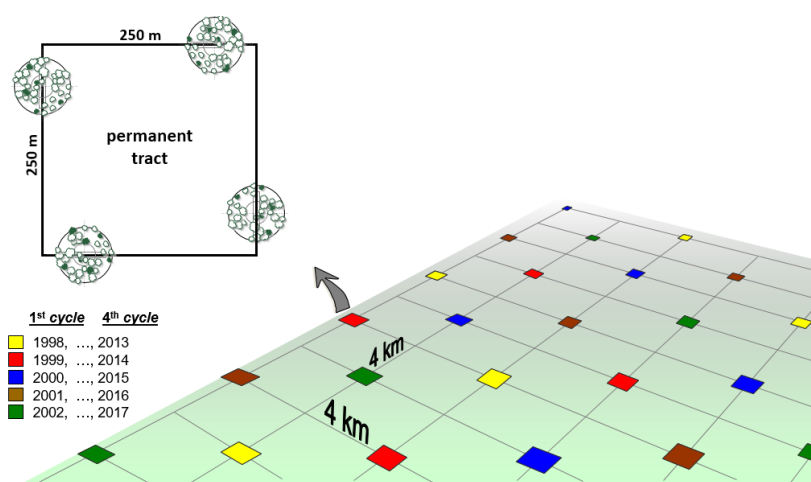


Fig. 1. National Forest Inventory permanent sample plots grid in Lithuania

The data were collected in 752 sample plots (**Fig. 2**).

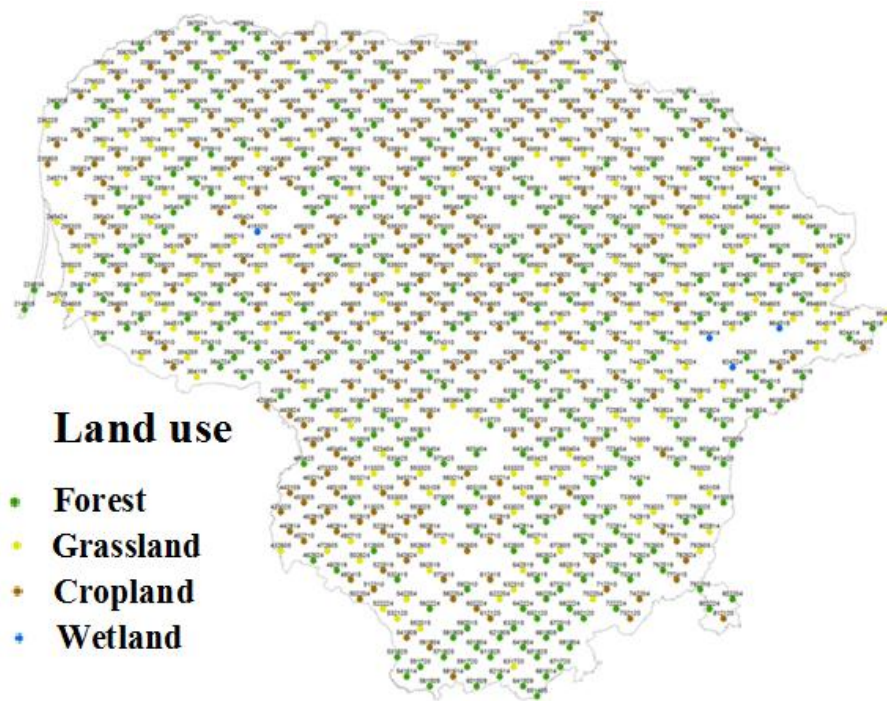


Fig. 2. Sample plots in the grid (9x9 km) of Lithuanian National Forest Inventory (NFI) (Total N=752; forest land – 298; grassland – 206; cropland – 244; wetland – 4)

Forest floor combined (from n=5) samples were collected for the determination of mass and carbon content, whereas mineral topsoil combined samples (from 0-10 cm and 10-30 cm surface layers, from n=10) – for bulk density (ISO 11272:1998) and soil organic carbon (SOC) concentrations (ISO 10694:1995) determination. The SOC stocks in 0-30 cm layer were calculated according following equation (Vesterdal et al., 2008):

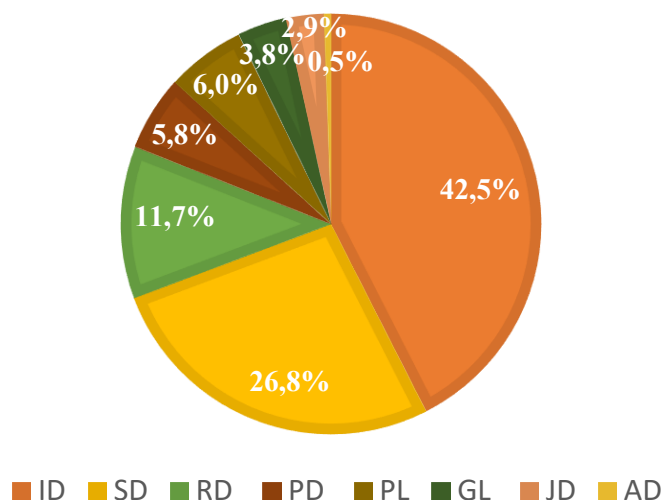
$$\text{SOC}_i = p_i \left(1 - \left(\frac{Q_{i,2mm}}{100}\right)\right) d_i C_i * 10^{-1}$$

where p_i is the bulk density of the <2 mm fraction in g cm^{-3} , $Q_{i,2mm}$ is the relative volume of the fraction ≥ 2 mm (%), d_i denotes the thickness of layer i in cm, C_i denotes the C concentration of layer i (mg g^{-1}), and 10^{-1} is a unit factor ($10^{-9} \text{ mg Mg}^{-1} \times 10^8 \text{ cm}^2 \text{ ha}^{-1}$)

Microsoft Excel2016 and Statistica12 were used to analyse the collected data. Mean values \pm SE are presented in the report.

Results and discussion

In total 9 major soil groups were found in sample plots (**Fig. 3**).



ID – *Luvisols/Retisols*; SD – *Arenosols*; RD – *Cambisols*; PD – *Histosols*; PL – *Planosols*;
GL – *Gleysols*; JD – *Podzols*; AD – *Fluvisols*

Fig.3. Distribution of major soil groups (WRB, 2014) in sample plots

Mean mass of forest floor (total mass of forest litter (OL) + fragmented (OF) + humified (OH) litters) of major soil groups is presented in **Table 1**.

Table.1. Mean mass of forest floor (OL+OF+OH) and mean organic carbon (OC) stocks in major soil groups

Major soil groups: LTKD-99 (WRB, 2014)	Number of sample plots (n)	Mean mass, t ha ⁻¹	Mean OC stocks (tC ha ⁻¹)
Rudžemiai (<i>Cambisols</i>)	8	4,1±0,6	1,6±0,2
Išplautžemiai ir balkšvažemiai (<i>Luvisols + Retisols</i>)	130	13,6±2,8	5,6±1,2
Palvažemiai (<i>Planosols</i>)	26	22,9±8,7	9,5±3,7
Smėlžemiai (<i>Arenosols</i>)	92	15,7±1,6	6,3±0,7
Jaurazemiai (<i>Podzols</i>)	21	58,1±15,5	25,0±6,7
Šlynžemiai (<i>Gleysols</i>)	20	14,4±6,7	6,3±3,2
Durpžemiai (<i>Histosols</i>)	37	12,7±2,5	5,3±1,1
Salpžemiai (<i>Fluvisols</i>)	3	2,3±1,0	0,9±0,4

As could be seen from **Fig 4**, from 2.5 time (*Histosols*) to 9 folds (*Arenosols*) mean OC stocks were found for organic layer of grassland as well.

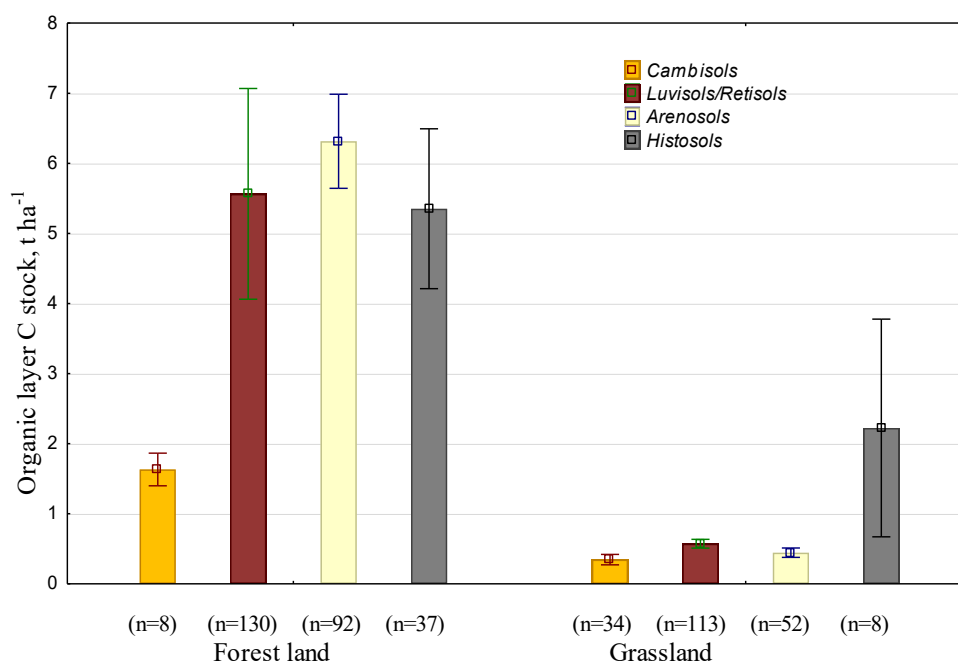


Fig. 4. Mean organic layer stocks of carbon in organic layer of different mineral soils in forest land and grassland (the bars represent SE)

It was found that mean stocks of soil organic carbon (SOC) in surface 0-30 cm layer of some major soil groups (*Cambisols*, *Arenosols*, *Podzols*, *Gleysols*, *Planosols*) are specific in Lithuanian forests (**Table 2**).

Table 2. Mean stocks of soil organic carbon (SOC) in surface 0-30 cm layer of major soil groups in forests

Major soil groups: LTK-99 (WRB, 2014)	Average in Europe, (de Vos et al., 2015)	LULUCF default values* (IPCC, 2006)	Average in Lithuania (2016 m., number of plots, n)
Rudžemiai (<i>Cambisols</i>)	75	95	118 (n=8)
Išplautžemiai/balkšvažemiai (<i>Luvisols+Retisols</i>)	73	95	96 (n=130)
Palvažemiai (<i>Planosols</i>)	45	95 (?)	81 (n=26)
Smėlžemiai (<i>Arenosols</i>)	50	71	58 (n=92)
Jaurazemiai (<i>Podzols</i>)	63	115	100 (n=21)
Šlynžemiai (<i>Gleysols</i>)	94	87	106 (n=20)
Durpžemiai (<i>Histosols</i>)	181	-	154 (n=37)
Salpžemiai (<i>Fluvisols</i>)	64	-	80 (n=3)

*Cold temperate, moist region

National values of soil organic carbon (SOC) stocks in surface 0-30 cm layer of major soil groups in forests, grassland and cropland are presented in **Table 3**. The most valuable values were determined for *Luvisols/Retisols* (number of sample plots in different land use – 81-130), *Arenosols* (n= 26-92) and *Cambisols* (n=18-81).

Table 3. National values of soil organic carbon (SOC) stocks in surface 0-30 cm layer of major soil groups in forests, grassland and cropland

Major soil groups: LTKD-99 (WRB, 2014)	Forests		Grassland		Cropland	
	n	DOC, tC ha ⁻¹	n	DOC, tC ha ⁻¹	n	DOC, tC ha ⁻¹
Rudžemiai (<i>Cambisols</i>)	18	118±8 (100%)	34	92±7 (78%)	81	91±4 (69%)
Išplautžemiai/balkšvažemiai (<i>Luvissols+Retissols</i>)	130	96±3 (100%)	113	79±3 (82%)	81	71±4 (74%)
Palvažemiai (<i>Planosols</i>)	26	81±8 (100%)	7	95±13 (117%)	9	61±7 (75%)
Smėlžemiai (<i>Arenosols</i>)	92	58±3 (100%)	52	56±3 (97%)	26	62±4 (107%)
Jaurazemiai (<i>Podzols</i>)	21	100±12 (100%)	1	83 (83%)	-	-
Šlynžemiai (<i>Gleysols</i>)	20	105±8 (100%)	2	106±1 (101%)	1	109 (104%)
Durpžemiai (<i>Histosols</i>)	37	154±11 (100%)	8	200±23 (130%)	2	243±131 (158%)
Salpžemiai (<i>Fluvisols</i>)	3	80±5 (100%)	1	65 (83%)	-	-

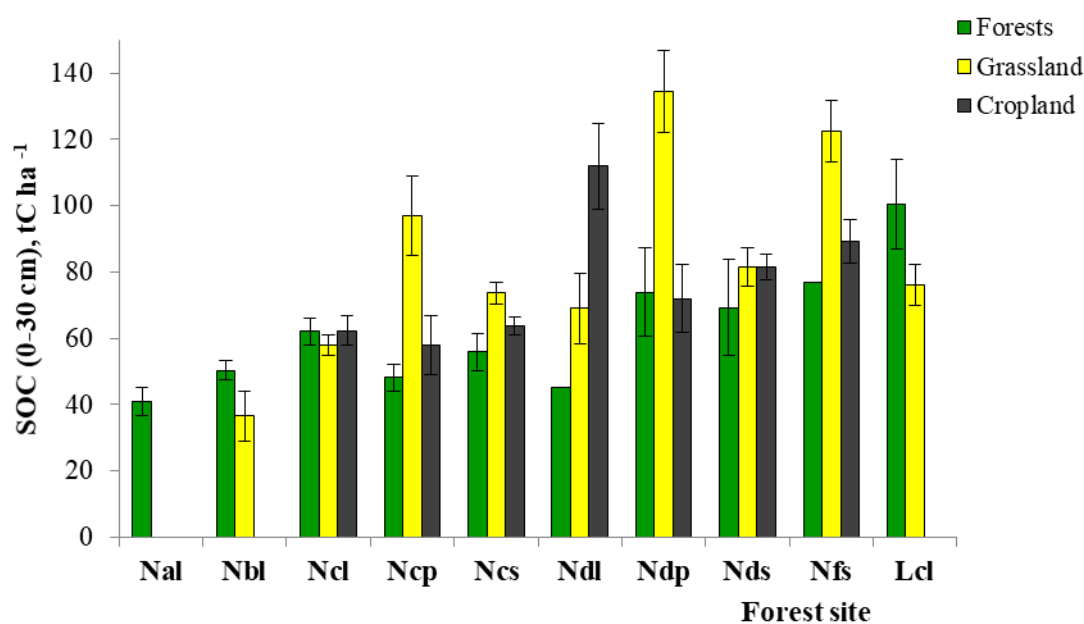


Fig. 5. Mean stocks of soil organic carbon (SOC) in surface 0-30 cm layer of different forest sites (according Lithuanian classification, Vaičys et al., 2006)

Mean stocks of soil organic carbon (SOC) in surface 0-30 cm layer of different forest sites according Lithuanian classification (Vaičys et al., 2006) were presented in **Fig. 5**.

Table 4. Mean stocks of soil organic carbon (SOC) in soil organic layer and surface 0-30 cm mineral layer in forest stands of different age at Luvisol/Retissols

Age, years	N	Mass of organic layer, t ha ⁻¹	SOC in organic layer, tC ha ⁻¹	SOC (0-30 cm), tC ha ⁻¹
1-20	11	2,6±0,5	1,1±0,2	120,7±10,0
21-40	16	4,6±0,8	1,8±0,3	107,6±9,7
41-60	14	3,3±0,6	1,2±0,2	93,2±8,4
61-80	12	4,8±0,6	1,9±0,2	94,9±7,8

In average	53	3,9±0,3	1,5±0,1	103,6±4,7
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It was found that the mean stocks of soil organic carbon (SOC) in soil organic layer and surface 0-30 cm mineral layer did not depend directly on forest stands of different age at *Luvisol/Retisols*.

ANNEX XIV. Improvements in response to UN reviews recommendations (ARR 2025)

<i>Review recommendation</i>	<i>Paragraph No</i>	<i>Response/status of implementation</i>	<i>Chapter/section in the NID</i>
The TERT recommends that Lithuania implement robust, comprehensive general and sector-level QC procedures for its NID in accordance with its QA/QC plan and the 2006 IPCC Guidelines and encourages Lithuania to implement QA procedures by conducting a basic expert peer review of its NIR.	2.G.1	Lithuania has reviewed and updated its general QC procedures to ensure that consistency checks, completeness checks and recalculation checks are systematically performed and properly documented. In parallel, sector-level QC procedures have been strengthened, including enhanced documentation of activity data verification, emission factor checks and time-series consistency assessments. Furthermore, QC procedures have been aligned with the national QA/QC plan and the relevant provisions of the 2006 IPCC Guidelines (Volume 1, Chapter 6), ensuring a structured and methodologically consistent approach to inventory quality management.	-
The TERT encourages Lithuania to include explanatory text on indirect N ₂ O emissions in the NID and report consistent information on the indirect emissions between the NID, CRT background tables and CRT 6.	2.G.2	Explanatory text on indirect emissions was added in the NID. Consistent information on the indirect emissions between the NID, CRT background tables and CRT 6 were reported.	NID Chapter 9 CRT Table 6
The TERT recommends that Lithuania include in its NID under category 1.A the explanation of the different trends of fuel consumption between oil and natural gas, including the distinction between market-driven fuel consumption changes and those changes resulting from policy or legal obligations.	3.E.1	In 2022, the share of oil and oil products increased till 41.6% due to the accumulation of secured stocks of oil products. This stock is ensured by the Law on Oil Products and State Oil Reserves. The purpose of the Law on Oil Products and State Oil Reserves in Lithuania is to ensure the accumulation, management, use, supervision, and regulation of oil products and state oil reserves. This law aims to maintain a strategic reserve of oil products to safeguard against supply disruptions and emergencies, aligning with European Union	NID Chapter 3.1 Overview of the sector and background information

Review recommendation	Paragraph No	Response/status of implementation	Chapter/section in the NID
		regulations. The explanation was provided in the NID submission.	
The TERT recommends that Lithuania (1) revise the allocation in the CRTs of CO ₂ , CH ₄ and N ₂ O emissions from the country's combined-cycle gas turbine unit to ensure alignment with IPCC category definitions and to reflect the actual function of the unit, either by reporting emissions from the unit separately under category 1.A.1.a.i or, if confidentiality concerns prevent this, by clearly indicating that the emissions from the unit are included elsewhere, that is reporting them as "IE" under category 1.A.1.a.i; and (2) include a clarification of the allocation in the NID to improve the transparency of the national GHG inventory.	3.E.2	The greenhouse gas emissions, which occurred at the combined cycle gas turbine in 2012-2024 were reallocated from the category 1.A.1.a.ii Combined heat and power generation to the category 1.A.1.a.i. Electricity generation based on information provided by the Elektrėnai complex on natural gas consumption.	NID Chapters 3.2.5.1.2 Electricity Generation (CRT 1.A.1.a.i) and 3.2.5.1.3 Combined Heat and Power Generation (CRT 1.A.1.a.ii)
The TERT recommends that Lithuania enhance the transparency of its inventory data by clearly reporting the assumptions made and methodologies used for allocating fuel consumption between mobile (off-road vehicles and other machinery) and stationary combustion sources, including, for example, the information provided during the review that petrol and diesel oil are assumed to be used only by mobile sources.	3.E.3	Lithuania enhances the transparency of its inventory data by reporting that petrol and diesel oil are currently assumed to be used exclusively by mobile off-road sources. The explanation was provided in the NID submission.	NID Chapter 3.2.7.5.2 Methodological issues
The TERT recommends that Lithuania explain in the NID that all biofuel use is attributed solely to the mobile combustion categories and revise the notation keys reported for relevant categories, such as off-road vehicle categories, to ensure the accurate representation of fuel types and that reporting is consistent with actual fuel use.	3.E.4	According to State Data Agency, all biofuels use is attributed solely to the mobile combustion categories in transport. The explanation was provided in the NID submission. Notation keys for off-road vehicle and fishing categories were changed from "NO" to "IE" in CRTs, and explanations were included in appropriate cells.	NID Chapter 3.2.7.5.2 Methodological issues
The TERT recommends that Lithuania enhance the transparency of the reported data by including in the NID clear and comprehensive explanations for any notable changes or anomalies in AD trends such as the sharp increase in biomass consumption for category 1.A.2.g.iv (wood and wood products) observed from 2002 onward.	3.E.5	In 2002, significant increase of biomass consumption is linked to the adoption of Lithuania's Law on Energy from Renewable Energy Sources. This legislation established a legal framework to support the development of renewable energy sources. At that time, support for biomass investment projects become available	NID Chapter 3.2.6.1.10 Wood and Wood Products (CRT 1.A.2.g.iv)

<i>Review recommendation</i>	<i>Paragraph No</i>	<i>Response/status of implementation</i>	<i>Chapter/section in the NID</i>
		through interest subsidies and soft-term loans from Lithuanian Environmental Investment Fund. The Lithuanian wood and wood products industry naturally generates large amounts of secondary biomass (sawdust, wood chips). Therefore, the support received has encouraged the development of biomass use in this industry. The explanation was provided in the NID submission.	
The TERT recommends that Lithuania explain the allocation of medical and hazardous waste combustion emissions and AD from the Toksika facility from category 1.A.2.g.viii (non-specified industry) to category 1.A.1.a.ii (CHP generation), including a brief description of the use of energy generated by the facility (e.g. in district heating, electricity supply) to ensure consistency with the 2006 IPCC Guidelines (vol. 2, chap. 2, p.2.7).	3.E.6	In 2015, the medical and hazardous waste started to be combusted at the facility operated by “Toksika” as a CHP plant recovering energy from this waste combustion. The explanation was provided in the NID submission.	NID Chapter 3.2.5.1.3.1 Category description
The TERT recommends that Lithuania include in the NID details on gasoline consumption including biofuel blends in category 1.A.3 transport to ensure clarity, as well as consistency between the national energy and fuel balance and the reported emissions.	3.E.7	Fossil fuels are provided together with mixed biofuels in transport, in line with data provided in Official statistics portal of Lithuania. On the contrary, only fossil parts of transport fuels are provided in CRT as fossil fuel. This explanation was provided in the NID submission (NID Annexes).	NID Annex III. Lithuanian energy balance
The TERT recommends that Lithuania ensure its reporting is consistent between the NID and the CRTs by clearly distinguishing between energy use and non-energy use of fuels and, more specifically, when referencing national energy and fuel balances in the NID, by clarifying the allocation of natural gas between combusted (fuel use) and emitted (fugitive/non-energy) quantities and reconciling these values with those reported in the inventory under categories 1.A (fuel combustion – sectoral approach), 1.A.3 (transport) and 1.B.2.b (fugitive emissions from fuels – natural gas), which will enhance transparency and ensure that reported data can be clearly understood and assessed.	3.E.8	The explanation was provided in the NID submission. Consumption of natural gas in pipeline transportation, provided by State Data Agency in Lithuanian energy balance, is allocated between combusted (fuel use) and emitted (fugitive/non-energy) quantities. Fugitive quantities are reported under 1.B.2.b (fugitive emissions from fuels – natural gas) based on data obtained from the natural gas transmission and distribution operators. The remaining (combusted) part of	NID Chapter 3.2.7.4.3.2 Methodological issues

Review recommendation	Paragraph No	Response/status of implementation	Chapter/section in the NID
		natural gas consumed in pipeline transportation is reported under 1.A.3.e.i (pipeline transport).	
The TERT recommends that Lithuania include in the NID the explanation about the split of 80 per cent fatty acid methyl ester and 20 per cent hydrotreated vegetable oil applied for road transport, specifying that this is a default setting in COPERT and it has not been adjusted to reflect national circumstances, and consider using the available country-specific AD on fatty acid methyl ester and hydrotreated vegetable oil quantities in diesel oil to improve the accuracy of the fuel split used in emission calculations, particularly where the actual shares may differ significantly from the COPERT default values.	3.E.9	The share of FAME biodiesel from 2004 to 2023 is 80% (default setting in COPERT) and in 2024 it is 69% as determined from the EU ETS for buildings, transport, industry and other sectors (EU ETS 2) GHG reports for year 2024. The explanation was provided in the NID submission, and the available country-specific AD was used for 2024 together with the start of monitoring for EU ETS 2 in 2024.	NID Chapters 3.2.7.2.1 Category description (CO ₂ emissions associated with the fossil carbon content in biofuels) and 3.2.7.2.2 Methodological issues (Emission factors)
The TERT recommends that Lithuania update the methodology description provided in the NID for category 2.A.3 (glass production) to accurately reflect that it uses the tier 3 approach to estimate emissions for this category.	4.1.1	Methodology description added in the NID submission.	NID Chapter 5.2.3.3
The TERT recommends that Lithuania include in CRT 2(I)A-H a description of AD for all inventory years for category 2.D.2 (paraffin wax use).	4.1.2	Inventory data description added for category 2.D.2 (paraffin wax use) in the current inventory submission.	CRT 2.D.2
The TERT recommends that Lithuania include a complete, transparent description of the methodology used for estimating HFC emissions for categories 2.F.1.a and 2.F.1.c.	4.1.3	Methodology description and relevant formulas included in the NID submission	NID Chapter 5.7.1.2
The TERT recommends that Lithuania provide a clear, transparent and detailed methodological justification for the change in assumption for equipment lifetime for category 2.F.1.b from a 20- to a 15-year lifetime for domestic refrigeration equipment, including a reference to the 2021 national study that the lifetime value is based on, the rationale for selecting the revised lifetime value and an assessment of the representativeness of the revised lifetime value in the context of national circumstances. Given that equipment lifetime is a key parameter affecting emission estimations, particularly through its influence on the temporal distribution of refrigerant losses and end-of-life emissions, the	4.1.4	Recalculations included with corresponding explanation provided in the NID submission.	NID Chapter 5.7.1.5

Review recommendation	Paragraph No	Response/status of implementation	Chapter/section in the NID
TERT also recommends that Lithuania perform recalculations for the entire inventory time series, where applicable, in accordance with the 2006 IPCC Guidelines, providing justification for the recalculations and an indication of relevant changes and their impact on emission trends.			
The TERT recommends that Lithuania include in the next NID an explanation as to why the nutria population is recorded as “NO” for 2022 and any applicable future years.	5.A.1	In the previous NID submission, the State Data Agency reported the nutria population as “NO” for the period 2022–2023. However, in 2025 the State Data Agency revised the nutria population data. Consequently, the annual average population figures for nutria were recalculated, and NO is now reported only for 2024. The implementation of legal and regulatory measures aimed at restricting the breeding of this species resulted in the complete cessation of nutria breeding activities in Lithuania in 2024. Further details are provided in the NID submission.	NID Chapter 5.1 Overview of the sector <i>Livestock population data</i>
The TERT encourages Lithuania to verify the suitability of the default value of Ym applied in estimating emissions from enteric fermentation of cattle, given that cattle are the most significant species in terms of enteric fermentation emissions in the country and the emission calculation depends highly on Ym, and if resources allow, to develop a country-specific Ym value for cattle and/or for other species for which enteric fermentation emissions may become significant.	5.A.2	Explanation provided in the 2026 NID submission.	5.2.4. Category-specific planned improvements
The TERT encourages Lithuania to verify the suitability of the default methane conversion factor values for cool climates for manure management systems that it applies in estimating CH4 emissions from manure management for cattle, swine, sheep and goats on the basis of the deviations from the annual average temperature, and to explore the possibility of conducting research aimed at developing a country-specific value as per the 2006 IPCC Guidelines (vol. 4, chap. 10, p.10.43).	5.A.3	Lithuania applies the 2006 IPCC default Methane Conversion Factors (MCF) for estimating emissions from manure management systems, using the values provided in Table 10.17, and uses end-of-range value from column Cool ≤10°C. Regional temperature differences across the country are relatively small, and the national average annual temperature is close to 10°C. In 2022, the average annual temperature was 8°C. However, in line with global climate trends, Lithuania is experiencing a gradual increase in average annual temperatures	5.3.2 Methodological issues 5.3.6. Category-specific planned improvements

<i>Review recommendation</i>	<i>Paragraph No</i>	<i>Response/status of implementation</i>	<i>Chapter/section in the NID</i>
		and according to Lithuanian hydrometeorological service data in 2024 the average annual temperature in Lithuania was 9,5°C. To address the recommendation, in the next NID submission, it is planned to assess the appropriateness of the default MCF values for manure management systems in relation to the country's climatic conditions by analyzing deviations from the average annual temperature, as well as to explore the possibility of conducting research aimed at developing country-specific values.	
The TERT encourages that Lithuania employ the tier 2 methodology with country-specific inputs to estimate indirect N ₂ O emissions from manure management, in line with decision tree 10.4 in the 2006 IPCC Guidelines (vol. 4, chap. 10, p.10.55), and make an effort to validate the fraction of nitrogen lost, for example, the fraction lost through leaching, or use values for the fraction of nitrogen lost and EFs from countries with similar environmental conditions and livestock management practices or values from international databases. In case that is not possible, the TERT recommends Lithuania to clearly document why the methodological choice for 3.B.5 category was not in line with the corresponding decision tree of the 2006 IPCC guidelines.	5.A.4	Aiming at improvement of the livestock GHG emissions estimation Lithuania has substantially improved quality and accuracy of manure management data (national Nex values for cattle and swine, national MMS data) however transferring to exclusively Tier 2 approach is constrained by missing country-specific emission factors and fractions of N losses, which development requires significant effort and resources, also solid scientific experience, to make such factors representative and reliable and it is hardly affordable to conduct such detailed investigations covering all required pathways in the nearest future. Considering this information, it was decided to use the 2019 IPCC Refinement GHG Guidelines to calculate the amount of nitrogen generated in manure to improve the nitrogen balance between livestock and agricultural soil (Animal manure applied to soil) categories.	5.4.6.2 Methodological issues
The TERT recommends that Lithuania report the area of wetlands as a consistent value between CRTs 4.1 and 4.D and clearly identify the total areas of managed and unmanaged wetlands when reporting land area in the NID.	6.L.1	Additional CRT tables were created to clearly identify total areas of managed and unmanaged areas for 4.D category.	CRT tables in 4.D category

<i>Review recommendation</i>	<i>Paragraph No</i>	<i>Response/status of implementation</i>	<i>Chapter/section in the NID</i>
The TERT recommends that Lithuania (1) report as “IE” CO2 emissions in CRT 4(II) for mineral soils under categories 4(II).A.2, 4(II).B.2, 4(II).C.2, 4(II).D.1, 4(II).D.2, 4(II).E and 4(II).F where numerical data are not available, together with a clarification on where the emissions have been included; and (2) use appropriate notation keys when CH4 and N2O emissions occur, indicating the reasons why emissions are not reported.	6.L.2	(1) According to this recommendation, the Party has started to report CO2 emissions in all 4.(II) tables as “IE” for mineral soils. (2) The Party uses appropriate notation keys in CRT tables for CH4 and N2O emissions.	CRT tables 4(II).A.2, 4(II).B.2, 4(II).C.2, 4(II).D.1, 4(II).D.2, 4(II).E and 4(II).F
The TERT recommends that Lithuania clearly document in the NID progress in conducting further scientific studies aimed at collecting additional data for determining CSCs in the litter pool for the forest land remaining forest land category or expand on the information provided in the NID on the rationale behind the use of the current reporting method and the assumption that no CSCs are assumed for litter on forest land remaining forest land.	6.L.3	Lithuania has updated the description of scientific research according to this recommendation for litter pool for the forest land remaining forest land with further planned improvements description.	6.4.6. Category specific improvements
The TERT recommends that Lithuania (1) consistently report AD for undrained managed organic soils under the categories 4.A (forest land), 4.B.2.a (forest land converted to cropland), 4.B.2.b (grassland converted to cropland), 4.B.2.d (settlements converted to cropland), 4.C.1 (grassland remaining grassland) and 4.C.2 (land converted to grassland) in CRTs 4.A–4.C and 4(II).A–4(II).C; and (2) report the corresponding CSCs as “NE” in CRTs 4.A–4.C, with a justification for use of the notation key provided in CRT 9.	6.L.4	Lithuania has updated it’s organic soils description in the NID 2026 with provision of relevant information about drained and undrained organic soils in tabular format. Furthermore, the relevant 4(II) tables were added to convey the information about drained and undrained areas of organic soils.	6.4.6; 6.5.6 and 6.6.6 Methodological issues
The TERT recommends that Lithuania enhance the information provided in the NID on the methods applied for calculating annual SOC changes for mineral soils for categories 4.A.2.5 (other land converted to forest land) and 4.B.2.1 (forest land converted to cropland) for all inventory years.	6.L.5	Lithuania has enhanced the information about the methods used to calculate annual SOC changes for categories 4.A.2.5 (other land converted to forest land) and 4.B.2.1 (forest land converted to cropland).	6.4.6.2 and 6.5.6.2 Methodological issues
The TERT recommends that Lithuania transparently describe in its NID the methods, assumptions, data and/or parameters that provide context for the significant inter-annual changes in the area of organic soils for category 4.B.2.3 (wetlands converted to cropland), the total land conversion area for category 4.C.2.1	6.L.6	Lithuania has provided transparent information in tabular format in NID 2026 about interannual changes in the area of organic soils for category 4.B.2.3 (wetlands converted to cropland), the total land conversion area for category 4.C.2.1 (forest land converted to grassland) and the area of	6.5.6.2 and 6.6.6.2 Methodological issues

<i>Review recommendation</i>	<i>Paragraph No</i>	<i>Response/status of implementation</i>	<i>Chapter/section in the NID</i>
(forest land converted to grassland) and the area of mineral soils for category 4.B.2.5 (other land converted to cropland).		mineral soils for category 4.B.2.5 (other land converted to cropland).	
The TERT encourages Lithuania to address the inconsistency in the land conversion area used to calculate CSCs for mineral soils under category 4.C.2.1 (forest land converted to grassland) for 2022 and report emissions/removals for this category if they are occurring.	6.L.7	Lithuania has addressed this inconsistency and now is reporting such emissions and further provided information about calculation methods in its NID 2026.	6.6.6.2 Methodological issues
The TERT recommends that Lithuania report AD and emission estimates for wetlands that were formerly drained and later abandoned under managed land, in accordance with the 2006 IPCC Guidelines (vol. 4, chap. 1.1), and continue reporting them consistently throughout the time series according to chapter 3.3 of the Guidelines. Additionally, the TERT encourages Lithuania to consider implementing the methodology provided in the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands for estimating GHG emissions/removals from drained organic soils.	6.L.8	This recommendation has not been implemented in 2026 submission yet. It will be done for the NID 2027 submission.	
The TERT encourages Lithuania to expand on the information reported in the NID on the assumptions underpinning instant oxidation of forest land converted to settlements and forest land converted to other land and on the method for calculating CSCs for dead organic matter, mineral soils and organic soils for both categories, noting that the Party may consider using methodologies such as the stock difference approach provided in the 2006 IPCC Guidelines (vol. 4, chap. 8, p.8.8) as an alternative to equation 2.25 of the 2006 IPCC Guidelines.	6.L.9	Lithuania has expanded the descriptions for these land-use change CSC and they are now fully compliant with IPCC 2006 guidelines. Lithuania moved from the assumption of instant oxidation, that all SOC is lost upon land-use change from forest land to settlements or other land. Furthermore, the Party has also adopted the IPCC guidelines approach described in vol.4, ch.8.3.3.2.	6.8.2.2 and 6.9.2.2 Methodological issues
The TERT recommends that Lithuania correct the information provided in the relevant CRTs and the NID on the EFs and parameters used to estimate CSCs in organic soils for categories 4.E.2.b (cropland converted to settlements), 4.E.2.c (grassland converted to settlements), 4.F.2.b (cropland converted to other land) and 4.F.2.c (grassland converted to other land), and report corrected estimates in CRTs 4.E and 4.F.	6.L.10	Lithuania has corrected and provided the relevant information regarding EF's for organic soils in categories 4.E.2.b (cropland converted to settlements), 4.E.2.c (grassland converted to settlements), 4.F.2.b (cropland converted to other land) and 4.F.2.c (grassland converted to other land).	6.8.2.2 and 6.9.2.2 Methodological issues

<i>Review recommendation</i>	<i>Paragraph No</i>	<i>Response/status of implementation</i>	<i>Chapter/section in the NID</i>
The TERT encourages the Party to consider improving the QC process for categories 4.E.2.b, 4.E.2.c, 4.F.2.b, 4.F.2.c, 4.E and 4.F.			
The TERT recommends that Lithuania increase the transparency of its estimation of CH ₄ emissions from unmanaged solid waste disposal sites by ensuring that methane correction factor values are consistent between the NID and CRT 5.A.	7.W.1	The recommendation was taken into account and additional explanations were included in the NID, together with weighted methane correction factors consistent with those reported in CRT Table 5.A.	NID Chapter 7.2.3, table 7-30
The TERT encourages Lithuania to make all efforts and overcome the lack of resources to developing tier 2 CH ₄ and N ₂ O emission estimation methods for the key categories 5.B (biological treatment of solid waste) and 5.D (wastewater treatment and discharge), in accordance with the good practices established in the 2006 IPCC Guidelines. In case that is not possible, the TERT recommends that the Party clearly document why the methodological choice for categories 5.B and 5.D was not in line with the corresponding decision tree of the 2006 IPCC Guidelines.	7.W.2	Although biological treatment of solid waste and wastewater treatment and discharge are key categories, they comprise a relatively small share of emissions. Currently, due to limited resources and capacities, the main efforts are focused on establishing Tier 2 calculation methods for the largest emission sources. Estimation of CH ₄ and N ₂ O emissions from composting and wastewater treatment using a combined Tier 1 and Tier 2 approach is planned in the near future.	NID Chapter 7.3.2 and Chapter 7.5.2
The TERT recommends that Lithuania report CH ₄ and N ₂ O emissions from the incineration of non-biogenic clinical waste at the disaggregated level in CRT 5.C or, if that is not possible, include an explanation as to where these emissions are reported in both the NID and CRT 9.	7.W.3	The explanation in CRT 5.C.1 is provided that CH ₄ and N ₂ O emissions from the incineration of clinical waste are reported under categories 5.C.1.a.ii.2 and 5.C.1.b.ii.2 (hazardous waste).	CRT 5.C.1